

The unique Databook containing comprehensive information and Comparison Tables on Sizes, weights and general data of Pipes, Tubes, Fittings, Flanges, Bars, Sheet & Strip, Hollow Sections and related products according to main International Standards.

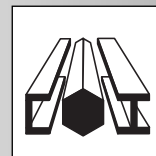
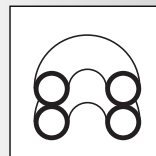
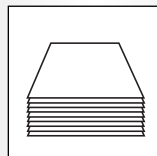
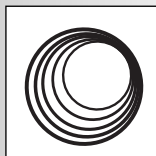
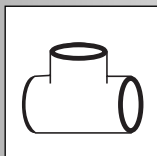
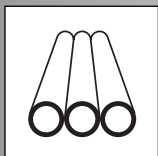
# General catalogue

EDITION 2004



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With this catalogue, TPS is giving complete information about the manufacturing and supply range of alloy steel, stainless steel, nickel alloys, titanium and non-ferrous metals from mill and ex stock.

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# Stainless Steels

## AUSTENITIC, FERRITIC AND MARTENSITIC STAINLESS STEEL

### Austenitic Stainless Steel Tubes

Material Standard: ASTM A 213 / 249 / 269 / 688

Manufacturing Process: Seamless or welded

| Grade     | UNSNo  | C         | Si       | Mn       | P         | S         |
|-----------|--------|-----------|----------|----------|-----------|-----------|
| TP 304    | S30400 | 0.08 max  | 0.75 max | 2.00 max | 0.040 max | 0.030 max |
| TP 304 H  | S30409 | 0.04-0.10 | 0.75 max | 2.00 max | 0.040 max | 0.030 max |
| TP 304 N  | S30451 | 0.08 max  | 0.75 max | 2.00 max | 0.040 max | 0.030 max |
| TP 304 LN | S30453 | 0.035 max | 0.75 max | 2.00 max | 0.040 max | 0.030 max |
| TP 304 L  | S30403 | 0.035 max | 0.75 max | 2.00 max | 0.040 max | 0.030 max |
| TP 309 S  | S30908 | 0.08 max  | 0.75 max | 2.00 max | 0.045 max | 0.030 max |
| TP 310 S  | S31008 | 0.08 max  | 0.75 max | 2.00 max | 0.045 max | 0.030 max |
| TP 316    | S31600 | 0.08 max  | 0.75 max | 2.00 max | 0.040 max | 0.030 max |
| TP 316 H  | S31609 | 0.04-0.10 | 0.75 max | 2.00 max | 0.040 max | 0.030 max |
| TP 316 L  | S31603 | 0.035 max | 0.75 max | 2.00 max | 0.040 max | 0.030 max |
| TP 316 N  | S31651 | 0.08 max  | 0.75 max | 2.00 max | 0.040 max | 0.030 max |
| TP 316 LN | S31653 | 0.035 max | 0.75 max | 2.00 max | 0.040 max | 0.030 max |
| TP 317    | S31700 | 0.08 max  | 0.75 max | 2.00 max | 0.040 max | 0.030 max |
| TP 317 L  | S31703 | 0.035 max | 0.75 max | 2.00 max | 0.040 max | 0.030 max |
| TP 321    | S32100 | 0.08 max  | 0.75 max | 2.00 max | 0.040 max | 0.030 max |
| TP 321 H  | S32109 | 0.04-0.10 | 0.75 max | 2.00 max | 0.040 max | 0.030 max |
| TP 347    | S34700 | 0.08 max  | 0.75 max | 2.00 max | 0.040 max | 0.030 max |
| TP 347 H  | S34709 | 0.04-0.10 | 0.75 max | 2.00 max | 0.040 max | 0.030 max |

### Ferritic and Martensitic Stainless Steel Tubes

Material Standard: ASTM-A 268

Manufacturing Process: seamless or welded

| Grade     | UNSNo  | C        | Si       | Mn       | P         | S         |
|-----------|--------|----------|----------|----------|-----------|-----------|
| TP 405    | S40500 | 0.08 max | 0.75 max | 1.00 max | 0.040 max | 0.030 max |
| TP 410    | S41000 | 0.15 max | 0.75 max | 1.00 max | 0.040 max | 0.030 max |
| TP 429    | S42900 | 0.12 max | 0.75 max | 1.00 max | 0.040 max | 0.030 max |
| TP 430    | S43000 | 0.12 max | 0.75 max | 1.00 max | 0.040 max | 0.030 max |
| TP 446-1  | S44600 | 0.20 max | 0.75 max | 1.50 max | 0.040 max | 0.030 max |
| TP 446-2  | S44600 | 0.12 max | 0.75 max | 1.50 max | 0.040 max | 0.030 max |
| TP 409    | S40900 | 0.08 max | 1.00 max | 1.00 max | 0.045 max | 0.045 max |
| TP 430 TI | S43036 | 0.10 max | 1.00 max | 1.00 max | 0.040 max | 0.030 max |

### Ferritic and Martensitic Stainless Steel Tubes

Material Standard: ASTM A 789

Manufacturing Process: Seamless or welded

| UNSNo                     | C         | Si        | Mn        | P         | S         | Ni        | Cr        | Mo        |
|---------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| S31803                    | 0.03 max  | 1.00 max  | 2.00 max  | 0.030 max | 0.020 max | 4.50-6.50 | 21.0-23.0 | 2.50-3.50 |
| S31500                    | 0.03 max  | 1.40-2.00 | 1.20-2.00 | 0.030 max | 0.030 max | 4.25-5.25 | 18.0-19.0 | 2.50-3.00 |
| S32550                    | 0.04 max  | 1.00 max  | 1.50 max  | 0.040 max | 0.030 max | 4.50-6.50 | 24.0-27.0 | 2.90-3.90 |
| S31200                    | 0.030 max | 1.00 max  | 2.00 max  | 0.045 max | 0.030 max | 5.50-6.50 | 24.0-26.0 | 1.20-2.00 |
| S31260                    | 0.030 max | 0.75 max  | 1.00 max  | 0.030 max | 0.030 max | 5.50-7.50 | 24.0-26.0 | 2.50-3.50 |
| S32304                    | 0.030 max | 1.00 max  | 2.50 max  | 0.040 max | 0.040 max | 3.0-5.5   | 21.5-24.5 | 0.05-0.60 |
| OD 1 in. [25mm] and Under |           |           |           |           |           |           |           |           |
| OD over 1 in. [25 mm]     |           |           |           |           |           |           |           |           |
| S32750                    | 0.030 max | 0.80 max  | 1.20 max  | 0.035 max | 0.020 max | 6.0-8.0   | 24.0-26.0 | 3.0-5.0   |
| S32760                    | 0.05 max  | 1.00 max  | 1.00 max  | 0.030 max | 0.010 max | 6.00-8.00 | 24.0-26.0 | 3.00-4.00 |

# Stainless Steels

## CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES



| Ni           | Cr          | Mo        | Others                    | YS min<br>KSI [MPa] | TS min<br>KSI [MPa] | El.*<br>min |
|--------------|-------------|-----------|---------------------------|---------------------|---------------------|-------------|
| 8.00-11.00   | 18.00-20.00 | ...       |                           | 30[205]             | 75[515]             | 35          |
| 8.00-11.00   | 18.00-20.00 | ...       |                           | 30[205]             | 75[515]             | 35          |
| 8.00-11.00   | 18.00-20.00 | ...       | N 0.10 - 0.16             | 35[240]             | 80[550]             | 35          |
| 8.00-11.00   | 18.00-20.00 | ...       | N 0.10 - 0.16             | 30[205]             | 75[515]             | 35          |
| 8.00-13.00   | 18.00-20.00 | ...       |                           | 25[170]             | 70[485]             | 35          |
| 12.00 -15.00 | 22.00-24.00 | ...       |                           | 30[205]             | 75[515]             | 35          |
| 19.00-22.00  | 24.00-26.00 | 0.75 max  |                           | 30[205]             | 75[515]             | 35          |
| 11.00-14.00  | 16.00-18.00 | 2.00-3.00 |                           | 30[205]             | 75[515]             | 35          |
| 11.00-14.00  | 16.00-18.00 | 2.00-3.00 |                           | 30[205]             | 75[515]             | 35          |
| 10.00-15.00  | 16.00-18.00 | 2.00-3.00 |                           | 25[170]             | 70[485]             | 35          |
| 11.00-14.00  | 16.00-18.00 | 2.00-3.00 | N 0.10 - 0.16             | 35[240]             | 80[550]             | 35          |
| 11.00-14.00  | 16.00-18.00 | 2.00-3.00 | N 0.10 - 0.16             | 30[205]             | 75[515]             | 35          |
| 11.00-14.00  | 18.00-20.00 | 3.00-4.00 |                           | 30[205]             | 75[515]             | 35          |
| 11.00-15.00  | 18.00-20.00 | 3.00-4.00 |                           | 30[205]             | 75[515]             | 35          |
| 9.00-13.00   | 17.00-20.00 | ...       | Ti ≥ 5xC, max 0.60%       | 30[205]             | 75[515]             | 35          |
| 9.00-13.00   | 17.00-20.00 | ...       | Ti ≥ 4xC, max 0.60%       | 30[205]             | 75[515]             | 35          |
| 9.00-13.00   | 17.00-20.00 | ...       | Co + Ta ≥ 10xC, max 1.00% | 30[205]             | 75[515]             | 35          |
| 9.00-13.00   | 17.00-20.00 | ...       | Co + Ta ≥ 8xC, max 1.00%  | 30[205]             | 75[515]             | 35          |

| Ni       | Cr          | Mo  | Others               | YS min<br>KSI [MPa] | TS min<br>KSI [MPa] | El.*<br>min |
|----------|-------------|-----|----------------------|---------------------|---------------------|-------------|
| 0.50 max | 11.50-13.50 | ... | Al 0.10 - 0.30       | 30[205]             | 60[415]             | 20          |
| 0.50 max | 11.50-13.50 | ... |                      | 30[215]             | 60[415]             | 20          |
| 0.50 max | 14.00-16.00 | ... |                      | 35[240]             | 60[415]             | 20          |
| 0.50 max | 16.00-18.00 | ... |                      | 35[240]             | 60[415]             | 20          |
| 0.50 max | 23.00-30.00 | ... | N 0.10 - 0.25        | 40[275]             | 70[485]             | 18          |
| 0.50 max | 23.00-30.00 | ... | N 0.10 - 0.25        | 40[275]             | 65[450]             | 20          |
| 0.50 max | 10.50-11.75 | ... | Ti 6xC min; 0.75 max | 30[205]             | 55[380]             | 20          |
| 0.75 max | 16.00-19.50 | ... | Ti 5xC min; 0.75 max | 35[240]             | 60[415]             | 20          |

\*Elongation in 2 in or 50 mm, (or 4D), min, %

| N         | Cu        | Others      | YS<br>KSI [Mpa] | TS<br>KSI [Mpa]      | El* | Brinell | Rock-<br>well C |
|-----------|-----------|-------------|-----------------|----------------------|-----|---------|-----------------|
| 0.08-0.20 | ...       | ...         | 65[450]         | 90[620]              | 25  | 290     | 30.5            |
| 0.05-0.10 | ...       | ...         | 64[440]         | 92[630]              | 30  | 290     | 30.5            |
| 0.10-0.25 | 1.50-2.50 | ...         | 80[550]         | 110[760]             | 15  | 297     | 31.5            |
| 0.14-0.20 | ...       | ...         | 65[450]         | 100[690]             | 25  | 280     | ...             |
| 0.10-0.30 | 0.20-0.80 | W 0.10-0.50 | 65[450]         | 100[690]             | 25  | 290     | 30.5            |
| 0.05-0.20 | 0.05-0.60 | ...         | 65[450]         | 100[690]             | 25  | ...     | ...             |
|           |           |             | 58[400]         | 87[600]              | 25  | 290     | 30.5            |
| 0.24-0.32 | 0.50 max  | ...         | 80[550]         | 116[800]             | 15  | 310     | 32              |
| 0.20-0.30 | 0.50-1.00 | W 0.50-1.00 | 80[550]         | 109-130<br>[750-895] | 25  | 270     | ...             |

\*Elongation in 2 in or 50 mm, (or 4D), min, %



# Stainless Steels

## COMPARISON OF INTERNATIONAL STANDARDS FOR STAINLESS STEEL

| Werkstoff-Nr. | DIN.                                      | AISI.        | UNS.    | AFNOR.                                | BS.                           | JIS                    | SS.          | GOST      |
|---------------|-------------------------------------------|--------------|---------|---------------------------------------|-------------------------------|------------------------|--------------|-----------|
| 1.4000        | X6Cr13<br>(X7Cr13)                        | 403(410S)    | S 41008 | Z6C13                                 | 403 S17                       | SUS 403                | 2301         | 08Ch13    |
| 1.4002        | X6CrAl13<br>(X7CrAl13)                    | 405          | S40500  | Z6CA13                                | 405 S17                       | SUS 405                |              | 08Ch11NYU |
| 1.4006        | X10Cr13                                   | 410          | S 41000 | Z12C13                                | 410 S21                       | SUS 410                | 2302         | 12Ch13    |
| 1.4016        | X6Cr17<br>(X8Cr17)                        | 430          | S43000  | Z8C17                                 | 430 S15<br>430 S17            | SUS 430                | 2320         | 12Ch17    |
| 1.4021        | X20Cr13                                   | 420          | S42000  | Z20C13                                | 420 S29<br>420 S37<br>420 S45 | SUS 420J1<br>SUS 420J2 | 2303         | 20Ch13    |
| 1.4024        | X15Cr13                                   | 410          | S 41000 | ...                                   | 420 S29<br>410 S21            | SUS 410J1              | ...          | ...       |
| 1.4028        | X30Cr13                                   | 420          | S 42000 | Z30C13                                | 420 S45                       | SUS 420J2              | 2304         | 30Ch13    |
| 1.4031        | X38Cr13<br>(X40Cr13)                      | 420          | S 42000 | Z40C14                                | ...                           | SUS 420J2              | 2304         | 40Ch13    |
| 1.4034        | X46Cr13                                   | 420          | S42000  | Z40C14<br>Z38C13M                     | 420 S45                       | ...                    | ...          | 40Ch13    |
| 1.4057        | X20CrNi172<br>(X22CrNi17)                 | 431          | S43100  | Z15CN 16-02                           | 431 S29                       | SUS 431                | 2321         | 20Ch17N2  |
| 1.4510        | X6CrTi17<br>(X8CrTi17)                    | XM8<br>430Ti | ...     | Z8CT17                                | ...                           | SUS 430LX              | ...          | 08Ch17T   |
| 1.4512        | X6CrTi12                                  | 409          | S 40900 | Z6CT12                                | 409 S19<br>409 S17            | SUH 409                | ...          | ...       |
| 1.4301        | X5CrNi1810<br>(X5CrNi189)                 | 304/304H     | S 30400 | Z6CN18-09                             | 304 S31                       | SUS 304                | 2332         | 08Ch18N10 |
| 1.4305        | X10CrNiS189<br>(X12CrNiS188)              | 303          | S 30300 | Z10CNF 18-09                          | 303 S21                       | SUS 303                | 2346         | ...       |
| 1.4306        | X2CrNi1911<br>(X2CrNi 189)<br>(G-X2Cr189) | 304L         | S 30403 | Z2CN18-10<br>Z3CN19-10M<br>Z2CN 18-09 | 304 S12<br>304 C12<br>304 S11 | SCS 19<br>SUS 304L     | 2352<br>2333 | 03Ch18N11 |
| 1.4310        | X12CrNi177                                | 301          | S 30100 | Z12CN17-07<br>Z12Cn18-07              | 301 S21                       | SUS 301                | ...          | ...       |
| 1.4311        | X2CrNiN 1810                              | 304LN        | S 30453 | Z2CN18-10Az                           | 304 S62                       | SUS 304LN              | 2371         | ...       |
| 1.4401        | X5CrNiMo17122                             | 316          | S       | 31600 Z6CND17-11                      | 316 S16                       | SUS 316                | 2347         | ...       |

# Stainless Steels

## COMPARISON OF INTERNATIONAL STANDARDS FOR STAINLESS STEEL



| Werkstoff-Nr. | DIN.                               | AISI.  | UNS.    | AFNOR.         | BS.                  | JIS       | SS.  | GOST           |
|---------------|------------------------------------|--------|---------|----------------|----------------------|-----------|------|----------------|
| 1.4404        | X2CrNiMo17132                      | 316L   | S 31603 | Z2CND 18-13    | 316 S14              | SUS 316L  | 2348 | ...            |
|               | (X2CrNiMo1810)<br>(G-X2CrNiMo1810) |        |         | Z2CND 17-12    |                      |           |      |                |
| 1.4429        | X2CrNiMoN17133                     | 316LN  | S31653  | Z2CND 17-13    | ...                  | SUS 316LN | 2375 | ...            |
|               | (X2CrNiMoN1813)                    |        |         |                |                      |           |      |                |
| 1.4435        | X2CrNiMo18143                      | 316L   | S 31603 | Z2CND 17-13    | 316 S11              | SCS 16    | 2353 | 03Ch17N14M2    |
|               | (X2CrNiMo1812)                     |        |         |                | 316 S12<br>316 S13   | SUS 316L  |      |                |
| 1.4436        | X5CrNiMo17133                      | 316    | S 31600 | Z6CND 17-12    | 316 S16              | SUS 316   | 2343 | ...            |
|               | (X5CrNiMo1812)                     |        |         |                | 316 S33              |           |      |                |
| 1.4438        | X2CrNiMo18164                      | 317L   | S31703  | Z2CND 19-15    | 317 S12              | SUS 317L  | 2367 | ...            |
|               | (X2CrNiMo1816)                     |        |         |                |                      |           |      |                |
| 1.4439        | X2CrNiMoN17135                     | 317LNM | S 31726 | Z2CND 19-15    | 317 S16              | ...       | ...  | ...            |
| 1.4449        | X5CrNiMo 1713                      | 317    | ...     | ...            | 317 S16              | SUS 317   | ...  | ...            |
| 1.4465        | X1CrNiMoN25252                     | ...    | N 08310 | ...            | ...                  | ...       | ...  | ...            |
| 1.4505        | X5CrNiMoCuNb2018                   | ...    | ...     | ...            | ...                  | ...       | ...  | 07Ch17N20M2D2T |
| 1.4521        | X2CrMoTi182                        | 440    | S44400  | ...            | ...                  | ...       | 2326 | ...            |
| 1.4529        | X1NiCrMoCuN25206                   | ...    | N 08925 | ...            | ...                  | ...       | ...  | ...            |
| 1.4539        | X1NiCrMoCu25205                    | 904L   | N 08904 | Z1NCUDU25-2004 | ...                  | ...       | 2562 | ...            |
| 1.4541        | X6CrNiTi1810                       | 321    | S 32100 | Z6CNT18-10     | 321 S12              | SUS 321   | 2337 | 1Ch18N12T      |
|               | (X10CrNiTi189)                     |        |         |                | 321 S20<br>(321 S31) |           |      |                |
| 1.4550        | X6CrNiNb1810                       | 347    | S 34700 | Z6CNNb 18-10   | 347 S17              | SUS 347   | 2338 | 08Ch 18N12B    |
|               | (X10CrNiNb189)                     |        |         |                | 347 S31              |           |      |                |
| 1.4558        | X2NiCrAlTi3220                     | ...    | N 08800 | ...            | ...                  | ...       | ...  | ...            |
| 1.4563        | X1NiCrMoCuN31274                   | ...    | N 08028 | Z1NCUDU31273Az | ...                  | ...       | ...  | ...            |
| 1.4571        | X6CrNiMoTi17122                    | 316Ti  | S 31635 | Z6CNDT 17-12   | 320 S31              | ...       | 2350 | 10Ch17N13M2T   |
|               | (X10CrNiMo Ti1810)                 |        |         |                | 320 S17              |           |      |                |
| 1.4580        | X6CrNiMoNb17122                    | 316 Nb | ...     | Z6CNDNb17-12   | ...                  | ...       | ...  | 08Ch16N13M2B   |
|               | (X10CrNiMoNb 1810)                 |        |         | Z6CNDNb19-13   |                      |           |      |                |
| 1.4583        | X10CrNiMoNb1812                    | 318    | ...     | ...            | ...                  | ...       | ...  | ...            |
| 1.4586        | X5CrMoCuNb2218                     | ...    | ...     | ...            | ...                  | ...       | ...  | ...            |



# Stainless Steels

## COMPARISON OF INTERNATIONAL STANDARDS FOR STAINLESS STEEL

| Werkstoff-Nr. | DIN.              | AISI.   | UNS.    | AFNOR.        | BS.       | JIS       | SS.  | GOST        |
|---------------|-------------------|---------|---------|---------------|-----------|-----------|------|-------------|
| 1.4335        | X1CrNi2521        | 310LC   | ...     | Z2CN25-20     | ...       | ...       | ...  | ...         |
| 1.4713        | X10CrAl7          | ...     | ...     | Z8CA7         | ...       | ...       | ...  | ...         |
| 1.4718        | X45CrSi93         | HNV3    | ...     | Z45CS9        | 401 S45   | SUH 1     | ...  | ...         |
| 1.4724        | X10CrAl13         | (405)   | ...     | Z10C13        | 403 S17   | ...       | ...  | ...         |
| 1.4742        | X10CrAl18         | (430)   | ...     | Z10CAS18      | 430 S15   | SUS 430   | ...  | ...         |
|               |                   |         |         |               |           | SUH 21    |      |             |
| 1.4749        | X18CrN28          | 446-1   | ...     | ..            | ...       | ...       | ...  | Ch25        |
| 1.4762        | X10CrAl24         | (446)   | ...     | Z10CAS24      | ...       | ...       | ...  | ...         |
| 1.4821        | X20CrNiSi254      | 327     | ...     | Z20CNS25-04   | ...       | ...       | ...  | ...         |
| 1.4828        | X15CrNiSi2012     | 309     | ...     | Z15CNS20_12   | 309 S24   | SUH 309   | ...  | Ch24N12S1   |
| 1.4833        | X7CrNi2314        | 309S    | ...     | Z15CN24-13    | ...       | SUS 309S  | ...  | ...         |
| 1.4841        | X15CrNiSi2520     | 314/310 | ...     | Z12CNS25-20   | ...       | SUH 310   | ...  | 20Ch25N20S2 |
| 1.4845        | X12CrNi2521       | 310S    | ...     | Z12CN25-20    | 310 S24   | SUH 310   | 2361 | 10Ch23N18   |
|               |                   |         |         |               |           | SUS 310S  |      |             |
| 1.4848        | (G-X40CrNiSi2520) | ...     | ...     | ...           | 310 C40   | SCH 21    | ...  | ...         |
| 1.4864        | X12NiCrSi3616     | 330     | N 08330 | Z12NCS37-18   | Na 17     | SUH 330   | ...  | ...         |
|               |                   |         |         | Z12NCS35-16   |           |           |      |             |
|               |                   |         |         | Z12NC37-18    |           |           |      |             |
| 1.4871        | X53CrMnNiN219     | EV8     | ...     | Z52CMN21-09   | 349 S54   | SUH 35    | ...  | ...         |
|               |                   |         |         |               |           | SUH 36    |      |             |
| 1.4876        | X10NiCrAlTi3320   | B163    | N 08800 | Z8NC32-21     | NA 15(H)  | NCF 8000  | ...  | ...         |
| 1.4876        | X10CrNiAlTi3320   | B163    | N 08810 | Z8NC32-21     | NA 15     | ...       | ...  | ...         |
| 1.4878        | X12CrNiTi189      | 321H    | ...     | Z6CNT18-12(B) | 321 S20   | SUS 321   | 2337 | ...         |
|               |                   |         |         |               | (321 S12) |           |      |             |
| 1.4893        | ...               | ...     | S 30815 | ...           | ...       | ...       | 2368 | ...         |
| ...           | ...               | ...     | S 32750 | ...           | ...       | ...       | ...  | ...         |
| 1.4362        | ...               | ...     | S 32304 | ...           | ...       | ...       | ...  | ...         |
| 1.4417        | ...               | ...     | S 31500 | ...           | ...       | ...       | ...  | ...         |
| 1.4460        | X4CrNiMo2751      | 329     | S 32900 | ...           | ...       | SUS 329J1 | 2324 | ...         |
|               | (X8CrNiMo275)     |         |         |               |           | SCH 11    |      |             |
|               |                   |         |         |               |           | SCS 11    |      |             |
| 1.4462        | X2CrNiMoN2253     | ...     | S 31803 | Z2CND22-05Az  | ...       | ...       | ...  | ...         |
| ...           | ...               | ...     | S 31200 | ...           | ...       | ...       | ...  | ...         |
| ...           | ...               | ...     | S 31260 | ...           | ...       | ...       | ...  | ...         |
| ...           | ...               | ...     | S 32550 | ...           | ...       | ...       | ...  | ...         |
| ...           | ...               | ...     | S 32950 | ...           | ...       | ...       | ...  | ...         |

(...) hitherto existing DIN-designation





### Chemical composition and mechanical properties

#### Material Standard SEW 470

| DIN                               | Material grade | %C           | %Si        | %Mn max | %P max | %S max | %Al         | %Cr          | %Ni          | % Others          |
|-----------------------------------|----------------|--------------|------------|---------|--------|--------|-------------|--------------|--------------|-------------------|
| <b>Ferritic steels</b>            |                |              |            |         |        |        |             |              |              |                   |
| X 10 CrAl 7                       | 1.4713         | ≤ 0.12       | 0.5 to 1.0 | 1.0     | 0.040  | 0.030  | 0.5 to 1.0  | 6.0 to 8.0   | ...          | ...               |
| X 7 CrTi 12                       | 1.4720         | ≤ 0.08       | ≤ 1.0      | 1.0     | 0.040  | 0.030  | ...         | 10.5 to 12.5 | ...          | Ti ≥ 6 x %C ≤ 1.0 |
| X 10 CrAl 18                      | 1.4742         | ≤ 0.12       | 0.7 to 1.4 | 1.0     | 0.040  | 0.030  | 0.7 to 1.2  | 17.0 to 19.0 | ...          | ...               |
| X 10 CrAl 24                      | 1.4762         | ≤ 0.12       | 0.7 to 1.4 | 1.0     | 0.040  | 0.030  | 1.2 to 1.7  | 23.0 to 26.0 | ...          | ...               |
| <b>Ferritic-austenitic steels</b> |                |              |            |         |        |        |             |              |              |                   |
| X 20 CrNiSi 25 4                  | 1.4821         | 0.10 to 0.20 | 0.8 to 1.5 | 2.0     | 0.040  | 0.030  | ...         | 24.0 to 27.0 | 3.5 to 5.5   | ...               |
| <b>Austenitic steel</b>           |                |              |            |         |        |        |             |              |              |                   |
| X 12 CrNiTi 18 9                  | 1.4878         | ≤ 0.12       | ≤ 1.0      | 2.0     | 0.045  | 0.030  | ...         | 17.0 to 19.0 | 9.0 to 12.0  | Ti ≥ 4 x %C ≤ 0.8 |
| X 15 CrNiSi 20 12                 | 1.4828         | ≤ 0.20       | 1.5 to 2.5 | 2.0     | 0.045  | 0.030  | ...         | 19.0 to 21.0 | 11.0 to 13.0 | ...               |
| X 12 CrNi 25 21                   | 1.4845         | ≤ 0.15       | ≤ 0.75     | 2.0     | 0.045  | 0.030  | ...         | 24.0 to 26.0 | 19.0 to 22.0 | ...               |
| X 15 CrNiSi 25 20                 | 1.4841         | ≤ 0.20       | 1.5 to 2.5 | 2.0     | 0.045  | 0.030  | ...         | 24.0 to 26.0 | 19.0 to 22.0 | ...               |
| X 12 NiCrSi 36 16                 | 1.4864         | ≤ 0.15       | 1.0 to 2.0 | 2.0     | 0.030  | 0.020  | ...         | 15.0 to 17.0 | 33.0 to 37.0 | ...               |
| X 10 NiCrAlTi 32 20               | 1.4876         | ≤ 0.12       | ≤ 1.0      | 2.0     | 0.030  | 0.020  | 0.15 to 0.6 | 19.0 to 23.0 | 30.0 to 34.0 | Ti 0.15 to 0.6    |

#### Mechanical Properties at Room Temperature

| DIN                        | Material grade | Heat treatment condition | Hardness<br><br>HB<br><br>max | Yield Strength<br>0.2 limit<br>N/mm <sup>2</sup><br>min | Tensile Strength<br><br>N/mm <sup>2</sup> | Elongation<br>(LO = 5d0)<br>longit.      transv.<br><br>% min |    |
|----------------------------|----------------|--------------------------|-------------------------------|---------------------------------------------------------|-------------------------------------------|---------------------------------------------------------------|----|
| Ferritic steels            |                |                          |                               |                                                         |                                           |                                                               |    |
| X 10 CrAl 7                | 1.4713         | annealed                 | 192                           | 220                                                     | 420 to 620                                | 20                                                            | 15 |
| X 7 CrTi 12                | 1.4720         | annealed                 | 179                           | 210                                                     | 400 to 600                                | 25                                                            | 20 |
| X 10 Cr Al 18              | 1.4742         | annealed                 | 212                           | 270                                                     | 500 to 700                                | 12                                                            | 9  |
| X 10 CrAl 24               | 1.4762         | annealed                 | 223                           | 280                                                     | 520 to 720                                | 10                                                            | 7  |
| Ferritic-austenitic steels |                |                          |                               |                                                         |                                           |                                                               |    |
| X 20 CrNiSi 25 4           | 1.4821         | quenched                 | 235                           | 400                                                     | 600 to 850                                | 16                                                            | 12 |
| Austenitic steels          |                |                          |                               |                                                         |                                           |                                                               |    |
| X12 CrNiTi 18 9            | 1.4878         | quenched                 | 192                           | 210                                                     | 500 to 750                                | 40                                                            | 30 |
| X15 CrNiSi 20 12           | 1.4828         | quenched                 | 223                           | 230                                                     | 500 to 750                                | 30                                                            | 22 |
| X 12 CrNi 25 21            | 1.4845         | quenched                 | 192                           | 210                                                     | 500 to 750                                | 35                                                            | 26 |
| X 15 CrNiSi 25 20          | 1.4841         | quenched                 | 223                           | 230                                                     | 550 to 800                                | 30                                                            | 22 |
| X12 NiCrSi 36 16           | 1.4864         | quenched                 | 223                           | 230                                                     | 550 to 800                                | 30                                                            | 22 |
| X 10 NiCrAlTi 32 20        | 1.4876         | recrystallised           | 192                           | 210                                                     | 500 to 750                                | 30                                                            | 22 |
|                            |                | annealed                 |                               |                                                         |                                           |                                                               |    |
|                            |                | solution annealed        | 192                           | 170                                                     | 450 to 700                                | 30                                                            | 22 |

Abovementioned values are applicable only for samples ≥ 3 mm.



# Techalloy 200

UNS NO. N02200, DIN W.NR. 2.4066

Techalloy 200 is technically pure nickel with good mechanical properties and excellent resistance to alkali hydroxides, dry halogen hydrides as well as organic compositions. Even when exposed to high temperatures, Techalloy 200 retains its strength and is ductile at low temperatures. Techalloy 200 is a multipurpose grade and is used in applications where alloys are not essential. It also has good magnetic and magnet ostrictive properties, high thermal and electrical conductivity as well as low gas content in the elctronics industry. Furthermore Techalloy 200 is of interest for its good weldability.

## Chemical Composition in %

| C            | Si           | Mn           | Fe          | Ni           | S             | Cu           |
|--------------|--------------|--------------|-------------|--------------|---------------|--------------|
| 0,15<br>max. | 0,35<br>max. | 0,35<br>max. | 0,4<br>max. | 99,0<br>min. | 0,010<br>max. | 0,25<br>max. |

## Mechanical Properties - at room temperature - annealed condition

| 0,2 % yield strength             | tensile strength                 | elongation (A5) |
|----------------------------------|----------------------------------|-----------------|
| N/mm <sup>3</sup><br>105<br>min. | N/mm <sup>3</sup><br>380<br>min. | %<br>35<br>min. |

## Specification

|                       |                                                                                                                                                           |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Seamless Pipes/Tubes: | ASTM-B-161                                                                                                                                                |
| Welded Pipes/Tubes:   | ASTM-B-725/730                                                                                                                                            |
| Plates/Sheets:        | ASTM-B-162                                                                                                                                                |
| Bars:                 | ASTM-B-160                                                                                                                                                |
| Fittings:             | ASTM-B-366                                                                                                                                                |
| Flange:               | ASTM-B-564                                                                                                                                                |
| Specific weight:      | 8,89 kg/dm <sup>3</sup>                                                                                                                                   |
| Melting range:        | 1435 - 1445° C                                                                                                                                            |
| Welding methods:      | Arc welding, TIG, MIG, autogenous welding<br>without thermal retreatment (details on request)                                                             |
| Machineability:       | Table on request                                                                                                                                          |
| Corrosion Resistance: | Refer to table Corrosion Data                                                                                                                             |
| Product forms:        | Tubes and pipes, fittings,, flanges, plates<br>and sheets, bars, forgings (cast iron),<br>profiles, wire                                                  |
| Range of application: | chemical and food industry, loading<br>plants, electrical and electronical parts,<br>parts and equipment for aircrafts and rok-<br>kets, transducers etc. |



# Techalloy 201

UNS NO. N02201, DIN W.NR. 2.4068



Techalloy 201 is an alloy similar to Nickel 200. The carbon content of the former is a little above that of Nickel 200. Due to this difference, Techalloy 201 is preferred in caustic soda above 300° C. Techalloy 201 disposes of the same high thermal and electrical conductivity and of the same magnetic and megnetostrictive properties as the grade Nickel 200.

## Chemical Composition in %

| C             | Si           | Mn           | Fe           | Ni           | S            | Cu           |
|---------------|--------------|--------------|--------------|--------------|--------------|--------------|
| 0,020<br>max. | 0,35<br>max. | 0,35<br>max. | 0,40<br>max. | 99,0<br>min. | 0,01<br>max. | 0,25<br>max. |

## Mechanical Properties - at room temperature - annealed condition

| 0,2 % yield strength    | tensile strength         | elongation (A5) |
|-------------------------|--------------------------|-----------------|
| N/mm <sup>2</sup><br>80 | N/mm <sup>2</sup><br>380 | %<br>35         |

## Specification:

|                       |                                                                                                                                                                           |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Seamless Pipes/Tubes: | ASTM-B-161                                                                                                                                                                |
| Welded Pipes/Tubes:   | ASTM-B-725/730                                                                                                                                                            |
| Plates/Sheets:        | ASTM-B-162                                                                                                                                                                |
| Bars:                 | ASTM-B-160                                                                                                                                                                |
| Fittings:             | ASTM-B-366                                                                                                                                                                |
| Flange:               | ASTM-B-564                                                                                                                                                                |
| Specific weight:      | 8,89 kg/dm <sup>3</sup>                                                                                                                                                   |
| Melting range:        | 1435 - 1445° C                                                                                                                                                            |
| Welding methods:      | Arc welding, TIG, MIG, autogenous welding<br>without thermal retreatment (details on request.)                                                                            |
| Machineability:       | Table on request                                                                                                                                                          |
| Corrosion resistance: | Refer to table Corrosion Data                                                                                                                                             |
| Product forms:        | Tubes and pipes, fittings, flanges, plates and<br>sheets, bars, forgings (cast iron), profiles, wire                                                                      |
| Range of application: | Caustic evaporators, plating rods, combustion<br>boats, chemical plants with operating<br>temperatures above 300° C, for example<br>in caustic soda manufacturing plants. |





# Techalloy 400

UNS NO. N04400, DIN W.NR. 2.4360

TECHALLOY 400 is a weldable nickel-copper alloy with good resistance to sea water, alkaline acids, organic acids, pharmaceutical products, ammonium sulfate, fatty acid etc. Tensile strength and ductility are retained in operating temperatures of max. 450° C.

## Chemical Composition in %

| C            | Si          | Mn          | Fe          | Ni           | S             | Cu          |
|--------------|-------------|-------------|-------------|--------------|---------------|-------------|
| 0,30<br>max. | 0,5<br>max. | 2,0<br>max. | 2,5<br>max. | 63,0<br>max. | 0,024<br>max. | 28,0 - 34,0 |

## Mechanical Properties - at room temperature - annealed condition

| 0,2 % yield strength | tensile strength     | elongation (A5) |
|----------------------|----------------------|-----------------|
| N/mm2<br>195<br>min. | N/mm2<br>480<br>min. | %<br>35<br>min. |

## Specification:

|                       |                                                                                                                                                                                                                                                                                                     |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Seamless Pipes/Tubes: | ASTM-B-165                                                                                                                                                                                                                                                                                          |
| Welded Pipes/Tubes:   | ASTM-B-725/730                                                                                                                                                                                                                                                                                      |
| Plates:               | ASTM-B-127                                                                                                                                                                                                                                                                                          |
| Bars:                 | ASTM-B-164                                                                                                                                                                                                                                                                                          |
| Fittings:             | ASTM-B-366                                                                                                                                                                                                                                                                                          |
| Flange:               | ASTM-B-564                                                                                                                                                                                                                                                                                          |
| Specific weight:      | 8,83 kg/dm <sup>3</sup>                                                                                                                                                                                                                                                                             |
| Melting range:        | 1300 - 1350° C                                                                                                                                                                                                                                                                                      |
| Welding methods:      | Arc welding, TIG, MIG, UP, autogenous welding, without thermal retreatment (details on request)                                                                                                                                                                                                     |
| Machineability:       | Table on request                                                                                                                                                                                                                                                                                    |
| Corrosion:            | Refer to table "Corrosion Data"                                                                                                                                                                                                                                                                     |
| Product forms:        | Tubes and pipes, fittings, flanges, plates and sheets, bars, forgings (cast iron), profiles, wire                                                                                                                                                                                                   |
| Range of application: | Techalloy 400 is mainly employed for valves and pumps, pump and propeller shafts, metal fittings and machine parts for ships, electronic and electric parts, tanks for petrol and drinking water, distilling apparatus for crude petroleum, electric water heater, plants for the chemical industry |



# Techalloy K 500

UNS NO. N05500, DIN W.NR. 2.4375



TECHALLOY K 500 is an age-hardening alloy which combines the high corrosion resistance of Techalloy 400 with increased tensile strength and hardness. With low permeability, Techalloy K 500 is not magnetic up to - 135° C.

## Chemical Composition in %

| C            | Si  | Mn          | Fe          | Ni           | S             | Cu            | Al          | Ti        |
|--------------|-----|-------------|-------------|--------------|---------------|---------------|-------------|-----------|
| 0,25<br>max. | 0,5 | 1,5<br>max. | 2,0<br>max. | 63,0<br>min. | 0,010<br>max. | 27,0-<br>33,0 | 2,3-<br>3,2 | 0,35-0,85 |

## Mechanical Properties - cold worked - cold drawn condition

| 0,2% yield strength | tensile strength                 | elongation (A5) |
|---------------------|----------------------------------|-----------------|
| N/mm<br>620<br>min. | N/mm <sup>2</sup><br>900<br>min. | %<br>15<br>min. |

## Specification:

|                       |                                                                                                                                                                                                           |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pipes/Tubes:          | BS 3074 NA 18                                                                                                                                                                                             |
| Bars:                 | BS 3074 Na 18                                                                                                                                                                                             |
| Specific weight:      | 8,46 kg/dm <sup>3</sup>                                                                                                                                                                                   |
| Melting rage:         | 1315 - 1350° C                                                                                                                                                                                            |
| Welding methods:      | Arc welding, TIG, MIG, autogenous welding, thermal retreatment required (details on request)                                                                                                              |
| Machineability:       | Table on request                                                                                                                                                                                          |
| Corrosion resistance: | Refer to table "Corrosion Data"                                                                                                                                                                           |
| Product forms:        | bars and forgings                                                                                                                                                                                         |
| Range of application: | Techalloy K 500 is mainly used for propeller shafts, Cardan and pump shafts, petrol drilling, bolts, doctor blades, scraping knives, valve spindles, electronical parts, medical instruments and springs. |





# Techalloy 600

UNS NO. N06600, DIN W.NR. 2.4816

Techalloy 600 has excellent mechanical properties and oxidation resistance at high temperatures. It is a standard engineering material and mainly employed in applications, which require the combination of resistance to corrosion and heat.

## Chemical Composition in %

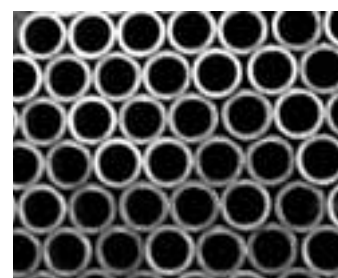
| C            | Si          | Mn          | Fe           | Cr            | Ni           | S             | Cu          |
|--------------|-------------|-------------|--------------|---------------|--------------|---------------|-------------|
| 0,15<br>max. | 0,5<br>max. | 1,0<br>max. | 6,0-<br>10,0 | 14,0-<br>17,0 | 72,0<br>min. | 0,015<br>max. | 0,5<br>max. |

## Mechanical Properties - at room temperature - annealed, cold drawn condition

| 0,2 % yield strength             | tensile strength                 | elongation (A5) |
|----------------------------------|----------------------------------|-----------------|
| N/mm <sup>2</sup><br>240<br>min. | N/mm <sup>2</sup><br>550<br>min. | %<br>30<br>min. |

## Specification:

|                       |                                                                                                                                                                            |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Seamless Pipes/Tubes: | ASTM-B-167                                                                                                                                                                 |
| Welded Pipes/Tubes:   | ASTM-B-516/517                                                                                                                                                             |
| Plates/Sheets:        | ASTM-B-168                                                                                                                                                                 |
| Bars:                 | ASTM-B-166                                                                                                                                                                 |
| Fittings:             | ASTM-B-366                                                                                                                                                                 |
| Flange:               | ASTM-B-564                                                                                                                                                                 |
| Specific weight:      | 8,42 kg/dm <sup>3</sup>                                                                                                                                                    |
| Melting rage:         | 1355 - 1415° C                                                                                                                                                             |
| Welding methods:      | Arc welding, TIG, MIG, UP and autogenous welding (details on request)                                                                                                      |
| Machineability:       | Table on request                                                                                                                                                           |
| Corrosion resistance: | Refer to table "Corrosion Data"                                                                                                                                            |
| Product forms:        | Tubes and pipes, fittings, flanges, plates and sheets, bars, forgings (cast iron), wire                                                                                    |
| Range of application: | Techalloy 600 is employed for muffles, heat exchanger tubes, evaporator tubes, combustion-chamber liners, nuclear reactors, plants for the food and chemical industry etc. |



# Techalloy 601

UNS NO. N06601, DIN W.NR. 2.4851



Techalloy 601 has very good properties at high temperatures and is oxidation resistant as well as scale-resistant at temperatures of up to 1250°C. The high chromium content results in good resistance oxidation, carburization and sulfurous media. The aluminium and nickel content result in a further improvement of the oxidation resistance.

## Chemical Composition in %

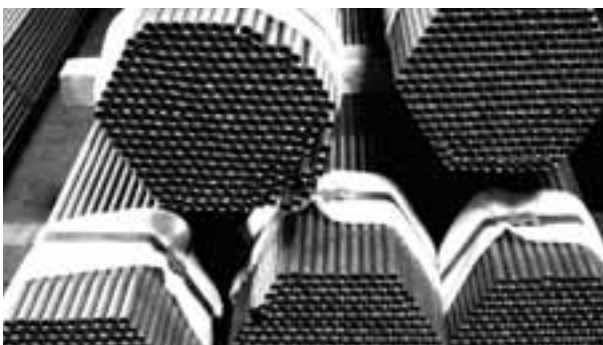
| C            | Si           | Mn          | Fe   | Cr            | Ni            | S             | Cu          | AL          |
|--------------|--------------|-------------|------|---------------|---------------|---------------|-------------|-------------|
| 0,10<br>max. | 0,50<br>max. | 1,0<br>max. | Rest | 21,0-<br>25,0 | 58,0-<br>63,0 | 0,015<br>max. | 1,0<br>max. | 1,0-<br>1,7 |

## Mechanical Properties - at room temperature - solution annealed, cold drawn

| 0,2 % yield strength | tensile strength  | elongation (A5) | hardness    |
|----------------------|-------------------|-----------------|-------------|
| N/mm 2<br>205-415    | N/mm 2<br>550-760 | %<br>65-35      | RB<br>70-95 |

## Specification:

|                       |                                                                                                                                                                                   |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Seamless Pipes/Tubes: | ASTM-B-167                                                                                                                                                                        |
| Plates/Sheets:        | ASTM-B-168                                                                                                                                                                        |
| Bars:                 | ASTM-B-166                                                                                                                                                                        |
| Fittings:             | ASTM-B-366                                                                                                                                                                        |
| Flange:               | ASTM-B-564                                                                                                                                                                        |
| Specific weight:      | 8,06 kg/dm 3                                                                                                                                                                      |
| Melting range:        | 1300 - 1370° C                                                                                                                                                                    |
| Welding methods:      | Details on request                                                                                                                                                                |
| Machineability:       | Table on request                                                                                                                                                                  |
| Product forms:        | Tubes and pipes, plates and sheets, bars wire, fittings and flanges                                                                                                               |
| Range of application: | heat treating baskets and fixtures, trays, radiant tubes, muffles, retorts, flame shields, burner nozzls etc. Techalloy 601 is a new grade for the space and processing industry. |







# Techalloy 625

UNS NO. N06625, DIN W.NR. 2.4856

Techalloy 625 is an alloy with high resistance and ductility at lowest temperatures and up to 1100° C. Techalloy 625 is not magnetic and apart from its high oxidation resistance it is also resistant against many media. High resistance against stress corrosion cracking, pitting and crevice corrosion is also a main characteristic of Techalloy 625.

## Chemical Composition in %

| C            | Si          | Mn           | Fe          | Cr            | Ni           | S             | Mo           | Al           | Nb/Ta         | Ti           | P             | Co           |
|--------------|-------------|--------------|-------------|---------------|--------------|---------------|--------------|--------------|---------------|--------------|---------------|--------------|
| 0,10<br>max. | 0,5<br>max. | 0,50<br>max. | 5,0<br>max. | 20,0-<br>23,0 | 58,0<br>min. | 0,015<br>max. | 8,0-<br>10,0 | 0,40<br>max. | 3,15-<br>4,15 | 0,40<br>max. | max.<br>0,015 | max.<br>1,0* |

\* If determined

## Mechanical Properties - at room temperature - solution annealed condition

| 0,2 % yield strength | tensile strength     | elongation (A5) |
|----------------------|----------------------|-----------------|
| N/mm2<br>414<br>min. | N/mm2<br>827<br>min. | %<br>30<br>min. |

## Specification:

|                       |                                                                                                                                                                                                  |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Seamless Pipes/Tubes: | ASTM-B-444                                                                                                                                                                                       |
| Welded Pipes/ Tubes:  | ASTM-B-704/705                                                                                                                                                                                   |
| Plates/ Sheets:       | ASTM-B-443                                                                                                                                                                                       |
| Bars:                 | ASTM-B-446                                                                                                                                                                                       |
| Fittings:             | ASTM-B-366                                                                                                                                                                                       |
| Flange:               | ASTM-B-564                                                                                                                                                                                       |
| Specific weight:      | 8,44 kg/dm 3                                                                                                                                                                                     |
| Melting range:        | 1290 - 1350° C                                                                                                                                                                                   |
| Welding methods:      | Arc welding, TIG,MIG, UP and autogenous welding (details on request)                                                                                                                             |
| Machineability:       | Table on request                                                                                                                                                                                 |
| Product forms:        | Tubes and pipes, plates and sheets, bars, wire, fittings and flanges                                                                                                                             |
| Range of application: | fuel and hydraulic line tubing, thrust-reverser systems, spray bars, bellows, thrust-chamber tubing for rocket motors, reaction vessels, distillation columns, heat exchanger tubes, valves etc. |





# Techalloy 800

UNS NO. N08800, DIN W.NR. 1.4876



Techalloy 800 is an austenitic alloy with high tensile strength and resistance against oxidation and carburization at high temperatures. This grade is resistant to stress corrosion cracking, sulfurous media and scale. The solution annealed execution of Techalloy 800, Techalloy 801, has significantly higher creep strength.

## Chemical Composition in %

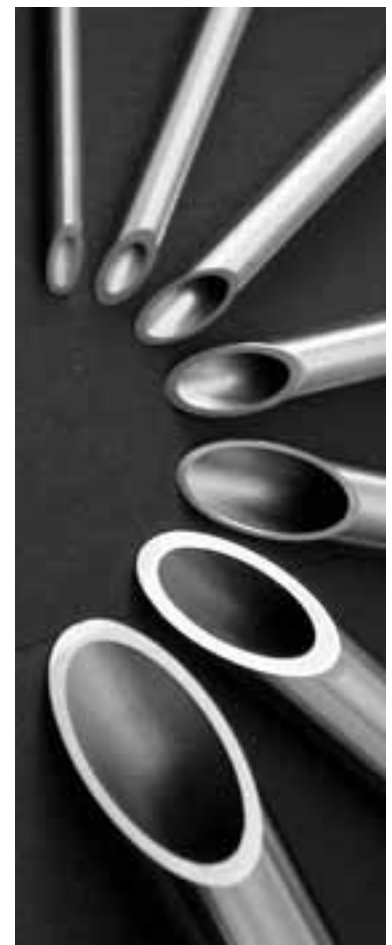
| Ni           | C            | Mn          | Fe                | S             | Si          | Cu           | Cr            | Al            | Ti            |
|--------------|--------------|-------------|-------------------|---------------|-------------|--------------|---------------|---------------|---------------|
| 30,0<br>35,0 | 0,10<br>max. | 1,5<br>max. | Rest<br>(Balance) | 0,015<br>max. | 1,0<br>max. | 0,75<br>max. | 19,0-<br>23,0 | 0,15-<br>0,60 | 0,15-<br>0,60 |

## Mechanical Properties - at room temperature - annealed, cold drawn condition

| 0,2 % yield strength             | tensile strength                 | elongation (A5) |
|----------------------------------|----------------------------------|-----------------|
| N/mm <sup>2</sup><br>205<br>min. | N/mm <sup>2</sup><br>520<br>min. | %<br>30<br>min. |

## Specification:

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Seamless Pipes/Tubes: | ASTM-B-407                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Welded Pipes/Tubes:   | ASTM-B-514/515                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Plates/Sheets:        | ASTM-B-443                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Bars:                 | ASTM-B446                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Fittings:             | ASTM-B-366                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Flange:               | ASTM-B-564                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Specific weight:      | 7,95 kg/dm <sup>3</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Melting range:        | 1355 - 1385° C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Welding methods:      | Arc welding, TIG, MIG, autogenous welding, without thermal retreatment (details on request)                                                                                                                                                                                                                                                                                                                                                                                                                |
| Machineability:       | Table on request                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Corrosion resistance: | Refer to table "Corrosion Data"                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Product forms:        | Tubes and pipes, fittings, flanges, plates and sheets bars, forgings and wire                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Range of application: | Techalloy 800 is mainly employed for all equipment and heating tubes in the furnace-building industry, in the petrochemical industry, Techalloy 800 is used for heat exchangers and other piping systems; in the plastics, chemical and food industry, where, due to chlorid-ions, great demands are made on the stress corrosion cracking resistance, Techalloy 800 is also used for steamgenerator tubing in nuclear power plants and as sheath in electric heating elements in domestic appliances etc. |





# Techalloy 800H

UNS NO. N08810, DIN W.NR. 1.4876

Techalloy 825 is a thermally stabilized alloy which is resistant to both inorganic and organic acids. It has excellent resistance to oxidizing and nonoxidizing hot acid conditions and at temperatures up to the boiling point it is resistant to many acids and alkaline solutions.

## Chemical Composition in %

| C         | Si       | Mn       | Fe   | Cr        | Ni        | S          | Cu        | Al        | Ti        |
|-----------|----------|----------|------|-----------|-----------|------------|-----------|-----------|-----------|
| 0,05-0,10 | 1,0 max. | 1,5 max. | Rest | 19,0-23,0 | 30,0-35,0 | 0,015 max. | 0,75 max. | 0,15-0,60 | 0,15-0,60 |

## Mechanical Properties - at room temperature - annealed condition, cold drawn

| 0,2 % yield strength             | tensile strength                 | elongation (A5) |
|----------------------------------|----------------------------------|-----------------|
| N/mm <sup>2</sup><br>170<br>min. | N/mm <sup>2</sup><br>450<br>min. | %<br>30<br>min. |

## Specification:

|                       |                                                                              |
|-----------------------|------------------------------------------------------------------------------|
| Seamless Pipes/Tubes: | ASTM-B-407                                                                   |
| Welded Pipes/Tubes:   | ASTM-B-514/515                                                               |
| Plates/Sheets:        | ASTM-B-409                                                                   |
| Bars:                 | ASTM-B-408                                                                   |
| Fittings:             | ASTM-B-366                                                                   |
| Flange:               | ASTM-B-564                                                                   |
| Specific weight:      | 7,95 kg/dm <sup>3</sup>                                                      |
| Melting range:        | 1335- 1385° C                                                                |
| Welding methods:      | Arc welding and common welding processes                                     |
| Machineability:       | Table on request                                                             |
| Range of application: | Techalloy 800H is employed where maximum creep-rupture strength is required. |



# Techalloy 825

UNS NO. N08825, DIN W.NR. 2.4858



Techalloy 825 is a thermally stabilized alloy which is resistant to both inorganic and organic acids. It has excellent resistance to oxidizing and nonoxidizing hot acid conditions and at temperatures up to the boiling point it is resistant to many acids and alkaline solutions.

## Chemical Composition in %

| C             | Si          | Mn          | Fe   | Cr            | Ni            | S            | Mo          | Cu          | Al Ti                |
|---------------|-------------|-------------|------|---------------|---------------|--------------|-------------|-------------|----------------------|
| 0,025<br>max. | 0,5<br>max. | 1,0<br>max. | Rest | 19,5-<br>23,5 | 38,0-<br>46,0 | 0,03<br>max. | 2,5-<br>3,5 | 1,5-<br>3,0 | 0,2 0,6-<br>max. 1,2 |

## Mechanical Properties - at room temperature - annealed condition, cold drawn

| 0,2 % yield strength             | tensile strength                 | elongation (A5) |
|----------------------------------|----------------------------------|-----------------|
| N/mm <sup>2</sup><br>241<br>min. | N/mm <sup>2</sup><br>586<br>min. | %<br>30<br>min. |

## Specification:

|                       |                                                                                                                                                                           |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Seamless Pipes/Tubes: | ASTM-B-423                                                                                                                                                                |
| Welded Pipes/Tubes:   | ASTM-B-704/705                                                                                                                                                            |
| Plates/Sheets:        | ASTM-B-424                                                                                                                                                                |
| Bars:                 | ASTM-B-425                                                                                                                                                                |
| Fittings:             | ASTM-B-366                                                                                                                                                                |
| Flange:               | ASTM-B-564                                                                                                                                                                |
| Specific weight:      | 8,14 kg/dm <sup>3</sup>                                                                                                                                                   |
| Melting range:        | 1370 - 1400° C                                                                                                                                                            |
| Welding methods:      | Arc welding, TIG, MIG, plasma, autogenous welding (Details on request)<br>Note: Take care that the surface is cleaned before welding                                      |
| Machineability:       | Table on request                                                                                                                                                          |
| Corrosion resistance: | Refer to table "Corrosion Data"                                                                                                                                           |
| Product forms:        | Tubes and pipes, fittings, flanges, plates and sheets, bars, forgings                                                                                                     |
| Range of application: | Techalloy 825 is employed for phosphoric acid evaporators, pickling vats, plants for chemical processing, propeller shafts, transportation means for corrosive media etc. |





# Techalloy B-2

UNS NO. N10665, DIN W.NR. 2.4617

Techalloy B-2 is the further development of Techalloy B and has the same excellent corrosion resistance to boiling hydrochloric acid/hydrogene chloride and boiling sulfuric acid (up to a concentration of 60 %). Techalloy B-2 is resistant to carbide grain boundary separations in the heat-influenced welding zone so that it can be employed for most chemical applications without heat-treatment. Techalloy B-2 is furthermore resistant to stress corrosion cracking as well as pitting corrosion.

## Chemical Composition: in %

| C         | Si        | Mn       | Fe       | Cr       | Ni   | S         | P          | Mo    | Co       |
|-----------|-----------|----------|----------|----------|------|-----------|------------|-------|----------|
| 0,02 max. | 0,10 max. | 1,0 max. | 2,0 max. | 1,0 max. | Rest | 0,03 max. | 0,04 max.. | 26-30 | 1,0 max. |

## Mechanical Properties - at room temperature - solution annealed condition

| 0,2 % yield strength | tensile strength  | elongation (A5) |
|----------------------|-------------------|-----------------|
| N/mm2<br>352 min.    | N/mm2<br>760 min. | %<br>40 min.    |

## Specification:

|                       |                                                                                                                                      |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Seamless Pipes/Tubes: | ASTM-B-622                                                                                                                           |
| Welded Pipes/Tubes:   | ASTM-B-619/626                                                                                                                       |
| Plates/Sheets:        | ASTM-B-333                                                                                                                           |
| Bars:                 | ASTM-B-335                                                                                                                           |
| Fittings:             | ASTM-B-366                                                                                                                           |
| Flange:               | ASTM-B-564                                                                                                                           |
| Specific weight:      | 9,217 kg/dm3                                                                                                                         |
| Welding methods:      | Arc welding, TIG<br>(Details on request)                                                                                             |
| Machineability:       | Details on request                                                                                                                   |
| Corrosion resistance: | Refer to table TECHALLOY B-2                                                                                                         |
| Product forms:        | Tubes and pipes, plates and sheet, bars, wire, fittings and flanges                                                                  |
| Range of application: | Techalloy B-2 is especially suited for applications conveying hydrochloric acid gas, sulfuric acid, acetic acid and phosphoric acid. |



# Techalloy C-276

UNS NO. N10276, DIN W.NR. 2.4819



Techalloy C-276 is the improved version of Techalloy C and is resistant to numerous media including strongly oxidizing chemicals (for example iron and cupric chloride) warm polluted acids, solvents, chloride and media contaminated by chloride (organic and inorganic), dry chloride, formic and acetic acid, acetic anhydride, sea water and saline solutions. Furthermore, Techalloy C-276 is resistant when exposed to damp chlorine gas, hypochlorite and chlorodioxide solutions. Techalloy C-276 combines this excellent corrosion resistance with immensely improved machineability. This alloy does not separate grain boundaries in the zone influenced by welding so that it is suited for most chemical applications even without heat-treatment.

## Chemical Composition: in % max.

| C            | Si           | Mn          | Fe  | Ni         | Cr            | S            | p            | Mo    | W     | Co          | V            |
|--------------|--------------|-------------|-----|------------|---------------|--------------|--------------|-------|-------|-------------|--------------|
| 0,01<br>max. | 0,08<br>max. | 1,0<br>max. | 4-7 | 57<br>Rest | 14,5-<br>16,5 | 0,03<br>max. | 0,04<br>max. | 15-17 | 3-4,5 | 2,5<br>max. | 0,35<br>max. |

## Mechanical Properties - at room temperature - solution annealed condition

| 0,2 % yield strength             | tensile strength                 | elongation (A5) |
|----------------------------------|----------------------------------|-----------------|
| N/mm <sup>2</sup><br>283<br>min. | N/mm <sup>2</sup><br>690<br>min. | %<br>40<br>min. |

## Specification:

|                       |                                                                                      |
|-----------------------|--------------------------------------------------------------------------------------|
| Seamless Pipes/Tubes: | ASTM-B.622                                                                           |
| Welded Pipes/Tubes:   | ASTM-B-619/626                                                                       |
| Plates/Sheets:        | ASTM-B-575                                                                           |
| Fittings:             | ASTM-B-366                                                                           |
| Flange:               | ASTM-B-564                                                                           |
| Specific Weight:      | 8,88 kg/dm <sup>3</sup>                                                              |
| Melting range         | ca. 1323° Celsius                                                                    |
| Welding methods:      | Arc welding. TIG (Details on request)                                                |
| Machineability        | Table on request                                                                     |
| Corrosion resistance  | Refer to table TECHALLOY C-276                                                       |
| Product forms:        | Tubes and pipes. sheets and plates.<br>bars. wire and forgings, fittings and flanges |





# Techalloy C-4

UNS NO. N06455, DIN W.NR. 2.4610

Techalloy C-4 is a relatively new Ni-Cr-Mo alloy with improved resistance at high temperatures. Even when used for a long period of time in the temperature range of 650 - 1050° Celsius, this alloy retains its high ductility and corrosion resistance; furthermore it is highly resistant to grain boundary separation in the heat-treated zone influenced by welding. Thus it can be employed without heatretreatment. Techalloy C-4 is also highly resistant against stress corrosion cracking and oxidizing atmospheres at temperatures up to 1050° Celsius.

## Chemical Composition in %

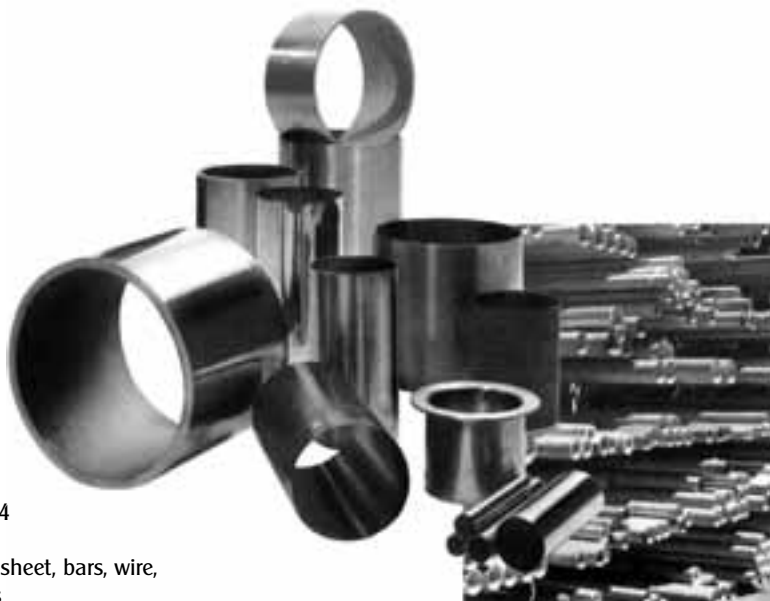
| C          | Si        | Mn       | Fe       | Cr    | Ni   | S         | P         | Mo    | Co       | Ti        |
|------------|-----------|----------|----------|-------|------|-----------|-----------|-------|----------|-----------|
| 0,015 max. | 0,08 max. | 1,0 max. | 3,0 max. | 14-18 | Rest | 0,03 max. | 0,04 max. | 14-17 | 2,0 max. | 0,70 max. |

## Mechanical Properties - at room temperature - solution annealed condition

| 0,2 % yield strength | tensile strength  | elongation (A5) |
|----------------------|-------------------|-----------------|
| N/mm2<br>276 min.    | N/mm2<br>690 min. | %<br>40 min.    |

## Specification:

|                       |                                                                                  |
|-----------------------|----------------------------------------------------------------------------------|
| Pipes/Tubes:          | ASTM-B.622                                                                       |
| Welded Pipes/Tubes:   | ASTM-B-619/626                                                                   |
| Plates/Sheets         | ASTM-B-575                                                                       |
| Fittings:             | ASTM-B-366                                                                       |
| Flange:               | ASTM-B-564                                                                       |
| Specific weight:      | 8,64 kg/dm3                                                                      |
| Welding methods:      | Arc welding,<br>TIG (Details on request)                                         |
| Machineability:       | Details on request                                                               |
| Corrosion resistance: | Refer to table TECHALLOY C-4                                                     |
| Product forms:        | Tubes and pipes, plates and sheet, bars, wire,<br>forgings, fittings and flanges |





Techalloy G3 is an Ni-Cr-Fe alloy with molybdenum and copper additions. This alloy is similar to Techalloy G. Techalloy G3 has excellent corrosion resistance to oxidizing chemicals. Due to its nickel and copper content, it is furthermore resistant to reducing chemicals. Techalloy G3 is very suited for evaporators, heat exchangers in air pollution control systems, tank liners etc.

## Chemical Composition in %

|                         |                          |                          |                          |                          |                              |                           |
|-------------------------|--------------------------|--------------------------|--------------------------|--------------------------|------------------------------|---------------------------|
| <b>Ni</b><br>Rest       | <b>Cr</b><br>21,0-23,0   | <b>Fe</b><br>18,0-21,0   | <b>Mo</b><br>6,0 - 8,0   | <b>Cu</b><br>1,5 - 2,5   | <b>Nb/Ta</b><br>0,50<br>max. | <b>C</b><br>0,015<br>max. |
| <b>W</b><br>1,5<br>max. | <b>Si</b><br>1,0<br>max. | <b>Mn</b><br>1,0<br>max. | <b>P</b><br>0,04<br>max. | <b>S</b><br>0,03<br>max. | <b>Co</b><br>5,0<br>max.     |                           |

## Mechanical Properties - at room temperature - annealed condition

| 0,2 % yield strength             | tensile strength                 | elongation (A5)   |
|----------------------------------|----------------------------------|-------------------|
| N/mm <sup>2</sup><br>241<br>min. | N/mm <sup>2</sup><br>621<br>min. | %<br>40,0<br>min. |

## Specification:

|                       |                                                                                                                 |
|-----------------------|-----------------------------------------------------------------------------------------------------------------|
| Pipes/Tubes:          | ASTM-B-622                                                                                                      |
| Welded Pipes/Tubes:   | ASTM-B-619/626                                                                                                  |
| Sheets/Plates:        | ASTM-B-582                                                                                                      |
| Fittings:             | ASTM-B-366                                                                                                      |
| Flange:               | ASTM-B-564                                                                                                      |
| Specific weight:      | 8,30 kg/dm <sup>3</sup>                                                                                         |
| Welding Methods:      | Arc welding                                                                                                     |
| Machineability:       | Details on request                                                                                              |
| Product forms:        | Tubes and pipes, sheets, plates and strips, bars, fittings and flanges                                          |
| Range of application: | Flue gas desulfurization systems, air pollution control systems, evaporators, heat exchangers, tank liners etc. |







# Techalloy DS

DIN W.NR. 1.4864

Techalloy DS is a heat-resistant Ni-Cr-Fe alloy with Si-addition for the employment at high temperatures where sufficient strength and corrosion resistance are required. Techalloy DS is heat-resistant up to 1100° Celsius when in fresh air. This alloy is especially resistant against changing oxidizing/reducing conditions as well as against the formation of sigma phase in the critical temperature range of 590 to 870° Celsius. Furthermore it is resistant to green rot. Due to the high strength and heat resistance of Techalloy DS, smaller sections than usual can be manufactured from this material.

## Chemical Composition: in %

| C           | Si          | Mn          | Fe   | Cr            | Ni            | Cu  | Ti           | S            |
|-------------|-------------|-------------|------|---------------|---------------|-----|--------------|--------------|
| 0,1<br>max. | 1,9-<br>2,6 | 0,8-<br>1,5 | Rest | 17,0-<br>19,0 | 34,5-<br>41,0 | 0,5 | 0,20<br>max. | 0,03<br>max. |

## Mechanical Properties - at room temperature - annealed condition

| 0,2 % yield strength | tensile strength     | elongation      |
|----------------------|----------------------|-----------------|
| N/mm2<br>363<br>min. | N/mm2<br>687<br>min. | %<br>50<br>min. |

## Specification:

|                       |                                                                                                                                                                                                                    |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pipes/Tubes:          | BS 3074 NA 17                                                                                                                                                                                                      |
| Plates/Sheets:        | BS 3072/3073 Na 17                                                                                                                                                                                                 |
| Specific weight:      | 7,92 kg/dm3                                                                                                                                                                                                        |
| Melting range:        | 1330 - 1400° Celsius                                                                                                                                                                                               |
| Welding methods:      | Arc welding. TIG, MIG, plasma, autogenous welding (Details on request)                                                                                                                                             |
| Machineability:       | Table on request                                                                                                                                                                                                   |
| Product forms         | Tubes and pipes. plates and sheets, bars. forgings                                                                                                                                                                 |
| Range of application: | Techalloy DS is mainly employed for all equipment and heating tubes in the furnace-building industry, it is used in a multiplicity of heat-treatment applications, i.a. for thermocouple element shield tubes etc. |







Techalloy 20 is a high-alloyed stainless steel. Its corrosion properties surpass those of usual stainless qualities. For example, Techalloy 20 has excellent stress corrosion resistance to boiling 20-40% sulfuric acid. Although Techalloy 20 was originally developed for usage in sulfuric environments. Its range of application has been steadily extended and today also includes machining of artificial rubber, plastics, synthetic fibers etc. In pharmaceutical and food-producing applications, where purity has to be guaranteed. Techalloy 20 is employed to prevent metallic contamination. The most important advantages of this grade are its excellent mechanical properties as well as its comparatively easy machineability.

### Chemical Composition: in %

| C         | Si       | Mn       | Cr    | Ni        | S          | P          | Mo  | Cu  | Cb&Ta                | Fe   |
|-----------|----------|----------|-------|-----------|------------|------------|-----|-----|----------------------|------|
| 0.07 max. | 1.0 max. | 2.0 max. | 19-21 | 32.0-38.0 | 0.035 max. | 0.045 max. | 2-3 | 3-4 | 8xC min.<br>1.0 max. | Rest |

### Mechanical Properties – at room temperature – annealed condition

| 0.2% yield strength           | tensile strength              | elongation (A5) |
|-------------------------------|-------------------------------|-----------------|
| N/mm <sup>2</sup><br>241 min. | N/mm <sup>2</sup><br>551 min. | %<br>30 min.    |

### Specification:

|                       |                                                          |
|-----------------------|----------------------------------------------------------|
| Seamless Pipes/Tubes: | ASTM-B-729                                               |
| Welded Pipes/Tubes:   | ASTM-B-464/468                                           |
| Plates/Sheets:        | ASTM-B-463                                               |
| Bars:                 | ASTM-B-472/473                                           |
| Fittings:             | ASTM-B-366                                               |
| Flange:               | ASTM-B-564                                               |
| Specific weight:      | 8.06 kg/dm <sup>3</sup>                                  |
| Welding methods:      | Arc welding                                              |
| Product forms:        | Tubes and pipes, sheets and plates, bars, wire, forgings |
| Range of application: | Heat-exchangers, pickling vats, pump shafts.             |





# TECHALLOY NICKEL ALLOYS

## CORROSION DATA

### Techalloy B-2 Corrosion Data

| Media             | Concentration percent by weight | Average Penetration Rate per year |        | Media                                | Concentration percent by weight | Average Penetration Rate per year |         |
|-------------------|---------------------------------|-----------------------------------|--------|--------------------------------------|---------------------------------|-----------------------------------|---------|
|                   |                                 | mils                              | mm     |                                      |                                 | mils                              | mm      |
| Acetic Acid       | 10                              | 0.5                               | <0.02  | Phosphoric Acid<br>(Chemically Pure) | 10                              | 2                                 | 0.05    |
|                   | 30                              | 0.4                               | 0.01   |                                      | 30                              | 3                                 | 0.05    |
|                   | 50                              | 0.4                               | 0.01   |                                      | 50                              | 6                                 | 0.15    |
|                   | 70                              | 0.3                               | <0.01  |                                      | 85                              | 25                                | 0.63    |
|                   | 99 (Glacial)                    | 0.3                               | <0.01  |                                      |                                 |                                   |         |
| Formic Acid       | 10                              | 0.3                               | <0.01  | Sulfuric Acid                        |                                 |                                   |         |
|                   | 20                              | 0.6                               | <0.02  |                                      | 2                               | 0.5                               | <0.02   |
|                   | 30                              | 0.7                               | <0.02  |                                      | 5                               | 3                                 | 0.08    |
|                   | 40                              | 0.7                               | <0.02  |                                      | 10                              | 2                                 | 0.05    |
|                   | 60                              | 0.5                               | <0.02  |                                      | 20                              | 0.7                               | <0.02   |
|                   | 89                              | 0.5                               | <0.02  |                                      | 30                              | 0.7                               | <0.02   |
| Hydrochloric Acid |                                 |                                   |        |                                      | 40                              | 0.9                               | <0.03   |
|                   | 1                               | 0.8                               | 0.02   |                                      | 50                              | 1                                 | 0.03    |
|                   | 2                               | 3                                 | 0.08   |                                      | 50                              | 2**                               | 0.05**  |
|                   | 5                               | 5                                 | 0.13   |                                      | 50                              | 1****                             | 0.03*** |
|                   | 10                              | 7                                 | 0.18   |                                      | 60                              | 2                                 | 0.05    |
|                   | 15                              | 11                                | 0.28   |                                      | 70                              | 9                                 | 0.23    |
|                   | 20                              | 15                                | 0.38   |                                      |                                 |                                   |         |
|                   | 20                              | 20**                              | 0.51** |                                      |                                 |                                   |         |

\* Determined in laboratory tests of 120 hours duration. It is recommended that samples be tested under actual plant conditions. All test specimens were heat-treated at 1950°F (1066°C), water quenched unless otherwise noted.

\*\* As gas tungsten arc welded

\*\*\* Aged 48 hours at 1000°F (538°C)

### Techalloy C-276

| Media             | Concentration percent by weight | Test Temp. °F (°C) | Penetration Rate, per year |      |              |      |                           |      |
|-------------------|---------------------------------|--------------------|----------------------------|------|--------------|------|---------------------------|------|
|                   |                                 |                    | Unwelded**                 |      | As-welded*** |      | Welded and Heat-treated** |      |
|                   |                                 |                    | mils                       | mm   | mils         | mm   | mils                      | mm   |
| Chromic Acid      | 10                              | Boiling            | 65                         | 1.65 | 81           | 2.06 | 43                        | 1.09 |
| Formic Acid       | 20                              | Boiling            | 4.8                        | 0.12 | 3.5          | 0.09 | 3.6                       | 0.09 |
| Hydrochloric Acid | 10                              | 150 (66)           | 21                         | 0.53 | 20           | 0.51 | 21                        | 0.53 |
| Hydrochloric Acid | 10                              | 167 (75)           | 40                         | 1.02 | 50           | 1.27 | -                         | -    |
| Hydrochloric Acid | 10+0.1 FeCl <sub>3</sub>        | 167 (75)           | 39                         | 0.99 | 45           | 1.14 | -                         | -    |
| Hydrochloric Acid | 10+0.5 NaOCl                    | 167 (75)           | 46                         | 1.17 | 50           | 1.27 | -                         | -    |
| Hydrochloric Acid | 3.5+8 FeCl <sub>3</sub>         | 190 (88)           | -                          | -    | 5            | 0.13 | -                         | -    |
| Hydrochloric Acid | 1.0+25 FeCl <sub>2</sub>        | 200 (93)           | -                          | -    | 45           | 1.14 | -                         | -    |
| Hydrochloric Acid | 0.1+2.5 FeCl <sub>2</sub>       | 150 (66)           | -                          | -    | nil          | nil  | -                         | -    |
| Nitric Acid       | 10                              | Boiling            | 16                         | 0.41 | 17           | 0.43 | 17                        | 0.43 |
| Nitric Acid       | 10+3 HF                         | 158 (70)           | 350                        | 8.89 | 380          | 9.65 | -                         | -    |
| Sulfuric Acid     | 10                              | Boiling            | 15                         | 0.38 | 14           | 0.36 | 18                        | 0.46 |
| Sulfuric Acid     | 85                              | 167 (75)           | 17                         | 0.43 | 17           | 0.43 | -                         | -    |
| Wet Chlorine (a)  | -                               | 150 (66)           | 0.5                        | 0.01 | -            | -    | -                         | -    |
| Wet Chlorine (a)  | -                               | 175 (80)           | 0.6                        | 0.02 | -            | -    | -                         | -    |

\* Determined in laboratory test. It is recommended that samples be tested under actual plant conditions.

\*\* Solution heat-treated

\*\*\* Gas tungsten-arc welded.

(a) Average of two specimens. Test period was 210 hours.

### Techalloy C4

| Media             | Concentration percent by weight | Test °F (°C) | Average Penetration Rate per year |        |              |        |          |        |
|-------------------|---------------------------------|--------------|-----------------------------------|--------|--------------|--------|----------|--------|
|                   |                                 |              | Unwelded**                        |        | As-Welded*** |        | Aged**** |        |
|                   |                                 |              | mils                              | (mm)   | mils         | (mm)   | mils     | (mm)   |
| Formic Acid       | 20                              | Boiling      | 2.9                               | (0.07) | 3.5          | (0.09) | 3.5      | (0.09) |
| Hydrochloric Acid | 10                              | 167 (75)     | 36                                | (0.91) | 34           | (0.86) | 35       | (0.89) |
| Nitric Acid       | 10                              | Boiling      | 5.9                               | (0.15) | 7.1          | (0.18) | 9.2      | (0.23) |
| Phosphoric Acid   | 85                              | Boiling      | 61                                | (1.55) | 52           | (1.32) | 85       | (2.16) |
| Sulfuric Acid     | 10                              | Boiling      | 22                                | (0.56) | 25           | (0.64) | 20       | (0.51) |
| Sulfuric Acid     | 85                              | 167 (75)     | 23                                | (0.58) | 17           | (0.43) | 21       | (0.53) |

\* Determined in laboratory tests. It is recommended that samples be tested under actual plant conditions.

\*\* Heat-treated at 1950°F (1066°C), water quenched.

\*\*\* Gas tungsten-arc welded.

\*\*\*\* Aged 100 hours at 1650°F (899°C)

# TECHALLOY NICKEL ALLOYS

## CORROSION DATA



### Corrosion Data

The following table summarises the typical resistance of various nickel base alloys to a wide range of corrosive environments. When using the table the following points should be borne in mind:

1: Data are summarised in this way for guidance only to show:

- i: The most suitable alloy for a given environment bearing in mind that no allowance is made for the effects of heat transfer, erosion, galvanic effects or the influence of minor impurities present in mixtures.

2: Materials are rated according to the determined corrosion rate in a particular environment:

- A= Corrosion rate less than 0.1 mm/a.
- B= Corrosion rate less than 0.5 mm/a but greater than 0.1 mm/a.
- C= Corrosion rate greater than 0.5 mm/a.

Corrosion rates less than 0.5 mm/a (A and B rating) are acceptable for most chemical and process plant.

3: The information should not be taken as an implied recommendation for the use of a particular material in a specific environment. It should not be a substitute for in plant trials with sample test coupons.

4: Concentrations refer to aqueous solutions or mixtures of gases in air.

5: Environments are listed in alphabetical order.

6: This data is typical of results obtained in these environments. However, these alloys are not limited to the corrosives, temperatures or concentrations given.

N.B. The A rating can be misleading in that very often the corrosion rate is very much less than 0.1 mm/a. Where thin-walled material is to be used and only very low corrosion rates can be tolerated, more precise corrosion data should be obtained.

| Media                      | Concentration %      | Temperature °C | Nickel 200 & 201 | Techalloy 400 | Techalloy 600 | Techalloy 800 | Techalloy 825 |
|----------------------------|----------------------|----------------|------------------|---------------|---------------|---------------|---------------|
| Acetaldehyde               | 99                   | 40             | A                | A             | A             | A             | A             |
| Acetic Acid                | 0-99                 | 30             | C                | B             | B             | A             | A             |
| Acetic Anhydride           | 100                  | 30             | B                | B             | B             | A             | A             |
| Acetone                    | 0-100                | 100            | A                | A             | A             | A             | A             |
| Acetylene                  | 100                  | 150            | A                | -             | -             | A             | A             |
| Acrolein                   | 100                  | 100            | B                | B             | B             | B             | B             |
| Air 100                    | -                    | A              | A                | A             | A             | A             | A             |
| Alcohol-Allyl              | 100                  | 30             | A                | A             | A             | A             | A             |
| Ethyl                      | 100                  | 30             | A                | A             | A             | A             | A             |
| Methyl                     | 100                  | 30             | A                | A             | A             | A             | A             |
| Allyl Chloride             | 100                  | 30             | A                | A             | B             | B             | A             |
| Aluminium Chloride         | 0-30                 | 30             | B                | B             | B             | C             | B             |
| Aluminium Sulphate (Alum.) | 100                  | 30             | C                | B             | C             | B             | A             |
| Ammonia Liquid             | 0-100                | 30             | C                | C             | B             | A             | A             |
| Ammonium Bicarbonate       | 0-100                | 100            | -                | -             | -             | B             | B             |
| Ammonium Carbonate         | 0-20                 | 30             | -                | -             | -             | C             | B             |
| Ammonium Chloride (dry)    | 0-20                 | 20             | -                | -             | -             | A             | A             |
|                            | 100                  | 100            | B                | B             | B             | C             | B             |
| Ammonium Hydroxide         | 0-30                 | 70             | -                | C             | -             | A             | A             |
| Ammonium Nitrate           | 0-40                 | 80             | -                | -             | -             | A             | A             |
| Ammonium Phosphate         | 5                    | 100            | B                | B             | B             | A             | A             |
| Ammonium Sulphate          | 0-40                 | 100            | B                | B             | B             | B             | A             |
| Amyl Acetate               | 100                  | 30             | A                | A             | A             | A             | A             |
| Amyl Chloride              | 100                  | 30             | A                | B             | B             | B             | B             |
| Aniline                    | 100                  | 30             | C                | C             | B             | A             | A             |
| Barium Chloride            | 0-40                 | 100            | B                | B             | B             | B             | B             |
| Barium Hydroxide           | 100                  | 1040           | B                | -             | B             | B             | A             |
|                            | 0-50                 | 100            | A                | B             | B             | B             | A             |
| Beer                       | -                    | 30             | A                | A             | A             | A             | A             |
| Beet Sugar Liquors         | 0-40                 | 30             | A                | A             | A             | A             | A             |
| Benzaldehyde               | 100                  | 30             | B                | B             | B             | A             | A             |
| Benzene                    | 100                  | 30             | A                | A             | A             | A             | A             |
| Black Sulphate Liquor      | 100                  | 100            | -                | -             | A             | B             | A             |
| Boric Acid                 | 0-20                 | 100            | B                | B             | B             | A             | A             |
| Bromine, Dry               | 100                  | 50             | A                | A             | A             | B             | B             |
| Butadiene                  | 100                  | 30             | A                | A             | A             | A             | A             |
| Butane                     | 100                  | 30             | A                | A             | A             | A             | A             |
| Butyl Acetate              | 100                  | 30             | B                | B             | B             | A             | A             |
| Butyric Acid               | 0-100                | 100            | C                | B             | C             | B             | A             |
| Calcium Chloride           | 0-25                 | 30             | A                | A             | A             | B             | A             |
| Calcium Hydroxide          | 0-30                 | 100            | B                | B             | B             | B             | B             |
| Cane Sugar Liquors         | 100                  | 90             | A                | A             | A             | A             | A             |
| Carbon Bisulphide          | 100                  | 30             | A                | B             | A             | A             | A             |
| Carbon Dioxide             | 100                  | 450            | A                | A             | A             | A             | A             |
| Carbon Tetrachloride       | 100                  | 30             | A                | B             | A             | A             | A             |
| Caustic Soda               | See Sodium Hydroxide |                |                  |               |               |               |               |
| Chlorine, Dry              | 100                  | 550            | B                | B             | A             | A             | C             |
| Chlorobenzene              | 100                  | 30             | A                | B             | B             | B             | B             |
| Chlorosulphonic Acid       | 100                  | 30             | B                | B             | B             | -             | B             |



# TECHALLOY NICKEL ALLOYS

## CORROSION DATA

| Media                                             | Concen-<br>tration % | Temper-<br>ature °C | Nickel<br>200 & 201 | Techalloy<br>400 | Techalloy<br>600 | Techalloy<br>800 | Techalloy<br>825 |
|---------------------------------------------------|----------------------|---------------------|---------------------|------------------|------------------|------------------|------------------|
| Chloroform                                        | 100                  | 100                 | A                   | A                | A                | A                | A                |
| Chromic Acid                                      | 0-100                | 30                  | C                   | C                | C                | C                | B                |
| Citric Acid                                       | 100                  | 30                  | B                   | B                | B                | B                | A                |
| Coffee                                            | -                    | 100                 | A                   | A                | A                | A                | A                |
| Copper Sulphate                                   | 0-30                 | 100                 | C                   | C                | C                | B                | A                |
| Cresylic Acid                                     | 100                  | 30                  | B                   | B                | B                | B                | B                |
| Dichlorethane                                     | 100                  | 30                  | A                   | A                | A                | B                | A                |
|                                                   | 100                  | 700                 | -                   | -                | A                | A                | -                |
| Ethyl Acetate                                     | 100                  | 30                  | B                   | B                | B                | B                | A                |
| Ethyl Cellulose                                   | All                  | 30                  | B                   | B                | B                | B                | A                |
| Ethyl Chloride                                    | 100                  | 30                  | A                   | A                | A                | A                | A                |
| Ethylene Dichloride                               | 100                  | 30                  | A                   | A                | A                | B                | A                |
|                                                   | 100                  | 700                 | -                   | -                | A                | A                | -                |
| Ethylene Glycol                                   | 100                  | 30                  | B                   | B                | B                | A                | A                |
| Fatty Acids                                       | 100                  | 30                  | A                   | A                | A                | A                | A                |
| Ferric Chloride                                   | 100                  | 30                  | C                   | C                | C                | C                | B                |
| Ferric Nitrate                                    | 100                  | 30                  | C                   | C                | C                | B                | A                |
| Ferric Sulphate                                   | 0-30                 | 30                  | C                   | B                | C                | B                | A                |
| Fluoboric Acid                                    | 25                   | 30                  | B                   | B                | B                | B                | B                |
| Fluosilicic Acid                                  | 20                   | 30                  | B                   | C                | B                | B                | B                |
| Formaldehyde                                      | 0-100                | 30                  | A                   | A                | A                | A                | A                |
| Formic Acid                                       | 0-100                | 100                 | B                   | B                | B                | C                | A                |
| Fuel Oil                                          | 100                  | 30                  | C                   | A                | C                | A                | A                |
| Furfural                                          | 30-100               | 100                 | B                   | B                | B                | B                | A                |
| Gelantine                                         | 0-40                 | 50                  | B                   | B                | A                | A                | A                |
| Glucose                                           | All                  | 30                  | A                   | A                | A                | A                | A                |
| Glutamic Acid                                     | All                  | 30                  | B                   | B                | B                | B                | A                |
| Glycerine                                         | 100                  | 30                  | A                   | A                | A                | A                | A                |
| Glycerol                                          | 0-100                | 150                 | A                   | A                | A                | A                | A                |
| High Temperature Salt<br>(nitrate/nitrite)        | -                    | 500                 | A                   | -                | A                | A                | -                |
| Hydraulic Oil                                     | -                    | -                   | A                   | A                | A                | A                | A                |
| Hydrazine                                         | 100                  | 35                  | C                   | C                | C                | C                | C                |
| Hydrobromic Acid                                  | -                    | -                   | C                   | C                | C                | C                | C                |
| Hydrochloric Acid                                 | 0-37                 | 35                  | -                   | -                | -                | -                | -                |
| Hydrocyanic Acid                                  | 100                  | 35                  | C                   | C                | A                | A                | A                |
| Hydrofluoric Acid                                 | 10-100               | 35                  | B                   | A                | B                | C                | B                |
|                                                   | 100                  | 350                 | B                   | B                | B                | C                | B                |
| Hydrogen Peroxide (acid free)                     | All                  | 30                  | B                   | B                | B                | A                | A                |
| Hydrogen Sulphide                                 | 0-20                 | 150                 | -                   | B                | -                | B                | A                |
| Hydroquinone                                      | All                  | 35                  | B                   | B                | A                | -                | A                |
| Insulin                                           | 100                  | 35                  | A                   | A                | A                | A                | A                |
| Lactic Acid                                       | 80                   | 30                  | C                   | C                | B                | B                | A                |
| Lead Acetate                                      | 20                   | 30                  | B                   | B                | A                | A                | A                |
| Lemon Juice                                       | All                  | 30                  | A                   | B                | A                | B                | A                |
| Linseed Oil                                       | 100                  | 30                  | A                   | A                | A                | A                | A                |
| Lithium Chloride                                  | All                  | 30                  | A                   | A                | A                | A                | A                |
| Lithium Hydroxide                                 | 10                   | 30                  | A                   | A                | A                | A                | A                |
| Magnesium Carbonate                               | All                  | 30                  | A                   | A                | A                | A                | A                |
| Magnesium Chloride                                | 0-50                 | 30                  | A                   | A                | A                | A                | A                |
| Magnesium Hydroxide                               | All                  | 30                  | A                   | A                | A                | A                | A                |
| Magnesium Nitrate                                 | All                  | 30                  | C                   | C                | B                | A                | A                |
| Magnesium Sulphate                                | 30                   | 30                  | B                   | A                | A                | A                | A                |
| Maleic Acid                                       | All                  | 30                  | B                   | B                | B                | B                | A                |
| Mercuric Chloride                                 | All                  | 30                  | C                   | C                | C                | C                | C                |
| Mercuric Cyanide                                  | All                  | 30                  | C                   | C                | C                | C                | B                |
| Mercuric Iodide                                   | All                  | 30                  | C                   | C                | C                | C                | C                |
| Mercurous Nitrate                                 | All                  | 30                  | C                   | C                | B                | A                | A                |
| Mercury                                           | All                  | 100                 | -                   | -                | -                | -                | -                |
| Methyl Alcohol                                    | 0-100                | 100                 | A                   | A                | A                | A                | A                |
| Methyl Chloride                                   | 100                  | 30                  | A                   | A                | A                | A                | A                |
| Methyl Ethyl Ketone                               | All                  | 100                 | B                   | B                | B                | A                | A                |
| Milk                                              | All                  | 30                  | B                   | B                | A                | A                | A                |
| Mine Water                                        | All                  | 65                  | C                   | C                | A                | A                | A                |
| Molasses                                          | All                  | 30                  | A                   | A                | A                | A                | A                |
| Mono (sodium, potassium or<br>ammonium) Phosphate | All                  | 30                  | A                   | A                | A                | A                | A                |
| Naphthenic Acid                                   | 100                  | 30                  | B                   | A                | A                | A                | A                |
| Nickel Chloride                                   | All                  | 30                  | B                   | B                | B                | B                | A                |
| Nickel Nitrate                                    | All                  | 30                  | C                   | C                | B                | B                | A                |
| Nickel Sulphate                                   | All                  | 30                  | B                   | B                | B                | B                | A                |
| Nitric Acid                                       | 0-65                 | 30                  | C                   | C                | B                | A                | A                |
|                                                   | 100                  | 80                  | C                   | C                | C                | B                | A                |
| Nitrobenzene                                      | 100                  | 100                 | B                   | B                | B                | B                | B                |
| Oils, Crude                                       | 100                  | 30                  | A                   | A                | A                | A                | A                |
| Oils, Essential                                   | 100                  | 30                  | A                   | A                | A                | A                | A                |

# TECHALLOY NICKEL ALLOYS

## CORROSION DATA



| Media                  | Concentration % | Temperature °C | Nickel 200 & 201 | Techalloy 400 | Techalloy 600 | Techalloy 800 | Techalloy 825 |
|------------------------|-----------------|----------------|------------------|---------------|---------------|---------------|---------------|
| Oils, Mineral          | 100             | 30             | A                | A             | A             | A             | A             |
| Oils, Palm             | 100             | 30             | A                | A             | A             | A             | A             |
| Oils, Peanut           | 100             | 30             | A                | A             | A             | A             | A             |
| Oils, Sulphonated      | 100             | 30             | A                | A             | A             | A             | A             |
| Oils, Vegetable        | 100             | 30             | A                | A             | A             | A             | A             |
| Oleic Acid             | 100             | 30             | B                | B             | A             | A             | A             |
| Oleum                  | 20              | 30             | C                | C             | A             | B             | A             |
| Orange Juice           | All             | 30             | A                | A             | A             | A             | A             |
| Oxalic Acid            | All             | 30             | C                | B             | B             | C             | B             |
| Oxidising gases        | 100             | °C             | 1000             | 550           | 1100          | 1100          | 900           |
| Palmitic Acid          | 100             | 30             | A                | A             | A             | A             | A             |
| Paraffin               | 100             | 35             | A                | A             | A             | A             | A             |
| Petrol                 | 100             | 30             | A                | A             | A             | A             | A             |
| Phenol                 | 100             | 30             | A                | B             | A             | A             | A             |
| Phenol Sulphonic Acid  | 100             | 30             | B                | B             | B             | B             | A             |
| Phosphoric Acid        | 0-25            | 30             | B                | A             | A             | B             | A             |
|                        | 25-85           | 85             | A                | A             | C             | C             | A             |
| Phthalic Anhydride     | 100             | 30             | B                | A             | A             | B             | A             |
| Picric Acid            | 100             | 30             | C                | C             | C             | C             | B             |
| Potassium Bicarbonate  | 0-30            | 30             | A                | A             | A             | A             | A             |
| Potassium Carbonate    | All             | 30             | A                | A             | A             | A             | A             |
| Potassium Chlorate     | All             | 30             | B                | B             | B             | B             | A             |
| Potassium Chloride     | All             | 30             | A                | A             | A             | A             | A             |
| Potassium Chromate     | 0-30            | 30             | A                | B             | A             | B             | A             |
| Potassium Cyanide      | 0-30            | 100            | B                | -             | B             | B             | B             |
| Potassium Dichromate   | 0-20            | 30             | B                | B             | B             | B             | A             |
| Potassium Ferricyanide | 0-30            | 30             | B                | B             | B             | B             | B             |
| Potassium Hydroxide    | 0-50            | 30             | A                | A             | B             | B             | B             |
|                        | 0-50            | 100            | A                | A             | B             | B             | B             |
| Potassium Nitrate      | All             | 30             | B                | B             | B             | A             | A             |
| Potassium Sulphate     | 10              | 30             | B                | B             | A             | A             | A             |
| Propane                | 100             | 100            | A                | A             | A             | A             | A             |
| Salicylic Acid         | All             | 30             | A                | A             | A             | A             | A             |
| Sea Water              | 100             | 100            | A                | A             | A             | A             | A             |
| Silicon Tetrachloride  | 100             | 30             | A                | A             | A             | B             | A             |
| Silver Nitrate         | All             | 30             | C                | C             | B             | B             | B             |
| Soap                   | 100             | 30             | A                | A             | A             | A             | A             |
| Sodium Acetate         | All             | 30             | B                | B             | B             | B             | A             |
| Sodium Bicarbonate     | All             | 30             | B                | B             | B             | B             | A             |
| Sodium Bisulphate      | 10              | 30             | B                | A             | B             | B             | A             |
| Sodium Bromide         | 0-50            | 30             | B                | B             | B             | B             | B             |
| Sodium Carbonate       | 30              | A              | B                | B             | B             | B             | A             |
| Sodium Chloride        | All             | 30             | B                | A             | B             | A             | A             |
| Sodium Hydroxide       | 0-50            | 30             | A                | A             | A             | A             | A             |
|                        | 50-75           | 30             | A                | A             | A             | B             | A             |
| Sodium Metaphosphate   | All             | 30             | B                | B             | A             | B             | A             |
| Sodium Metasilicate    | 0-50            | 30             | A                | A             | A             | A             | A             |
| Sodium Nitrate         | 10              | 30             | B                | B             | A             | A             | A             |
|                        | All             | 30             | B                | B             | A             | A             | A             |
| Sodium Peroxide        | 100             | 100            | B                | B             | B             | C             | B             |
| Sodium Phosphate       | All             | 30             | A                | A             | A             | A             | A             |
| Sodium Sulphate        | All             | 30             | A                | A             | A             | A             | A             |
| Sodium Sulphide        | All             | 30             | B                | B             | A             | B             | A             |
| Steam                  | 100             | 450            | A                | A             | A             | A             | A             |
| Stearic Acid           | All             | 30             | A                | A             | A             | A             | A             |
| Sugar (liquid)         | All             | 30             | A                | A             | A             | A             | A             |
| Sulphuric Acid         | 0-15            | 30             | B                | A             | B             | B             | A             |
|                        | 15-75           | 30             | C                | B             | C             | B             | A             |
|                        | 75-96           | 30             | C                | C             | C             | C             | A             |
| Sulphurous Acid        | 0-60            | 100            | -                | -             | -             | C             | B             |
| Tall Oil               | 100             | 30             | A                | A             | A             | A             | A             |
| Tannic Acid            | 10              | 30             | B                | B             | B             | B             | B             |
| Tartaric Acid          | 58              | 30             | B                | B             | B             | B             | A             |
| Tetraphosphoric Acid   | 100             | 30             | C                | C             | B             | -             | A             |
| Toluene                | 100             | 100            | A                | A             | A             | A             | A             |
| Trichloroethylene      | 100             | 100            | A                | A             | B             | B             | B             |
| Turpentine             | 100             | 30             | A                | A             | A             | A             | A             |
| Urea                   | 50-100          | 375            | -                | -             | B             | B             | A             |
| Vinegar                | 100             | 30             | A                | A             | A             | B             | A             |
| Vinyl Chloride         | 100             | 30             | A                | A             | A             | A             | A             |
| Water                  | 100             | 100            | A                | A             | A             | A             | A             |
| Xylene                 | 100             | 100            | B                | B             | A             | B             | A             |
| Zinc Ammonium Chloride | 0-40            | 100            | -                | B             | B             | C             | B             |
| Zinc Chloride          | 0-100           | 30             | B                | B             | B             | C             | B             |
| Zinc Nitrate           | 10              | 30             | C                | C             | B             | B             | A             |
| Zinc Sulphate          | 20              | 30             | B                | B             | B             | B             | A             |



## Chemical composition, mechanical properties and heat treatment

| Titanium tubes                 |                      |            |            |             |            |             |            |             |           |           |  |
|--------------------------------|----------------------|------------|------------|-------------|------------|-------------|------------|-------------|-----------|-----------|--|
| ASTM Grade<br>(sim. DIN Grade) | Chemical Composition |            |            |             |            |             |            |             |           |           |  |
|                                | N<br>% max           | C<br>% max | H<br>% max | Fe<br>% max | O<br>% max | Al<br>% max | V<br>% max | Pa          | Mo        | Ni        |  |
| ASTM B 338 Grade 1             | 0,03                 | 0,08       | 0,015      | 0,20        | 0,18       | -           | -          | -           | -         | -         |  |
| DIN 17861 Ti 1 - 3.7025        | 0,05                 | 0,06       | 0,013*     | 0,15        | 0,12       | -           | -          | -           | -         | -         |  |
| VdTÜV 230/2                    |                      |            |            |             |            |             |            |             |           |           |  |
| ASTM B 338 Grade 2             | 0,03                 | 0,08       | 0,015      | 0,30        | 0,25       | -           | -          | -           | -         | -         |  |
| DIN 17861 Ti2 - 3.7035         | 0,05                 | 0,06       | 0,013*     | 0,20        | 0,18       | -           | -          | -           | -         | -         |  |
| VdTÜV 230/2                    |                      |            |            |             |            |             |            |             |           |           |  |
| ASTM B 338 Grade 3             | 0,05                 | 0,08       | 0,015      | 0,30        | 0,35       | -           | -          | -           | -         | -         |  |
| DIN 17861 Ti 3 - 3.7055        | 0,05                 | 0,06       | 0,013*     | 0,25        | 0,25       | -           | -          | -           | -         | -         |  |
| VdTÜV 230/2                    |                      |            |            |             |            |             |            |             |           |           |  |
| ASTM B 338 Grade 7             | 0,03                 | 0,08       | 0,015      | 0,30        | 0,25       | -           | -          | 0,12 - 0,25 | -         | -         |  |
| DIN 17861 Ti 2 Pd - 3.7235     | 0,05                 | 0,06       | 0,013*     | 0,20        | 0,18       | -           | -          | 0,05 - 0,25 | -         | -         |  |
| VdTÜV 230/2                    |                      |            |            |             |            |             |            |             |           |           |  |
| ASTM B 338 Grade 9             | 0,02                 | 0,08       | 0,015      | 0,25        | 0,15       | 2,5 - 3,5   | 2,0 - 3,0  | -           | -         | -         |  |
| ASTM B 338 Grade 11            | 0,03                 | 0,08       | 0,015      | 0,20        | 0,18       | -           | -          | 0,12 - 0,25 | -         | -         |  |
| DIN 17861 Ti1 Pd - 3.7225      | 0,05                 | 0,06       | 0,013*     | 0,20        | 0,18       | -           | -          | 0,15 - 0,25 | -         | -         |  |
| VdTÜV 230/2                    |                      |            |            |             |            |             |            |             |           |           |  |
| ASTM B 338 Grade 12            | 0,03                 | 0,08       | 0,015      | 0,30        | 0,25       | -           | -          | -           | 0,2 - 0,4 | 0,6 - 0,9 |  |
| DIN 17861 Ti AL3V2,5           | 0,04                 | 0,05       | 0,015      | 0,30        | 0,12       | 2,5 - 3,5   | 2,0 - 3,0  | -           | -         | -         |  |
| 3.7195                         |                      |            |            |             |            |             |            |             |           |           |  |

\* In case wallthickness is under 2 mm, the Hydrogen content up to 0,015% is allowed.







| Mechanical properties and heat treatment |                   |                    |          |                           |                      |                       |              |                |
|------------------------------------------|-------------------|--------------------|----------|---------------------------|----------------------|-----------------------|--------------|----------------|
|                                          | Residuals<br>Each | Residuals<br>Total | Titanium | Rp 0,2 N/mm2<br>min. max. | Rp 1,0 N/mm2<br>min. | Rm N/mm2<br>min. max. | A5 %<br>min. | Heat Treatment |
|                                          | 0,1               | 0,4                | Rem.     | 170 - 310                 | -                    | 240 min.              | 24           | annealed       |
|                                          | 0,1               | 0,4                | Rem.     | 180                       | 200                  | 290 - 410             | 30           | soft annealed  |
|                                          |                   |                    |          |                           |                      |                       |              |                |
|                                          | 0,1               | 0,4                | Rem.     | 275 - 450                 | -                    | 345 min.              | 20           | annealed       |
|                                          | 0,1               | 0,4                | Rem.     | 250                       | 270                  | 390 - 540             | 22           | soft annealed  |
|                                          |                   |                    |          |                           |                      |                       |              |                |
|                                          | 0,1               | 0,4                | Rem.     | 380 - 550                 | -                    | 450 min.              | 18           | annealed       |
|                                          | 0,1               | 0,4                | Rem.     | 320                       | 350                  | 460 - 590             | 18           | soft annealed  |
|                                          |                   |                    |          |                           |                      |                       |              |                |
|                                          | 0,1               | 0,4                | Rem.     | 275 - 450                 | -                    | 345 min.              | 20           | annealed       |
|                                          | 0,1               | 0,4                | Rem.     | 250                       | 270                  | 390 - 540             | 22           | soft annealed  |
|                                          |                   |                    |          |                           |                      |                       |              |                |
|                                          | 0,1               | 0,4                | Rem.     | 725                       | -                    | 860                   | 10           | annealed       |
|                                          |                   |                    |          |                           |                      |                       |              |                |
|                                          | 0,1               | 0,4                | Rem.     | 170 - 310                 | -                    | 240                   | 24           | annealed       |
|                                          | 0,1               | 0,4                | Rem.     | 320                       | 350                  | 460 - 590             | 18           | soft annealed  |
|                                          |                   |                    |          |                           |                      |                       |              |                |
|                                          | 0,1               | 0,4                | Rem.     | 345                       | -                    | 483                   | 18           | annealed       |
|                                          | 0,1               | 0,4                | Rem.     | 520                       | -                    | 620 min.              | 15*          | soft annealed  |

\* Wall thickness under 1 mm 12%



View of pilger process area







## ASTM GRADES - ALLOY FEATURES

- Grade 1 (unalloyed Titanium) . . . . . used to increase formability.
- Grade 2 (unalloyed Titanium). . . . . the most common Titanium grade for cooling water systems; good strength with high ductility, formability, weldability and corrosion resistance.
- Grade 3 (unalloyed Titanium) . . . . . specified when higher levels of strength are required.
- Grade 7 (unalloyed Titanium) . . . . . enhanced resistance to hot brine crevice corrosion and reducing acids, mechanical properties similar to grade 2 alloy.
- Grade 9 (Titanium alloy) . . . . . offers excellent corrosion resistance to sea water and is medium-high strength alloy with highest code design allowables.
- Grade 11 (unalloyed Titanium) . . . . . mechanical properties are the same as those of grade 1 however, with greater resistance to corrosion against acid chlorides.
- Grade 12 (Titanium alloy) . . . . . more resistant even at temperatures up to 300°C with improved strength and code design allowables over grade 2.

## Comparison of Common Titanium DIN- and ASTM Grades

### A. Chemical Analysis

|           | DIN Standard<br>3.7025 | ASTM Standard<br>Grade 1 | DIN Standard<br>3.7035 | ASTM Standard<br>Grade 2 | DIN Standard<br>3.7055 | ASTM Standard<br>Grade 3 |
|-----------|------------------------|--------------------------|------------------------|--------------------------|------------------------|--------------------------|
| Iron      | 0,15 % max.            | 0,20 % max.              | 0,20 % max.            | 0,30 % max.              | 0,25 % max.            | 0,30 % max.              |
| Oxygen    | 0,12 % max.            | 0,18 % max.              | 0,18 % max.            | 0,25 % max.              | 0,25 % max.            | 0,35 % max.              |
| Nitrogen  | 0,05 % max.            | 0,03 % max.              | 0,05 % max.            | 0,03 % max.              | 0,05 % max.            | 0,05 % max.              |
| Carbon    | 0,06 % max.            | 0,08 % max.              | 0,06 % max.            | 0,08 % max.              | 0,06 % max.            | 0,08 % max.              |
| Hydrogen  | 0,013 % max.           | 0,015% max.              | 0,013 % max.           | 0,015 % max.             | 0,013 % max.           | 0,015 % max.             |
| Residuals | 0,40 % max.            | 0,40 % max.              | 0,40 % max.            | 0,40 % max.              | 0,40 % max.            | 0,40 % max.              |
| Titanium  | balance                | balance                  | balance                | balance                  | balance                | balance                  |

### B. Mechanical Properties (Annealed)

|                            |           |           |           |           |           |           |
|----------------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Tensile Strength<br>in MPA | 290-410   | 240 Min.  | 390-540   | 345 Min.  | 460-590   | 450 Min.  |
| Yield Strength<br>in MPA   | 180 Min.  | 170-310   | 250 Min.  | 275-450   | 320 Min.  | 380-550   |
| Elongation                 | 30 % Min. | 24 % Min. | 22 % Min. | 20 % Min. | 18 % Min. | 18 % Min. |



## Typical Tensile Properties and Hardness of Condenser Tube Materials

| Material                        | Yield Strength (Mpa) | Tensile Strength (Mpa) | Hardness (Vickers) | Elongation Nitrogen (%) |
|---------------------------------|----------------------|------------------------|--------------------|-------------------------|
| Titanium Grade 2                | 334                  | 432                    | 145                | 40                      |
| 18-8 Stainless Steel (annealed) | 275                  | 598                    | 142                | 68                      |
| Aluminium Brass (annealed)      | 177                  | 451                    | 85                 | 55                      |
| Admiralty Brass (annealed)      | 137                  | 343                    | 75                 | 65                      |
| 70-30 Cupronickel (annealed)    | 177                  | 422                    | 95                 | 45                      |
| 90-10 Cupronickel (annealed)    | 137                  | 353                    | 75                 | 42                      |

## Comparison with other Materials

| Material        | Density kg/m <sup>3</sup> | Melting point °C | Thermal conductivity W/(m.K) | Coefficient of thermal expansion | Modulus of elasticity Mpa | Electrical resistivity Ohm x m |
|-----------------|---------------------------|------------------|------------------------------|----------------------------------|---------------------------|--------------------------------|
| Titanium        | 4505                      | 1667             | 17                           | 8.4 x 10 <sup>-6</sup>           | 106.4 x 10 <sup>3</sup>   | 55.0 x 10 <sup>-8</sup>        |
| Monel           | 8800                      | 1325             | 26                           | 14.0 x 10 <sup>-6</sup>          | 179.5 x 10 <sup>3</sup>   | 48.0 x 10 <sup>-8</sup>        |
| Nickel          | 8900                      | 1453             | 92                           | 15.0 x 10 <sup>-6</sup>          | 206.0 x 10 <sup>3</sup>   | 9.5 x 10 <sup>-8</sup>         |
| Stainless Steel | 7900                      | 1410             | 16                           | 17.0 x 10 <sup>-6</sup>          | 200.1 x 10 <sup>3</sup>   | 72.0 x 10 <sup>-8</sup>        |
| Aluminium       | 2700                      | 660              | 205                          | 23.0 x 10 <sup>-6</sup>          | 69.2 x 10 <sup>3</sup>    | 2.7 x 10 <sup>-8</sup>         |
| Brass           | 8400                      | 970              | 100                          | 18.5 x 10 <sup>-6</sup>          | 107.9 x 10 <sup>3</sup>   | 7.5 x 10 <sup>-8</sup>         |
| Iron            | 7900                      | 1530             | 63                           | 12.0 x 10 <sup>-6</sup>          | 206.0 x 10 <sup>3</sup>   | 9.7 x 10 <sup>-8</sup>         |
| Copper          | 8900                      | 1083             | 385                          | 17.0 x 10 <sup>-6</sup>          | 107.9 x 10 <sup>3</sup>   | 1.7 x 10 <sup>-8</sup>         |



# Titanium and Titanium Alloys

## Corrosion Resistance to Seawater

1 = Lowest  
6 = Highest

|                                 | Titanium | 304<br>Stainless Steel | 90-10<br>CU-NI | Aluminium<br>Brass | Admiralty<br>Brass |
|---------------------------------|----------|------------------------|----------------|--------------------|--------------------|
| Corrosion in General            | 6        | 5                      | 4              | 3                  | 2                  |
| Pitting (Flowing)               | 6        | 4                      | 6              | 4                  | 4                  |
| Pitting (Stagnant)              | 6        | 1                      | 5              | 2                  | 2                  |
| Stress Corrosion                | 6        | 5                      | 6              | 1                  | 1                  |
| Erosion Corrosion               | 6        | 6                      | 4              | 2                  | 2                  |
| Chloride Corrosion              | 6        | 1                      | 6              | 5                  | 3                  |
| Ammonia Corrosion               | 6        | 6                      | 4              | 2                  | 2                  |
| High Flow Speed                 | 6        | 6                      | 4              | 3                  | 3                  |
| Impact of Steam (Tube Exterior) | 6        | 6                      | 3              | 2                  | 2-1                |
| Turbulence (Tube Interior)      | 6        | 6                      | 3              | (2)                | 2-1                |
| Bio-Fouling                     | 3        | 2                      | 4              | (5)                | 5                  |
| Total                           | 63       | 48                     | 49             | 31                 | 27                 |
| (Average)                       | (5.7)    | (4.4)                  | (4.5)          | (2.8)              | (2.5)              |



# Titanium and Titanium Alloys

## CORROSION RESISTANCE IN GENERAL



Titanium is a thermo dynamically active metal. Owing to a thin passive film formed on the surface, it has excellent corrosion characteristics and is resistant to most types of corrosives as listed in the following table:

| Corrosives                                            | Concentration (%)        | Temperature (°C) | Corrosion resistance |                     |                     |                  |
|-------------------------------------------------------|--------------------------|------------------|----------------------|---------------------|---------------------|------------------|
|                                                       |                          |                  | Titanium             | 304 Stainless Steel | 316 Stainless Steel | Nickelbase Alloy |
| Seawater                                              | High flow speed          | 24               | ●                    | —                   | ●*                  | —                |
|                                                       | Stagnant Seawater        | 100              | ●*                   | —                   | —                   | ●                |
| Hydrochloric acid HCl                                 | 10                       | 24               | *                    | ■                   | ■                   | ●                |
|                                                       | 30                       | 24               | ■                    | ■                   | ■                   | ●                |
|                                                       | 10                       | 80               | ■                    | —                   | —                   | *                |
|                                                       | 30                       | 80               | ■                    | —                   | —                   | ▲                |
| Nitric acid HNO <sub>3</sub>                          | 10                       | 24               | ●                    | ●                   | ●                   | ●                |
|                                                       | 50                       | 24               | ●                    | ●                   | ●                   | —                |
|                                                       | 10                       | 100              | ●                    | ●                   | ●                   | ▲                |
|                                                       | 50                       | 100              | ●                    | *                   | *                   | —                |
| Sulphuric acid H <sub>2</sub> SO <sub>4</sub>         | 10                       | 24               | ▲                    | —                   | *                   | ●                |
|                                                       | 50                       | 24               | ■                    | ■                   | ■                   | ●                |
|                                                       | 10                       | 100              | ■                    | —                   | ■                   | ●                |
|                                                       | 50                       | 100              | ■                    | —                   | ■                   | ●                |
| Ferric Chloride FeCl <sub>3</sub>                     | 10                       | 24               | ●                    | ■                   | ■                   | ●                |
|                                                       | 30                       | 24               | ●                    | ■                   | ■                   | ●                |
|                                                       | 10                       | 100              | ●                    | —                   | —                   | ■                |
|                                                       | 30                       | 100              | ●                    | —                   | —                   | ■                |
| Phosphoric acid H <sub>3</sub> PO <sub>4</sub>        | 10 (Aerated)             | 24               | *                    | ●                   | ●                   | ●                |
|                                                       | 50 (Aerated)             | 24               | ▲                    | ●                   | ●                   | ●                |
|                                                       | 10 (Aerated)             | 100              | ■                    | ●                   | ●                   | ●                |
|                                                       | 50 (Aerated)             | 100              | ■                    | *                   | *                   | ●                |
| Aqua Regia HCl—HNO <sub>3</sub>                       | HCl—HNO <sub>3</sub> 3:1 | 24               | ●                    | ■                   | ■                   | ▲                |
|                                                       |                          | 100              | *                    | —                   | —                   | —                |
| Chromic acid CrO <sub>3</sub><br>Hydrogen fluoride HF | 5                        | 24               | ●                    | —                   | *                   | ●                |
|                                                       | 5                        | 30               | ■                    | ■                   | ■                   | ▲                |
| Ammonia NH <sub>3</sub>                               | 10                       | 24               | ●                    | ●                   | ●                   | ●                |
|                                                       | 30                       | 24               | ●                    | ●                   | ●                   | ●                |
|                                                       | 10                       | 80               | ●                    | *                   | *                   | *                |
|                                                       | 30                       | 80               | ●                    | *                   | *                   | ●                |
| Chlorine Cl <sub>2</sub>                              | Dry Gas                  | 24               | ■                    | —                   | *                   | ●                |
|                                                       | Wet Gas                  | 24               | ●                    | —                   | ■                   | ▲                |
|                                                       | Dry Gas                  | 100              | —                    | ●                   | *                   | *                |
|                                                       | Wet Gas                  | 90               | ●                    | —                   | ■                   | ▲                |
| Sodium Hydroxide NaOH                                 | 10                       | 24               | ●                    | ●                   | ●                   | ●                |
|                                                       | 50                       | 24               | ●                    | ●                   | ●                   | —                |
|                                                       | 10                       | 100              | ●                    | ●                   | ●                   | ●                |
|                                                       | 50                       | 100              | *                    | *                   | *                   | ●                |
| Formic acid HCOOH                                     | 10                       | 24               | *                    | *                   | ●                   | ●                |
|                                                       | 50                       | 24               | *                    | *                   | ●                   | ●                |
|                                                       | 10                       | 100              | *                    | ■                   | *                   | ●                |
|                                                       | 30                       | 100              | ■                    | ■                   | *                   | ●                |
| Sodium Carbonate Na <sub>2</sub> CO <sub>3</sub>      | 10                       | 24               | ●                    | ●                   | ●                   | ●                |
|                                                       | 30                       | 24               | —                    | —                   | —                   | —                |
|                                                       | 10                       | 100              | ●                    | ●                   | ●                   | ●                |
|                                                       | 30                       | 100              | ●                    | ●                   | ●                   | ●                |

● = < 0,051 mm/year    \* = < 0,508 mm/year    ▲ = 0,508 – 1,27 mm/year    ■ = > 1,27 mm/year

-Notes- \*Localized corrosion such pitting corrosion may occur.



# Titanium and Titanium Alloys

## CORROSION RESISTANCE IN GENERAL

| Corrosives                                               | Concentration (%) | Temperature (°C) | Corrosion resistance |                     |                     |                  |
|----------------------------------------------------------|-------------------|------------------|----------------------|---------------------|---------------------|------------------|
|                                                          |                   |                  | Titanium             | 304 Stainless Steel | 316 Stainless Steel | Nickelbase Alloy |
| Cupric Chloride<br>$\text{CuCl}_2$                       | 10                | 24               | *                    | ■                   | ■                   | *                |
|                                                          | 30                | 24               | *                    | ■                   | ■                   | *                |
|                                                          | 10                | 100              | *                    | —                   | —                   | —                |
|                                                          | 30                | 100              | *                    | —                   | —                   | —                |
| Calcium Chloride<br>$\text{CaCl}_2$                      | 10                | 24               | ●                    | ●                   | ●                   | ●                |
|                                                          | 50                | 24               | ●                    | *                   | *                   | ●                |
|                                                          | 10                | 100              | ●*                   | —                   | —                   | ●                |
|                                                          | 50                | 100              | ●*                   | ■                   | —                   | ●                |
| Sodium Chloride<br>$\text{NaCl}$                         | 10                | 24               | ●                    | *                   | *                   | *                |
|                                                          | 40                | 24               | ●                    | *                   | *                   | *                |
|                                                          | 10                | 100              | ●*                   | * <sup>*</sup>      | * <sup>*</sup>      | *                |
|                                                          | 40                | 100              | ●*                   | * <sup>*</sup>      | * <sup>*</sup>      | *                |
| Ammonium Chloride<br>$\text{NH}_4\text{Cl}$              | 10                | 24               | ●                    | ▲                   | ●                   | ●                |
|                                                          | 40                | 24               | ●                    | —                   | —                   | ●                |
|                                                          | 10                | 100              | ●*                   | —                   | ●*                  | ●                |
|                                                          | 40                | 100              | ●*                   | —                   | —                   | ●                |
| Hydrogen sulfide $\text{H}_2\text{S}$                    | Dry Gas           | 24               | ●                    | ▲                   | *                   | ●                |
|                                                          | Wet Gas           | 24               | ●                    | *                   | ●                   | *                |
| Sulfur Dioxide $\text{SO}_2$                             | Dry Gas           | 30–60            | ●                    | —                   | —                   | —                |
|                                                          | Wet Gas           | 30–90            | ●                    | —                   | —                   | —                |
| Acetic acid $\text{CH}_3\text{COOH}$                     | 10                | 24               | ●                    | ●                   | ●                   | ●                |
|                                                          | 60                | 24               | ●                    | ●                   | ●                   | ●                |
|                                                          | 10                | 100              | ●                    | ●                   | ●                   | ●                |
|                                                          | 60                | 100              | ●                    | *                   | *                   | ●                |
| Magnesium Chloride<br>$\text{MgCl}_2$                    | 10                | 24               | ●                    | ▲                   | *                   | ●                |
|                                                          | 40                | 24               | ●                    | *                   | *                   | ●                |
|                                                          | 10                | 100              | ●*                   | ▲*                  | —                   | ●                |
|                                                          | 40                | 100              | ●*                   | —                   | —                   | ●                |
| Ferrous Sulfate $\text{FeSO}_4$                          | 10                | 24               | ●                    | *                   | *                   | *                |
|                                                          | 50                | 24               | ●                    | *                   | *                   | *                |
|                                                          | 10                | 100              | ●                    | *                   | *                   | *                |
|                                                          | 50                | 100              | ●                    | —                   | —                   | *                |
| Lactic acid $\text{CH}_3\text{CH}(\text{OH})\text{COOH}$ | 10                | 24               | ●                    | *                   | ●                   | *                |
|                                                          | 50                | 24               | ●                    | *                   | ●                   | ●                |
|                                                          | 10                | 100              | ●                    | *                   | *                   | *                |
|                                                          | 50                | 100              | ●                    | ■                   | *                   | *                |
| Citric acid $\text{C}_6\text{H}_8\text{O}_7$             | 10                | 24               | ●                    | *                   | ●                   | ●                |
|                                                          | 50                | 24               | ●                    | *                   | ●                   | ●                |
|                                                          | 10                | 100              | ●                    | *                   | ●                   | ●                |
|                                                          | 50                | 100              | ■                    | ■                   | ●                   | ●                |
| Oxalic acid $(\text{COOH})_2$                            | 10                | 24               | *                    | *                   | *                   | *                |
|                                                          | 20                | 52               | ■                    | —                   | —                   | *                |
|                                                          | 50                | 24               | —                    | *                   | *                   | *                |
|                                                          | 10                | 100              | —                    | —                   | ■                   | *                |
|                                                          | 50                | 100              | —                    | ■                   | ■                   | *                |

● = < 0,051 mm/year    \* = < 0,508 mm/year    ▲ = 0,508 – 1,27 mm/year    ■ = > 1,27 mm/year

-Notes- \*Localized corrosion such pitting corrosion may occur.



## Super-Duplex Stainless Steels and their characteristics

The first-generation Duplex stainless steels were developed more than 70 years ago in Sweden for use in the sulfite paper industry. Duplex alloy were originally created to combat corrosion problems caused by chloride-bearing cooling waters and other aggressive chemical process fluids.

Called Duplex because of its mixed microstructure with about equal proportions of ferrite and austenite, Duplex stainless steels are a family of grades, which range in corrosion performance depending on their alloy content. The term "Super-Duplex" was first used in the 1980's to denote highly alloyed, high-performance Duplex steel with a pitting resistance equivalent of >40 (based on Cr% + 3.3 Mo% + 16N%)

With its high level of chromium, Super-Duplex steel provides outstanding resistance to acids, acid chlorides, caustic solutions and other environments in the chemical / petrochemical, pulp and paper industries, often replacing 300 series stainless steel, high nickel superaustenitic steels and nickel-based alloys.

The chemical composition based on high contents of chromium, nickel and molybdenum improves intergranular and pitting corrosion resistance. Additions of nitrogen promote structural hardening by interstitial solid solution mechanism, which raises the yield strength and ultimate strength values without impairing toughness. Moreover, the two-phase microstructure guarantees higher resistance to pitting and stress corrosion cracking in comparison with conventional stainless steels.

From the introduction of its first-generation, Duplex steel has seen a steady increase in popularity. Recently, the production of high strength, corrosion resistant super-duplex coil has been implemented in the marine and chemical industries, architecture and mast riggings, wire lines, lifting and pulley equipment and well service strands. In fact, development of wire processing techniques has enabled the production of steel wires down to 1 mm in diameter.

### The various Alloys

Super-Duplex falls under the Duplex stainless steel grouping. Duplex stainless steels are graded for their corrosion performance depending on their alloy content. Today, modern Duplex stainless steel can be divided into four groups:

- . . . . .Lean Duplex such as 2304, which contains no deliberate Mo addition;
- . . . . .2205, the work-horse grade accounting for more than 80% of duplex usage;
- . . . . .25Cr duplex such as Alloy 255 and DP-3;
- . . . . .Super-Duplex; with 25-26 Cr and increased Mo and N compared 25 Cr grades, including such as 2507, Zeron 100, UR 52N+, and DP-3W





# Super-Duplex Stainless Steels

TUBING, PIPE, FLANGES, FITTINGS, ROUND BAR & PLATE

## Composition of Duplex Stainless Steels <sup>a</sup>

The Table lists the duplex stainless steel covered in ASTM specifications for plate, sheet and bar products.

| UNS Number    | Type <sup>b</sup> | C     | Mn      | P     | S     | Si   | Cr        | Ni        | Mo        | N         | Cu        | Other      |
|---------------|-------------------|-------|---------|-------|-------|------|-----------|-----------|-----------|-----------|-----------|------------|
| Duplex Grades |                   |       |         |       |       |      |           |           |           |           |           |            |
| S31200        | ...               | 0.030 | 2.00    | 0.045 | 0.030 | 1.00 | 24.0-26.0 | 5.5-6.5   | 1.20-2.00 | 0.14-0.20 | ...       | ...        |
| S31260        | ...               | 0.03  | 1.00    | 0.030 | 0.030 | 0.75 | 24.0-26.0 | 5.5-7.5   | 2.5-3.5   | 0.10-0.20 | 0.20-0.80 | W0.10-0.20 |
| S31803        | ...               | 0.030 | 2.00    | 0.030 | 0.020 | 1.00 | 21.0-23.0 | 4.5-6.5   | 2.5-3.5   | 0.08-0.20 | ...       |            |
| S32001        | ...               | 0.030 | 4.0-6.0 | 0.040 | 0.030 | 1.00 | 22.0-23.0 | 1.00-3.00 | 0.60      | 0.05-0.17 | 1.00      |            |
| S32205        | 2205              | 0.030 | 2.00    | 0.030 | 0.020 | 1.00 | 19.5-21.5 | 4.5-6.5   | 3.0-3.5   | 0.14-0.20 | ...       |            |
| S32304        | 2304              | 0.030 | 2.50    | 0.040 | 0.030 | 1.00 | 21.5-24.5 | 3.0-5.5   | 0.05-0.60 | 0.05-0.20 | 0.05-0.60 |            |
| S32520        | ...               | 0.030 | 1.50    | 0.035 | 0.020 | 0.80 | 24.0-26.0 | 5.5-8.0   | 3.0-4.0   | 0.20-0.35 | 0.50-2.00 |            |
| S32550        | 255               | 0.04  | 1.50    | 0.040 | 0.030 | 1.00 | 24.0-27.0 | 4.5-6.5   | 2.9-3.9   | 0.10-0.25 | 1.5-2.5   |            |
| S32750        | 2507              | 0.030 | 1.20    | 0.035 | 0.020 | 0.80 | 24.0-26.0 | 6.0-8.0   | 3.0-5.0   | 0.24-0.32 | 0.50      |            |
| S32760        | ...               | 0.030 | 1.00    | 0.030 | 0.010 | 1.00 | 24.0-26.0 | 6.0-8.0   | 3.0-4.0   | 0.20-0.30 | 0.50-1.00 | c          |
| S32900        | 329 <sup>d</sup>  | 0.06  | 1.00    | 0.040 | 0.030 | 0.75 | 23.0-28.0 | 2.5-5.0   | 1.0-2.0   | ...       | ...       |            |
| S32950        | ...               | 0.03  | 2.00    | 0.035 |       |      |           |           |           |           |           |            |

a ... Weight percent, maximum unless otherwise noted.

b ... Unless otherwise indicated, a common name, not a trademark, widely used, not associated with any one producer, as listed in ASTM A240.

c ... W 0.50-1.00; Cr+3.3 Mo + 16N=40 min

d ... AISI designation

## BENEFITS

- High strength
- High resistance pitting, crevice corrosion resistance
- High resistance stress corrosion cracking, corrosion fatigue and erosion
- Excellent resistance to chloride stress-corrosion cracking
- High thermal conductivity
- Low coefficient of thermal expansion
- Good sulfide stress corrosion resistance
- Low thermal expansion and higher heat conductivity than austenitic steels
- Good workability and weldability
- High energy absorption

## APPLICATIONS

- Heat exchangers, tubes and pipes for production and handling of gas and oil
- Heat exchangers and pipes in desalination plants
- Mechanical and structural components
- Power industry FGD systems
- Pipes in process industries handling solutions containing chlorides
- Utility and industrial systems, rotors, fans, shafts and press rolls where the high corrosion fatigue strength can be utilized
- Cargo tanks, vessels, piping and welding consumables for chemical tankers
- High-strength, highly resistant wiring



# Special Stainless Steels

## FOR THE UREA/FERTILIZER INDUSTRY • MATERIAL NO. 1.4429



Material No. 1.4429 is a fullyaustenitic steel with an extremely low Carbon content. Like Material No. 1.4465 this steel has a guaranteed low Ferrite content, and it is used particularly in equipment of Urea plants which is likely to be subjected to corrosion.

**1. Material description**  
 DIN X 2 Cr Ni Mo N 17-13-3  
 Material No. (1.4429)  
 AISI (316L)  
 BS 316 S 12

**2. Supply form and condition**  
 seamless tubes, pickled  
 sheets, strips, rods, forgings

**3. Range of dimension (Tubes)**  
 Outside diameter .....10-114 mm  
 Wall Thickness .....1-12 mm  
 Length .....max. 18 m  
 (depending on diameter and wall)

**4. Chemical composition** (nominal analysis in %)

| C      | Si    | Mn    | Cr        | Ni        | Mo      | N         |
|--------|-------|-------|-----------|-----------|---------|-----------|
| ≤ 0.03 | ≤ 1.0 | ≤ 2.0 | 16.5-18.5 | 12.0-14.5 | 2.5-3.0 | 0.14-0.22 |

### 5. Mechanical properties

a. at room temperature

| 0.2 proof stress N/mm <sup>2</sup> | Tensile strength N/mm <sup>2</sup> | Elongation (A <sub>5</sub> ) % |
|------------------------------------|------------------------------------|--------------------------------|
| ≥ 300                              | 600-800                            | ≥ 35                           |

b. at increased temperatures (minimum values)

| Temperature °C                     | 50  | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 550 |
|------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0.2-proof stress N/MM <sup>2</sup> | 265 | 225 | 197 | 178 | 165 | 155 | 150 | 145 | 140 | 138 | 136 |
| 1%-proof stress N/MM <sup>2</sup>  | 300 | 260 | 227 | 208 | 195 | 185 | 180 | 175 | 170 | 168 | 166 |



# Special Stainless Steels

FOR THE UREA/FERTILIZER INDUSTRY • MATERIAL NO. 1.4429

## 6. Physical properties

|                       |                               |
|-----------------------|-------------------------------|
| Density               | 7.95 g/cm <sup>3</sup>        |
| Electrical resistance | 0.75 Ohm – mm <sup>2</sup> /m |
| Thermal conductivity  | 15 W/m°C                      |

| Temperature °C                                     | 20  | 100  | 200  | 300  | 400  | 500  |
|----------------------------------------------------|-----|------|------|------|------|------|
| Linear coefficient<br>(106 m/m °C)<br>of expansion |     | 16.5 | 17.5 | 17.5 | 18.5 | 18.5 |
| Modulus of elasticity<br>(103 N/mm <sup>2</sup> )  | 200 | 194  | 186  | 179  | 172  | 165  |

## 7. Heat treatment

Quench annealing: 1150-1050 °C/water

## 8. Welding

The weldability of Material No. 1.4429 is as good as that of the known austenitic Cr-Ni-Mo steels. The TIG process and welding with rod electrodes are mainly used as welding processes. Welding additives, specially designed for this steel, are available, which produce a weld with limited, Ferrite content and low corrosion rates at the Huey-test. Heat treatment (pre-or subsequent heating) is generally not necessary.

The heat input during welding should be kept to a minimum.

## 9. Cold bending

After cold bending to the usual bending radii heat treatment is not necessary.

At a higher degree of deformation and operational conditions, which may suggest danger of stress corrosion cracking, heat treatment at 1150-1050 °C with quenching is recommended.

## 10. Hot bending

The working temperatures should be in the region of 1150-750 °C and the parts should be quenched as quickly as possible after hot forming. Annealing is generally not necessary after the bending.

## 11. Corrosion resistance

a) Because of the special chemical composition and special procedures during production a better intercrystalline corrosion performance and a lesser corrosion rate in Carbamate solutions and at the Huey-test are obtained than with 316 L. The very low Ferrite content has also a decisive influence on the good corrosion performance.

b) Huey (Test Corrosion Rate)  
max. 0,6 mm/y (13 g/m<sup>2</sup> 24 h)

## 12. Application

In Urea plants Material No. 1.4429 is used in particular for the scrubber, condenser and line pipes.

# Special Stainless Steels

## FOR THE UREA / FERTILIZER INDUSTRY • MATERIAL NO. 1.4439



Material No. 1.4439 is a fully austenitic chromium-nickel-molybdenum-steel with increased resistance to pitting corrosion

### 1. Material description

X2CrNiMoN 17135

Material No. 1.4439

(SEW 400)

### 2. Supply form and condition

seamless tubes, annealed

(plates, strips, rods, forgings)

### 3. Range of dimensions (Tubes)

Outside Diameter: .....10-114 mm

Wall Thickness: .....1-12 mm

Length: .....max. 26.5 m

(depending on diameter and wall)

### 4. Chemical composition

(nominal analysis in %)

| C     | Si    | Mn    | P      | S     | Cr        | Ni        | Mo      | N         |
|-------|-------|-------|--------|-------|-----------|-----------|---------|-----------|
| ≤0.04 | ≤1.00 | ≤2.00 | ≤0.045 | ≤0.03 | 16.5-18.5 | 12.5-14.5 | 4.0-5.0 | 0.10-0.20 |

### 5. Mechanical properties

#### a. at room temperature

| 0.2 proof stress<br>N/mm <sup>2</sup> | 1%-proof stress<br>N/mm <sup>2</sup> | Tenile Strength<br>N/mm <sup>2</sup> | Elongation<br>(A5) % |
|---------------------------------------|--------------------------------------|--------------------------------------|----------------------|
| ≥ 285                                 | ≥ 315                                | 590-780                              | ≥40                  |

#### b. at increased temperature

(minimum values)

| Temperature in °C                     | 100 | 150 | 200 | 250 | 300 | 350 | 400 |
|---------------------------------------|-----|-----|-----|-----|-----|-----|-----|
| 0.2-proof stress<br>N/mm <sup>2</sup> | 225 | 200 | 185 | 175 | 165 | 155 | 150 |
| 1%-proof stress<br>N/mm <sup>2</sup>  | 255 | 230 | 210 | 200 | 190 | 180 | 175 |



# Special Stainless Steels

FOR THE UREA / FERTILIZER INDUSTRY • MATERIAL NO. 1.4439

## 6. Physical properties

|                                 |                                       |
|---------------------------------|---------------------------------------|
| Density                         | 7.9 g/cm <sub>3</sub>                 |
| Electrical resistance           | 0.85 Ohm mm <sub>2</sub> /m           |
| Thermal conductivity            | 15 W/M°C                              |
| Linear coefficient of expansion | 20-100°C 16.5 10 <sup>-6</sup> m/m°C  |
|                                 | 20-200°C 17.5 10 <sup>-6</sup> m/m°C  |
|                                 | 20-300°C 17.5 10 <sup>-6</sup> m/m°C  |
|                                 | 20-400°C 18.5 10 <sup>-6</sup> m/m°C  |
| Modulus of elasticity           | 200 10 <sup>3</sup> N/mm <sup>2</sup> |

## 7. Heat treatment

|                   |                        |
|-------------------|------------------------|
| Recrystallization | 1050-1150 °C/air/water |
| Stress-relieving  | 500-600 °C/air         |

## 3. Range of dimensions (Tubes)

|                                  |                  |
|----------------------------------|------------------|
| Outside Diameter:                | .....10-114 mm   |
| Wall Thickness:                  | .....1-12 mm     |
| Length:                          | .....max. 26.5 m |
| (depending on diameter and wall) |                  |

## 8. Welding

Electrode rod welding as well as the WIG (TIG)-method is suitable for welding tubes into tube plates. The use of additives of the same type is recommended in order to obtain a weld free of ferrites and with the favourable properties of the basic material. Welding should be carried out with as little heat as possible. There is usually no need for further heat treatment.

## 9. Cold bending

Heat treatment is in most cases not necessary after cold bending to normal bending radii. At a higher degree of forming and at operational conditions which could cause stress corrosion in austenitic steels, a stress-relieving annealing is recommended.

## 10. Corrosion resistance

The addition of nitrogen provides a good austenitic stability for Material No. 1.4439 giving it a superior corrosion resistance to that of 1.4435. Even after heat treatment e.g. welding, a good corrosion resistance is maintained as there is no possibility of the formation of harmful phases e.g. the sigma phase. The increased molybdenum content affords a high corrosion resistance in chlorine-ion-containing media. Pitting corrosion resistance is particularly improved.

Material No. 1.4439 is characterized by good resistance in

|                        |                                                                |
|------------------------|----------------------------------------------------------------|
| Mixed acids            | -sulphuric acid / nitric acid, Hydrofluoric acid / nitric acid |
| Bleaching solutions    | -sodium chlorite, sodium-hypochlorite                          |
| Sea and brackish water | -sodium chloride                                               |

## 11. Application

Positive experiences with Material No. 1.4439 can be expected amongst others in the following applications:

- Fatty acid plants
- Bleaching plants
- Nuclear evaporation plants
- Plants admitting aqueous chloride solutions

# Special Stainless Steels

FOR THE UREA / FERTILIZER INDUSTRY • MATERIAL NO. 1.4417



Material No. 1.4417 is a ferritic-austenitic chromium-nickel-molybdenum steel of increased yield point and increased resistance against stress corrosion.

## 1. Material description

X2 CrNiMoSi 2 5-7-3  
Material No. 1.4417  
ASTM A 669  
Vd TÜV-Data Sheet 1.79 385  
Equivalent SANDVIC 3RE60

## 2. Supply form and condition

seamless tubes, annealed

## 3. Range of dimensions (Tubes)

Outside Diameter: .....10-50 mm  
Wall Thickness: .....1-4 mm  
Length: .....max. 12.5 mm  
(depending on diameter and wall)

## 4. Chemical composition

(nominal analysis in %)

| C      | Si      | Mn      | Cr        | Ni      | Mo      |
|--------|---------|---------|-----------|---------|---------|
| ≤ 0.03 | 1.5-2.0 | 1.3-2.0 | 18.0-20.0 | 4.5-5.0 | 2.5-3.0 |

## 5. Mechanical properties

(minimum values)

| 0.2 proof stress at a temperature<br>in °C N/mm <sup>2</sup> |     |     |     | tensile strength<br>N/mm <sup>2</sup> |     |     |     | Elongation<br>(A5) % |      |
|--------------------------------------------------------------|-----|-----|-----|---------------------------------------|-----|-----|-----|----------------------|------|
| 20                                                           | 100 | 150 | 200 | 250                                   | 285 | 300 | 325 | 700-900              | ≥ 30 |
| min.500                                                      | 370 | 350 | 330 | 325                                   | 320 | 315 | 310 |                      |      |

## 6. Physical properties

|                                 |                              |                              |
|---------------------------------|------------------------------|------------------------------|
| Density                         | 7.7 g/cm <sup>3</sup>        |                              |
| Electrical resistance           | 0.25 Ohm mm <sup>2</sup> /m  |                              |
| Thermal conductivity            | at 20°C                      | 20.9 W/m°C                   |
| at 300°C                        | 25.5 W/m°C                   |                              |
| Linear coefficient of expansion | at 20-100°C                  | 11.2 10 <sup>-6</sup> m/m °C |
| at 20-200°C                     |                              | 13.0 10 <sup>-6</sup> m/m °C |
| at 20-300°C                     | 13.6 10 <sup>-6</sup> m/m °C |                              |
| at 20-400°C                     | 14.2 10 <sup>-6</sup> m/m °C |                              |
| Modulus of elasticity           | at 20°C                      | 198 10 <sup>3</sup> m/m °C   |
| at 250°C                        | 174 10 <sup>3</sup> m/m °C   |                              |
| at 300°C                        | 169 10 <sup>3</sup> m/m °C   |                              |



# Special Stainless Steels

FOR THE UREA / FERTILIZER INDUSTRY • MATERIAL NO. 1.4417

## 7. Heat treatment

Quench annealing 950-1050°C/air or water

## 3. Range of dimensions (Tubes)

|                                  |             |
|----------------------------------|-------------|
| Outside Diameter:                | 10-114 mm   |
| Wall Thickness:                  | 1-12 mm     |
| Length:                          | max. 26.5 m |
| (depending on diameter and wall) |             |

## 8. Welding

Weldability of Material No. 1.4417 is good. Due to the danger of carburizing, gas fusion welding should be avoided. For wall thickness from 0.8 mm up TIG-welding is recommended; from 1.5 mm up especially in case of fillet welds-arc welding with sheated bar electrodes is possible. After welding no heat treatment is required.

For the design of heat exchangers, tubes of Material No. 1.4417 are normally connected with tube sheets of fully austenitic steel or boiler construction steel. For these cases the following welding filler metals may be recommended:

### a. to austenitic steel, e.g. (1.4571

Nominal analysis

|        |           |          |
|--------|-----------|----------|
| 20% Cr | 67 % Ni   | 3 % Fe   |
| 19% Cr | 10 % Ni   | 2.5 % Mo |
| 19% Cr | 11.5 % Ni | 2.8 % Mo |

### b. to low-alloyed steel, e.g. boiler plate 17Mn4

Nominal analysis

|         |         |        |
|---------|---------|--------|
| 24 % Cr | 13 % Ni |        |
| 20 % Cr | 67 % Ni | 3 % Fe |
| 18 % Cr | 8 % Ni  | 6 % Mn |

The welding filler metals mentioned under a. and b. have a C-content of max. 0.03% with the exception of alloy-type 18/8/6 having a C-content of approx 0.10%. If high stress of the welding joints has to be taken into account, welding filler metals of LC-quality should be used. In case of using Mo-free filler metal, the corrosion characteristics of the weld metal have to be taken into account.

## 9. Cold bending

Generally, in case of usual bending radii, post heating will not be required. In case of a higher degree of deformation at low temperatures ( > 10% ) annealing as indicated under 7. is necessary.

## 10. Hot bending

Hot bending should be performed in the temperature range from 1100-900°C. Afterwards, quench annealing as described under 7. will have to be carried out.

## 11. Corrosion behaviour

Due to its two-phase structure, Material No. 1.4417 has a higher resistivity against stress corrosion cracking than comparable fully austenitic CrNi-steels. Its use in media containing chloride, e.g. brackish water, is to be recommended, when austenitic steels have failed because of stress corrosion cracking. Its resistance against pitting is similar to that of X2CrNiMo 1812. In non-oxidizing solutions, e.g. formic acid and oxalic acid, a good continuity is noted.

## 12. Application

Due to its favourable physical-technological and corrosion-chemical characteristics, Material No. 1.4417 is preferably used in the following fields:

High pressure processes of the chemical industry

Due to its increased yield point there are advantages regarding wall thickness design.

## 13. Application

Application over long periods exceeding 325°C should be avoided. For pressure vessels according to AD-W2 the service temperature should range between -10°C up to + 285°C (VdTÜV-Data Sheet)

# Special Stainless Steels

FOR THE UREA / FERTILIZER INDUSTRY • MATERIAL NO. 1.4465



Material No. 1.4465 is a fully austenitic Chromium-Nickel-Molybdenum steel with an extremely low Carbon content. The material is distinguished by very low corrosion rates at the Huey-test, and it is applied especially in those parts of Urea plants which are subjected to the most corrosive conditions.

## 1. Material description

X2CrNiMoN 25-25-2  
Material No. (1.4465)

## 2. Supply form and condition

seamless tubes, pickled  
(sheets, strips, rods, forgings)

## 3. Range of dimensions (Tubes)

Outside Diameter: .....10-114 mm  
Wall thickness: .....1-12 mm  
Length: .....max. 26.5 m  
(depending on diameter and wall)

## 4. Chemical composition

(nominal analysis in %)

| C       | Si     | Mn      | Cr        | Ni        | Mo      | N         |
|---------|--------|---------|-----------|-----------|---------|-----------|
| ≤ 0.020 | ≤ 0.40 | 1.5-2.0 | 24.5-25.5 | 21.5-22.5 | 1.9-2.3 | 0.10-0.14 |

## 5. Mechanical properties

### a) at room temperature

| 0,2% proof stress<br>N/mm <sup>2</sup> | Tensile strength<br>N/mm <sup>2</sup> | Elongation<br>(A5) |
|----------------------------------------|---------------------------------------|--------------------|
| min. 255                               | min. 540                              | > 30               |

### b) at increased temperature (minimum values)

| Temperature °C                        | 100 | 200 | 300 | 400 | 500 |
|---------------------------------------|-----|-----|-----|-----|-----|
| 0,2-proof stress<br>N/mm <sup>2</sup> | 230 | 210 | 185 | 160 | 140 |
| 1%-proof stress<br>N/mm <sup>2</sup>  | 270 | 240 | 220 | 195 | 170 |





## Special Stainless Steels

FOR THE UREA / FERTILIZER INDUSTRY • MATERIAL NO. 1.4465

### 6. Physical properties

|                             |                             |
|-----------------------------|-----------------------------|
| Density                     | 7,9 g/cm <sup>3</sup>       |
| Spec. electrical resistance | 0,90 Ohm mm <sup>2</sup> /m |
| Thermal conductivity        | 15 W/m °C                   |

| Temperature °C                                                  | 20  | 100  | 200  | 300  | 400  | 500  |
|-----------------------------------------------------------------|-----|------|------|------|------|------|
| Linear coefficient<br>(10 <sup>-6</sup> m/m °C)<br>of expansion |     | 15,0 | 15,7 | 16,0 | 16,6 | 16,8 |
| Modulus of elasticity<br>(10 <sup>3</sup> N/mm <sup>2</sup> )   | 200 | 195  | 180  | 178  | 170  | 164  |

### 7. Heat treatment

Quench annealing: 1050-1150 °C/water

Bright annealed: 1050-1150 °C/gas

### 8. Welding

The weldability of Material No. 1.4465 can be described as good. For welding into tube sheets welding rods as well as the TIG welding process can be used.

As welding additives we recommend for the above processes S-NiCrFe27MoCu Material No. 1.4455, depending on application. Heat treatment (pre-or subsequent heating, resp) is generally not required.

As usual with austenitic Cr-Ni-steels, Material No. 1.4465 must also be welded with the least possible heat input.

### 9. Cold bending

There is generally no need for heat treatment after cold bending to usual bending radii. At a higher degree of deformation and operational conditions, which may suggest danger of stress corrosion cracking, heat treatment at 1050-1150 °C is recommended.

### 10. Hot bending

Hot bending should be carried out at a temperature range of 1150-850 °C. A quenching after hot forming can be advisable in some cases for maintaining the optimum corrosion performance. At rapid quenching from the hot forming temperature a subsequent annealing is generally not necessary.

### 11. Corrosion resistance

Material No. 1.4465 is distinguished from similar alloy steels not only by a better performance in respect of the corrosion rate, but also by higher resistance when subjected to pitting, stress corrosion cracking and inter-crystalline corrosion.

#### a. Inter-crystalline corrosion

The excellent resistance to inter-crystalline corrosion is proved by the Strauss-test

(SEP 1875-61 / DIN 50914) as well as the Huey-test (ASTM A 262, Practice C.)



## **b.Huey-test**

Apart from the testing for resistance to grain disintegration the Huey-test also serves for investigating whether there are any further inhomogeneities such as precipitations within the grain, sigma phase and inclusions of Ferrite. For this reason the Huey-test represents a very strict testing method, which includes a great number of parameters.

Material No. 1.4465 has a max. corrosion rate of 1,5 µm/48h=

5,91 g/m<sup>2</sup> 24h=0.27 mm/year at the Huey-test. This extraordinarily low value can only be guaranteed by special provisions at the production of the steel and by extensive quality control during the various of production.

## **c.Pitting corrosion**

Due to the Molybdenum content and the increased Chromium content there is a good corrosion resistance to flowing waters containing Chlorides.

## **d.Stress corrosion cracking**

Due to the increased Nickel content, Material No. 1.4465 has a considerably higher range of resistance to stress corrosion cracking than e.g. X2CrNiMo 1812 (TP 316 L)

## **e.Special environments**

Material No. 1.4465 offers excellent corrosion resistance to a great number of corrosion environments. Especially worth noting here is the good performance in Nitric acid, Phosphoric acid and the Ammonium carbamate solution occurring in the Urea process.

## **12. Application**

### **Urea plants**

Material No. 1.4465 has been developed for the especially high requirements in strippers of Urea plants to the Stamicarbon process route.

This steel can also be successfully used, however, for other processes, where similar operational conditions exist as in the stripping process.

### **Nitric acid plants**

Due to the very small corrosion rates at the Huey-test, Material No. 1.4465 is suitable for the application in Nitric acid plants and in equipment that is subjected to Nitric acid.

### **Other plants**

Because of the increased corrosion performance as against comparable steels such as

X3CrNiMoN 2525, X2CrNiMo 1810 and X2CrNi 189 the application of Material No. 1.4465 should be also considered, if the former steels have failed to produce satisfactory results.



# Special Stainless Steel Urea Tubes

AISI 316 L (1.4435) / 1.4466 MATERIAL DATA

## Characteristics:

Material No. 1.4466 and Mat. No. 1.4435 are austenitic, stainless and acid resisting nickel, chromium, molybdenum steels with a very low carbon content (ELC type).

Both grades have a fully austenitic structure. Material No. 1.4466 features improved strength due to its nitrogen addition, which is of particular importance for the 0,2% proof stress to be used as design basis. Material No. 1.4435 was mainly developed for urea plant applications.

## Applications:

Material No. 1.4466 and Material No. 1.4435 are mainly used for parts and equipment in urea plant subjected to high pressures and temperatures, and to severe corrosion (steam separator, condenser, reactor, stripper, scrubber). Both grades are also suitable for applications involving the attack of a variety of chemicals in dyemills, in the textile, paper and leather industries, as well as the chemical, pharmaceutical and plastics industries.

The steels are not magnetic.

## Corrosion resistance Intergranular corrosion

Owing to their alloying elements and to the melting technique employed.

Material No. 1.4466 and 1.4435 feature very good resistance to intergranular

corrosion when tested according to DIN 50914. Their corrosion resistance is also found to be excellent when subjected to a Huey test according to ASTM A 252 Practice C – a maximum corrosion rate of 0.247 g/m<sub>hr</sub> (1.4466) and 0.54 g/m<sub>hr</sub> (1.4435) obtained as an average of 5 boiling periods of 48 hours each can be guaranteed.

## Stress corrosion cracking and pitting

The alloying elements of Material No. 1.4466 give this grade improved resistance to stress corrosion cracking and pitting in high-chloride media (e.g. sea water) compared to that of conventional 18/8 steels.

## Forming properties

Both grades can conveniently be cold formed, hot formed and machined.

## Welding properties

Welding presents no difficulties. With an approved welding technique for fully austenitic filler metals sound weld joints can be achieved up to a plate thickness of 80 mm. Welding should be carried out with a short arc and mean amperage taking care to prevent weave beads exceeding two times the electrode diameter. Thick layers are to be avoided. It is recommended to chip out the end craters. Interpass temperature should not exceed 150°. Quite on general, no postheat-treatment is required.

## Material Data 1.4435

X 2 CrNiMo 18-14-3

W. No. 1.4435

AISI TYPE 316 L

Stamicarbon nv: Spez. 18005 Section I Material

## Chemical composition in wt.%

| C         | Si   | Mn   | P         | S         | Cr   | Mo  | Ni   |
|-----------|------|------|-----------|-----------|------|-----|------|
| max.0,020 | 0,50 | 1,70 | max.0,015 | max.0,010 | 17,5 | 2,5 | 14,5 |

## Mechanical properties at 20°C

| 0,2% proof stress<br>N/mm <sup>2</sup> min. | 1% proof stress<br>N/mm <sup>2</sup> min. | tensile strength<br>N/mm <sup>2</sup> | elongation after<br>fracture (Lo=5do) |
|---------------------------------------------|-------------------------------------------|---------------------------------------|---------------------------------------|
| 195                                         | 235                                       | 450-700                               | 40                                    |

## Mechanical properties at elevated temperatures in N/mm<sup>2</sup>

| Temperature °C    | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 |
|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0,2% proof stress | 165 | 150 | 137 | 127 | 119 | 113 | 108 | 103 | 100 |
| 1% proof stress   | 200 | 180 | 165 | 153 | 145 | 139 | 135 | 130 | 128 |

## Physical properties

Specific gravity at 20°C ..... 7,95 g/cm<sup>3</sup>

Thermal conductivity at 20°C ..... 15 W/mK

Specific heat at 20°C ..... 500 J/kgK

Modulus of elasticity at 20°C ..... 200000 N/mm<sup>2</sup>

Thermal expansion in 10<sup>-6</sup> m/m °C ..... 20 to 100°C 16,5

..... 20 to 200°C 17,5

..... 20 to 300°C 17,5

..... 20 to 400°C 18,5

..... 20 to 500°C 18,5

# Special Stainless Steel Urea Tubes

AISI 316L (1.4435) / 1.4466



## Material Data 1.4466

X 1 CrNiMoN 25-25-2

W.Nr. 1.4466

Stamicarbon nv: Spez: 53930-X 2 CrNiMo 25 22 2\*

## Chemical composition in wt.%

| C          | Si        | Mn  | P          | S          | Cr | Mo   | Ni | N    |
|------------|-----------|-----|------------|------------|----|------|----|------|
| max. 0.020 | max. 0.40 | 1,7 | max. 0.015 | max. 0.015 | 25 | 2,15 | 22 | 0,12 |

## Size range

\*) Approval already obtained

## Mechanical properties at 20°C

| 0.2% proof stress<br>N/mm2 min. | 1% proof stress<br>N/mm2 min. | tensile strength<br>N/mm2 | elongation after fracture<br>(Lo=5do) % min. |
|---------------------------------|-------------------------------|---------------------------|----------------------------------------------|
| 255                             | 295                           | 540-740                   | 35                                           |

## Mechanical properties at elevated temperature in N/mm2

| Temperature °C    | 100 | 150 | 200 | 250 | 300 | 350 | 400 |
|-------------------|-----|-----|-----|-----|-----|-----|-----|
| 0.2% proof stress | 226 | 216 | 206 | 191 | 177 | 167 | 162 |
| 1% proof stress   | 255 | 235 | 226 | 216 | 206 | 196 | 182 |

## Physical properties

Specific gravity at 20°C .....795 g/cm<sup>3</sup>  
 Thermal conductivity at 20°C .....15W/mk  
 Specific heat at 20°C .....500 J/kg K  
 Modulus of elasticity at 20°C .....200000 N/mm<sup>2</sup>

Thermal expansion in 10 m/m °C ...  
 20 to 100°C .....16.5  
 20 to 200°C .....17.5  
 20 to 300°C .....18.5  
 20 to 400°C .....18.5

## Lengths available, finish and size range

The seamless tubes are supplied cold finished and hot finished.

The standard finish is in accordance with ASTM A 213, ASTM A 312 and DIN 2462 or DIN 2464.

Abbreviations according to DIN 17440

C2 .....hot finished, heat treated, pickled  
 h .....descaled, cold finished, heat treated, pickled  
 m .....descaled, cold finished, bright annealed

Tubes are supplied in random lengths, restricted lengths, multiple lengths, approximate lengths, fixed lengths and bent as U-tubes. The greatest lengths available are 30 m and differ according to grade, size and finish. Detailed information can be given upon request.



## Heat resisting Stainless steel Grades

### MATERIAL NUMBER 1.4713 – X 10 CRAL7

#### Composition in %:

| C        | Si        | Mn       | P         | S         | Cr        | Mo | Ni |
|----------|-----------|----------|-----------|-----------|-----------|----|----|
| Max.0,12 | 0,50-1,00 | max.1,00 | max.0,040 | max.0,030 | 6,00-8,00 |    |    |
| V        | W         | Ti       | Cu        | Al        | Nb        | B  | N  |
|          |           |          |           | 0,50-1,00 |           |    |    |

#### Range of application and heat treatment:

Stainless Steel: beams and pipes in the furnace making, mains cable and wiring components

soft annealing: 780-840°C

### MATERIAL NUMBER 1.4724 – X10 CRAL 13

#### Composition in %:

| C        | Si        | Mn       | P         | S         | Cr          | Mo | Ni |
|----------|-----------|----------|-----------|-----------|-------------|----|----|
| max.0,12 | 0,70-1,40 | max.1,00 | max.0,040 | max.0,030 | 12,00-14,00 |    |    |
| V        | W         | Ti       | Cu        | Al        | Nb          | B  | N  |
|          |           |          |           | 0,70-1,20 |             |    |    |

#### Range of application and heat treatment:

Stainless steel: stove-and boiler engineering, mains cable and wiring ropes

Soft annealing: 800-860°C

### MATERIAL NUMBER 1.4762 – X 10 CRAL 24

#### Composition in %:

| C        | Si        | Mn       | P         | S         | Cr          | Mo | Ni |
|----------|-----------|----------|-----------|-----------|-------------|----|----|
| Max.0,12 | 0,70-1,40 | max.1,00 | max.0,040 | max.0,030 | 23,00-26,00 |    |    |
| V        | W         | Ti       | Cu        | Al        | Nb          | B  | N  |
|          |           |          |           | 1,20-1,70 |             |    |    |

#### Range of application and heat treatment:

Heat resisting steel: components for high temperatures at lower mechanical load, convector

Soft annealing: 800-860°



## MATERIAL NUMBER 1.4742 – X 10 CRAL 18

| C        | Si        | Mn       | P         | S         | Cr          | Mo | Ni |
|----------|-----------|----------|-----------|-----------|-------------|----|----|
| max.0,12 | 0,70-1,40 | max.1,00 | max.0,040 | max.0,030 | 17,00-19,00 |    |    |
| V        | W         | Ti       | Cu        | Al        | Nb          | B  | N  |
|          |           |          |           | 0,70-1,20 |             |    |    |

**Composition in %:**

**Range of application and heat treatment:**

Heat resisting steel: stove accessories, annealing tubes, annealing pots

Soft annealing: 800-860°C

## MATERIAL NUMBER 1.4828 – X 15 CRNISI 20-12

| C        | Si        | Mn       | P         | S         | Cr          | Mo | Ni          |
|----------|-----------|----------|-----------|-----------|-------------|----|-------------|
| Max.0,20 | 1,50-2,50 | max.2,00 | max.0,045 | max.0,030 | 19,00-21,00 |    | 11,00-13,00 |
| V        | W         | Ti       | Cu        | Al        | Nb          | B  | N           |
|          |           |          |           |           |             |    |             |

**Composition in %:**

**Range of application and heat treatment:**

Heat resisting steel: stove-and apparatus construction, beams, plates, annealing bells

Solution annealing: 1050-1150°C

## MATERIAL NUMBER 1.4841 – X 15 CRNISI 25-20

| C        | Si        | Mn       | P         | S         | Cr          | Mo | Ni          |
|----------|-----------|----------|-----------|-----------|-------------|----|-------------|
| max.0,20 | 1,50-2,50 | max.2,00 | max.0,045 | max.0,030 | 24,00-26,00 |    | 19,00-22,00 |
| V        | W         | Ti       | Cu        | Al        | Nb          | B  | N           |
|          |           |          |           |           |             |    |             |

**Composition in %:**

**Range of application and heat treatment:**

Heat resisting steel: heating conductor, burning baskets, suspensions

Solution annealing: 1050-1150 °C



# Heat resisting Stainless steel Grades

## Properties, applications and processing

1.4713 is the standard grade of heat resisting steel used in furnace building and construction.

## High temperature corrosion resistance

1.4713 is resistant to oxidising sulphur bearing gases and is also resistant to carburisation. This grade of steel is resistant to scaling in air up to temperatures of 800°C. Only limited resistance to nitrogen containing and oxygen denuded gasses is to be expected.

## Heat treatment / mechanical properties

Optimal material properties are realised after solution annealing by holding in the temperature range 780-840°C, followed by rapid cooling in air or water. In this condition the following mechanical properties can be expected:

| Property                              | Specification | Typical |
|---------------------------------------|---------------|---------|
| yield strength (N/mm <sup>2</sup> )   | Rp0,2: ≥250   | 310     |
| tensile strength (N/mm <sup>2</sup> ) | Rm: 450-600   | 490     |
| hardness                              | HB: ≤200      |         |

## Welding

1.4713 is weldable using all usual welding processes with preheating to a temperature between 200 and 300°C, being recommended. Low heat inputs should be used when welding to reduce any possible grain coarsening. Although post weld heat treatment is not necessary, a stress relief treatment is sometime performed in the temperature range 650 to 750°C.

1.4502 and 1.4551 are suitable for use as filler materials when welding 1.4713.

## Forging

Forging is usually performed at 800-1150°C followed by rapid cooling in air or water. Generally, forging is followed by the heat treatment described previously. Post forging heat treatment may not be necessary if the temperature of the final forging pass is above 900°C and the forged components are then allowed to cool slowly in a closed box.

## Machining properties

Ferritic stainless steels such as 1.4713 tend to smear during machining which results in the formation of longer swarf which makes machining difficult and creates extreme difficulty during automated machining. When machining this grade of steel with coated hard metal cutting / machining tools, the following machining parameters can be used as a guideline:

|                                              | depth of cut (mm)<br>feed (mm/rev) |                  |                  |
|----------------------------------------------|------------------------------------|------------------|------------------|
| tensile strengths<br>Rm in N/mm <sup>2</sup> | 6 mm<br>0,5 mm/r                   | 3 mm<br>0,4 mm/r | 1 mm<br>0,2 mm/r |
| solution annealed<br>(450-550)               | 160 m/min                          | 190 m/min        | 260 m/min        |



1.4724 is resistant to oxidising sulphur bearing gases and displays somewhat less, but still good, resistance to sulphur bearing gasses in reducing environments. 1.4724 displays poor resistance to carburising gasses, and is also not resistant to high temperature nitriding, oxygen denuded gasses. This grade of steel is resistant to scaling in air up to temperatures of 850°C.

## Heat treatment / mechanical properties

Optimal material properties are realised after annealing by holding in the temperature range 800-860°C, followed by rapid cooling in air or water. In this condition the following mechanical properties can be expected when testing in the longitudinal direction at room temperature:

| Property                              | Specification | Typical |
|---------------------------------------|---------------|---------|
| yield strength (N/mm <sup>2</sup> )   | Rp0,2: ≥250   | 360     |
| tensile strength (N/mm <sup>2</sup> ) | Rm: 450-650   | 510     |
| tensile elongation (%)                | A5: ≥15       | 18      |
| hardness                              | HB: ≤192      |         |

A slight tendency for grain growth and embrittlement exists at above temperatures of 950°C. It must be noted that any properties that are adversely affected by grain coarsening occurs cannot be recovered by simple thermal treatments.

The moderate chromium content and fully ferritic microstructure of this steel makes it susceptible to 475 embrittlement when held at temperatures within the range

400 to 550°C. Slow heating or cooling through this temperature range should thus be avoided. The effects of 475 embrittlement can be reversed by briefly heating to within the temperature range 700 to 800°C. This steel is also susceptible to embrittlement by sigma phase formation within the temperature range 600 to 800°C over long periods of time. The effects of sigma phase formation may be reversed by heating to above 1050°C to take all of the sigma phase into solution again.

When heat treatment is performed in a continuous furnace, the upper temperature must be aimed for and in some cases can even be exceeded.

## Welding

1.4724 is weldable using all usual welding processes with preheating to a temperature between 200 and 300°C, being recommended. Low heat inputs should be used when welding to reduce any possible grain coarsening effects. Although post weld heat treatment is not necessary, a stress relief treatment is sometimes performed in the temperature range 750 to 800°C, followed by air cooling, when large differences in cross-section exist and/or when the components have been extensively cold worked.

1.4723, 1.4820 and 1.4829 are all suitable for use as filler material when welding 1.4724.

## Elevated temperature properties

Due to the much poorer high temperature mechanical properties of 1.4724 compared to the heat resistant austenitic grades, this steel can be used in applications where the high temperature mechanical requirements are not too great.

## Forging

Forging is usually performed at 1150-800°C followed by rapid cooling in air or water. Generally, forging is followed by the heat treatment described previously.

## Machining properties

Ferritic stainless steels such as 1.4724 tend to smear during machining which results in the formation of longer swarf thereby making machining difficult. When machining this grade of steel with coated hard metal cutting/machining tools, the following machining parameters can be used as a guideline:

|                                              | depth of cut (mm) feed (mm/rev) |                  |                  |
|----------------------------------------------|---------------------------------|------------------|------------------|
| tensile strengths<br>Rm in N/mm <sup>2</sup> | 6 mm<br>0,5 mm/r                | 3 mm<br>0,4 mm/r | 1 mm<br>0,2 mm/r |
| solution annealed (450-550)                  | 140 m/min                       | 170 m/min        | 240 m/min        |





# Heat resisting Stainless steel Grades

## High temperature corrosion resistance

1.4742 is highly resistant to oxidising sulphur bearing gases and displays somewhat less, but still good, resistance to sulphur bearing gasses in reducing environments. 1.4742 is moderately resistant to carburising gasses, but is not resistant to high temperature nitriding or oxygen denuded gasses. This grade of steel is resistant to scaling in air up to temperatures of 1000°C.

## Heat treatment / mechanical properties

Optimal material properties are realised after annealing by holding in the temperature range 800 – 860°C \*, followed by rapid cooling in air or water. In this condition the following mechanical properties can be expected when testing in the longitudinal direction at room temperature:

| Property                              | Specification | Typical |
|---------------------------------------|---------------|---------|
| yield strength (N/mm <sup>2</sup> )   | Rp0,2: ≥ 270  | 370     |
| tensile strength (N/mm <sup>2</sup> ) | Rm: 500 – 700 | 580     |
| tensile elongation (%)                | A5: ≥15       | 18      |
| hardness                              | HB: ≤ 212     |         |

The high chromium content and fully ferritic microstructure of this steel makes it susceptible to 475 embrittlement when held at temperatures within the range 400 to 550°C. Slow heating or cooling through this temperature range should thus be avoided. The effects of 475 embrittlement can be reversed by briefly heating to within the temperature range 700 to 800 °C. Due to the high chromium content of this steel, it is susceptible to embrittlement by sigma phase formation within the temperature range 600 to 800°C. The effects of sigma phase formation may be reversed by heating to above 1050°C to take all of the sigma phase into solution again.

A slight tendency for grain growth and embrittlement exists at above temperatures of 950°C. It must be noted that any properties that are adversely affected by grain coarsening occurs cannot be recovered by simple thermal treatments.

\* When heat treatment is performed in a continuous furnace, the upper temperature must be aimed for and in some cases can even be exceeded.

## Welding

1.4742 is weldable using all usual welding processes with preheating to a temperature between 200 and 300°C, being recommended. Low heat inputs should be used when welding to reduce any possible grain coarsening. Although post weld heat treatment is not necessary, a stress relief treatment is sometimes performed in the temperature range 650 to 800°C when large differences in cross-section exist and/or when the components have been extensively cold worked.

If an austenitic filler metal is used and the component is destined for use in either a sulphur containing or carburising environment, then the austenitic weld bead must be over-laid with a ferritic weld run to ensure some resistance to the operational environment.

1.4820 is suitable for use as a filler material when welding 1.4742.

## Elevated temperature properties

Due to the much poorer high temperature mechanical properties of 1.4742, compared to the heat resistant austenitic grades, this steel can only be used in applications where the high temperature mechanical requirements are not too great.

## Forging

Forging is usually performed at 1150 – 800°C followed by rapid cooling in air or water. Generally, forging is followed by the heat treatment described previously.

## Machining properties

Ferritic stainless steels such as 1.4742 tend to smear during machining which results in the formation of longer swarf thereby making machining difficult. When machining this grade of steel with coated hard metal cutting/machining tools, the following machining parameters can be used as a guideline:

|                                              | depth of cut (mm) feed (mm/rev) |                  |                  |
|----------------------------------------------|---------------------------------|------------------|------------------|
| tensile strengths<br>Rm in N/mm <sup>2</sup> | 6 mm<br>0.5 mm/r                | 3 mm<br>0.4 mm/r | 1 mm<br>0.2 mm/r |
| solution annealed (550 – 650)                | 100 m/min                       | 130 m/min        | 150 m/min        |

## General comments

1.4742 is less formable than the austenitic grades and is best formed within the temperature range 600 to 800°C, especially when the cross section is greater than 3 mm.



1.4828 is a standard steel grade used for the fabrication of furnace furniture and other high temperature components. Compared with 1.4878 and 1.4713, 4828 exhibits superior resistance to scaling. Due to its high tensile strength at elevated temperatures, compared with other grades, 4828 is ideally suited for applications where a greater emphasis is placed on mechanical property requirements.

## High temperature corrosion resistance

1.4828 has a low resistance to oxidising and reducing sulphur bearing gases. In these gasses, the use of 1.4828 is generally limited to temperatures below 650°C. The resistance to carburising (up to 900°C) and to nitrogen bearing, oxygen depleted gases is average.

| Property                                | Specification     | Typical |
|-----------------------------------------|-------------------|---------|
| - yield strength (N/mm <sup>2</sup> )   | Rp0,2: $\geq 230$ | 400     |
| - tensile strength (N/mm <sup>2</sup> ) | Rm: 550 – 750     | 675     |
| - tensile elongation (%)                | A5: $\geq 30$     | 45      |
| - hardness                              | HB: $\leq 223$    |         |

## Heat treatment/mechanical properties

Optimal material properties are realised after solution annealing in the temperature range 1050 – 1150°C followed by rapid cooling in air or water. During operation and fabrication, the time spent in the temperature range 550 – 900°C must be minimised to avoid embrittlement, resulting from both chromium carbide precipitation and sigma phase formation. This embrittlement effect can be reversed by solution annealing the steel at a temperature in the range 1050 to 1100°C.

In the solution annealed condition the following mechanical properties may be attained when testing in the longitudinal direction at room temperature.

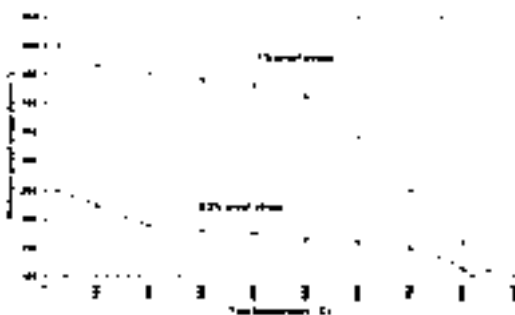
## Welding

4828 is weldable using all usual welding processes with no preheating being required. Low heat inputs should be used when welding, and post weld heat treatment is not necessary. 1.4829 and 4842 are suitable for use as filler materials when welding 4828.

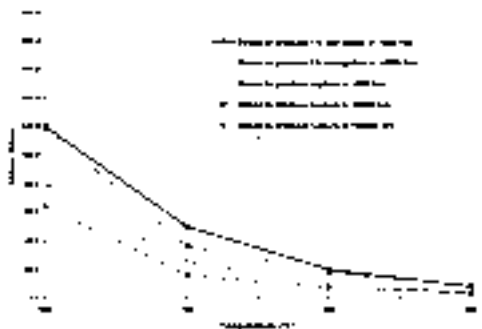
Forging is usually performed at 1150 – 800°C followed by rapid cooling in air or water.

## Elevated temperature properties

The following minimum tensile properties at various temperatures are what can be typically expected of this grade of steel.



The temperature-stress-time relationships that are important for 1.4828 from a creep point of view are presented in the graph below:



## Machining properties:

The formation of carbides in 1.4828 will result in increased wear of cutting tools. In addition to this, rapid work hardening and poor thermal conductivity require the use of adequate cooling and good quality cutting/machining tools. It is thus recommended that machining is performed in the solution annealed condition using coated hard metal cutting/machining tools and the following machining parameters as a guideline.

|                                              | depth of cut (mm) feed (mm/rev) |                  |                  |
|----------------------------------------------|---------------------------------|------------------|------------------|
| tensile strengths<br>Rm in N/mm <sup>2</sup> | 6 mm<br>0.5 mm/r                | 3 mm<br>0.4 mm/r | 1 mm<br>0.2 mm/r |
| solution annealed (550 – 625)                | 100 m/min                       | 130 m/min        | 150 m/min        |



## Comparison of International Non Ferrous Standards

| Group                    | DIN code        | DIN material no. | EN code          | EN material no. |
|--------------------------|-----------------|------------------|------------------|-----------------|
| Copper                   | OF-Cu           | 2.0040           | Cu-OF            | CW008A          |
|                          | SE-Cu           | 2.0070           | Cu-PHC/Cu-HPC    | CW020A/021A     |
|                          | SF-Cu           | 2.0090           | Cu-DHP           | CW024A          |
|                          | E-Cu 58         | 2.0060           | Cu-ETP/FRHC      | CW004A/005A     |
| Low Alloy Copper         | CuCrZr          | 2.1293           | CuCr1Zr          | CW106C          |
| Copper-Zinc Alloy        | CuZn5           | 2.0220           | CuZn5            | CW500L          |
|                          | CuZn10          | 2.0230           | CuZn10           | CW501L          |
|                          | CuZn15          | 2.0240           | CuZn15           | CW502L          |
|                          | CuZn20          | 2.0250           | CuZn20           | CW503L          |
|                          | CuZn28          | 2.0260           | CuZn28           | CW504L          |
|                          | CuZn30/33       | 2.0265/2.0280    | CuZn30/33        | CW505/506L      |
|                          | CuZn36          | 2.0335           | CuZn36           | CW507L          |
|                          | CuZn37          | 2.0321           | CuZn37           | CW508L          |
|                          | CuZn40          | 2.0360           | CuZn40           | CW509L          |
|                          | CuZn37Pb0.5     | 2.0332           | CuZn37Pb0.5      | CW604N          |
|                          | CuZn36Pb1.5     | 2.0331           | CuZn35Pb1        | CW600N          |
|                          | CuZn38Pb1.5     | 2.0371           | CuZn38Pb1        | CW607N          |
|                          | CuZn39Pb0.5     | 2.0372           | CuZn39Pb0.5      | CW610N          |
|                          | CuZn36Pb3       | 2.0375           | CuZn36Pb3        | CW603N          |
|                          | CuZn39Pb2       | 2.0380           | CuZn39Pb2        | CW612N          |
|                          | CuZn40Pb2       | 2.0402           | CuZn40Pb2        | CW617N          |
|                          | CuZn39Pb3       | 2.0401           | CuZn39Pb3        | CW614N          |
|                          | n.V.            |                  | CuZn36Pb2As      | CW602N          |
|                          | CuZn44Pb2       | 2.0410           | CuZn43Pb2        | CW623N          |
|                          | CuZn28Sn1       | 2.0470           | CuZn28Sn1As      | CW706R          |
|                          | CuZn31Si1       | 2.0490           | CuZn31Si1        | CW708R          |
|                          | CuZn35Ni2       | 2.0540           | CuZn35Ni3Mn2AlPb | CW710R          |
|                          | CuZn37Al1       | 2.0510           | CuZn38Mn1Al      | CW716R          |
|                          | CuZn40Mn2       | 2.0572           | CuZn40Mn2Fe1     | CW723R          |
|                          | CuZn40Al2       | 2.0550           | CuZn37Mn3Al2SiPb | CW713R          |
|                          | CuZn20Al2       | 2.0460           | CuZn20Al2As      | CW720R          |
| Copper-Tin Alloy         | CuSn4           | 2.1016           | CuSn4            | CW450K          |
|                          | CuSn6           | 2.1020           | CuSn6            | CW452K          |
|                          | CuSn8           | 2.1030           | CuSn8            | CW453K          |
|                          | CuSn6Zn6        | 2.1080           | n.V.             | n.V.            |
| Copper-Nickel Zinc-Alloy | CuNi12Zn24      | 2.0730           | CuNi12Zn24       | CW403J          |
|                          | CuNi18Zn27      | 2.0742           | CuNi18Zn27       | CW410J          |
|                          | CuNi18Zn20      | 2.0740           | CuNi18Zn20       | CW409J          |
|                          | CuNi7Zn39Mn5Pb3 | 2.0771           | n.V.             | n.V.            |
|                          | CuNi12Zn30Pb1   | 2.0780           | CuNi12Zn30Pb1    | CW406J          |
|                          | CuNi18Zn19Pb1   | 2.0790           | CuNi18Zn19Pb1    | CW408J          |
| Copper-Nickel Alloy      | CuNi10Fe1Mn     | 2.0872           | CuNi10Fe1Mn      | CW325H          |
|                          | CuNi30Mn1Fe     | 2.0882           | CuNi30Mn1Fe      | CW354H          |
|                          | CuNi9Sn2        | 2.0875           | CuNi9Sn2         | CW351H          |
| Continuous Cast          | GC-CuSn7ZnPb    | 2.1090           | CuSn7Zn4Pb7-C-GC | CC 493K         |
|                          | GC-CuSn12       | 2.1052           | CuSn12-C-GC      | CC 483K         |
|                          | GC-CuPb10Sn     | 2.1176           | CuSn10Pb10-C-GC  | CC 495K         |
|                          | GC-CuPb15Sn     | 2.1182           | CuSn7Pb15-C-GC   | CC 496K         |
|                          | GC-CuSn12Pb     | 2.1061           | CuSn11Pb2-C-GC   | CC 482K         |
|                          | GC-CuSn12Ni     | 2.1060           | CuSn12Ni2-C-GC   | CC 484K         |



| Codes:<br>Germany | US                                   | GB                 | France                    | International                 |
|-------------------|--------------------------------------|--------------------|---------------------------|-------------------------------|
| DIN 1787          | ASTM B 224                           | BS 6017            | NF A 51-050<br>NF A51-108 | ISO 431-1981<br>ISO 1337-1980 |
| E-Cu 57           | C11000/ETP                           | C 101/Cu-ETP-2     | Cu al                     | Cu-EPT                        |
| E-Cu 58           | C 10300/OXXLP                        | C 102/Cu OF        | Cu-pl                     | Cu-HCP                        |
| SE-Cu             | C 012200/DHP                         | C 106/Cu-DHP       | Cu-bl                     |                               |
| SF-Cu             | C 12000/DLP                          |                    | Cu-b2                     |                               |
| CuZn5             | B36,134,587,642<br>C21000            | 2870/2875<br>CZ125 | A51-101/103<br>CuZn5      | CuZn5                         |
| Cu Zn 10          | B 36130,131,134<br>135,587 C 22000   | CZ 101             | CuZn10                    | Cu Zn 10                      |
| Cu Zn 15          | B36,43,111,135,<br>359, 587 C23000   | CZ 102             | CuZn15                    | Cu Zn 15                      |
| Cu Zn 20          | B 36,134C 24000                      | CZ 103             | Cu Zn20                   | Cu Zn 20                      |
| Cu Zn 28          |                                      |                    |                           |                               |
| Cu Zn 30          | B 19 36,134,135,<br>569, 587 C 26000 | CZ 106             | Cu Zn 30                  | Cu Zn 30                      |
| Cu Zn 33          | B 36, 587 C 26800                    | CZ 107             | Cu Zn 33                  | Cu Zn 33                      |
| Cu Zn 36          | B 36 134,135,587<br>C 27000          |                    | Cu Zn 36                  |                               |
| Cu Zn 37          | B36, 134,135,587<br>C 27400 C 27200  | CZ 108             |                           | Cu Zn 37                      |
| Cu Zn 40          | B111,135 C28000                      | CZ 109             | Cu Zn40                   | Cu Zn 40                      |
| Cu Zn 36 Pb 1.5   | B 453<br>C34500,C34700               | CZ 119<br>CZ 118   | Cz Zn 35 Pb2              | Cu Zn 35 Pb2<br>Cu Zn 36 Pb 1 |
| Cu Zn 37 Pb 0.5   | C 34900, C 34800                     |                    |                           |                               |
| Cu Zn 36 Pb 3     | B 16,121,453<br>C 36000,C 35600      | CZ 124             | Cu Zn 36 Pb 3             | Cu Zn 36 Pb 3                 |
| Cu Zn 38 Pb 1.5   | B 135 C 35300<br>C37000              | CZ 128             | Cu Zn 38 Pb2              | Cu Zn 38 Pb 2                 |
| Cu Zn 39 Pb 0.5   | B 171 C 36500                        | CZ 123             |                           | Cu Zn 40 Pb                   |
| Cu Zn 39 Pb 2     | B 124, 283<br>C37700                 | CZ 120             | Cu Zn 39 Pb2              | Cu Zn 39 Pb 2                 |
| Cu Zn 39 Pb 3     | B455 C 38500                         | CZ 121             | Cu Zn 40 Pb3              | Cu Zn 40 Pb 3                 |
| Cz Zn 40 Pb 2     | B455 C 38000                         | CZ 122             | Cu Zn 39 Pb 2             | Cu Zn 39 Pb 2                 |
| Cu Zn 44 Pb 2     |                                      | CZ 130             |                           | Cu Zn 43 Pb 2                 |
| Cu Zn 20 Al       | B 111, 359,395<br>C68700             | CZ 110             | Cu Zn 22 Al 2             | Cu Zn 22 Al 2                 |
| Cu Zn 28 Sn       | B111,171,359,395,543C<br>44300       | CZ 111             | Cu Zn 29 Sn 1             | Cu Zn 28 Sn 1                 |
| Cu Zn 31 Si       | C 69800                              |                    |                           |                               |
| Cu Zn35 Ni        |                                      |                    |                           |                               |
| Cu Zn 39 Sn       | B 21,124,171,283<br>C46400           | CZ112,113          |                           | Cu Zn 38 Sn 1                 |
| Cu Zn 40 Al 1     |                                      | CZ 114             |                           | Cu Zn 39 Al<br>FeMn           |
| Cu Zn 40 Al 2     | C 67400                              | CZ 114             |                           |                               |
| Cu Zn 40 Ni       |                                      |                    |                           |                               |
| Cu Zn 40 Mn       |                                      |                    |                           |                               |
| Cu Zn 40 MnPb     |                                      | CZ 115             |                           |                               |
| Cu Sn 4           | B 100,103 C51100                     | PB 101             | Cu Sn 4 P                 | Cu Sn 4                       |
| Cu Sn 6           | C 51900                              | PB 103             | Cu Sn 6 P                 | Cu Sn 6                       |
| Cu Sn 8           | B 103,139,159<br>C52100              | PB 104             | Cu Sn 8 P                 | Cu Sn 8                       |
| Cu Sn 6 Zn 6      |                                      |                    |                           |                               |



# Comparison table

## ALUMINIUM

| European<br>EN 573             | Germany<br>DIN | Great Britain<br>BS | France | Italy<br>UNI |        | USA<br>ASTM | Japan<br>JIS | AA    |
|--------------------------------|----------------|---------------------|--------|--------------|--------|-------------|--------------|-------|
|                                |                |                     |        | Hold         | New    |             |              |       |
| EN AW-1080A<br>(Al 99.8 (A))   | Al99.8         | 1080A               | 1080A  | 4509         | 9001/4 | A1080       | A1080        | 1080A |
| EN AW-1070A<br>(Al 99.7)       | Al99.7         |                     | 1070A  | 4508         | 9001/3 | 1070A       | A1070        | 1070A |
| EN AW-1050A<br>(Al 99.5)       | Al99.5         | 1050A               | 1050A  | 4507         | 9001/2 | 1050A       | A1050        | 1050A |
| EN AW-1200<br>(Al 99.0)        | Al99           | 1200                | 1200   | 3567         | 9001/1 | 1200        | A1200        | 1200  |
| EN AW-1100<br>(Al 99.0Cu)      |                |                     | 1100   |              |        | 1100        | A1100        | 1100  |
| EN AW-2011<br>(Al Cu6BiPb)     | Al Cu6BiPb     | 2011                | 2011   | 6362         | 9002/5 | 2011        | A2011        | 2011  |
| EN AW-2014<br>(Al Cu4SiMg)     | AlCuSiMn       | 2014A               | 2014   | 3581         | 9002/3 | 2014        | A2014        | 2014  |
| EN AW-2017A<br>(Al Cu4MqSi(A)) | AlCuMg1        | 2017A               | 2017A  | 3579         | 9002/2 | 2017A       | A2017        | 2017  |
| EN AW-2618A<br>(Al Cu2Mg1.5Ni) |                | 2618A               | 2618A  | 7250         |        | 2618A       |              | 2618A |
| EN AW-2024<br>(Al Cu4Mq1)      | AlCuMg2        | 2024                | 2024   | 3583         | 9002/4 | 2024        | A2024        | 2024  |
| EN AW-2030<br>(Al Cu4PbMg)     | AlCuMqPb       |                     | 2030   |              |        | 2030        |              | 2030  |
| EN AW-3003<br>(Al Mn Cu)       | AlMnCu         | 3103                | 3003   | 7788         | 9003/1 | 3003        | A3003        | 3003  |
| EN AW-3004<br>(Al Mn1 Mg1)     | AlMn1Mq1       |                     | 3004   | 6361         | 9003/2 | 3004        | A3004        | 3004  |
| EN AW-3005<br>(Al Mn1Mq0.5)    | AlMn1Mg0.5     |                     | 3005   |              | 9003/4 | 3005        | A3005        | 3005  |
| EN AW-3105<br>(Al Mn0.5Mg0.5)  | AlMn0.5Mq0.5   | 3105                | 3105   | 3103         |        |             |              |       |
| EN AW-5005<br>(Al Mq1(B))      | AlMg1          | 5005                | 5005   | 5764         | 9005/1 | 5005        | A5005        | 5005  |
| EN AW-5049<br>(Al Mg2.5Mn0.8)  | AlMq2Mn0.8     |                     | 5049   |              |        | 5049        |              | 5049  |

# Comparison table

## ALUMINIUM



| European<br>EN 573            | Germany<br>DIN | Great Britain<br>BS | France | Italy<br>UNI |        | USA<br>ASTM | Japan<br>JIS | AA    |
|-------------------------------|----------------|---------------------|--------|--------------|--------|-------------|--------------|-------|
|                               |                |                     |        | Hold         | New    |             |              |       |
| EN AW-5251<br>(Al Mg2)        | AlMg2Mn0.3     | 5251                | 5251   | 4511         | 5251   |             | 5251         |       |
| EN AW-5052<br>(Al Mg2.5)      | AlMg2.5        |                     | 5052   | 3574         | 9005/2 | 5052        | A5052        | 5052  |
| EN AW-5454<br>(Al Mg3Mn)      | AlMg2.7Mn      | 5454                | 5454   | 7789         | 9005/3 | 5454        | A5454        | 5454  |
| EN AW-5754<br>(Al Mg3)        | AlMg3          |                     | 5754   |              |        | 5754        |              | 5754  |
| EN AW-5356<br>(Al Mg5Cr(A))   | AlMg5          | 3576                | 5356   |              |        | 5356        |              |       |
| EN AW-5182<br>(Al Mg4.5Mn0.4) | AlMg5Mn        |                     | 5182   |              |        | 5182        |              | 5182  |
| EN AW-5083                    | AlMg4.5Mn      | 5083                | 5083   | 7790         | 9004/5 | 5083        | A5083        | 5083  |
| EN AW-5086<br>(Al Mg4)        | AlMg4Mn        |                     | 5086   | 5452         | 9005/4 | 5086        | A5086        | 5086  |
| EN AW-6005A<br>(Al MgSi(A))   | AlMgSi0.7      |                     | 6005A  |              | 9006/6 | 6005A       |              | 6005A |
| EN AW-6060<br>(Al Mg Si)      | AlMgSi0.5      | 6063                | 6060   | 3569         | 9006/1 | 6060        |              | 6060  |
| EN AW-6061<br>(Al Mg1SiCu)    | AlMg1SiCu      | 6061                | 6061   | 6170         | 9006/2 | 6061        | A6061        | 6061  |
| EN AW-6082<br>(Al Si MgMn)    | AlMgSi1        | 6082                | 6082   | 3571         | 9006/4 | 6082        |              | 6082  |
| EN AW-7020<br>(AlZn4.5Mg1)    | AlZn4.5Mg1     | 7020                | 7020   | 7791         | 9009/1 | 7020        | 7020         |       |
| EN AW-7049A<br>(Al Zn)        |                |                     | 7049A  |              |        | 7049A       |              |       |
| EN AW-7075<br>(Al Zn5.5MgCu)  | AlZnMgCu1.5    | 7075                | 7075   | 3735         | 9007/2 | 7075        | A7075        | 7075  |
| EN AW-8011<br>(Al FeSi)       |                |                     | 8011   |              | 8011   |             |              | 8011  |

Equivalence only. Composition not always identical for each standard.



# Changed designation of temper for sheets and plates

## Alloy

| Earlier<br>Temper | 1050 A<br>Al99.5 | 3103<br>AlMn1 | 5052<br>AlMg2.5 | 5754<br>AlMg3 | 5083<br>AlMg4.5Mn |
|-------------------|------------------|---------------|-----------------|---------------|-------------------|
| W7                | 0/H111           | —             | —               | —             | —                 |
| F8                | H112             | —             | —               | —             | —                 |
| W9                | —                | 0/H111        | —               | —             | —                 |
| F9                | H12              | —             | —               | —             | —                 |
| G9                | H22              | —             | —               | —             | —                 |
| G11               | H24              | —             | —               | —             | —                 |
| F11               | H14              | —             | —               | —             | —                 |
| F12               | —                | H12           | —               | —             | —                 |
| G13               | H26              | —             | —               | —             | —                 |
| F13               | H16              | —             | —               | —             | —                 |
| F14               | —                | H14           | —               | —             | —                 |
| F15               | H19              | —             | —               | —             | —                 |
| W17               | —                | —             | 0/H111          | —             | —                 |
| F17               | —                | H16           | —               | —             | —                 |
| W19               | —                | —             | —               | 0/H111        | —                 |
| F19               | —                | —             | —               | H112          | —                 |
| F20               | —                | —             | —               | H112          | —                 |
| F21               | —                | H18           | H12             | H112          | —                 |
| G21               | —                | —             | H22             | —             | —                 |
| F22               | —                | —             | —               | H12           | —                 |
| G22               | —                | —             | —               | H22           | —                 |
| F23               | —                | —             | H14             | —             | —                 |
| G23               | —                | —             | H24             | —             | —                 |
| F24               | —                | —             | —               | H14           | —                 |
| G24               | —                | —             | —               | H24           | —                 |
| F25               | —                | —             | H16             | —             | —                 |
| G25               | —                | —             | H26             | —             | —                 |
| F27               | —                | —             | H18             | H16           | —                 |
| G27               | —                | —             | H28             | H26           | —                 |
| W28               | —                | —             | —               | —             | 0/H111            |
| F28               | —                | —             | —               | —             | H112              |
| F29               | —                | —             | —               | H18           | —                 |
| G31               | —                | —             | —               | —             | H22               |
| G35               | —                | —             | —               | —             | H24               |

# Line Pipes for Low Temperature Service

ASTM-A333/SEAMLESS AND WELDED



## Chemical Composition

| Element         | Composition % |           |           |           |           |           |           |           |           |
|-----------------|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                 | Grade 1       | Grade 3   | Grade 4   | Grade 6   | Grade 7   | Grade 8   | Grade 9   | Grade 10  | Grade 11  |
| Carbon, max.    | 0.30          | 0.19      | 0.12      | 0.30      | 0.19      | 0.13      | 0.20      | 0.20      | 0.10      |
| Manganese       | 0.40-1.06     | 0.31-0.64 | 0.50-1.05 | 0.29-1.06 | 0.90 max  | 0.90 max  | 0.40-1.06 | 1.15-1.50 | 0.60 max  |
| Phosphorus, max | 0.025         | 0.025     | 0.025     | 0.025     | 0.025     | 0.025     | 0.025     | 0.035     | 0.025     |
| Sulfur, max     | 0.025         | 0.025     | 0.025     | 0.025     | 0.025     | 0.025     | 0.025     | 0.015     | 0.025     |
| Silicon         | -             | 0.18-0.37 | 0.08-0.37 | 0.10 min  | 0.13-0.32 | 0.13-0.32 | -         | 0.10-0.35 | 0.35 max  |
| Nickel          | -             | 3.18-3.82 | 0.47-0.98 | -         | 2.03-2.57 | 8.40-9.60 | 1.60-2.24 | 0.25 max  | 35.0-37.0 |
| Chromium        | -             | -         | 0.44-1.01 | -         | -         | -         | -         | 0.15 max  | 0.50 max  |
| Copper          | -             | -         | 0.40-0.75 | -         | -         | -         | 0.75-1.25 | 0.15 max  | -         |
| Aluminium       | -             | -         | 0.04-0.30 | -         | -         | -         | -         | 0.06 max  | -         |
| Vanadium, max   | -             | -         | -         | -         | -         | -         | -         | 0.12      | -         |
| Columbium, max  | -             | -         | -         | -         | -         | -         | -         | 0.05      | -         |
| Molybdenum, max | -             | -         | -         | -         | -         | -         | -         | 0.05      | 0.50 max  |
| Cobalt          | -             | -         | -         | -         | -         | -         | -         | -         | 0.50 max  |

## Tensile Requirement

|                                                                                                                                                                                    | Grade 1           |                 | Grade 3           |                 | Grade 4           |                 | Grade 6           |                 | Grade 7           |                 | Grade 8           |                 | Grade 9           |                 | Grade 10          |                 | Grade 11          |     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------|-------------------|-----------------|-------------------|-----------------|-------------------|-----------------|-------------------|-----------------|-------------------|-----------------|-------------------|-----------------|-------------------|-----------------|-------------------|-----|
|                                                                                                                                                                                    | psi               | MPa             | psi               | MPa             | psi               | MPa             | psi               | MPa             | psi               | MPa             | psi               | MPa             | psi               | MPa             | psi               | MPa             | psi               | Mpa |
| Tensile strength, min                                                                                                                                                              | 55 000            | 380             | 65 000            | 450             | 60 000            | 415             | 60 000            | 415             | 65 000            | 450             | 100 000           | 690             | 63 000            | 435             | 80 000            | 550             | 65 000            | 450 |
| Yield strength, min                                                                                                                                                                | 30 000            | 205             | 35 000            | 240             | 35 000            | 240             | 35 000            | 240             | 35 000            | 240             | 75 000            | 515             | 46 000            | 315             | 65 000            | 450             | 35 000            | 240 |
|                                                                                                                                                                                    | Longi-<br>tudinal | Trans-<br>verse | Longi-<br>tudinal | Trans-<br>verse | Longi-<br>tudinal | Trans-<br>verse | Longi-<br>tudinal | Trans-<br>verse | Longi-<br>tudinal | Trans-<br>verse | Longi-<br>tudinal | Trans-<br>verse | Longi-<br>tudinal | Trans-<br>verse | Longi-<br>tudinal | Trans-<br>verse | Longi-<br>tudinal |     |
| Elongation in 2 in. or 50 mm, (or 4D), min. % Basic minimum elongation for walls 5/16 in. (8mm) and over in thickness, strip tests, and for all small sizes tested in full section | 35                | 25              | 30                | 20              | 30                | 16.5            | 30                | 16.5            | 30                | 22              | 22                | -               | 28                | -               | 22                | -               | 18A               |     |
| When standard round 2-in. or 50-mm gage-length or proportionally smaller size test specimen with the gage length equal to 4D (4 times the diameter) is used                        | 28                | 20              | 22                | 14              | 22                | 12              | 22                | 12              | 22                | 14              | 16                | -               | -                 | -               | 16                | -               | -                 |     |
| For strip tests, a deduction for each 1/32 in. (0.8 mm) decrease in wall thickness below 5/16 in. (8 mm) from the basic minimum elongation of the following percentage             | 1.75              | 1.25            | 1.50              | 1.00            | 1.50              | 1.00            | 1.50              | 1.00            | 1.50              | 1.00            | 1.25              | -               | 1.50              | -               | 1.25              | -               | -                 |     |





# Line Pipes for Low Temperature Service

ASTM-A333/SEAMLESS AND WELDED

## Tensile Requirements (continued)

| Wall Thickness |     | Elongation in 2 in. or 50 mm, min, %C |                 |                   |                 |                   |                 |                   |                 |                   |                 |                   |                 |                   |                 |                   |                 |
|----------------|-----|---------------------------------------|-----------------|-------------------|-----------------|-------------------|-----------------|-------------------|-----------------|-------------------|-----------------|-------------------|-----------------|-------------------|-----------------|-------------------|-----------------|
| in             | mm  | Grade 1                               |                 | Grade 3           |                 | Grade 4           |                 | Grade 6           |                 | Grade 7           |                 | Grade 8           |                 | Grade 9           |                 | Grade 10          |                 |
|                |     | Longi-<br>tudinal                     | Trans-<br>verse | Longi-<br>tudinal | Trans-<br>verse | Longi-<br>tudinal | Trans-<br>verse | Longi-<br>tudinal | Trans-<br>verse | Longi-<br>tudinal | Trans-<br>verse | Longi-<br>tudinal | Trans-<br>verse | Longi-<br>tudinal | Trans-<br>verse | Longi-<br>tudinal | Trans-<br>verse |
| 5/16 (0.312)   | 8   | 35                                    | 25              | 30                | 20              | 30                | 16              | 30                | 16              | 30                | 22              | 22                | -               | 28                | -               | 22                | -               |
| 9/32 (0.281)   | 7.2 | 33                                    | 24              | 28                | 19              | 28                | 15              | 28                | 15              | 28                | 21              | 21                | -               | 26                | -               | 21                | -               |
| 1/4 (0.250)    | 6.4 | 32                                    | 23              | 27                | 18              | 27                | 15              | 27                | 15              | 27                | 20              | 20                | -               | 25                | -               | 20                | -               |
| 7/32 (0.219)   | 5.6 | 30                                    | -               | 26                | -               | 26                | -               | 26                | -               | 26                | -               | 18                | -               | 24                | -               | 18                | -               |
| 3/16 (0.188)   | 4.8 | 28                                    | -               | 24                | -               | 24                | -               | 24                | -               | 24                | -               | 17                | -               | 22                | -               | 17                | -               |
| 5/32 (0.156)   | 4   | 26                                    | -               | 22                | -               | 22                | -               | 22                | -               | 22                | -               | 16                | -               | 20                | -               | 16                | -               |
| 1/8 (0.125)    | 3.2 | 25                                    | -               | 21                | -               | 21                | -               | 21                | -               | 21                | -               | 15                | -               | 19                | -               | 15                | -               |
| 3/32 (0.094)   | 2.4 | 23                                    | -               | 20                | -               | 20                | -               | 20                | -               | 20                | -               | 13                | -               | 18                | -               | 13                | -               |
| 1/16 (0.062)   | 1.6 | 21                                    | -               | 18                | -               | 18                | -               | 18                | -               | 18                | -               | 12                | -               | 16                | -               | 12                | -               |

| Grade    | Direction of Test | Equation                                  |
|----------|-------------------|-------------------------------------------|
| 1        | Longitudinal      | $E = 56t + 17.50$ ( $E = 2.19t + 17.50$ ) |
|          | Transverse        | $E = 40t + 12.50$ ( $E = 1.56t + 12.50$ ) |
| 3        | Longitudinal      | $E = 48t + 15.00$ ( $E = 1.87t + 15.00$ ) |
|          | Transverse        | $E = 32t + 10.00$ ( $E = 1.25t + 10.00$ ) |
| 4        | Longitudinal      | $E = 48t + 15.00$ ( $E = 1.87t + 15.00$ ) |
|          | Transverse        | $E = 32t + 6.50$ ( $E = 1.25t + 6.50$ )   |
| 6        | Longitudinal      | $E = 48t + 15.00$ ( $E = 1.87t + 15.00$ ) |
|          | Transverse        | $E = 32t + 6.50$ ( $E = 1.25t + 6.50$ )   |
| 7        | Longitudinal      | $E = 48t + 15.00$ ( $E = 1.87t + 15.00$ ) |
|          | Transverse        | $E = 32t + 11.00$ ( $E = 1.25t + 11.00$ ) |
| 8 and 10 | Longitudinal      | $E = 40t + 9.50$ ( $E = 1.56t + 9.50$ )   |
| 9        | Longitudinal      | $E = 48t + 13.00$ ( $E = 1.87t + 13.00$ ) |

Where

E = elongation in 2 in. or 50 mm, in %, and

t = actual thickness of specimen, in . (mm)

# Line Pipe Alloy Steel

## ASTM-A335/SEAMLESS



### Chemical Composition

| Grade | UNS Designation | Composition, % |                |            |            |           |             |            |                                                                                                                             |
|-------|-----------------|----------------|----------------|------------|------------|-----------|-------------|------------|-----------------------------------------------------------------------------------------------------------------------------|
|       |                 | Carbon         | Manganese max. | Phosphorus | Sulfur max | Silicon   | Chromium    | Molybdenum | Others                                                                                                                      |
| P1    | K11522          | 0.10-0.20      | 0.30-0.80      | 0.025      | 0.025      | 0.10-0.50 | —           | 0.44-0.65  | —                                                                                                                           |
| P2    | K11547          | 0.10-0.20      | 0.30-0.61      | 0.025      | 0.025      | 0.10-0.30 | 0.50-0.81   | 0.44-0.65  | —                                                                                                                           |
| P5    | K41545          | 0.15 max       | 0.30-0.60      | 0.025      | 0.025      | 0.50 max  | 4.00-6.00   | 0.45-0.65  | —                                                                                                                           |
| P5b   | K51545          | 0.15 max       | 0.30-0.60      | 0.025      | 0.025      | 1.00-2.00 | 4.00-6.00   | 0.45-0.65  | —                                                                                                                           |
| P5c   | K41245          | 0.12 max       | 0.30-0.60      | 0.025      | 0.025      | 0.50 max  | 4.00-6.00   | 0.45-0.65  | —                                                                                                                           |
| P9    | S50400          | 0.15 max       | 0.30-0.60      | 0.025      | 0.025      | 0.25-1.00 | 8.00-10.00  | 0.90-1.10  | —                                                                                                                           |
| P11   | K11597          | 0.05-0.15      | 0.30-0.60      | 0.025      | 0.025      | 0.50-1.00 | 1.00-1.50   | 0.44-0.65  | —                                                                                                                           |
| P12   | K11562          | 0.05-0.15      | 0.30-0.61      | 0.025      | 0.025      | 0.50 max  | 0.80-1.25   | 0.44-0.65  | —                                                                                                                           |
| P15   | K11578          | 0.05-0.15      | 0.30-0.60      | 0.025      | 0.025      | 1.15-1.65 | —           | 0.44-0.65  | —                                                                                                                           |
| P21   | K31545          | 0.05-0.15      | 0.30-0.60      | 0.025      | 0.025      | 0.50 max  | 2.65-3.35   | 0.80-1.06  | —                                                                                                                           |
| P22   | K21590          | 0.05-0.15      | 0.30-0.60      | 0.025      | 0.025      | 0.50 max  | 1.90-2.60   | 0.87-1.13  | —                                                                                                                           |
| P91   | K91560          | 0.08-0.12      | 0.30-0.60      | 0.020      | 0.010      | 0.20-0.50 | 8.00-9.50   | 0.85-1.05  | V0.18-0.25<br>N 0.030-0.070<br>Ni 0.40 max<br>Al 0.04 max<br>Cb 0.06-0.10                                                   |
| P92   | K92460          | 0.07-0.13      | 0.30-0.60      | 0.020      | 0.010      | 0.50 max  | 8.50-9.50   | 0.30-0.60  | V0.15-0.25<br>N 0.03-0.07<br>Ni 0.40 max<br>Al 0.04 max<br>Cb 0.04-0.09<br>W 1.5-2.00<br>B 0.001-0.006                      |
| P122  | K92930          | 0.07-0.14      | 0.70 max       | 0.020      | 0.010      | 0.50 max  | 10.00-12.50 | 0.25-0.60  | V0.15-0.30<br>W 1.50-2.50<br>Cu 0.30-1.70<br>Cb 0.04-0.10<br>B 0.0005-0.005<br>N 0.040-0.100<br>Ni 0.50 max<br>Al 0.040 max |

### Tensile Requirements

| Identification Symbol  | P1, P2 | P12 | P91 | P92 | P122 | All Others |
|------------------------|--------|-----|-----|-----|------|------------|
| Tensile strength, min: |        |     |     |     |      |            |
| ksi                    | 55     | 60  | 85  | 90  | 90   | 60         |
| MPa                    | 380    | 415 | 585 | 620 | 620  | 415        |
| Yield strength, min:   |        |     |     |     |      |            |
| ksi                    | 30     | 32  | 60  | 64  | 58   | 30         |
| MPa                    | 205    | 220 | 415 | 440 | 400  | 205        |

### Elongation requirements

| All grades except P91 and P92                                                                                                                                                          |              |            | P91 and P122 |            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|------------|--------------|------------|
|                                                                                                                                                                                        | Longitudinal | Transverse | Longitudinal | Transverse |
| Elongation in 2 in. or 50 mm, (or 4D), min, %:                                                                                                                                         |              |            |              |            |
| Basic minimum elongation for wall 5/16 in. (8 mm) and over in thickness, strip tests, and for all small sizes tested in full section.                                                  | 30           | 20         | 20           | -          |
| When standard round 2-in. proportionally smaller size specimen with the gage length equal to 4D (4 times the diameter) is use.                                                         | 22           | 14         | 20           | 13         |
| For strip tests a deduction for each 1/32-in. (0.8 mm) decrease in wall thickness below in. (8 mm) from the basic minimum elongation of, the following percentage points shall be made | 1.50         | 1.00       | 1.00         | -          |



# Line Pipes for Atmospheric & Lower Temperature

EFW (SAW) WELDED • ASTM-A671

## Pipe Grades

| Pipe Grade | Type of Steel                                                         | ASTM Specification |        |
|------------|-----------------------------------------------------------------------|--------------------|--------|
|            |                                                                       | No.                | Grades |
| CA 55      | plain carbon                                                          | A 285/A 285M       | C      |
| CB 60      | plain carbon, killed                                                  | A 515/A 515M       | 60     |
| CB 65      | plain carbon, killed                                                  | A 515/A 515M       | 65     |
| CB 70      | plain carbon, killed                                                  | A 515/A 515M       | 70     |
| CC 60      | plain carbon, killed, fine grain                                      | A 516/A 516M       | 60     |
| CC 65      | plain carbon, killed, fine grain                                      | A 516/A 516M       | 65     |
| CC 70      | plain carbon, killed, fine grain                                      | A 516/A 516M       | 70     |
| CD 70      | manganese-silicon, normalized                                         | A 537/A 537M       | 1      |
| CD 80      | manganese-silicon, quenched and tempered                              | A 537/A 537M       | 2      |
| CE 55      | plain carbon                                                          | A 442/A 442M       | 55     |
| CE 60      | plain carbon                                                          | A 442/A 442M       | 60     |
| CF 65      | nickel steel                                                          | A 203/A 203M       | A      |
| CF 70      | nickel steel                                                          | A 203/A 203M       | B      |
| CF 66      | nickel steel                                                          | A 203/A 203M       | D      |
| CF 71      | nickel steel                                                          | A 203/A 203M       | E      |
| CJ 101     | alloy steel, quenched and tempered                                    | A 517/A 517M       | A      |
| CJ 102     | alloy steel, quenched and tempered                                    | A 517/A 517M       | B      |
| CJ 103     | alloy steel, quenched and tempered                                    | A 517/A 517M       | C      |
| CJ 104     | alloy steel, quenched and tempered                                    | A 517/A 517M       | D      |
| CJ 105     | alloy steel, quenched and tempered                                    | A 517/A 517M       | E      |
| CJ 106     | alloy steel, quenched and tempered                                    | A 517/A 517M       | F      |
| CJ 107     | alloy steel, quenched and tempered                                    | A 517/A 517M       | G      |
| CJ 108     | alloy steel, quenched and tempered                                    | A 517/A 517M       | H      |
| CJ 109     | alloy steel, quenched and tempered                                    | A 517/A 517M       | J      |
| CJ 110     | alloy steel, quenched and tempered                                    | A 517/A 517M       | K      |
| CJ 111     | alloy steel, quenched and tempered                                    | A 517/A 517M       | L      |
| CJ 112     | alloy steel, quenched and tempered                                    | A 517/A 517M       | M      |
| CJ 113     | alloy steel, quenched and tempered                                    | A 517/A 517M       | P      |
| CK 75      | carbon-manganese-silicon                                              | A 299/A 299M       |        |
| CP65       | alloy steel, age hardening, normalized and precipitation heat treated | A 736/A 736M       | 2      |
| CP75       | alloy steel, age hardening, quenched and precipitation heat treated   | A 736/A 736M       | 3      |

## Heat Treatment on Pipe

| Class |                                           | Radiography, see Section | Pressure Test, see: |
|-------|-------------------------------------------|--------------------------|---------------------|
| 10    | none                                      | none                     | none                |
| 11    | none                                      | 9                        | none                |
| 12    | none                                      | 9                        | 8.3                 |
| 13    | none                                      | none                     | 8.3                 |
| 20    | stress relieved, see 5.3.1                | none                     | none                |
| 21    | stress relieved, see 5.3.1                | 9                        | none                |
| 22    | stress relieved, see 5.3.1                | 9                        | 8.3                 |
| 23    | stress relieved, see 5.3.1                | none                     | 8.3                 |
| 30    | normalized, see 5.3.2                     | none                     | none                |
| 31    | normalized, see 5.3.2                     | 9                        | none                |
| 32    | normalized, see 5.3.2                     | 9                        | 8.3                 |
| 33    | normalized, see 5.3.2                     | none                     | 8.3                 |
| 40    | normalized and tempered, see 5.3.3        | none                     | none                |
| 41    | normalized and tempered, see 5.3.3        | 9                        | none                |
| 42    | normalized and tempered, see 5.3.3        | 9                        | 8.3                 |
| 43    | normalized and tempered, see 5.3.3        | none                     | 8.3                 |
| 50    | quenched and tempered, see 5.3.4          | none                     | none                |
| 51    | quenched and tempered, see 5.3.4          | 9                        | none                |
| 52    | quenched and tempered, see 5.3.4          | 9                        | 8.3                 |
| 53    | quenched and tempered, see 5.3.4          | none                     | 8.3                 |
| 60    | normalized and precipitation heat treated | none                     | none                |
| 61    | normalized and precipitation heat treated | 9                        | none                |
| 62    | normalized and precipitation heat treated | 9                        | 8.3                 |
| 63    | normalized and precipitation heat treated | none                     | 8.3                 |
| 70    | quenched and precipitation heat treated   | none                     | none                |
| 71    | quenched and precipitation heat treated   | 9                        | none                |
| 72    | quenched and precipitation heat treated   | 9                        | 8.3                 |
| 73    | quenched and precipitation heat treated   | none                     | 8.3                 |

## Heat Treatment Parameters

| Pipe Grade | ASTM Specification and Grade | Post-Weld Heat-Treatment Temperature Range °F (°C) | Normalizing Temperature, max, °F (°C) | Quenching Temperature, max, °F (°C) | Tempering Temperature, min, °F (°C) | Precipitation Heat Treatment Temperature Range °F (°C) |
|------------|------------------------------|----------------------------------------------------|---------------------------------------|-------------------------------------|-------------------------------------|--------------------------------------------------------|
| CA 55      | A 285/A 285M (C)             | 1100-1250 (590-680)                                | 1700 (925)                            | ...                                 | ...                                 | ...                                                    |
| CB 60      | A 515/A 515M (60)            | 1100-1250 (590-680)                                | 1750 (950)                            | ...                                 | ...                                 | ...                                                    |
| CB 65      | A 515/A 515M (65)            | 1100-1250 (590-680)                                | 1750 (950)                            | ...                                 | ...                                 | ...                                                    |
| CB 70      | A 515/A 515M (70)            | 1100-1250 (590-680)                                | 1750 (950)                            | ...                                 | ...                                 | ...                                                    |
| CC 60      | A 516/A 516M (60)            | 1100-1250 (590-680)                                | 1700 (925)                            | 1650 (900)                          | 1200 (650) <sup>c</sup>             | ...                                                    |
| CC 65      | A 516/A 516M (65)            | 1100-1250 (590-680)                                | 1700 (925)                            | 1650 (900)                          | 1200 (650)                          | ...                                                    |
| CC 70      | A 516/A 516M (70)            | 1100-1250 (590-680)                                | 1700 (925)                            | 1650 (900)                          | 1200 (650)                          | ...                                                    |
| CD 70      | A 537/A 537M (1)             | 1100-1250 (590-680)                                | 1700 (925)                            | ...                                 | ...                                 | ...                                                    |
| CD 80      | A 537/A 537M (2)             | 1100-1250 (590-680)                                | ...                                   | 1650 (900)                          | 1100 (590)                          | ...                                                    |
| CE 55      | A 442/A 442M (55)            | 1100-1250 (590-680)                                | 1700 (925)                            | 1650 (900)                          | 1200 (650)                          | ...                                                    |
| CE 60      | A 442/A 442M (60)            | 1100-1250 (590-680)                                | 1700 (925)                            | 1650 (900)                          | 1200 (650)                          | ...                                                    |
| CF 65      | A 203/A 203M (A)             | 1100-1175 (590-635)                                | 1750 (950)                            | ...                                 | ...                                 | ...                                                    |
| CF 70      | A 203/A 203M (B)             | 1100-1175 (590-635)                                | 1750 (950)                            | ...                                 | ...                                 | ...                                                    |
| CF 66      | A 203/A 203M (D)             | 1100-1175 (590-635)                                | 1750 (950)                            | ...                                 | ...                                 | ...                                                    |
| CF 71      | A 203/A 203M (E)             | 1100-1175 (590-635)                                | 1750 (950)                            | ...                                 | ...                                 | ...                                                    |
| CJ 101     | A 517/A 517M (A)             | 1000-1100 (540-590)                                | ...                                   | 1725 (940)                          | 1150 (620)                          | ...                                                    |
| CJ 102     | A 517/A 517M (B)             | 1000-1100 (540-590)                                | ...                                   | 1725 (940)                          | 1150 (620)                          | ...                                                    |
| CJ 103     | A 517/A 517M (C)             | 1000-1100 (540-590)                                | ...                                   | 1725 (940)                          | 1150 (620)                          | ...                                                    |
| CJ 104     | A 517/A 517M (D)             | 1000-1100 (540-590)                                | ...                                   | 1725 (940)                          | 1150 (620)                          | ...                                                    |
| CJ 105     | A 517/A 517M (E)             | 1000-1100 (540-590)                                | ...                                   | 1725 (940)                          | 1150 (620)                          | ...                                                    |
| CJ 106     | A 517/A 517M (F)             | 1000-1100 (540-590)                                | ...                                   | 1725 (940)                          | 1150 (620)                          | ...                                                    |
| CJ 107     | A 517/A 517M (G)             | 1000-1100 (540-590)                                | ...                                   | 1725 (940)                          | 1150 (620)                          | ...                                                    |
| CJ 108     | A 517/A 517M (H)             | 1000-1100 (540-590)                                | ...                                   | 1725 (940)                          | 1150 (620)                          | ...                                                    |
| CJ 109     | A 517/A 517M (J)             | 1000-1100 (540-590)                                | ...                                   | 1725 (940)                          | 1150 (620)                          | ...                                                    |
| CJ 110     | A 517/A 517M (K)             | 1000-1100 (540-590)                                | ...                                   | 1725 (940)                          | 1150 (620)                          | ...                                                    |
| CJ 111     | A 517/A 517M (L)             | 1000-1100 (540-590)                                | ...                                   | 1725 (940)                          | 1150 (620)                          | ...                                                    |
| CJ 112     | A 517/A 517M (M)             | 1000-1100 (540-590)                                | ...                                   | 1725 (940)                          | 1150 (620)                          | ...                                                    |
| CJ 113     | A 517/A 517M (P)             | 1000-1100 (540-590)                                | ...                                   | 1725 (940)                          | 1150 (620)                          | ...                                                    |
| CK 75      | A 299/A 299M                 | 1100-1250 (590- 680)                               | 1700 (925)                            | ...                                 | ...                                 | ...                                                    |
| CP65       | A 736/A 736M (2)             | 1000-1175 (540-635)                                | 1725 (940)                            | ...                                 | ...                                 | 1000-1200 (540-650)                                    |
| CP75       | A 736/A 736M (3)             | 1000-1175 (540-635)                                | ...                                   | 1725 (940)                          | ...                                 | 1000-1225 (540-665)                                    |

# Line Pipes for High-Pressure Service

EFW (SAW) WELDED • ASTM-A672



## Pipe Grades

| Pipe Grade | Type of Steel                    | ASTM Specification |           |
|------------|----------------------------------|--------------------|-----------|
|            |                                  | No.                | Grades    |
| A 45       | plain carbon                     | A 285              | A         |
| A 50       | plain carbon                     | A 285              | B         |
| A 55       | plain carbon                     | A 285              | C         |
| B 55       | plain carbon, killed             | A 515              | 55        |
| B 60       | plain carbon, killed             | A 515              | 60        |
| B 65       | plain carbon, killed             | A 515              | 65        |
| B 70       | plain carbon, killed             | A 515              | 70        |
| C 55       | plain carbon, killed, fine grain | A 516              | 55        |
| C 60       | plain carbon, killed, fine grain | A 516              | 60        |
| C 65       | plain carbon, killed, fine grain | A 516              | 65        |
| C 70       | plain carbon, killed, fine grain | A 516              | 70        |
| D 70       | manganese-silicon-normalized     | A 537              | 1         |
| D 80       | manganese-silicon-Q+T            | A 537              | 2         |
| E 55       | plain carbon                     | A 442              | 55        |
| E 60       | plain carbon                     | A 442              | 60        |
| H 75       | manganese-molybdenum-normalized  | A 302              | A         |
| H 80       | manganese-molybdenum-normalized  | A 302              | B, C or D |
| J 80       | manganese-molybdenum-Q&T         | A 533              | Cl-1B     |
| J 90       | manganese-molybdenum-Q&T         | A 533              | Cl-2B     |
| J 100      | manganese-molybdenum-Q&T         | A 533              | Cl-3B     |
| K 75       | chromium-manganese-silicon       | A 202              | A         |
| K 85       | chromium-manganese-silicon       | A 202              | B         |
| L 65       | molybdenum                       | A 204              | A         |
| L 70       | molybdenum                       | A 204              | B         |
| L 75       | molybdenum                       | A 204              | C         |
| N 75       | manganese-silicon                | A 299              | ...       |

## Heat Treatment on Pipe

| Class |                                    | Radiography, see Section | Pressure Test, see: |
|-------|------------------------------------|--------------------------|---------------------|
| 10    | none                               | none                     | none                |
| 11    | none                               | 9                        | none                |
| 12    | none                               | 9                        | 8.3                 |
| 13    | none                               | none                     | 8.3                 |
| 20    | stress relieved, see 5.3.1         | none                     | none                |
| 21    | stress relieved, see 5.3.1         | 9                        | none                |
| 22    | stress relieved, see 5.3.1         | 9                        | 8.3                 |
| 23    | stress relieved, see 5.3.1         | none                     | 8.3                 |
| 30    | normalized, see 5.3.2              | none                     | none                |
| 31    | normalized, see 5.3.2              | 9                        | none                |
| 32    | normalized, see 5.3.2              | 9                        | 8.3                 |
| 33    | normalized, see 5.3.2              | none                     | 8.3                 |
| 40    | normalized and tempered, see 5.3.3 | none                     | none                |
| 41    | normalized and tempered, see 5.3.3 | 9                        | none                |
| 42    | normalized and tempered, see 5.3.3 | 9                        | 8.3                 |
| 43    | normalized and tempered, see 5.3.3 | none                     | 8.3                 |
| 50    | quenched and tempered, see 5.3.4   | none                     | none                |
| 51    | quenched and tempered, see 5.3.4   | 9                        | none                |
| 52    | quenched and tempered, see 5.3.4   | 9                        | 8.3                 |
| 53    | quenched and tempered, see 5.3.4   | none                     | 8.3                 |

## Heat Treatment Parameters

| Pipe Grade | Specification and Grade °F (°C) | Post-Weld Heat-Treat Temperature Range, °F (°C) | Normalizing Temperature, max, °F (°C) | Quenching Temperature, max, | Tempering Temperature, min, |
|------------|---------------------------------|-------------------------------------------------|---------------------------------------|-----------------------------|-----------------------------|
| A 45       | A 285A                          | 1100-1250 (590-680)                             | 1700 (925)                            | ...                         | ...                         |
| A 50       | A 285B                          | 1100-1250 (590-680)                             | 1700 (925)                            | ...                         | ...                         |
| A 55       | A 285C                          | 1100-1250 (590-680)                             | 1700 (925)                            | ...                         | ...                         |
| B 55       | A 515-55                        | 1100-1250 (590-680)                             | 1750 (950)                            | ...                         | ...                         |
| B 60       | A 515-60                        | 1100-1250 (590-680)                             | 1750 (950)                            | ...                         | ...                         |
| B 65       | A 515-65                        | 1100-1250 (590-680)                             | 1750 (950)                            | ...                         | ...                         |
| B 70       | A 515-70                        | 1100-1250 (590-680)                             | 1750 (950)                            | ...                         | ...                         |
| C 55       | A 516-55                        | 1100-1250 (590-680)                             | 1700 (925)                            | 1650 (900)                  | 1200 (650)                  |
| C 60       | A 516-60                        | 1100-1250 (590-680)                             | 1700 (925)                            | 1650 (900)                  | 1200 (650)                  |
| C 65       | A 516-65                        | 1100-1250 (590-680)                             | 1700 (925)                            | 1650 (900)                  | 1200 (650)                  |
| C 70       | A 516-70                        | 1100-1250 (590-680)                             | 1700 (925)                            | 1650 (900)                  | 1200 (650)                  |
| D 70       | A 537-1                         | 1100-1250 (590-680)                             | 1700 (925)                            | ...                         | ...                         |
| D 80       | A 537-2                         | 1100-1250 (590-680)                             | ...                                   | 1650 (900)                  | 1200 (650)                  |
| E 55       | A 442-55                        | 1100-1250 (590-680)                             | 1700 (925)                            | 1650 (900)                  | 1200 (650)                  |
| E 60       | A 442-60                        | 1100-1250 (590-680)                             | 1700 (925)                            | 1650 (900)                  | 1200 (650)                  |
| H 75       | A 302-A                         | 1100-1250 (590-680)                             | 1800 (980)                            | ...                         | 1100 (590)                  |
| H 80       | A 302-B, C or D                 | 1100-1250 (590-680)                             | 1800 (980)                            | ...                         | 1100 (590)                  |
| J 80       | A 533-C11                       | 1100-1250 (590-680)                             | ...                                   | 1800 (980)                  | 1100 (590)                  |
| J 90       | A 533-C12                       | 1100-1250 (590-680)                             | ...                                   | 1800 (980)                  | 1100 (590)                  |
| J 100      | A 533-C13                       | 1100-1250 (590-680)                             | ...                                   | 1800 (980)                  | 1100 (590)                  |
| K 75       | A 202A                          | 1100-1200 (590-650)                             | ...                                   | ...                         | ...                         |
| K 85       | A 202B                          | 1100-1200 (590-650)                             | ...                                   | ...                         | ...                         |
| L 65       | A 204A                          | 1100-1200 (590-650)                             | ...                                   | ...                         | ...                         |
| L 70       | A 204B                          | 1100-1200 (590-650)                             | ...                                   | ...                         | ...                         |
| L 75       | A 204C                          | 1100-1200 (590-650)                             | ...                                   | ...                         | ...                         |
| N 75       | A 299                           | 1100-1200 (590-650)                             | 1700 (925)                            | ...                         | ...                         |



# Line Pipe Carbon and Alloy Steel

ASTM-A 691 • EFW (SAW) WELDED

## Pipe Grades

| Pipe Grade | Type of Steel                                         | ASTM Specification |        | HB, max |
|------------|-------------------------------------------------------|--------------------|--------|---------|
|            |                                                       | No.                | Grades |         |
| CM-65      | carbon-molybdenum steel                               | A 204/A 204M       | A      | 201     |
| CM-70      | carbon-molybdenum steel                               | A 204/A 204M       | B      | 201     |
| CM-75      | carbon-molybdenum steel                               | A 204/A 204M       | C      | 201     |
| CMSH-70    | carbon-manganese-silicon steel, normalized            | A 537/A 537M       | 1      |         |
| CMS-75     | carbon-manganese-silicon steel                        | A 299/A 299M       | ...    | ...     |
| CMSH-80    | carbon-manganese-silicon steel, quenched and tempered | A 537/A 537M       | 2      |         |
| 1/2 CR     | 1/2 % chromium, 1/2 % molybdenum steel                | A 387/A 387M       | 2      | 201     |
| 1CR        | 1 % chromium, 1/2 % molybdenum steel                  | A 387/A 387M       | 12     | 201     |
| 1 1/4 CR   | 1 1/4 % chromium, 1/2 % molybdenum steel              | A 387/A 387M       | 11     | 201     |
| 2 1/4 CR   | 2 1/4 % chromium, 1 % molybdenum steel                | A 387/A 387M       | 22     | 201     |
| 3CR        | 3 % chromium, 1 % molybdenum steel                    | A 387/A 387M       | 21     | 201     |
| 5CR        | 5 % chromium, 1/2 % molybdenum steel                  | A 387/A 387M       | 5      | 225     |
| 9CR        | 9 % chromium, 1 % molybdenum steel                    | A 387/A 387M       | 9      | 241     |
| 91         | 9% chromium, 1% molybdenum, vanadium, columbium       | A 387/A 387M       | 91     | 241     |

## Heat Treatment on Pipe

| Class |                                    | Radiography, | Pressure Test: |
|-------|------------------------------------|--------------|----------------|
| 10    | none                               | none         | none           |
| 11    | none                               | 9            | none           |
| 12    | none                               | 9            | 8.3            |
| 13    | none                               | none         | 8.3            |
| 20    | stress relieved, see 5.3.1         | none         | none           |
| 21    | stress relieved, see 5.3.1         | 9            | none           |
| 22    | stress relieved, see 5.3.1         | 9            | 8.3            |
| 23    | stress relieved, see 5.3.1         | none         | 8.3            |
| 30    | normalized, see 5.3.2              | none         | none           |
| 31    | normalized, see 5.3.2              | 9            | none           |
| 32    | normalized, see 5.3.2              | 9            | 8.3            |
| 33    | normalized, see 5.3.2              | none         | 8.3            |
| 40    | normalized and tempered, see 5.3.3 | none         | none           |
| 41    | normalized and tempered, see 5.3.3 | 9            | none           |
| 42    | normalized and tempered, see 5.3.3 | 9            | 8.3            |
| 43    | normalized and tempered, see 5.3.3 | none         | 8.3            |
| 50    | quenched and tempered, see 5.3.4   | none         | none           |
| 51    | quenched and tempered, see 5.3.4   | 9            | none           |
| 52    | quenched and tempered, see 5.3.4   | 9            | 8.3            |
| 53    | quenched and tempered, see 5.3.4   | none         | 8.3            |

## Heat Treatment Parameters

| Pipe Grade | ASTM Specification | Post-Weld Heat-Treat Temperature Range (Stress Relieving), °F (°C) | Normalizing Temperature, max unless otherwise noted, °F (°C) | Quenching Temperature, max unless otherwise noted, °F (°C) | Tempering, Temperature, min, °F (°C) |
|------------|--------------------|--------------------------------------------------------------------|--------------------------------------------------------------|------------------------------------------------------------|--------------------------------------|
| CM-65      | A 204/A 204M       | 1100 to 1200 (590 to 650)                                          | 1700 (925)                                                   | ...                                                        | ...                                  |
| CM-70      | A 204/A 204M       | 1100 to 1200 (590 to 650)                                          | 1700 (925)                                                   | ...                                                        | ...                                  |
| CM-75      | A 204/A 204M       | 1100 to 1200 (590 to 650)                                          | 1700 (925)                                                   | ...                                                        | ...                                  |
| CMSH-70    | A 537/A 537M       | 1100 to 1200 (590 to 650)                                          | 1700 (925)                                                   | ...                                                        | ...                                  |
| CMS-75     | A 299/A 299M       | 1100 to 1200 (590 to 650)                                          | 1700 (925)                                                   | ...                                                        | ...                                  |
| CMSH-80    | A 537/A 537M       | 1100 to 1200 (590 to 650)                                          | ...                                                          | 1700 (925)                                                 | 1100 to 1250 (590 to 675)            |
| 1/2CR      | A 387/A 387M       | 1100 to 1300 (590 to 705)                                          | 1850 (1010)                                                  | 1700 (925)                                                 | 1150 to 1375 (620 to 745)            |
| 1CR        | A 387/A 387M       | 1100 to 1350 (590 to 730)                                          | 1850 (1010)                                                  | 1700 (925)                                                 | 1150 to 1375 (620 to 745)            |
| 11/4CR     | A 387/A 387M       | 1100 to 1375 (590 to 745)                                          | 1850 (1010)                                                  | 1700 (925)                                                 | 1150 to 1375 (620 to 745)            |
| 21/4CR     | A 387/A 387M       | 1200 to 1400 (650 to 760)                                          | 1850 (1010)                                                  | 1700 (925)                                                 | 1250 to 1400 (675 to 760)            |
| 3CR        | A 387/A 387M       | 1200 to 1400 (650 to 760)                                          | 1850 (1010)                                                  | 1700 (925)                                                 | 1250 to 1400 (675 to 760)            |
| 5CR        | A 387/A 387M       | 1200 to 1400 (650 to 760)                                          | 1850 (1010)                                                  | 1650 (900)                                                 | 1300 to 1400 (705 to 760)            |
| 9CR        | A 387/A 387M       | 1325 to 1375 (715 to 745)                                          | ...                                                          | ...                                                        | 1325 to 1375 (715 to 745)            |
| 91         | A 387/A 387M       | 1350 to 1420 (730 to 770)                                          | 1900 to 2000 (1040 to 1095)                                  | 1900 min (1040 min)                                        | 1350 to 1440 (730 to 780)            |

# Line Pipe Carbon Steel

## ASTM A53 • WELDED AND SEAMLESS



### Chemical Composition

| Composition, %                                 |        |           |            |        |        |        |          |            |          |
|------------------------------------------------|--------|-----------|------------|--------|--------|--------|----------|------------|----------|
|                                                | Carbon | Manganese | Phosphorus | Sulfur | Copper | Nickel | Chromium | Molybdenum | Vanadium |
| <b>Type S (seamless pipe)</b>                  |        |           |            |        |        |        |          |            |          |
| Open hearth, electric-furnace or basic-oxygen: |        |           |            |        |        |        |          |            |          |
| Grade A                                        | 0.25   | 0.95      | 0.05       | 0.045  | 0.40   | 0.40   | 0.40     | 0.15       | 0.08     |
| Grade B                                        | 0.30   | 1.20      | 0.05       | 0.045  | 0.40   | 0.40   | 0.40     | 0.15       | 0.08     |
| <b>Type E (Electric-resistance-welded)</b>     |        |           |            |        |        |        |          |            |          |
| Open-heart, electric-furnace or basic-oxygen:  |        |           |            |        |        |        |          |            |          |
| Grade A                                        | 0.25   | 0.95      | 0.05       | 0.045  | 0.40   | 0.40   | 0.40     | 0.15       | 0.08     |
| Grade B                                        | 0.30   | 1.20      | 0.05       | 0.045  | 0.40   | 0.40   | 0.40     | 0.15       | 0.08     |
| <b>Type F (furnace-welded pipe)</b>            |        |           |            |        |        |        |          |            |          |
| Open-hearth, electric-furnace, or basic oxygen |        |           |            |        |        |        |          |            |          |
| Grade A                                        | 0.30   | 1.20      | 0.05       | 0.045  | 0.40   | 0.40   | 0.40     | 0.15       | 0.08     |

### Tensile Requirements

|                                  | Type F Open-Hearth, Basic Oxygen, or Electric-Furnace, | Types E and S |              |
|----------------------------------|--------------------------------------------------------|---------------|--------------|
|                                  | Grade A                                                | Grade A       | Grade B      |
| Tensile strength, min, psi (MPa) | 48 000 (330)                                           | 48 000 (330)  | 60 000 (415) |
| Yield strength, min, psi, (MPa)  | 30 000 (205)                                           | 30 000 (205)  | 35 000 (240) |
| Elongation in 2 in. (50 mm)      |                                                        |               |              |

<sup>A</sup> The minimum elongation in 2 in. (50 mm) shall be that determined by the following equation:  
 $e = 625\,000 [1940] A^{0.2} [U]^{0.9}$

where:

- e = minimum elongation in 2 in. (50 mm) in percent rounded to the nearest percent,
- A = cross-sectional area of the tension specimen, rounded to the nearest 0.01 in.2 (1 mm2), based on the specified outside diameter or the nominal specimen width and specified wall thickness. If the area calculated is equal to or greater than 0.75 in.2 (500 mm2), then the value 0.75 in.2 (500 mm 2) shall be used , and
- U = specified tensile strength, psi (MPa).

<sup>B</sup> See Table X4.1 or Table X4.2, whichever is applicable, for minimum elongation values for various size tension specimens and grades.





# Line Pipe Carbon Steel

ASTM-A106 • SEAMLESS

## Chemical Composition

| Composition %   |           |           |           |
|-----------------|-----------|-----------|-----------|
|                 | Grade A   | Grade B   | Grade C   |
| Carbon, max     | 0.25      | 0.30      | 0.35      |
| Manganese       | 0.27-0.93 | 0.29-1.06 | 0.29-1.06 |
| Phosphorus, max | 0.035     | 0.035     | 0.035     |
| Sulfur, max     | 0.035     | 0.035     | 0.035     |
| Silicon, min    | 0.10      | 0.10      | 0.10      |
| Chrome, max     | 0.40      | 0.40      | 0.40      |
| Copper, max     | 0.40      | 0.40      | 0.40      |
| Molybdenum, max | 0.15      | 0.15      | 0.15      |
| Nickel, max     | 0.40      | 0.40      | 0.40      |
| Vanadium, max   | 0.08      | 0.08      | 0.08      |

## Transverse Elongation

| Wall Thickness |     | Elongation in 2 in. or 50 mm, min, % |                           |
|----------------|-----|--------------------------------------|---------------------------|
| in             | mm  | Grade A, Transverse                  | Grade B and C, Transverse |
| 5/16 (0.312)   | 7.9 | 25.00                                | 16.50                     |
| 9/32 (0.281)   | 7.1 | 23.75                                | 15.50                     |
| 1/4 (0.250)    | 6.4 | 22.50                                | 14.50                     |

<sup>A</sup> This table gives the computed minimum elongation values for each 1/32-in. (0.8 mm) decrease in wall thickness. Where the wall thickness lies between two values shown above, the minimum elongation value is determined by the following equation:

| Grade   | Direction of Test | Equation          |
|---------|-------------------|-------------------|
| A       | Transverse        | $E = 40t + 12.50$ |
| B and C | Transverse        | $E = 32t + 6.50$  |

where:

|   |   |                                      |
|---|---|--------------------------------------|
| E | = | elongation in 2 in. or 50 mm, %, and |
| t | = | actual thickness of specimen, in.    |

## Tensile Requirements

|                                                                                                                                                                                                  | Grade A<br>(Explanatory Note 2) |                   | Grade B      |                   | Grade C      |                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|-------------------|--------------|-------------------|--------------|-------------------|
| Tensile strength, min, psi (MPa)                                                                                                                                                                 | 48 000 (330)                    |                   | 60 000 (415) |                   | 70 000 (485) |                   |
| Yield strength, min, psi (MPa)                                                                                                                                                                   | 30 000 (205)                    |                   | 35 000 (240) |                   | 40 000 (275) |                   |
|                                                                                                                                                                                                  | Longitudinal                    | Transverse        | Longitudinal | Transvers         | Longitudinal | Transvers         |
| Elongation in 2 in. or 50 mm, min, %:                                                                                                                                                            | 35                              | 25                | 30           | 16.5              | 30           | 16.5              |
| Basic minimum elongation transverse strip tests, and for all small sizes tested in full section                                                                                                  | 28                              | 20                | 22           | 12                | 20           | 12                |
| When standard round 2-in. or 50-mm gage length test specimen is used                                                                                                                             |                                 |                   |              |                   |              |                   |
| For longitudinal strip tests                                                                                                                                                                     |                                 |                   |              |                   |              |                   |
| For transverse strip tests, a deduction for each 1/32-in. (0.8 mm) decrease in wall thickness below 5/16in. (7.9 mm) from the basic minimum elongation of the following percentage shall be made |                                 | 1.25 <sup>C</sup> |              | 1.00 <sup>C</sup> |              | 1.00 <sup>C</sup> |

<sup>A</sup> The minimum elongation in 2 in. (50.8 mm) shall be determined by the following equation:

$$e = 625 \cdot 000A^{0.2} / U^{0.9}$$

where:

e = minimum elongation in 2 in. (50.8 mm), %, rounded to the nearest 0.5%.

A = cross-sectional area of the tension test specimen, in.<sup>2</sup>, based on specified outside diameter or nominal specimen width and specified wall thickness rounded to the nearest 0.01 in.<sup>2</sup> (if the area thus calculated is greater than the value 0.75 in.<sup>2</sup> shall be used), and

U = specified tensile strength, psi.

<sup>B</sup> See Table number 4 for minimum elongation values for various size tension specimens and grades.

<sup>C</sup> Table number 3 gives the computed minimum values:

# Line Pipe Carbon Steel

API 5L • SEAMLESS/ERW/SAW



## PSL 1 Chemical Composition for Heat and Product Analyses

| (1)              | (2)                | (3)                   | (4)        |         | (5)                |
|------------------|--------------------|-----------------------|------------|---------|--------------------|
| Grade & Class    | Carbon,<br>Maximum | Manganese,<br>Maximum | Phosphorus |         | Sulfur,<br>Maximum |
|                  |                    |                       | Minimum    | Maximum |                    |
| Seamless         |                    |                       |            |         |                    |
| A25, CI I        | 0.21               | 0.60                  |            | 0.030   | 0.030              |
| A25, CI II       | 0.21               | 0.60                  | 0.045      | 0.080   | 0.030              |
| A                | 0.22               | 0.90                  |            | 0.030   | 0.030              |
| B                | 0.28               | 1.20                  |            | 0.030   | 0.030              |
| X42              | 0.28               | 1.30                  |            | 0.030   | 0.030              |
| X46, X52, X56    | 0.28               | 1.40                  |            | 0.030   | 0.030              |
| X60, X65,<br>X70 | 0.28               | 1.40                  |            | 0.030   | 0.030              |
| Welded           |                    |                       |            |         |                    |
| A25, CI I        | 0.21               | 0.60                  |            | 0.030   | 0.030              |
| A25, CI II       | 0.21               | 0.60                  | 0.045      | 0.080   | 0.030              |
| A                | 0.22               | 0.90                  |            | 0.030   | 0.030              |
| B                | 0.26               | 1.20                  |            | 0.030   | 0.030              |
| X42              | 0.26               | 1.30                  |            | 0.030   | 0.030              |
| X46, X52, X56    | 0.26               | 1.40                  |            | 0.030   | 0.030              |
| X60              | 0.26               | 1.40                  |            | 0.030   | 0.030              |
| X65              | 0.26               | 1.45                  |            | 0.030   | 0.030              |
| X70              | 0.26               | 1.65                  |            | 0.030   | 0.030              |

## PSL 2 Chemical Composition for Heat and Product Analyses

| (1)              | (2)                             | (3)                                | (4)                    | (5)                |
|------------------|---------------------------------|------------------------------------|------------------------|--------------------|
| Grade            | Carbon,<br>Maximum <sup>a</sup> | Manganese,<br>Maximum <sup>a</sup> | Phosphorus,<br>Maximum | Sulfur,<br>Maximum |
| Seamless         |                                 |                                    |                        |                    |
| B                | 0.24                            | 1.20                               | 0.025                  | 0.015              |
| X42              | 0.24                            | 1.30                               | 0.025                  | 0.015              |
| X46,X52,X56      | 0.24                            | 1.40                               | 0.025                  | 0.015              |
| X60,X65,X70,X800 | 0.24                            | 1.40                               | 0.025                  | 0.015              |
| Welded           |                                 |                                    |                        |                    |
| B                | 0.22                            | 1.20                               | 0.025                  | 0.015              |
| X42              | 0.22                            | 1.30                               | 0.025                  | 0.015              |
| X46,X52,X56      | 0.22                            | 1.40                               | 0.025                  | 0.015              |
| X60e             | 0.22                            | 1.40                               | 0.025                  | 0.015              |
| X65e             | 0.22                            | 1.45                               | 0.025                  | 0.015              |
| X70e             | 0.22                            | 1.65                               | 0.025                  | 0.015              |
| X80e             | 0.22                            | 1.85                               | 0.025                  | 0.015              |





# Line Pipe Carbon Steel

API 5L • SEAMLESS/ERW/SAW

## Tensile Requirements for PSL 1

| (1)   | (2)                     |       | (3)                                |       | (4)                                             |
|-------|-------------------------|-------|------------------------------------|-------|-------------------------------------------------|
| Grade | Yield Strength, Minimum |       | Ultimate Tensile Strength, Minimum |       | Elongation in 2 in. (50.8 mm), Minimum, Percent |
|       | psi                     | MPa   | psi                                | MPa   |                                                 |
| A25   | 25.000                  | (172) | 45.000                             | (310) | a                                               |
| A     | 30.000                  | (207) | 48.000                             | (331) | a                                               |
| B     | 35.000                  | (241) | 60.000                             | (414) | a                                               |
| X42   | 42.000                  | (290) | 60.000                             | (414) | a                                               |
| X46   | 46.000                  | (317) | 63.000                             | (434) | a                                               |
| X52   | 52.000                  | (359) | 66.00                              | (455) | a                                               |
| X56   | 56.000                  | (386) | 71.000                             | (490) | a                                               |
| X60   | 60.000                  | (414) | 75.000                             | (517) | a                                               |
| X65   | 65.000                  | (448) | 77.000                             | (531) | a                                               |
| X70   | 70.000                  | (483) | 82.000                             | (565) | a                                               |

## Tensile Requirements for PSL 2

| (1)   | (2)                     |       | (3)                                  |       | (4)                                |       | (5)                                             |       | (6)                                             |
|-------|-------------------------|-------|--------------------------------------|-------|------------------------------------|-------|-------------------------------------------------|-------|-------------------------------------------------|
| Grade | Yield Strength, Minimum |       | Yield Strength, Maximum <sup>b</sup> |       | Ultimate Tensile Strength, Minimum |       | Ultimate Tensile Strength, Maximum <sup>c</sup> |       | Elongation in 2 in. (50.8 mm), Minimum, Percent |
|       | psi                     | MPa   | psi                                  | MPa   | psi                                | MPa   | psi                                             | MPa   |                                                 |
| B     | 35.000                  | (241) | 65.000d                              | (448) | 60.000                             | (414) | 110.000                                         | (758) | a                                               |
| X42   | 42.000                  | (290) | 72.000                               | (496) | 60.000                             | (414) | 110.000                                         | (758) | a                                               |
| X46   | 46.000                  | (317) | 76.000                               | (524) | 63.000                             | (434) | 110.000                                         | (758) | a                                               |
| X52   | 52.000                  | (359) | 77.000                               | (531) | 66.000                             | (455) | 110.000                                         | (758) | a                                               |
| X56   | 56.000                  | (386) | 79.000                               | (544) | 71.000                             | (490) | 110.000                                         | (758) | a                                               |
| X60   | 60.000                  | (414) | 82.000                               | (565) | 75.000                             | (517) | 110.000                                         | (758) | a                                               |
| X65   | 65.000                  | (448) | 87.000                               | (600) | 77.000                             | (531) | 110.000                                         | (758) | a                                               |
| X70   | 70.000                  | (483) | 90.000                               | (621) | 82.000                             | (565) | 110.000                                         | (758) | a                                               |
| X80   | 80.000                  | (552) | 100.000e                             | (690) | 90.000                             | (621) | 120.000                                         | (827) | a                                               |

Footnotes to Tables 3A and 3B:

a = The minimum elongation in 2 in. (50.8mm) shall be that determined by the following equation:

U.S. Customary Unit Equation

SI Unit Equation

$$e = 625.000 \frac{A^{0.2}}{U^{0.9}}$$

$$e = 1.944 \frac{A^{0.2}}{U^{0.9}}$$

where

e = minimum elongation in 2 in. (50.8 mm) in percent rounded to the nearest percent.

A = applicable tensile test specimen area, as follows:

a. For both sizes of round bar specimens, 0.20 in.2 (130 mm2);

b. For full section specimens, the smaller of (i) 0.75 in.2 (485 mm2) and (ii) the cross-sectional area of the test specimen, calculated using the specified outside diameter of the pipe and the specified wall thickness of the pipe, rounded to the nearest 0.01 in.2 (10 mm2); and

c. For strip specimens, the smaller of (i) 0.75 in.2 (485 mm2) and (ii) the cross-sectional area of the test specimen, calculated using the specified width of the test specimen and the specified wall thickness of the pipe, rounded to the nearest 0.01 in.2 (10 mm2).

U = specified minimum ultimate tensile strength in psi (MPa).

See Appendix D for the specified minimum elongation values for various tensile specimen sizes and grades.

b = Maximum yield strength for an intermediate grade shall be the maximum for the next higher listed grade.

c = All intermediate grades have a maximum ultimate tensile strength of 110.000 psi (758 MPa).

d = Maximum yield strength for Grade B pipe in sizes subject to longitudinal testing is 72.000 psi (496 MPa).

e = For wall thickness greater than 0.984 inch (25.0 mm), the maximum yield strength shall be determined by agreement between the purchaser and the manufacturer.





## Comparison of steel grades

| API 5L  | ISO 3183<br>EN 10208 | NFA 49.211<br>NFA 49.411 | DNV OS-F101 | EEMUA 166 | BS 3602   | ASTM A 53 | ASTM 333            | ASTM 106 |
|---------|----------------------|--------------------------|-------------|-----------|-----------|-----------|---------------------|----------|
| Grade A |                      |                          |             |           | Steel 360 | Grade A   | Grade 1             | Grade A  |
|         |                      | TUE 220                  |             |           |           |           |                     |          |
| Grade B | L245NB               | TUE 250                  | 245         | EP 240    |           | Grade B   | Grade 3/<br>Grade 6 | Grade B  |
| TUE 275 |                      |                          | Steel 430   |           |           | Grade C   |                     |          |
| X 42    | L290NB               | TUE 290                  | 290         | EP290     |           |           |                     |          |
| X 46    |                      | TUE 320                  |             |           |           |           |                     |          |
| X 52    | L360NB/<br>L360QB    | TUE 360                  | 360         | EP 360    |           |           |                     |          |
| X 56    |                      |                          |             |           |           |           |                     |          |
| X 60    | L415QB               | TUE 415                  | 415         | EP 415    |           |           |                     |          |
| X 65    | L450QB               | TUE 450                  | 450         | EP 450    |           |           |                     |          |
| X 70    | L485QB               |                          | 485         | EP 485    |           |           |                     |          |
| X 80    | L555QB               |                          | 555         |           |           |           |                     |          |

\*latest issue each





# Furnace Tubes for Refinery Service

ASTM-A 161 (94) • SEAMLESS

## Chemical Composition

| Element          | Composition. %         |           |
|------------------|------------------------|-----------|
|                  | Low Carbon Steel Tubes | Grade T1  |
| Carbon           | 0.10-0.20              | 0.10-0.20 |
| Manganese        | 0.30-0.80              | 0.30-0.80 |
| Phosphorus. max. | 0.035                  | 0.025     |
| Sulfur. max.     | 0.035                  | 0.025     |
| Silicon          | 0.025 max              | 0.10-0.50 |
| Molybdenum       | ...                    | 0.44-0.65 |

## Tensile Requirements

|                                                                                                                                                                                                    | Low Carbon Steel Tubes | Grade T1          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------------------|
| Tensile strength. min. ksi (MPa)                                                                                                                                                                   | 47 (324)               | 55 (379)          |
| Yield strength. min. ksi (MPa)                                                                                                                                                                     | 26 (179)               | 30 (207)          |
| Elongation in 2 in. or 50 mm (or 4D) min%                                                                                                                                                          |                        |                   |
| Basic minimum elongation for walls 5/16 in. (7.9 mm) and over in thickness                                                                                                                         | 35                     | 30                |
| When standard round tension test specimen with 2-in. or 50-mm gage length or smaller proportionally sized specimen with the gage length equal to 4D (4 times the diameter) is used                 | 28                     | 22                |
| For longitudinal strip tests, a deduction shall be made for each 1/32-in. (0.80mm) decrease in wall thickness below 3/16 in.(7.9mm) from the basic minimum. elongation of the following percentage | 1.75 <sup>A</sup>      | 1.50 <sup>A</sup> |



## Minimum Elongation Values

| Wall thickness<br>in. (mm) | Elongation in 2 in. or 50 mm. min. % <sup>A</sup> |          |
|----------------------------|---------------------------------------------------|----------|
|                            | Low Carbon Steel Tubes                            | Grade T1 |
| 5/16 (0.312) 7.94          | 35                                                | 30       |
| 9/32 (0.281) 7.14          | 33                                                | 28       |
| 1/4 (0.250) 6.35           | 32                                                | 27       |
| 7/32 (0.219) 5.56          | 30                                                | 26       |
| 3/16 (0.188) 4.76          | 28                                                | 24       |
| 5/32 (0.156) 3.97          | 26                                                | 22       |
| 1/8 (0.125) 3.18           | 25                                                | 21       |
| 3/32 (0.094) 2.38          | 23                                                | 20       |
| 1/16 (0.062) 1.59          | 21                                                | 18       |



|                     | Brinell Hardness Number |          |
|---------------------|-------------------------|----------|
|                     | Low Carbon Steel Tubes  | Grade T1 |
| Hot-rolled tubes    | 137                     | 150      |
| Cold-finished tubes | 125                     | 137      |

# Furnace Tubes for Refinery Service

ASTM-A 200 (94)



## Chemical Composition

| Grade | Composition, %    |           |                |             |           |            |            |                                                                          |
|-------|-------------------|-----------|----------------|-------------|-----------|------------|------------|--------------------------------------------------------------------------|
|       | Carbon            | Manganese | Phosphorus max | Sulfur, max | Silicon   | Chromium   | Molybdenum | Others                                                                   |
| T4    | 0.05-0.15 max     | 0.30-0.60 | 0.025          | 0.025       | 0.50-1.00 | 2.15-2.85  | 0.44-0.65  | —                                                                        |
| T5    | 0.15 max          | 0.30-0.60 | 0.025          | 0.025       | 0.50 max  | 4.00-6.00  | 0.45-0.65  | —                                                                        |
| T7    | 0.15 max          | 0.30-0.60 | 0.025          | 0.025       | 0.50-1.00 | 6.00-8.00  | 0.45-0.65  | —                                                                        |
| T9    | 0.15 max          | 0.30-0.60 | 0.025          | 0.025       | 0.25-1.00 | 8.00-10.00 | 0.90-1.10  | —                                                                        |
| T91   | 0.08-0.12         | 0.30-0.60 | 0.020          | 0.010       | 0.20-0.50 | 8.00-9.00  | 0.85-1.05  | Ni-0.40max<br>V-0.8-0.25<br>Cb-0.06-0.10<br>N-0.030-0.070<br>Al-0.04 max |
| T11   | 0.05 min-0.15 max | 0.30-0.60 | 0.025          | 0.025       | 0.50-1.00 | 1.00-1.50  | 0.44-0.65  | —                                                                        |
| T21   | 0.05 min-0.15 max | 0.30-0.30 | 0.025          | 0.025       | 0.50 max  | 2.65-3.35  | 0.80-1.06  | —                                                                        |
| T22   | 0.05 min-0.15 max | 0.30-0.60 | 0.025          | 0.025       | 0.50 max  | 1.90-2.60  | 0.87-1.13  | —                                                                        |

## Tensile Requirements

|                                                                                                                                                                                                           | All grades except T91 | Grade T91 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------|
| Tensile strength, min. ksi (MPa)                                                                                                                                                                          | 60 (414)              | 85 (585)  |
| Yield strength, min. ksi (MPa)                                                                                                                                                                            | 25 (172)              | 60 (414)  |
| Elongation in 2 in. or 50 mm (or 4D), min. %                                                                                                                                                              | 30                    | 20        |
| Basic minimum elongation for walls 5/16 in (7.9 mm) and over in thickness, longitudinal strip tests, and for all small sizes tested in full section                                                       | 22                    | 20        |
| When standard round 2-in. or 50-mm gage or smaller proportionally sized specimen with the gage length equal to 4D (4 times the diameter) is used.                                                         | 1.50 <sup>A</sup>     | 1.00      |
| For longitudinal strip tests a deduction shall be made for each 1/32 in. (0.79 mm) decrease in wall thickness below 5/16in. (7.9 mm) from the basic minimum elongation of the following percentage points |                       |           |

## Minimum Elongation Values

| Wall Thickness<br>in. | Elongation in 2 in. or 50 mm. min. % |                       |           |
|-----------------------|--------------------------------------|-----------------------|-----------|
|                       | mm                                   | All grades except T91 | Grade T91 |
| 5/16 (0.312)          | 7.94                                 | 30                    | 20        |
| 3/32 (0.281)          | 7.14                                 | 28                    | 19        |
| 1/4 (0.250)           | 6.35                                 | 27                    | 18        |
| 7/32 (0.219)          | 5.56                                 | 26                    | 17        |
| 3/16 (0.188)          | 4.76                                 | 24                    | 16        |
| 5/32 (0.156)          | 3.97                                 | 22                    | 15        |
| 1/8 (0.125)           | 3.18                                 | 21                    | 14        |
| 3/32 (0.094)          | 2.38                                 | 20                    | 13        |
| 1/18 (0.062)          | 1.59                                 | 18                    | 12        |





# Seamless Tubes

STAINLESS STEEL · NICKEL ALLOYS · TITANIUM · TITANIUM ALLOYS

## MILL'S APPROVALS

In 1989 **TPS** Technitube Röhrenwerke GmbH was the first German producer of seamless stainless steel tubes to be ISO certified. Consequently, **TPS** has more than 14 years of experience with the ISO 9000 system. Therefore, the ISO system is not just a marketing parameter for **TPS**. It is a useful tool, from which both the company **TPS** itself and especially the customers are able to benefit significantly.

**The quality management systems of the following departments of **TPS** are ISO 9002 certified:**

- Manufacture of seamless tubes and U-bends
- Trade of seamless and welded tubes.
- Stock holding of seamless and welded tubes
- Production of OCTG products (Oil Country Tubular Goods), primarily for the oil and gas industry.

Besides the **ISO 9000** approval, **TPS** is approved manufacturer according to Pressure Equipment Directive 97/23/EC Annex 1,4.3. in addition to this **TPS** holds the following approvals:

### Tubes and U-Tubes for pressure vessels:

- UDT Poland
- ISCIR Romania

### For power plants:

- FRAMATOME ANP KTA 1401, QSP 4a and AVS D 100/50

### For shipbuilding:

- GL - Germanischer Lloyd

### For OCTG-Products:

- API 5CT
- API 5D
- API 5L







## The Standards

|                |                                                                                                                                                    |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| ASTM A 213     | Seamless Ferritic+Austenitic Alloy-Steel Boiler, Superheater, and Heat Exchanger Tubes                                                             |
| ASTM A 268     | Seamless and Welded Ferritic+Martensitic Stainless Steel Tubing for General Service                                                                |
| ASTM A 269     | Seamless and Welded Austenitic Stainless Steel Tubing for General Service                                                                          |
| ASTM A 312     | Seamless and Welded Austenitic Stainless Steel Pipes                                                                                               |
| ASTM A 450     | General Requirements for Carbon, Ferritic Alloy, and Austenitic Alloy Steel Tubes                                                                  |
| ASTM A 530     | General Requirements for Specialized Carbon and Alloy Steel Pipe                                                                                   |
| ASTM A 789     | Seamless and Welded Ferritic+Austenitic Stainless Steel Tubing for General Service                                                                 |
| ASTM A 790     | Seamless and Welded Ferritic+Austenitic Stainless Steel Pipe                                                                                       |
| ASTM B 677     | Seamless Pipe and Tube (UNS N08904)                                                                                                                |
| ASTM B 668     | Seamless Tubes (UNS N08028)                                                                                                                        |
| ASTM B 161     | Standard Specification for Nickel seamless Pipes and Tubes                                                                                         |
| ASTM B 163     | Seamless Nickel and Nickel Alloy Condenser and Heat Exchanger Tubes                                                                                |
| ASTM B 165     | Nickel-Copper Alloy Seamless Pipe and Tube                                                                                                         |
| ASTM B 167     | Nickel-Chromium-Iron Alloys Seamless Pipe and Tube                                                                                                 |
| ASTM B 407     | Nickel-Iron-Chromium Alloy Seamless Pipe and Tube                                                                                                  |
| ASTM B 423     | Nickel-Iron-Chromium-Molybdenum-Copper Alloy (UNS N08825) Seamless Pipe and Tube                                                                   |
| ASTM B 337     | Seamless and Welded Titanium and Titanium Alloy Pipe                                                                                               |
| ASTM B 338     | Seamless and Welded Titanium and Titanium Alloy Tubes for Condensers and Heat- Exchangers                                                          |
| DIN 17456      | Seamless Circular Tubes of Stainless Steels with General Quality Requirements; Technical Delivery Conditions                                       |
| DIN 17458      | Seamless Circular Tubes of Stainless Steels with Special Quality Requirements; Technical Delivery Conditions                                       |
| DIN 2462/1     | Seamless Stainless Steel Tubes; Dimensions and Masses per Unit Length                                                                              |
| EN ISO 1127    | Stainless Steel Tubes - Dimensions, Tolerances and Conventional Masses per Unit Length (replaced DIN 2462)                                         |
| DIN 2391       | Seamless Precision Steel Tubes, Technical Delivery Conditions                                                                                      |
| DIN 28180      | Seamless Steel Tubes for Tubular Heat-Exchangers: Dimensions, Tolerances and Materials                                                             |
| DIN 17850      | Titanium, Chemical Composition                                                                                                                     |
| DIN 17861      | Titanium and Titanium Alloy Seamless Circular Tubes; Technical Conditions of Delivery                                                              |
| SEW 400        | Rolled and Forged Stainless Steels                                                                                                                 |
| SEW 470        | Heatresisting Rolled and Forged Steels                                                                                                             |
| VdTÜV-WB 418   | Rolled and Forged Ferritic-Austenitic Steel (1.4462)                                                                                               |
| VdTÜV-WB 421   | Rolled and Forged Austenitic Steel (1.4539)                                                                                                        |
| VdTÜV-WB 230/2 | Tubes Titanium unalloyed and low alloyed                                                                                                           |
| NFA 49117      | Seamless Plain End Tubes for Pipe-Lines and Other Uses. Ferritic and Austenitic Stainless Steels<br>Dimensions - Technical Delivery Conditions     |
| NFA 49217      | Seamless Tubes for Heat-Exchangers - Stainless Ferritic, Austenitic or Ferritaustenitic Steel Grades<br>Dimensions - Technical Delivery Conditions |
| BS 3059        | Steel Boiler and Superheater Tubes                                                                                                                 |
| BS 3605        | Austenitic Stainless Steel Pipes and Tubes for Pressure Purposes                                                                                   |
| BS 3606        | Steel Tubes for Heat Exchangers                                                                                                                    |



## Selection Data

### Standard Grades - Composition - Applications - Properties



Assembled U-tube Heat Exchanger Bundle

#### 1. Austenitic Steels

**TP 304=UNS S30400=1.4301=**

**TPS-INOX-4301-304**

The most popular stainless steel has an economic balance of alloying elements to ensure its good cold formability, corrosion resistance, toughness and good mechanical properties with no excessive work-hardening. It performs well in unpolluted atmospheres but can tarnish or lightly rust in damp atmospheres around some industrial and on/offshore locations. The steel has been used extensively for potable water tubing and in fresh feedwater systems where precautions are taken to avoid crevice attack under deposits, etc. Performance in aerated seawater is not good without adequate galvanic or cathodic protection. Stability and toughness at cryogenic temperatures is high.

**TP 304H=UNS S30409=TPS-INOX-304H**

TP 304H with guaranteed carbon content of min. 0,04% which gives a better creep resistance. Similar oxidation resistance to TP 304. Main applications: Heat exchangers, chemical and petrochemical furnaces.

**TP 304L=UNS S30403=1.4306=**

**TPS-INOX-4306-304L**

Low carbon version of TP 304 guaranteed no creep resistance above 500°C. Good high temperature oxidation resistance up to 900°C. General corrosion characteristics are similar to TP 304. Stability and toughness at cryogenic temperatures is high. Main applications: Pipe and heat exchanger tubes in chemical, petrochemical and food industries.

**TP 316/TP 316L=UNS S31600/31603=1.4401/1.4404=TPS-INOX-4401/4404-316/316L**

These grades belong to the family of 17%Cr12-13%Ni steels containing 2,0-3,0%Mo. This standard grade is used where specific attributes of other members of the family are not necessary - eg. no likelihood of intercrystalline corrosion caused by welding. Special for TP 316L, low carbon content, minimizes chromium carbide precipitation and improves resistance to intercrystalline corrosion. After TP 304/304L type steels, these TP 316/316L grades are the most widely used austenitics. Good high temperature oxidation resistance up to 900°C. In the damp industrial or onshore atmospheres of Europe, they perform better than TP 304/304L and ferritic grades. In low temperature seawater they offer limited resistance to pitting but are susceptible to crevice attack. Their short- and long-time properties at elevated temperatures are also superior to those of comparable TP 304/304L grades. Main applications: Pipe and heat exchanger tubes in chemical and petrochemical plant, in boilers and food industry.



## Selection Data

### Standard Grades - Composition - Applications - Properties

TP 316H=UNS S31609=**TPS**-INOX-316H

This grade with guaranteed carbon content of min. 0,04% enhances strength at elevated temperatures. Similar oxidation resistance to TP 316.  
Main applications: Heat exchangers, furnaces, chemical and petrochemical plant.







# Seamless Tubes

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## Selection Data

Standard Grades - Composition - Applications - Properties

### TP 321=UNS S32100=1.4541=~~TPS~~-INOX-4541-321

High carbon steels prone more to intercrystalline attack in weld zones and slower cooling sections. These steel avoids such attacks through its stabilization with Ti. The corrosion behaviour of this alloy in natural environments is very similar to the TP 304/304L alloys. Architecturally, it may not be adequate for near-industrial or onshore locations in Europe. Satisfactory in many low-chloride waters, it is prone to pitting or crevice corrosion in seawater. Water treatment, galvanic protection and deaeration can influence the performance.

### TP 321H=UNS S32100=1.4878=~~TPS~~-INOX-4878-321H

This is the high carbon version of TP 321 which ensures greater creep resistance. Behaves much the same as TP 321 in oxidation resistance. Main applications: Heat exchangers, furnaces, boilers in chemical and petrochemical plant.

### TP 316Ti=UNS S31635=1.4571=~~TPS~~-INOX-4571-316Ti

This is one of the family of 17%Cr12-13%Ni steels containing Mo of 2,0-2,4% stabilized with Ti which minimizes chromium carbide precipitation and improves resistance to intergranular corrosion. In the damp industrial or coastal atmospheres of Europe, they perform better than TP 304/304L and ferritic grades. In low temperature seawater they offer limited resistance to pitting but are susceptible to crevice attack. Their short- and long-time properties at elevated temperatures are also superior to those of comparable TP 304/304L grades.

## 2. Super-Austenitic Steels

### TP 904L=UNS N08904=1.4539=~~TPS~~-Technichromo 904L

This high-alloy austenitic is very resistant to attack from diluted sulphuric acid, phosphoric acid and acetic acid. It resists pitting in neutral chloride solutions. Its resistance to stress corrosion cracking in some hot chlorides is much superior to that of the lower nickel austenites. This steel has good formability and weldability. This material is present in all common standards like ASTM, DIN, BS and NFA, however with some differences. Design stresses up to 370°C are included in ASME II.





## Selection Data

Standard Grades - Composition - Applications - Properties

### 3. Ferritic and Martensitic Steel

**TP 405=UNS S40500=1.4002=TPS-FS-4002-405**

TP 405 is a low carbon, 12% chrome steel, not subject to appreciable hardening through air cooling from high temperatures. This tendency retards the formation of hardening cracks caused by welding. Practically the same corrosion and oxidation resistance as TP 410. Can be machined, drawn, spun and formed without difficulty. Used for applications where hardening upon cooling from high temperatures must be avoided. Has excellent long-time stability up to 1200°F.

**TP 410=UNS S41000=1.4006=TPS-FS-4006-410**

This 12% chrome steel is very deep hardening, meaning that hard martensite is formed at cooling rates as slow as 20°C/minute. The hard brittle martensites require prompt tempering at a high enough temperature to improve impact properties. Increasing nickel achieves a better combination of properties. Not very resistant to aerated seawater. Welding is limited because high preheat and immediate postweld tempering is necessary to minimize the risk of hardzone cracking. Type 410 is not equal to the austenitic steels in corrosion resistance, but satisfactorily withstands the effects of the milder acids, alkalis, fresh water and atmospheric conditions. It is the least costly of the stainless steels, containing just enough to yield stainless properties.



Tube straightener

### 4. Duplex

**UNS S31803=1.4462=TPS-Techniduplex TD2205**

A widely used duplex steel combining high strength and corrosion resistance in various organic acids, anorganic acids, aggressive coolingwaters and hydrous H<sub>2</sub>S/NaCl mixtures. With a near equal mix of austenite and ferrite, they give yield strength 30% higher and tensile strengths marginally higher than comparable nitrogen-containing austenitics. High resistance to general corrosion and specifically to pitting and crevice corrosion. Their resistance to stress-corrosion cracking in neutral chlorides is superior to that of the austenites. In high chloride acidic or moderately sour environments where hydrogen or sulphide stress cracking is more likely, higher alloyed austenitics need also to be considered. Impact values are high and transition temperatures of base materials vary around -50°C. However, the proportion and orientation of ferrite in welds and base materials may significantly affect toughness at subzero temperatures. Exposure to moderate and high temperatures and less rapid cooling may cause embrittlement.



Eddy current testing equipment

### 5. Super Duplex

**UNS S32760=TPS-Technisuperduplex TSD2507**

UNS S32760 (TSD2507) is a super ferritic-austenitic grade with high mechanical properties and superior corrosion resistance. Besides the ferritic-austenitic structure, TSD2507 has an excellent resistance to pitting and crevice corrosion and is therefore particularly suitable for sea water applications and for process systems on off-shore platforms, respectively in all situations where there is a risk of stress corrosion. The high tensile properties are twice comparing with TP 316 L stainless steel. The service range is between - 50° C up to + 275° C. More detailed informations about this particular grade are described in our TSD 2507 data sheet.

### 6. Nickel Alloys

**UNS N02200=2.4066=TPS-TECHALLOY 200**

TECHALLOY 200 is technically pure nickel with good mechanical properties and excellent resistance to corrosive media. Even when exposed to high temperatures, TECHALLOY 200 retains its strength and is ductile at low temperatures. TECHALLOY 200 is a multipurpose grade and is used in applications where alloys are not essential. It also has good magnetic and magnetostrictive properties, high thermal and electrical conductivity as well as low gas content in electronics industry. Furthermore TECHALLOY 200 is of interest for its good weldability.



# Seamless Tubes

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## Chemical composition, mechanical properties and heat treatment

| 1. Austenitic Steels                                    |              |                      |      |      |       |       |             |             |           |              |
|---------------------------------------------------------|--------------|----------------------|------|------|-------|-------|-------------|-------------|-----------|--------------|
| Norm                                                    | Grade        | Chemical composition |      |      |       |       |             |             |           |              |
|                                                         |              | C                    | Si   | Mn   | P     | S     | Cr          | Ni          | Mo        | Ti           |
|                                                         |              | max.                 | max. | max. | max.  | max.  | min-max     | min-max     | min-max   |              |
| ASTM A 213                                              | TP 304       | 0,080                | 1,00 | 2,00 | 0,040 | 0,030 | 18,0 - 20,0 | 8,0 - 10,5  | -         | -            |
| DIN 17456/17458                                         | 1. 4301      | 0,070                | 1,00 | 2,00 | 0,045 | 0,030 | 17,0 - 19,0 | 8,5 - 10,5  | -         | -            |
| NF A 49217                                              | Z 6 CN1809   | 0,080                | 1,00 | 2,00 | 0,040 | 0,030 | 17,0 - 20,0 | 8,0 - 11,0  | -         | -            |
| BS 3606                                                 | 304 S31      | 0,070                | 1,00 | 2,00 | 0,040 | 0,030 | 17,0 - 19,0 | 8,0 - 11,0  | -         | -            |
| ASTM A 213                                              | TP 304H      | 0,04 - 0,10          | 0,75 | 2,00 | 0,040 | 0,030 | 18,0 - 20,0 | 8,0 - 11,0  | -         | -            |
| ASTM A 213                                              | TP 304 L     | 0,030                | 1,00 | 2,00 | 0,040 | 0,030 | 18,0 - 20,0 | 8,0 - 12,0  | -         | -            |
| DIN 17456/17458                                         | 1. 4306      | 0,030                | 1,00 | 2,00 | 0,045 | 0,030 | 18,0 - 20,0 | 10,0 - 12,5 | -         | -            |
| NF A 49217                                              | Z 2 CN1810   | 0,030                | 1,00 | 2,00 | 0,040 | 0,030 | 17,0 - 20,0 | 9,0 - 12,0  | -         | -            |
| BS 3606                                                 | 304 S11      | 0,030                | 1,00 | 2,00 | 0,040 | 0,030 | 17,0 - 19,0 | 9,0 - 12,0  | -         | -            |
| ASTM A 213                                              | TP 316       | 0,080                | 1,00 | 2,00 | 0,040 | 0,030 | 16,0 - 18,0 | 10,0 - 14,0 | 2,0 - 3,0 | -            |
| DIN 17456/17458                                         | 1. 4401      | 0,070                | 1,00 | 2,00 | 0,045 | 0,030 | 16,5 - 18,5 | 10,5 - 13,5 | 2,0 - 2,5 | -            |
| NF A 49217                                              | Z 2 CND1711  | 0,070                | 1,00 | 2,00 | 0,040 | 0,030 | 16,0 - 18,0 | 10,0 - 12,5 | 2,0 - 2,4 | -            |
| BS 3606                                                 | 316 S31      | 0,070                | 1,00 | 2,00 | 0,040 | 0,030 | 16,5 - 18,5 | 10,5 - 13,5 | 2,0 - 2,5 | -            |
| ASTM A 213                                              | TP 316 L     | 0,030                | 1,00 | 2,00 | 0,040 | 0,030 | 16,0 - 18,0 | 10,0 - 14,0 | 2,0 - 3,0 | -            |
| DIN 17456/17458                                         | 1. 4404      | 0,030                | 1,00 | 2,00 | 0,045 | 0,030 | 16,5 - 18,5 | 11,0 - 14,0 | 2,0 - 2,5 | -            |
| NF A 49217                                              | Z 2 CND1712  | 0,030                | 1,00 | 2,00 | 0,040 | 0,030 | 16,0 - 18,0 | 10,5 - 13,0 | 2,0 - 2,4 | -            |
| BS 3606                                                 | 316 S11      | 0,030                | 1,00 | 2,00 | 0,040 | 0,030 | 16,5 - 18,5 | 11,0 - 14,0 | 2,0 - 2,5 | -            |
| ASTM A213/A240                                          | TP 316L-Mo   | 0,030                | 0,75 | 2,00 | 0,040 | 0,030 | 16,0 - 18,0 | 10,0 - 14,0 | 2,0 - 3,0 | -            |
| DIN 17456/17458                                         | 1. 4435      | 0,030                | 1,00 | 2,00 | 0,045 | 0,025 | 17,0 - 18,5 | 12,5 - 15,0 | 2,5 - 3,0 | -            |
| *NF A 35575                                             | Z 2 CND1713  | 0,030                | 1,00 | 2,00 | 0,040 | 0,030 | 16,0 - 18,0 | 10,5 - 13,0 | 2,0 - 2,4 | -            |
| BS 3606                                                 | 316 S33      | 0,030                | 1,00 | 2,00 | 0,040 | 0,030 | 16,5 - 18,5 | 11,0 - 14,0 | 2,5 - 3,0 | -            |
| ASTM A 213                                              | TP 321       | 0,080                | 1,00 | 2,00 | 0,040 | 0,030 | 17,0 - 19,0 | 9,0 - 12,0  | -         | 5x%C         |
| DIN 17456/17458                                         | 1. 4541      | 0,080                | 1,00 | 2,00 | 0,045 | 0,030 | 17,0 - 19,0 | 9,0 - 12,0  | -         | 5x%C max.0,8 |
| NF A 49217                                              | Z 6 CNT1810  | 0,080                | 1,00 | 2,00 | 0,040 | 0,030 | 17,0 - 20,0 | 9,0 - 12,0  | -         | 5x%C max.0,6 |
| BS 3606                                                 | 321 S31      | 0,080                | 1,00 | 2,00 | 0,040 | 0,030 | 17,0 - 19,0 | 9,0 - 12,0  | -         | 5x%C max.0,8 |
| ASTM A 213                                              | TP 321H      | 0,04 - 0,10          | 1,00 | 2,00 | 0,040 | 0,030 | 17,0 - 19,0 | 9,0 - 13,0  | -         | 5x%C max.0,6 |
| **SEW 470                                               | 1. 4878      | 0,120                | 1,00 | 2,00 | 0,045 | 0,030 | 17,0 - 19,0 | 9,0 - 12,0  | -         | 4x%C max.0,8 |
| *ASTM A 240                                             | TP 316 Ti    | 0,080                | 0,75 | 2,00 | 0,045 | 0,030 | 16,0 - 18,0 | 10,0 - 14,0 | 2,0 - 3,0 | 5x%C         |
| DIN 17456/17458                                         | 1. 4571      | 0,080                | 1,00 | 2,00 | 0,045 | 0,030 | 16,5 - 18,5 | 10,5 - 13,5 | 2,0 - 2,5 | 5x%C         |
| NF A 49217                                              | Z 6 CNDT1712 | 0,080                | 1,00 | 2,00 | 0,040 | 0,030 | 16,0 - 18,0 | 10,5 - 13,0 | 2,0 - 2,4 | 5x%C max.0,6 |
| * tubes manufactured and tested according to ASTM A 213 |              |                      |      |      |       |       |             |             |           |              |
| ** tubes manufactured and tested according to DIN 17456 |              |                      |      |      |       |       |             |             |           |              |
| *** tubes manufactured and tested acc. to NFA 49217     |              |                      |      |      |       |       |             |             |           |              |
| 2. Super-Austenitic Steels                              |              |                      |      |      |       |       |             |             |           |              |
| Norm                                                    | Grade        | Chemical composition |      |      |       |       |             |             |           |              |
|                                                         |              | C                    | Si   | Mn   | P     | S     | Cr          | Ni          | Mo        | Ti           |
|                                                         |              | max.                 | max. | max. | max.  | max.  | min-max     | min-max     | min-max   |              |
| ASTM B 677                                              | UNS 8904     | 0,020                | 1,00 | 2,00 | 0,045 | 0,035 | 19,0 - 23,0 | 23,0 - 28,0 | 4,0 - 5,0 | -            |
| VDTÜV 421                                               | 1. 4539      | 0,020                | 0,70 | 2,00 | 0,030 | 0,015 | 19,0 - 21,0 | 24,0 - 26,0 | 4,0 - 5,0 | -            |
| NF A 49217                                              | Z 1 NCDU25.2 | 0,020                | 1,05 | 2,04 | 0,035 | 0,025 | 19,0 - 22,2 | 24,0 - 27,2 | 4,0 - 5,1 | -            |



## Chemical composition, mechanical properties and heat treatment

| Mechanical properties and heat treatment |                |                |            |      |          |                  |
|------------------------------------------|----------------|----------------|------------|------|----------|------------------|
| Others                                   | Rp 0,2 N/sq.mm | Rp 1,0 N/sq.mm | Rm N/sq.mm | A5 % | Hardness | Heat treatment   |
|                                          | min.           | min.           | min-max    | min. | HRB max. |                  |
| -                                        | 205            | -              | 515        | 35   | 90       | solution 1070° C |
| -                                        | 195            | 230            | 500 - 700  | 40   | -        | solution 1070° C |
| -                                        | 200            | -              | 490 - 740  | 45   | 90       | solution 1070° C |
| -                                        | 235            | -              | 490 - 690  | 30   | -        | solution 1070° C |
| -                                        | 205            | -              | 515        | 35   | 90       | solution 1040° C |
| -                                        | 170            | -              | 485        | 35   | 90       | solution 1070° C |
| -                                        | 180            | 215            | 460 - 680  | 40   | -        | solution 1070° C |
| -                                        | 175            | -              | 470 - 720  | 45   | 90       | solution 1070° C |
| -                                        | 205            | -              | 490 - 690  | 30   | -        | solution 1070° C |
| -                                        | 205            | -              | 515        | 35   | 90       | solution 1070° C |
| -                                        | 205            | 240            | 510 - 710  | 40   | -        | solution 1070° C |
| -                                        | 190            | -              | 490 - 740  | 45   | 90       | solution 1070° C |
| -                                        | 215            | -              | 490 - 690  | 30   | -        | solution 1070° C |
| -                                        | 170            | -              | 485        | 35   | 90       | solution 1070° C |
| -                                        | 190            | 225            | 490 - 690  | 40   | -        | solution 1070° C |
| -                                        | 175            | -              | 470 - 720  | 45   | 90       | solution 1070° C |
| -                                        | 215            | -              | 490 - 690  | 30   | -        | -                |
| -                                        | 205            | -              | 515        | 35   | 90       | solution 1040° C |
| -                                        | 190            | 225            | 490 - 690  | 40   | -        | solution 1070° C |
| -                                        | 195            | -              | 480 - 680  | 45   | -        | -                |
| -                                        | 245            | -              | 510 - 710  | 30   | -        | solution 1070° C |
| -                                        | 205            | -              | 515        | 35   | 90       | solution 1070° C |
| -                                        | 200            | 235            | 500 - 730  | 35   | -        | solution 1070° C |
| -                                        | 190            | -              | 490 - 740  | 45   | 90       | solution 1070° C |
| -                                        | 245            | -              | 510 - 710  | 30   | -        | -                |
| -                                        | 205            | -              | 515        | 35   | 90       | solution 1100° C |
| -                                        | 210            | -              | 500 - 750  | 40   | 90       | quenched         |
| -                                        | 205            | -              | 515        | 35   | 90       | solution 1070° C |
| -                                        | 210            | 245            | 500 - 730  | 35   | -        | solution 1070° C |
| -                                        | 190            | -              | 490 - 740  | 45   | 90       | solution 1070° C |
|                                          |                |                |            |      |          |                  |
| Mechanical properties and heat treatment |                |                |            |      |          |                  |
| Others                                   | Rp 0,2 N/sq.mm | Rp 1,0 N/sq.mm | Rm N/sq.mm | A5 % | Hardness | Heat treatment   |
|                                          | min.           | min.           | min-max    | min. | HRB max. |                  |
| Cu 1,00 - 2,00                           | 220            | -              | 490        | 35   | 35       | solution 1070° C |
| Cu 1,00 - 2,00                           | 220            | 250            | 520 - 720  | 35   | -        | solution 1070° C |
| Cu 1,00 - 2,00                           | 230            | -              | 550 - 700  | 40   | -        | solution 1070° C |

Rp 0,2 = Yield Strength - ASTM Standards  
 Rp 1,0 = Yield Strength - DIN Standards  
 Rm = Tensile Strength



# Seamless Tubes

STAINLESS STEEL · NICKEL ALLOYS · TITANIUM · TITANIUM ALLOYS

## Chemical composition, mechanical properties and heat treatment

### 3. Ferritic and Martensitic Steel

| Norm         | Grade    | Chemical composition |      |      |       |       |             |         |         |    |
|--------------|----------|----------------------|------|------|-------|-------|-------------|---------|---------|----|
|              |          | C                    | Si   | Mn   | P     | S     | Cr          | Ni      | Mo      | Ti |
|              |          | max.                 | max. | max. | max.  | max.  | min-max     | min-max | min-max |    |
| ASTM A 268   | TP 405   | 0,080                | 1,00 | 1,00 | 0,040 | 0,030 | 11,5 - 14,5 | 0,500   | -       | -  |
| DIN 17456    | 1. 4002  | 0,080                | 1,00 | 1,00 | 0,045 | 0,030 | 12,0 - 14,0 | -       | -       | -  |
| *NF A 35574  | Z 6 CA13 | 0,080                | 1,00 | 1,00 | 0,040 | 0,030 | 11,5 - 13,5 | -       | -       | -  |
| ASTM A 268   | TP 410   | 0,150                | 1,00 | 1,00 | 0,040 | 0,030 | 11,5 - 13,5 | -       | -       | -  |
| DIN 17456    | 1. 4006  | 0,08 - 0,12          | 1,00 | 1,00 | 0,045 | 0,030 | 12,0 - 14,0 | -       | -       | -  |
| NF A 49217   | Z 12 C13 | 0,150                | 1,00 | 1,00 | 0,040 | 0,030 | 11,5 - 13,5 | 0,500   | -       | -  |
| **ASTM A 240 | TP 410S  | 0,080                | 1,00 | 1,00 | 0,040 | 0,030 | 11,5 - 13,5 | -       | -       | -  |

\* tubes manufactured and tested according to NFA 49217

\*\* tubes manufactured and tested according to ASTM A 268

### 4. Duplex

| Norm       | Grade        | Chemical composition |      |      |       |       |             |           |           |    |
|------------|--------------|----------------------|------|------|-------|-------|-------------|-----------|-----------|----|
|            |              | C                    | Si   | Mn   | P     | S     | Cr          | Ni        | Mo        | Ti |
|            |              | max.                 | max. | max. | max.  | max.  | min-max     | min-max   | min-max   |    |
| ASTM A789  | UNS S31803   | 0,030                | 1,00 | 2,00 | 0,030 | 0,020 | 21,0 - 23,0 | 4,5 - 6,5 | 2,5 - 3,5 | -  |
| VDTÜV 418  | 1. 4462      | 0,030                | 1,00 | 2,00 | 0,030 | 0,020 | 21,0 - 23,0 | 4,5 - 6,5 | 2,5 - 3,5 | -  |
| NF A 49217 | Z 2 CND22.05 | 0,030                | 1,05 | 2,04 | 0,035 | 0,025 | 21,0 - 23,2 | 4,5 - 6,7 | 2,5 - 3,6 | -  |

### 5. Super Duplex

| Norm           | Grade      | Chemical composition |      |      |       |       |             |           |           |    |
|----------------|------------|----------------------|------|------|-------|-------|-------------|-----------|-----------|----|
|                |            | C                    | Si   | Mn   | P     | S     | Cr          | Ni        | Mo        | Ti |
|                |            | max.                 | max. | max. | max.  | max.  | min-max     | min-max   | min-max   |    |
| ASTM-A 789/790 | UNS S32760 | 0,030                | 1,00 | 1,00 | 0,030 | 0,010 | 24,0 - 26,0 | 6,0 - 8,0 | 3,0 - 4,0 | -  |

### 6. Nickel Alloys

| Norm            | Grade      | Chemical composition |      |      |       |       |             |             |           |                |
|-----------------|------------|----------------------|------|------|-------|-------|-------------|-------------|-----------|----------------|
|                 |            | C                    | Si   | Mn   | P     | S     | Cr          | Ni          | Mo        | Ti             |
|                 |            | max.                 | max. | max. | max.  | max.  | min-max     | min-max     | min-max   |                |
| ASTM B 161/163  | Alloy 200  | 0,15                 | 0,35 | 0,35 | -     | 0,01  | -           | 99,0 min.   | -         | -              |
| DIN 17751       | 2. 4066    | 0,08                 | -    | -    | -     | -     | -           | 99,2 min.   | -         | -              |
| UNS Grade       | N02200     | 0,15                 | 0,35 | 0,35 | -     | 0,01  | -           | 99,0 min.   | -         | -              |
| ASTM B 163/165  | Alloy 400  | 0,300                | 0,50 | 2,00 | -     | 0,024 | -           | 63,0 min.   | -         | -              |
| DIN 17743/17751 | 2. 4360    | 0,150                | 0,50 | 2,00 | -     | 0,020 | -           | 63,0 min.   | -         | -              |
| UNS-Grade       | N 04400    | 0,300                | 0,50 | 2,00 | -     | 0,024 | -           | 63,0 min.   | -         | -              |
| ASTM B 163/167  | Alloy 600  | 0,150                | 0,50 | 1,00 | -     | 0,015 | 14,0 - 17,0 | 72,0 min.   | -         | -              |
| DIN 17742/17751 | 2. 4816    | 0,025-0,100          | 0,50 | 1,00 | 0,020 | 0,015 | 14,0 - 17,0 | 72,0 min.   | -         | 0,30 max.      |
| UNS-Grade       | N 06600    | 0,150                | 0,50 | 1,00 | -     | 0,015 | 14,0 - 17,0 | 72,0 min.   | -         | -              |
| ASTM B 163/407  | Alloy 800  | 0,100                | 1,00 | 1,50 | 0,030 | 0,015 | 19,0 - 23,0 | 30,0 - 35,0 | -         | 0,15 - 0,60    |
| *SEW 470        | 1. 4876    | 0,120                | 1,00 | 2,00 | 0,030 | 0,020 | 19,0 - 23,0 | 30,0 - 34,0 | -         | -              |
| UNS-Grade       | N 08800    | 0,100                | 1,00 | 1,50 | 0,030 | 0,015 | 19,0 - 23,0 | 30,0 - 35,0 | -         | 0,15 - 0,60    |
| ASTM B 163/423  | Alloy 825  | 0,050                | 0,50 | 1,00 | -     | 0,030 | 19,5 - 23,5 | 38,0 - 46,0 | 2,5 - 3,5 | 0,60 - 1,20    |
| DIN 17744/17751 | 2. 4858    | 0,025                | 0,50 | 1,00 | 0,025 | 0,015 | 19,5 - 23,5 | 38,0 - 46,0 | 2,5 - 3,5 | 0,60 - 1,20    |
| UNS-Grade       | N 08825    | 0,050                | 0,50 | 1,00 | -     | 0,030 | 19,5 - 23,5 | 38,0 - 46,0 | 2,5 - 3,5 | 0,6-1,2 ≥ 20xC |
| ASTM B 729/829  | Alloy 8020 | 0,070                | 1,00 | 2,00 | 0,045 | 0,035 | 19,0 - 21,0 | 32,0 - 38,0 | 2,0 - 3,0 |                |
| DIN E 17744     | 2.4660     | 0,070                | 1,00 | 2,00 | 0,025 | 0,015 | 19,0 - 21,0 | 32,0 - 38,0 | 2,0 - 3,0 | Co 1,50        |
| UNS-Grade       | N 08020    | 0,070                | 1,00 | 2,00 | 0,045 | 0,035 | 19,0 - 21,0 | 32,0 - 38,0 | 2,0 - 3,0 |                |

\* tubes manufactured and tested according to DIN 17456





## Chemical composition, mechanical properties and heat treatment

| Mechanical properties and heat treatment |                |                |            |      |          |                     |
|------------------------------------------|----------------|----------------|------------|------|----------|---------------------|
| Others                                   | Rp 0,2 N/sq.mm | Rp 1,0 N/sq.mm | Rm N/sq.mm | A5 % | Hardness | Heat treatment      |
|                                          | min.           | min.           | min-max    | min. | HRB max. |                     |
| Al 0.1 - 0.3                             | 205            | -              | 415        | 20   | 90       | annealed 780° C     |
| Al 0.1 - 0.3                             | 250            | -              | 400 - 600  | 20   | -        | annealed 780° C     |
| Al 0.1 - 0.3                             | 225            | -              | 420 - 620  | 20   | -        | annealed 750-780° C |
| -                                        | 215            | -              | 415        | 20   | 90       | annealed 780° C     |
| -                                        | 250            | -              | 450 - 650  | 20   | -        | annealed 780° C     |
| -                                        | 210            | -              | 420 - 670  | 17   | -        | annealed 780° C     |
| -                                        | 205            | -              | 415        | 30   | 89       | annealed 780° C     |
| Mechanical properties and heat treatment |                |                |            |      |          |                     |
| Others                                   | Rp 0,2 N/sq.mm | Rp 1,0 N/sq.mm | Rm N/sq.mm | A5 % | Hardness | Heat treatment      |
|                                          | min.           | min.           | min-max    | min. | HRC max. |                     |
| N 0.08 - 0.20                            | 450            | -              | 620        | 25   | 31       | solution 1070° C    |
| N 0.08 - 0.20                            | 450            | -              | 540 - 880  | 22   | -        | solution 1070° C    |
| -                                        | 450            | -              | 680 - 880  | 25   | -        | solution 1070° C    |
| Mechanical properties and heat treatment |                |                |            |      |          |                     |
| Others                                   | Rp 0,2 N/sq.mm | Rp 1,0 N/sq.mm | Rm N/sq.mm | A5 % | Hardness | Heat treatment      |
|                                          |                | min.           | min.       | min. | HRC max. |                     |
| N 0,2-0,3; Cu 0,5-1,0; W 0,5-1,0         | 750 - 895      | -              | 550        | 25   | 30       | solution 1100° C    |
| Mechanical properties and heat treatment |                |                |            |      |          |                     |
| Others                                   | Rp 0,2 N/sq.mm | Rp 1,0 N/sq.mm | Rm N/sq.mm | A5 % | Hardness | Heat treatment      |
|                                          | min.           | min.           | min-max    | min. | HRB max. |                     |
| Cu 0,25max.                              | 105            | -              | 380        | 35   | -        | annealed            |
| -                                        | 100            | 125            | 370        | 40   | -        | annealed            |
| Cu 0,25max.                              | 105            | -              | 380        | 35   | -        | annealed            |
| Cu 28,0-34,0; Fe 2,5max.                 | 193            | -              | 621        | 32   | 80       | annealed            |
| Cu 28,0-34,0; Fe 1,0-2,5; Al 0,5max.     | 180            | 210            | min. 450   | 35   | 80       | annealed            |
| Cu 28,0-34,0; Fe 2,5max.                 | 193            | -              | 621        | 32   | 80       | annealed            |
| Cu 0,5max.; Fe 6,0-10,0                  | 241            | -              | 552 - 758  | 35   | 92       | annealed            |
| Cu 0,5max.; Fe 6,0-10,0                  | 180            | 210            | min. 500   | 35   | 90       | annealed            |
| Cu 0,5max.; Fe 6,0-10,0                  | 241            | -              | 552 - 758  | 35   | 92       | annealed            |
| Cu 0,75max.; Al 0,15-0,6; Fe 39,5 min    | 207            | -              | 517 - 688  | 30   | 95       | annealed            |
| -                                        | 170            | -              | 450 - 700  | 30   | 90       | annealed            |
| Cu 0,75max.; Al 0,15-0,6; Fe 39,5 min    | 207            | -              | 517 - 688  | 30   | 95       | annealed            |
| Cu 1,5-3,0; Al 0,2max.; Fe 22,0min.      | 241            | -              | 586 - 793  | 30   | 90       | annealed            |
| Co 1,0; Cu 1,5-3,0; Al 0,2; Fe Rest      | 235            | 265            | min. 550   | 30   | 90       | annealed            |
| Cu 1,5-3,0; Al 0,2max.; Fe Rest          | 241            | -              | 586 - 793  | 30   | 90       | annealed            |
| Cu 3-4; Nb+Ta 8xC max.1,0; Fe Rest       | 240            | -              | min. 550   | 30   | 80       | annealed            |
| Cu 3-4; Nb+Ta 8xC max.1,0; Fe Rest       | 240            | -              | min. 550   | 30   | 80       | annealed            |
| Cu 3-4; Nb+Ta 8xC max.1,0; Fe Rest       | 240            | -              | min. 550   | 30   | 80       | annealed            |



# Seamless Tubes

STAINLESS STEEL · NICKEL ALLOYS · TITANIUM · TITANIUM ALLOYS

## Chemical composition, mechanical properties and heat treatment

| ASTM Grade<br>(sim. DIN Grade) | Chemical composition |            |            |             |            |             |            |             |           |           |
|--------------------------------|----------------------|------------|------------|-------------|------------|-------------|------------|-------------|-----------|-----------|
|                                | N<br>% max           | C<br>% max | H<br>% max | Fe<br>% max | O<br>% max | Al<br>% max | V<br>% max | Pa          | Mo        | Ni        |
| ASTM B 338 Grade 1             | 0,03                 | 0,08       | 0,015      | 0,20        | 0,18       | -           | -          | -           | -         | -         |
| DIN 17861 Ti 1 - 3.7025        | 0,05                 | 0,06       | 0,013*     | 0,15        | 0,12       | -           | -          | -           | -         | -         |
| VdTÜV 230/2                    |                      |            |            |             |            |             |            |             |           |           |
| ASTM B 338 Grade 2             | 0,03                 | 0,08       | 0,015      | 0,30        | 0,25       | -           | -          | -           | -         | -         |
| DIN 17861 Ti2 - 3.7035         | 0,05                 | 0,06       | 0,013*     | 0,20        | 0,18       | -           | -          | -           | -         | -         |
| VdTÜV 230/2                    |                      |            |            |             |            |             |            |             |           |           |
| ASTM B 338 Grade 3             | 0,05                 | 0,08       | 0,015      | 0,30        | 0,35       | -           | -          | -           | -         | -         |
| DIN 17861 Ti 3 - 3.7055        | 0,05                 | 0,06       | 0,013*     | 0,25        | 0,25       | -           | -          | -           | -         | -         |
| VdTÜV 230/2                    |                      |            |            |             |            |             |            |             |           |           |
| ASTM B 338 Grade 7             | 0,03                 | 0,08       | 0,015      | 0,30        | 0,25       | -           | -          | 0,12 - 0,25 | -         | -         |
| DIN 17861 Ti 2 Pd - 3.7235     | 0,05                 | 0,06       | 0,013*     | 0,20        | 0,18       | -           | -          | 0,05 - 0,25 | -         | -         |
| VdTÜV 230/2                    |                      |            |            |             |            |             |            |             |           |           |
| ASTM B 338 Grade 9             | 0,02                 | 0,08       | 0,015      | 0,25        | 0,15       | 2,5 - 3,5   | 2,0 - 3,0  | -           | -         | -         |
| ASTM B 338 Grade 11            | 0,03                 | 0,08       | 0,015      | 0,20        | 0,18       | -           | -          | 0,12 - 0,25 | -         | -         |
| DIN 17861 Ti1 Pd - 3.7225      | 0,05                 | 0,06       | 0,013*     | 0,20        | 0,18       | -           | -          | 0,15 - 0,25 | -         | -         |
| VdTÜV 230/2                    |                      |            |            |             |            |             |            |             |           |           |
| ASTM B 338 Grade 12            | 0,03                 | 0,08       | 0,015      | 0,30        | 0,25       | -           | -          | -           | 0,2 - 0,4 | 0,6 - 0,9 |
| DIN 17861 Ti AL3V2,5 - 3.7195  | 0,04                 | 0,05       | 0,015      | 0,30        | 0,12       | 2,5 - 3,5   | 2,0 - 3,0  | -           | -         | -         |

\* In case wallthickness is under 2 mm, the Hydrogenium-content up to 0,015 % is allowed.

## ASTM GRADES

### ALLOY FEATURES

#### Grade 1 (unalloyed Titanium):

used to increase formability.

#### Grade 2 (unalloyed Titanium):

the most common Titanium grade for cooling water systems; good strength with high ductility, formability, weldability and corrosion resistance.

#### Grade 3 (unalloyed Titanium):

specified when higher levels of strength are required.

#### Grade 7 (unalloyed Titanium):

enhanced resistance to hot brine crevice corrosion and reducing acids, mechanical properties similar to grade 2 alloy.

#### Grade 9 (Titanium alloy):

offers excellent corrosion resistance to sea water and is medium-high strength alloy with highest code design allowables.

#### Grade 11 (unalloyed Titanium):

mechanical properties are the same as those of grade 1 however, with greater resistance to corrosion against acid chlorides.

#### Grade 12 (Titanium alloy):

more resistant even at temperatures up to 300 °C with improved strength and code design allowables over grade 2.





## Chemical composition, mechanical properties and heat treatment

|                    |                     |          | Mechanical properties and heat treatment |                        |                         |               |                |
|--------------------|---------------------|----------|------------------------------------------|------------------------|-------------------------|---------------|----------------|
| Residuals/<br>Each | Residuals/<br>Total | Titanium | Rp 0,2 N/sq.mm<br>min. max.              | Rp 1,0 N/sq.mm<br>min. | Rm N/sq.mm<br>min. max. | A 5 %<br>min. | Heat Treatment |
| 0,1                | 0,4                 | Rem.     | 170 - 310                                | -                      | 240 min.                | 24            | annealed       |
| 0,1                | 0,4                 | Rem.     | 180                                      | 200                    | 290 - 410               | 30            | soft annealed  |
|                    |                     |          |                                          |                        |                         |               |                |
| 0,1                | 0,4                 | Rem.     | 275 - 450                                | -                      | 345 min.                | 20            | annealed       |
| 0,1                | 0,4                 | Rem.     | 250                                      | 270                    | 390 - 540               | 22            | soft annealed  |
|                    |                     |          |                                          |                        |                         |               |                |
| 0,1                | 0,4                 | Rem.     | 380 - 550                                | -                      | 450 min.                | 18            | annealed       |
| 0,1                | 0,4                 | Rem.     | 320                                      | 350                    | 460 - 590               | 18            | soft annealed  |
|                    |                     |          |                                          |                        |                         |               |                |
| 0,1                | 0,4                 | Rem.     | 275 - 450                                | -                      | 345 min.                | 20            | annealed       |
| 0,1                | 0,4                 | Rem.     | 250                                      | 270                    | 390 - 540               | 22            | soft annealed  |
|                    |                     |          |                                          |                        |                         |               |                |
| 0,1                | 0,4                 | Rem.     | 725                                      | -                      | 860                     | 10            | annealed       |
|                    |                     |          |                                          |                        |                         |               |                |
| 0,1                | 0,4                 | Rem.     | 170 - 310                                | -                      | 240                     | 24            | annealed       |
| 0,1                | 0,4                 | Rem.     | 320                                      | 350                    | 460 - 590               | 18            | soft annealed  |
|                    |                     |          |                                          |                        |                         |               |                |
| 0,1                | 0,4                 | Rem.     | 345                                      | -                      | 483                     | 18            | annealed       |
| 0,1                | 0,4                 | Rem.     | 520                                      | -                      | 620 min.                | 15*           | soft annealed  |
|                    |                     |          |                                          |                        |                         |               |                |

\* Wall thickness under 1 mm 12 %



View of pilger process area



# Seamless Tubes

STAINLESS STEEL · NICKEL ALLOYS · TITANIUM · TITANIUM ALLOYS

## COMPARISON OF TOLERANCES

### Pipes and Heat Exchanger Tubes

Seamless cold-finished tubes in the size range 6,0 up to 60,3 mm OD particularly in heatexchanger and condenser tube dimensions can be supplied in fix- and random lengths, in straight lengths as well as in U-bend execution. **TPS** seamless tubes in stainless steel, nickel alloys and titanium as mentioned are applied in Chemical-, Petrochemical-, Fertilizer-, Power-, Thermal Processing Plants and Shipbuilding Industry all over the world. Even when applied under most severe operating conditions **TPS** Seamless Tubes have proved that they meet highest requirements in respect to quality, performance and resistance.

#### General

Whereas the ASTM A 213 combined with tolerances according to ASTM A 450 exclusively prescribes minimum wall tolerance, the NFA and BS allows both, minimum wall and average wall tolerances.

An exception here presents the DIN standard. There are no indications about tolerances within the production standards of DIN 17456/17458. Those are separately specified within the EN-ISO 1127 (previously: DIN 2462) and DIN 28180 giving several possibilities of average wallthickness, whereby different combinations for O.D. and tolerance of wallthickness can be chosen.

### Cold Finished Pipes

|                        |                                  |            |            |            |              |
|------------------------|----------------------------------|------------|------------|------------|--------------|
| Manufacturing Standard | DIN 17456                        | ASTM A 268 | ASTM A 269 | ASTM A 312 | NFA 49117    |
| Tol. Standard:         | EN-ISO 1127<br>(prior: DIN 2462) | ASTM A 268 | ASTM A 269 | ASTM A 530 | Average wall |

Tubes according to these specifications must not be used as heat exchanger tubes.

### Cold Finished Heat Exchanger Tubes

|                        |                                                    |                           |                                  |
|------------------------|----------------------------------------------------|---------------------------|----------------------------------|
| Manufacturing Standard | DIN 17458/AD-W2<br>VD-TÜV-WB                       | ASTM A 213                | NFA 49217                        |
| Tol. Standard:         | EN-ISO 1127<br>(previously: DIN 2462)<br>DIN 28180 | ASTM A 450<br>(min. wall) | Average wall<br><br>Minimum wall |

Tubes according to these specifications can be used as line pipes as well.

**TPS** Technitube Röhrenwerke seamless tube production mill and TechniPark





## COMPARISON OF TOLERANCES

### Cold Finished Pipes and Tubes

| Specification                                       |                                | Outside Diameter                                |            |            |           | Wallthickness                       |          |
|-----------------------------------------------------|--------------------------------|-------------------------------------------------|------------|------------|-----------|-------------------------------------|----------|
| ASTM                                                |                                |                                                 |            |            |           |                                     |          |
| A 450                                               |                                | < 25,4mm                                        | < 38,1mm   | < 50,8mm   | > 50,8 mm |                                     |          |
|                                                     |                                | +/- 0,10mm                                      | +/- 0,15mm | +/- 0,20mm | +/-0,25mm | -0/+20% (min. wall)                 |          |
|                                                     |                                |                                                 |            |            |           | (average wall +/-10% not included)  |          |
| A 530                                               |                                | < 48,3mm > 48,3mm                               |            |            |           |                                     |          |
|                                                     |                                | +0,4/-0,8mm +/-0,8mm                            |            |            |           | +/-12,5%                            |          |
|                                                     |                                |                                                 |            |            |           |                                     |          |
| A 269                                               |                                | < 38,1mm                                        |            | < 63,5mm   |           |                                     |          |
|                                                     |                                | +/- 0,13mm                                      |            | +/-0,25mm  |           | +/-10%                              |          |
|                                                     |                                |                                                 |            |            |           |                                     |          |
| EN-ISO 1127 (previously: DIN 2462)                  |                                |                                                 |            |            |           |                                     |          |
| Tol.class                                           | TC D2                          | +/-1,00% min.+/-0,5mm                           |            |            |           | T 2 +/-12,5% min. +/-0,40 mm        |          |
|                                                     | TC D3                          | +/-0,75% min. +/-0,3mm                          |            |            |           | T 3 +/-10% min. +/-0,20 mm          |          |
|                                                     | TC D4                          | +/-0,50% min. +/-0,1mm                          |            |            |           | T 4 +/-7,5% min. +/-0,15 mm         |          |
|                                                     |                                |                                                 |            |            |           |                                     |          |
| DIN 28180 (valid only for heatexchanger dimensions) |                                |                                                 |            |            |           |                                     |          |
| Tol.class                                           |                                | 16-20mm                                         | 25mm       | 30mm       | 38mm      | < 2 mm                              | > 2 mm   |
|                                                     | TC 1                           | +/-0,10mm                                       | 0,12mm     | 0,15mm     | 0,20mm    | +/-0,2mm                            | +/-10%   |
|                                                     | TC 2                           | 0,30mm                                          | 0,30mm     | 0,30mm     | 0,40mm    | +/-0,2mm                            | +/-10%   |
|                                                     | TC 3                           | -                                               | -          | -          | -         | +/-0,2mm                            | +15/-10% |
|                                                     |                                |                                                 |            |            |           |                                     |          |
| NFA                                                 | Quality F (cold finished)      |                                                 |            |            |           |                                     |          |
| 49117                                               | Quality F (cold finished)      | +/-0,75% with a minimum tolerances of +/-0,30mm |            |            |           | +/-10% with a minimum of +/-0,20 mm |          |
|                                                     |                                |                                                 |            |            |           |                                     |          |
| 49217                                               |                                | < 25,4mm                                        | < 38,1mm   | < 50,8mm   | >50,8mm   |                                     |          |
|                                                     | Ferritic                       | +/-0,10mm                                       | +/-0,15mm  | +/-0,20mm  | +/-0,50%  | normally +/-10%                     |          |
|                                                     | Austenitic+Austenitic-Ferritic | +/-0,25mm                                       | +/-0,25mm  | +/-0,25mm  | +/-0,50%  | (on request:-0+20% min. wall)       |          |
|                                                     |                                |                                                 |            |            |           |                                     |          |
| BS                                                  | CFS                            |                                                 |            |            |           |                                     |          |
| 3059                                                | Part 2 Austenitic              | +/-0,50% with a minimum tolerances of +/-0,15mm |            |            |           | +/-10%(<3,25 mm) +/-7,5%(>3,25 mm)  |          |
|                                                     |                                |                                                 |            |            |           |                                     |          |
| 3605                                                | Part 1 Austenitic              | +/-0,75% with a minimum tolerances of +/-0,20mm |            |            |           | +/- 10% min. +/- 0,15 mm            |          |
|                                                     |                                |                                                 |            |            |           |                                     |          |
| 3606                                                |                                | < 25mm                                          | < 38mm     | < 50mm     |           |                                     |          |
|                                                     | Ferritic                       | +/-0,10mm                                       | +/-0,15mm  | +/-0,20mm  |           | +/-10%                              |          |
|                                                     | Austenitic                     | +/-0,15mm                                       | +/-0,15mm  | +/-0,20mm  |           | (on request:-0/+20% or -0/+22%)     |          |





# Seamless Tubes

STAINLESS STEEL · NICKEL ALLOYS · TITANIUM · TITANIUM ALLOYS

## BWG AND SWG DIMENSIONS AND WEIGHTS

For stainless steel only

### BWG (Birmingham wire gauge)

| Wall thickness   |        |                |       |       |       |       |       |       |       |
|------------------|--------|----------------|-------|-------|-------|-------|-------|-------|-------|
| BWG              |        | 22             | 20    | 18    | 16    | 14    | 12    | 11    | 10    |
| mm               |        | 0.711          | 0.889 | 1.245 | 1.651 | 2.108 | 2.769 | 3.048 | 3.404 |
|                  |        | Weight in kg/m |       |       |       |       |       |       |       |
| outside diameter |        |                |       |       |       |       |       |       |       |
| inches           | mm     |                |       |       |       |       |       |       |       |
| 1/4"             | 6.350  |                | 0.122 | 0.159 | 0.194 |       |       |       |       |
| 5/16"            | 7.950  |                | 0.157 | 0.209 | 0.260 |       |       |       |       |
| 3/8"             | 9.525  |                | 0.192 | 0.258 | 0.326 | 0.392 |       |       |       |
| 1/2"             | 12.700 | 0.213          | 0.263 | 0.357 | 0.457 | 0.559 | 0.688 | 0.737 |       |
| 5/8"             | 15.875 | 0.270          | 0.334 | 0.456 | 0.588 | 0.727 | 0.908 | 0.979 |       |
| 3/4"             | 19.050 |                | 0.404 | 0.555 | 0.719 | 0.894 | 1.130 | 1.220 | 1.330 |
| 7/8"             | 22.225 | 0.383          | 0.475 | 0.654 | 0.851 | 1.060 | 1.350 | 1.460 | 1.600 |
| 1"               | 25.400 | 0.440          | 0.546 | 0.752 | 0.982 | 1.230 | 1.570 | 1.710 | 1.870 |
| 1 1/4"           | 31.750 | 0.553          | 0.687 | 0.950 | 1.240 | 1.570 | 2.010 | 2.190 | 2.420 |
| 1 1/2"           | 38.100 | 0.666          | 0.828 | 1.150 | 1.510 | 1.900 | 2.450 | 2.680 | 2.960 |
| 1 3/4"           | 44.450 | 0.779          | 0.970 | 1.350 | 1.770 | 2.240 | 2.890 | 3.160 | 3.500 |
| 2"               | 50.800 | 0.892          | 1.110 | 1.540 | 2.030 | 2.570 | 3.330 | 3.650 | 4.040 |
| 2 1/2"           | 63.500 |                |       | 1.940 | 2.560 | 3.240 | 4.210 | 4.610 | 5.120 |

### SWG (Standard wire gauge)

| Wall thickness   |        |                |       |       |       |       |       |       |       |
|------------------|--------|----------------|-------|-------|-------|-------|-------|-------|-------|
| SWG              |        | 22             | 20    | 18    | 16    | 14    | 12    | 11    | 10    |
| mm               |        | 0.711          | 0.914 | 1.219 | 1.626 | 2.032 | 2.642 | 2.946 | 3.251 |
|                  |        | Weight in kg/m |       |       |       |       |       |       |       |
| outside diameter |        |                |       |       |       |       |       |       |       |
| inches           | mm     |                |       |       |       |       |       |       |       |
| 1/4"             | 6.350  |                | 0.124 | 0.157 | 0.192 |       |       |       |       |
| 5/16"            | 7.950  |                | 0.161 | 0.205 | 0.257 |       |       |       |       |
| 3/8"             | 9.525  |                | 0.197 | 0.253 | 0.321 | 0.381 |       |       |       |
| 1/2"             | 12.700 | 0.213          | 0.270 | 0.350 | 0.451 | 0.543 | 0.665 | 0.720 |       |
| 5/8"             | 15.875 | 0.270          | 0.342 | 0.447 | 0.580 | 0.704 | 0.875 | 0.954 |       |
| 3/4"             | 19.050 |                | 0.415 | 0.544 | 0.709 | 0.866 | 1.090 | 1.190 | 1.290 |
| 7/8"             | 22.225 | 0.383          | 0.488 | 0.641 | 0.838 | 1.030 | 1.300 | 1.420 | 1.550 |
| 1"               | 25.400 | 0.440          | 0.560 | 0.738 | 0.967 | 1.190 | 1.510 | 1.660 | 1.800 |
| 1 1/4"           | 31.750 | 0.553          | 0.706 | 0.931 | 1.230 | 1.510 | 1.930 | 2.130 | 2.320 |
| 1 1/2"           | 38.100 | 0.666          | 0.851 | 1.130 | 1.480 | 1.840 | 2.350 | 2.590 | 2.840 |
| 1 3/4"           | 44.450 | 0.779          | 0.996 | 1.320 | 1.740 | 2.160 | 2.770 | 3.060 | 3.350 |
| 2"               | 50.800 | 0.892          | 1.140 | 1.510 | 2.000 | 2.480 | 3.190 | 3.530 | 3.870 |
| 2 1/2"           | 63.500 |                |       | 1.900 | 2.520 | 3.130 | 4.030 | 4.470 | 4.910 |



## ASA PIPE SCHEDULE

### Wallthickness and weight per meter

ANSI/ASME B36.19 Stainless steel pipe

| NB    | O.D.<br>mm | 5s          | 5           | 10s         | 10          | 20 | 30 | STD<br>40s  | 40                         | 60 | XS<br>80s   | 80                        | 100 | 120 | 140 | 160          | XXS          |
|-------|------------|-------------|-------------|-------------|-------------|----|----|-------------|----------------------------|----|-------------|---------------------------|-----|-----|-----|--------------|--------------|
| 1/8   | 10,3       |             |             |             |             |    |    | 1,73        |                            |    | 2,41        |                           |     |     |     |              |              |
|       |            |             |             |             |             |    |    | <b>0,37</b> |                            |    | <b>0,47</b> |                           |     |     |     |              |              |
| 1/4   | 13,7       |             |             |             |             |    |    | 2,24        |                            |    | 3,02        |                           |     |     |     |              |              |
|       |            |             |             |             |             |    |    | <b>0,64</b> |                            |    | <b>0,82</b> |                           |     |     |     |              |              |
| 3/8   | 17,2       |             |             |             |             |    |    | 2,31        |                            |    | 3,20        |                           |     |     |     |              |              |
|       |            |             |             |             |             |    |    | <b>0,87</b> |                            |    | <b>1,12</b> |                           |     |     |     |              |              |
| 1/2   | 21,3       | 1,65        | 1,65        | 2,11        | 2,11        |    |    | 2,77        | identical with STD and 40S |    | 3,73        | identical with XS and 80S |     |     |     | 4,75         | 7,47         |
|       |            | <b>0,81</b> | <b>0,81</b> | <b>1,02</b> | <b>1,02</b> |    |    | <b>1,29</b> |                            |    | <b>1,64</b> |                           |     |     |     | <b>1,97</b>  | <b>2,59</b>  |
| 3/4   | 26,7       | 1,65        | 1,65        | 2,11        | 2,11        |    |    | 2,87        |                            |    | 3,91        |                           |     |     |     | 5,54         | 7,82         |
|       |            | <b>1,03</b> | <b>1,03</b> | <b>1,30</b> | <b>1,30</b> |    |    | <b>1,71</b> |                            |    | <b>2,23</b> |                           |     |     |     | <b>2,93</b>  | <b>3,69</b>  |
| 1     | 33,4       | 1,65        | 1,65        | 2,77        | 2,77        |    |    | 3,38        |                            |    | 4,55        |                           |     |     |     | 6,35         | 9,09         |
|       |            | <b>1,31</b> | <b>1,31</b> | <b>2,13</b> | <b>2,13</b> |    |    | <b>2,54</b> |                            |    | <b>3,29</b> |                           |     |     |     | <b>4,30</b>  | <b>5,53</b>  |
| 1 1/4 | 42,2       | 1,65        | 1,65        | 2,77        | 2,77        |    |    | 3,56        |                            |    | 4,85        |                           |     |     |     | 6,35         | 9,70         |
|       |            | <b>1,67</b> | <b>1,67</b> | <b>2,73</b> | <b>2,73</b> |    |    | <b>3,44</b> |                            |    | <b>4,53</b> |                           |     |     |     | <b>5,69</b>  | <b>7,88</b>  |
| 1 1/2 | 48,3       | 1,65        | 1,65        | 2,77        | 2,77        |    |    | 3,68        |                            |    | 5,08        |                           |     |     |     | 7,14         | 10,16        |
|       |            | <b>1,93</b> | <b>1,93</b> | <b>3,16</b> | <b>3,16</b> |    |    | <b>4,11</b> |                            |    | <b>5,49</b> |                           |     |     |     | <b>7,35</b>  | <b>9,69</b>  |
| 2     | 60,3       | 1,65        | 1,65        | 2,77        | 2,77        |    |    | 3,91        |                            |    | 5,54        |                           |     |     |     | 8,71         | 11,07        |
|       |            | <b>2,42</b> | <b>2,42</b> | <b>3,99</b> | <b>3,99</b> |    |    | <b>5,52</b> |                            |    | <b>7,60</b> |                           |     |     |     | <b>11,26</b> | <b>13,65</b> |

1,65 = Wallthickness in mm 2,42 = weight in kg/m

Packing in bundles ▼ and with sheet plastic cover ►







## MECHANICAL-, NON-DESTRUCTIVE- AND CORROSION TESTS

**TPS** stainless steel, nickel and titanium alloy tubes are manufactured on most modern production equipment, whereby the applied production methods assure the highest possible standard of quality (certified acc. to ISO 9002). Moreover, for continuous quality assurance and -control, our independent testing department is equipped with most modern testing facilities, i.e. tensile test machinery, hardness measuring apparatus, ultrasonic and eddy-current testing line, coldwater-pressure test equipment and many other modern destructive and non-destructive test instruments.

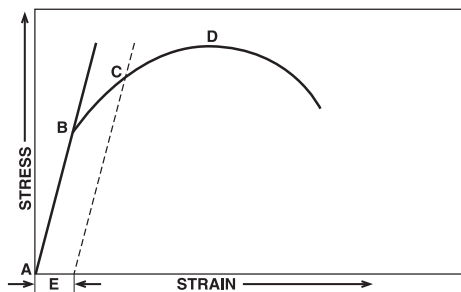
All tests carried out on material or finished products can be split into three major categories: Mechanical tests, Non-Destructive tests and Corrosion tests.

The tests mentioned below will be carried out according to the relevant material specification or on special request to be agreed upon in the purchase order.

### MECHANICAL TESTS

#### Tensile Test

A longitudinal specimen of known cross sectional area is taken from the material and gripped at each end, pulled apart until rupture occurs. By recording the load applied and the extension during loading a Stress-Strain Graph can be plotted (see diagram).



- A-B Elastic deformation range
- B Elastic limit
- C Proof stress
- D Ultimate tensile stress
- E Specified strain

From this graph the following values can be computed:

#### Ultimate tensile strength (D)

The maximum load applied during the test divided by the original cross-sectional area of the test-piece

#### Proof stress (C)

This is the load at which the sample is permanently elongated by a specific percentage of the original length (e.g.0.2%).

#### Elastic limit (B)

The highest load at which there is no permanent deformation of the test piece.

#### Yield point

The lowest stress at which the elongation of the test-piece proceeds without any increase in load.

#### Modulus of elasticity

In the tensile test, the ratio between stress and strain within the elastic deformation range is known as Young's modulus. From the ruptured test-piece, two other values can be computed

#### Elongation

This is the extension of the test-piece expressed as a percentage of its original length

#### Reduction of areas

This is the reduction in cross-sectional area of the test-piece after tensile fracture expressed as a percentage of the original cross-sectional area.



Tensile testing



## MECHANICAL-, NON-DESTRUCTIVE- AND CORROSION TESTS



### Flattening Test

This is usually applied to tube and involves flattening sample of tube between two parallel faces without showing flaws or cracks. The length of the test-piece and degree to which it is to be flattened is specified. The latter usually expressed in terms of the wall thickness of the tube.

### Flare or Drift Test

This is a form of ductility test and applies to tube. The end of the tube is required to be expanded by a specified increase in diameter without splits or cracks. The included angle of drift is also specified.

## Hardness Tests

These tests determine the resistance of material to indentation.

### Brinell hardness test

A standard size hardened steel ball is indented into the surface of material by an applied standard load for a duration of 15 seconds. The diameter of the impression is measured accurately by microscope and the hardness value calculated.

### Rockwell hardness test

This determines hardness by measuring the depth to which a diamond cone or hardened steel ball, under specific load, penetrates the material. The hardness number is indicated on a scale according to the load applied.

### Vickers diamond hardness test

This determines hardness by measuring the impression left in material by diamond pyramid under a standard load for a specified time. The square impression is measured, accurately, diagonally and its area calculated. The hardness value is calculated.



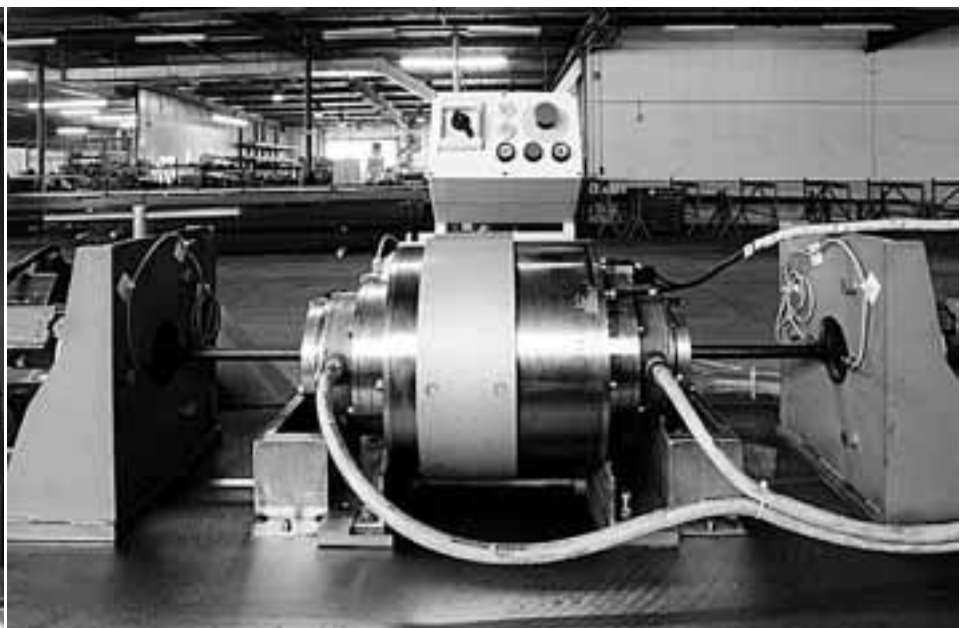
Hardness Testing

## NON-DESTRUCTIVE TESTS

### Ultrasonic Testing

acc. to ASTM-E213 / SEP1915; 1918; 1919

This test involves ultrasonic sound waves being aimed, via a coupling medium, at the material to be tested. A proportion of sound is bounced back at the coupling medium/material interface but the remainder enters the material and is bounced back from the internal surface, to the external surface, where a transducer converts the sound into electrical energy. This is then monitored on a cathode



Ultrasonic testing equipment





## Seamless Tubes

STAINLESS STEEL · NICKEL ALLOYS · TITANIUM · TITANIUM ALLOYS

### MECHANICAL-, NON-DESTRUCTIVE- AND CORROSION TESTS

ray tube. If a calibrated standard is shown on the tube, any deviation from the standard will be immediately visible, thus indicating cracks or internal defects.

#### Eddy-Current Testing

**acc. to ASTM-E426 / SEP1925**

This involves inducing eddy currents into the material by exciting a coil which surmounts two narrow search coils surrounding the material. Any discontinuities in material are found by comparing the electrical conditions that exist in the two search coils. The fault signals are amplified and can be shown on a cathode ray tube or as an audible signal.

#### Hydrostatic Test

**acc. to tube specification**

This is used to test the manufactured items under a test pressure equivalent or greater than pressure encountered in operation. It involves filling the tube with demineralized water, which cannot be compressed, and increasing the pressure, to that specified, inside the tube. The pressure is transmitted to the tube by the water and therefore a pressure to which the tube has been tested is obtained.

#### Dye-penetrant Test

**acc. to ASTM-E165 / DIN 54152**

This is used to detect cracks and involves spraying a dye on the area to be tested. After allowing time for penetration the surplus dye is removed and the area is then sprayed with a white developer. Any faults are revealed as coloured lines or spots caused by the developer absorbing the dye seeping from the cracks.

#### PMI ( positive material identification) - Mix-Up Control

PMI / Mix-Up Control is carried out by spectrotest. Spectrotest is used for "Mix-Up Control" work, testing of a material quality is carried out on a Yes / No basis in relation to the quality of the reference material.

The operator is prompted to "Recalibrate", "Test the reference material" and " Carry out mix-up control" by the instrument.

#### Microstructure test according to

**ASTM E 112 / DIN 50601.**

These test methods of determination of average grain size in metallic materials are primarily measuring procedures and, because of their purely geometric basis, are independent of the metal or alloy concerned. The basis procedures may also be used for the estimation of average grain, crystal or cell size in nonmetallic materials. The comparison method by planimetric (or Jeffries) procedure is used if the structure to the material approaches the appearance of one of the standard comparison charts.



Micro structure photography





## MECHANICAL-, NON-DESTRUCTIVE- AND CORROSION TESTS

### CORROSION TESTS

Various corrosion tests are available using different corrosive environments to indicate the performance of material under heavy duty applications.

#### **Strauss Test**

**acc. to ASTM-A262 Practice E /**

**EN ISO 3651-2 / SEP 1877**

This test detects inter-crystalline corrosion and involves the use of boiling copper sulphate/sulphuric acid solution which must contain solid electrolytic copper. The test samples are immersed in the solution for 15 hours. After immersion the samples are bent through 90°. Those samples which bend without cracking are considered resistant to inter-crystalline corrosion.

#### **Huey Test**

**acc. to ASTM-A262 Practice C / SEP1870**

This test detects the susceptibility to intergranular attack and involves the use of boiling nitric acid. The test samples are immersed in the solution at a concentration of 65% nitric acid by weight for five 48 hour periods. The effects of the acid on the material is measured by the loss in weight after each period and the corrosion rate assessed as a thickness loss in a given time.



Corrosion Testing

## TYPES OF CORROSION

Many different types of corrosion exist and positive identification of the results of corrosion often pinpoint the cause and consequently a potential remedy. The following are the more generally encountered:

### **Stress Corrosion**

The presence of residual stresses within a fabrication, caused by deformation, welding etc. may produce an accelerated form of corrosive attack, especially when the environment contains chloride. This phenomenon is more prevalent in austenitic steels than those with a duplex structure. This type of corrosive attack may be obviated by a stress relieving annealing at a temperature of 880 °C or above.

### **Intercrystalline Corrosion**

This type of corrosion is to be found fundamentally in the austenitic steels. If an austenitic stainless steel is maintained during a certain period of time at temperatures between 400 and 900 °C a precipitation of carbides at the grain boundaries is provoked which depletes the chrome of the adjoining areas. If, in these conditions, the steel is subjected to reactive media, there may be intergranular oxidation known as intercrystalline corrosion. It is essential to avoid slow cooling through the critical temperature range. The cause of the precipitation may be incorrect heat treatment, defective heating or cooling during the transformation of the steel, heating during welding.

### **Selective Corrosion or Pitting**

When a series of conditions forces the passivity to disappear from some points of the surface of a stainless steel they transform into anodes giving way to the creation of galvanic pairs. In general it is shown by very fine pitting which rapidly develops in depth and in length. A typical case of this corrosion is produced by sea water in almost all steels, and it is dangerous because it is difficult to detect. The chlorides, bromides and hypochlorides are those which present the greatest aggressivity. The composition of the steel and its structure are factors which also influence this type of corrosion. If dirt accumulates on the surface of a stainless steel, the access of oxygen is avoided on the covered areas, pitting forming as a result of the loss of passivity. The austenitic steels with molybdenum show good resistance and this improves if they are copper alloyed. Nitrogen also reduces the tendency towards corrosion by pitting.



## INSPECTION DOCUMENTS

### Types of Inspection Documents DIN EN 10204 (previously DIN 50.049)

#### 1 General

This European Standard defines the different types of inspection documents supplied to the purchaser, in accordance with the requirements of the order, for the delivery of metallic products.

#### 2 Inspection documents drawn up from inspection and tests carried out by personnel authorized by the manufacturer and who may be involved in the manufacturing department

##### Certificate of compliance with the order 2.1/EN 10204

Document in which the manufacturer certifies that the products supplied are in compliance with the requirements of the order, without mention of any test results.

The certificate of compliance with the order is a document drawn up on the basis of non-specific inspection and testing.

##### Test report 2.2/EN 10204

Document in which the manufacturer certifies that the products supplied are in compliance with the requirements of the order and in which he supplies test results based on non-specific inspection and testing.

##### Specific test report 2.3/EN 10204

Document in which the manufacturer certifies that the products supplied are in compliance with the specifications of the order and in which he supplies test results based on specific inspection and testing.

(The specific test report is only used by a manufacturer who does not have an authorized quality control department operating independently of the manufacturing department).

#### 3 Inspection documents drawn up from inspection and tests carried out or supervised by authorized personnel independent of the manufacturing department, and based on specific testing

##### Inspection certificate 3.1.

Document issued on the basis of inspection and tests carried out in accordance with the technical specifications of the order or the official regulations and the corresponding technical rules. The tests shall be carried out on the products supplied or the products in the inspection unit, of which the consignment constitutes a part.

The inspection unit is set by the product standard, the official regulations and corresponding technical rules or by the order.

There are different types:

##### Inspection certificate 3.1.B/EN 10204

is issued by the department independent of the manufacturing department and validated by an authorized representative of the staff independent of the manufacturing department.

##### Inspection certificate 3.1.C/EN 10204

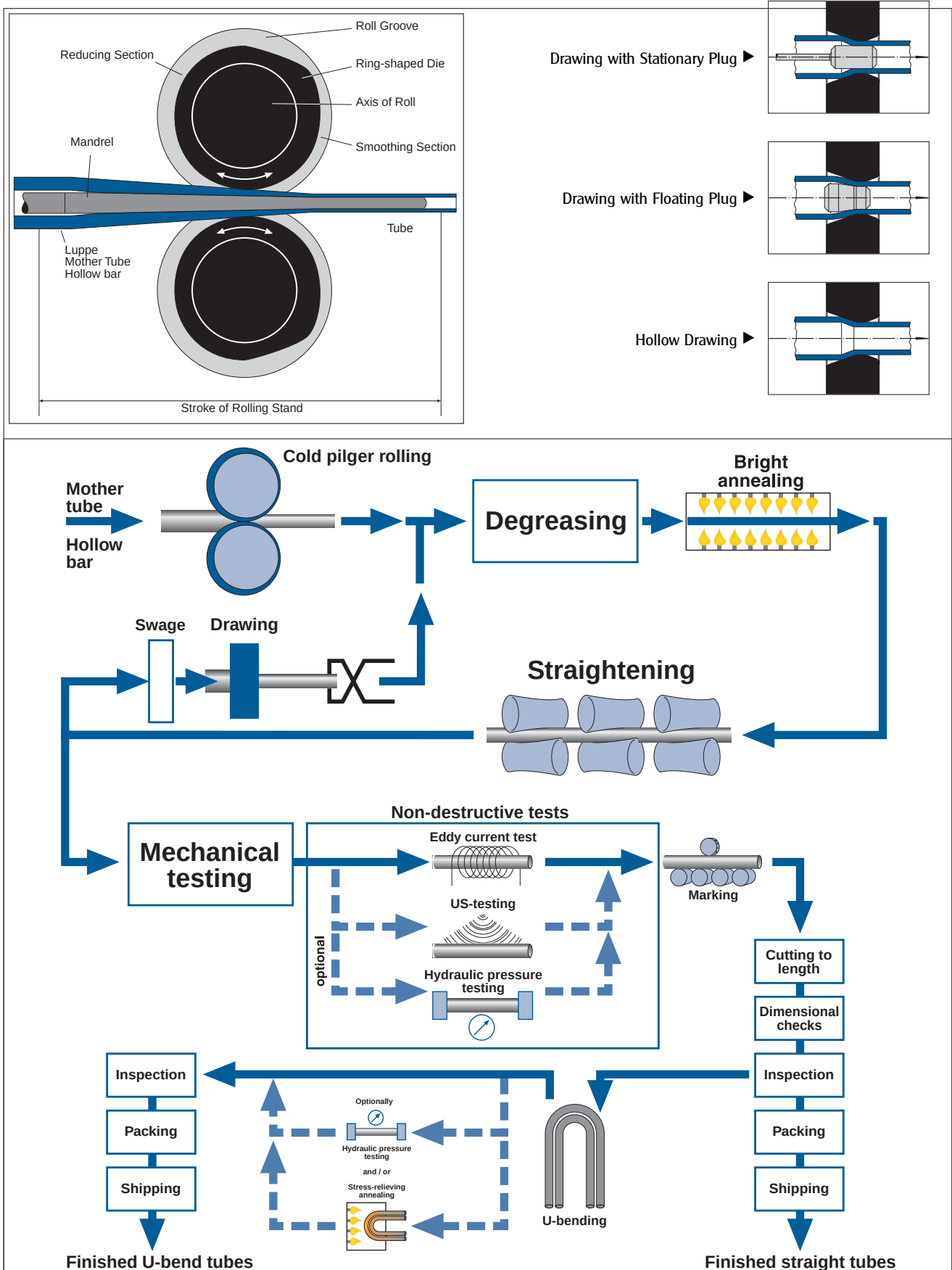
is issued and validated by an authorized representative of the purchaser, in accordance with the specifications of the order.

##### Inspection report 3.2/EN 10204

Where the inspection certificate is validated, following special agreement, both by the manufacturer's authorized representative and the purchaser's authorized representative, it is known as the inspection report.



## PRODUCTION PROCESS





# Low Carbon Steel Tubes for Heatexchanger and Boilers

## Chemical composition and mechanical properties

| STANDARD              | ASTM-A | 179       | 214       | 192       | 226       |
|-----------------------|--------|-----------|-----------|-----------|-----------|
| Manufacturing Process |        | Seamless  | ERW       | Seamless  | ERW       |
| Chemical Analysis     |        |           |           |           |           |
| C                     | %      | 0.06-0.18 | 0.18 max  | 0.06-0.18 | 0.06-0.18 |
| Mn                    | %      | 0.27-0.63 | 0.27-0.63 | 0.27-0.63 | 0.27-0.63 |
| P max                 | %      | 0.035     | 0.035     | 0.035     | 0.035     |
| S max                 | %      | 0.035     | 0.035     | 0.035     | 0.035     |
| Si max                | %      |           |           | 0.25      | 0.25      |

## Mechanical Properties

|                     |               |          |          |          |          |
|---------------------|---------------|----------|----------|----------|----------|
| Tensile Strength    | min KSI [MPA] | 47 [325] | 47 [325] | 47 [325] | 47 [325] |
| Yield Strength      | min KSI [MPA] | 26 [180] | 26 [180] | 26 [180] | 26 [180] |
| Elongation in 2 in. | min %         | 35       | 35       | 35       | 35       |

## Comparison of International Specifications & Grades

| ASTM  | DIN       | BS              | NFA     | JIS     |
|-------|-----------|-----------------|---------|---------|
| A 179 | 17175     | 3602 Pt1        | A 49215 | G 3461  |
|       | ST 35.8/1 | 3059 Pt2 St 360 | TU 37C  | STB 340 |
| A 192 | 17175     | CAT2            | A 49215 | JIS     |
|       | ST 35.8/1 | 3602 Pt1        | TU 37C  | G3461   |
|       |           | 3059 Pt2        |         | STB 340 |
|       |           | ST 360 CAT2     |         |         |
| A 214 | 17177     | BS 3059 Pt2     | A 49242 | G 3461  |
|       | ST 37.8/1 | 3602 Pt1        | A 49245 | STB 340 |
|       |           | ERW 360 CAT2    | TS 37C  |         |
| A 226 | 17177     | BS 3059 Pt2     | A 49242 | G 3461  |
|       | ST 37.8/1 | BS 3602 Pt1     | A 49245 | STB 340 |
|       |           | ERW 360 CAT2    | TS 37C  |         |

# Medium Carbon Steel Tubes for Heatexchanger and Boilers



## Chemical composition and mechanical properties

| Material Standard     |       | ASTM-A 210 |       |       |        |                  |                  |        |
|-----------------------|-------|------------|-------|-------|--------|------------------|------------------|--------|
| Manufacturing Process |       | Seamless   |       |       |        |                  |                  |        |
| Grade                 | C max | Mn         | P max | S max | Si min | min YS KSI [MPa] | min TS KSI [MPa] | El (%) |
| A1                    | 0.27  | 0.93 max   | 0.035 | 0.035 | 0.1    | 37 [255]         | 60 [415]         | 30     |
| C                     | 0.35  | 0.29-1.06  | 0.035 | 0.035 | 0.1    | 40 [275]         | 70 [485]         | 30     |

| Material Standard     |       | ASTM-A 556 |       |       |        |                  |                  |        |
|-----------------------|-------|------------|-------|-------|--------|------------------|------------------|--------|
| Manufacturing Process |       | Seamless   |       |       |        |                  |                  |        |
| Grade                 | C max | Mn         | P max | S max | Si min | min YS KSI [MPa] | min TS KSI [MPa] | El (%) |
| A2                    | 0.18  | 0.27-0.63  | 0.035 | 0.035 | ...    | 26[180]          | 47[320]          | 35     |
| B2                    | 0.27  | 0.29-0.93  | 0.035 | 0.035 | 0.10   | 37[260]          | 60[410]          | 30     |
| C2                    | 0.30  | 0.29-1.06  | 0.035 | 0.035 | 0.10   | 40[280]          | 70[480]          | 30     |

| Comparison of International Specifications & Standards |              |           |           |          |
|--------------------------------------------------------|--------------|-----------|-----------|----------|
| ASTM-A                                                 | BS           | DIN       | NFA       | JIS      |
| 210 A1                                                 | 3602 Pt1     | 17175     | A 49215/9 | G 3461   |
| A556 B2                                                | ST 430 Cat2  | St 45.8/1 | T 442 b/F | ST B 410 |
| 210 Gr. C                                              | 3606         | DIN 17175 | ...       | ...      |
| A 556 Gr. C2                                           | St 440 Cat.2 | 17 Mn 4   | ...       | ...      |

## Alloy Steel Tubes for Heatexchanger and Boilers

### Chemical composition and mechanical properties

| Material Standard     |           | ASTM-A 209 |       |       |           |           |
|-----------------------|-----------|------------|-------|-------|-----------|-----------|
| Manufacturing Process |           | Seamless   |       |       |           |           |
| Chemical Requirements |           |            |       |       |           |           |
| Grade                 | Element   |            |       |       |           |           |
|                       | C         | Mn         | P     | S     | Si        | Mo        |
| T1                    | 0.10-0.20 | 0.30-0.80  | 0.025 | 0.025 | 0.10-0.50 | 0.44-0.65 |
| T1a                   | 0.15-0.25 | 0.30-0.80  | 0.025 | 0.025 | 0.10-0.50 | 0.44-0.65 |
| T1b                   | 0.14 max  | 0.30-0.80  | 0.025 | 0.025 | 0.10-0.50 | 0.44-0.65 |

| Tensile Requirements |                                       |                                                         |                                                     |
|----------------------|---------------------------------------|---------------------------------------------------------|-----------------------------------------------------|
| Grade                | Tensile Strength,<br>min<br>KSI (MPa) | Yield Strength, min<br>(0.2% offset), min,<br>KSI (MPa) | Elongation<br>in 2 in. or 50 mm,<br>(or 4D), min, % |
| T1                   | 55 [380]                              | 30 [205]                                                | 30                                                  |
| T1a                  | 60 [415]                              | 32 [220]                                                | 30                                                  |
| T1b                  | 53 [365]                              | 28 [195]                                                | 30                                                  |



# Alloy Steel Tubes for Heatexchanger and Boilers

## Chemical composition and mechanical properties

| Material Standard                                                  |             | ASTM-A 199 (94) |       |       |           |            |           |        |
|--------------------------------------------------------------------|-------------|-----------------|-------|-------|-----------|------------|-----------|--------|
| Manufacturing Process                                              |             | Seamless        |       |       |           |            |           |        |
| Chemical Requirements                                              |             |                 |       |       |           |            |           |        |
| Element                                                            | C           | Mn              | P     | S     | Si        | Cr         | Mo        | Others |
| Grade                                                              |             |                 |       |       |           |            |           |        |
| T4                                                                 | 0.05 - 0.15 | 0.30-0.60       | 0.025 | 0.025 | 0.50-1.00 | 2.15-2.85  | 0.44-0.65 | ...    |
| T5                                                                 | 0.15 max    | 0.30-0.60       | 0.025 | 0.025 | 0.50 max  | 4.00-6.00  | 0.45-0.65 | ...    |
| T9                                                                 | 0.15 max    | 0.30-0.60       | 0.025 | 0.025 | 0.25-1.00 | 8.00-10.00 | 0.90-1.10 | ...    |
| T11                                                                | 0.05 - 0.15 | 0.30-0.60       | 0.025 | 0.025 | 0.50-1.00 | 1.00-1.50  | 0.44-0.65 | ...    |
| T21                                                                | 0.05 - 0.15 | 0.30-0.60       | 0.025 | 0.025 | 0.50 max  | 2.65-3.35  | 0.80-1.06 | ...    |
| T22                                                                | 0.05 - 0.15 | 0.30-0.60       | 0.025 | 0.025 | 0.50 max  | 1.90-2.60  | 0.87-1.13 | ...    |
| T91                                                                | 0.08 - 0.12 | 0.30-0.60       | 0.020 | 0.010 | 0.20-0.50 | 8.00-9.50  | 0.85-1.05 | *      |
| * Ni 0.40 max; V 0.18-0.25; Cb 0.06-0.10; N 0.03-0.07; Al 0.04 max |             |                 |       |       |           |            |           |        |

| Tensile Requirements |                                    |                                                         |                                                     |
|----------------------|------------------------------------|---------------------------------------------------------|-----------------------------------------------------|
| Grade                | Tensile Strength, min<br>KSI (MPa) | Yield Strength, min<br>(0.2% offset), min,<br>KSI (MPa) | Elongation<br>in 2 in. or 50 mm,<br>(or 4D), min, % |
| All Grades           |                                    |                                                         |                                                     |
| Except T91           | 60 [415]                           | 25 [170]                                                | 30                                                  |
| Grade T91            | 85 [585]                           | 60 [415]                                                | 20                                                  |

| Material Standard:    |           | ASTM A 213 |           |       |       |            |           |           |                     |                     |        |
|-----------------------|-----------|------------|-----------|-------|-------|------------|-----------|-----------|---------------------|---------------------|--------|
| Manufacturing Process |           | Seamless   |           |       |       |            |           |           |                     |                     |        |
| Grade                 | C         | Si         | Mn        | P     | S     | Cr         | Mo        | V         | YS min<br>KSI [MPa] | TS min<br>KSI [MPa] | El (%) |
| T2                    | 0.10-0.20 | 0.10-0.30  | 0.30-0.61 | 0.025 | 0.025 | 0.50-0.81  | 0.44-0.65 | ...       | 30[205]             | 60[415]             | 30     |
| T5                    | 0.15 max  | 0.50 max   | 0.30-0.60 | 0.025 | 0.025 | 4.00-6.00  | 0.45-0.65 | ...       | 30[205]             | 60[415]             | 30     |
| T5b                   | 0.15 max  | 1.00-2.00  | 0.30-0.60 | 0.025 | 0.025 | 4.00-6.00  | 0.45-0.65 | ...       | 30[205]             | 60[415]             | 30     |
| T5c <sup>1</sup>      | 0.12 max  | 0.50 max   | 0.30-0.60 | 0.025 | 0.025 | 4.00-6.00  | 0.45-0.65 | ...       | 30[205]             | 60[415]             | 30     |
| T9                    | 0.15 max  | 0.25-1.00  | 0.30-0.60 | 0.025 | 0.025 | 8.00-10.00 | 0.90-1.10 | ...       | 30[205]             | 60[415]             | 30     |
| T11                   | 0.05-0.15 | 0.50-1.00  | 0.30-0.60 | 0.025 | 0.025 | 1.00-1.50  | 0.44-0.65 | ...       | 30[205]             | 60[415]             | 30     |
| T12                   | 0.05-0.15 | 0.50 max   | 0.30-0.61 | 0.025 | 0.025 | 0.80-1.25  | 0.44-0.65 | ...       | 32[220]             | 60[415]             | 30     |
| T17                   | 0.15-0.25 | 0.15-0.35  | 0.30-0.61 | 0.025 | 0.025 | 0.80-1.25  | ...       | 0.15      | 30[205]             | 60[415]             | 30     |
| T21                   | 0.05-0.15 | 0.50 max   | 0.30-0.60 | 0.025 | 0.025 | 2.65-3.35  | 0.80-1.06 | ...       | 30[205]             | 60[415]             | 30     |
| T22                   | 0.05-0.15 | 0.50 max   | 0.30-0.60 | 0.025 | 0.025 | 1.90-2.60  | 0.87-1.13 | ...       | 30[205]             | 60[415]             | 30     |
| T91 <sup>2</sup>      | 0.08-0.12 | 0.20-0.50  | 0.30-0.60 | 0.020 | 0.010 | 8.00-9.50  | 0.85-1.05 | 0.18-0.25 | 60[415]             | 85[585]             | 20     |
| T92 <sup>3</sup>      | 0.07-0.13 | 0.50 max   | 0.30-0.60 | 0.020 | 0.010 | 8.50-9.50  | 0.30-0.60 | 0.15-0.25 | 64[440]             | 90[620]             | 20     |
| 18Cr-2Mo <sup>4</sup> | 0.025 max | 1.00 max   | 0.30-0.60 | 0.040 | 0.030 | 17.5-19.5  | 1.75-2.50 | ...       | 40[275]             | 60[415]             | 20     |

<sup>1</sup> Grade T5c shall have a titanium content of not less than 4 times the carbon content and not more than 0.70%.

<sup>2</sup> Grade T91 - other elements: Cb 0.06 - 0.10 · N 0.030 - 0.070 · Ni 0.40 max · Al 0.04 max.

<sup>3</sup> Grade T92 - other elements: W 1.50 - 2.00 · Cb 0.04 - 0.09 · B 0.001 - 0.006 · N 0.03 - 0.07 · Ni 0.40 max · Al 0.04 max.

<sup>4</sup> Grade 18Cr-2Mo shall have Ti + Cb = 0.20 + 4(C + N) min, 0.80 max, other elements N max 0.035 · (Ni + Cu) max 1.00.





## Chemical composition and mechanical properties

| Material Standard                         |       |           | ASTM-A 334         |       |           |           |                  |                  |        |
|-------------------------------------------|-------|-----------|--------------------|-------|-----------|-----------|------------------|------------------|--------|
| Manufacturing Process:                    |       |           | Seamless or Welded |       |           |           |                  |                  |        |
| Chemical Analysis                         |       |           |                    |       |           |           |                  |                  |        |
| Grade                                     | C max | Mn        | P max              | S max | Si        | Ni        | min YS KSI [MPa] | min TS KSI [MPa] | El (%) |
| 1                                         | 0.30  | 0.40-1.06 | 0.025              | 0.025 |           |           | 30 [205]         | 55 [380]         | 35     |
| 3                                         | 0.19  | 0.31-0.64 | 0.025              | 0.025 | 0.18-0.37 | 3.18-3.82 | 35 [240]         | 65 [450]         | 30     |
| 6                                         | 0.30  | 0.29-1.06 | 0.025              | 0.025 | 0.10 min  |           | 35 [240]         | 60 [415]         | 30     |
| 7                                         | 0.19  | 0.90 max  | 0.025              | 0.025 | 0.13-0.32 | 2.03-2.57 | 35 [240]         | 65 [450]         | 30     |
| 8                                         | 0.13  | 0.90 max  | 0.025              | 0.025 | 0.13-0.32 | 8.40-9.60 | 75 [520]         | 100 [690]        | 22     |
| 91                                        | 0.20  | 0.40-1.06 | 0.025              | 0.025 |           | 1.60-2.24 | 46 [315]         | 63 [435]         | 28     |
| 112                                       | 0.10  | 0.60 max  | 0.025              | 0.025 | 0.35 max  | 35.0-37.0 | 35 [240]         | 65 [450]         | 18     |
| 1 Cu 0.75-1.25                            |       |           |                    |       |           |           |                  |                  |        |
| 2 Cr 0.50 max · Co 0.50 max · Mo 0.50 max |       |           |                    |       |           |           |                  |                  |        |

## Comparison of International Specifications & Grades

| ASTM                              | DIN                   | BS                   | NFA                         | JIS                  |
|-----------------------------------|-----------------------|----------------------|-----------------------------|----------------------|
| A209 T1/a/b                       | VD-TÜV                | 3606                 | ...                         | G 3462               |
| A161 T1/A335 P1                   | 16Mo5                 | St 245               | ...                         | ST BA 12             |
| A213 T2                           | ...                   | ...                  | A 49-213<br>15 CD 2-05      | ...                  |
| A 199 T4                          | ...                   | ...                  | ...                         | ...                  |
| A 199/213 T5/P5                   | 17176                 | 3604/6               | A 49 213                    | G3462                |
| A 200/A 335                       | 12 Cr Mo 195          | ST 625               | TU Z 10CD505                | ST BA 25             |
| A 199/213 T9/P9                   | 17176                 | 3604                 | A 49213                     | ...                  |
| A 200/A 335                       | X 12CrMo9.1           | ST 629               | Z 10CD9                     | ...                  |
| A 199 T11/<br>A 213 T11/12/P11/12 | 17176<br>13CrMo44     | 3059<br>3604/6       | A49213/5/9<br>TU 13 CD 4.04 | G 3462<br>STBA 22,33 |
| A 200/A335                        |                       | ST 620-460           | TU 10 CD 505                | ...                  |
| A 213 T17                         | ...                   | ...                  | ...                         | ...                  |
| A 199/A213/A200/T21               | ...                   | ...                  | ...                         | ...                  |
| A 199/A213 T22/P212               | DIN 17176             | 3059                 | A 49213/5/9                 | G 3462               |
| A 200/A335                        | 10 Cr Mo 910          | 3604/6<br>ST 620-490 | TU 10CD 910                 | STBK 24              |
| A 199/A213 T91/P91                | 17175                 | ...                  | A 49213                     | ...                  |
| A 200/A 335                       | X10CrMoYNb 9.1        | ...                  | Z 10 CD Nb Y09-01           | ...                  |
| A 213 T92                         | ...                   | ...                  | ...                         | ...                  |
| A213 18Cr2Mo                      | ...                   | ...                  | ...                         | ...                  |
| A 334                             | DIN                   | BS                   | NFA                         | JIS                  |
| Gr.1                              | 17173<br>TTSt 35 N    | 3603                 | ...                         | G 3464<br>STBL 39    |
| Gr.3                              | 10 Ni 14              | 503LT                | 49215/30/330<br>TU 10 N 14  | STBL 46              |
| Gr.6                              | DIN 17179<br>TST E285 | 430 LT               | TU 42 BT                    | ...                  |



# Aluminium Brass

## ALLOY 687

| STANDARD<br>GRADE | BS 2871/PART 3<br>CZ 110 | ASTM B 111<br>C 68700 | DIN 17660/1785<br>CuZn20Al2 | NFA 51102<br>CuZn22Al2 | JIS H3300<br>C 6870 |
|-------------------|--------------------------|-----------------------|-----------------------------|------------------------|---------------------|
| Cu                | 76,0 - 78,0              | 76,0 - 79,0           | 76,0 - 79,0                 | 76,0 - 79,0            | 76,0 - 79,0         |
| Al                | 1,8 - 2,3                | 1,8 - 2,5             | 1,8 - 2,3                   | 1,8 - 2,5              | 1,8 - 2,5           |
| Pb                | 0,07 max.                | 0,07 max              | 0,07 max.                   | 0,07 max.              | 0,07 max.           |
| Ni                |                          |                       | 0,1 max.                    |                        |                     |
| Fe                | 0,06 max.                | 0,06 max.             | 0,07 max.                   | 0,06 max.              | 0,06 max.           |
| Zn                | Rem.                     | Rem.                  | Rem.                        | Rem.                   | Rem.                |
| As                | 0,02 - 0,06              | 0,02 - 0,10           | 0,02 - 0,035                | 0,02 - 0,06            | 0,02 - 0,06         |
| P                 |                          |                       | 0,01 max.                   |                        |                     |
| Mg                |                          |                       | 0,005 max.                  |                        |                     |
| Mn                |                          |                       | 0,1 max.                    |                        |                     |
| Total Impurities  | 0,3 max.                 |                       | Others Total                | 0,03 max.              |                     |
|                   |                          |                       | 0,1 max.                    |                        |                     |
| CONDITION         | M                        | 061                   | F39                         | Annealed (X690)        | O                   |
|                   | TA                       |                       | F34                         | —                      | —                   |
|                   | O                        |                       |                             | —                      | —                   |
| Yield Strength    | —                        | 125 min.              | 150 - 230                   | —                      | —                   |
| N/mm2             | —                        | —                     | 120 - 180                   | —                      | —                   |
|                   | —                        | —                     |                             | —                      | —                   |
| Tensile Strength  | —                        | 345 min.              | 390 min.                    | —                      | 373 min.            |
| N/mm2             | —                        | —                     | 340 min.                    | —                      | —                   |
|                   | —                        | —                     | —                           | —                      | —                   |
| Elongation (%)    | —                        | —                     | 45 min.                     | —                      | 40 min.             |
|                   | —                        | —                     | 55 min.                     | —                      | —                   |
|                   | —                        | —                     |                             | —                      | —                   |
| Hardness Hv5      | 150 min.                 | —                     | —                           | 80 - 130               | —                   |
|                   | 85 - 110                 | —                     | —                           | —                      | —                   |
|                   | 75 max.                  | —                     | —                           | —                      | —                   |
| Grain Size (mm)   | 0,050 max.               | 0,010 - 0,045         | 0,010 - 0,050               | 0,010 - 0,045          | 0,010 - 0,045       |
|                   | (Condition TA)           |                       |                             |                        |                     |

### Typical use:

Most used copper alloy for heat exchanger tubes application.  
Represents the best option for any heat exchanger which is involved with saline water. The addition of arsenic has solved the problem of dezincification.

Melting Point: 935° C · Hot Working Properties: OK  
Density (2° C): 8,33 g/cm3 · Cold Working Properties: Very Good

### Weight

Average wall: (OD-WT) x WT x 0,0265 = Kg/m (all sizes in mm)

### formula:

Minium wall: (OD-WT) x WT x 0,0275 = Kg/m (all sizes in mm)

# Admiralty Brass

## ALLOY 443



| STANDARD<br>GRADE | BS 2871/PART 3<br>CZ 111 | ASTM B 111<br>C 44300 | DIN 17660/1785<br>CuZn28Sn1 | NFA 51102<br>CuZn29Sn1 | JIS H3300<br>C 4430 |
|-------------------|--------------------------|-----------------------|-----------------------------|------------------------|---------------------|
| Cu                | 70,0 - 73,0              | 70,0 - 73,0           | 70,0 - 72,5                 | 70,0 - 73,0            | 70,0 - 73,0         |
| Sn                | 1,0 - 1,5                | 0,9 - 1,2             | 0,9 - 1,3                   | 0,9 - 1,2              | 0,9 - 1,2           |
| Pb                | 0,07 max.                | 0,07 max              | 0,07 max.                   | 0,07 max.              | 0,07 max.           |
| Ni                |                          |                       | 0,1 max.                    |                        |                     |
| Fe                | 0,06 max.                | 0,06 max.             | 0,07 max.                   | 0,06 max.              | 0,06 max.           |
| Zn                | Rem.                     | Rem.                  | Rem.                        | Rem.                   | Rem.                |
| As                | 0,02 - 0,06              | 0,02 - 0,06           | 0,02 - 0,035                | 0,02 - 0,06            | 0,02 - 0,06         |
| P                 |                          |                       | 0,01 max.                   |                        |                     |
| Mn                |                          |                       | 0,1 max.                    |                        |                     |
| Total Impurities  | 0,3 max.                 |                       | Others Total<br>0,1 max.    | 0,03 max.              |                     |
| CONDITION         | M                        | 061                   | F36                         | Annealed (X690)        | O                   |
|                   | TA                       |                       | F32                         | —                      | —                   |
|                   | O                        |                       |                             | —                      | —                   |
| Yield Strength    | —                        | 105 min.              | 140 - 220                   | —                      | —                   |
| N/mm2             | —                        | —                     | 100 - 170                   | —                      | —                   |
|                   | —                        | —                     |                             | —                      | —                   |
| Tensile Strength  | —                        | 310 min.              | 360 min.                    | —                      | 314 min.            |
| N/mm2             | —                        | —                     | 320 min.                    | —                      | —                   |
|                   | —                        | —                     | —                           | —                      | —                   |
| Elongation (%)    | —                        | —                     | 45 min.                     | —                      | 30 min.             |
|                   | —                        | —                     | 55 min.                     | —                      | —                   |
|                   | —                        | —                     |                             | —                      | —                   |
| Hardness Hv5      | 150 min.                 | —                     | —                           | 80 - 120               | —                   |
|                   | 85 - 105                 | —                     | —                           | —                      | —                   |
|                   | 75 max.                  | —                     | —                           | —                      | —                   |
| Grain Size (mm)   | 0,050 max.               | 0,010 - 0,045         | 0,010 - 0,050               | 0,010 - 0,045          | 0,010 - 0,045       |
|                   | (Condition TA)           |                       |                             |                        |                     |

### Typical use:

The specific copper alloy for application fresh water. Often used for heat exchangers which are involved with operations in petroleum refineries and petrochemical plants.

Melting Point: 935 ° C      ·      Hot Working Properties: OK  
Density (20° C): 8,53 g/cm3      ·      Cold Working Properties: Very Good

### Weight

Average wall: (OD-WT) x WT x 0,0270 = Kg/m (all sizes in mm)

### formula:

Minium wall: (OD-WT) x WT x 0,0281 = Kg/m (all sizes in mm)



# Copper Nickel 90/10

## ALLOY 706

| STANDARD<br>GRADE | BS 2871/PART 3<br>CN 102 | ASTM B 111<br>C 70600 | DIN 17664/1785<br>CuNi10Fe1Mn | NFA 51102<br>CuNi10Fe1Mn | JIS H3300<br>C 7060 |
|-------------------|--------------------------|-----------------------|-------------------------------|--------------------------|---------------------|
| Cu                | Rem.                     | Rem.                  | Rem.                          | Rem.                     | Rem.                |
| Pb                | 0,01 max.                | 0,05 max.             | 0,03 max.                     | 0,05 Sn+Pb max.          | 0,05 max.           |
| Ni                | 10,0 - 11,0              | 9,0 - 11,0            | 9,0 - 11,0                    | 9,0 - 11,0               | 9,0 - 11,0          |
| Fe                | 1,0 - 2,0                | 1,0 - 1,8             | 1,0 - 1,8                     | 1,0 - 2,0                | 1,0 - 1,8           |
| Mn                | 0,5 - 1,0                | 1,0 max.              | 0,5 - 1,0                     | 0,3 - 1,0                | 0,2 - 1,0           |
| Zn                |                          | 1,0 max.              | 0,5 max.                      | 0,5 max.                 | 0,5 max.            |
| S                 | 0,05 max.                |                       | 0,05 max.                     | 0,02 max.                |                     |
| C                 | 0,05 max.                |                       | 0,05 max.                     | 0,05 max.                |                     |
| Cu+Ni+Fe+Mn       |                          |                       |                               |                          | 99,5 min.           |
| Total Impurities  | 0,3 max.                 |                       | Others Total<br>0,1 max.      |                          |                     |
| CONDITION         | M                        | 061                   | F29                           | Annealed (X690)          | O                   |
|                   | O                        | H55                   |                               | —                        | —                   |
| Yield Strength    | —                        | 105 min.              | 90 - 180                      | —                        | —                   |
| N/mm2             | —                        | 240 min.              | —                             | —                        | —                   |
| Tensile Strength  | —                        | 275 min.              | 290 min.                      | —                        | 275 min.            |
| N/mm2             | —                        | 310 min.              |                               | —                        | —                   |
| Elongation (%)    | —                        | —                     | 30 min.                       | —                        | 30 min.             |
|                   | —                        | —                     | —                             | —                        | —                   |
| Hardness Hv5      | 150 min.                 | —                     | —                             | 70 - 100                 | —                   |
|                   | 80 - 110                 | —                     | —                             | —                        | —                   |
| Grain Size (mm)   | 0,050 max.               | 0,010 - 0,045         | 0,010 - 0,050                 | 0,010 - 0,045            | 0,010 - 0,045       |
|                   | (Condition O)            |                       |                               |                          |                     |

### Typical use:

Used for the working in sea water, mainly for shipbuilding and sea water pipelines, stations, desalination, because of its very good corrosive resistance.

Melting Point: 1150° C · Hot Working Properties: Good  
Density (20° C): 8,94 g/cm3 · Cold Working Properties: Good

### Weight

Average wall:  $(OD-WT) \times WT \times 0,0284 = \text{Kg/m}$  (all sizes in mm)

### formula:

Minium wall:  $(OD-WT) \times WT \times 0,0295 = \text{Kg/m}$  (all sizes in mm)

# Copper Nickel 70/30

## ALLOY 715



| STANDARD<br>GRADE | BS 2871/PART 3<br>CN 107 | ASTM B 111<br>C 71500 | DIN 17664/1785<br>CuNi30Mn1Fe | NFA 51102<br>CuNi30Mn1Fe | JIS H3300<br>C 7150 |
|-------------------|--------------------------|-----------------------|-------------------------------|--------------------------|---------------------|
| Cu                | Rem.                     | Rem.                  | Rem.                          | Rem.                     | Rem.                |
| Pb                | 0,01 max.                | 0,05 max.             | 0,03 max.                     | 0,05 Sn+Pb max.          | 0,05 max.           |
| Ni                | 30,0 - 32,0              | 29,0 - 33,0           | 30,0 - 32,0                   | 29,0 - 32,0              | 29,0 - 33,0         |
| Fe                | 0,4 - 1,0                | 0,4 - 1,0             | 0,4 - 1,0                     | 0,4 - 0,7                | 0,4 - 0,7           |
| Mn                | 0,5 - 1,5                | 1,0 max.              | 0,5 - 1,5                     | 0,5 - 1,5                | 0,2 - 1,0           |
| Zn                |                          | 1,0 max.              | 0,5 max.                      | 0,5 max.                 | 0,5 max.            |
| S                 | 0,08 max.                |                       | 0,06 max.                     | 0,02 max.                |                     |
| C                 | 0,06 max.                |                       | 0,06 max.                     | 0,06 max.                |                     |
| Cu+Ni+Fe+Mn       |                          |                       |                               |                          | 99,5 min.           |
| Total Impurities  | 0,3 max.                 |                       | Others Total<br>0,1 max.      | 0,1 max.                 |                     |
| CONDITION         | M                        | 061                   | F37                           | Annealed (X690)          | O                   |
|                   | O                        | HR50                  | —                             | —                        | —                   |
| Yield Strength    | —                        | 125 min.              | 120 - 220                     | —                        | —                   |
| N/mm2             | —                        | 345 min.              | —                             | —                        | —                   |
| Tensile Strength  | —                        | 360 min.              | 370 min.                      | —                        | 363 min.            |
| N/mm2             | —                        | 495 min.              | —                             | —                        | —                   |
| Elongation (%)    | —                        | —                     | 35 min.                       | —                        | 30 min.             |
|                   | —                        | 12 min. (WT≤1,21 mm)  | —                             | —                        | —                   |
|                   |                          | 15 min. (WT>1,21 mm)  |                               |                          |                     |
| Hardness Hv5      | 150 min.                 | —                     | —                             | 90 - 130                 | —                   |
|                   | 90 - 120                 | —                     | —                             | —                        | —                   |
| Grain Size (mm)   | 0,050 max.               | 0,010 - 0,045         | 0,010 - 0,050                 | 0,010 - 0,045            | 0,010 - 0,045       |
|                   | (Condition O)            |                       |                               |                          |                     |

### Typical use:

This alloy has all the characteristics of CuNi 90/10, but also offers excellent corrosion resistance in high velocity sea water. Also the operating temperature is much higher than of CuNi 90/10. Can assure a long service life and reliability.

Melting Point: 1240° C · Hot Working Properties: Good  
Density (20° C): 8,94 g/cm<sup>3</sup> · Cold Working Properties: Good

### Weight

Average wall: (OD-WT) x WT x 0,0284 = Kg/m (all sizes in mm)

### formula:

Minium wall: (OD-WT) x WT x 0,0295 = Kg/m (all sizes in mm)



# Copper Nickel Iron Manganese 66/30/2/2

ALLOY 71640

| STANDARD<br>GRADE | BS 2871/PART 3<br>CN 108 | ASTM B 111<br>C 71640 | DIN 17664/1785<br>CuNi30Fe2Mn2 | NFA 51102<br>CuNi30Fe2Mn2 | JIS H3300<br>C 7164 |
|-------------------|--------------------------|-----------------------|--------------------------------|---------------------------|---------------------|
| Cu                | Rem.                     | Rem.                  | Rem.                           | Rem.                      | Rem.                |
| Pb                |                          | 0,05 max.             | 0,02 max.                      | 0,05 Sn+Pb max.           | 0,05 max.           |
| Ni                | 29,0 - 32,0              | 29,0 - 32,0           | 29,0 - 32,0                    | 29,0 - 32,0               | 29,0 - 32,0         |
| Fe                | 1,7 - 2,3                | 1,7 - 2,3             | 1,5 - 2,5                      | 1,5 - 2,0                 | 1,7 - 2,3           |
| Mn                | 1,5 - 2,5                | 1,5 - 2,5             | 1,5 - 2,5                      | 1,5 - 2,0                 | 1,5 - 2,5           |
| Zn                |                          | 1,0 max.              | 0,5 max.                       | 0,5 max.                  | 0,5 max.            |
| S                 |                          |                       | 0,06 max.                      | 0,02 max.                 |                     |
| C                 |                          |                       | 0,05 max.                      | 0,06 max.                 |                     |
| Cu+Ni+Fe+Mn       |                          |                       |                                |                           | min. 99,5           |
| Total Impurities  | 0,3 max.                 |                       | 0,3 max.                       | 0,1 max.                  |                     |
| CONDITION         | M                        | 061                   | F42                            | Annealed (X690)           | O                   |
|                   | O                        | HR50                  | —                              |                           | —                   |
| Yield Strength    | —                        | 170 min.              | 150 - 260                      | —                         | —                   |
| N/mm2             | —                        | 400 min.              | —                              | —                         | —                   |
| Tensile Strength  | —                        | 435 min.              | 420 min.                       | —                         | 430 min.            |
| N/mm2             | —                        | 560 min.              | —                              | —                         | —                   |
| Elongation (%)    | —                        | —                     | 30 min.                        | —                         | 30 min.             |
|                   | —                        | —                     | —                              | —                         | —                   |
| Hardness Hv5      | 150 min.                 | —                     | —                              | 90 - 130                  | —                   |
|                   | 90 - 120                 | —                     | —                              | —                         | —                   |
| Grain Size (mm)   | 0,050 max.               | 0,010 - 0,045         | 0,010 - 0,050                  | 0,010 - 0,045             | 0,010 - 0,045       |
|                   | (Condition O)            |                       |                                |                           |                     |

## Typical use:

Has the most resistance against impingement attack and corrosion by suspended solids of all copper based alloys which are used for heat exchanger tube applications. This alloy is preferred for desalination plants.

Melting Point: 1240°C · Hot Working Properties: Good  
Density (20°C): 8,94 g/cm3 · Cold Working Properties: Good

## Weight

Average wall: (OD-WT) x WT x 0,0284 = Kg/m (all sizes in mm)

## formula:

Minium wall: (OD-WT) x WT x 0,0295 = Kg/m (all sizes in mm)



## TPS - SHUTDOWN SERVICE

TPS has increased the department for Refinery Shutdown- and Emergency Services.

This department is specialized in the supply of Heat-Exchanger and Condenser Tubes in

- Carbon Steel
- Alloy Steel
- Non Ferrous Metals
- Stainless Steel
- Nickel Alloys and
- Titanium

for urgent requirements and emergency purposes.

The material is either available ex stock for delivery within hours or from special new production within a very short lead time.

"Just in time deliveries" is not only an idiom. It is proved that TPS has served a lot of refineries with quick and excellent deliveries. The result is a tremendous saving in costs and time for the endusers.

A further advantage is that the refinery or the petrochemical plant does not have to keep its own stock for shutdowns and maintenance periods.

As mentioned above, deliveries ex stock can be made within 24 hours during the week and within 48 hours during the weekend.

We have experience with this type of business and therefore we now offer our worldwide "Shutdown Service".

Furthermore we offer a complete service with yearly contracts and estimated quantities for all kinds of Heat-Exchanger tubes used in your plant.

In case you have special questions please do not hesitate to contact us by phone, by fax or by e-mail:



### Shutdown Service

TPS-Technitube Röhrenwerke GmbH  
Julius-Saxler-Straße 7 · Industriegebiet · D-54550 Daun, Germany  
P.O. BOX 509 · D-54541 Daun, Germany

PHONE: (49) 6592 7120 · FAX: (49) 6592 1305  
E-MAIL: [service@TPSD.de](mailto:service@TPSD.de)  
WEB-SITE: [www.TPS-Technitube.de](http://www.TPS-Technitube.de)





# Carbon Steel, Alloy, Aluminium Brass, Admiralty Brass & Copper Nickel Tubes Ex Stock

## Stock Sizes and Grades

| Tube OD<br>AD | Thickness<br>WS | ASTM<br>A 179 | ST 35.8/I<br>DIN 17175 | ASTM<br>A 199/<br>A 213<br>T 5 | ASTM<br>A 199/<br>A 213<br>T 9 | ASTM<br>A 214 | ASTM<br>B 111C 687<br>BS 2871/3<br>CZ 110 | ASTM<br>B 111 C 443<br>BS 2871/3<br>CZ 111 | ASTM<br>B 111 C 706<br>BS 2871/3<br>CN 102 | ASTM<br>B 111 C 715<br>BS 2871/3<br>CN 107 | Tube OD<br>AD | Thickness<br>WS |
|---------------|-----------------|---------------|------------------------|--------------------------------|--------------------------------|---------------|-------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|---------------|-----------------|
|               |                 |               |                        |                                |                                |               |                                           |                                            |                                            |                                            | in mm         | in mm           |
| 5/8"          | 18 SWG          |               |                        |                                |                                |               | X                                         | X                                          |                                            |                                            | 15,88         | 1,219           |
| 5/8"          | 18 BWG          |               |                        |                                |                                |               | X                                         | X                                          |                                            |                                            | 15,88         | 1,245           |
| 5/8"          | 16 BWG          |               |                        |                                |                                |               | X                                         | X                                          |                                            |                                            | 15,88         | 1,651           |
| 3/4"          | 18 BWG          |               |                        |                                |                                |               | X                                         | X                                          | X (1)                                      | X (1)                                      | 19,05         | 1,245           |
| 3/4"          | 16 SWG          |               |                        |                                |                                |               | X                                         | X                                          | X (1)                                      | X (1)                                      | 19,05         | 1,626           |
| 3/4"          | 16 BWG          | X             | X                      |                                |                                |               | X                                         | X                                          | X (1)                                      | X (1)                                      | 19,05         | 1,651           |
| 3/4"          | 14 SWG          |               |                        |                                |                                | X             | X                                         | X                                          | X (1)                                      | X (1)                                      | 19,05         | 2,032           |
| 3/4"          | 14 BWG          | X             | X                      | X                              |                                |               | X                                         | X                                          | X (1)                                      | X (1)                                      | 19,05         | 2,108           |
| 3/4"          | 12 BWG          | X             | X                      |                                |                                |               | X                                         | X                                          |                                            |                                            | 19,05         | 2,769           |
| 1" 14         | SWG             |               |                        |                                |                                |               | X                                         | X                                          |                                            |                                            | 25,40         | 2,032           |
| 1" 14         | BWG             | X             | X                      |                                |                                |               | X                                         | X                                          |                                            |                                            | 25,40         | 2,108           |
| 1" 13         | BWG             |               |                        |                                |                                |               | X                                         | X                                          |                                            |                                            | 25,40         | 2,413           |
| 1" 12         | BWG             | X             | X                      | X                              | X                              |               | X                                         | X                                          |                                            |                                            | 25,40         | 2,769           |
| 1" 10         | BWG             | X             | X                      |                                |                                |               |                                           |                                            |                                            |                                            | 25,40         | 3,404           |
| 20 mm         | 2,00 mm         | X (1)         | X (1)                  |                                |                                |               |                                           |                                            |                                            |                                            | 20,00         | 2,00            |
| 25 mm         | 2,00 mm         | X (1)         | X (1)                  |                                |                                |               |                                           |                                            |                                            |                                            | 25,00         | 2,00            |
| 25 mm         | 2,50 mm         | X (1)         | X (1)                  |                                |                                |               |                                           |                                            |                                            |                                            | 25,00         | 2,50            |

(1) Average wall thickness

### Tubes are certified as follows:

|                         |                           |
|-------------------------|---------------------------|
| Carbon Steel:           | ASTM/ASME/DIN/BS/NFA      |
| Alloy Steel:            | ASTM/ASME                 |
| Aluminium Brass:        | ASTM/ASME/BS              |
| Admiralty Brass:        | ASTM/ASME/BS              |
| Copper-Nickel:          | ASTM/ASME/BS              |
| Stainless Steel:        | ASTM/ASME/DIN/NFA/NACE/EN |
| Longitudinal Fin Tubes: | DIN                       |

### New Stock Items

Different Stainless Steel Grades in lengths up to 19.600 mm available ex Stock.



## Stock Sizes and Grades

| Tube OD<br>AD | Thickness<br>WS | ASTM<br>A 213<br>TP<br>304 | ASTM<br>A 213<br>TP<br>304L | ASTM<br>A 213<br>TP<br>316 | ASTM<br>A 213<br>TP<br>316L | ASTM<br>A 213<br>TP<br>321 | ASTM<br>A 213<br>TP<br>316 Ti | Tube OD<br>AD | Thickness<br>WS |
|---------------|-----------------|----------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|-------------------------------|---------------|-----------------|
|               |                 |                            |                             |                            |                             |                            |                               | in mm         | in mm           |
| 5/8"          | 18 SWG          |                            |                             |                            |                             |                            |                               | 15,88         | 1,219           |
| 5/8"          | 18 BWG          |                            |                             |                            |                             |                            |                               | 15,88         | 1,245           |
| 5/8"          | 16 BWG          |                            |                             |                            |                             |                            |                               | 15,88         | 1,651           |
| 3/4"          | 18 BWG          |                            |                             |                            |                             |                            |                               | 19,05         | 1,245           |
| 3/4"          | 16 SWG          | X                          | X                           | X                          | X                           | X                          |                               | 19,05         | 1,626           |
| 3/4"          | 16 BWG          | X                          | X                           | X                          | X                           | X                          |                               | 19,05         | 1,651           |
| 3/4"          | 14 SWG          | X                          | X                           | X                          | X                           |                            |                               | 19,05         | 2,032           |
| 3/4"          | 14 BWG          | X                          | X                           | X                          | X                           |                            |                               | 19,05         | 2,108           |
| 3/4"          | 12 BWG          |                            |                             |                            |                             |                            |                               | 19,05         | 2,769           |
| 1"            | 16 SWG          |                            |                             | X                          | X                           |                            |                               | 25,40         | 1,626           |
| 1"            | 16 BWG          |                            |                             | X                          | X                           |                            |                               | 25,40         | 1,626           |
| 1"            | 14 SWG          | X                          | X                           | X                          | X                           |                            |                               | 25,40         | 2,032           |
| 1"            | 14 BWG          | X                          | X                           | X                          | X                           |                            |                               | 25,40         | 2,108           |
| 1"            | 13 BWG          |                            |                             |                            |                             |                            |                               | 25,40         | 2,413           |
| 1"            | 12 BWG          |                            |                             |                            |                             |                            |                               | 25,40         | 2,769           |
| 1"            | 10 BWG          |                            |                             |                            |                             |                            |                               | 25,40         | 3,404           |
| 20 mm         | 2,00 mm         |                            |                             | X(1)                       | X(1)                        |                            |                               | 20,00         | 2,00            |
| 25 mm         | 2,00 mm         |                            |                             | X(1)                       | X(1)                        | X(1)                       | X(1)                          | 25,00         | 2,00            |

(1) Average wall thickness



# U-Tubes for Heat Exchangers

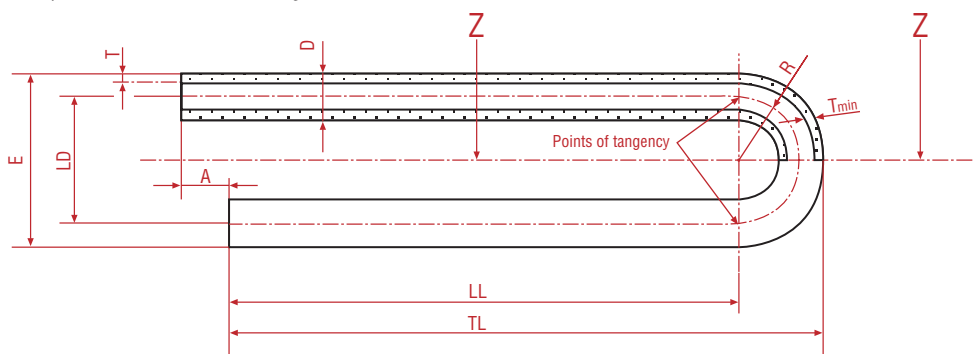
## Definition

U-Tubes as per this technical delivery standard are bend hairpin tubes which are usually used in heat exchangers.

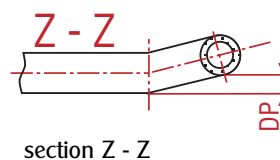
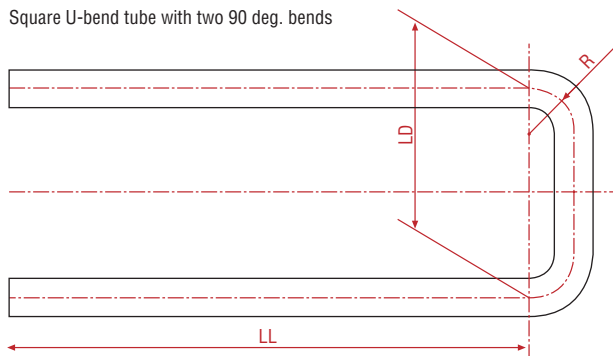
## Scope

This technical delivery standard refers to U-bend tubes with radii from 1,5 D. Tolerances for smaller radii have to be agreed with the customer.

Hairpin U-bend tube with one 180 deg. bend



Square U-bend tube with two 90 deg. bends



## The meaning of measurements and symbols:

|              |                                                      |              |                                             |
|--------------|------------------------------------------------------|--------------|---------------------------------------------|
| <b>A</b>     | LEG LENGTH DIFFERENCE                                | <b>R</b>     | CENTERLINE BEND RADIUS                      |
| <b>E</b>     | $(2R + D) \times 2$ RADIUS PLUS OUTSIDE DIAMETER     | <b>Rmin.</b> | MIN. RADIUS                                 |
| <b>D</b>     | NOMINAL OUTSIDE DIAMETER                             | <b>T</b>     | WALL THICKNESS                              |
| <b>Dmax.</b> | MAX. OUTSIDE DIAMETER                                | <b>Tmin.</b> | MIN. WALL THICKNESS IN OUTSIDE BENDING AREA |
| <b>Dmin.</b> | MIN. OUTSIDE DIAMETER                                | <b>SW</b>    | SMALLEST WALL THICKNESS OF STRAIGHT TUBE    |
| <b>LD</b>    | LEG LENGTH DISTANCE MEASURED FROM POINTS OF TANGENCY | <b>O</b>     | OVALITY                                     |
| <b>LL</b>    | LEG LENGTH                                           | <b>DP</b>    | DEVIATION FROM PLANE OF BEND                |
| <b>TL</b>    | TOTAL LENGTH                                         | <b>Z</b>     | Section                                     |



## • Wall thinning of bending area

Wall thinning refers to the minimum wall thickness of straight tube

Radius  $\geq 1,5 D$ : max. 17 % wall thinning

$$T_{\min.} \geq \frac{SW (2 R + D)}{2 (R + D)}$$

## • Flattening on bend (TEMA R.C.B. 2.31 only)

Flattening does not exceed 10 % of nominal diameter

## • Tolerance for leg spacing

$$(2 R - D) = 1,5 \text{ mm}$$

## • Tolerance on ovality

Allowable deviation from ovality in %

$$\leq 4 D \quad \frac{D}{5 R} 100 = \%$$

$$> 4 D \leq 5\%$$

The deviation  $O$  of the ovality will be calculated as follows:

$$O = 200 \frac{D_{\max.} - D_{\min.}}{D_{\max.} + D_{\min.}} = \%$$

## • Tolerance on straight leg length

$$\text{straight leg} \leq 6000 \text{ mm} \quad -0 / +3 \text{ mm}$$

$$\text{straight leg} > 6000 \text{ mm} - 9000 \text{ mm} \quad -0 / +4 \text{ mm}$$

$$\text{straight leg} > 9000 \text{ mm} \quad -0 / +5 \text{ mm}$$

## • Difference in leg length

$$\text{leg length} \leq 5000 \text{ mm} \quad -0 / +3 \text{ mm}$$

$$\text{leg length} > 5000 \text{ mm} \quad -0 / +5 \text{ mm}$$

## • Tolerance on total length

The total length specifies the length of the external bend tangent line to the end of straight leg.

$$TL = LL + 0,5 D + R$$

$$\text{Tolerances} \leq 6000 \text{ mm} \quad -0/+5 \text{ mm}$$

$$> 6000 \text{ mm} \quad -0/+8 \text{ mm}$$

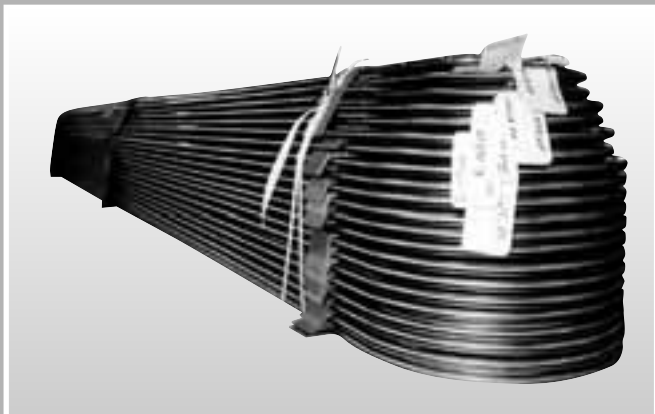
## • Deviation from plane of bend

$$DP \text{ max } 1/16'' = 1,5 \text{ mm}$$

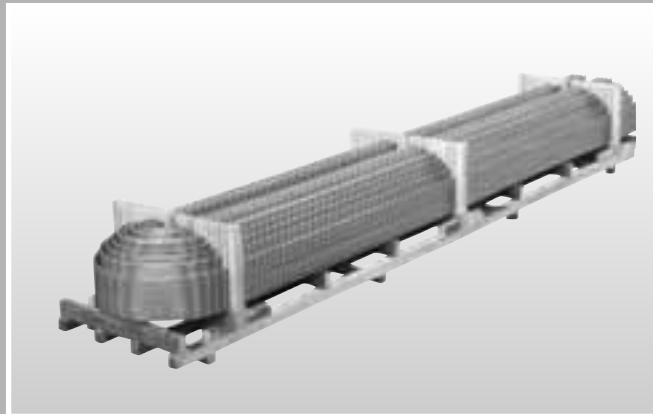


## U-Tubes for Heat Exchangers

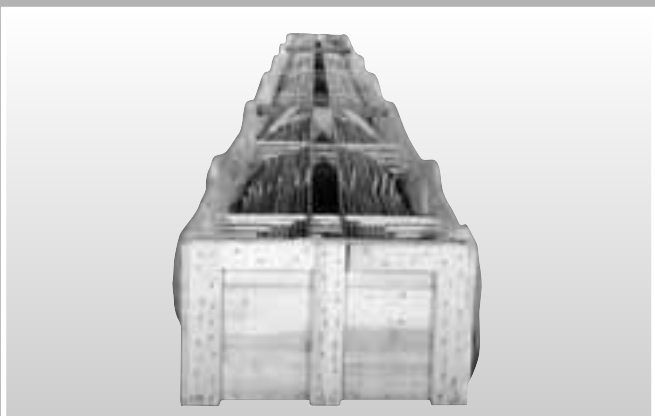
### Types of packing



Packing in layers, each radius marked with labels



Packing in wooden "combs" on pallets



Packing in layers and seaworthy wooden boxes



Packing on pallets protected with sheet plastic.



## 7 Excellent reasons to buy U-Tubes from TPS

### 1 Saving time and money due to In-House Bending

Tube production and bending in one facility. No need to transport tubes from manufacturer to the bending shop and from there to the fabricator. This eliminates also the additional transportation costs for the long length straight tubing.

Furthermore there is a considerable saving of time due to In-house bending, because bending process can be started immediately after the first straight tubes have been rolled.

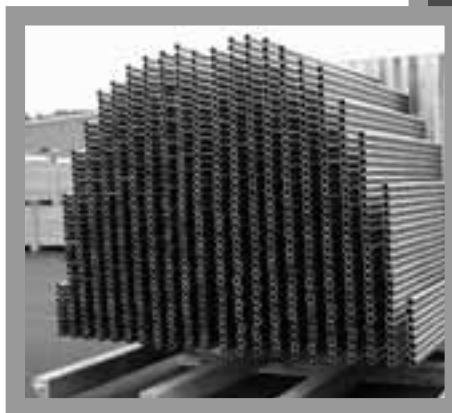
### 2 3-Year Warranty\*

Our warranty period is above the legal rules and covers 36 months for the tubes and the tube bends made at **TPS** in accordance to the specifications.

### 3 User friendly packing methods

The pre-sorted packing methods in rows or layers and sorted by radius will allow quick and easy removal of the tubes either from top row by row or from the box end by layers

You will save space, time and money.



\* In line with our general terms and conditions of sale we guarantee defect free materials and good workmanship



# 7 Excellent reasons to buy U-Tubes from TPS

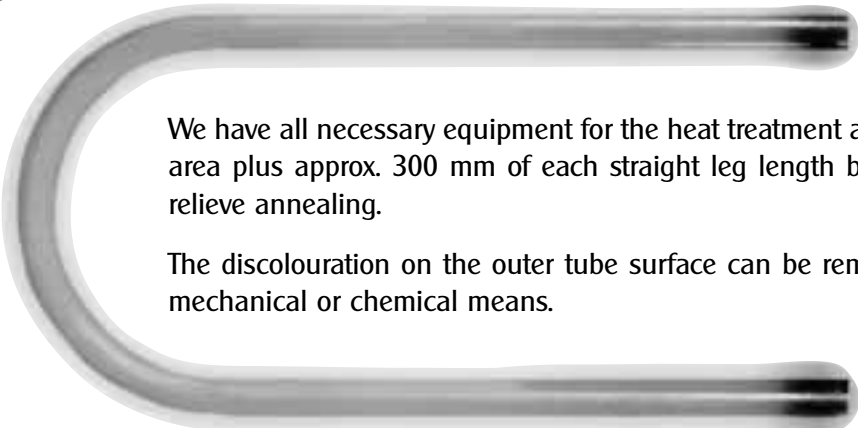
## 4 Spares

We keep spare tubes of longest developed length in our factory during the time of assembling the tube bundle. This spares can be bent with correct radius and be delivered against actual freight rate.

## 5 Cutting Allowances

Have you ever noticed how other suppliers charge you for the cutting allowance? **TPS** only charges the actual quantity shown on the bending schedule.

## 6 Heat Treatment of Bending Zone



We have all necessary equipment for the heat treatment after bending of bent area plus approx. 300 mm of each straight leg length by solution- or stress relieve annealing.

The discolouration on the outer tube surface can be removed on request by mechanical or chemical means.

## 7 Quality Assurance

The U-tubes supplied by **TPS** are subject to the same strict quality assurance requirements as the straight tubes and we grant full warranty for the bending area also.







Electric resistance heat treatment with controlled temperature by an automatic Infra-Red-Camera



Pre-sorted packing by radii



Ready for packing into wooden boxes



# Condenser & Heatexchanger Tubes

## Carbon Alloy Steel

| WT<br>OD            | SWG       | SWG       | BWG       | BWG       | SWG       | SWG       | BWG       | BWG       | SWG       | SWG       | BWG       | BWG       | SWG       | SWG       | BWG       | BWG       | SWG       | SWG       | BWG       | BWG       |
|---------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                     | M/W<br>mm | A/W<br>mm | M/W<br>mm | A/W<br>mm | M/W<br>mm | A/W<br>mm | M/W<br>mm | A/W<br>mm | M/W<br>mm | A/W<br>mm | M/W<br>mm | A/W<br>mm | M/W<br>mm | A/W<br>mm | M/W<br>mm | A/W<br>mm | M/W<br>mm | A/W<br>mm | M/W<br>mm | A/W<br>mm |
| 3/16"<br>4.76 mm    | 0,058     | 0,053     | 0,058     | 0,053     | 0,068     | 0,062     | 0,075     | 0,065     | 0,077     | 0,071     | 0,077     | 0,071     | 0,086     | 0,079     | 0,086     | 0,079     | 0,094     | 0,087     | 0,092     |           |
| 1/4"<br>6.35 mm     | 0,080     | 0,073     | 0,080     | 0,073     | 0,095     | 0,086     | 0,098     | 0,089     | 0,108     | 0,099     | 0,108     | 0,099     | 0,121     | 0,111     | 0,121     | 0,111     | 0,133     | 0,123     | 0,131     |           |
| 3/8"<br>9.53 mm     | 0,125     | 0,113     | 0,125     | 0,113     | 0,148     | 0,134     | 0,153     | 0,139     | 0,170     | 0,155     | 0,170     | 0,155     | 0,192     | 0,175     | 0,192     | 0,175     | 0,213     | 0,194     | 0,208     |           |
| 1/2"<br>12.7 mm     | 0,169     | 0,153     | 0,169     | 0,152     | 0,201     | 0,182     | 0,208     | 0,189     | 0,232     | 0,210     | 0,232     | 0,210     | 0,262     | 0,238     | 0,262     | 0,238     | 0,292     | 0,266     | 0,285     |           |
| 5/8"<br>15.88 mm    |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           | 0,372     | 0,337     | 0,362     |           |           |
| 3/4"<br>19.05 mm    |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           | 0,451     | 0,409     | 0,440     |           |           |
| 7/8"<br>22.2 mm     |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |
| 1"<br>25.4 mm       |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |
| 1 1/16"<br>26.99 mm |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |
| 1 1/8"<br>28.58 mm  |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |
| 1 1/4"<br>31.75 mm  |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |
| 1 1/2"<br>38.1 mm   |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |
| 1 3/4"<br>44.45 mm  |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |
| 2"<br>50.8 mm       |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |
| 2 1/4"<br>57.15 mm  |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |
| 2 1/2"<br>63.5 mm   |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |
| 2 3/4"<br>69.85 mm  |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |
| 3"<br>76.2 mm       |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |
| WT<br>OD            | SWG       | SWG       | BWG       | BWG       | SWG       | SWG       | BWG       | BWG       | SWG       | SWG       | BWG       | BWG       | SWG       | SWG       | BWG       | BWG       | SWG       | SWG       | BWG       | BWG       |
|                     | M/W<br>mm | A/W<br>mm | M/W<br>mm | A/W<br>mm | M/W<br>mm | A/W<br>mm | M/W<br>mm | A/W<br>mm | M/W<br>mm | A/W<br>mm | M/W<br>mm | A/W<br>mm | M/W<br>mm | A/W<br>mm | M/W<br>mm | A/W<br>mm | M/W<br>mm | A/W<br>mm | M/W<br>mm | A/W<br>mm |
| 1/2"<br>12.7 mm     | 0,647     | 0,597     | 0,662     | 0,612     | 0,706     | 0,655     | 0,729     | 0,678     |           |           |           |           |           |           |           |           |           |           |           |           |
| 5/8"<br>15.88 mm    | 0,850     | 0,780     | 0,872     | 0,801     | 0,936     | 0,862     | 0,970     | 0,895     |           |           |           |           |           |           |           |           |           |           |           |           |
| 3/4"<br>19.05 mm    | 1,053     | 0,962     | 1,082     | 0,990     | 1,165     | 1,069     | 1,210     | 1,111     |           |           |           |           |           |           |           |           |           |           |           |           |
| 7/8"<br>22.2 mm     | 1,255     | 1,146     | 1,290     | 1,179     | 1,394     | 1,276     | 1,450     | 1,328     | 1,523     | 1,401     | 1,523     | 1,441     | 1,657     | 1,521     |           | 1,579     |           |           |           |           |
| 1"<br>25.4 mm       | 1,459     | 1,329     | 1,502     | 1,368     | 1,624     | 1,483     | 1,691     | 1,545     | 1,780     | 1,632     | 1,835     | 1,680     | 1,940     | 1,776     | 2,014     | 1,846     | 2,137     | 1,961     |           |           |
| 1 1/16"<br>26.99 mm | 1,561     | 1,421     | 1,607     | 1,463     | 1,742     | 1,586     | 1,814     | 1,654     | 1,915     | 1,747     | 1,972     | 1,800     | 2,083     | 1,903     | 2,165     | 1,980     | 2,298     | 2,105     |           |           |
| 1 1/8"<br>28.58 mm  | 1,660     | 1,512     | 1,710     | 1,557     | 1,854     | 1,690     | 1,933     | 1,763     | 2,041     | 1,862     | 2,101     | 1,919     | 2,223     | 2,030     | 2,310     | 2,112     | 2,455     | 2,248     |           |           |
| 1 1/4"<br>31.75 mm  | 1,865     | 1,695     | 1,921     | 1,764     | 2,082     | 1,897     | 2,171     | 1,979     | 2,290     | 2,093     | 2,365     | 2,157     | 2,505     | 2,285     | 2,607     | 2,379     | 2,772     | 2,534     | 2,836     |           |
| 1 1/2"<br>38.1 mm   | 2,268     | 2,061     | 2,341     | 2,124     | 2,541     | 2,310     | 2,656     | 2,412     | 2,801     | 2,555     | 2,894     | 2,635     | 3,071     | 2,794     | 3,199     | 2,912     | 3,408     | 3,107     | 3,489     |           |
| 1 3/4"<br>44.45 mm  | 2,676     | 2,427     | 2,759     | 2,502     | 3,003     | 2,724     | 3,137     | 2,845     | 3,311     | 3,015     | 3,423     | 3,112     | 3,636     | 3,303     | 3,791     | 3,445     | 4,044     | 3,680     | 4,142     |           |
| 2"<br>50.8 mm       | 3,084     | 2,793     | 3,180     | 2,879     | 3,461     | 3,138     | 3,619     | 3,279     | 3,822     | 3,478     | 3,953     | 3,589     | 4,201     | 3,812     | 4,380     | 3,978     | 4,680     | 4,253     | 4,795     |           |
| 2 1/4"<br>57.15 mm  | 3,490     | 3,159     | 3,596     | 3,256     | 3,920     | 3,551     | 4,098     | 3,712     | 4,332     | 3,939     | 4,482     | 4,066     | 4,765     | 4,321     | 4,975     | 4,510     | 4,332     | 3,939     | 5,450     |           |
| 2 1/2"<br>63.5 mm   | 3,896     | 3,525     | 4,020     | 3,635     | 4,379     | 3,965     | 4,582     | 4,146     | 4,843     | 4,401     | 5,011     | 4,544     | 5,332     | 4,830     | 5,567     | 5,044     | 5,951     | 5,398     | 6,101     |           |
| 2"<br>50.8 mm       | 4,302     | 3,891     | 4,436     | 4,013     | 4,838     | 4,379     | 5,060     | 4,580     | 5,353     | 4,862     | 5,541     | 5,021     | 5,897     | 5,339     | 6,159     | 5,576     | 6,587     | 5,971     | 6,757     |           |
| 2 3/4"<br>69.85 mm  | 4,708     | 4,257     | 4,859     | 4,391     | 5,297     | 4,792     | 5,545     | 5,013     | 5,864     | 5,323     | 6,070     | 5,499     | 6,462     | 5,848     | 6,751     | 6,109     | 7,223     | 6,544     | 7,411     |           |
| 3"<br>76.2 mm       | 5,115     | 4,623     | 5,278     | 4,768     | 5,757     | 5,206     | 6,023     | 5,446     | 6,394     | 5,785     | 6,599     | 5,976     | 7,027     | 6,356     | 7,343     | 6,642     | 7,858     | 7,116     | 8,064     |           |
| 3 1/4"<br>82.55 mm  | 5,521     | 4,989     | 5,698     | 5,145     | 6,216     | 5,620     | 6,504     | 5,879     | 6,885     | 6,246     | 7,129     | 6,453     | 7,593     | 6,866     | 7,935     | 7,175     | 8,494     | 7,689     | 8,713     |           |
| 3 1/2"<br>95.25 mm  |           |           |           |           | 6,675     | 6,034     | 6,985     | 6,313     | 7,395     | 6,708     | 7,657     | 6,930     | 8,158     | 7,375     | 8,526     | 7,708     | 9,130     | 8,262     | 9,370     |           |
| 4"<br>101.6 mm      |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |

# Principal Inch and SWG-BWG Sizes and their mm Equivalents



|                                     | SWG<br>A/W<br>mm | SWG<br>M/W<br>mm | BWG<br>A/W<br>mm | BWG<br>M/W<br>mm | SWG<br>A/W<br>mm | SWG<br>M/W<br>mm | BWG<br>A/W<br>mm | BWG<br>M/W<br>mm    | SWG<br>A/W<br>mm | SWG<br>M/W<br>mm | BWG<br>A/W<br>mm | BWG<br>M/W<br>mm | SWG<br>A/W<br>mm | SWG<br>M/W<br>mm | BWG<br>A/W<br>mm | BWG<br>M/W<br>mm | SWG<br>A/W<br>mm | SWG<br>M/W<br>mm | BWG<br>A/W<br>mm | BWG<br>M/W<br>mm | WT<br><br>OD       |
|-------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|---------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|--------------------|
|                                     | 19<br>1,016      | 19<br>1,086      | 19<br>1,086      | 18<br>1,219      | 18<br>1,219      | 18<br>1,244      | 18<br>1,244      | 16<br>1,626         | 16<br>1,626      | 16<br>1,651      | 16<br>1,651      | 15<br>1,829      | 15<br>1,829      | 15<br>1,828      | 15<br>1,828      | 14<br>2,032      | 14<br>2,032      | 14<br>2,108      | 14<br>2,108      |                  |                    |
|                                     | 0,134            | 0,153            | 0,141            | 0,167            | 0,154            | 0,169            | 0,157            | 0,202               | 0,189            | 0,204            | 0,191            | 0,216            | 0,204            | 0,216            | 0,204            |                  |                  |                  |                  |                  | 1/4"<br>6.35 mm    |
|                                     | 0,293            | 0,342            | 0,311            | 0,379            | 0,345            | 0,385            | 0,351            | 0,485               | 0,444            | 0,491            | 0,450            | 0,534            | 0,490            | 0,534            | 0,490            | 0,581            | 0,536            | 0,599            | 0,551            |                  | 1/2"<br>12.7mm     |
|                                     | 0,452            | 0,530            | 0,481            | 0,590            | 0,536            | 0,601            | 0,545            | 0,766               | 0,698            | 0,779            | 0,709            | 0,852            | 0,777            | 0,852            | 0,777            | 0,936            | 0,853            | 0,964            | 0,881            |                  | 3/4"<br>19,05 mm   |
|                                     |                  |                  |                  | 0,802            | 0,726            | 0,817            | 0,714            | 1,048               | 0,953            | 1,068            | 0,970            | 1,170            | 1,063            | 1,169            | 1,063            | 1,290            | 1,171            | 1,331            | 1,211            |                  | 1"<br>25.4 mm      |
|                                     |                  |                  |                  |                  |                  |                  |                  | 1,193               | 1,081            | 1,210            | 1,097            | 1,331            | 1,207            | 1,329            | 1,206            | 1,466            | 1,330            | 1,514            | 1,376            |                  | 1 1/8"<br>28,58 mm |
|                                     |                  |                  |                  |                  |                  |                  |                  | 1,615               | 1,462            | 1,637            | 1,483            | 1,805            | 1,636            | 1,805            | 1,636            | 1,998            | 1,807            | 2,064            | 1,871            |                  | 1 1/2"<br>38,1 mm  |
|                                     |                  |                  |                  |                  |                  |                  |                  |                     |                  |                  |                  |                  |                  |                  |                  | 2,704            | 2,444            | 2,796            | 2,531            |                  | 2"<br>50.8 mm      |
|                                     |                  |                  |                  |                  |                  |                  |                  |                     |                  |                  |                  |                  |                  |                  |                  | 3,407            | 3,080            | 3,529            | 3,192            |                  | 2 1/2"<br>63.5 mm  |
|                                     |                  |                  |                  |                  |                  |                  |                  |                     |                  |                  |                  |                  |                  |                  |                  | 4,121            | 3,716            | 4,262            | 3,852            |                  | 3"<br>76,2 mm      |
|                                     | SWG<br>A/W<br>mm | SWG<br>M/W<br>mm | BWG<br>A/W<br>mm | BWG<br>M/W<br>mm | SWG<br>A/W<br>mm | SWG<br>M/W<br>mm | BWG<br>A/W<br>mm | WT<br><br>OD        |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                    |
|                                     | 8<br>40,64       | 8<br>4,191       | 8<br>4,191       | 7<br>4,471       | 7<br>4,471       | 7<br>4,572       | 7<br>4,572       |                     |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                    |
|                                     |                  |                  |                  |                  |                  |                  |                  | 5/8"<br>15,88 mm    |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                    |
|                                     |                  |                  |                  |                  |                  |                  |                  | 7/8"<br>22,2 mm     |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                    |
|                                     |                  |                  |                  |                  |                  |                  |                  | 1 1/16"<br>26,99 mm |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                    |
|                                     | 2,775            | 3,108            | 2,848            |                  |                  |                  |                  | 1 1/4"<br>31,75 mm  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                    |
|                                     | 4,047            | 4,564            | 4,161            | 4,833            | 4,408            | 4,928            | 4,496            | 1 3/4"<br>44,45 mm  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                    |
|                                     | 5,320            | 6,022            | 5,473            | 6,387            | 5,808            | 6,517            | 5,928            | 2 1/4"<br>57,15 mm  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                    |
|                                     | 6,593            | 7,479            | 6,786            | 7,941            | 7,208            | 8,106            | 7,36             | 2"<br>50.8 mm       |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                    |
|                                     | 7,866            | 8,933            | 8,098            | 9,496            | 8,608            | 9,696            | 8,792            | 3"<br>76,2 mm       |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                    |
|                                     | 9,138            | 10,393           | 9,411            | 11,050           | 10,009           | 11,285           | 10,223           | 3 1/2"<br>95,25 mm  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                    |
|                                     |                  |                  |                  |                  |                  |                  |                  |                     |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                    |
| Weights in kg/m                     |                  |                  |                  |                  |                  |                  |                  |                     |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                    |
| Conversion Factors                  |                  |                  |                  |                  |                  |                  |                  |                     |                  |                  |                  |                  |                  |                  | Carbon Steel     |                  |                  |                  |                  |                  |                    |
| Aluminium Brass (Alloy 687)         |                  |                  |                  |                  |                  |                  |                  |                     |                  |                  |                  |                  |                  |                  | x                | 1.057            |                  |                  |                  |                  |                    |
| Admiralty Brass (Alloy 443)         |                  |                  |                  |                  |                  |                  |                  |                     |                  |                  |                  |                  |                  |                  | x                | 1.082            |                  |                  |                  |                  |                    |
| Cu/Ni 90/10 (Alloy 706)             |                  |                  |                  |                  |                  |                  |                  |                     |                  |                  |                  |                  |                  |                  | x                | 1.133            |                  |                  |                  |                  |                    |
| Cu/Ni 70/30 (Alloy 715)             |                  |                  |                  |                  |                  |                  |                  |                     |                  |                  |                  |                  |                  |                  | x                | 1.133            |                  |                  |                  |                  |                    |
| Stainless steel:                    |                  |                  |                  |                  |                  |                  |                  |                     |                  |                  |                  |                  |                  |                  | x                | 1.015            |                  |                  |                  |                  |                    |
| UNS N04400                          |                  |                  |                  |                  |                  |                  |                  |                     |                  |                  |                  |                  |                  |                  | x                | 1.125            |                  |                  |                  |                  |                    |
| UNS N06600                          |                  |                  |                  |                  |                  |                  |                  |                     |                  |                  |                  |                  |                  |                  | x                | 1.073            |                  |                  |                  |                  |                    |
| UNS N08800                          |                  |                  |                  |                  |                  |                  |                  |                     |                  |                  |                  |                  |                  |                  | x                | 1.013            |                  |                  |                  |                  |                    |
| UNS N08810                          |                  |                  |                  |                  |                  |                  |                  |                     |                  |                  |                  |                  |                  |                  | x                | 1.013            |                  |                  |                  |                  |                    |
| UNS N08825                          |                  |                  |                  |                  |                  |                  |                  |                     |                  |                  |                  |                  |                  |                  | x                | 1.037            |                  |                  |                  |                  |                    |
| UNS N0N10665                        |                  |                  |                  |                  |                  |                  |                  |                     |                  |                  |                  |                  |                  |                  | x                | 1.174            |                  |                  |                  |                  |                    |
| UNS N0N06455                        |                  |                  |                  |                  |                  |                  |                  |                     |                  |                  |                  |                  |                  |                  | x                | 1.131            |                  |                  |                  |                  |                    |
| M/W minimum wall · A/W average wall |                  |                  |                  |                  |                  |                  |                  |                     |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                    |

## Weights in kg/m

### Conversion Factors

### Carbon Steel

Aluminium Brass (Alloy 687)

x 1.057

Admiralty Brass (Alloy 443)

x 1.082

Cu/Ni 90/10 (Alloy 706)

x 1.133

Cu/Ni 70/30 (Alloy 715)

x 1.133

Stainless steel:

x 1.015

UNS N04400

x 1.125

UNS N06600

x 1.073

UNS N08800

x 1.013

UNS N08810

x 1.013

UNS N08825

x 1.037

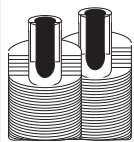
UNS N0N10665

x 1.174

UNS N0N06455

x 1.131

M/W minimum wall · A/W average wall

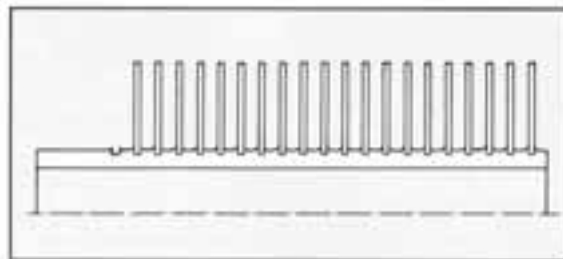


# Description of available types of TECHNIFIN® Tubes

TECHNIFIN®

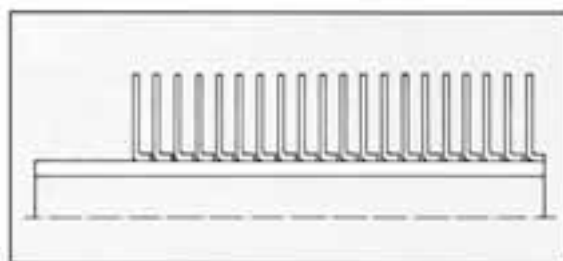
## TECHNIFIN TYPE „G“

The fin strip is wound into a mechanically produced groove and tightened by backfilling of the base material under pressure. Groove depth 0,4 mm. Advantages: High fin stability, excellent heat transfer, high operating temperature.



## TECHNIFIN TYPE „L“, „KL“, „DL“

The fin strip is shaped into a „L“ and wound onto the tube surface under tension. Advantages: Core tube extensively protected against corrosion by the fin foot, finning of very thin-walled tubes possible.

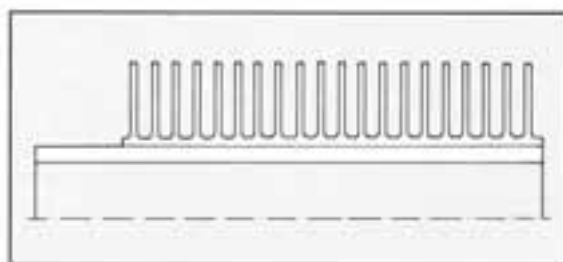


## TECHNIFIN TYPE „HY“

A smooth core tube is inserted into an aluminium tube and then fins are extruded out of the aluminium tube. Advantages: Bond of outer and inner tube removes the risk of loss of contact due to thermal stress, fins are more rigid, also available as serrated type TECHNIFIN „HYS“ see below.

## TECHNIFIN TYPE „HYS“

As per type „HY“, but fins are serrated. Advantages: Higher heat transfer coefficient, for same pressure drop compared with „HY“ fin.



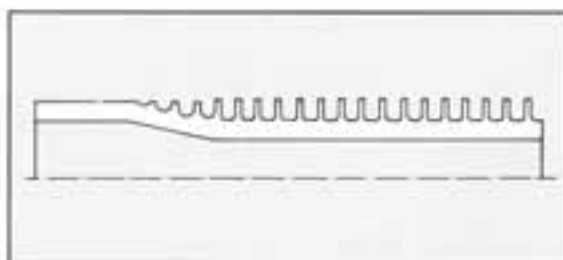
## TECHNIFIN TYPE „I“

The fin strip is wound onto the base tube. Typical fin material: steel.



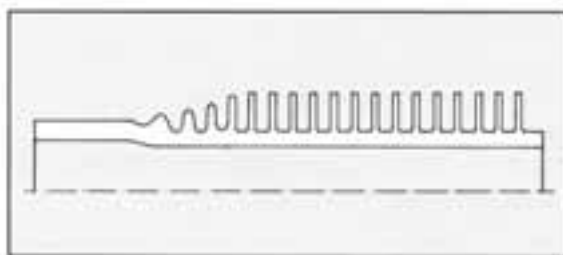
## TECHNIFIN TYPE „N“

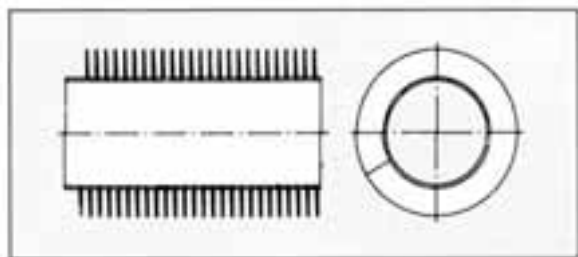
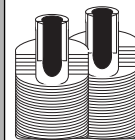
The fins are rolled out of the wall of the plain tube. Tube and fin are consisting of one piece. Advantages: Excellent heattransfer, good bending properties, wide range of material can be used.



## TECHNIFIN TYPE „M“

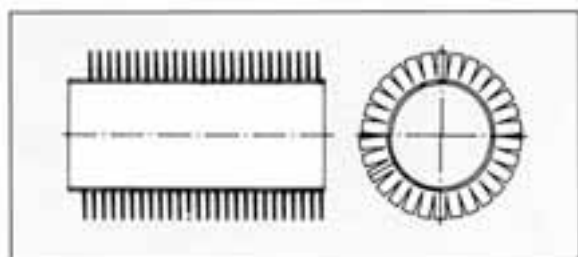
Manufacturing and advantages as described for type „N“ but with higher fins.





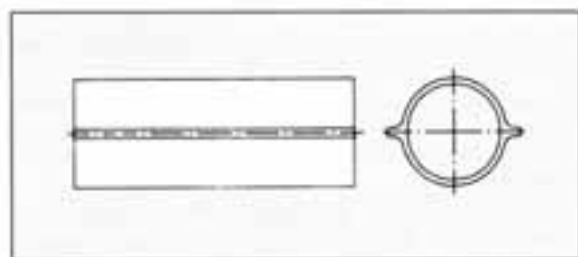
## **TECHNIFIN TYPE „WO“**

The fin strip is wound spirally onto the tube and welded continuously to the tube along the spiral root. Advantages: Strong connection between fin and base tube, prevents loosening of fin because of heat stress, oxidization, corrosion etc., use at very high temperatures possible.



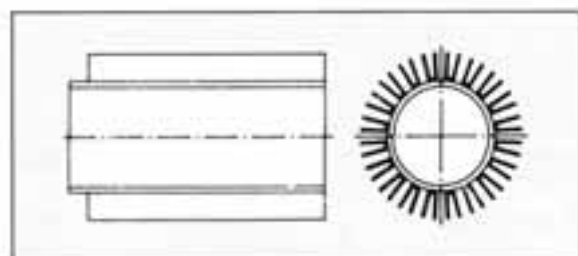
## **TECHNIFIN TYPE „WOS“**

As per type „WO“, but fins are serrated. Advantages: Higher heat transfer coefficient. For the same pressure drop compared with „WO“ fin.



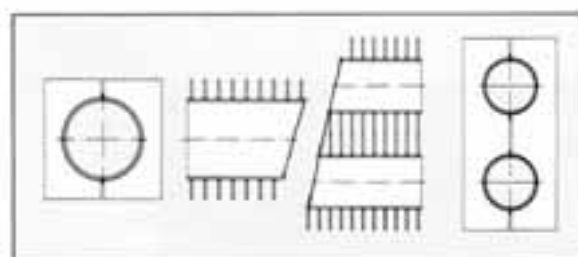
## **TECHNIFIN TYPE „LFS“**

Extruded or drawn fin tube, seamless with two longitudinal opposite fins. Used in boiler wall constructions.



## **TECHNIFIN TYPE „LFW“**

I/L or U fins welded longitudinally onto the base tube.

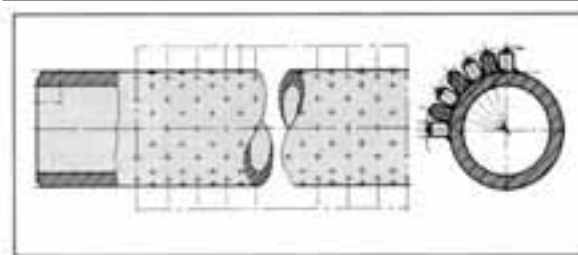


## **TECHNIFIN TYPE „S“**

Square fins are welded onto a round base tube.

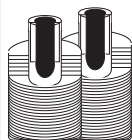
## **TECHNIFIN TYPE „Double S“**

Square fins are welded onto two round base tubes.

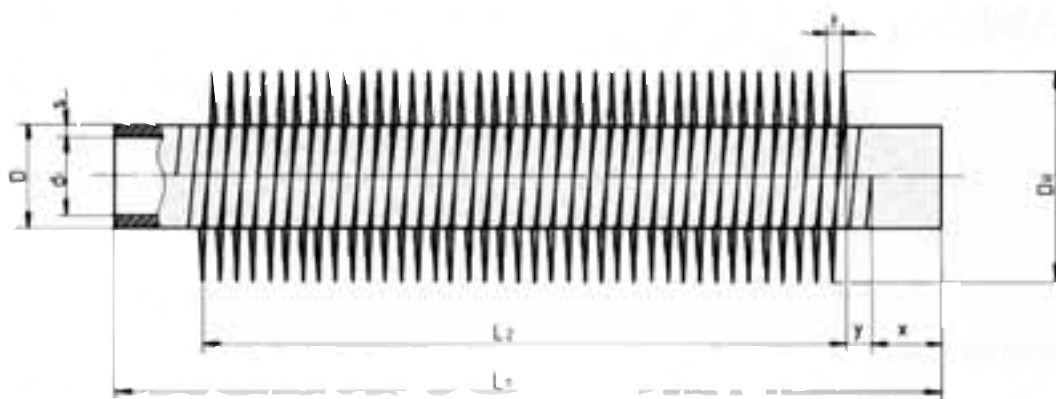


## **TECHNISTUD**

Steel studs are welded by a special process onto the base tube.



# TECHNIFIN® Type "G"



L1 max. = 12 000 mm

L2 max. = L1 - 2y

Y max. = 4 x t

Fin Thickness = 0,3 - 0,4 mm

x = acc. to clients specification

Fa = Outer Tube Surface Area incl. Surface Area of Fins

Fi = Interior Tube Surface Area per Meter (m<sup>2</sup>/m)

FZR = Uncovered Tube Area between the fins

## MATERIAL COMBINATIONS

### Core Tube

Carbon steels (ASTM A 179/ A 214, St 35.8,ect.), low-alloy steels, stainless steels, copper-nickel alloys, aluminium bronze, copper, nickel-alloys (Alloy 400, etc.), bimetal

### Fins

Aluminium / Steel / Galvanized Steel

## MANUFACTURING PROCESS

The manufacturing tool is made up of 2 non-cutting plates set at 90° to the axis of the base tube.

The first plate effects a groove for metal spinning. The second directs the ribbon in the groove and sets the fin foot in the groove through pressure on the metal displaced for the groove.

A similar plate made of tungsten carbure allows us to manufacture G finned tubes with base tubes made of austenitic steel or exotic alloys.

## FIELDS OF APPLICATION

- the petroleum, chemical and petrochemical process industries
- natural gas treatment
- the steel industry: blast furnace and converter systems
- power generation: steam turbine exhaust condensing
  - contact condensing with cooling of circulating condensate
  - fossil and nuclear power plants
- air conditioning (freon, ammonia, propane)
- incineration of household refuse
- compressor coolers, ect.

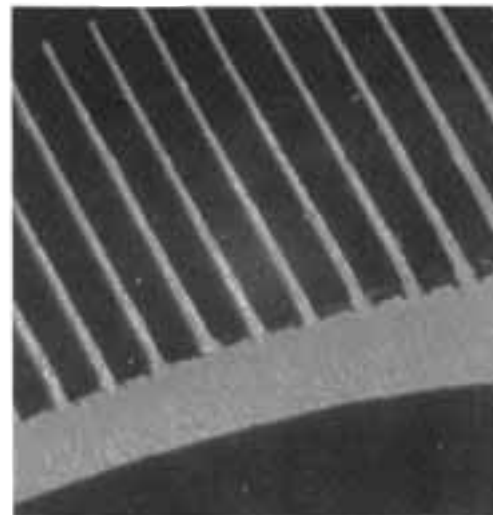
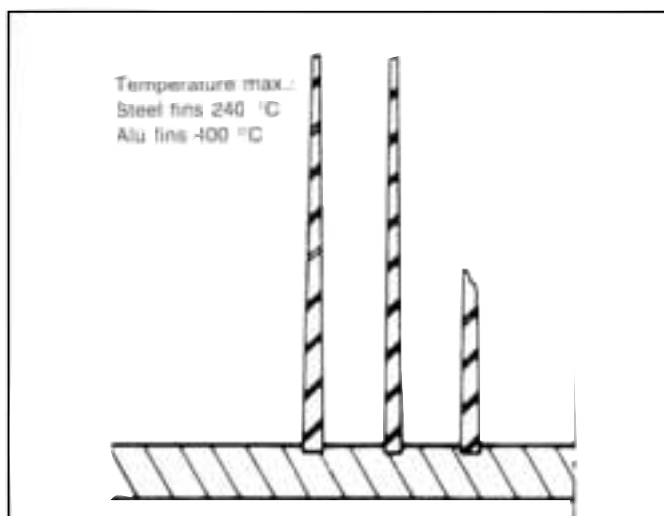
## ADVANTAGES

### 1) Thermal

The fin/tube wall contact is constant because of the setting and makes it possible to use a wall temperature of up to 400° C.

### 2) Mechanical

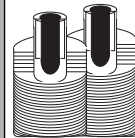
The fin is set throughout its length and consequently does not unwind even when partially uprooted.





# TECHNIFIN® Type "G"

## Standard Size Range



**D = 25,4 mm\* DR = 50,8 mm + DR = 57 mm**

\* on request, other core tube dimensions available

| ORDER-No.                 | s<br>mm                               | di<br>mm | Fins/in.<br>t | Fa<br>m <sup>2</sup> */m | Fa/Fi | Weight<br>Kg/m | FZR<br>m <sup>2</sup> */m |
|---------------------------|---------------------------------------|----------|---------------|--------------------------|-------|----------------|---------------------------|
| TECHNIFIN® G 1.2.51- 5    | 2                                     | 21,4     | 5             | 0,678                    | 10,09 | 1,51           | 0,0234                    |
| TECHNIFIN® G 1.2.51- 6    |                                       |          | 6             | 0,798                    | 11,87 | 1,58           | 0,0230                    |
| TECHNIFIN® G 1.2.51- 7    |                                       |          | 7             | 0,918                    | 13,65 | 1,65           | 0,0226                    |
| TECHNIFIN® G 1.2.51- 8    |                                       |          | 8             | 1,037                    | 15,43 | 1,72           | 0,0222                    |
| TECHNIFIN® G 1.2.51- 9    |                                       |          | 9             | 1,157                    | 17,21 | 1,79           | 0,0218                    |
| TECHNIFIN® G 1.2.51-10    |                                       |          | 10            | 1,277                    | 18,99 | 1,85           | 0,0214                    |
| TECHNIFIN® G 1.2.51-11    |                                       |          | 11            | 1,396                    | 20,77 | 1,94           | 0,0210                    |
| TECHNIFIN® G 1.2.5.51- 5  | 2,11<br>(14 BWG)<br>Min. Wall<br>-2,5 | (20,4)   | 5             | 0,678                    | 10,58 | 1,76           | 0,0234                    |
| TECHNIFIN® G 1.2.5.51- 6  |                                       |          | 6             | 0,798                    | 12,45 | 1,83           | 0,0230                    |
| TECHNIFIN® G 1.2.5.51- 7  |                                       |          | 7             | 0,918                    | 14,32 | 1,90           | 0,0226                    |
| TECHNIFIN® G 1.2.5.51- 8  |                                       |          | 8             | 1,037                    | 16,19 | 1,98           | 0,0222                    |
| TECHNIFIN® G 1.2.5.51- 9  |                                       |          | 9             | 1,157                    | 18,05 | 2,05           | 0,0218                    |
| TECHNIFIN® G 1.2.5.51-10  |                                       |          | 10            | 1,277                    | 19,92 | 2,11           | 0,0214                    |
| TECHNIFIN® G 1.2.5.51-11  |                                       |          | 11            | 1,396                    | 21,79 | 2,19           | 0,0210                    |
| TECHNIFIN® G 1.3.51- 5    | 2,77<br>(12 BWG)<br>Min. Wall<br>-3,0 | (19,4)   | 5             | 0,678                    | 11,13 | 2,01           | 0,0234                    |
| TECHNIFIN® G 1.3.51- 6    |                                       |          | 6             | 0,798                    | 13,09 | 2,08           | 0,0230                    |
| TECHNIFIN® G 1.3.51- 7    |                                       |          | 7             | 0,918                    | 15,06 | 2,15           | 0,0226                    |
| TECHNIFIN® G 1.3.51- 8    |                                       |          | 8             | 1,037                    | 17,02 | 2,22           | 0,0222                    |
| TECHNIFIN® G 1.3.51- 9    |                                       |          | 9             | 1,157                    | 18,98 | 2,29           | 0,0218                    |
| TECHNIFIN® G 1.3.51-10    |                                       |          | 10            | 1,277                    | 20,95 | 2,36           | 0,0214                    |
| TECHNIFIN® G 1.3.51-11    |                                       |          | 11            | 1,396                    | 22,91 | 2,44           | 0,0210                    |
| TECHNIFIN® G 1.2.57- 5    | 2                                     | 21,4     | 5             | 0,885                    | 13,16 | 1,65           | 0,0291                    |
| TECHNIFIN® G 1.2.57- 6    |                                       |          | 6             | 1,046                    | 15,56 | 1,73           | 0,0286                    |
| TECHNIFIN® G 1.2.57- 7    |                                       |          | 7             | 1,207                    | 17,95 | 1,82           | 0,0281                    |
| TECHNIFIN® G 1.2.57- 8    |                                       |          | 8             | 1,368                    | 20,35 | 1,92           | 0,0276                    |
| TECHNIFIN® G 1.2.57- 9    |                                       |          | 9             | 1,529                    | 22,74 | 2,01           | 0,0271                    |
| TECHNIFIN® G 1.2.57-10    |                                       |          | 10            | 1,690                    | 25,14 | 2,11           | 0,0266                    |
| TECHNIFIN® G 1.2.57-11    |                                       |          | 11            | 1,851                    | 27,53 | 2,20           | 0,0261                    |
| TECHNIFIN® G 1.2.5.57- 5  | 2,11<br>(14 BWG)<br>Min. Wall<br>-2,5 | (20,4)   | 5             | 0,885                    | 13,81 | 1,89           | 0,0291                    |
| TECHNIFIN® G 1.2.5.57- 6  |                                       |          | 6             | 1,046                    | 16,32 | 1,99           | 0,0286                    |
| TECHNIFIN® G 1.2.5.57- 7  |                                       |          | 7             | 1,207                    | 18,83 | 2,08           | 0,0281                    |
| TECHNIFIN® G 1.2.5.57- 8  |                                       |          | 8             | 1,368                    | 21,35 | 2,18           | 0,0276                    |
| TECHNIFIN® G 1.2.5.57- 9  |                                       |          | 9             | 1,529                    | 23,86 | 2,27           | 0,0271                    |
| TECHNIFIN® G 1.2.5.57- 10 |                                       |          | 10            | 1,690                    | 26,37 | 2,37           | 0,0266                    |
| TECHNIFIN® G 1.2.5.57- 11 |                                       |          | 11            | 1,851                    | 28,88 | 2,46           | 0,0261                    |
| TECHNIFIN® G 1.3.57- 5    | 2,77<br>(12 BWG)<br>Min. Wall<br>-3,0 | (19,4)   | 5             | 0,885                    | 14,42 | 2,14           | 0,0291                    |
| TECHNIFIN® G 1.3.57- 6    |                                       |          | 6             | 1,046                    | 17,16 | 2,23           | 0,0286                    |
| TECHNIFIN® G 1.3.57- 7    |                                       |          | 7             | 1,207                    | 19,80 | 2,33           | 0,0281                    |
| TECHNIFIN® G 1.3.57- 8    |                                       |          | 8             | 1,368                    | 22,45 | 2,42           | 0,0276                    |
| TECHNIFIN® G 1.3.57- 9    |                                       |          | 9             | 1,529                    | 25,09 | 2,52           | 0,0271                    |
| TECHNIFIN® G 1.3.57-10    |                                       |          | 10            | 1,690                    | 27,73 | 2,61           | 0,0266                    |
| TECHNIFIN® G 1.3.57-11    |                                       |          | 11            | 1,851                    | 30,37 | 2,71           | 0,0261                    |

Given weights are for steel tubes with Aluminium fins. Weight calculation for steel fins: Kg/m ≈ weight of table + 0,1827 x fins per inch.





$F_a$  = Outer Tube Surface Area incl. Surface Area of Fins  
 $F_i$  = Interior Tube Surface Area per Meter ( $m^2/m$ )  
 $F_{7P}$  = Uncovered Tube Area between the fins

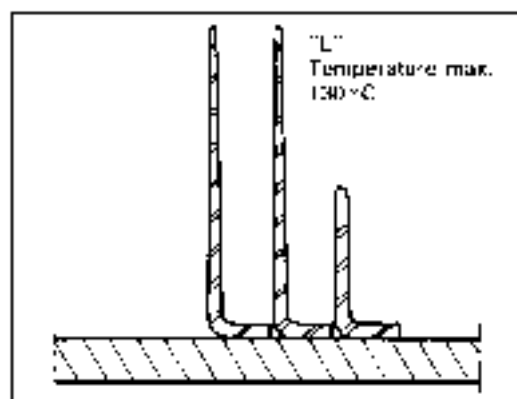
## MATERIAL COMBINATIONS

### Core Tube

Carbon steels (ASTM A 179/ A 214, St 35,8,ect.), low-alloy steels, stainless steels, copper-nickel alloys, aluminium bronze, copper, nickel-alloys (Alloy 400, ext.), bimetal

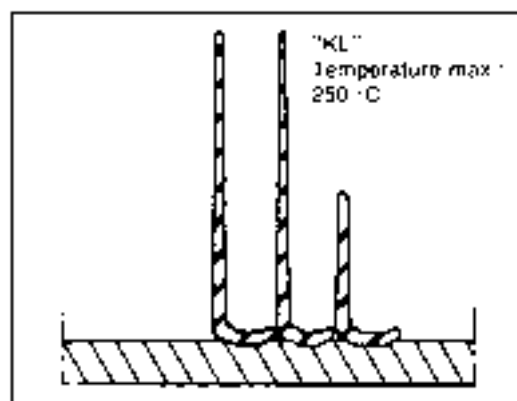
## Fins

## Aluminium



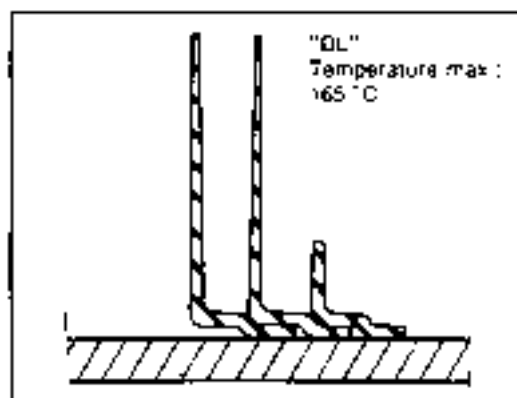
## FIELDS OF APPLICATION

- the petroleum, chemical and petrochemical process industries
- natural gas treatment
- the steel industry: blast furnace and converter systems
- power generation: steam turbine exhaust condensing
  - contact condensing with cooling of circulating condensate
  - fossil and nuclear power plants
- air conditioning (freon, ammonia, propane)
- incineration of household refuse
- compressor coolers, ect.



## MANUFACTURING PROCESS

The manufacturing strip is folded to form an L shape and then wound around the base tube. The feet of the fins are joined together and cover the whole of the finned surface. Both leads are clamped down to avoid unrolling through damage.

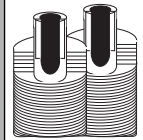


## ADVANTAGES

## Economic

This method of manufacturing enables us to place the finning on a very thin-walled tube with is particularly desirable when using noble alloys (titanium, stainless, copper, nickel).

The tube can withstand a temperature of up to 130°C without the risk of atmospheric corrosion or thermal stress.

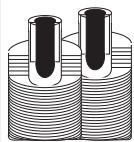


**D = 25,4 mm\* DR = 50,8mm + DR = 57 mm**

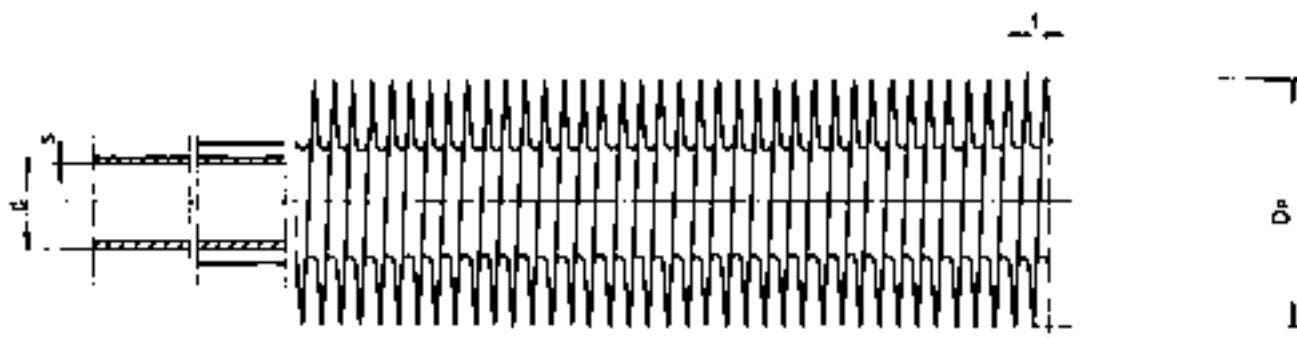
\* on request, other core tube dimensions available

| ORDER-No.                | S<br>mm                               | di<br>mm | Fins/in.<br>t | Fa<br>m <sup>2</sup> /m | Fa/Fi | Weight<br>Kg/m | FRZ<br>m <sup>2</sup> /m |
|--------------------------|---------------------------------------|----------|---------------|-------------------------|-------|----------------|--------------------------|
| TECHNIFIN® L 1.2.51-5    | 2                                     | 21,4     | 5             | 0,678                   | 10,09 | 1,51           | 0,0229                   |
| TECHNIFIN® L 1.2.51-6    |                                       |          | 6             | 0,798                   | 11,87 | 1,58           | 0,0224                   |
| TECHNIFIN® L 1.2.51-7    |                                       |          | 7             | 0,918                   | 13,65 | 1,65           | 0,0219                   |
| TECHNIFIN® L 1.2.51-8    |                                       |          | 8             | 1,037                   | 15,43 | 1,72           | 0,0214                   |
| TECHNIFIN® L 1.2.51-9    |                                       |          | 9             | 1,157                   | 17,21 | 1,79           | 0,0209                   |
| TECHNIFIN® L 1.2.51-10   |                                       |          | 10            | 1,277                   | 18,99 | 1,85           | 0,0204                   |
| TECHNIFIN® L 1.2.51-11   |                                       |          | 11            | 1,396                   | 20,77 | 1,94           | 0,0199                   |
| TECHNIFIN® L 1.2.5.51-5  | 2,11<br>(14 BWG)<br>Min. Wall<br>-2,5 | (20,4)   | 5             | 0,678                   | 10,58 | 1,76           | 0,0229                   |
| TECHNIFIN® L 1.2.5.51-6  |                                       |          | 6             | 0,798                   | 12,45 | 1,83           | 0,0224                   |
| TECHNIFIN® L 1.2.5.51-7  |                                       |          | 7             | 0,918                   | 14,32 | 1,90           | 0,0219                   |
| TECHNIFIN® L 1.2.5.51-8  |                                       |          | 8             | 1,037                   | 16,19 | 1,98           | 0,0214                   |
| TECHNIFIN® L 1.2.5.51-9  |                                       |          | 9             | 1,157                   | 18,05 | 2,05           | 0,0209                   |
| TECHNIFIN® L 1.2.5.51-10 |                                       |          | 10            | 1,277                   | 19,92 | 2,11           | 0,0204                   |
| TECHNIFIN® L 1.2.5.51-11 |                                       |          | 11            | 1,396                   | 21,79 | 2,19           | 0,0199                   |
| TECHNIFIN® L 1.3.51-5    | 2,77<br>(12 BWG)<br>Min. Wall<br>-3,0 | (19,4)   | 5             | 0,678                   | 11,13 | 2,01           | 0,0229                   |
| TECHNIFIN® L 1.3.51-6    |                                       |          | 6             | 0,798                   | 13,09 | 2,08           | 0,0224                   |
| TECHNIFIN® L 1.3.51-7    |                                       |          | 7             | 0,918                   | 15,06 | 2,15           | 0,0219                   |
| TECHNIFIN® L 1.3.51-8    |                                       |          | 8             | 1,037                   | 17,02 | 2,22           | 0,0214                   |
| TECHNIFIN® L 1.3.51-9    |                                       |          | 9             | 1,157                   | 18,98 | 2,29           | 0,0209                   |
| TECHNIFIN® L 1.3.51-10   |                                       |          | 10            | 1,277                   | 20,95 | 2,36           | 0,0204                   |
| TECHNIFIN® L 1.3.51-11   |                                       |          | 11            | 1,396                   | 22,91 | 2,44           | 0,0199                   |
| TECHNIFIN® L 1.2.57-5    | 2                                     | 21,4     | 5             | 0,885                   | 13,16 | 1,65           | 0,0286                   |
| TECHNIFIN® L 1.2.57-6    |                                       |          | 6             | 1,046                   | 15,56 | 1,73           | 0,0280                   |
| TECHNIFIN® L 1.2.57-7    |                                       |          | 7             | 1,207                   | 17,95 | 1,82           | 0,0274                   |
| TECHNIFIN® L 1.2.57-8    |                                       |          | 8             | 1,368                   | 20,35 | 1,92           | 0,0268                   |
| TECHNIFIN® L 1.2.57-9    |                                       |          | 9             | 1,529                   | 22,74 | 2,01           | 0,0262                   |
| TECHNIFIN® L 1.2.57-10   |                                       |          | 10            | 1,690                   | 25,14 | 2,11           | 0,0256                   |
| TECHNIFIN® L 1.2.57-11   |                                       |          | 11            | 1,851                   | 27,53 | 2,20           | 0,0250                   |
| TECHNIFIN® L 1.2.5.57-5  | 2,11<br>(14BWG)<br>Min.Wall<br>-2,5   | (20,4)   | 5             | 0,885                   | 13,81 | 1,89           | 0,0286                   |
| TECHNIFIN® L 1.2.5.57-6  |                                       |          | 6             | 1,046                   | 16,32 | 1,99           | 0,0280                   |
| TECHNIFIN® L 1.2.5.57-7  |                                       |          | 7             | 1,207                   | 18,83 | 2,08           | 0,0274                   |
| TECHNIFIN® L 1.2.5.57-8  |                                       |          | 8             | 1,368                   | 21,35 | 2,18           | 0,0268                   |
| TECHNIFIN® L 1.2.5.57-9  |                                       |          | 9             | 1,529                   | 23,86 | 2,27           | 0,0262                   |
| TECHNIFIN® L 1.2.5.57-10 |                                       |          | 10            | 1,690                   | 26,37 | 2,37           | 0,0256                   |
| TECHNIFIN® L 1.2.5.57-11 |                                       |          | 11            | 1,851                   | 28,88 | 2,46           | 0,0250                   |
| TECHNIFIN® L 1.3.57-5    | 2,77<br>(12BWG)<br>Min.Wal<br>-3,0    | (19,4)   | 5             | 0,885                   | 14,42 | 2,14           | 0,0286                   |
| TECHNIFIN® L 1.3.57-6    |                                       |          | 6             | 1,046                   | 17,16 | 2,23           | 0,0280                   |
| TECHNIFIN® L 1.3.57-7    |                                       |          | 7             | 1,207                   | 19,80 | 2,33           | 0,0274                   |
| TECHNIFIN® L 1.3.57-8    |                                       |          | 8             | 1,368                   | 22,45 | 2,42           | 0,0268                   |
| TECHNIFIN® L 1.3.57-9    |                                       |          | 9             | 1,529                   | 25,09 | 2,52           | 0,0262                   |
| TECHNIFIN® L 1.3.57-10   |                                       |          | 10            | 1,690                   | 27,73 | 2,61           | 0,0256                   |
| TECHNIFIN® L 1.3.57-11   |                                       |          | 11            | 1,851                   | 30,37 | 2,71           | 0,0250                   |

Given weights are for steel tubes with Aluminium fins. Weight calculation for steel fins: Kg/m weight of table + 0,1827 x fins per inch.



# TECHNIFIN® Type "HY", "HYS"



$L_{1max}$  = 12 000 mm  
 $L_{2max}$  = acc. to clients specification

Fin Thickness = 0,4 mm

$F_a$  = Outer Tube Surface Area incl. Surface Area of Fins  
 $F_i$  = Interior Tube Surface Area per Meter (m<sup>2</sup>/m)  
 $F_{RZ}$  = Uncovered Tube Area between the fins

## MATERIAL COMBINATIONS

### Core Tube

Carbon steels (ASTM A179 / A 214, St 35.8, ect.), low-alloy steels, stainless steels, copper-nickel alloys, aluminium bronze, copper, nickel-alloys, as well as exotic grades.

Core tubes with extremely thin wall of above stated materials can be applied.

### Exterior Tube & Fins

Generally Aluminium

## FIELDS OF APPLICATION

- the petroleum, chemical and petrochemical industries
- natural gas treatment
- the steel industry: blast furnace and converter cooling systems
- power generation: steam turbine exhaust condensing
  - contact condensing with cooling of circulating condensate
  - fossil and nuclear power plants
- air conditioning (freon, ammonia, propane)
- incineration of household refuse
- compressor coolers, ect.

## MANUFACTURING PROCESS

A polished and deoiled base tube is set in an aluminium sleeve. The whole goes through the fin-machine wich consists of three spindles set at 120° each on bearing a stack of plates. These plates, stacked in from and diameter first build the fin, then bond the outer and inner tubes together.

In certain cases (high air speed) the fins are serrated after fin process so as to increase the air coefficient.

## ADVANTAGES

### 1) Thermal

The bonding of the outer and inner tubes removes the risk of loss of contact with the aluminium due to thermal stress.

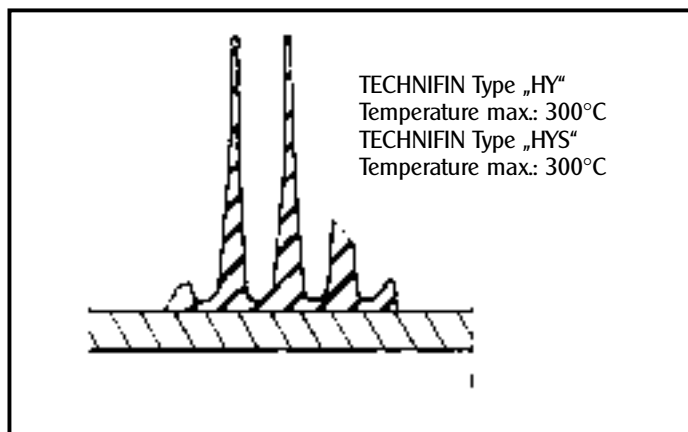
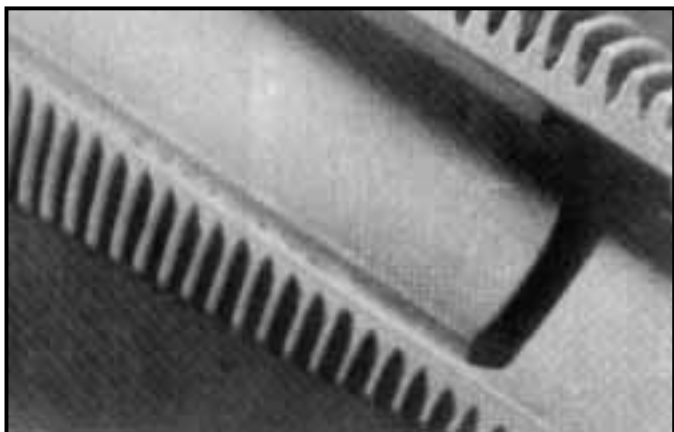
Maximum operating temperature: 250°C.

The transfer coefficient remains steady.

Additionally as the outer sleeve is continuous no electrolytic couple is created.

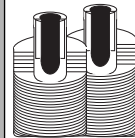
### 2) Mechanical

The fins are more rigid and stand the handling shocks better, compared to types „G“ an „L“.



# TECHNIFIN® Type "HY", "HYS"

## Standard Size Range

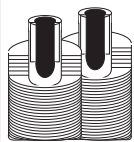


**D = 25,4 mm\* DR = 50,8 mm + DR = 57 mm**

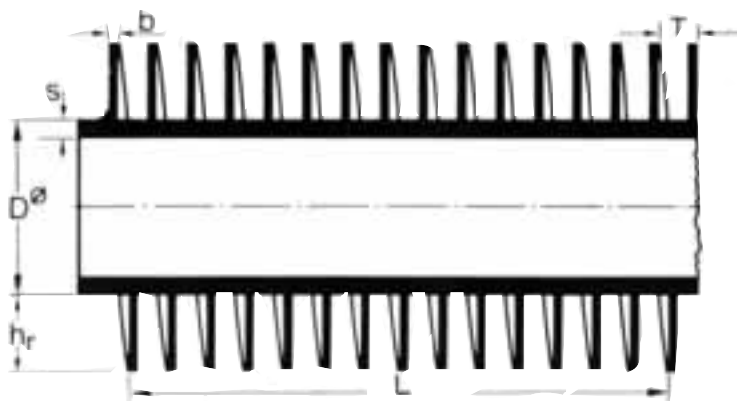
\*on request, other core tube dimensions available

| ORDER-No.                  | S<br>mm | di<br>mm | Fins/in.<br>t | Fa<br>m <sup>2</sup> /m | Fa/Fi | Weight<br>Kg/m | FZR<br>m <sup>2</sup> /m |
|----------------------------|---------|----------|---------------|-------------------------|-------|----------------|--------------------------|
| TECHNIFIN® HY 1.1.51-8     | 1,0     | 23,4     | 8             | 0,991                   | 13,48 | 1,49           | 0,0204                   |
| TECHNIFIN® HY 1.1.51-9     |         |          | 9             | 1,105                   | 15,02 | 1,49           | 0,0200                   |
| TECHNIFIN® HY 1.1.51-10    |         |          | 10            | 1,218                   | 16,56 | 1,49           | 0,0197                   |
| TECHNIFIN® HY 1.1.2.51-8   | 1,2     | 23,0     | 8             | 0,991                   | 13,72 | 1,68           | 0,0204                   |
| TECHNIFIN® HY 1.1.2.51-9   |         |          | 9             | 1,105                   | 15,28 | 1,68           | 0,0200                   |
| TECHNIFIN® HY 1.1.2.51-10  |         |          | 10            | 1,218                   | 16,85 | 1,68           | 0,0197                   |
| TECHNIFIN® HY 1.1.5.51-8   | 1,5     | 22,4     | 8             | 0,991                   | 14,09 | 1,85           | 0,0204                   |
| TECHNIFIN® HY 1.1.5.51-9   |         |          | 9             | 1,105                   | 15,69 | 1,85           | 0,0200                   |
| TECHNIFIN® HY 1.1.5.51-10  |         |          | 10            | 1,218                   | 17,30 | 1,85           | 0,0197                   |
| TECHNIFIN® HY 1.2.51-8     | 2,0     | 21,4     | 8             | 0,991                   | 14,74 | 2,12           | 0,0204                   |
| TECHNIFIN® HY 1.2.51-9     |         |          | 9             | 1,105                   | 16,43 | 2,12           | 0,0200                   |
| TECHNIFIN® HY 1.2.51-10    |         |          | 10            | 1,218                   | 18,11 | 2,12           | 0,0197                   |
| TECHNIFIN® HY 1.2.5.51-8   | 2,5     | 20,4     | 8             | 0,991                   | 15,47 | 2,38           | 0,0204                   |
| TECHNIFIN® HY 1.2.5.51-9   |         |          | 9             | 1,105                   | 17,23 | 2,38           | 0,0200                   |
| TECHNIFIN® HY 1.2.5.51-10  |         |          | 10            | 1,218                   | 19,00 | 2,38           | 0,0197                   |
| TECHNIFIN® HY 1.3.51-8     | 3,0     | 19,4     | 8             | 0,991                   | 16,26 | 2,62           | 0,0204                   |
| TECHNIFIN® HY 1.3.51-9     |         |          | 9             | 1,105                   | 18,12 | 2,62           | 0,0200                   |
| TECHNIFIN® HY 1.3.51-10    |         |          | 10            | 1,218                   | 19,98 | 2,62           | 0,0197                   |
| TECHNIFIN® HY 1.1.5.7-8    | 1,0     | 23,4     | 8             | 1,330                   | 18,10 | 1,69           | 0,0259                   |
| TECHNIFIN® HY 1.1.5.7-9    |         |          | 9             | 1,486                   | 20,23 | 1,69           | 0,0254                   |
| TECHNIFIN® HY 1.1.5.7-10   |         |          | 10            | 1,642                   | 22,33 | 1,69           | 0,0249                   |
| TECHNIFIN® HY 1.1.2.5.7-8  | 1,2     | 23,0     | 8             | 1,330                   | 18,41 | 1,88           | 0,0259                   |
| TECHNIFIN® HY 1.1.2.5.7-9  |         |          | 9             | 1,486                   | 20,58 | 1,88           | 0,0254                   |
| TECHNIFIN® HY 1.1.2.5.7-10 |         |          | 10            | 1,642                   | 22,72 | 1,88           | 0,0249                   |
| TECHNIFIN® HY 1.1.5.5.7-8  | 1,5     | 22,4     | 8             | 1,330                   | 18,91 | 2,05           | 0,0259                   |
| TECHNIFIN® HY 1.1.5.5.7-9  |         |          | 9             | 1,486                   | 21,11 | 2,05           | 0,0254                   |
| TECHNIFIN® HY 1.1.5.5.7-10 |         |          | 10            | 1,642                   | 23,33 | 2,05           | 0,0249                   |
| TECHNIFIN® HY 1.2.5.7-8    | 2,0     | 21,4     | 8             | 1,330                   | 19,79 | 2,32           | 0,0259                   |
| TECHNIFIN® HY 1.2.5.7-9    |         |          | 9             | 1,486                   | 22,12 | 2,32           | 0,0254                   |
| TECHNIFIN® HY 1.2.5.7-10   |         |          | 10            | 1,642                   | 24,41 | 2,32           | 0,0249                   |
| TECHNIFIN® HY 1.2.5.5.7-8  | 2,5     | 20,4     | 8             | 1,330                   | 20,76 | 2,58           | 0,0259                   |
| TECHNIFIN® HY 1.2.5.5.7-9  |         |          | 9             | 1,486                   | 23,20 | 2,58           | 0,0254                   |
| TECHNIFIN® HY 1.2.5.5.7-10 |         |          | 10            | 1,642                   | 25,61 | 2,58           | 0,0249                   |
| TECHNIFIN® HY 1.3.5.7-8    | 3,0     | 19,4     | 8             | 1,330                   | 21,83 | 2,82           | 0,0259                   |
| TECHNIFIN® HY 1.3.5.7-9    |         |          | 9             | 1,486                   | 24,40 | 2,82           | 0,0254                   |
| TECHNIFIN® HY 1.3.5.7-10   |         |          | 10            | 1,642                   | 26,93 | 2,82           | 0,0249                   |

Given weights are for steel tubes with Aluminium fins. Weight calculation for steel fins: Kg/m weight of tube + 0,1827 x fins per inch.



# TECHNIFIN® Type "I"



## Size Range

Base tube size: 6-219.1 (other sizes upon request)  
 Fins: 50-500 fins/meter  
 Fin thickness: 0.4-1.5 mm

Fin quantity and size depend on diameter of base tube. In case of deviation against the sizes of the opposite page, please ask us.

Tolerances:      Fin height:            +/- 1mm  
                       Fins/meter:           +/- 2%/meter  
                       Plain ends:            +/- 5mm

## Manufacturing Process

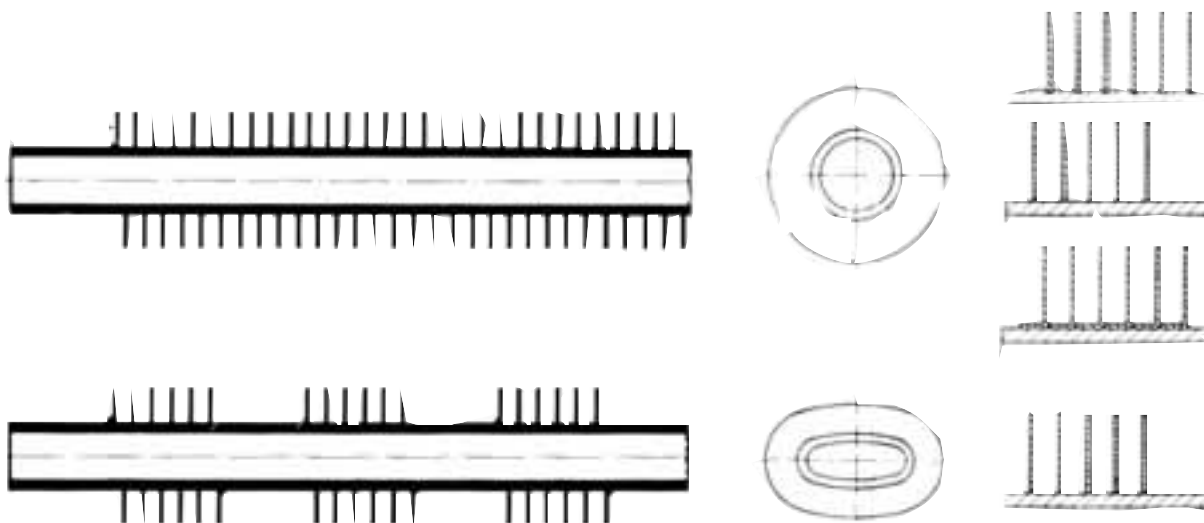
Fins are spirally wound on a steel base tube, without welding/soldering.

Execution: black, galvanized and for special applications Stainless Steel, Copper, Brass, and/or Aluminium.

Ends can be bevelled, bended or spot welded upon request.

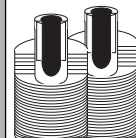
## Fields of application

Climatic Industry, Cooling  
 Heating, Drying



# TECHNIFIN® Type "I"

## Standard Size Range



| OD   | Tube Wall | Strip Size | Fins Diam. | Fins/m | Surface Area | Weight kg/m |
|------|-----------|------------|------------|--------|--------------|-------------|
| 10,2 | 1,6       | 10 x 0,4   | 30         | 115    | 0,22         | 0,60        |
|      |           |            |            | 200    | 0,37         | 0,83        |
|      |           |            |            | 320    | 0,57         | 1,09        |
| 15   | 1,5       | 10 x 0,4   | 35         | 150    | 0,34         | 0,91        |
|      |           |            |            | 250    | 0,54         | 1,16        |
|      |           |            |            | 350    | 0,74         | 1,47        |
| 17,2 | 1,8       | 10 x 0,4   | 37,2       | 80     | 0,22         | 0,91        |
|      |           |            |            | 150    | 0,37         | 1,11        |
|      |           |            |            | 225    | 0,52         | 1,32        |
|      |           |            |            | 300    | 0,68         | 1,54        |
|      |           |            |            | 330    | 0,74         | 1,62        |
| 17,2 | 1,8       | 14 x 0,4   | 45,2       | 85     | 0,35         | 1,10        |
|      |           |            |            | 110    | 0,44         | 1,21        |
|      |           |            |            | 210    | 0,80         | 1,70        |
|      |           |            |            | 250    | 0,95         | 1,88        |
| 18   | 2         | 10 x 0,4   | 38         | 80     | 0,22         | 1,02        |
|      |           |            |            | 150    | 0,37         | 1,22        |
|      |           |            |            | 200    | 0,48         | 1,37        |
|      |           |            |            | 250    | 0,59         | 1,51        |
|      |           |            |            | 300    | 0,70         | 1,65        |
| 18   | 2         | 14 x 0,4   | 46         | 81     | 0,35         | 1,18        |
|      |           |            |            | 150    | 0,60         | 1,52        |
|      |           |            |            | 220    | 0,85         | 1,88        |
|      |           |            |            | 290    | 1,11         | 2,21        |
| 20   | 2         | 10 x 0,4   | 48         | 80     | 0,24         | 1,13        |
|      |           |            |            | 120    | 0,33         | 1,25        |
|      |           |            |            | 180    | 0,47         | 1,44        |
|      |           |            |            | 250    | 0,62         | 1,65        |
|      |           |            |            | 300    | 0,74         | 1,80        |
| 20   | 2         | 14 x 0,4   | 48         | 100    | 0,44         | 1,40        |
|      |           |            |            | 150    | 0,63         | 1,65        |
|      |           |            |            | 200    | 0,82         | 1,91        |
|      |           |            |            | 250    | 1,01         | 2,17        |
| 21,3 | 2         | 10 x 0,4   | 41,3       | 100    | 0,30         | 1,27        |
|      |           |            |            | 130    | 0,37         | 1,37        |
|      |           |            |            | 185    | 0,49         | 1,54        |
|      |           |            |            | 210    | 0,55         | 1,62        |
|      |           |            |            | 250    | 0,64         | 1,75        |
|      |           |            |            | 300    | 0,76         | 1,94        |
| 21,3 | 2         | 14 x 0,4   | 49,3       | 98     | 0,45         | 1,49        |
|      |           |            |            | 150    | 0,65         | 1,78        |
|      |           |            |            | 200    | 0,84         | 2,05        |
|      |           |            |            | 250    | 1,04         | 2,32        |
| 21,3 | 2         | 20 x 0,5   | 61,3       | 65     | 0,51         | 1,70        |
|      |           |            |            | 100    | 0,75         | 2,17        |
|      |           |            |            | 135    | 1,00         | 2,50        |
| 25   | 2         | 14 x 0,4   | 53         | 100    | 0,49         | 1,69        |
|      |           |            |            | 150    | 0,70         | 2,09        |
|      |           |            |            | 200    | 0,91         | 2,26        |
|      |           |            |            | 250    | 1,12         | 2,55        |
| 26,9 | 2,3       | 14 x 0,4   | 54,9       | 100    | 0,51         | 1,99        |
|      |           |            |            | 160    | 0,77         | 2,34        |
|      |           |            |            | 210    | 0,99         | 2,64        |
| 26,9 | 2,3       | 20 x 0,5   | 66,9       | 60     | 0,53         | 2,15        |
|      |           |            |            | 100    | 0,83         | 2,65        |
|      |           |            |            | 140    | 1,14         | 3,15        |
| 30   | 2,6       | 20 x 0,5   | 70         | 100    | 0,88         | 3,08        |
|      |           |            |            | 150    | 1,28         | 3,73        |
|      |           |            |            | 200    | 1,67         | 4,38        |
| 33,7 | 2,6       | 20 x 0,5   | 73,7       | 40     | 0,43         | 2,56        |
|      |           |            |            | 110    | 1,02         | 3,52        |
|      |           |            |            | 157    | 1,41         | 4,32        |
|      |           |            |            | 220    | 1,93         | 5,03        |
| 33,7 | 2,6       | 26 x 1     | 85,7       | 40     | 0,60         | 3,64        |
|      |           |            |            | 67     | 0,95         | 4,75        |
|      |           |            |            | 110    | 1,48         | 6,51        |

| OD   | Tube Wall | Strip Size | Fins Diam. | Fins/m | Surface Area | Weight kg/m |
|------|-----------|------------|------------|--------|--------------|-------------|
| 38   | 2,6       | 26 x 1     | 90         | 40     | 0,64         | 4,01        |
|      |           |            |            | 80     | 1,17         | 5,73        |
|      |           |            |            | 123    | 1,74         | 7,58        |
| 38   | 2,6       | 30 x 1     | 98         | 48     | 0,91         | 4,88        |
|      |           |            |            | 83     | 1,49         | 6,77        |
|      |           |            |            | 128    | 2,24         | 9,20        |
| 38   | 2,6       | 35 x 1     | 108        | 48     | 1,14         | 5,62        |
|      |           |            |            | 88     | 2,00         | 8,40        |
|      |           |            |            | 120    | 2,68         | 10,62       |
| 44,5 | 2,6       | 26 x 1     | 96,5       | 50     | 0,84         | 5,00        |
|      |           |            |            | 85     | 1,34         | 6,61        |
|      |           |            |            | 120    | 1,84         | 8,23        |
| 44,5 | 2,6       | 30 x 1     | 104,5      | 44     | 0,91         | 5,22        |
|      |           |            |            | 72     | 1,41         | 6,84        |
|      |           |            |            | 120    | 2,26         | 9,61        |
| 44,5 | 2,6       | 35 x 1     | 114,5      | 50     | 1,27         | 6,38        |
|      |           |            |            | 70     | 1,72         | 7,85        |
|      |           |            |            | 105    | 2,51         | 10,42       |
| 48,3 | 2,6       | 26 x 1     | 100,3      | 40     | 0,74         | 4,86        |
|      |           |            |            | 85     | 1,40         | 7,02        |
|      |           |            |            | 155    | 2,43         | 10,37       |
| 48,3 | 2,6       | 30 x 1     | 108,3      | 62,5   | 1,29         | 6,69        |
|      |           |            |            | 91     | 1,82         | 8,40        |
|      |           |            |            | 115    | 2,26         | 9,81        |
| 48,3 | 2,6       | 35 x 1     | 118,3      | 50     | 1,32         | 6,75        |
|      |           |            |            | 70     | 1,78         | 8,27        |
|      |           |            |            | 90     | 2,25         | 9,79        |
| 57   | 2,9       | 30 x 1     | 117        | 67     | 1,50         | 8,21        |
|      |           |            |            | 92     | 2,00         | 9,83        |
|      |           |            |            | 117    | 2,50         | 11,44       |
|      |           |            |            | 140    | 2,95         | 12,93       |
| 57   | 2,9       | 35 x 1     | 127        | 52     | 1,48         | 8,14        |
|      |           |            |            | 72     | 1,98         | 9,78        |
|      |           |            |            | 92     | 2,49         | 11,42       |
|      |           |            |            | 112    | 2,99         | 13,04       |
| 57   | 2,9       | 50 x 1     | 157        | 33     | 1,64         | 8,66        |
|      |           |            |            | 40     | 1,95         | 9,67        |
|      |           |            |            | 52,5   | 2,50         | 11,47       |
| 76,1 | 2,9       | 30 x 1     | 136,1      | 63     | 1,69         | 10,01       |
|      |           |            |            | 77     | 2,01         | 11,05       |
|      |           |            |            | 98     | 2,49         | 12,62       |
|      |           |            |            | 110    | 2,77         | 13,52       |
| 76,1 | 2,9       | 35 x 1     | 146,1      | 44     | 1,50         | 8,58        |
|      |           |            |            | 61     | 2,00         | 11,30       |
|      |           |            |            | 78     | 2,50         | 12,60       |
|      |           |            |            | 96     | 3,00         | 14,30       |
| 76,1 | 2,9       | 50 x 1     | 176,1      | 36     | 2,03         | 11,00       |
|      |           |            |            | 45     | 2,48         | 12,56       |
|      |           |            |            | 56     | 3,02         | 14,33       |
| 88,9 | 3,2       | 35 x 1     | 158,9      | 55     | 2,00         | 12,43       |
|      |           |            |            | 71     | 2,51         | 14,06       |
|      |           |            |            | 87     | 3,01         | 15,70       |
| 88,9 | 3,2       | 50 x 1     | 188,9      | 35     | 2,14         | 12,88       |
|      |           |            |            | 50     | 2,95         | 15,49       |
|      |           |            |            | 65     | 3,75         | 18,09       |
| 108  | 3,6       | 35 x 1     | 178        | 47     | 1,99         | 14,71       |
|      |           |            |            | 62     | 2,52         | 16,42       |
|      |           |            |            | 76     | 3,01         | 18,03       |
| 108  | 3,6       | 40 x 1     | 188        | 51     | 2,50         | 16,37       |
|      |           |            |            | 69     | 3,27         | 18,86       |
|      |           |            |            | 86     | 3,99         | 21,22       |
| 108  | 3,6       | 50 x 1     | 208        | 30     | 2,10         | 15,06       |
|      |           |            |            | 45     | 2,98         | 17,93       |
|      |           |            |            | 62     | 3,98         | 21,18       |

OTHER SIZES CAN BE OFFERED UPON REQUEST!



Figure 1 displays six diagrams illustrating different thread forms and their corresponding descriptions:

- AD:** Both ends plain
- AE:** As AD, with land sections
- AF:** One end plain, one end stripped
- AG:** Both ends stripped
- AH:** Full-thread
- AI:** One end expanded, one end plain

can be pickled or tinned upon request.

DIN 50049/3.1 B or  
DIN 50049/3.1 C

Please refer to the „Alloy table for fintubes TECHNIFIN Type N and M“

Chemical-, Petrochemical- and Petroleum Industries. Used in condensers, oilcoolers, waterheaters, heatexchangers, evaporators and heat-recoverers.

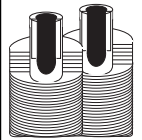
The fins are rolled out of the wall of the plain tube by use of a pass roller. Tube and fin consist of one piece.

Economical solution of heatexchange problems of media with different heat conduction abilities or different current conditions. High chemical-, thermal- and mechanical resistance, suitable for rough working conditions.



# TECHNIFIN® Type "N"

## Standard Size Range



### 16 FINS/ INCH FIN PITCH M = 1.59

| Plain section                |            |                      |       |                   | Finned section       |                      |        |                      |      |              |                        |        |
|------------------------------|------------|----------------------|-------|-------------------|----------------------|----------------------|--------|----------------------|------|--------------|------------------------|--------|
| Code No.<br>TECHNIFIN<br>„N“ | External Ø |                      | Int.  | Wall-thic-<br>kn. | Root dia. Ø          |                      | Ext. Ø | Wall-thickn.         |      | Ext. surface | Radio outs.<br>to ins. | Weight |
|                              | Inch       | d <sub>1</sub><br>mm |       |                   | d <sub>3</sub><br>mm | d <sub>4</sub><br>mm |        | d <sub>5</sub><br>mm | BWG  |              |                        |        |
|                              |            |                      |       |                   |                      |                      |        |                      |      |              |                        |        |
| 16.1/2.19                    | 1/2"       | 12,70                | 9,80  | 1,45              | 750                  | 9,50                 | 12,50  | 19                   | 1,00 | 0,08         | 3,6                    | 0,38   |
| 16.1/2.18                    |            |                      | 9,40  | 1,65              | 700                  |                      |        | 18                   | 1,25 |              | 3,8                    |        |
| 16.5/8.17                    | 5/8"       | 15,90                | 11,90 | 2,00              | 970                  | 12,70                | 15,70  | 17                   | 1,50 | 0,11         | 3,6                    | 0,65   |
| 16.5/8.16                    |            |                      | 11,60 | 2,15              | 940                  |                      |        | 16                   | 1,65 |              | 3,7                    |        |
| 16.3/4.17                    | 3/4"       | 19,00                | 15,00 | 2,00              | 1280                 | 15,80                | 18,80  | 17                   | 1,50 | 0,13         | 3,3                    | 0,83   |
| 16.3/4.16                    |            |                      | 14,70 | 2,15              | 1250                 |                      |        | 16                   | 1,65 |              | 3,4                    |        |
| 16.3/4.14                    |            |                      | 14,00 | 2,50              | 11,60                |                      |        | 14                   | 2,10 |              | 3,6                    | 1,03   |
| 16.7/8.17                    | 7/8"       | 22,20                | 18,20 | 2,00              | 1600                 | 19,00                | 22,00  | 17                   | 1,50 | 0,16         | 3,1                    | 1,00   |
| 16.7/8.16                    |            |                      | 17,90 | 2,15              | 1570                 |                      |        | 16                   | 1,65 |              | 3,2                    |        |
| 16.7/8.14                    |            |                      | 17,20 | 2,50              | 1480                 |                      |        | 14                   | 2,10 |              | 3,3                    | 1,25   |
| 16.1.17                      | 1"         | 25,40                | 21,40 | 2,00              | 1920                 | 22,20                | 25,20  | 17                   | 1,50 | 0,18         | 3,0                    | 1,18   |
| 16.1.16                      |            |                      | 21,10 | 2,15              | 1890                 |                      |        | 16                   | 1,65 |              | 3,1                    | 1,25   |
| 16.1.14                      |            |                      | 20,40 | 2,50              | 1800                 |                      |        | 14                   | 2,10 |              | 3,2                    | 1,49   |

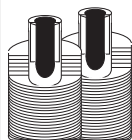
### 19 FINS/ INCH FIN PITCH M = 1.33

| Plain section                |            |                      |                              |                                            | Finned section               |                              |                                   |              |                      |                            |                                 |                            |
|------------------------------|------------|----------------------|------------------------------|--------------------------------------------|------------------------------|------------------------------|-----------------------------------|--------------|----------------------|----------------------------|---------------------------------|----------------------------|
| Code No.<br>TECHNIFIN<br>„N“ | External Ø |                      | Int.<br>d <sub>2</sub><br>mm | Wall-thick-<br>kn.<br>S <sub>1</sub><br>mm | Root dia. Ø                  |                              | Ext.<br>Ø<br>d <sub>5</sub><br>mm | Wall-thickn. |                      | Ext. surface<br>Aa<br>m² m | Radio outs.<br>to ins.<br>Aa/Ai | Weight<br>G Cu<br>ca. kg/m |
|                              | Inch       | d <sub>1</sub><br>mm |                              |                                            | Int.<br>d <sub>3</sub><br>mm | Ext.<br>d <sub>4</sub><br>mm |                                   | BWG          | S <sub>2</sub><br>mm |                            |                                 |                            |
|                              |            |                      |                              |                                            |                              |                              |                                   |              |                      |                            |                                 |                            |
| 19.1/2.21                    | 1/2"       | 12,70                | 10,30                        | 1,20                                       | 790                          | 9,50                         | 12,50                             | 21           | 0,80                 | 0,1                        | 4,0                             | 0,32                       |
| 19.1/2.20                    |            |                      | 10,10                        | 1,30                                       | 770                          |                              |                                   | 20           | 0,90                 |                            | 4,1                             | 0,34                       |
| 19.1/2.19                    |            |                      | 9,90                         | 1,40                                       | 750                          |                              |                                   | 19           | 1,00                 |                            | 4,2                             | 0,38                       |
| 19.1/2.18                    |            |                      | 9,50                         | 1,60                                       | 700                          |                              |                                   | 18           | 1,25                 |                            | 4,5                             | 0,42                       |
| 19.5/8.21                    | 5/8"       | 15,90                | 13,40                        | 1,25                                       | 11,10                        | 12,70                        | 15,70                             | 21           | 0,80                 | 0,12                       | 3,6                             | 0,44                       |
| 19.5/8.20                    |            |                      | 13,20                        | 1,35                                       | 10,90                        |                              |                                   | 20           | 0,90                 |                            | 3,7                             | 0,47                       |
| 19.5/8.19                    |            |                      | 13,00                        | 1,45                                       | 10,70                        |                              |                                   | 19           | 1,00                 |                            | 3,8                             | 0,51                       |
| 19.5/8.18                    |            |                      | 12,60                        | 1,65                                       | 10,20                        |                              |                                   | 18           | 1,25                 |                            | 4,0                             | 0,58                       |
| 19.5/8.17                    | 3/4"       | 19,00                | 11,90                        | 2,00                                       | 9,70                         | 15,80                        | 18,80                             | 17           | 1,50                 | 0,15                       | 4,2                             | 0,69                       |
| 19.5/8.16                    |            |                      | 11,60                        | 2,15                                       | 9,40                         |                              |                                   | 16           | 1,65                 |                            | 4,3                             | 0,74                       |
| 19.3/4.20                    |            |                      | 16,30                        | 1,35                                       | 14,00                        |                              |                                   | 20           | 0,90                 |                            | 3,5                             | 0,61                       |
| 19.3/4.19                    |            |                      | 16,10                        | 1,45                                       | 13,80                        |                              |                                   | 19           | 1,00                 |                            | 3,6                             | 0,63                       |
| 19.3/4.18                    |            |                      | 15,70                        | 1,65                                       | 13,30                        |                              |                                   | 18           | 1,25                 |                            | 3,7                             | 0,72                       |
| 19.3/4.17                    |            |                      | 15,00                        | 2,00                                       | 12,80                        |                              |                                   | 17           | 1,50                 |                            | 3,8                             | 0,83                       |
| 19.3/4.16                    |            |                      | 14,80                        | 2,10                                       | 12,50                        |                              |                                   | 16           | 1,65                 |                            | 3,9                             | 0,88                       |
| 19.3/4.14                    |            |                      | 14,10                        | 2,45                                       | 11,60                        |                              |                                   | 14           | 2,10                 |                            | 4,2                             | 1,03                       |
| 19.7/8.19                    | 7/8"       | 22,20                | 19,30                        | 1,45                                       | 17,00                        | 19,00                        | 22,00                             | 19           | 1,00                 | 0,18                       | 3,4                             | 0,80                       |
| 19.7/8.18                    |            |                      | 18,90                        | 1,65                                       | 16,50                        |                              |                                   | 18           | 1,25                 |                            | 3,5                             | 0,89                       |
| 19.7/8.17                    |            |                      | 18,20                        | 2,00                                       | 16,00                        |                              |                                   | 17           | 1,50                 |                            | 3,6                             | 1,00                       |
| 19.7/8.16                    |            |                      | 18,00                        | 2,10                                       | 15,70                        |                              |                                   | 16           | 1,65                 |                            | 3,7                             | 1,07                       |
| 19.7/8.14                    | 1"         | 25,40                | 17,30                        | 2,45                                       | 14,80                        | 22,20                        | 25,20                             | 14           | 2,10                 | 0,21                       | 3,9                             | 1,26                       |
| 19.1.18                      |            |                      | 22,10                        | 1,65                                       | 19,70                        |                              |                                   | 18           | 1,25                 |                            | 3,4                             | 1,05                       |
| 19.1.17                      |            |                      | 21,40                        | 2,00                                       | 19,20                        |                              |                                   | 17           | 1,50                 |                            | 3,5                             | 1,19                       |
| 19.1.16                      |            |                      | 21,10                        | 2,15                                       | 18,90                        |                              |                                   | 16           | 1,65                 |                            | 3,6                             | 1,27                       |
| 19.1.14                      |            |                      | 20,50                        | 2,45                                       | 18,00                        |                              |                                   | 14           | 2,10                 |                            | 3,7                             | 1,50                       |

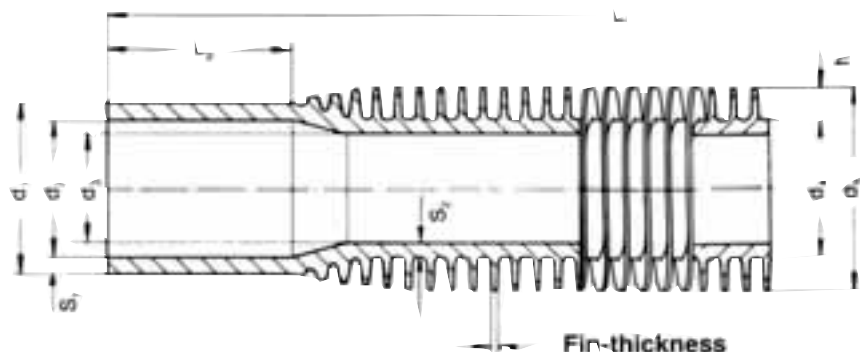
### 26 FINS/ INCH FIN PITCH M = 0.97

| Plain section                |            |                      |       |                   | Finned section               |                              |        |              |                      |              |                        |        |
|------------------------------|------------|----------------------|-------|-------------------|------------------------------|------------------------------|--------|--------------|----------------------|--------------|------------------------|--------|
| Code No.<br>TECHNIFIN<br>„N“ | External Ø |                      | Int.  | Wall-thic-<br>kn. | Root dia. Ø                  |                              | Ext. Ø | Wall-thickn. |                      | Ext. surface | Radio outs.<br>to ins. | Weight |
|                              | Inch       | d <sub>1</sub><br>mm |       |                   | Int.<br>d <sub>3</sub><br>mm | Ext.<br>d <sub>4</sub><br>mm |        | BWG          | S <sub>2</sub><br>mm |              |                        |        |
|                              |            |                      |       |                   |                              |                              |        |              |                      |              |                        |        |
| 26.1/2.21                    | 1/2"       | 12,70                | 10,30 | 1,20              | 7,90                         | 9,50                         | 12,50  | 21           | 0,80                 | 0,12         | 5,0                    | 0,34   |
| 26.1/2.19                    |            |                      | 9,90  | 1,40              | 7,50                         |                              | 19     | 1,00         | 5,3                  |              | 0,40                   |        |
| 26.1/2.18                    |            |                      | 9,50  | 1,60              | 7,00                         |                              | 18     | 1,25         | 5,8                  |              | 0,45                   |        |
| 26.5/8.21                    | 5/8"       | 15,90                | 13,40 | 1,25              | 11,10                        | 12,70                        | 15,70  | 21           | 0,80                 | 0,16         | 4,6                    | 0,46   |
| 26.5/8.19                    |            |                      | 13,00 | 1,45              | 10,70                        | 19                           | 1,00   | 4,8          | 0,53                 |              |                        |        |
| 26.5/8.18                    |            |                      | 12,60 | 1,65              | 10,20                        | 18                           | 1,25   | 5,0          | 0,60                 |              |                        |        |
| 26.3/4.20                    | 3/4"       |                      | 16,30 | 1,35              | 14,00                        | 15,80                        | 18,80  | 20           | 0,90                 | 0,20         | 4,5                    | 0,63   |
| 26.3/4.19                    |            |                      | 16,10 | 1,45              | 13,80                        | 19                           | 1,00   | 4,6          | 0,67                 |              |                        |        |
| 26.3/4.18                    |            |                      | 15,70 | 1,65              | 13,30                        | 18                           | 1,25   | 4,8          | 0,77                 |              |                        |        |
| 26.7/8.19                    | 7/8"       | 22,20                | 19,30 | 1,45              | 17,00                        | 19,00                        | 22,00  | 19           | 1,00                 | 0,23         | 4,4                    | 0,81   |
| 26.7/8.18                    |            |                      | 18,90 | 1,65              | 16,50                        | 18                           | 1,25   | 4,5          | 0,93                 |              |                        |        |
| 26.7/8.17                    |            |                      | 18,20 | 2,00              | 16,00                        | 17                           | 1,50   | 4,7          | 1,04                 |              |                        |        |
| 26.1.18                      | 1"         | 25,40                | 22,10 | 1,65              | 19,70                        | 22,20                        | 25,20  | 18           | 1,25                 | 0,27         | 4,4                    | 1,09   |
| 26.1.17                      |            |                      | 21,40 | 2,00              | 19,20                        | 17                           | 1,50   | 4,5          | 1,23                 |              |                        |        |
| 26.1.16                      |            |                      | 21,10 | 2,15              | 18,90                        | 16                           | 1,65   | 4,6          | 1,31                 |              |                        |        |

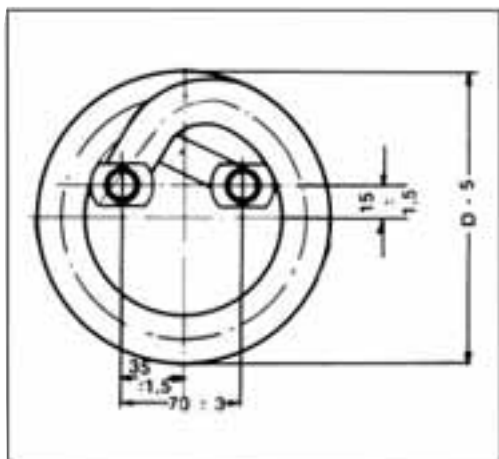
Weights are based on SF-Cu Copper. For other materials please apply the following conversion factors: CuNi 70/30: 1.0, CuNi 90/10: 1.0, Aluminium Brass: 0.93, Admiralty Brass: 0.96, Aluminium: 0.31, Steel: 0.88



## TECHNIFIN® Type "M"



| d <sub>1</sub> | d <sub>3</sub> | d <sub>4</sub><br>stripped | s <sub>1</sub> | s <sub>2</sub> | L <sub>2</sub> | L <sub>1</sub>                                                                  |
|----------------|----------------|----------------------------|----------------|----------------|----------------|---------------------------------------------------------------------------------|
| +0<br>-0,2     | ± 0,13         | +0<br>-0,2                 | ± 10%          | ± 10%          | +5<br>-0       | up to 2000 mm + 2 mm<br>2000 - 8000 mm + 1 ‰, max. 5 mm<br>over 8000 mm + 0,7 ‰ |



### Fields of application

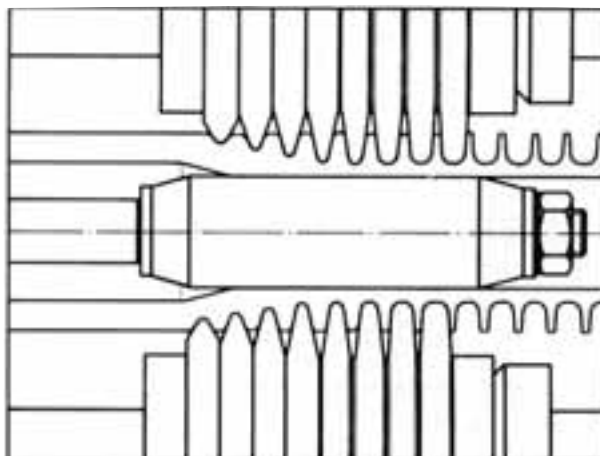
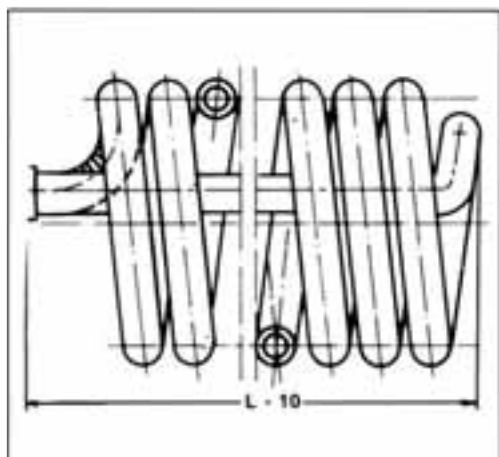
Water heating, solar technics, oil-cooling, heat-exchangers, condensers, evaporators.

### Manufacturing process

The fins are rolled out of the wall of the plain tube as type „N“, but higher fins.

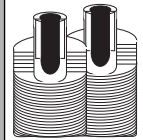
### Advantages

Economical solution of heat-exchange problems of media with different heat conduction abilities or different current conditions. High chemical-, thermal- and mechanical resistance, suitable for rough working conditions.



# TECHNIFIN® Type "M"

## Standard Size Range



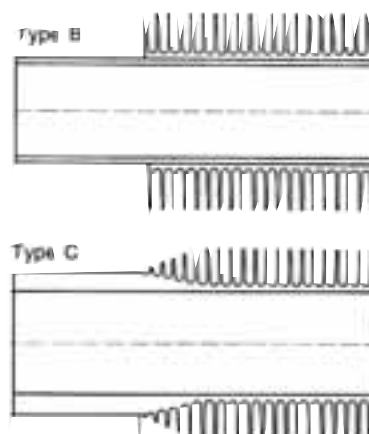
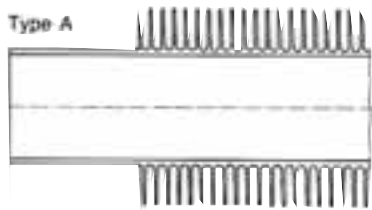
Fins per inch : 11 Fin-height:  $h=3,5 \text{ mm} \pm 0,35 \text{ mm}$  Fin thickness ~ 0,3 mm Length max. 12,0 m

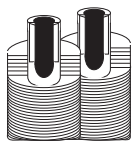
| External<br>Ø<br><br>$d_1$<br>mm | Int.<br>Ø<br><br>$d_2$<br>mm | Wall-thick-<br>kn.<br><br>$S_1$<br>mm | Root dia.                       |                                 | Ext.<br><br>$\varnothing d_5$<br>mm | Wall-thickn. |             | Ext. surface<br><br>$A_a$<br>$\text{m}^2/\text{m}$ | Radio outs.<br>to ins.<br><br>$A_a/A_i$ | Weight<br><br>G Cu<br>ca. kg/m |
|----------------------------------|------------------------------|---------------------------------------|---------------------------------|---------------------------------|-------------------------------------|--------------|-------------|----------------------------------------------------|-----------------------------------------|--------------------------------|
|                                  |                              |                                       | Int.<br>$\varnothing d_3$<br>mm | Ext.<br>$\varnothing d_4$<br>mm |                                     | BWG          | $S_2$<br>mm |                                                    |                                         |                                |
| 13,00                            | 9,40                         | 1,80                                  | 7,90                            | 9,50                            | 16,50                               | 21           | 0,80        | 0,16                                               | 6,5                                     | 0,50                           |
| 13,00                            | 9,00                         | 2,00                                  | 7,50                            | 9,50                            | 16,50                               | 19           | 1,00        | 0,16                                               | 6,7                                     | 0,53                           |
| 16,00                            | 12,40                        | 1,80                                  | 10,90                           | 12,50                           | 19,50                               | 21           | 0,80        | 0,19                                               | 5,6                                     | 0,61                           |
| 16,00                            | 12,00                        | 2,00                                  | 10,50                           | 12,50                           | 19,50                               | 19           | 1,00        | 0,19                                               | 5,8                                     | 0,67                           |
| 18,00                            | 14,00                        | 2,00                                  | 12,50                           | 14,50                           | 21,50                               | 19           | 1,00        | 0,21                                               | 5,4                                     | 0,77                           |
| 18,00                            | 13,50                        | 2,25                                  | 12,00                           | 14,50                           | 21,50                               | 18           | 1,25        | 0,21                                               | 5,6                                     | 0,85                           |
| 22,00                            | 18,00                        | 2,00                                  | 16,50                           | 18,50                           | 25,50                               | 19           | 1,00        | 0,27                                               | 5,2                                     | 0,96                           |
| 22,00                            | 17,50                        | 2,25                                  | 16,00                           | 18,50                           | 25,50                               | 18           | 1,25        | 0,27                                               | 5,4                                     | 1,06                           |
| 28,00                            | 23,50                        | 2,25                                  | 22,00                           | 24,50                           | 31,50                               | 18           | 1,25        | 0,34                                               | 4,9                                     | 1,45                           |
| 28,00                            | 23,00                        | 2,50                                  | 21,50                           | 24,50                           | 31,50                               | 17           | 1,50        | 0,34                                               | 5,1                                     | 1,60                           |
| Alloys:                          |                              |                                       | SF-Cu                           | CuAsP                           | CuNi10Fe                            | Al 99,5      | AlMn        | AlMg 3                                             |                                         |                                |
| Weight Conversion factor:        |                              |                                       | 1,0                             | 1,0                             | 1,0                                 | 0,31         | 0,31        | 0,31                                               |                                         |                                |

## Alloy table for fin-tubes TECHNIFIN® Type "N" and "M"

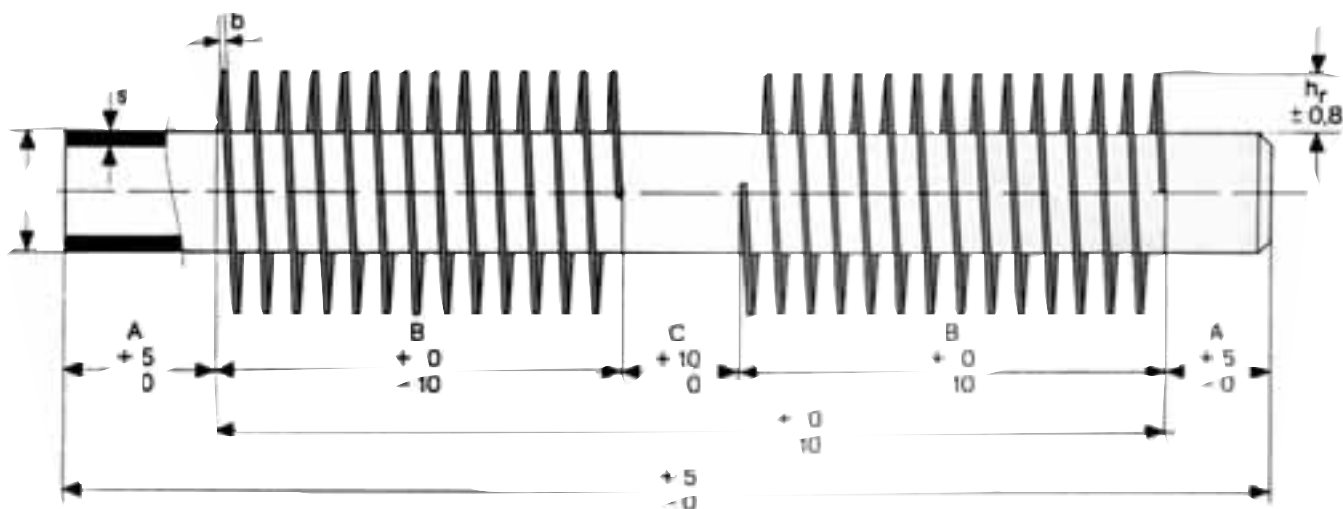
| Alloys available                     |             |       |        | Properties of various alloys (Standard value)                                       |                 |               |                |        |
|--------------------------------------|-------------|-------|--------|-------------------------------------------------------------------------------------|-----------------|---------------|----------------|--------|
| Alloy-No.                            | Designation | DIN*  | Weight | Plain tube section                                                                  |                 |               | Finned section |        |
|                                      |             |       |        | Tensile strength                                                                    | 0,2 Yield str.  | Elongation    | Tensile str.   | State  |
|                                      |             |       |        | Rm min.<br>N/mm2                                                                    | RP 0,2<br>N/mm2 | A 5 min.<br>% | Rm<br>N/mm2    |        |
| DIN 17007                            |             |       | G/G Cu |                                                                                     |                 |               |                |        |
| 2.0090                               | SF-Cu       | 1787  | 1,00   | 220                                                                                 | 50-120          | 40            | 350            | 1,3    |
| 2.1491                               | CuAsP       | 17666 | 1,00   | 220                                                                                 | 50-120          | 40            | 350            | 1,3    |
| 2.0470                               | CuZn28Sn    | 17660 | 0,96   | 320                                                                                 | 100-170         | 55            | 340            | 2      |
| 2.0460                               | CuZn20Al    | 17660 | 0,93   | 340                                                                                 | 120-180         | 55            | 340            | 2      |
| 2.0872                               | CuNi10Fe    | 17664 | 1,00   | 290                                                                                 | 90-180          | 30            | 400            | 1,3    |
| 2.0882                               | CuNi30Fe    | 17664 | 1,00   | 370                                                                                 | 120-220         | 35            | 500            | 1,3    |
| 3.0255                               | Al99,5      | 1712  | 0,30   | 100                                                                                 | 70              | 6             | 130            | 1      |
| 3.3535                               | AlMg3       | 1725  | 0,30   | 180                                                                                 | 80              | 12            | 230            | 1      |
| 3.0515                               | AlMn        | 1725  | 0,31   | 125                                                                                 | 90              | 6             | 160            | 1      |
| 1.4301                               | 5 CrNi 18 9 | 17440 | 0,88   | 500                                                                                 | 185             | 25            | 700            | 1,3    |
| 1.4571                               | 10 CrNiMoTi | 17440 | 0,88   | 500                                                                                 | 185             | 25            | 700            | 1,3    |
| 1.0308                               | St35        | 1629  | 0,88   | 350                                                                                 | 240             | 25            | 500            | 1,2,3, |
| 1.0305                               | St35.8      | 17175 | 0,88   | 360                                                                                 | 235             | 25            | 500            | 1,2,3, |
| * or corresponding foreign standards |             |       |        | 1. hard, as finned - 2. relieved, annealed - 3. Heat treatment acc. to your request |                 |               |                |        |

### TYPES OF TUBE ENDS AVAILABLE:





## TECHNIFIN® Type "WO"/"WOS"



### Fields of application

Fired Heaters, Heat Exchangers, Boilers, Pre-Heaters, Coolers, Heat Pipes, Dryers, Heaters

### Manufacturing process

The fin strip is spirally wound onto the tube and welded continuously to the tube along the spiral foot.

Welding process: HF, SF, TIG, MIG

For type „WOS“ fins are serrated.

### Advantage

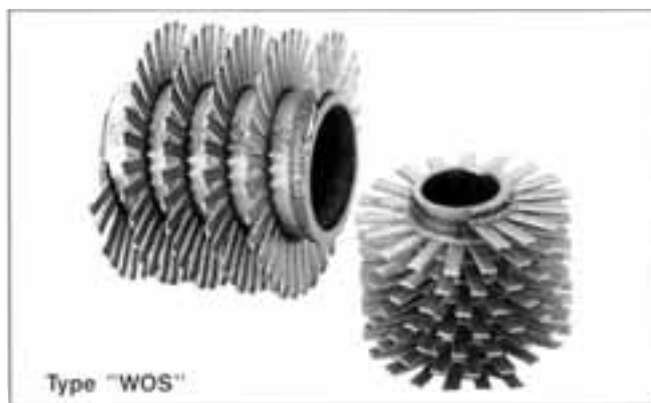
#### Type „WO“

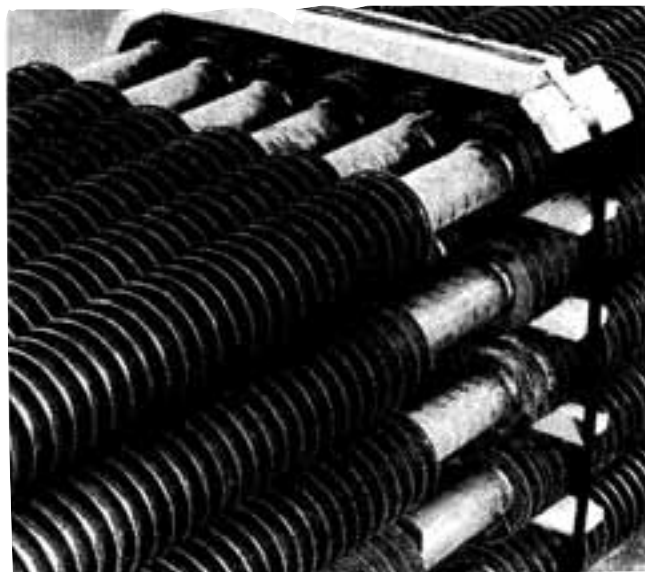
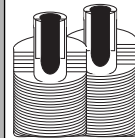
Strong connection between fin and base tube, prevents loosening of fin because of heat stress, oxydization, corrosion etc.

Use at very high temperatures possible.

#### Type „WOS“

As per Type „WO“, but fins are serrated. Therefore higher heat transfer coefficient, for the same pressure drop compared with „WO“-fin.





## Materials

**Base tube**  
Carbon Steel  
Low Alloy Steel  
Stainless Steel  
Nickel Alloys

## Fins

Carbon Steel  
Low Alloy Steel  
Ferritic Stainless Steel  
Austenitic Stainless Steel  
Nickel Alloys

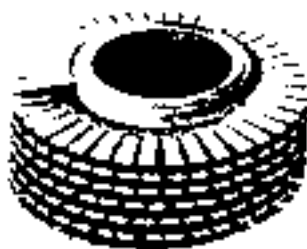
Heat transfer surface to be calculated as follows:

$$HTS = \frac{\pi}{106} \left[ 10^3 \cdot da + 2N \cdot HR (HR + da) - N \cdot da \cdot b \right]$$

HTS = Heat Transfer Surface in m<sup>2</sup>/m  
da = Outside Diameter of the Bare Tubes in mm  
HR = Fin height in mm  
b = Fin Thickness in mm  
N = Number of Fins per mm



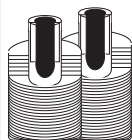
Type "WOS"



Type "WOS"



Type "WO"



# TECHNIFIN® Type "WO"

## Finned Steel Tubes with Welded-on Fins · Standard Programme



| Core Tubes                       |                           |                                                        |                                      | Number of fins<br>N |      | Fin height x fin thickness (HR x b)<br>Fin tube surface area / fin tube weight |      |                   |      |                   |      |                   |      |                   |      |
|----------------------------------|---------------------------|--------------------------------------------------------|--------------------------------------|---------------------|------|--------------------------------------------------------------------------------|------|-------------------|------|-------------------|------|-------------------|------|-------------------|------|
| O.D.<br><br>d <sub>a</sub><br>mm | Wall<br>thickn<br>s<br>mm | Surface<br>area<br>F <sub>k</sub><br>m <sup>2</sup> /m | Weight<br><br>G <sub>k</sub><br>kg/m |                     |      | 10 x 1,3                                                                       |      | 13 x 1,3          |      | 15 x 1,3          |      | 19 x 1,5          |      | 25 x 1,5          |      |
|                                  |                           |                                                        |                                      |                     |      | m <sup>2</sup> /m                                                              | kg/m | m <sup>2</sup> /m | kg/m | m <sup>2</sup> /m | kg/m | m <sup>2</sup> /m | kg/m | m <sup>2</sup> /m | kg/m |
| 16                               | 1,8                       | 0,05                                                   | 0,63                                 | 250                 | 6,35 | 0,44                                                                           | 2,72 |                   |      |                   |      |                   |      |                   |      |
|                                  |                           |                                                        |                                      | 200                 | 5    | 0,36                                                                           | 2,30 |                   |      |                   |      |                   |      |                   |      |
|                                  |                           |                                                        |                                      | 150                 | 3,8  | 0,29                                                                           | 1,88 |                   |      |                   |      |                   |      |                   |      |
|                                  |                           |                                                        |                                      | 118                 | 3    | 0,24                                                                           | 1,64 |                   |      |                   |      |                   |      |                   |      |
|                                  |                           |                                                        |                                      | 100                 | 2,5  | 0,21                                                                           | 1,47 |                   |      |                   |      |                   |      |                   |      |
| 21,3                             | 2                         | 0,07                                                   | 0,95                                 | 250                 | 6,35 | 0,54                                                                           | 3,46 |                   |      |                   |      |                   |      |                   |      |
|                                  |                           |                                                        |                                      | 200                 | 5    | 0,44                                                                           | 2,96 |                   |      |                   |      |                   |      |                   |      |
|                                  |                           |                                                        |                                      | 150                 | 3,8  | 0,35                                                                           | 2,46 |                   |      |                   |      |                   |      |                   |      |
|                                  |                           |                                                        |                                      | 118                 | 3    | 0,29                                                                           | 2,14 |                   |      |                   |      |                   |      |                   |      |
|                                  |                           |                                                        |                                      | 100                 | 2,5  | 0,26                                                                           | 1,96 |                   |      |                   |      |                   |      |                   |      |
| 25                               | 2                         | 0,08                                                   | 1,13                                 | 250                 | 6,35 | 0,60                                                                           | 3,94 | 0,83              | 5,09 |                   |      |                   |      |                   |      |
|                                  |                           |                                                        |                                      | 200                 | 5    | 0,50                                                                           | 3,38 | 0,68              | 4,30 |                   |      |                   |      |                   |      |
|                                  |                           |                                                        |                                      | 150                 | 3,8  | 0,39                                                                           | 2,82 | 0,53              | 3,51 |                   |      |                   |      |                   |      |
|                                  |                           |                                                        |                                      | 118                 | 3    | 0,33                                                                           | 2,46 | 0,43              | 3,01 |                   |      |                   |      |                   |      |
|                                  |                           |                                                        |                                      | 100                 | 2,5  | 0,29                                                                           | 2,26 | 0,38              | 2,72 |                   |      |                   |      |                   |      |
| 31,8                             | 2,6                       | 0,10                                                   | 1,87                                 | 200                 | 5    | 0,60                                                                           | 4,55 | 0,81              | 5,61 | 0,96              | 6,37 |                   |      |                   |      |
|                                  |                           |                                                        |                                      | 150                 | 3,8  | 0,48                                                                           | 3,88 | 0,63              | 4,67 | 0,74              | 5,25 |                   |      |                   |      |
|                                  |                           |                                                        |                                      | 118                 | 3    | 0,40                                                                           | 3,46 | 0,52              | 4,08 | 0,61              | 4,53 |                   |      |                   |      |
|                                  |                           |                                                        |                                      | 100                 | 2,5  | 0,35                                                                           | 3,22 | 0,45              | 3,74 | 0,53              | 4,13 |                   |      |                   |      |
|                                  |                           |                                                        |                                      | 80                  | 2    | 0,30                                                                           | 2,95 | 0,38              | 3,37 | 0,44              | 3,68 |                   |      |                   |      |
| 38                               | 3,2                       | 0,12                                                   | 2,75                                 | 200                 | 5    | 0,69                                                                           | 5,82 | 0,92              | 7,00 | 1,09              | 7,84 | 1,44              | 10,8 |                   |      |
|                                  |                           |                                                        |                                      | 150                 | 3,8  | 0,55                                                                           | 5,05 | 0,72              | 5,93 | 0,85              | 6,57 | 1,11              | 8,76 |                   |      |
|                                  |                           |                                                        |                                      | 118                 | 3    | 0,46                                                                           | 4,56 | 0,59              | 5,26 | 0,69              | 5,76 | 0,90              | 7,48 |                   |      |
|                                  |                           |                                                        |                                      | 100                 | 2,5  | 0,41                                                                           | 4,29 | 0,52              | 4,87 | 0,60              | 5,30 | 0,78              | 6,76 |                   |      |
|                                  |                           |                                                        |                                      | 80                  | 2    | 0,35                                                                           | 3,98 | 0,44              | 4,45 | 0,51              | 4,79 | 0,65              | 5,96 |                   |      |
| 48,3                             | 3,2                       | 0,15                                                   | 3,56                                 | 200                 | 5    | 0,85                                                                           | 7,30 | 1,11              | 8,67 | 1,31              | 9,64 | 1,71              | 13,0 |                   |      |
|                                  |                           |                                                        |                                      | 150                 | 3,8  | 0,67                                                                           | 6,36 | 0,87              | 7,39 | 1,02              | 8,12 | 1,32              | 10,7 |                   |      |
|                                  |                           |                                                        |                                      | 118                 | 3    | 0,56                                                                           | 5,76 | 0,72              | 6,57 | 0,83              | 7,15 | 1,07              | 9,14 |                   |      |
|                                  |                           |                                                        |                                      | 100                 | 2,5  | 0,50                                                                           | 5,43 | 0,63              | 6,11 | 0,73              | 6,60 | 0,93              | 8,29 |                   |      |
|                                  |                           |                                                        |                                      | 80                  | 2    | 0,43                                                                           | 5,06 | 0,54              | 5,61 | 0,61              | 6,00 | 0,78              | 7,35 |                   |      |
| 51                               | 3,2                       | 0,16                                                   | 3,77                                 | 200                 | 5    | 0,89                                                                           | 7,68 | 1,16              | 9,10 | 1,36              | 10,1 | 1,78              | 13,6 | 2,50              | 178  |
|                                  |                           |                                                        |                                      | 150                 | 3,8  | 0,70                                                                           | 6,70 | 0,91              | 7,77 | 1,06              | 8,53 | 1,38              | 11,2 | 1,92              | 14,3 |
|                                  |                           |                                                        |                                      | 118                 | 3    | 0,59                                                                           | 6,08 | 0,75              | 6,92 | 0,87              | 7,52 | 1,12              | 9,58 | 1,54              | 12,1 |
|                                  |                           |                                                        |                                      | 100                 | 2,5  | 0,52                                                                           | 5,73 | 0,66              | 6,44 | 0,76              | 6,95 | 0,97              | 8,69 | 1,33              | 10,8 |
|                                  |                           |                                                        |                                      | 80                  | 2    | 0,45                                                                           | 5,34 | 0,56              | 5,91 | 0,64              | 6,31 | 0,81              | 7,71 | 1,10              | 9,4  |
| 57                               | 3,2                       | 0,18                                                   | 4,24                                 | 200                 | 5    | 0,97                                                                           | 8,54 | 1,28              | 10,1 | 1,49              | 11,2 | 1,94              | 14,9 | 2,70              | 19,4 |
|                                  |                           |                                                        |                                      | 150                 | 3,8  | 0,78                                                                           | 7,47 | 1,00              | 8,62 | 1,16              | 9,44 | 1,50              | 12,3 | 2,07              | 15,6 |
|                                  |                           |                                                        |                                      | 118                 | 3    | 0,65                                                                           | 6,78 | 0,83              | 7,69 | 0,95              | 8,33 | 1,22              | 10,6 | 1,67              | 13,2 |
|                                  |                           |                                                        |                                      | 100                 | 2,5  | 0,58                                                                           | 6,39 | 0,73              | 7,16 | 0,84              | 7,71 | 1,06              | 9,59 | 1,44              | 11,8 |
|                                  |                           |                                                        |                                      | 80                  | 2    | 0,50                                                                           | 5,96 | 0,62              | 6,58 | 0,70              | 7,02 | 0,88              | 8,52 | 1,19              | 10,3 |
| 60,3                             | 3,2                       | 0,19                                                   | 4,5                                  | 200                 | 5    | 1,02                                                                           | 9,01 | 1,34              | 10,6 | 1,56              | 11,7 | 2,03              | 15,7 | 2,81              | 20,3 |
|                                  |                           |                                                        |                                      | 150                 | 3,8  | 0,82                                                                           | 7,88 | 1,05              | 9,09 | 1,22              | 9,94 | 1,57              | 12,9 | 2,16              | 16,3 |
|                                  |                           |                                                        |                                      | 118                 | 3    | 0,68                                                                           | 7,16 | 0,87              | 8,11 | 1,00              | 8,78 | 1,27              | 11,1 | 1,74              | 13,8 |
|                                  |                           |                                                        |                                      | 100                 | 2,5  | 0,61                                                                           | 6,76 | 0,76              | 7,56 | 0,88              | 8,13 | 1,11              | 10,1 | 1,50              | 12,4 |
|                                  |                           |                                                        |                                      | 80                  | 2    | 0,52                                                                           | 6,31 | 0,65              | 6,95 | 0,74              | 7,40 | 0,93              | 8,97 | 1,24              | 10,8 |

Formula for Calculation of Fin Tube Weight: - Carbon Steel -

$$\text{kg/m} = \frac{785 \cdot \pi}{10^6} \left[ 1000 \cdot s \cdot (d_a - s) + b \cdot N \cdot HR \cdot (HR + d_a) \right]$$

d<sub>a</sub> = bare pipe O.D. (mm)

s = bare pipe wallthickness (mm)

b = fin thickness (mm)

N = fins per meter

HR = fin height (mm)

This is a simplified formula and should be used as estimation only, since manufacturing tolerances are not considered

Factor other than Carbon Steel:

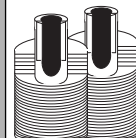
Type 304/310/316/321 : 1.024      Techalloy 200 : 1.133

Techalloy 600/625 : 1.073      Techalloy 825 : 1.038

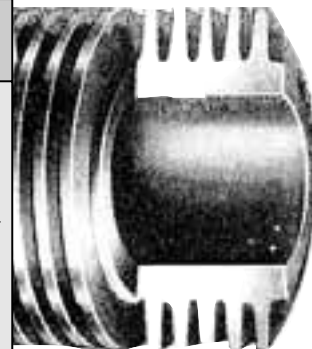


# TECHNIFIN® Type "WO"

Finned Steel Tubes with Welded-on Fins · Standard Programme



| Core Tubes                   |                           |                                                         |                                  | Number of fins<br>N |             | Fin height x fin thickness (HR x b)<br>Fin tube surface area / fin tube weight |      |                   |      |                   |      |                   |      |                   |      |
|------------------------------|---------------------------|---------------------------------------------------------|----------------------------------|---------------------|-------------|--------------------------------------------------------------------------------|------|-------------------|------|-------------------|------|-------------------|------|-------------------|------|
| O.D.<br>d <sub>a</sub><br>mm | Wall<br>thickn<br>s<br>mm | Surfac<br>e area<br>F <sub>k</sub><br>m <sup>2</sup> /m | Weight<br>G <sub>k</sub><br>kg/m | per<br>m            | per<br>inch | 10 x 1,                                                                        |      | 13 x 1,           |      | 15 x 1,3          |      | 19 x 1,5          |      | 25 x 1,5          |      |
|                              |                           |                                                         |                                  |                     |             | m <sup>2</sup> /m                                                              | kg/m | m <sup>2</sup> /m | kg/m | m <sup>2</sup> /m | kg/m | m <sup>2</sup> /m | kg/m | m <sup>2</sup> /m | kg/m |
| 76,1                         | 3,2                       | 0,24                                                    | 5,75                             | 200                 | 5           | 1,26                                                                           | 11,3 | 1,63              | 13,2 | 1,89              | 14,5 | 2,44              | 19,1 | 3,34              | 24,4 |
|                              |                           |                                                         |                                  | 150                 | 3,8         | 1,00                                                                           | 9,89 | 1,28              | 11,3 | 1,48              | 12,3 | 1,89              | 15,8 | 2,57              | 19,8 |
|                              |                           |                                                         |                                  | 118                 | 3           | 0,84                                                                           | 9,01 | 1,06              | 10,1 | 1,22              | 10,9 | 1,54              | 13,6 | 2,07              | 16,8 |
|                              |                           |                                                         |                                  | 100                 | 2,5         | 0,75                                                                           | 8,51 | 0,94              | 9,46 | 1,07              | 10,1 | 1,34              | 12,4 | 1,79              | 15,1 |
|                              |                           |                                                         |                                  | 80                  | 2           | 0,65                                                                           | 7,96 | 0,80              | 8,72 | 0,90              | 9,26 | 1,12              | 11,1 | 1,48              | 13,2 |
| 88,9                         | 3,2                       | 0,28                                                    | 6,76                             | 200                 | 5           | 1,45                                                                           | 13,1 | 1,87              | 15,3 | 2,16              | 16,8 | 2,77              | 21,9 | 3,77              | 27,8 |
|                              |                           |                                                         |                                  | 150                 | 3,8         | 1,16                                                                           | 11,5 | 1,47              | 13,1 | 1,69              | 14,3 | 2,15              | 18,1 | 2,90              | 22,6 |
|                              |                           |                                                         |                                  | 118                 | 3           | 0,97                                                                           | 10,5 | 1,22              | 11,8 | 1,39              | 12,7 | 1,75              | 15,7 | 2,34              | 19,2 |
|                              |                           |                                                         |                                  | 100                 | 2,5         | 0,86                                                                           | 9,93 | 1,08              | 11,0 | 1,22              | 11,8 | 1,53              | 14,3 | 2,03              | 17,3 |
|                              |                           |                                                         |                                  | 80                  | 2           | 0,75                                                                           | 9,30 | 0,92              | 10,2 | 1,03              | 10,8 | 1,28              | 12,8 | 1,68              | 15,2 |
| 101,6                        | 3,6                       | 0,32                                                    | 8,70                             | 200                 | 5           | 1,64                                                                           | 15,9 | 2,11              | 18,3 | 2,43              | 19,9 | 3,10              | 25,6 | 4,20              | 32,1 |
|                              |                           |                                                         |                                  | 150                 | 3,8         | 1,31                                                                           | 14,1 | 1,66              | 15,9 | 1,91              | 17,1 | 2,41              | 21,4 | 3,23              | 26,3 |
|                              |                           |                                                         |                                  | 118                 | 3           | 1,10                                                                           | 12,9 | 1,37              | 14,3 | 1,57              | 15,3 | 1,96              | 18,7 | 2,61              | 22,5 |
|                              |                           |                                                         |                                  | 100                 | 2,5         | 0,98                                                                           | 12,3 | 1,21              | 13,5 | 1,38              | 14,3 | 1,71              | 17,2 | 2,26              | 20,4 |
|                              |                           |                                                         |                                  | 80                  | 2           | 0,85                                                                           | 11,6 | 1,04              | 12,5 | 1,17              | 13,2 | 1,43              | 15,5 | 1,87              | 18,1 |
| 114,3                        | 3,6                       | 0,36                                                    | 9,82                             | 200                 | 5           |                                                                                |      | 2,34              | 20,4 | 2,70              | 22,3 | 3,43              | 28,6 | 4,63              | 35,6 |
|                              |                           |                                                         |                                  | 150                 | 3,8         |                                                                                |      | 1,85              | 17,8 | 2,12              | 19,2 | 2,66              | 23,9 | 3,56              | 29,1 |
|                              |                           |                                                         |                                  | 118                 | 3           |                                                                                |      | 1,53              | 16,1 | 1,74              | 17,2 | 2,17              | 20,9 | 2,88              | 25,0 |
|                              |                           |                                                         |                                  | 100                 | 2,5         |                                                                                |      | 1,35              | 15,1 | 1,53              | 16,0 | 1,90              | 19,2 | 2,49              | 22,7 |
|                              |                           |                                                         |                                  | 80                  | 2           |                                                                                |      | 1,15              | 14,1 | 1,30              | 14,8 | 1,59              | 17,3 | 2,07              | 20,1 |
| 141,3                        | 4,0                       | 0,44                                                    | 13,5                             | 200                 | 5           |                                                                                |      | 2,85              | 26,4 | 3,27              | 28,6 | 4,14              | 36,1 | 5,53              | 44,3 |
|                              |                           |                                                         |                                  | 150                 | 3,8         |                                                                                |      | 2,25              | 23,2 | 2,57              | 24,8 | 3,21              | 30,4 | 4,26              | 36,6 |
|                              |                           |                                                         |                                  | 118                 | 3           |                                                                                |      | 1,86              | 21,1 | 2,11              | 22,4 | 2,62              | 26,8 | 3,45              | 31,7 |
|                              |                           |                                                         |                                  | 100                 | 2,5         |                                                                                |      | 1,65              | 19,0 | 1,86              | 21,1 | 2,29              | 24,8 | 2,99              | 28,9 |
|                              |                           |                                                         |                                  | 80                  | 2           |                                                                                |      | 1,41              | 18,7 | 1,58              | 19,6 | 1,92              | 22,6 | 2,48              | 25,8 |
| 159                          | 4,5                       | 0,50                                                    | 17,14                            | 200                 | 5           |                                                                                |      | 3,18              | 31,5 | 3,65              | 33,9 | 4,60              | 42,2 | 6,13              | 51,2 |
|                              |                           |                                                         |                                  | 150                 | 3,8         |                                                                                |      | 2,51              | 27,9 | 2,86              | 29,7 | 3,57              | 35,9 | 4,72              | 42,7 |
|                              |                           |                                                         |                                  | 118                 | 3           |                                                                                |      | 2,08              | 25,6 | 2,36              | 27,0 | 2,92              | 31,9 | 3,82              | 37,2 |
|                              |                           |                                                         |                                  | 100                 | 2,5         |                                                                                |      | 1,84              | 24,3 | 2,07              | 25,5 | 2,55              | 29,6 | 3,31              | 34,2 |
|                              |                           |                                                         |                                  | 80                  | 2           |                                                                                |      | 1,57              | 22,9 | 1,76              | 23,8 | 2,14              | 27,1 | 2,75              | 30,8 |
| 168,3                        | 4,5                       | 0,53                                                    | 18,17                            | 200                 | 5           |                                                                                |      | 3,35              | 33,3 | 3,85              | 35,8 | 4,84              | 44,5 | 6,44              | 53,9 |
|                              |                           |                                                         |                                  | 150                 | 3,8         |                                                                                |      | 2,65              | 29,5 | 3,02              | 31,4 | 3,76              | 37,9 | 4,96              | 45,0 |
|                              |                           |                                                         |                                  | 118                 | 3           |                                                                                |      | 2,19              | 27,1 | 2,49              | 28,6 | 3,07              | 33,7 | 4,02              | 39,3 |
|                              |                           |                                                         |                                  | 100                 | 2,5         |                                                                                |      | 1,94              | 25,7 | 2,19              | 27,0 | 2,68              | 31,3 | 3,48              | 36,0 |
|                              |                           |                                                         |                                  | 80                  | 2           |                                                                                |      | 1,66              | 24,2 | 1,86              | 25,2 | 2,25              | 28,7 | 2,89              | 32,5 |
| 193,7                        | 5,4                       | 0,61                                                    | 25,06                            | 200                 | 5           |                                                                                |      | 3,83              | 42,3 | 4,38              | 45,1 | 5,50              | 55,0 | 7,29              | 65,5 |
|                              |                           |                                                         |                                  | 150                 | 3,8         |                                                                                |      | 3,02              | 38,0 | 3,44              | 40,1 | 4,28              | 47,5 | 5,62              | 55,4 |
|                              |                           |                                                         |                                  | 118                 | 3           |                                                                                |      | 2,51              | 35,2 | 2,84              | 36,9 | 3,50              | 42,7 | 4,55              | 48,9 |
|                              |                           |                                                         |                                  | 100                 | 2,5         |                                                                                |      | 2,22              | 33,7 | 2,50              | 35,1 | 3,06              | 40,0 | 3,95              | 45,3 |
|                              |                           |                                                         |                                  | 80                  | 2           |                                                                                |      | 1,90              | 32,0 | 2,12              | 33,1 | 2,57              | 37,0 | 3,28              | 41,2 |
| 219,1                        | 5,9                       | 0,69                                                    | 31,01                            | 200                 | 5           |                                                                                |      | 4,30              | 50,3 | 4,92              | 53,2 | 6,16              | 64,5 | 8,15              | 76,1 |
|                              |                           |                                                         |                                  | 150                 | 3,8         |                                                                                |      | 3,40              | 45,5 | 3,86              | 47,9 | 4,80              | 56,1 | 6,28              | 64,9 |
|                              |                           |                                                         |                                  | 118                 | 3           |                                                                                |      | 2,82              | 42,4 | 3,19              | 44,3 | 3,92              | 50,7 | 5,09              | 57,6 |
|                              |                           |                                                         |                                  | 100                 | 2,5         |                                                                                |      | 2,49              | 40,7 | 2,80              | 42,3 | 3,43              | 47,7 | 4,42              | 53,6 |
|                              |                           |                                                         |                                  | 80                  | 2           |                                                                                |      | 2,13              | 38,7 | 2,38              | 40,0 | 2,88              | 44,4 | 3,67              | 49,1 |



**Many other  
sizes upon  
request -  
ask TPS!**

## Dimensions

**Core tubes:** to DIN 2448, 2458 or ANSI B 36.10 from 16 to 219.1 mm O.D.  
(other dimensions upon enquiry)

**Fins:** 50 to 250 fins per meter finned tube  
Height: up to 50 mm  
Thickness: 0.9 to 6.0 mm  
Number of fins and dimensions depend upon core tube diameter.  
For dimensions not listed in the above table, please give your detailed enquiry.

**Lengths:** Limited only by transportation facilities or availability of core tube

### Dimensional tolerances:

Core tube: to respective core tube specification  
Fin height: ± 0.8 mm  
Number of fins: + 2%/m  
Free ends: + 5mm  
Free sections: + 10 mm

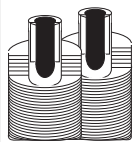
**Fin design**  
free ends

free sections on the core tube

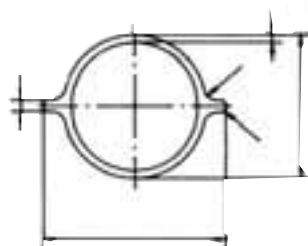
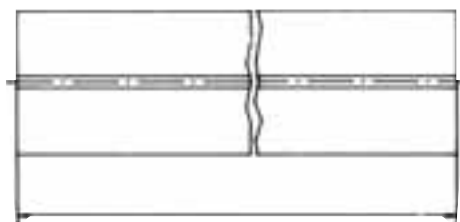
**End shapes**  
plain  
calibrated

bevelled for welding on one side to DIN 2559  
bevelled for welding on both sides or ANSI B 16.25





## TECHNIFIN® Type "LFS"



### Standard Size Range

Inside diameter: 29 - 110 mm  
 Wall thickness: 3.2 - 20 mm  
 W.T. ratio: approx 10% O.D.  
 Length: max. 11 - 12 meter  
 Fin dia: max. 200 mm

### Eccentricity:

max. 10%

### Max. torsion

up to 6 mtr-L = 1,5 mm  
 6 - 8 mm-L = 2.25 mm  
 8 mtr and longer-L = 3.0 mm

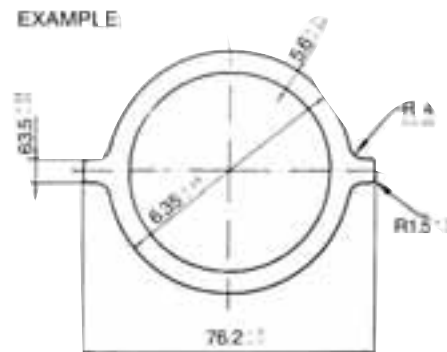
### Straightness:

max. 0,2%  
 on total length

### Advantage

The fin tube is seamless and manufactured out of equal raw material.  
 No welding seams.

### EXAMPLE:



### Field of application

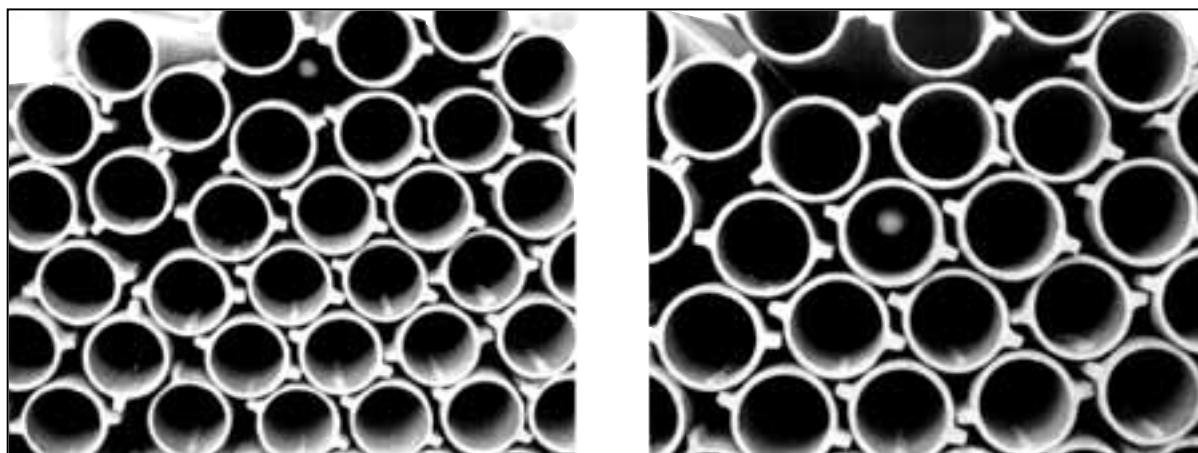
Boiler water wall constructions  
 Water power plants  
 Atomic power stations  
 Steam generators  
 Gas recuperators  
 Flue tube boilers  
 Fuel element coils

### Materials

Mainly Carbon Steels, Ferritic Alloy and Austenitic Stainless Steel,  
 Nickel Alloy

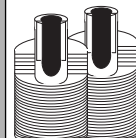
### Manufacturing Process

Hot-extrusion process  
 Cold drawn process



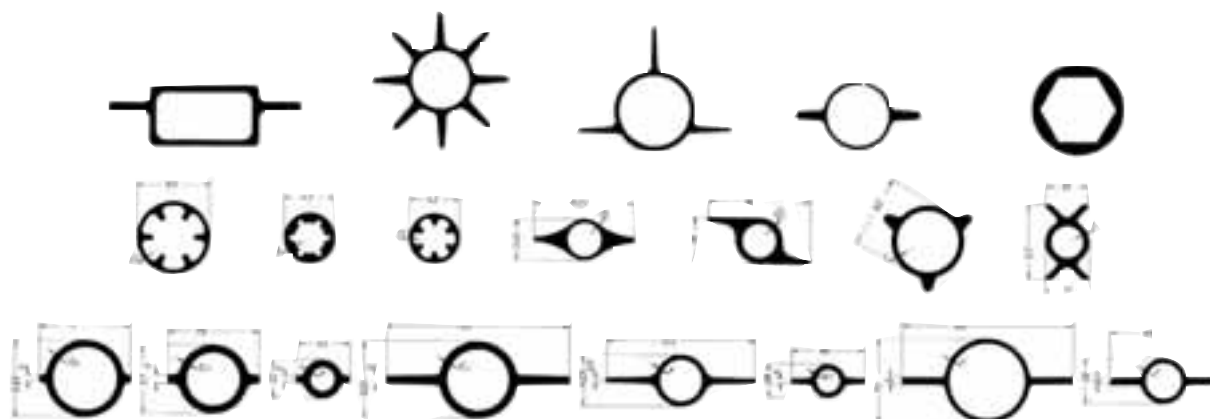
# TECHNIFIN® Type "LFS"

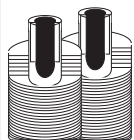
## Standard Size Range



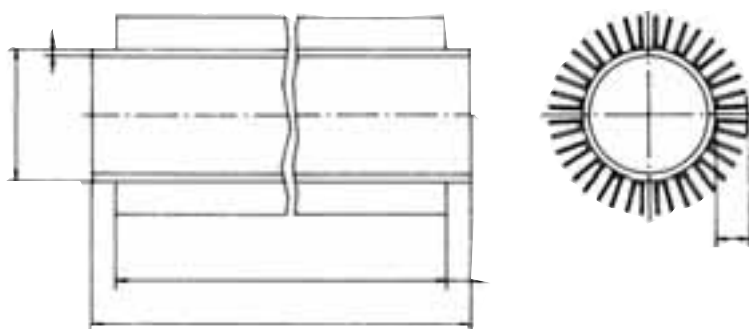
| Tube<br>d | Width<br>of profile<br>e | Typical wall thicknesses |      |      |      |       |       |       | Fin thickness |     |   |
|-----------|--------------------------|--------------------------|------|------|------|-------|-------|-------|---------------|-----|---|
|           |                          | 3,2                      | 3,6  | 4,0  | 4,5  | 5,0   | 5,6   | 6,2   |               |     |   |
|           |                          | Weight kg/m              |      |      |      |       |       |       | b1            | b2  | r |
| 25,0      | 36,0                     | 2,15                     | 2,33 | 2,50 | 2,71 | 2,90  |       |       | 4,5           | 5,5 | 5 |
| 26,9      | 37,5                     | 2,39                     | 2,59 | 2,78 | 2,98 | 3,20  | 3,44  | 3,71  | 5,0           | 6,0 | 5 |
| 30,0      | 42,5                     | 2,72                     | 2,95 | 3,17 | 3,41 | 3,66  | 3,95  | 4,28  | 5,0           | 6,0 | 5 |
|           | 45,0                     | 2,83                     | 3,06 | 3,28 | 3,52 | 3,77  | 4,06  | 4,39  |               |     |   |
|           | 47,5                     | 2,94                     | 3,17 | 3,39 | 3,63 | 3,88  | 4,17  | 4,50  |               |     |   |
| 31,8      | 45,0                     | 2,90                     | 3,16 | 3,39 | 3,65 | 3,93  | 4,23  | 4,60  | 5,0           | 6,5 | 5 |
|           | 47,5                     | 3,02                     | 3,27 | 3,51 | 3,77 | 4,05  | 4,35  | 4,72  |               |     |   |
|           | 50,0                     | 3,13                     | 3,38 | 3,62 | 3,88 | 4,16  | 4,46  | 4,83  |               |     |   |
| 33,7      | 45,0                     | 2,88                     | 3,15 | 3,41 | 3,69 | 4,00  | 4,33  | 4,73  | 5,5           | 7,0 | 5 |
|           | 47,5                     | 3,14                     | 3,41 | 3,67 | 3,95 | 4,26  | 4,59  | 4,99  |               |     |   |
|           | 50,0                     | 3,26                     | 3,53 | 3,79 | 4,07 | 4,38  | 4,71  | 5,11  |               |     |   |
| 38,0      | 50,0                     | 3,55                     | 3,86 | 4,16 | 4,49 | 4,85  | 5,25  | 5,37  | 6,0           | 8,0 | 6 |
|           | 52,5                     | 3,69                     | 4,00 | 4,30 | 4,63 | 4,99  | 5,39  | 5,51  |               |     |   |
|           | 57,5                     | 3,97                     | 4,28 | 4,58 | 4,91 | 5,27  | 5,67  | 5,79  |               |     |   |
| 42,4      | 52,5                     |                          | 4,15 | 4,49 | 4,87 | 5,29  | 5,75  | 6,30  | 6,0           | 8,0 | 6 |
|           | 57,5                     |                          | 4,42 | 4,76 | 5,14 | 5,56  | 6,02  | 6,57  |               |     |   |
|           | 60,0                     |                          | 4,56 | 4,90 | 5,28 | 5,70  | 6,16  | 6,81  |               |     |   |
| 44,5      | 60,0                     |                          | 4,69 | 5,06 | 5,46 | 5,91  | 6,39  | 6,99  | 6,5           | 8,5 | 6 |
|           | 65,0                     |                          | 4,98 | 5,35 | 5,75 | 6,20  | 6,68  | 7,28  |               |     |   |
| 48,3      | 65,0                     |                          | 5,11 | 5,52 | 5,96 | 6,45  | 7,00  | 7,66  | 6,5           | 8,5 | 6 |
|           | 70,0                     |                          | 5,40 | 5,81 | 6,25 | 6,74  | 7,39  | 7,95  |               |     |   |
| 51,0      | 65,0                     |                          | 5,23 | 5,66 | 6,13 | 6,67  | 7,24  | 7,95  | 7,0           | 9,0 | 6 |
|           | 70,0                     |                          | 5,55 | 5,98 | 6,45 | 6,98  | 7,56  | 8,27  |               |     |   |
| 57,0      | 70,0                     |                          |      | 6,21 | 6,75 | 7,35  | 8,02  | 8,85  | 7,0           | 9,0 | 6 |
|           | 75,0                     |                          |      | 6,52 | 7,06 | 7,66  | 8,33  | 9,16  |               |     |   |
| 60,3      | 75,0                     |                          |      | 6,64 | 7,22 | 7,87  | 8,68  | 9,47  | 7,0           | 9,0 | 6 |
|           | 80,0                     |                          |      | 6,95 | 7,53 | 8,18  | 8,89  | 9,78  |               |     |   |
| 63,5      | 80,0                     |                          |      | 7,07 | 7,68 | 8,37  | 9,13  | 10,07 | 7,0           | 9,0 | 6 |
|           | 85,0                     |                          |      | 7,38 | 7,99 | 8,68  | 9,44  | 10,38 |               |     |   |
| 70,0      | 85,0                     |                          |      | 7,73 | 8,42 | 9,19  | 10,03 | 11,10 | 7,5           | 9,5 | 7 |
|           | 90,0                     |                          |      | 8,07 | 8,76 | 9,53  | 10,37 | 11,44 |               |     |   |
| 76,1      | 90,0                     |                          |      | 8,28 | 9,03 | 9,88  | 10,82 | 12,01 | 7,5           | 9,5 | 7 |
|           | 95,0                     |                          |      | 8,61 | 9,36 | 10,21 | 11,15 | 12,34 |               |     |   |

In addition to longitudinal fin tubes, sections of many shapes can be produced by hot extrusion with two or more internal and/or external fins in the size range mentioned on the left page.





## TECHNIFIN® Type "LFW"



### Size Range

As per opposite page

### Fields of application

Chemical-, Petrochemical-, Oil-,  
Power Industry  
Heat-Exchangers  
Fired Heaters  
Gas Coolers and Heaters  
Tank Heaters

### Manufacturing process

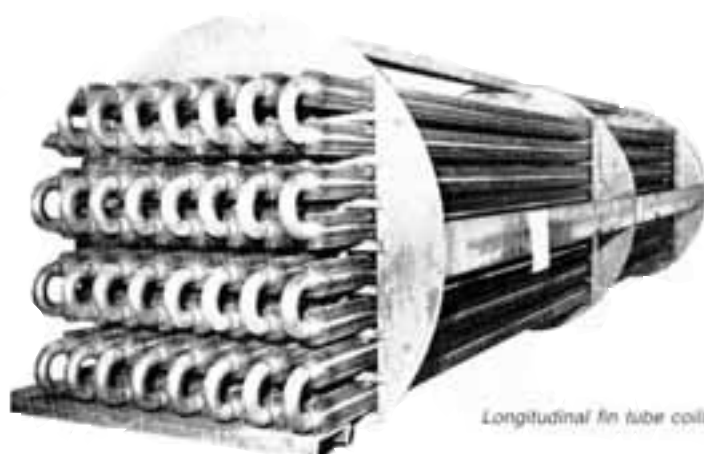
The longitudinal I/L or U fins are welded onto the base tube by resistance welding or welding with filler metal.

### Advantage

Increase of heat transfer rates for viscous liquids. Perforated fin type used whenever drainage of liquid from fin channels become a problem. Widely used in horizontal heat-ex hangers.

### Material

Carbon Steel  
Alloy Steel  
Stainless Steel  
Nickel Alloy  
Other Alloys

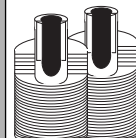


Longitudinal fin tube coils



# TECHNIFIN® Type "LFW"

## Standard Size Range

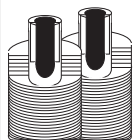


| FINNED TUBE AND PIPE SURFACES<br>square feet per foot of finned length |            |       |       |       |                | FINNED TUBE AND PIPE SURFACES<br>m <sup>2</sup> /meter of finned length |        |        |        |                                 |
|------------------------------------------------------------------------|------------|-------|-------|-------|----------------|-------------------------------------------------------------------------|--------|--------|--------|---------------------------------|
| O.D. or<br>Nominal<br>Pipe Size                                        | Fin Height |       |       |       | No. of<br>Fins | Fin Height - mm                                                         |        |        |        | O.D. or<br>Nominal<br>Pipe Size |
|                                                                        | 1/4"       | 1/2"  | 3/4"  | 1"    |                | 6.35                                                                    | 12.7   | 19.05  | 25.4   |                                 |
| 3/4" O.D.                                                              | 0.863      | 1.529 | 2.196 | 2.863 | 16             | 0.2627                                                                  | 0.4654 | 0.6685 | 0.8715 | 19.05 mm                        |
| 7/8" O.D.                                                              | 0.895      | 1.562 | 2.229 | 2.896 | 16             | 0.2724                                                                  | 0.4755 | 0.6785 | 0.8816 | 22.22 mm                        |
|                                                                        | 1.062      | 1.895 | 2.729 | 3.562 | 20             | 0.3233                                                                  | 0.5768 | 0.8307 | 1.0843 |                                 |
| 1" O.D.                                                                | 0.928      | 1.595 | 2.262 | 2.928 | 16             | 0.2825                                                                  | 0.4855 | 0.6886 | 0.8913 | 25.4 mm                         |
|                                                                        | 1.095      | 1.928 | 2.762 | 3.595 | 20             | 0.3333                                                                  | 0.5869 | 0.8408 | 1.0944 |                                 |
|                                                                        | 1.262      | 2.262 | 3.262 | 4.262 | 24             | 0.3842                                                                  | 0.6886 | 0.9930 | 1.2974 |                                 |
| 3/4" I.P.S.<br>1.05" O.D.                                              | 0.941      | 1.608 | 2.275 | 2.942 | 16             | 0.2865                                                                  | 0.4895 | 0.6925 | 0.8956 | 3/4" I.P.S.<br>26.67 mm         |
|                                                                        | 1.108      | 1.941 | 2.775 | 3.608 | 20             | 0.3373                                                                  | 0.5909 | 0.8447 | 1.0983 |                                 |
|                                                                        | 1.275      | 2.275 | 3.275 | 4.275 | 24             | 0.3881                                                                  | 0.6925 | 0.9970 | 1.3014 |                                 |
| 1 1/2" I.P.S.<br>1.9" O.D.                                             | 1.497      | 2.497 | 3.497 | 4.497 | 24             | 0.4557                                                                  | 0.7601 | 1.0645 | 1.3689 | 1 1/2" I.P.S.<br>48.26 mm       |
|                                                                        | 1.830      | 3.163 | 4.497 | 5.830 | 32             | 0.5571                                                                  | 0.9629 | 1.3689 | 1.7747 |                                 |
|                                                                        | 2.163      | 3.830 | 5.497 | 7.163 | 40             | 0.6584                                                                  | 1.1659 | 1.6734 | 2.1805 |                                 |
| 2" I.P.S.<br>2.375" O.D.                                               | 1.955      | 3.288 | 4.622 | 5.956 | 32             | 0.5951                                                                  | 1.0009 | 1.4070 | 1.8131 | 2" I.P.S.<br>60.32 mm           |
|                                                                        | 2.288      | 3.955 | 5.622 | 7.288 | 40             | 0.6965                                                                  | 1.2040 | 1.7114 | 2.2186 |                                 |

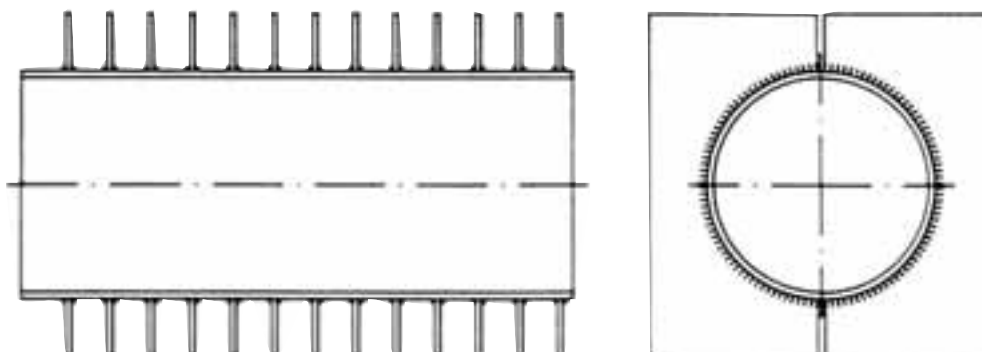
| OBSTRUCTION - square inches     |            |        |        |        |                | OBSTRUCTION - mm <sup>2</sup> |         |         |         |                                 |
|---------------------------------|------------|--------|--------|--------|----------------|-------------------------------|---------|---------|---------|---------------------------------|
| O.D. or<br>Nominal<br>Pipe Size | Fin Height |        |        |        | No. of<br>Fins | Fin Height - mm               |         |         |         | O.D. or<br>Nominal<br>Pipe Size |
|                                 | 1/4"       | 1/2"   | 3/4"   | 1"     |                | 6.35                          | 12.7    | 19.05   | 25.4    |                                 |
| 3/4" O.D.                       | 0.6215     | 0.7791 | 0.9367 | 1.0943 | 16             | 400.97                        | 502.64  | 604.32  | 706.00  | 19.05 mm                        |
| 7/8" O.D.                       | 0.7810     | 0.9386 | 1.0962 | 1.2538 | 16             | 503.87                        | 605.55  | 707.22  | 808.90  | 22.22 mm                        |
|                                 | 0.8259     | 1.0229 | 1.2199 | 1.4169 | 20             | 532.84                        | 659.93  | 787.03  | 914.13  |                                 |
| 1" O.D.                         | 0.9651     | 1.1227 | 1.2803 | 1.4379 | 16             | 622.64                        | 724.32  | 826.00  | 927.68  | 25.4 mm                         |
|                                 | 1.0100     | 1.2070 | 1.4040 | 1.6010 | 20             | 651.61                        | 778.71  | 905.80  | 1032.90 |                                 |
|                                 | 1.0549     | 1.2913 | 1.5277 | 1.7641 | 24             | 680.58                        | 833.10  | 985.61  | 1138.13 |                                 |
| 3/4" I.P.S.<br>1.05" O.D.       | 1.0456     | 1.2032 | 1.3608 | 1.5184 | 16             | 674.58                        | 776.26  | 877.93  | 979.61  | 3/4" I.P.S.<br>26.67 mm         |
|                                 | 1.0905     | 1.2875 | 1.4845 | 1.6815 | 20             | 703.55                        | 830.64  | 957.74  | 1084.84 |                                 |
|                                 | 1.1354     | 1.3718 | 1.6082 | 1.8446 | 24             | 732.51                        | 885.03  | 1037.55 | 1190.06 |                                 |
| 1 1/2" I.P.S.<br>1.9" O.D.      | 3.1048     | 3.3412 | 3.5776 | 3.8140 | 24             | 2003.09                       | 2155.61 | 2308.12 | 2460.64 | 1 1/2" I.P.S.<br>48.26 mm       |
|                                 | 3.1946     | 3.5098 | 3.8250 | 4.1402 | 32             | 2061.03                       | 2264.38 | 2467.74 | 2671.09 |                                 |
|                                 | 3.2845     | 3.6785 | 4.0725 | 4.4665 | 40             | 2119.03                       | 2373.22 | 2627.41 | 2882.61 |                                 |
| 2" I.P.S.<br>2.375" O.D.        | 4.7894     | 5.1046 | 5.4198 | 5.7350 | 32             | 3089.93                       | 3293.28 | 3496.64 | 3699.99 | 2" I.P.S.<br>60.32 mm           |
|                                 | 4.8793     | 5.2733 | 5.6673 | 6.0613 | 40             | 3147.93                       | 3402.12 | 3656.31 | 3910.51 |                                 |

**KEY TO TABLES:**

- A tube of 1" O.D. with 24 fins 1/2" high has a total surface area of 0.079 + 0.610 = 0.689 m<sup>2</sup>/m
- A tube of 3/4" I.P.S. with 24 fins 1" high has a total surface area of 0.083 + 1.218 = 1.301 m<sup>2</sup>/m
- A tube of 2" I.P.S. with 40 fins 1/2" high has a total surface area of 0.189 + 1.016 = 1.205 m<sup>2</sup>/m



## TECHNIFIN® Type "S"



### TechniFin Typ „S“

#### Standard Size Range Type „S“

|                 |              |
|-----------------|--------------|
| Base Tube O.D.: | 31.8 - 57 mm |
| Fin Size:       | 60 - 145 mm  |
| Fin Pitch:      | 12.5 - 50 mm |
| Tube Length:    | 1 - 10 mm    |
| Fin Thickness:  | 2 - 3 mm     |

#### Manufacturing Process:

Square or rectangular fins are welded on a steel base tube.

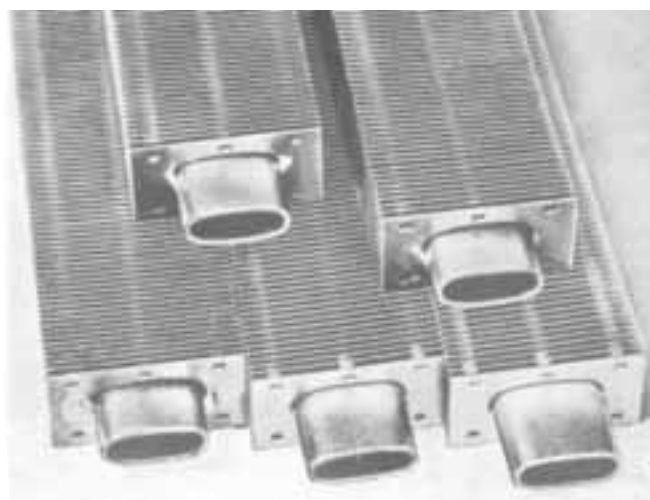
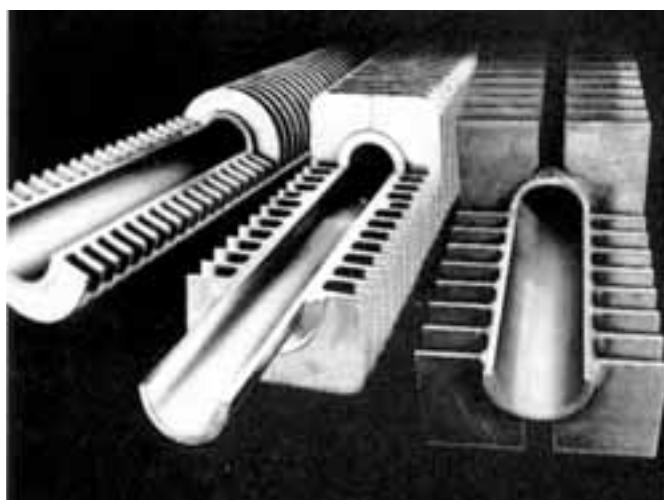
#### Advantages:

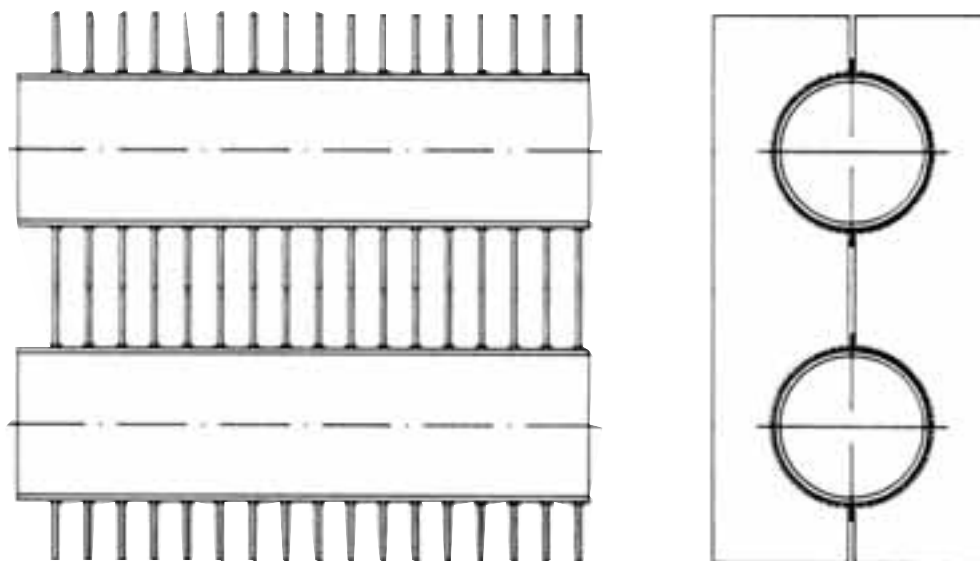
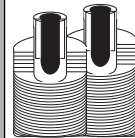
High efficiency / Minimum power loss / easy cleaning

#### Field of application:

Economisers, Biolers, Heat Exchangers.

Often used in non-corrosive gas streams, minimal resistance to gas flow and the straight gas paths inhibit fouling and ease cleaning.





TechniFin Typ „DOUBLE S“

## Standard Size Range Type „S“

|                 |              |
|-----------------|--------------|
| Base Tube O.D.: | 31.8 - 57 mm |
| Fin Size:       | 60 - 175 mm  |
| Fin Pitch:      | 10 - 30 mm   |
| Tube Length:    | 1 - 10 mm    |
| Fin Thickness:  | 2 - 3 mm     |

## Manufacturing Process:

Square or rectangular fins are welded on two steel base tubes.

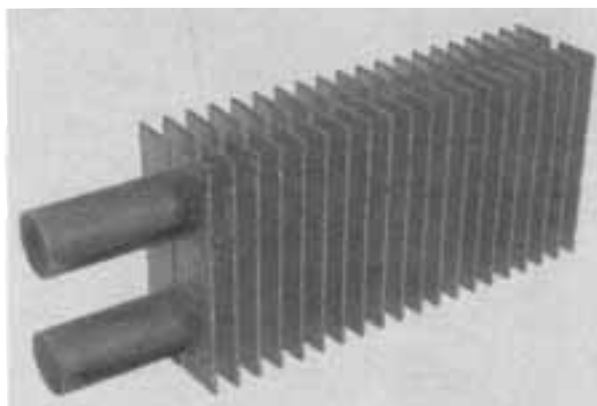
## Advantages:

High efficiency / Minimum power loss / easy cleaning

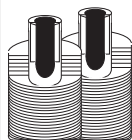
## Field of application:

Economisers, Biolers, Heat Exchangers.

Often used in non-corrosive gas streams, minimal resistance to gas flow and the straight gas paths inhibit fouling and ease cleaning.



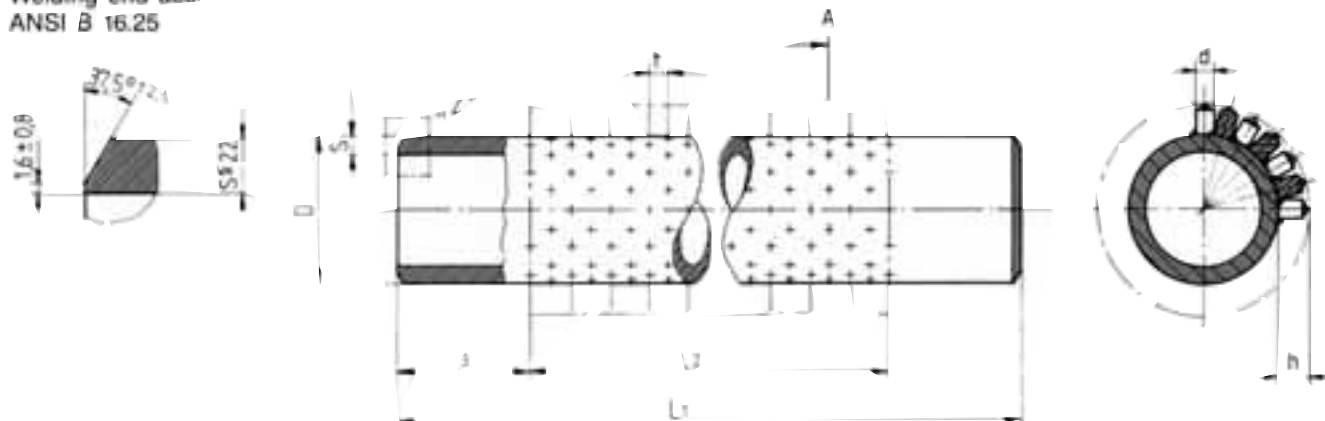




# TECHNISTUD - STUDDED TUBES

Detail "Z"

Welding end acc.  
ANSI B 16.25



L max. 24 000 mm  
L<sub>1</sub> max. (L<sub>1</sub> 2 L<sub>2</sub> min.)  
L<sub>2</sub> min. 20 mm  
L<sub>3</sub> 12.7 - 83.5 mm  
L<sub>4</sub> 8 - 12.7 mm  
L<sub>5</sub> 15.87 mm a 63 Rows / Meter

F<sub>a</sub> Studded Outer Tube Surface Area  
F<sub>i</sub> Interior Tube Area  
D<sub>a</sub> Outside Diameter of Tube

D<sub>i</sub> Inside Diameter of Tube  
N<sub>B</sub> No. of Studs per Row  
N<sub>RM</sub> No. of Stud Rows per Meter

## Standard Size Range:

See opposite page

## Fields of Application:

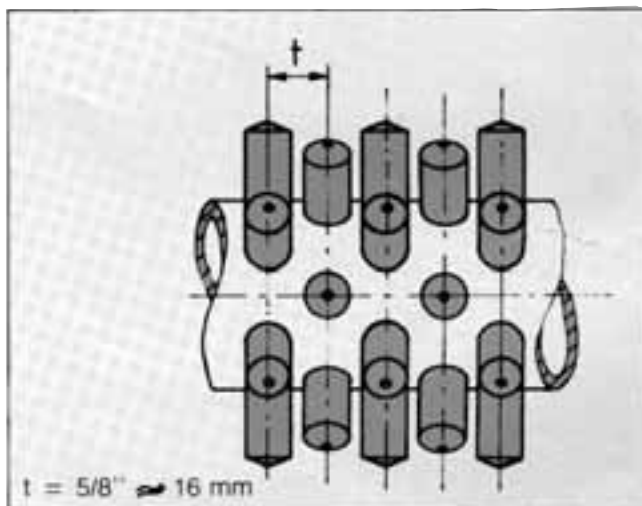
Furnaces-, Chemical-, Petrochemical-Industry, Power stations etc. where liquid media under high pressure are to be heated or cooled.

## Advantages

Due to their high rigidity, studded tubes can be used even under extreme temperature and pressure conditions.

## Manufacturing Process:

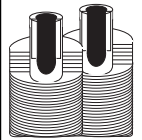
Studs are fully automatically welded onto the tube by resistance welding.





# TECHNISTUD - STUDDED TUBES

## Standard Size Range



| Standard Tube Dimensions* |       |               |       |                              |             |       |                                                                   |
|---------------------------|-------|---------------|-------|------------------------------|-------------|-------|-------------------------------------------------------------------|
| Outside Diameter          |       | Wallthickness |       | Max. Number of Studs per Row |             | Fi    | Aspect Ratio**<br>at: NB (max.), T = Stand.<br>d (max.), h (max.) |
| mm                        | in.   | mm            | in.   | d = 8 mm                     | d = 12,7 mm | m2/m  | Fi                                                                |
| 60,3                      | 2.375 | 3,9           | 0.154 | 9                            | 7           | 0,165 | 7,92                                                              |
| 73,0                      | 2.875 | 5,2           | 0.203 | 10                           | 8           | 0,197 | 7,66                                                              |
| 88,9                      | 3.500 | 5,5           | 0.216 | 13                           | 10          | 0,245 | 7,66                                                              |
| 101,6                     | 4.000 | 5,7           | 0.226 | 15                           | 12          | 0,283 | 7,88                                                              |
| 114,3                     | 4.500 | 6,0           | 0.237 | 17                           | 13          | 0,321 | 7,57                                                              |
| 127,0                     | 5.000 | 4,0           | 0.156 | 18                           | 15          | 0,374 | 7,47                                                              |
| 141,3                     | 5.563 | 6,6           | 0.258 | 21                           | 17          | 0,402 | 7,84                                                              |
| 152,4                     | 6.000 | 4,5           | 0.179 | 22                           | 18          | 0,451 | 7,44                                                              |
| 159,0                     | 6.260 | 4,5           | 0.179 | 23                           | 19          | 0,471 | 7,49                                                              |
| 168,3                     | 6.625 | 7,1           | 0.281 | 25                           | 20          | 0,484 | 7,68                                                              |
| 219,1                     | 8.625 | 8,2           | 0.322 | 32                           | 26          | 0,637 | 7,60                                                              |

\* The Standard Tube Dimensions given in the above table are taken from typical orders. Of course, we produce studded tubes also with other base tube dimensions in the range 60,3 up to 219,1 mm Outside Diameter.

\*\* Calculation of Aspect Ratio:  $Fi = \frac{d \times h \times NB \times NRM}{Di} + Da$

### Materials:

#### Base Tube & Studs

Carbon Steel  
Low Alloy Steel  
Stainless Steel

### Length:

Up to 24 meters. If necessary with circumferential weld, 100% x-rayed. If required pressure tested.

### Studs:

General Stud spacing 1/8" (16mm) = 63 Stud rows per meter

### Type of Studs:

Cylindrical, elliptical or lens type





# ANSI B 36.10

## DIMENSIONS AND WEIGHTS OF SEAMLESS AND WELDED STEEL PIPE

according to ANSI-B 36.10 supplemented with all new dimensions of API Stds. 5 L, 5 LS and 5 LX

| Size<br>in. | Outside<br>Diameter |       | Wall<br>Thickness                                                                                        |                                                                                   | Weight                                                                                       |                                                                                                | Identification                                                                                                        |                                                  |                                                 |
|-------------|---------------------|-------|----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|-------------------------------------------------|
|             | in.                 | mm    | in.                                                                                                      | mm                                                                                | ln/ft                                                                                        | kg/m                                                                                           | API                                                                                                                   | STD<br>XS; XXS                                   | Schedule<br>No                                  |
| 1/8         | 0,405               | 10,30 | 0,068<br>0,095                                                                                           | 1,7<br>2,4                                                                        | 0,24<br>0,31                                                                                 | 0,357<br>0,461                                                                                 | 5L<br>5L                                                                                                              | STD<br>XS                                        | 40<br>80                                        |
| 1/4         | 0,540               | 13,70 | 0,088<br>0,119                                                                                           | 2,2<br>3,0                                                                        | 0,42<br>0,54                                                                                 | 0,625<br>0,804                                                                                 | 5L<br>5L                                                                                                              | STD<br>XS                                        | 40<br>80                                        |
| 3/8         | 0,675               | 17,10 | 0,091<br>0,126                                                                                           | 2,3<br>3,2                                                                        | 0,57<br>0,74                                                                                 | 0,848<br>1,10                                                                                  | 5L<br>5L                                                                                                              | STD<br>XS                                        | 40<br>80                                        |
| 1/2         | 0,840               | 21,30 | 0,109<br>0,147<br>0,188<br>0,294                                                                         | 2,8<br>3,7<br>4,8<br>7,5                                                          | 0,85<br>1,09<br>1,31<br>1,71                                                                 | 1,26<br>1,62<br>1,95<br>2,54                                                                   | 5L<br>5L<br>5L<br>5L                                                                                                  | STD<br>XS<br><br>XXS                             | 40<br>80<br>160                                 |
| 3/4         | 1,050               | 26,70 | 0,113<br>0,154<br>0,219<br>0,308                                                                         | 2,9<br>3,9<br>5,6<br>7,8                                                          | 1,13<br>1,47<br>1,94<br>2,44                                                                 | 1,68<br>2,19<br>2,88<br>3,63                                                                   | 5L<br>5L<br>5L<br>5L                                                                                                  | STD<br>XS<br><br>XXS                             | 40<br>80<br>160                                 |
| 1           | 1,315               | 33,40 | 0,133<br>0,179<br>0,250<br>0,358                                                                         | 3,4<br>4,5<br>6,4<br>9,1                                                          | 1,68<br>2,17<br>2,84<br>3,66                                                                 | 2,50<br>3,23<br>4,23<br>5,45                                                                   | 5L<br>5L<br>5L<br>5L                                                                                                  | STD<br>XS<br><br>XXS                             | 40<br>80<br>160                                 |
| 1 1/4       | 1,660               | 42,20 | 0,140<br>0,191<br>0,250<br>0,382                                                                         | 3,6<br>4,9<br>6,4<br>9,7                                                          | 2,27<br>3,00<br>3,76<br>5,21                                                                 | 3,38<br>4,46<br>5,60<br>7,75                                                                   | 5L<br>5L<br>5L<br>5L                                                                                                  | STD<br>XS<br><br>XXS                             | 40<br>80<br>160                                 |
| 1 1/2       | 1,900               | 48,30 | 0,145<br>0,200<br>0,281<br>0,400                                                                         | 3,7<br>5,1<br>7,1<br>10,2                                                         | 2,72<br>3,63<br>4,86<br>6,41                                                                 | 4,05<br>5,40<br>7,23<br>9,54                                                                   | 5L<br>5L<br>5L<br>5L                                                                                                  | STD<br>XS<br><br>XXS                             | 40<br>80<br>160                                 |
| 2           | 2,375               | 60,30 | 0,083<br>0,109<br>0,126<br>0,141<br>0,154<br>0,172<br>0,188<br>0,218<br>0,250<br>0,281<br>0,344<br>0,436 | 2,1<br>2,8<br>3,2<br>3,6<br>3,9<br>4,4<br>4,8<br>5,5<br>6,4<br>7,1<br>8,7<br>11,1 | 2,03<br>2,64<br>3,00<br>3,36<br>3,65<br>4,05<br>4,39<br>5,02<br>5,67<br>6,28<br>7,46<br>9,03 | 3,02<br>3,93<br>4,47<br>5,00<br>5,44<br>6,03<br>6,54<br>7,48<br>8,45<br>9,35<br>11,10<br>13,40 | 5L, 5LX<br>5L, 5LX<br>5L, 5LX<br>5L, 5LX<br>5L, 5LX<br>5L, 5LX<br>5L, 5LX<br>5L, 5LX<br>5L, 5LX<br>5L, 5LX<br>5L, 5LX | STD<br><br><br><br><br><br><br>XS<br><br><br>XXS | 40<br><br><br><br><br><br><br>80<br><br><br>160 |

# ANSI B 36.10

## DIMENSIONS AND WEIGHTS OF SEAMLESS AND WELDED STEEL PIPE



| Size<br>in. | Outside<br>Diameter |        | Wall<br>Thickness |      | Weight |       | Identification |                |                |
|-------------|---------------------|--------|-------------------|------|--------|-------|----------------|----------------|----------------|
|             | in.                 | mm     | in.               | mm   | ln/ft  | kg/m  | API            | STD<br>XS; XXS | Schedule<br>No |
| 2 1/2       | 2,875               | 73,00  | 0,083             | 2,1  | 2,47   | 3,68  | 5L, 5LX        | STD            |                |
|             |                     |        | 0,109             | 2,8  | 3,22   | 4,80  | 5L, 5LX        |                |                |
|             |                     |        | 0,125             | 3,2  | 3,67   | 5,46  | 5L, 5LX        |                |                |
|             |                     |        | 0,141             | 3,6  | 4,12   | 6,12  | 5L, 5LX        |                |                |
|             |                     |        | 0,156             | 4,0  | 4,53   | 6,75  | 5L, 5LX        |                |                |
|             |                     |        | 0,172             | 4,4  | 4,97   | 7,40  | 5L, 5LX        |                |                |
|             |                     |        | 0,188             | 4,8  | 5,40   | 8,04  | 5L, 5LX        |                |                |
|             |                     |        | 0,203             | 5,2  | 5,79   | 8,62  | 5L, 5LX        |                |                |
|             |                     |        | 0,216             | 5,5  | 6,13   | 9,13  | 5L, 5LX        |                |                |
|             |                     |        | 0,250             | 6,4  | 7,01   | 10,40 | 5L, 5LX        |                |                |
|             |                     |        | 0,276             | 7,0  | 7,66   | 11,40 | 5L, 5LX        | XS             | 80             |
|             |                     |        | 0,375             | 9,5  | 10,00  | 14,90 |                |                | 160            |
|             |                     |        | 0,552             | 14,0 | 13,70  | 20,40 | 5L, 5LX        | XXS            |                |
| 3           | 3,500               | 88,90  | 0,083             | 2,1  | 3,03   | 4,51  | 5L, 5LX        | STD            | 40             |
|             |                     |        | 0,109             | 2,8  | 3,95   | 5,88  | 5L, 5LX        |                |                |
|             |                     |        | 0,125             | 3,2  | 4,57   | 6,72  | 5L, 5LX        |                |                |
|             |                     |        | 0,141             | 3,6  | 5,06   | 7,54  | 5L, 5LX        |                |                |
|             |                     |        | 0,156             | 4,0  | 5,57   | 8,30  | 5L, 5LX        |                |                |
|             |                     |        | 0,172             | 4,4  | 6,11   | 9,10  | 5L, 5LX        |                |                |
|             |                     |        | 0,188             | 4,8  | 6,65   | 9,91  | 5L, 5LX        |                |                |
|             |                     |        | 0,216             | 5,5  | 7,58   | 11,3  | 5L, 5LX        |                |                |
|             |                     |        | 0,250             | 6,4  | 8,68   | 12,9  | 5L, 5LX        |                |                |
|             |                     |        | 0,281             | 7,1  | 9,66   | 14,4  | 5L, 5LX        |                |                |
|             |                     |        | 0,300             | 7,6  | 10,30  | 15,3  | 5L, 5LX        | XS             | 80             |
|             |                     |        | 0,438             | 11,1 | 14,30  | 21,3  |                |                | 160            |
|             |                     |        | 0,600             | 15,2 | 18,60  | 27,7  | 5L, 5LX        | XXS            |                |
| 3 1/2       | 4                   | 101,60 | 0,083             | 2,1  | 3,47   | 5,17  | 5L, 5LX        | STD            | 40             |
|             |                     |        | 0,109             | 2,8  | 4,53   | 6,75  | 5L, 5LX        |                |                |
|             |                     |        | 0,125             | 3,2  | 5,17   | 7,70  | 5L, 5LX        |                |                |
|             |                     |        | 0,141             | 3,6  | 5,81   | 8,65  | 5L, 5LX        |                |                |
|             |                     |        | 0,156             | 4,0  | 6,40   | 9,53  | 5L, 5LX        |                |                |
|             |                     |        | 0,172             | 4,4  | 7,03   | 10,5  | 5L, 5LX        |                |                |
|             |                     |        | 0,188             | 4,8  | 7,65   | 11,4  | 5L, 5LX        |                |                |
|             |                     |        | 0,226             | 5,7  | 9,11   | 13,6  | 5L, 5LX        |                |                |
|             |                     |        | 0,250             | 6,4  | 10,00  | 14,9  | 5L, 5LX        |                |                |
|             |                     |        | 0,281             | 7,1  | 11,20  | 16,6  | 5L, 5LX        |                |                |
|             |                     |        | 0,318             | 8,1  | 12,50  | 18,6  | 5L, 5LX        | XS             | 80             |
| 4           | 4,5                 | 114,30 | 0,083             | 2,1  | 3,92   | 5,84  | 5L, 5LS, 5LX   | STD            | 40             |
|             |                     |        | 0,109             | 2,8  | 5,11   | 7,61  | 5L, 5LS        |                |                |
|             |                     |        | 0,125             | 3,2  | 5,84   | 8,70  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,141             | 3,6  | 6,56   | 9,77  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,156             | 4,0  | 7,24   | 10,8  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,172             | 4,4  | 7,95   | 11,8  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,188             | 4,8  | 8,66   | 12,9  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,203             | 5,2  | 9,32   | 13,9  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,219             | 5,6  | 10,00  | 14,9  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,237             | 6,0  | 10,80  | 16,1  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,250             | 6,4  | 11,40  | 16,9  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,281             | 7,1  | 12,70  | 18,9  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,312             | 7,9  | 14,00  | 20,8  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,337             | 8,6  | 15,00  | 22,3  | 5L, 5LS, 5LX   | XS             | 80             |
|             |                     |        | 0,438             | 11,1 | 19,00  | 28,3  | 5L, 5LS, 5LX   |                | 120            |
|             |                     |        | 0,531             | 13,5 | 22,50  | 33,5  | 5L, 5LS, 5LX   |                | 160            |
|             |                     |        | 0,674             | 17,1 | 27,50  | 41,0  | 5L, 5LS, 5LX   | XXS            |                |



| Size<br><br>in. | Outside<br>Diameter |        | Wall<br>Thickness |              | Weight |       | Identification |                |                |      |              |              |
|-----------------|---------------------|--------|-------------------|--------------|--------|-------|----------------|----------------|----------------|------|--------------|--------------|
|                 | in.                 | mm     | in.               | mm           | ln/ft  | kg/m  | API            | STD<br>XS; XXS | Schedule<br>No |      |              |              |
| 5               | 5,563               | 141,30 | 0,083             | 2,1          | 4,86   | 7,24  | 5L, 5LS        | STD            | 40             |      |              |              |
|                 |                     |        | 0,125             | 3,2          | 7,26   | 10,8  | 5L, 5LS        |                |                |      |              |              |
|                 |                     |        | 0,156             | 4,0          | 9,01   | 13,4  | 5L, 5LS        |                |                |      |              |              |
|                 |                     |        | 0,188             | 4,8          | 10,80  | 16,1  | 5L, 5LS        |                |                |      |              |              |
|                 |                     |        | 0,219             | 5,6          | 12,50  | 18,6  | 5L, 5LS        |                |                |      |              |              |
|                 |                     |        | 0,258             | 6,6          | 14,60  | 21,8  | 5L, 5LS        |                |                |      |              |              |
|                 |                     |        | 0,281             | 7,1          | 15,80  | 23,6  | 5L, 5LS        |                |                |      |              |              |
|                 |                     |        | 0,312             | 7,9          | 17,50  | 26,1  | 5L, 5LS        |                |                |      |              |              |
|                 |                     |        | 0,344             | 8,7          | 19,20  | 28,6  | 5L, 5LS        |                |                |      |              |              |
|                 |                     |        | 0,375             | 9,5          | 20,80  | 31,0  | 5L             |                |                | XS   | 80           |              |
|                 |                     |        | 0,500             | 12,7         | 27,00  | 40,3  | 5L, 5LS        |                |                | 120  |              |              |
|                 |                     |        | 0,625             | 15,9         | 33,00  | 49,1  | 5L, 5LS        |                |                | 160  |              |              |
|                 |                     |        | 0,750             | 19,0         | 38,60  | 57,4  | 5L             |                |                | XXS  |              |              |
|                 |                     |        | 6                 | 6,625        | 168,30 | 0,083 | 2,1            |                |                | 5,80 | 8,64         | 5L, 5LS, 5LX |
| 0,109           | 2,8                 | 7,59   |                   |              |        | 11,3  | 5L, 5LS, 5LX   |                |                |      |              |              |
| 0,125           | 3,2                 | 8,68   |                   |              |        | 12,0  | 5L, 5LS, 5LX   |                |                |      |              |              |
| 0,141           | 3,6                 | 9,76   |                   |              |        | 14,5  | 5L, 5LS, 5LX   |                |                |      |              |              |
| 0,156           | 4,0                 | 10,80  |                   |              |        | 16,1  | 5L, 5LS, 5LX   |                |                |      |              |              |
| 0,172           | 4,4                 | 11,80  |                   |              |        | 17,6  | 5L, 5LS, 5LX   |                |                |      |              |              |
| 0,188           | 4,8                 | 12,90  |                   |              |        | 19,2  | 5L, 5LS, 5LX   |                |                |      |              |              |
| 0,203           | 5,2                 | 13,90  |                   |              |        | 20,7  | 5L, 5LS, 5LX   |                |                |      |              |              |
| 0,219           | 5,6                 | 15,00  |                   |              |        | 22,3  | 5L, 5LS, 5LX   |                |                |      |              |              |
| 0,250           | 6,4                 | 17,0   |                   |              |        | 25,4  | 5L, 5LS, 5LX   |                |                |      |              |              |
| 0,280           | 7,1                 | 19,0   |                   |              |        | 28,3  | 5L, 5LS, 5LX   |                |                |      |              |              |
| 0,312           | 7,9                 | 21,0   |                   |              |        | 31,3  | 5L, 5LS, 5LX   |                |                |      |              |              |
| 0,344           | 8,7                 | 23,1   |                   |              |        | 34,4  | 5L, 5LS, 5LX   |                |                |      |              |              |
| 0,375           | 9,5                 | 25,0   |                   |              |        | 37,3  | 5L, 5LS, 5LX   |                |                |      |              |              |
| 0,432           | 11,0                | 28,6   |                   |              |        | 42,6  | 5L, 5LS, 5LX   | XS             | 80             |      |              |              |
| 0,500           | 12,7                | 32,7   |                   |              |        | 48,7  | 5L, 5LS, 5LX   | XXS            | 120            |      |              |              |
| 0,562           | 14,3                | 36,4   |                   |              |        | 54,2  | 5L, 5LS, 5LX   |                | 160            |      |              |              |
| 0,625           | 15,9                | 40,0   |                   |              |        | 59,6  | 5L, 5LS, 5LX   |                |                |      |              |              |
| 0,719           | 18,3                | 45,4   | 67,6              | 5L, 5LS, 5LX |        |       |                |                |                |      |              |              |
| 8               | 8,625               | 219,10 | 0,125             | 3,2          | 11,4   | 19,9  | 5L, 5LS, 5LX   | STD            | 40             |      |              |              |
|                 |                     |        | 0,156             | 4,0          | 14,1   | 21,0  | 5L, 5LS, 5LX   |                |                |      |              |              |
|                 |                     |        | 0,188             | 4,8          | 16,9   | 25,2  | 5L, 5LS, 5LX   |                |                |      |              |              |
|                 |                     |        | 0,203             | 5,2          | 18,3   | 27,3  | 5LS, 5LX       |                |                |      |              |              |
|                 |                     |        | 0,219             | 5,6          | 19,7   | 29,3  | 5L, 5LS, 5LX   |                |                |      |              |              |
|                 |                     |        | 0,250             | 6,4          | 22,4   | 33,3  | 5L, 5LS, 5LX   |                |                |      |              |              |
|                 |                     |        | 0,277             | 7,0          | 24,7   | 36,8  | 5L, 5LS, 5LX   |                |                |      |              |              |
|                 |                     |        | 0,312             | 7,9          | 27,7   | 41,3  | 5L, 5LS, 5LX   |                |                |      |              |              |
|                 |                     |        | 0,322             | 8,2          | 28,6   | 42,5  | 5L, 5LS, 5LX   |                |                |      |              |              |
|                 |                     |        | 0,344             | 8,7          | 30,4   | 45,3  | 5L, 5LS, 5LX   |                |                |      |              |              |
|                 |                     |        | 0,375             | 9,5          | 33,0   | 49,2  | 5L, 5LS, 5LX   |                |                |      |              |              |
|                 |                     |        | 0,406             | 10,3         | 35,7   | 53,1  | 5L, 5LS, 5LX   |                |                | XS   | 60           |              |
|                 |                     |        | 0,438             | 11,1         | 38,3   | 57,0  |                |                |                |      | 80           |              |
|                 |                     |        | 0,500             | 12,7         | 43,4   | 64,6  |                |                |                |      | 5L, 5LS, 5LX | 100          |
|                 |                     |        | 0,562             | 14,3         | 48,4   | 72,1  |                |                |                |      | 5L, 5LS, 5LX | 120          |
|                 |                     |        | 0,594             | 15,1         | 50,9   | 75,8  | 5L, 5LS, 5LX   |                |                | XXS  | 140          |              |
|                 |                     |        | 0,625             | 15,9         | 53,4   | 79,5  |                |                |                |      | 5L, 5LS, 5LX | 160          |
|                 |                     |        | 0,719             | 18,3         | 60,7   | 90,4  |                |                |                |      | 5L, 5LS, 5LX |              |
|                 |                     |        | 0,812             | 20,6         | 67,8   | 101,0 |                |                |                |      |              |              |
|                 |                     |        | 0,875             | 22,6         | 72,4   | 108,0 | 5L, 5LS, 5LX   |                |                |      |              |              |
| 0,906           | 23,0                | 74,4   | 111,0             |              |        |       |                |                |                |      |              |              |

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## DIMENSIONS AND WEIGHTS OF SEAMLESS AND WELDED STEEL PIPE



| Size<br>in. | Outside<br>Diameter |        | Wall<br>Thickness |      | Weight |       | Identification |                                                          |                                                                                |
|-------------|---------------------|--------|-------------------|------|--------|-------|----------------|----------------------------------------------------------|--------------------------------------------------------------------------------|
|             | in.                 | mm     | in.               | mm   | ln/ft  | kg/m  | API            | STD<br>XS; XXS                                           | Schedule<br>No                                                                 |
| 10          | 10,750              | 2730   | 0,156             | 4,0  | 17,6   | 26,3  | 5L, 5LS, 5LX   | STD<br><br>XS<br><br><br><br><br><br><br><br><br><br>XXS | 20<br><br>30<br><br>40<br><br>60<br><br>80<br><br>100<br><br>120<br>140<br>160 |
|             |                     |        | 0,188             | 4,8  | 21,2   | 31,6  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,203             | 5,2  | 22,9   | 34,1  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,219             | 5,6  | 24,6   | 36,7  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,250             | 6,4  | 28,0   | 41,8  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,279             | 7,1  | 31,2   | 46,5  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,307             | 7,8  | 34,2   | 51,0  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,344             | 8,7  | 38,2   | 56,9  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,365             | 9,3  | 40,5   | 60,3  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,438             | 11,1 | 48,2   | 71,8  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,500             | 12,7 | 54,7   | 81,5  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,562             | 14,3 | 61,2   | 91,1  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,594             | 15,1 | 64,4   | 95,8  |                |                                                          |                                                                                |
|             |                     |        | 0,625             | 15,9 | 67,7   | 101,0 | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,719             | 18,3 | 77,0   | 115,0 | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,812             | 20,6 | 86,2   | 128,0 | 5L, 5LS        |                                                          |                                                                                |
|             |                     |        | 0,844             | 21,4 | 89,3   | 133,0 |                |                                                          |                                                                                |
|             |                     |        | 1,000             | 25,4 | 104,1  | 155,0 |                |                                                          |                                                                                |
|             |                     |        | 1,125             | 28,6 | 115,6  | 172,0 |                |                                                          |                                                                                |
| 12          | 12,750              | 323,80 | 0,172             | 4,4  | 23,1   | 34,4  | 5L, 5LS, 5LX   | STD<br><br>XS<br><br><br><br><br><br><br><br><br><br>XXS | 20<br><br>30<br><br>40<br><br>60<br><br>80<br><br>100<br>120<br>140<br>160     |
|             |                     |        | 0,188             | 4,8  | 25,2   | 37,6  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,203             | 5,2  | 27,2   | 40,5  | 5LS, 5LX       |                                                          |                                                                                |
|             |                     |        | 0,219             | 5,6  | 29,3   | 43,7  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,250             | 6,4  | 33,4   | 49,7  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,281             | 7,1  | 37,4   | 55,7  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,312             | 7,9  | 41,4   | 61,7  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,330             | 8,4  | 43,8   | 65,2  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,344             | 8,7  | 45,6   | 67,9  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,375             | 9,5  | 49,6   | 73,8  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,406             | 10,3 | 53,5   | 79,7  | 5LS, 5LX       |                                                          |                                                                                |
|             |                     |        | 0,438             | 11,1 | 57,6   | 85,8  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,500             | 12,7 | 65,4   | 97,4  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,562             | 14,3 | 73,1   | 109,0 | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,625             | 15,9 | 80,9   | 121,0 | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,688             | 17,5 | 88,6   | 132,0 | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,750             | 19,0 | 96,1   | 143,0 | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,812             | 20,6 | 104    | 154   | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,844             | 21,4 | 107    | 160   |                |                                                          |                                                                                |
|             |                     |        | 0,875             | 22,2 | 111    | 165   | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 1,000             | 25,4 | 125    | 187   |                |                                                          |                                                                                |
|             |                     |        | 1,125             | 28,6 | 140    | 208   |                |                                                          |                                                                                |
|             |                     |        | 1,312             | 33,3 | 160    | 239   |                |                                                          |                                                                                |
| 14          | 14,000              | 355,60 | 0,188             | 4,8  | 27,7   | 41,3  | 5L, 5LS, 5LX   | STD<br><br><br><br><br><br><br><br><br><br>XS            | 10<br><br>20<br><br>30<br><br>40                                               |
|             |                     |        | 0,203             | 5,2  | 29,9   | 44,6  | 5L, 5LS        |                                                          |                                                                                |
|             |                     |        | 0,210             | 5,3  | 30,9   | 46,1  | 5LS, 5LX       |                                                          |                                                                                |
|             |                     |        | 0,219             | 5,6  | 32,2   | 48,0  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,250             | 6,4  | 36,7   | 54,7  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,281             | 7,1  | 41,2   | 61,3  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,312             | 7,9  | 45,6   | 67,9  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,344             | 8,7  | 50,2   | 74,7  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,375             | 9,5  | 54,6   | 81,3  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,406             | 10,3 | 58,9   | 87,8  | 5LS, 5LX       |                                                          |                                                                                |
|             |                     |        | 0,438             | 11,1 | 63,4   | 94,5  | 5L, 5LS, 5LX   |                                                          |                                                                                |
|             |                     |        | 0,469             | 11,9 | 67,8   | 101   | 5LS, 5LX       |                                                          |                                                                                |
|             |                     |        | 0,500             | 12,7 | 72,1   | 107   | 5L, 5LS, 5LX   |                                                          |                                                                                |



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## DIMENSIONS AND WEIGHTS OF SEAMLESS AND WELDED STEEL PIPE

| Size<br>in. | Outside<br>Diameter |        | Wall<br>Thickness |      | Weight |      | Identification |                |                |
|-------------|---------------------|--------|-------------------|------|--------|------|----------------|----------------|----------------|
|             | in.                 | mm     | in.               | mm   | ln/ft  | kg/m | API            | STD<br>XS; XXS | Schedule<br>No |
|             |                     |        | 0,562             | 14,3 | 80,7   | 120  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,594             | 15,1 | 85,0   | 127  |                |                | 60             |
|             |                     |        | 0,625             | 15,9 | 89,3   | 133  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,688             | 17,5 | 97,8   | 146  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,750             | 19,0 | 106    | 158  | 5L, 5LS, 5LX   |                | 80             |
|             |                     |        | 0,812             | 20,6 | 114    | 170  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,875             | 22,2 | 123    | 183  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,938             | 23,8 | 131    | 195  | 5L, 5LS, 5LX   |                | 100            |
|             |                     |        | 1,094             | 27,8 | 151    | 224  |                |                | 120            |
|             |                     |        | 1,250             | 31,8 | 170    | 253  |                |                | 140            |
|             |                     |        | 1,406             | 35,7 | 189    | 281  |                |                | 160            |
|             |                     |        | 2,000             | 50,8 | 256    | 381  |                |                |                |
|             |                     |        | 2,125             | 54,0 | 270    | 401  |                |                |                |
|             |                     |        | 2,200             | 55,9 | 277    | 413  |                |                |                |
|             |                     |        | 2,500             | 63,5 | 307    | 457  |                |                |                |
| 16          | 16,000              | 406,40 | 0,188             | 4,8  | 31,8   | 47,3 | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,203             | 5,2  | 34,2   | 51,0 | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,219             | 5,6  | 36,9   | 55,0 | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,250             | 6,4  | 42,0   | 62,6 | 5L, 5LS, 5LX   |                | 10             |
|             |                     |        | 0,281             | 7,1  | 47,2   | 70,3 | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,312             | 7,9  | 52,3   | 77,9 | 5L, 5LS, 5LX   |                | 20             |
|             |                     |        | 0,344             | 8,7  | 57,7   | 85,7 | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,375             | 9,5  | 62,6   | 93,2 | 5L, 5LS, 5LX   | STD            | 30             |
|             |                     |        | 0,406             | 10,3 | 67,6   | 101  | 5LS, 5LX       |                |                |
|             |                     |        | 0,438             | 11,1 | 72,8   | 108  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,469             | 11,9 | 77,8   | 116  | 5LS, 5LX       |                |                |
|             |                     |        | 0,500             | 12,7 | 82,8   | 123  | 5L, 5LS, 5LX   | XS             | 40             |
|             |                     |        | 0,562             | 14,3 | 92,7   | 138  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,625             | 15,0 | 103    | 153  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,656             | 16,7 | 108    | 160  |                |                | 60             |
|             |                     |        | 0,688             | 17,5 | 113    | 168  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,750             | 19,0 | 122    | 182  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,812             | 20,6 | 132    | 196  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,844             | 21,4 | 137    | 203  |                |                | 80             |
|             |                     |        | 0,875             | 22,2 | 141    | 211  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,938             | 23,8 | 151    | 225  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,000             | 25,4 | 160    | 239  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,031             | 26,2 | 165    | 245  |                |                | 100            |
|             |                     |        | 1,062             | 26,9 | 169    | 253  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,125             | 28,6 | 179    | 266  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,219             | 31,0 | 192    | 286  |                |                | 120            |
|             |                     |        | 1,438             | 36,5 | 224    | 333  |                |                | 140            |
|             |                     |        | 1,594             | 40,5 | 245    | 365  |                |                | 160            |
| 18          | 18,000              | 457,20 | 0,188             | 4,8  | 35,8   | 53,3 | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,219             | 5,6  | 41,6   | 62,0 | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,250             | 6,4  | 47,4   | 70,6 | 5L, 5LS, 5LX   |                | 10             |
|             |                     |        | 0,281             | 7,1  | 53,2   | 79,2 | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,312             | 7,9  | 58,9   | 87,8 | 5L, 5LS, 5LX   |                | 20             |
|             |                     |        | 0,344             | 8,7  | 64,9   | 96,6 | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,375             | 9,5  | 70,6   | 105  | 5L, 5LS, 5LX   | STD            |                |
|             |                     |        | 0,406             | 10,3 | 76,3   | 114  | 5LS, 5LX       |                |                |
|             |                     |        | 0,438             | 11,1 | 82,2   | 122  | 5L, 5LS, 5LX   |                | 30             |
|             |                     |        | 0,469             | 11,9 | 87,8   | 131  | 5LS, 5LX       |                |                |
|             |                     |        | 0,500             | 12,7 | 93,4   | 139  | 5L, 5LS, 5LX   | XS             |                |
|             |                     |        | 0,562             | 14,3 | 105    | 156  | 5L, 5LS, 5LX   |                | 40             |

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## DIMENSIONS AND WEIGHTS OF SEAMLESS AND WELDED STEEL PIPE



| Size<br>in. | Outside<br>Diameter |        | Wall<br>Thickness |      | Weight |      | Identification |                |                |
|-------------|---------------------|--------|-------------------|------|--------|------|----------------|----------------|----------------|
|             | in.                 | mm     | in.               | mm   | ln/ft  | kg/m | API            | STD<br>XS; XXS | Schedule<br>No |
|             |                     |        | 0,625             | 15,9 | 116    | 173  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,688             | 17,5 | 127    | 189  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,750             | 19,0 | 138    | 206  | 5L, 5LS, 5LX   |                | 60             |
|             |                     |        | 0,812             | 20,6 | 149    | 222  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,875             | 22,2 | 160    | 238  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,938             | 23,8 | 171    | 255  | 5L, 5LS, 5LX   |                | 80             |
|             |                     |        | 1,000             | 25,4 | 182    | 270  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,062             | 27,0 | 192    | 286  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,125             | 28,6 | 203    | 302  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,156             | 29,4 | 208    | 310  |                |                | 100            |
|             |                     |        | 1,187             | 30,8 | 213    | 317  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,250             | 31,8 | 224    | 333  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,375             | 34,9 | 244    | 363  |                |                | 120            |
|             |                     |        | 1,562             | 39,7 | 274    | 408  |                |                | 140            |
|             |                     |        | 1,781             | 45,2 | 309    | 459  |                |                | 160            |
| 20          | 20,000              | 508,00 | 0,219             | 5,6  | 46,3   | 68,9 | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,250             | 6,4  | 52,7   | 78,5 | 5L, 5LS, 5LX   |                | 10             |
|             |                     |        | 0,281             | 7,1  | 59,2   | 88,2 | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,312             | 7,9  | 65,6   | 97,7 | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,344             | 8,7  | 72,2   | 108  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,375             | 9,5  | 78,6   | 117  | 5L, 5LS, 5LX   | STD            | 20             |
|             |                     |        | 0,406             | 10,3 | 85,0   | 127  | 5LS, 5LX       |                |                |
|             |                     |        | 0,438             | 11,1 | 91,5   | 136  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,469             | 11,9 | 97,8   | 146  | 5LS, 5LX       |                |                |
|             |                     |        | 0,500             | 12,7 | 104    | 155  | 5L, 5LS, 5LX   | XS             | 30             |
|             |                     |        | 0,562             | 14,3 | 117    | 174  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,594             | 15,1 | 123    | 183  |                |                | 40             |
|             |                     |        | 0,625             | 15,9 | 129    | 193  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,688             | 17,5 | 142    | 211  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,750             | 19,0 | 154    | 230  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,812             | 20,6 | 166    | 248  | 5L, 5LS, 5LX   |                | 60             |
|             |                     |        | 0,875             | 22,2 | 179    | 266  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,938             | 23,8 | 191    | 284  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,000             | 25,4 | 203    | 302  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,031             | 26,2 | 209    | 311  |                |                | 80             |
|             |                     |        | 1,062             | 27,0 | 215    | 320  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,125             | 28,6 | 227    | 338  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,187             | 30,2 | 238    | 355  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,250             | 31,8 | 250    | 372  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,281             | 32,5 | 256    | 381  |                |                | 100            |
|             |                     |        | 1,312             | 33,3 | 262    | 390  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,375             | 34,9 | 274    | 407  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,500             | 38,1 | 296    | 441  |                |                | 120            |
|             |                     |        | 1,750             | 44,4 | 341    | 508  |                |                | 140            |
|             |                     |        | 1,969             | 50,0 | 379    | 564  |                |                | 160            |
| 22          | 22,000              | 558,80 | 0,219             | 5,6  | 50,9   | 75,9 | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,250             | 6,4  | 58,1   | 86,5 | 5L, 5LS, 5LX   |                | 10             |
|             |                     |        | 0,281             | 7,1  | 65,2   | 97,1 | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,312             | 7,9  | 72,3   | 108  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,344             | 8,7  | 79,6   | 118  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,375             | 9,5  | 86,6   | 129  | 5L, 5LS, 5LX   | STD            | 20             |
|             |                     |        | 0,406             | 10,3 | 93,6   | 139  | 5LS, 5LX       |                |                |
|             |                     |        | 0,438             | 11,1 | 101    | 150  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,469             | 11,9 | 108    | 161  | 5LS, 5LX       |                |                |
|             |                     |        | 0,500             | 12,7 | 115    | 171  | 5L, 5LS, 5LX   | XS             | 30             |
|             |                     |        | 0,562             | 14,3 | 129    | 192  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,625             | 15,9 | 143    | 213  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,688             | 17,5 | 157    | 233  | 5L, 5LS, 5LX   |                |                |





# ANSI B 36.10

## DIMENSIONS AND WEIGHTS OF SEAMLESS AND WELDED STEEL PIPE

| Size<br>in. | Outside<br>Diameter |        | Wall<br>Thickness |      | Weight |      | Identification |                |                |
|-------------|---------------------|--------|-------------------|------|--------|------|----------------|----------------|----------------|
|             | in.                 | mm     | in.               | mm   | ln/ft  | kg/m | API            | STD<br>XS; XXS | Schedule<br>No |
|             |                     |        | 0,750             | 19,0 | 170    | 254  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,812             | 20,6 | 184    | 274  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,875             | 22,2 | 197    | 294  | 5L, 5LS, 5LX   |                | 60             |
|             |                     |        | 0,938             | 23,8 | 211    | 314  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,000             | 25,4 | 224    | 334  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,062             | 27,0 | 237    | 354  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,125             | 28,6 | 251    | 374  | 5L, 5LS, 5LX   |                | 80             |
|             |                     |        | 1,187             | 30,2 | 264    | 393  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,250             | 31,8 | 277    | 413  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,312             | 33,3 | 290    | 432  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,375             | 34,9 | 303    | 451  | 5L, 5LS, 5LX   |                | 100            |
|             |                     |        | 1,437             | 36,5 | 316    | 470  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,500             | 38,1 | 328    | 489  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,625             | 41,3 | 354    | 526  |                |                | 120            |
|             |                     |        | 1,875             | 47,6 | 403    | 600  |                |                | 140            |
|             |                     |        | 2,125             | 54,0 | 451    | 671  |                |                | 160            |
| 24          | 24,000              | 609,60 | 0,250             | 6,4  | 63,4   | 94,4 | 5L, 5LS, 5LX   |                | 10             |
|             |                     |        | 0,281             | 7,1  | 71,2   | 106  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,312             | 7,9  | 78,9   | 118  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,344             | 8,7  | 86,9   | 129  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,375             | 9,5  | 94,6   | 141  | 5L, 5LS, 5LX   | STD            | 20             |
|             |                     |        | 0,406             | 10,3 | 102    | 152  | 5LS, 5LX       |                |                |
|             |                     |        | 0,438             | 11,1 | 110    | 164  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,469             | 11,9 | 118    | 176  | 5LS, 5LX       |                |                |
|             |                     |        | 0,500             | 12,7 | 125    | 187  | 5L, 5LS, 5LX   | X S            |                |
|             |                     |        | 0,562             | 14,3 | 141    | 210  | 5L, 5LS, 5LX   |                | 30             |
|             |                     |        | 0,625             | 15,9 | 156    | 232  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,688             | 17,5 | 171    | 255  | 5L, 5LS, 5LX   |                | 40             |
|             |                     |        | 0,750             | 19,0 | 186    | 277  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,812             | 20,6 | 201    | 300  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,875             | 22,2 | 216    | 322  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,938             | 23,8 | 231    | 344  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,969             | 24,6 | 238    | 355  |                |                | 60             |
|             |                     |        | 1,000             | 25,4 | 246    | 366  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,062             | 27,0 | 260    | 342  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,125             | 28,6 | 275    | 409  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,187             | 30,2 | 289    | 431  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,219             | 31,0 | 297    | 441  |                |                | 80             |
|             |                     |        | 1,250             | 31,8 | 304    | 452  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,312             | 33,3 | 318    | 474  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,375             | 34,9 | 332    | 495  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,437             | 36,5 | 346    | 516  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,500             | 38,1 | 360    | 537  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,531             | 38,9 | 367    | 547  |                |                | 100            |
|             |                     |        | 1,562             | 39,7 | 374    | 558  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 1,812             | 46,0 | 430    | 639  |                |                | 120            |
|             |                     |        | 2,062             | 52,4 | 483    | 719  |                |                | 140            |
|             |                     |        | 2,344             | 59,5 | 542    | 807  |                |                | 160            |
| 26          | 26,000              | 660,40 | 0,250             | 6,4  | 68,8   | 102  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,281             | 7,1  | 77,2   | 115  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,312             | 7,9  | 85,6   | 128  | 5L, 5LS, 5LX   |                | 10             |
|             |                     |        | 0,344             | 8,7  | 94,3   | 140  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,375             | 9,5  | 103    | 153  | 5L, 5LS, 5LX   | STD            |                |
|             |                     |        | 0,406             | 10,3 | 111    | 165  | 5 LS,5 LX      |                |                |
|             |                     |        | 0,438             | 11,1 | 120    | 178  | 5L, 5LS, 5LX   |                |                |
|             |                     |        | 0,469             | 11,9 | 128    | 190  | 5 LS,5 Lh      |                |                |
|             |                     |        | 0,500             | 12,7 | 136    | 203  | 5L, 5LS, 5LX   | XS             | 20             |
|             |                     |        | 0,562             | 14,3 | 153    | 227  | 5L, 5LS, 5LX   |                |                |



| Size<br><br>in. | Outside<br>Diameter |        | Wall<br>Thickness                                           |                                                      | Weight                                        |                                               | Identification                                                                                               |                |                |              |
|-----------------|---------------------|--------|-------------------------------------------------------------|------------------------------------------------------|-----------------------------------------------|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------|----------------|----------------|--------------|
|                 | in.                 | mm     | in.                                                         | mm                                                   | ln/ft                                         | kg/m                                          | API                                                                                                          | STD<br>XS; XXS | Schedule<br>No |              |
|                 |                     |        | 0,625<br>0,688<br>0,750<br>0,812<br>0,875<br>0,938<br>1,000 | 15,9<br>17,5<br>19,0<br>20,6<br>22,2<br>23,8<br>25,4 | 169<br>186<br>202<br>218<br>235<br>251<br>267 | 252<br>277<br>301<br>325<br>350<br>374<br>398 | 5L, 5LS, 5LX<br>5L, 5LS, 5LX<br>5L, 5LS, 5LX<br>5L, 5LS, 5LX<br>5L, 5LS, 5LX<br>5L, 5LS, 5LX<br>5L, 5LS, 5LX |                |                |              |
| 28              | 28,000              | 711,20 | 0,250                                                       | 6,4                                                  | 74,1                                          | 110                                           | 5L, 5LS, 5LX                                                                                                 | STD            | 10             |              |
|                 |                     |        | 0,281                                                       | 7,1                                                  | 83,2                                          | 124                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
|                 |                     |        | 0,312                                                       | 7,9                                                  | 92,3                                          | 137                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
|                 |                     |        | 0,344                                                       | 8,7                                                  | 102                                           | 151                                           | 5LS, 5LX                                                                                                     |                |                |              |
|                 |                     |        | 0,375                                                       | 9,5                                                  | 111                                           | 165                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
|                 |                     |        | 0,406                                                       | 10,3                                                 | 120                                           | 178                                           | 5LS, 5LX                                                                                                     |                |                |              |
|                 |                     |        | 0,438                                                       | 11,1                                                 | 129                                           | 192                                           | 5L, 5LS, 5LX                                                                                                 | XS             |                | 20           |
|                 |                     |        | 0,469                                                       | 11,9                                                 | 138                                           | 205                                           | 5LS, 5LX                                                                                                     |                |                |              |
|                 |                     |        | 0,500                                                       | 12,7                                                 | 147                                           | 219                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
|                 |                     |        | 0,562                                                       | 14,3                                                 | 165                                           | 245                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
|                 |                     |        | 0,625                                                       | 15,9                                                 | 183                                           | 272                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
|                 |                     |        | 0,688                                                       | 17,5                                                 | 201                                           | 299                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
|                 |                     |        | 0,750                                                       | 19,0                                                 | 218                                           | 325                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
|                 |                     |        | 0,812                                                       | 20,6                                                 | 236                                           | 351                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
|                 |                     |        | 0,875                                                       | 22,2                                                 | 253                                           | 378                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
|                 |                     |        | 0,938                                                       | 23,8                                                 | 271                                           | 404                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
|                 |                     |        | 1,000                                                       | 25,4                                                 | 288                                           | 430                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
|                 |                     |        | 30                                                          | 30,000                                               | 762                                           | 0,250                                         | 6,4                                                                                                          | 79,4           |                | 118          |
| 0,281           | 7,1                 | 89,2   |                                                             |                                                      |                                               | 133                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
| 0,312           | 7,9                 | 98,9   |                                                             |                                                      |                                               | 147                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
| 0,344           | 8,7                 | 109    |                                                             |                                                      |                                               | 162                                           | 5LS, 5LX                                                                                                     |                |                |              |
| 0,375           | 9,5                 | 119    |                                                             |                                                      |                                               | 177                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
| 0,406           | 10,3                | 128    |                                                             |                                                      |                                               | 191                                           | 5LS, 5LX                                                                                                     |                |                |              |
| 0,438           | 11,1                | 138    |                                                             |                                                      |                                               | 206                                           | 5L, 5LS, 5LX                                                                                                 | XS             | 20             |              |
| 0,469           | 11,9                | 148    |                                                             |                                                      |                                               | 220                                           | 5LS, 5LX                                                                                                     |                |                |              |
| 0,500           | 12,7                | 158    |                                                             |                                                      |                                               | 235                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
| 0,562           | 14,3                | 177    |                                                             |                                                      |                                               | 263                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
| 0,625           | 15,9                | 196    |                                                             |                                                      |                                               | 292                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
| 0,688           | 17,5                | 215    |                                                             |                                                      |                                               | 321                                           | 5L, 5LS, 5LX                                                                                                 |                |                | 30           |
| 0,750           | 19,0                | 234    |                                                             |                                                      |                                               | 349                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
| 0,812           | 20,6                | 253    |                                                             |                                                      |                                               | 377                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
| 0,875           | 22,2                | 272    |                                                             |                                                      |                                               | 405                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
| 0,938           | 23,8                | 291    |                                                             |                                                      |                                               | 434                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
| 1,000           | 25,4                | 310    |                                                             |                                                      |                                               | 461                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
| 32              | 32,000              | 812,80 |                                                             |                                                      |                                               | 0,250                                         | 6,4                                                                                                          | 84,8           | 126            | 5L, 5LS, 5LX |
|                 |                     |        | 0,281                                                       | 7,1                                                  | 95,2                                          | 142                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
|                 |                     |        | 0,312                                                       | 7,9                                                  | 106                                           | 157                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
|                 |                     |        | 0,344                                                       | 8,7                                                  | 116                                           | 173                                           | 5LS, 5LX                                                                                                     |                |                |              |
|                 |                     |        | 0,375                                                       | 9,5                                                  | 127                                           | 189                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
|                 |                     |        | 0,406                                                       | 10,3                                                 | 137                                           | 204                                           | 5LS, 5LX                                                                                                     |                |                |              |
|                 |                     |        | 0,438                                                       | 11,1                                                 | 148                                           | 220                                           | 5L, 5LS, 5LX                                                                                                 | XS             | 20             |              |
|                 |                     |        | 0,469                                                       | 11,9                                                 | 158                                           | 235                                           | 5LS, 5LX                                                                                                     |                |                |              |
|                 |                     |        | 0,500                                                       | 12,7                                                 | 168                                           | 251                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
|                 |                     |        | 0,562                                                       | 14,3                                                 | 189                                           | 281                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
|                 |                     |        | 0,625                                                       | 15,9                                                 | 209                                           | 312                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
|                 |                     |        | 0,688                                                       | 17,5                                                 | 230                                           | 343                                           | 5L, 5LS, 5LX                                                                                                 |                |                | 30<br>40     |
|                 |                     |        | 0,750                                                       | 19,0                                                 | 250                                           | 373                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
|                 |                     |        | 0,812                                                       | 20,6                                                 | 270                                           | 403                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
|                 |                     |        | 0,875                                                       | 22,2                                                 | 291                                           | 433                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
|                 |                     |        | 0,938                                                       | 23,8                                                 | 311                                           | 463                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |
|                 |                     |        | 1,000                                                       | 25,4                                                 | 331                                           | 493                                           | 5L, 5LS, 5LX                                                                                                 |                |                |              |



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## DIMENSIONS AND WEIGHTS OF SEAMLESS AND WELDED STEEL PIPE



| Size<br>in. | Outside<br>Diameter |         | Wall<br>Thickness |      | Weight |      | Identification |                |                |
|-------------|---------------------|---------|-------------------|------|--------|------|----------------|----------------|----------------|
|             | in.                 | mm      | in.               | mm   | ln/ft  | kg/m | API            | STD<br>XS; XXS | Schedule<br>No |
|             |                     |         | 0,625             | 15,9 | 263    | 391  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,688             | 17,5 | 289    | 430  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,050             | 19,0 | 314    | 468  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,812             | 20,6 | 340    | 506  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,875             | 22,2 | 366    | 545  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,938             | 23,8 | 391    | 583  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 1,000             | 25,4 | 417    | 620  | 5L, 5LS, 5LX   |                |                |
| 42          | 42,000              | 1066,80 | 0,344             | 8,7  | 153    | 228  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,375             | 9,5  | 167    | 248  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,406             | 10,3 | 180    | 269  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,438             | 11,1 | 194    | 290  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,460             | 11,9 | 208    | 310  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,500             | 12,7 | 222    | 330  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,562             | 14,3 | 249    | 370  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,625             | 15,9 | 276    | 411  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,688             | 17,5 | 304    | 452  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,750             | 19,0 | 330    | 492  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,812             | 20,6 | 357    | 532  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,875             | 22,2 | 384    | 572  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,938             | 23,8 | 411    | 615  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 1,000             | 25,4 | 438    | 652  | 5L, 5LS, 5LX   |                |                |
| 44          | 44,000              | 1117,60 | 0,344             | 8,7  | 160    | 239  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,375             | 9,5  | 175    | 260  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,406             | 10,3 | 189    | 282  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,438             | 11,1 | 204    | 304  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,469             | 11,9 | 218    | 325  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,500             | 12,7 | 232    | 346  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,562             | 14,3 | 261    | 388  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,625             | 15,9 | 290    | 431  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,688             | 17,5 | 318    | 474  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,750             | 19,0 | 346    | 516  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,812             | 20,6 | 375    | 558  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,875             | 22,2 | 403    | 600  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,938             | 23,8 | 431    | 643  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 1,000             | 25,4 | 474    | 684  | 5L, 5LS, 5LX   |                |                |
| 46          | 46,000              | 1168,40 | 0,344             | 8,7  | 168    | 250  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,375             | 9,5  | 183    | 272  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,406             | 10,3 | 198    | 294  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,438             | 11,1 | 213    | 317  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,469             | 11,9 | 228    | 340  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,500             | 12,7 | 243    | 362  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,562             | 14,3 | 273    | 406  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,625             | 15,9 | 303    | 451  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,688             | 17,5 | 333    | 496  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,750             | 19,0 | 362    | 540  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,812             | 20,6 | 392    | 584  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,875             | 22,2 | 422    | 628  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,938             | 23,8 | 451    | 602  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 1,000             | 25,4 | 481    | 716  | 5L, 5LS, 5LX   |                |                |



# ANSI B 36.10

## DIMENSIONS AND WEIGHTS OF SEAMLESS AND WELDED STEEL PIPE

| Size<br>in. | Outside<br>Diameter |         | Wall<br>Thickness |      | Weight |      | Identification |                |                |
|-------------|---------------------|---------|-------------------|------|--------|------|----------------|----------------|----------------|
|             | in.                 | mm      | in.               | mm   | ln/ft  | kg/m | API            | STD<br>XS; XXS | Schedule<br>No |
| 48          | 48,000              | 1219,20 | 0,344             | 8,7  | 175    | 261  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,375             | 9,5  | 191    | 284  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,406             | 10,3 | 206    | 307  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,438             | 11,1 | 222    | 331  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,469             | 11,9 | 238    | 355  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,500             | 12,7 | 254    | 378  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,562             | 14,3 | 285    | 424  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,625             | 15,9 | 316    | 471  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,688             | 17,5 | 348    | 518  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,750             | 19,0 | 378    | 564  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,812             | 20,6 | 409    | 610  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,875             | 22,2 | 440    | 656  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 0,938             | 23,8 | 471    | 702  | 5L, 5LS, 5LX   |                |                |
|             |                     |         | 1,000             | 25,4 | 502    | 748  | 5L, 5LS, 5LX   |                |                |



# ASA Pipe Schedule

ACC. TO. ANSI B 36.19



|       | OD<br>mm | STD<br>5s             | XS<br>5              | 10s                   | 10                    | 20                     | 30                     | 40s                   | 40                         | 60                     | 80s                    | 80                        | 100                    | 120                    | 140                    | 160                    | XXS                    |
|-------|----------|-----------------------|----------------------|-----------------------|-----------------------|------------------------|------------------------|-----------------------|----------------------------|------------------------|------------------------|---------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| 1/8   | 10.3     |                       |                      |                       |                       |                        |                        | 1.73<br><b>0.37</b>   | Identical with STD and 40s |                        | 2.41<br><b>0.47</b>    | Identical with XS and 80s |                        |                        |                        |                        |                        |
| 1/4   | 13.7     |                       |                      |                       |                       |                        |                        | 2.24<br><b>0.64</b>   |                            |                        | 3.02<br><b>0.82</b>    |                           |                        |                        |                        |                        |                        |
| 3/8   | 17.2     |                       |                      |                       |                       |                        |                        | 2.31<br><b>0.87</b>   |                            |                        | 3.20<br><b>1.12</b>    |                           |                        |                        |                        |                        |                        |
| 1/2   | 21.3     | 1.65<br><b>0.81</b>   | 1.65<br><b>0.81</b>  | 2.11<br><b>1.02</b>   | 2.11<br><b>1.02</b>   |                        |                        | 2.77<br><b>1.29</b>   |                            |                        | 3.73<br><b>1.64</b>    |                           |                        |                        |                        | 4.75<br><b>1.97</b>    | 7.47<br><b>2.59</b>    |
| 3/4   | 26.7     | 1.65<br><b>1.03</b>   | 1.65<br><b>1.03</b>  | 2.11<br><b>1.30</b>   | 2.11<br><b>1.30</b>   |                        |                        | 2.87<br><b>1.71</b>   |                            |                        | 3.91<br><b>2.23</b>    |                           |                        |                        |                        | 5.54<br><b>2.93</b>    | 7.82<br><b>3.69</b>    |
| 1     | 33.4     | 1.65<br><b>1.31</b>   | 1.65<br><b>1.31</b>  | 2.77<br><b>2.13</b>   | 2.77<br><b>2.13</b>   |                        |                        | 3.38<br><b>2.54</b>   |                            |                        | 4.55<br><b>3.29</b>    |                           |                        |                        |                        | 6.35<br><b>4.30</b>    | 9.09<br><b>5.53</b>    |
| 1 1/4 | 42.2     | 1.65<br><b>1.67</b>   | 1.65<br><b>1.67</b>  | 2.77<br><b>2.73</b>   | 2.77<br><b>2.73</b>   |                        |                        | 3.56<br><b>3.44</b>   |                            |                        | 4.85<br><b>4.53</b>    |                           |                        |                        |                        | 6.35<br><b>5.69</b>    | 9.70<br><b>7.88</b>    |
| 1 1/2 | 48.3     | 1.65<br><b>1.93</b>   | 1.65<br><b>1.93</b>  | 2.77<br><b>3.16</b>   | 2.77<br><b>3.16</b>   |                        |                        | 3.68<br><b>4.11</b>   |                            |                        | 5.08<br><b>5.49</b>    |                           |                        |                        |                        | 7.14<br><b>7.35</b>    | 10.16<br><b>9.69</b>   |
| 2     | 60.3     | 1.65<br><b>2.42</b>   | 1.65<br><b>2.42</b>  | 2.77<br><b>3.99</b>   | 2.77<br><b>3.99</b>   |                        |                        | 3.91<br><b>5.52</b>   |                            |                        | 5.54<br><b>7.60</b>    |                           |                        |                        |                        | 8.71<br><b>11.26</b>   | 11.07<br><b>13.65</b>  |
| 2 1/2 | 73.0     | 2.11<br><b>3.75</b>   | 2.11<br><b>3.75</b>  | 3.05<br><b>5.34</b>   | 3.05<br><b>5.34</b>   |                        |                        | 5.16<br><b>8.77</b>   |                            |                        | 7.01<br><b>11.59</b>   |                           |                        |                        |                        | 9.53<br><b>15.15</b>   | 14.02<br><b>20.72</b>  |
| 3     | 88.9     | 2.11<br><b>4.59</b>   | 2.11<br><b>4.59</b>  | 3.05<br><b>6.56</b>   | 3.05<br><b>6.56</b>   |                        |                        | 5.49<br><b>11.47</b>  |                            |                        | 7.62<br><b>15.51</b>   |                           |                        |                        |                        | 11.13<br><b>21.67</b>  | 15.24<br><b>28.11</b>  |
| 3 1/2 | 101.6    | 2.11<br><b>5.25</b>   | 2.11<br><b>5.25</b>  | 3.05<br><b>7.53</b>   | 3.05<br><b>7.53</b>   |                        |                        | 5.74<br><b>13.78</b>  |                            |                        | 8.08<br><b>18.92</b>   |                           |                        |                        |                        |                        | 16.15<br><b>34.56</b>  |
| 4     | 114.3    | 2.11<br><b>5.93</b>   | 2.11<br><b>5.93</b>  | 3.05<br><b>8.50</b>   | 3.05<br><b>8.50</b>   |                        |                        | 6.02<br><b>16.32</b>  |                            |                        | 8.56<br><b>22.66</b>   |                           |                        | 11.13<br><b>28.75</b>  |                        | 13.49<br><b>34.05</b>  | 17.12<br><b>41.66</b>  |
| 5     | 141.3    | 2.77<br><b>9.61</b>   | 2.77<br><b>9.61</b>  | 3.40<br><b>11.74</b>  | 3.40<br><b>11.74</b>  |                        |                        | 6.55<br><b>22.10</b>  |                            |                        | 9.53<br><b>31.44</b>   |                           |                        | 12.70<br><b>40.90</b>  |                        | 15.88<br><b>49.87</b>  | 19.05<br><b>58.31</b>  |
| 6     | 168.3    | 2.77<br><b>11.47</b>  | 2.77<br><b>11.47</b> | 3.40<br><b>14.04</b>  | 3.40<br><b>14.04</b>  |                        |                        | 7.11<br><b>28.69</b>  |                            |                        | 10.97<br><b>43.21</b>  |                           |                        | 14.27<br><b>55.03</b>  |                        | 18.24<br><b>68.53</b>  | 21.95<br><b>80.43</b>  |
| 8     | 219.1    | 2.77<br><b>15.00</b>  | 2.77<br><b>15.00</b> | 3.76<br><b>20.27</b>  | 3.76<br><b>20.27</b>  | 6.35<br><b>33.82</b>   | 7.04<br><b>37.38</b>   | 8.18<br><b>43.20</b>  |                            | 10.81<br><b>53.90</b>  | 12.70<br><b>65.63</b>  |                           | 15.06<br><b>76.93</b>  | 18.24<br><b>91.73</b>  | 20.62<br><b>102.47</b> | 23.01<br><b>112.97</b> | 22.23<br><b>109.57</b> |
| 10    | 273.1    | 3.40<br><b>22.95</b>  | 3.40<br><b>22.95</b> | 4.19<br><b>28.20</b>  | 4.19<br><b>28.20</b>  | 6.35<br><b>42.41</b>   | 7.80<br><b>51.81</b>   | 9.27<br><b>61.22</b>  |                            | 12.70<br><b>82.80</b>  | 12.70<br><b>82.80</b>  | 15.06<br><b>97.27</b>     | 18.24<br><b>116.38</b> | 21.41<br><b>134.90</b> | 25.40<br><b>157.51</b> | 28.58<br><b>174.95</b> | 25.40<br><b>157.51</b> |
| 12    | 323.9    | 3.96<br><b>31.72</b>  | 4.19<br><b>33.60</b> | 4.57<br><b>36.54</b>  | 4.57<br><b>36.54</b>  | 6.35<br><b>50.48</b>   | 8.38<br><b>66.20</b>   | 9.53<br><b>75.01</b>  | 10.31<br><b>80.94</b>      | 14.27<br><b>110.62</b> | 12.70<br><b>98.95</b>  | 17.45<br><b>133.88</b>    | 21.41<br><b>162.14</b> | 25.40<br><b>189.82</b> | 28.58<br><b>211.31</b> | 33.32<br><b>242.40</b> | 25.40<br><b>189.82</b> |
| 14    | 355.6    | 3.96<br><b>34.86</b>  |                      | 4.78<br><b>41.99</b>  | 6.35<br><b>55.53</b>  | 7.92<br><b>68.95</b>   | 9.53<br><b>82.58</b>   | 9.53<br><b>82.58</b>  | 11.13<br><b>96.00</b>      | 15.06<br><b>128.42</b> | 12.70<br><b>109.04</b> | 19.05<br><b>160.54</b>    | 23.80<br><b>197.74</b> | 27.76<br><b>227.88</b> | 31.75<br><b>257.47</b> | 35.71<br><b>286.04</b> |                        |
| 16    | 406.4    | 4.19<br><b>42.20</b>  |                      | 4.78<br><b>48.07</b>  | 6.35<br><b>63.61</b>  | 7.92<br><b>79.03</b>   | 9.53<br><b>94.70</b>   | 9.53<br><b>94.70</b>  | 12.70<br><b>125.20</b>     | 16.66<br><b>206.40</b> | 12.70<br><b>249.34</b> | 21.41<br><b>290.88</b>    | 26.19<br><b>338.32</b> | 30.94<br><b>370.74</b> | 36.53<br><b>404.66</b> |                        |                        |
| 18    | 457.2    | 4.19<br><b>47.46</b>  |                      | 4.78<br><b>54.15</b>  | 6.35<br><b>71.69</b>  | 7.92<br><b>89.10</b>   | 11.13<br><b>124.32</b> | 9.53<br><b>106.83</b> | 14.27<br><b>158.27</b>     | 19.05<br><b>209.00</b> | 12.70<br><b>141.35</b> | 23.80<br><b>258.29</b>    | 29.36<br><b>314.54</b> | 34.93<br><b>369.34</b> | 39.67<br><b>414.75</b> | 45.24<br><b>466.67</b> |                        |
| 20    | 508.0    | 4.78<br><b>60.23</b>  |                      | 5.54<br><b>69.70</b>  | 6.35<br><b>79.76</b>  | 9.53<br><b>118.93</b>  | 12.70<br><b>157.51</b> | 9.53<br><b>118.93</b> | 15.06<br><b>185.89</b>     | 20.62<br><b>251.65</b> | 12.70<br><b>157.51</b> | 26.19<br><b>315.97</b>    | 32.54<br><b>387.41</b> | 38.10<br><b>448.30</b> | 44.45<br><b>515.94</b> | 49.99<br><b>573.31</b> |                        |
| 22    | 558.8    | 4.78<br><b>65.95</b>  |                      | 5.54<br><b>76.75</b>  | 6.35<br><b>87.84</b>  | 9.53<br><b>131.07</b>  | 12.70<br><b>173.66</b> | 9.53<br><b>131.07</b> | 15.88<br><b>216.04</b>     | 22.23<br><b>298.55</b> | 12.70<br><b>173.66</b> | 28.57<br><b>379.70</b>    | 34.92<br><b>457.83</b> | 41.27<br><b>535.17</b> | 47.62<br><b>609.30</b> | 53.97<br><b>682.57</b> |                        |
| 24    | 609.6    | 5.54<br><b>83.80</b>  |                      | 6.35<br><b>95.92</b>  | 6.35<br><b>95.92</b>  | 9.53<br><b>143.20</b>  | 14.27<br><b>212.72</b> | 9.53<br><b>143.20</b> | 17.45<br><b>258.74</b>     | 24.59<br><b>360.21</b> | 12.70<br><b>189.82</b> | 30.94<br><b>448.30</b>    | 38.89<br><b>555.76</b> | 46.02<br><b>649.44</b> | 52.37<br><b>730.72</b> | 59.51<br><b>819.70</b> |                        |
| 26    | 660.4    |                       |                      |                       | 7.92<br><b>129.40</b> | 12.70<br><b>205.97</b> |                        | 9.53<br><b>155.32</b> |                            |                        | 12.70<br><b>205.97</b> |                           |                        |                        |                        |                        |                        |
| 28    | 711.2    |                       |                      |                       | 7.92<br><b>139.47</b> | 12.70<br><b>222.13</b> | 15.88<br><b>276.48</b> | 9.53<br><b>167.44</b> |                            |                        | 12.70<br><b>222.13</b> |                           |                        |                        |                        |                        |                        |
| 30    | 762.0    | 6.35<br><b>120.15</b> |                      | 7.92<br><b>149.55</b> | 7.92<br><b>149.55</b> | 12.70<br><b>238.28</b> | 15.88<br><b>296.68</b> | 9.53<br><b>179.56</b> |                            |                        | 12.70<br><b>238.28</b> |                           |                        |                        |                        |                        |                        |
| 32    | 812.8    |                       |                      |                       | 7.92<br><b>159.62</b> | 12.70<br><b>254.44</b> | 15.88<br><b>316.88</b> | 9.53<br><b>191.69</b> | 17.48<br><b>348.11</b>     |                        | 12.70<br><b>254.44</b> |                           |                        |                        |                        |                        |                        |
| 34    | 863.6    |                       |                      |                       | 7.92<br><b>169.64</b> | 12.70<br><b>270.50</b> | 15.88<br><b>336.96</b> | 9.53<br><b>203.74</b> | 17.48<br><b>370.22</b>     |                        | 12.70<br><b>270.50</b> |                           |                        |                        |                        |                        |                        |
| 36    | 914.4    |                       |                      |                       | 7.92<br><b>179.77</b> | 12.70<br><b>286.75</b> | 15.88<br><b>357.28</b> | 9.53<br><b>215.93</b> | 19.05<br><b>427.09</b>     |                        | 12.70<br><b>286.75</b> |                           |                        |                        |                        |                        |                        |

1.65 = Wall thickness in mm

0.81 = kg/m





# Seamless tubes - sizes and weights

DIN 2448

| O.D.<br>mm                                                                    | Standard Wall<br>thickness<br>mm                     | weight<br><br>kg/m                                          | other weights in mm              |                                  |                                  |                                 |                                |                                |                                |                                              |                                              |                                              |                                              |                                              |                                              |                                              |                                              |                                              |                                              |                                                      |                                                      |
|-------------------------------------------------------------------------------|------------------------------------------------------|-------------------------------------------------------------|----------------------------------|----------------------------------|----------------------------------|---------------------------------|--------------------------------|--------------------------------|--------------------------------|----------------------------------------------|----------------------------------------------|----------------------------------------------|----------------------------------------------|----------------------------------------------|----------------------------------------------|----------------------------------------------|----------------------------------------------|----------------------------------------------|----------------------------------------------|------------------------------------------------------|------------------------------------------------------|
|                                                                               |                                                      |                                                             | 2                                | 2,3                              | 2,6                              | 2,9                             | 3,2                            | 3,6                            | 4                              | 4,5                                          | 5                                            | 5,6                                          | 6,3                                          | 7,1                                          | 8                                            | 8,8                                          | 10                                           | 11                                           | 12,5                                         | 14,2                                                 | 16                                                   |
|                                                                               |                                                      |                                                             | Gewicht kg/m                     |                                  |                                  |                                 |                                |                                |                                |                                              |                                              |                                              |                                              |                                              |                                              |                                              |                                              |                                              |                                              |                                                      |                                                      |
| 10,29*)<br>13,5*)<br>16<br>17,2*)<br>20                                       | 1,6<br>1,8<br>1,8<br>1,8<br>2                        | 0,344<br>0,522<br>0,632<br>0,688<br>0,890                   | 0,410<br>0,571<br>0,692<br>0,754 | 0,454<br>0,639<br>0,778<br>0,850 | 0,493<br>0,703<br>0,860<br>0,942 | 0,525<br>0,762<br>0,938<br>1,03 | 0,555<br>0,817<br>1,01<br>1,11 | 0,588<br>0,883<br>1,10<br>1,21 | 0,614<br>0,940<br>1,18<br>1,31 | <br>0,996<br>1,27<br>1,41                    | <br>1,05<br>1,36<br>1,50                     | <br><br>1,43<br>1,60                         | <br><br>1,51<br>1,70                         | <br><br><br><br>                             | <br><br><br><br>                             | <br><br><br><br>                             | <br><br><br><br>                             | <br><br><br><br>                             | <br><br><br><br>                             | <br><br><br><br>                                     |                                                      |
| 21,3*)<br>25<br>26,9*)<br>30<br>31,8                                          | 2<br>2<br>2,3<br>2,6<br>2,6                          | 0,962<br>1,13<br>1,41<br>1,77<br>1,88                       | <br>1,09<br>1,29                 | 1,09<br>1,29<br>1,57             | 1,21<br>1,33<br>1,58             | 1,33<br>1,44<br>1,73            | 1,44<br>1,59<br>2,09           | 1,59<br>1,72<br>2,07           | 1,72<br>2,07<br>2,28           | 1,87<br>2,28<br>2,48                         | 2,01<br>2,47<br>2,70                         | 2,17<br>2,68<br>2,94                         | 2,34<br>2,91<br>3,21                         | 2,49<br>3,13<br>3,48                         | 2,62<br>3,35<br>3,72                         | 2,71<br>3,52<br>3,92                         | <br>3,70<br>4,17                             | <br><br><br><br>                             | <br><br><br><br>                             | <br><br><br><br>                                     |                                                      |
| 33,7*)<br>38<br>42,4*)<br>44,5<br>48,3*)                                      | 2,6<br>2,6<br>2,6<br>2,6<br>2,6                      | 2,01<br>2,29<br>2,57<br>2,70<br>2,95                        | <br><br><br><br>                 | <br><br><br><br>                 | 2,22<br>2,53<br>2,84             | 2,42<br>2,77<br>3,11            | 2,69<br>3,08<br>3,47           | 2,95<br>3,38<br>3,81           | 3,23<br>3,71<br>4,19           | 3,54<br>4,07<br>4,61                         | 3,87<br>4,47<br>5,07                         | 4,27<br>4,95<br>5,62                         | 4,67<br>5,43<br>6,19                         | 5,05<br>5,91<br>6,76                         | 5,39<br>6,33<br>7,27                         | 5,84<br>6,91<br>7,99                         | 6,17<br>7,36<br>8,54                         | <br>7,90<br>9,25                             | <br><br>9,88                                 | <br><br><br><br>                                     |                                                      |
| 51<br>(54)<br>57<br>60,3*)<br>63,5<br>70                                      | 2,6<br>2,6<br>2,9<br>2,9<br>2,9<br>2,9               | 3,12<br>3,30<br>3,90<br>4,14<br>4,36<br>4,83                | <br><br><br><br>                 | <br><br><br><br>                 | 3,46<br>3,65                     | 3,79<br>4,01                    | 4,23<br>4,47                   | 4,66<br>4,93                   | 5,13<br>5,49                   | 5,67<br>6,04                                 | 6,24<br>6,68                                 | 6,95<br>7,41                                 | 7,69<br>8,21                                 | 8,43<br>9,08                                 | 9,10<br>9,81                                 | 10,1<br>10,9                                 | 10,9<br>11,7                                 | 11,9<br>12,8                                 | 12,9<br>13,9                                 | 13,7<br>15,0                                         |                                                      |
| 76,1*)<br>82,5<br>88,9*)<br>(95)<br>101,6*)<br>108                            | 2,9<br>3,2<br>3,2<br>3,6<br>3,6<br>3,6               | 5,28<br>6,31<br>6,81<br>8,11<br>8,76<br>9,33                | <br><br><br><br>                 | <br><br><br><br>                 | <br><br><br><br>                 | 5,80<br>7,05                    | 6,49<br>7,80                   | 7,17<br>8,63                   | 7,92<br>8,63                   | 8,77<br>9,56                                 | 9,71<br>10,6                                 | 10,9<br>11,9                                 | 12,1<br>13,2                                 | 13,4<br>14,6                                 | 14,6<br>14,9                                 | 16,3<br>17,9                                 | 17,7<br>19,5                                 | 19,7<br>21,7                                 | 21,7<br>24,0                                 | 23,7<br>26,2                                         |                                                      |
| 114,3*)<br>(121)<br>127<br>133<br>139,7*)                                     | 3,6<br>4<br>4<br>4<br>4                              | 9,90<br>11,5<br>12,2<br>12,8<br>13,5                        | <br><br><br><br>                 | <br><br><br><br>                 | <br><br><br><br>                 | <br><br><br><br>                | <br><br><br><br>               | 11,0<br>12,9                   | 12,1<br>14,3                   | 13,5<br>15,0                                 | 15,0<br>16,7                                 | 16,8<br>18,8                                 | 18,8<br>21,0                                 | 20,9<br>23,4                                 | 22,8<br>25,5                                 | 25,7<br>27,4                                 | 28,1<br>29,8                                 | 31,6<br>33,4                                 | 35,1<br>37,4                                 | 38,6<br>41,4                                         |                                                      |
| (146)<br>152,4<br>159<br>165,1<br>168,3*)<br>(171)<br>177,8                   | 4,5<br>4,5<br>4,5<br>4,5<br>4,5<br>5                 | 15,7<br>16,4<br>17,1<br>17,8<br>18,1<br>18,5<br>21,3        | <br><br><br><br>                 | <br><br><br><br>                 | <br><br><br><br>                 | <br><br><br><br>                | <br><br><br><br>               | <br><br><br><br>               | <br><br><br><br>               | 17,4<br>18,2<br>19,0<br>19,7<br>20,1<br>20,5 | 19,4<br>20,2<br>21,1<br>21,9<br>22,4<br>22,8 | 21,7<br>22,8<br>23,8<br>24,8<br>25,3<br>25,6 | 24,3<br>25,5<br>26,6<br>27,7<br>28,3<br>28,7 | 27,2<br>28,4<br>29,6<br>30,9<br>31,5<br>32,2 | 29,8<br>31,0<br>32,4<br>33,8<br>34,5<br>35,2 | 33,5<br>35,1<br>36,7<br>38,2<br>39,0<br>39,7 | 36,6<br>38,5<br>40,3<br>42,0<br>42,9<br>43,4 | 41,2<br>43,4<br>45,4<br>47,4<br>48,4<br>48,9 | 46,2<br>48,5<br>50,8<br>53,0<br>54,1<br>54,9 | 51,3<br>53,6<br>56,2<br>58,6<br>59,9<br>61,2         |                                                      |
| (191)<br>193,7*)<br>(216)<br>219,1*)<br>(241)<br>244,5*)<br>267               | 5,4<br>5,4<br>6<br>5,9<br>6,3<br>6,3<br>6,3          | 24,7<br>25,0<br>31,1<br>31,0<br>36,5<br>37,1<br>40,6        | <br><br><br><br>                 | <br><br><br><br>                 | <br><br><br><br>                 | <br><br><br><br>                | <br><br><br><br>               | <br><br><br><br>               | <br><br><br><br>               | <br><br><br><br>                             | <br><br><br><br>                             | <br><br><br><br>                             | 28,7<br>29,2<br>32,6<br>37,2                 | 32,2<br>32,8<br>41,0<br>41,5                 | 36,1<br>36,5<br>45,0<br>45,4                 | 39,5<br>40,0<br>45,3<br>46,0                 | 44,6<br>45,8<br>50,8<br>51,6                 | 48,8<br>49,8<br>55,6<br>56,7                 | 55,0<br>56,2<br>62,7<br>64,1                 | 61,9<br>63,0<br>70,7<br>71,9                         |                                                      |
| 273*)<br>(292)<br>298,5<br>(318)<br>323,9*)<br>(343)<br>355,6*)               | 6,3<br>7<br>7,1<br>7,5<br>7,1<br>8<br>8              | 41,6<br>49,2<br>51,1<br>57,4<br>55,6<br>66,1<br>68,3        | <br><br><br><br>                 | <br><br><br><br>                 | <br><br><br><br>                 | <br><br><br><br>                | <br><br><br><br>               | <br><br><br><br>               | <br><br><br><br>               | <br><br><br><br>                             | <br><br><br><br>                             | <br><br><br><br>                             | 46,7<br>26,0<br>57,1<br>61,2<br>62,1         | 52,1<br>61,5<br>62,6<br>67,1<br>68,1         | 57,1<br>69,5<br>71,1<br>76,0<br>77,4         | 64,9<br>76,2<br>78,3<br>83,3<br>85,3         | 71,4<br>86,2<br>88,8<br>94,2<br>96,7         | 80,9<br>86,2<br>88,8<br>92,0<br>96,7         | 90,9<br>97,3<br>99,8<br>106<br>109           |                                                      |                                                      |
| 368<br>(394)<br>406,4*)<br>419<br>(445)<br>457,2<br>(470)                     | 8<br>9<br>8,8<br>10<br>10<br>10,5                    | 70,8<br>85,5<br>85,9<br>101<br>107<br>110<br>119            | <br><br><br><br>                 | <br><br><br><br>                 | <br><br><br><br>                 | <br><br><br><br>                | <br><br><br><br>               | <br><br><br><br>               | <br><br><br><br>               | <br><br><br><br>                             | <br><br><br><br>                             | <br><br><br><br>                             | <br><br><br><br>                             | <br><br><br><br>                             | 77,7<br>94,7<br>97,8                         | 88,3<br>104<br>108                           | 97,3<br>118<br>122                           | 110<br>118<br>126                            | 124<br>139<br>138                            | 138<br>149<br>153                                    |                                                      |
| (495)<br>508*)<br>(521)<br>(546)<br>558,8<br>(572)<br>609,6<br>(622)<br>660,4 | 11<br>11<br>11,5<br>12<br>12,5<br>12,5<br>13<br>14,2 | 131<br>135<br>144<br>158<br>170<br>172<br>185<br>195<br>227 | <br><br><br><br>                 | <br><br><br><br>                 | <br><br><br><br>                 | <br><br><br><br>                | <br><br><br><br>               | <br><br><br><br>               | <br><br><br><br>               | <br><br><br><br>                             | <br><br><br><br>                             | <br><br><br><br>                             | <br><br><br><br>                             | <br><br><br><br>                             | <br><br><br><br>                             | <br><br><br><br>                             | <br><br><br><br>                             | <br><br><br><br>                             | 149<br>154                                   | 168<br>173<br>177<br>186<br>191<br>195<br>209<br>213 | 189<br>193<br>199<br>209<br>213<br>233<br>239<br>253 |

Sizes not enclosed within the bold lines are not covered by DIN 2448.

\* Up to 139.7 mm incl., these outside diameters are in conformity with threaded pipe to ISO Recommendation R7, from 168.3 mm in conformity with ANSI B 2.1, API Std 5A, 5L or 5LX (without threads).



# Seamless tubes - sizes and weights

DIN 2448



| other weights in mm                                         |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                              |                                                               |                                                                |                                                                 |                                                                   |                                                                     |                                                                      | O.D.<br>mm                                                           |                                                                               |
|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------------------------|---------------------------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------|-------------------------------------------------------------------|---------------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------|
| 17,5                                                        | 20                                                          | 22,2                                                        | 25                                                          | 28                                                          | 30                                                          | 32                                                          | 36                                                          | 40                                                          | 45                                                          | 50                                                          | 55                                                          | 60                                                          | 65                                                          | 70                                                           | 75                                                            | 80                                                             | 85                                                              | 90                                                                | 100                                                                 | 110                                                                  | 120                                                                  |                                                                               |
| Gewicht kg/m                                                |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                              |                                                               |                                                                |                                                                 |                                                                   |                                                                     |                                                                      |                                                                      |                                                                               |
|                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                              |                                                               |                                                                |                                                                 |                                                                   |                                                                     |                                                                      |                                                                      | 10,29*)<br>13,5*)<br>16<br>17,2*)<br>20                                       |
|                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                              |                                                               |                                                                |                                                                 |                                                                   |                                                                     |                                                                      |                                                                      | 21,3*)<br>25<br>26,9*)<br>30<br>31,8                                          |
|                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                              |                                                               |                                                                |                                                                 |                                                                   |                                                                     |                                                                      |                                                                      | 33,7*)<br>38<br>42,4*)<br>44,5<br>48,3*)                                      |
|                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                              |                                                               |                                                                |                                                                 |                                                                   |                                                                     |                                                                      |                                                                      | 51<br>(54)<br>57<br>60,3*)<br>63,5<br>70                                      |
| 18,5<br>19,8<br>22,6                                        |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                              |                                                               |                                                                |                                                                 |                                                                   |                                                                     |                                                                      |                                                                      | 76,1*)<br>82,5<br>88,9*)<br>(95)<br>101,6*)<br>108                            |
| 25,3<br>28,0<br>30,8<br>33,4<br>36,2<br>39,0                | 27,7<br>30,8<br>34,0<br>37,0<br>40,2<br>43,4                | 33,0<br>36,5<br>39,9<br>43,2<br>47,5<br>51,4                | 35,6<br>39,6<br>43,2<br>47,5<br>51,4                        | 46,3<br>50,8<br>55,2                                        | 57,6                                                        |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                              |                                                               |                                                                |                                                                 |                                                                   |                                                                     |                                                                      |                                                                      | 114,3*)<br>(121)<br>127<br>133<br>139,7*)                                     |
| 41,7<br>44,7<br>47,2<br>49,9<br>52,7                        | 46,5<br>49,8<br>54,1<br>57,4<br>60,8<br>64,3                | 50,4<br>54,1<br>59,2<br>63,2<br>67,1<br>71,1                | 55,3<br>59,2<br>64,2<br>68,3<br>72,5<br>77,0                | 59,5<br>64,2<br>68,3<br>71,7<br>74,9<br>79,8                | 62,3<br>67,3<br>70,2<br>74,9<br>79,8<br>85,0                | 64,9<br>70,2<br>74,9<br>79,8<br>85,0<br>91,8                | 80,8<br>86,3<br>91,8<br>98,2<br>105                         |                                                             |                                                             |                                                             |                                                             |                                                             |                                                             |                                                              |                                                               |                                                                |                                                                 |                                                                   |                                                                     |                                                                      |                                                                      | (146)<br>152,4<br>159<br>165,1<br>168,3*)<br>(171)<br>177,8                   |
| 55,5<br>58,1<br>60,9<br>63,6<br>65,0<br>66,2<br>69,1        | 62,1<br>65,3<br>68,6<br>71,6<br>73,1<br>74,5<br>77,8        | 67,8<br>71,3<br>74,8<br>78,2<br>80,0<br>81,5<br>85,2        | 74,6<br>79,0<br>83,0<br>86,9<br>88,9<br>90,9<br>94,8        | 81,5<br>85,8<br>90,5<br>95,3<br>99,9<br>102<br>103          | 85,8<br>90,5<br>95,3<br>100<br>105<br>108<br>109            | 90,0<br>95<br>100<br>105<br>110<br>112<br>115               | 97,7<br>103<br>109<br>115<br>120<br>126<br>136              | 105<br>111<br>117<br>123<br>129<br>136<br>147               | 112<br>119<br>126<br>133<br>142<br>149<br>158               | 134<br>141<br>142<br>149<br>154<br>157<br>167               |                                                             |                                                             |                                                             |                                                              |                                                               |                                                                |                                                                 |                                                                   |                                                                     |                                                                      |                                                                      | (191)<br>193,7*)<br>(216)<br>219,1*)<br>(241)<br>244,5*)<br>267               |
| 74,9<br>75,9<br>85,7<br>86,9<br>96,5<br>97,8<br>107         | 84,3<br>85,7<br>96,7<br>98,2<br>109<br>111<br>122           | 92,4<br>93,9<br>106<br>108<br>120<br>122<br>134             | 102<br>105<br>118<br>120<br>133<br>136<br>150               | 113<br>114<br>130<br>132<br>147<br>149<br>165               | 119<br>121<br>138<br>140<br>156<br>159<br>175               | 125<br>128<br>145<br>148<br>165<br>168<br>185               | 138<br>140<br>160<br>174<br>182<br>185<br>205               | 149<br>151<br>174<br>176<br>198<br>201<br>223               | 162<br>165<br>177<br>190<br>218<br>221<br>246               | 174<br>188<br>205<br>218<br>236<br>240<br>267               | 184<br>190<br>205<br>218<br>252<br>257<br>287               | 268<br>273<br>301<br>306                                    | 282<br>288<br>301<br>323                                    | 295<br>301<br>340                                            | 355                                                           | 368                                                            | 381                                                             |                                                                   |                                                                     |                                                                      |                                                                      | 273*)<br>(292)<br>298,5<br>(318)<br>323,9*)<br>(343)<br>355,6*)               |
| 110<br>118<br>121<br>130<br>132<br>140<br>146               | 125<br>134<br>137<br>147<br>150<br>159<br>166               | 137<br>148<br>161<br>181<br>186<br>196<br>203               | 154<br>165<br>170<br>200<br>204<br>218<br>226               | 169<br>182<br>187<br>213<br>217<br>232<br>241               | 180<br>194<br>198<br>210<br>226<br>230<br>245<br>255        | 190<br>205<br>210<br>227<br>230<br>252<br>284               | 211<br>227<br>233<br>250<br>256<br>273<br>311               | 229<br>249<br>255<br>274<br>280<br>299<br>344               | 253<br>274<br>281<br>303<br>309<br>331<br>377               | 275<br>298<br>306<br>330<br>338<br>361<br>408               | 296<br>322<br>330<br>357<br>365<br>391<br>408               | 315<br>343<br>353<br>382<br>390<br>419<br>437               | 333<br>364<br>374<br>406<br>415<br>446<br>466               | 350<br>383<br>394<br>428<br>438<br>496<br>493                | 366<br>401<br>413<br>449<br>460<br>519<br>519                 | 381<br>418<br>431<br>469<br>481<br>541<br>544                  | 394<br>434<br>447<br>488<br>500<br>561<br>567                   | 448<br>462<br>505<br>519<br>561<br>630                            |                                                                     |                                                                      |                                                                      |                                                                               |
| 151<br>162<br>168<br>173<br>184<br>189<br>195               | 172<br>184<br>191<br>197<br>210<br>216<br>222               | 189<br>204<br>210<br>217<br>231<br>238<br>245               | 213<br>228<br>237<br>245<br>259<br>268<br>274               | 235<br>253<br>261<br>270<br>288<br>296<br>305               | 250<br>269<br>278<br>288<br>307<br>316<br>326               | 265<br>286<br>295<br>305<br>326<br>335<br>346               | 295<br>318<br>329<br>340<br>363<br>374<br>385               | 323<br>349<br>361<br>373<br>400<br>411<br>424               | 358<br>387<br>401<br>415<br>444<br>457<br>472               | 392<br>424<br>439<br>455<br>487<br>502<br>518               | 425<br>460<br>477<br>494<br>529<br>546<br>563               | 456<br>494<br>512<br>531<br>570<br>587<br>607               | 486<br>527<br>547<br>567<br>609<br>629<br>649               | 514<br>559<br>580<br>602<br>647<br>668<br>691                | 542<br>590<br>613<br>636<br>684<br>707<br>731                 | 568<br>620<br>644<br>669<br>720<br>744<br>769                  | 593<br>648<br>673<br>700<br>755<br>780<br>807                   | 617<br>675<br>702<br>730<br>788<br>815<br>843                     | 661<br>725<br>755<br>786<br>851<br>881<br>912                       | 804<br>847<br>838<br>909<br>942<br>977                               | 847<br>885<br>962<br>998<br>1036                                     | 368<br>(394)<br>406,4*)<br>419<br>(445)<br>457,2<br>(470)                     |
| 206<br>211<br>217<br>228<br>233<br>239<br>255<br>261<br>277 | 234<br>241<br>247<br>259<br>266<br>272<br>291<br>297<br>316 | 259<br>266<br>273<br>287<br>294<br>301<br>322<br>328<br>349 | 290<br>300<br>306<br>321<br>331<br>337<br>363<br>368<br>395 | 323<br>331<br>340<br>358<br>366<br>376<br>401<br>410<br>436 | 344<br>353<br>363<br>382<br>391<br>401<br>428<br>438<br>466 | 365<br>375<br>386<br>406<br>416<br>426<br>456<br>466<br>496 | 408<br>419<br>431<br>453<br>464<br>476<br>509<br>520<br>555 | 449<br>461<br>474<br>499<br>511<br>525<br>561<br>574<br>611 | 499<br>513<br>528<br>556<br>570<br>585<br>626<br>640<br>682 | 549<br>565<br>581<br>581<br>627<br>644<br>690<br>705<br>753 | 597<br>615<br>632<br>666<br>684<br>701<br>753<br>769<br>822 | 644<br>662<br>682<br>719<br>737<br>758<br>813<br>832<br>888 | 689<br>710<br>731<br>771<br>791<br>813<br>867<br>893<br>954 | 734<br>756<br>779<br>822<br>843<br>871<br>919<br>953<br>1019 | 777<br>801<br>825<br>871<br>894<br>919<br>988<br>1012<br>1082 | 819<br>844<br>870<br>919<br>944<br>971<br>1021<br>1069<br>1145 | 859<br>886<br>914<br>966<br>993<br>1021<br>1099<br>1126<br>1206 | 899<br>927<br>957<br>1012<br>1040<br>1070<br>1153<br>1181<br>1265 | 974<br>1006<br>1038<br>1100<br>1131<br>1164<br>1256<br>1287<br>1381 | 1045<br>1080<br>1115<br>1183<br>1218<br>1253<br>1355<br>1389<br>1493 | 1110<br>1148<br>1187<br>1261<br>1298<br>1337<br>1449<br>1485<br>1599 | (495)<br>508*)<br>(521)<br>(546)<br>558,8<br>(572)<br>609,6<br>(622)<br>660,4 |

\* Sizes given in parentheses are complementary sizes.

\*\* Usually, standard sizes are available from stock. In general, seamless tubing and pipe are only manufactured in those sizes for which weights are indicated. Other sizes upon request. English units are conversions of the metric ones.

\*\*\* Minimum wall thickness see DIN 2440.



# Welded Steel Tubing and Pipe - sizes and weights

DIN 2458

| Outside Diameter<br>mm | Standard Wall Thickness |       | Weight<br>kg/m | 1,8<br>0,072 | 2<br>0,080 | 2,3<br>0,092 | 2,6<br>0,104 | Other Wall Thicknesses mm/in. |              |              |            |             |      | 4,5<br>0,176 | 5<br>0,192 | 5,6<br>0,219 | 6,3<br>0,250 |
|------------------------|-------------------------|-------|----------------|--------------|------------|--------------|--------------|-------------------------------|--------------|--------------|------------|-------------|------|--------------|------------|--------------|--------------|
|                        | mm                      | in.   |                |              |            |              |              | 2,9<br>0,116                  | 3,2<br>0,128 | 3,6<br>0,144 | 4<br>0,160 |             |      |              |            |              |              |
|                        |                         |       |                |              |            |              |              |                               |              |              |            | Weight kg/m |      |              |            |              |              |
| 10,2")                 | 1,6                     | 0,064 | 0,344          | 0,378        | 0,410      | 0,454        | 0,493        | 0,525                         |              |              |            |             |      |              |            |              |              |
| 13,5")                 | 1,8                     | 0,072 | 0,522          | 0,522        | 0,571      | 0,639        | 0,703        | 0,762                         |              |              |            |             |      |              |            |              |              |
| 16                     | 1,8                     | 0,072 | 0,632          | 0,632        | 0,692      | 0,778        | 0,860        | 0,938                         | 1,01         | 1,10         |            |             |      |              |            |              |              |
| 17,2")                 | 1,8                     | 0,072 | 0,688          | 0,688        | 0,754      | 0,850        | 0,942        | 1,03                          | 1,11         | 1,21         |            |             |      |              |            |              |              |
| 21,3")                 | 2                       | 0,080 | 0,962          | 0,874        | 0,962      | 1,09         | 1,21         | 1,33                          | 1,44         | 1,59         | 1,72       | 1,87        |      |              |            |              |              |
| 25                     | 2                       | 0,080 | 1,13           | 1,03         | 1,13       | 1,29         | 1,44         | 1,58                          | 1,72         | 1,90         | 2,07       | 2,28        |      |              |            |              |              |
| 26,9")                 | 2                       | 0,080 | 1,24           | 1,12         | 1,24       | 1,41         | 1,57         | 1,73                          | 1,89         | 2,09         | 2,28       | 2,48        | 2,70 |              |            |              |              |
| 30                     | 2                       | 0,080 | 1,39           |              | 1,39       | 1,59         | 1,77         | 1,96                          | 2,14         | 2,37         | 2,59       | 2,83        | 3,08 |              |            |              |              |
| 31,8                   | 2                       | 0,080 | 1,48           |              | 1,48       | 1,68         | 1,88         | 2,08                          | 2,27         | 2,52         | 2,76       | 3,02        | 3,30 |              |            |              |              |
| 33,7")                 | 2                       | 0,080 | 1,57           |              | 1,57       | 1,79         | 2,01         | 2,22                          | 2,42         | 2,69         | 2,95       | 3,23        | 3,54 |              |            |              |              |
| 38                     | 2                       | 0,080 | 1,79           |              | 1,79       | 2,04         | 2,29         | 2,53                          | 2,77         | 3,08         | 3,38       | 3,71        | 4,07 |              |            |              |              |
| 42,4")                 | 2                       | 0,080 | 2,01           |              | 2,01       | 2,29         | 2,57         | 2,84                          | 3,11         | 3,47         | 3,81       | 4,19        | 4,61 | 5,07         |            |              |              |
| 44,5                   | 2                       | 0,080 | 2,11           |              | 2,11       | 2,41         | 2,70         | 2,99                          | 3,28         | 3,65         | 4,02       | 4,42        | 4,87 | 5,35         |            |              |              |
| 48,3")                 | 2,3                     | 0,092 | 2,63           |              | 2,30       | 2,63         | 2,95         | 3,27                          | 3,59         | 4,00         | 4,41       | 4,85        | 5,34 | 5,89         |            |              |              |
| 51                     | 2,3                     | 0,092 | 2,78           |              | 2,43       | 2,78         | 3,12         | 3,46                          | 3,79         | 4,23         | 4,66       | 5,13        | 5,67 | 6,24         |            |              |              |
| 57                     | 2,3                     | 0,092 | 3,13           |              |            | 3,13         | 3,52         | 3,90                          | 4,28         | 4,78         | 5,27       | 5,81        | 6,41 | 7,08         |            |              |              |
| 60,3")                 | 2,3                     | 0,092 | 3,31           |              |            | 3,31         | 3,73         | 4,14                          | 4,54         | 5,07         | 5,59       | 6,17        | 6,82 | 7,53         |            |              |              |
| 63,5                   | 2,3                     | 0,092 | 3,50           |              |            | 3,50         | 3,93         | 4,36                          | 4,79         | 5,36         | 5,91       | 6,52        | 7,21 | 7,97         |            |              |              |
| 70                     | 2,6                     | 0,104 | 4,35           |              |            | 3,86         | 4,35         | 4,83                          | 5,30         | 5,93         | 6,55       | 7,24        | 8,01 | 8,85         | 9,92       |              |              |
| 76,1")                 | 2,6                     | 0,104 | 4,75           |              |            | 4,22         | 4,75         | 5,28                          | 5,80         | 6,49         | 7,17       | 7,92        | 8,77 | 9,71         | 10,9       |              |              |
| 88,9")                 | 2,9                     | 0,116 | 6,20           |              |            |              | 5,57         | 6,20                          | 6,81         | 7,63         | 8,43       | 9,33        | 10,3 | 11,5         | 12,9       |              |              |
| 101,6")                | 2,9                     | 0,116 | 7,11           |              |            |              |              | 7,11                          | 7,82         | 8,76         | 9,70       | 10,7        | 11,9 | 13,2         | 14,9       |              |              |
| 108                    | 2,9                     | 0,116 | 7,57           |              |            |              |              |                               | 8,33         | 9,33         | 10,3       | 11,4        | 12,7 | 14,1         | 15,8       |              |              |
| 114,3")                | 3,2                     | 0,128 | 8,83           |              |            |              |              |                               | 8,83         | 9,90         | 11,0       | 12,1        | 13,5 | 15,0         | 16,8       |              |              |
| 127                    | 3,2                     | 0,128 | 9,84           |              |            |              |              |                               | 9,84         | 11,0         | 12,2       | 13,5        | 15,0 | 16,7         | 18,8       |              |              |
| 133                    | 3,6                     | 0,144 | 11,6           |              |            |              |              |                               | 10,3         | 11,6         | 12,8       | 14,2        | 15,8 | 17,6         | 19,8       |              |              |
| 139,7")                | 3,6                     | 0,144 | 12,2           |              |            |              |              |                               | 10,9         | 12,2         | 13,5       | 14,9        | 16,6 | 18,5         | 20,8       |              |              |
| 152,4                  | 4                       | 0,160 | 14,7           |              |            |              |              |                               | 11,9         | 13,3         | 14,7       | 16,4        | 18,2 | 20,2         | 22,8       |              |              |
| 159                    | 4                       | 0,160 | 15,4           |              |            |              |              |                               | 12,4         | 13,9         | 15,4       | 17,1        | 19,0 | 21,1         | 23,8       |              |              |
| 165,1                  | 4                       | 0,160 | 16,0           |              |            |              |              |                               | 12,9         | 14,4         | 16,0       | 17,8        | 19,7 | 21,9         | 24,8       |              |              |
| 168,3")                | 4                       | 0,160 | 16,3           |              |            |              |              |                               | 13,1         | 14,7         | 16,3       | 18,1        | 20,1 | 22,4         | 25,3       |              |              |
| 219,1")                | 4,5                     | 0,176 | 23,7           |              |            |              |              |                               | 17,2         | 19,3         | 21,4       | 23,7        | 26,4 | 29,4         | 33,2       |              |              |
| 273")                  | 5                       | 0,192 | 33,0           |              |            |              |              |                               | 21,5         | 24,1         | 26,7       | 29,7        | 33,0 | 36,8         | 41,6       |              |              |
| 323,9")                | 5,6                     | 0,219 | 43,8           |              |            |              |              |                               |              | 28,6         | 31,8       | 35,3        | 39,3 | 43,8         | 49,5       |              |              |
| 355,6")                | 5,6                     | 0,219 | 48,2           |              |            |              |              |                               |              |              | 34,9       | 38,8        | 43,2 | 48,2         | 54,5       |              |              |
| 406,4")                | 6,3                     | 0,250 | 62,4           |              |            |              |              |                               |              |              |            | 44,4        | 49,5 | 55,1         | 62,4       |              |              |
| 419                    | 6,3                     | 0,250 | 64,3           |              |            |              |              |                               |              |              |            | 45,8        | 51,0 | 56,9         | 64,3       |              |              |
| 457,2                  | 6,3                     | 0,250 | 70,3           |              |            |              |              |                               |              |              |            |             | 55,8 | 62,1         | 70,3       |              |              |
| 508")                  | 6,3                     | 0,250 | 78,2           |              |            |              |              |                               |              |              |            |             | 62,0 | 69,1         | 78,2       |              |              |
| 559                    | 6,3                     | 0,250 | 86,1           |              |            |              |              |                               |              |              |            |             | 68,3 | 76,1         | 86,1       |              |              |
| 610")                  | 6,3                     | 0,250 | 94,1           |              |            |              |              |                               |              |              |            |             |      | 83,1         | 94,1       |              |              |
| 660                    | 7,1                     | 0,281 | 115            |              |            |              |              |                               |              |              |            |             |      |              | 102        |              |              |
| 711")                  | 7,1                     | 0,281 | 124            |              |            |              |              |                               |              |              |            |             |      |              | 110        |              |              |
| 762                    | 8                       | 0,312 | 148            |              |            |              |              |                               |              |              |            |             |      |              | 118        |              |              |
| 813")                  | 8                       | 0,312 | 158            |              |            |              |              |                               |              |              |            |             |      |              | 126        |              |              |
| 864                    | 8,8                     | 0,344 | 185            |              |            |              |              |                               |              |              |            |             |      |              |            | 134          |              |
| 914")                  | 10                      | 0,394 | 223            |              |            |              |              |                               |              |              |            |             |      |              |            | 142          |              |
| 1016")                 | 10                      | 0,394 | 248            |              |            |              |              |                               |              |              |            |             |      |              |            | 157          |              |
| 1120                   | 11                      | 0,438 | 302            |              |            |              |              |                               |              |              |            |             |      |              |            | 174          |              |
| 1220                   | 12,5                    | 0,500 | 375            |              |            |              |              |                               |              |              |            |             |      |              |            |              |              |
| 1320                   | 12,5                    | 0,500 | 406            |              |            |              |              |                               |              |              |            |             |      |              |            |              |              |
| 1420                   | 14,2                    | 0,562 | 493            |              |            |              |              |                               |              |              |            |             |      |              |            |              |              |
| 1520                   | 14,2                    | 0,562 | 528            |              |            |              |              |                               |              |              |            |             |      |              |            |              |              |
| 1620                   | 16                      | 0,625 | 630            |              |            |              |              |                               |              |              |            |             |      |              |            |              |              |
| 1720                   | 17,5                    | 0,688 | 734            |              |            |              |              |                               |              |              |            |             |      |              |            |              |              |
| 1820                   | 17,5                    | 0,688 | 777            |              |            |              |              |                               |              |              |            |             |      |              |            |              |              |
| 1920                   | 20                      | 0,787 | 937            |              |            |              |              |                               |              |              |            |             |      |              |            |              |              |
| 2020                   | 20                      | 0,787 | 986            |              |            |              |              |                               |              |              |            |             |      |              |            |              |              |

Sizes not enclosed within the bold lines are not covered by DIN 2458.

\* Up to 139,7 mm incl., these outside diameters are in conformity with threaded pipe to ISO

Recommendation R 7; from 168,3 mm in conformity with threaded pipe to ANSI B 2.1, API Stds 5A, 5L and 5LX (without threads).

# Welded Steel Tubing and Pipe - sizes and weights

DIN 2458 (Extract from ISO Recommen



|                                      |                                     |                                    |                                         |                                        |                                 | Other                           |                                 | Wall Thicknesses mm/in.         |                                 |                                 |                                  |                          |                                                     |                                           |                                          | Outside Diameter |  | Suited for<br>pipe threads2)<br>to DIN 259<br>and DIN 2999 |
|--------------------------------------|-------------------------------------|------------------------------------|-----------------------------------------|----------------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|----------------------------------|--------------------------|-----------------------------------------------------|-------------------------------------------|------------------------------------------|------------------|--|------------------------------------------------------------|
| 7,1<br>0,281                         | 8<br>0,312                          | 8,8<br>0,344                       | 10<br>0,394                             | 11<br>0,438                            | 12,5<br>0,500                   | 14,2<br>0,562                   | 16<br>0,625                     | 17,5<br>0,688                   | 20<br>0,787                     | 22,2<br>0,875                   | 25<br>1                          |                          |                                                     |                                           |                                          |                  |  |                                                            |
| Weight kg/m                          |                                     |                                    |                                         |                                        |                                 |                                 |                                 |                                 |                                 |                                 |                                  |                          | mm                                                  | in.                                       |                                          |                  |  |                                                            |
|                                      |                                     |                                    |                                         |                                        |                                 |                                 |                                 |                                 |                                 |                                 |                                  |                          | 10,2*)<br>13,5*)<br>16<br>17,2*)<br>21,3*)          | 0,402<br>0,531<br>0,630<br>0,677<br>0,840 | R 1/8"<br>R 1/4"<br><br>R 3/8"<br>R 1/2" |                  |  |                                                            |
|                                      |                                     |                                    |                                         |                                        |                                 |                                 |                                 |                                 |                                 |                                 |                                  |                          | 25<br>26,9*)<br>30<br>31,8<br>33,7*)                | -<br>1,059<br>1,181<br>1,250<br>1,327     | R 3/4"<br><br><br>R 1"                   |                  |  |                                                            |
|                                      |                                     |                                    |                                         |                                        |                                 |                                 |                                 |                                 |                                 |                                 |                                  |                          | 38<br>42,4*)<br>44,5<br>48,3*)<br>51                | 1,500<br>1,669<br>1,750<br>1,900<br>2     | R 1 1/4"<br><br><br>R 1 1/2"             |                  |  |                                                            |
|                                      |                                     |                                    |                                         |                                        |                                 |                                 |                                 |                                 |                                 |                                 |                                  |                          | 57<br>60,3*)<br><br>70<br>76,1*)                    | 2,250<br>2,375<br><br>2,750<br>3          | R 2"<br><br><br>R 2 1/2"                 |                  |  |                                                            |
|                                      |                                     |                                    |                                         |                                        |                                 |                                 |                                 |                                 |                                 |                                 |                                  |                          | 88,9*)<br>101,6*)<br>108<br>114,3*)<br>127          | 3,500<br>4<br>4,250<br>4,500<br>5         | R 3"<br><br><br>R 4"                     |                  |  |                                                            |
| 18,8<br>21,0                         |                                     |                                    |                                         |                                        |                                 |                                 |                                 |                                 |                                 |                                 |                                  |                          | 133<br>139,7*)<br>152,4<br>159<br>165,1             | 5,250<br>5,500<br>6<br>6,250<br>6,500     | R 5"<br><br><br>R 6"                     |                  |  |                                                            |
| 22,1<br>23,3<br>25,5<br>26,6<br>27,7 | 29,6<br>30,9                        |                                    |                                         |                                        |                                 |                                 |                                 |                                 |                                 |                                 |                                  |                          | 168,3*)<br>219,1*)<br>273,0*)<br>323,9*)<br>355,6*) | 6,625<br>8,625<br>10,750<br>12,750<br>14  |                                          |                  |  |                                                            |
| 70,1<br>72,3<br>79,0<br>87,9<br>96,9 | 78,3<br>80,7<br>88,2<br>98,2<br>108 | 85,9<br>88,7<br>96,9<br>108<br>119 | 97,8<br>101<br>110<br>123<br>135<br>149 | 108<br>111<br>122<br>135<br>154<br>170 | 122<br>126<br>138<br>154<br>170 |                                 |                                 |                                 |                                 |                                 |                                  |                          | 406,4*)<br>419<br>457,2<br>508,0*)<br>559           | 16<br>16,500<br>18<br>20<br>22            |                                          |                  |  |                                                            |
| 106<br>115<br>124<br>133<br>141      | 118<br>128<br>138<br>148<br>158     | 130<br>141<br>152<br>163<br>174    | 148<br>160<br>173<br>185<br>198         | 163<br>177<br>191<br>205<br>219        | 185<br>201<br>217<br>233<br>249 | 209<br>227<br>245<br>263<br>280 | 233<br>253<br>273<br>293<br>313 | 255<br>277<br>299<br>321<br>343 | 291<br>315<br>341<br>366<br>391 |                                 | 349<br>377<br>405<br>433         | 395<br>426<br>458<br>489 | 610,0*)<br>660,0<br>711,0*)<br>762,0<br>813,0*)     | 24<br>26<br>28<br>30<br>32                |                                          |                  |  |                                                            |
| 150<br>159<br>177                    | 168<br>178<br>198                   | 185<br>196<br>218                  | 211<br>223<br>248                       | 232<br>246<br>274                      | 264<br>280<br>312               | 298<br>316<br>352               | 333<br>353<br>393               | 365<br>386<br>430               | 416<br>441<br>491               | 461<br>489<br>544               | 521<br>552<br>615                |                          | 864<br>914,0*)<br>1016,0*)                          | 34<br>36<br>40                            |                                          |                  |  |                                                            |
| 195<br>213                           | 218<br>238                          | 240<br>262                         | 274<br>298                              | 302<br>330                             | 344<br>375                      | 388<br>423                      | 434<br>473                      | 475<br>518                      | 542<br>591                      | 601<br>656                      | 680<br>742                       |                          | 1120<br>1220                                        | 44,1<br>48                                |                                          |                  |  |                                                            |
| 230                                  | 258<br>277<br>297<br>316            | 284<br>305<br>327<br>348<br>370    | 323<br>348<br>372<br>397<br>422         | 357<br>384<br>411<br>439<br>466        | 406<br>437<br>468<br>499<br>530 | 458<br>493<br>528<br>564<br>599 | 512<br>552<br>591<br>630<br>669 | 562<br>605<br>647<br>691<br>734 | 641<br>690<br>739<br>789<br>838 | 711<br>765<br>820<br>875<br>929 | 805<br>866<br>928<br>991<br>1053 |                          | 1320<br>1420<br>1520<br>1620<br>1720                | 52<br>55,9<br>59,8<br>63,8<br>67,7        |                                          |                  |  |                                                            |
|                                      |                                     | 392                                | 446<br>471<br>496                       | 493<br>521<br>548                      | 562<br>592<br>623               | 634<br>669<br>704               | 709<br>748<br>787               | 777<br>820<br>863               | 887<br>937<br>986               | 985<br>1039<br>1094             | 1115<br>1177<br>1239             |                          | 1820<br>1920<br>2020                                | 71,7<br>75,6<br>79,5                      |                                          |                  |  |                                                            |

<sup>1)</sup> Usually, standard sizes are available from stock. In general, welded tubing and pipe are only manufactured in those sizes for which weights are indicated. Other sizes upon request. English units are conversions of the metric ones.

<sup>2)</sup> Minimum wall thickness see DIN 2440.



# Hollow Bar Mechanical Tubing

mm sizes

| O.D.   | Thickness | I.D.   | Minimum guaranteed thickness | kg/m. | Centering on O.D. |              | Centering on I.D. |              |          |
|--------|-----------|--------|------------------------------|-------|-------------------|--------------|-------------------|--------------|----------|
|        |           |        |                              |       | maximum O.D.      | minimum I.D. | maximum O.D.      | minimum I.D. |          |
| 32,00  | 6,00      | 20,00  | 5,7                          | 4,2   | 31,5              | 21,6         | 30,4              | 20,5         | Series 1 |
| 36,00  | 5,5       | 25,00  | 5,2                          | 4,5   | 35,5              | 26,6         | 34,4              | 25,5         |          |
| 40,00  | 6,00      | 28,00  | 5,7                          | 5,4   | 39,5              | 29,6         | 38,4              | 28,5         |          |
| 45,00  | 6,5       | 32,00  | 6,2                          | 6,6   | 44,5              | 33,6         | 43,4              | 32,5         |          |
| 50,00  | 7,00      | 36,00  | 6,7                          | 7,9   | 49,5              | 37,6         | 48,4              | 36,5         |          |
| 56,00  | 8,00      | 40,00  | 7,6                          | 10,0  | 55,5              | 41,9         | 54,2              | 40,5         |          |
| 63,00  | 6,5       | 50,00  | 6,2                          | 9,9   | 62,00             | 51,9         | 61,4              | 51,00        |          |
| 71,00  | 7,5       | 56,00  | 7,1                          | 12,7  | 70,00             | 58,2         | 69,1              | 57,00        |          |
| 75,00  | 7,5       | 60,00  | 7,1                          | 13,6  | 74,00             | 62,3         | 73,1              | 61,00        |          |
| 80,00  | 8,5       | 63,00  | 8,1                          | 16,3  | 79,00             | 65,5         | 77,9              | 64,00        |          |
| 85,00  | 9,00      | 67,00  | 8,6                          | 18,3  | 84,00             | 69,6         | 82,8              | 68,00        |          |
| 90,00  | 9,5       | 71,00  | 9,0                          | 20,5  | 89,00             | 73,8         | 87,6              | 72,00        |          |
| 95,00  | 10,00     | 80,00  | 9,5                          | 22,9  | 94,00             | 77,9         | 92,5              | 76,00        |          |
| 100,00 | 10,00     | 80,00  | 9,5                          | 24,2  | 99,00             | 83,0         | 97,4              | 81,00        |          |
| 106,00 | 13,00     | 90,00  | 12,4                         | 32,0  | 105,00            | 83,4         | 103,1             | 81,00        |          |
| 112,00 | 11,00     | 90,00  | 10,5                         | 30,0  | 111,00            | 93,3         | 109,1             | 91,00        |          |
| 118,00 | 14,00     | 90,00  | 13,3                         | 38,8  | 117,00            | 93,8         | 114,8             | 91,00        |          |
| 125,00 | 12,5      | 100,00 | 11,9                         | 37,8  | 124,00            | 103,8        | 121,8             | 101,00       |          |
| 132,00 | 13,00     | 106,00 | 12,4                         | 41,8  | 131,00            | 109,9        | 128,6             | 107,00       |          |
| 140,00 | 14,00     | 112,00 | 13,3                         | 47,5  | 139,00            | 116,2        | 136,4             | 113,00       |          |
| 150,00 | 12,5      | 125,00 | 11,9                         | 47,0  | 149,00            | 129,3        | 146,3             | 126,00       |          |
| 160,00 | 14,00     | 132,00 | 13,3                         | 55,8  | 159,00            | 136,6        | 156,0             | 133,00       |          |
| 170,00 | 15,00     | 140,00 | 14,3                         | 63,4  | 169,00            | 144,9        | 165,7             | 141,00       |          |
| 180,00 | 15,00     | 150,00 | 14,3                         | 68,0  | 179,00            | 155,1        | 175,5             | 151,00       |          |
| 190,00 | 15,00     | 160,00 | 14,3                         | 72,3  | 189,00            | 165,3        | 185,3             | 161,00       |          |
| 200,00 | 20,00     | 160,00 | 19,0                         | 96,8  | 199,00            | 166,0        | 194,8             | 161,00       |          |
| 212,00 | 21,00     | 170,00 | 20,0                         | 108,0 | 211,00            | 176,3        | 206,5             | 171,00       |          |
| 224,00 | 22,00     | 180,00 | 20,9                         | 120,0 | 223,00            | 186,7        | 218,2             | 181,00       |          |
| 236,00 | 23,00     | 190,00 | 21,9                         | 132,2 | 235,00            | 197,0        | 229,9             | 191,00       |          |
| 250,00 | 25,00     | 200,00 | 23,8                         | 151,8 | 249,00            | 207,5        | 243,5             | 201,00       |          |





| O.D.   | Thickness | I.D.   | Minimum thickness | kg/m. | Centering on O.D. |              | Centering on I.D. |              |          |
|--------|-----------|--------|-------------------|-------|-------------------|--------------|-------------------|--------------|----------|
|        |           |        |                   |       | maximum O.D.      | minimum I.D. | maximum O.D.      | minimum I.D. |          |
| 36,00  | 8,00      | 20,00  | 7,6               | 5,8   | 35,5              | 21,8         | 34,2              | 20,5         | Series 2 |
| 40,00  | 7,5       | 25,00  | 7,1               | 6,4   | 39,5              | 26,8         | 38,2              | 25,5         |          |
| 45,00  | 8,5       | 28,00  | 8,1               | 8,1   | 44,5              | 29,8         | 43,2              | 28,5         |          |
| 50,00  | 9,00      | 32,00  | 8,5               | 9,6   | 49,5              | 34,0         | 48,0              | 32,5         |          |
| 56,00  | 10,00     | 36,00  | 9,4               | 11,9  | 55,5              | 38,3         | 53,8              | 36,5         |          |
| 63,00  | 11,5      | 40,00  | 10,9              | 15,2  | 62,00             | 42,4         | 61,1              | 41,00        |          |
| 71,00  | 13,00     | 45,00  | 12,4              | 19,5  | 70,00             | 47,7         | 68,8              | 46,00        |          |
| 75,00  | 12,5      | 50,00  | 11,9              | 20,3  | 74,00             | 52,8         | 72,8              | 51,00        |          |
| 80,00  | 15,00     | 50,00  | 14,3              | 25,2  | 79,00             | 53,1         | 77,5              | 51,00        |          |
| 85,00  | 15,00     | 55,00  | 14,3              | 27,2  | 84,00             | 58,2         | 82,4              | 56,00        |          |
| 90,00  | 13,5      | 63,00  | 12,8              | 27,0  | 89,00             | 66,2         | 87,4              | 64,00        |          |
| 95,00  | 14,00     | 67,00  | 13,3              | 29,7  | 94,00             | 70,3         | 92,3              | 68,00        |          |
| 100,00 | 14,5      | 71,00  | 13,8              | 32,4  | 99,00             | 74,5         | 97,1              | 72,00        |          |
| 106,00 | 17,5      | 71,00  | 16,6              | 40,0  | 105,00            | 74,9         | 102,8             | 72,00        |          |
| 112,00 | 16,00     | 80,00  | 15,2              | 40,1  | 111,00            | 83,8         | 108,8             | 81,00        |          |
| 118,00 | 19,00     | 80,00  | 18,1              | 48,9  | 117,00            | 84,3         | 114,5             | 81,00        |          |
| 125,00 | 17,5      | 90,00  | 16,6              | 49,4  | 124,00            | 94,3         | 121,5             | 91,00        |          |
| 132,00 | 21,00     | 90,00  | 20,0              | 60,7  | 131,00            | 94,7         | 128,1             | 91,00        |          |
| 140,00 | 20,00     | 100,00 | 19,0              | 63,0  | 139,00            | 104,8        | 136,0             | 101,00       |          |
| 150,00 | 22,00     | 106,00 | 20,9              | 73,7  | 149,00            | 111,2        | 145,7             | 107,00       |          |
| 160,00 | 24,00     | 112,00 | 22,8              | 85,0  | 159,00            | 117,6        | 155,4             | 113,00       |          |
| 170,00 | 26,00     | 118,00 | 24,7              | 97,8  | 169,00            | 124,0        | 165,0             | 119,00       |          |
| 180,00 | 27,5      | 125,00 | 26,1              | 109,5 | 179,00            | 131,4        | 174,8             | 126,00       |          |
| 190,00 | 29,00     | 132,00 | 27,6              | 121,5 | 189,00            | 138,7        | 184,5             | 133,00       |          |
| 200,00 | 30,00     | 140,00 | 28,5              | 133,1 | 199,00            | 147,0        | 194,2             | 141,00       |          |
| 212,00 | 31,00     | 150,00 | 29,5              | 147,0 | 211,00            | 157,3        | 205,9             | 151,00       | Series 3 |
| 224,00 | 32,00     | 160,00 | 30,4              | 161,0 | 223,00            | 167,7        | 217,6             | 161,00       |          |
| 236,00 | 33,00     | 170,00 | 31,4              | 176,0 | 235,00            | 178,0        | 229,3             | 171,00       |          |
| 250,00 | 35,00     | 180,00 | 33,3              | 197,4 | 249,00            | 188,5        | 242,9             | 181,00       |          |
| 32,00  | 8,00      | 16,00  | 7,6               | 5,0   | 31,5              | 17,8         | 30,2              | 16,5         |          |
| 36,00  | 10,00     | 16,00  | 9,5               | 6,7   | 35,5              | 18,0         | 34,0              | 16,5         |          |
| 40,00  | 10,00     | 20,00  | 9,5               | 7,7   | 39,5              | 22,0         | 38,0              | 20,5         |          |
| 45,00  | 12,5      | 20,00  | 11,9              | 10,4  | 44,5              | 22,2         | 42,8              | 20,5         |          |
| 50,00  | 12,5      | 25,00  | 11,9              | 12,0  | 49,5              | 27,2         | 47,8              | 25,5         |          |
| 56,00  | 14,00     | 28,00  | 13,3              | 15,0  | 55,5              | 30,5         | 53,6              | 28,5         |          |
| 63,00  | 15,5      | 32,00  | 14,7              | 18,7  | 62,00             | 34,8         | 60,8              | 33,00        |          |
| 71,00  | 17,5      | 36,00  | 16,6              | 23,7  | 70,00             | 39,2         | 68,5              | 37,00        |          |
| 75,00  | 17,5      | 40,00  | 16,6              | 25,8  | 74,00             | 43,3         | 72,5              | 41,00        |          |
| 80,00  | 20,00     | 40,00  | 19,0              | 30,6  | 79,00             | 43,6         | 77,2              | 41,00        |          |
| 85,00  | 20,00     | 45,00  | 19,0              | 33,3  | 84,00             | 48,7         | 82,1              | 46,00        |          |
| 90,00  | 20,00     | 50,00  | 19,0              | 35,8  | 89,00             | 53,8         | 87,0              | 51,00        |          |
| 95,00  | 22,5      | 50,00  | 21,4              | 41,6  | 94,00             | 54,2         | 91,8              | 51,00        |          |
| 100,00 | 22,00     | 56,00  | 20,9              | 43,9  | 99,00             | 60,2         | 96,7              | 57,00        |          |
| 106,00 | 25,00     | 56,00  | 22,8              | 51,8  | 105,00            | 60,6         | 102,4             | 57,00        |          |
| 112,00 | 24,5      | 63,00  | 23,3              | 54,9  | 111,00            | 67,7         | 108,3             | 64,00        |          |
| 118,00 | 27,5      | 63,00  | 26,1              | 63,7  | 117,00            | 68,1         | 114,0             | 64,00        |          |
| 125,00 | 27,00     | 71,00  | 25,7              | 67,8  | 124,00            | 76,2         | 120,9             | 72,00        |          |
| 132,00 | 30,5      | 71,00  | 29,0              | 79,1  | 131,00            | 76,7         | 127,5             | 72,00        |          |
| 140,00 | 30,00     | 80,00  | 28,5              | 84,7  | 139,00            | 85,8         | 135,4             | 81,00        |          |
| 150,00 | 35,00     | 80,00  | 33,3              | 102,9 | 149,00            | 86,5         | 144,9             | 81,00        |          |
| 160,00 | 35,00     | 90,00  | 33,3              | 112,0 | 159,00            | 96,7         | 154,7             | 91,00        |          |
| 170,00 | 35,00     | 100,00 | 33,3              | 121,0 | 169,00            | 106,9        | 164,5             | 101,00       |          |
| 180,00 | 40,00     | 100,00 | 38,0              | 143,4 | 179,00            | 107,6        | 174,0             | 101,00       |          |
| 190,00 | 42,00     | 106,00 | 39,9              | 159,0 | 189,00            | 114,0        | 183,7             | 107,00       |          |
| 200,00 | 44,00     | 112,00 | 41,8              | 176,0 | 199,00            | 120,4        | 193,4             | 113,00       |          |
| 212,00 | 43,5      | 125,00 | 41,3              | 188,4 | 211,00            | 133,6        | 205,2             | 126,00       |          |
| 224,00 | 46,00     | 132,00 | 43,7              | 210,5 | 223,00            | 141,1        | 216,8             | 133,00       |          |
| 236,00 | 48,00     | 140,00 | 45,6              | 232,0 | 235,00            | 149,5        | 228,4             | 141,00       |          |
| 250,00 | 50,00     | 150,00 | 47,5              | 257,0 | 249,00            | 160,0        | 242,0             | 151,00       |          |



# Electric Resistance Welded Steel Pipe & Tubes

Weight kg/m

| OD/WT | 1.0 | 1.2   | 1.4   | 1.6   | 1.8   | 2.0   | 2.3   | 2.4   | 2.5  | 2.6   | 2.8  | 2.9  | 3.2  | 3.5  | 4.0  | 4.2   | 4.5  | 4.8  | 5.0  | 5.5  | 5.8  | 6.0  |
|-------|-----|-------|-------|-------|-------|-------|-------|-------|------|-------|------|------|------|------|------|-------|------|------|------|------|------|------|
| 15    |     |       |       |       |       |       |       |       |      |       |      |      |      |      |      |       |      |      |      |      |      |      |
| 17.8  |     |       |       |       |       |       |       |       |      |       |      |      |      |      |      |       |      |      |      |      |      |      |
| 19    |     | 0.527 | 0.608 | 0.687 | 0.763 | 0.838 | 0.947 | 0.982 | 1.02 | 1.05  | 1.12 |      |      |      |      |       |      |      |      |      |      |      |
| 21.7  |     | 0.607 | 0.701 | 0.973 | 0.883 | 0.972 | 1.10  | 1.14  | 1.18 | 1.22  | 1.31 | 1.34 | 1.46 |      |      |       |      |      |      |      |      |      |
| 25.4  |     | 0.716 | 0.829 | 0.939 | 1.05  | 1.15  | 1.31  | 1.36  | 1.41 | 1.46  | 1.56 | 1.61 | 1.75 | 1.89 | 2.11 |       |      |      |      |      |      |      |
| 26.7  |     | 0.765 | 0.886 | 0.979 | 1.09  | 1.21  | 1.39  | 1.44  | 1.50 | 1.54  | 1.65 | 1.71 | 1.85 | 2.00 | 2.24 |       |      |      |      |      |      |      |
| 27.2  |     | 0.769 | 0.891 | 1.01  | 1.13  | 1.24  | 1.41  | 1.47  | 1.52 | 1.58  | 1.68 | 1.74 | 1.89 | 2.05 | 2.29 |       |      |      |      |      |      |      |
| 28.6  |     | 0.811 | 0.939 | 1.07  | 1.19  | 1.31  | 1.49  | 1.55  | 1.61 | 1.67  | 1.78 | 1.84 | 2.00 | 2.17 | 2.43 |       |      |      |      |      |      |      |
| 31.8  |     | 0.906 | 1.05  | 1.19  | 1.33  | 1.47  | 1.67  | 1.74  | 1.81 | 1.87  | 2.00 | 2.07 | 2.26 | 2.44 | 2.74 | 2.86  | 3.03 |      |      |      |      |      |
| 34.0  |     | 0.971 | 1.13  | 1.28  | 1.43  | 1.58  | 1.80  | 1.87  | 1.94 | 2.01  | 2.15 | 2.22 | 2.43 | 2.63 | 2.96 | 3.09  | 3.27 |      |      |      |      |      |
| 36.4  |     | 1.05  | 1.22  | 1.35  | 1.52  | 1.68  | 1.94  | 2.01  | 2.10 | 2.16  | 2.32 | 2.41 | 2.62 | 2.82 | 3.20 | 3.34  | 3.54 |      |      |      |      |      |
| 38.1  |     | 1.09  | 1.27  | 1.44  | 1.61  | 1.78  | 2.03  | 2.11  | 1.19 | 2.28  | 2.44 | 2.52 | 2.75 | 2.99 | 3.36 | 3.51  | 3.73 | 3.94 | 4.08 | 4.42 | 4.62 | 4.75 |
| 42.3  |     | 1.23  | 1.43  | 1.58  | 1.78  | 1.97  | 2.28  | 2.36  | 2.46 | 2.54  | 2.73 | 2.83 | 3.08 | 3.33 | 3.79 | 3.95  | 4.19 | 4.42 | 4.58 | 4.99 | 5.22 | 5.37 |
| 42.7  |     | 1.23  | 1.43  | 1.62  | 1.82  | 2.01  | 2.29  | 2.39  | 2.48 | 2.57  | 2.76 | 2.85 | 3.12 | 3.38 | 3.82 | 3.99  | 4.24 | 4.47 | 4.65 | 5.05 | 5.28 | 5.43 |
| 44.0  |     | 1.28  | 1.49  | 1.65  | 1.85  | 2.05  | 2.37  | 2.46  | 2.57 | 2.65  | 2.84 | 2.95 | 3.22 | 3.48 | 3.96 | 4.12  | 4.38 | 4.62 | 4.79 | 5.22 | 5.46 | 5.62 |
| 45.0  |     | 1.30  | 1.51  | 1.71  | 1.92  | 2.12  | 2.42  | 2.52  | 2.62 | 2.72  | 2.91 | 3.01 | 3.30 | 3.58 | 4.04 | 4.23  | 4.49 | 4.74 | 4.93 | 5.36 | 5.61 | 5.77 |
| 48.6  |     | 1.40  | 1.63  | 1.85  | 2.08  | 2.30  | 2.63  | 2.73  | 2.84 | 2.95  | 3.16 | 3.27 | 3.58 | 3.89 | 4.40 | 4.60  | 4.89 | 5.18 | 5.38 | 5.85 | 6.12 | 6.30 |
| 50.8  |     | 1.48  | 1.71  | 1.94  | 2.18  | 2.41  | 2.75  | 2.86  | 2.98 | 3.09  | 3.31 | 3.43 | 3.76 | 4.08 | 4.62 | 4.83  | 5.14 | 5.44 | 5.65 | 6.14 | 6.44 | 6.63 |
| 51.0  |     | 1.49  | 1.73  | 1.92  | 2.16  | 2.41  | 2.76  | 2.88  | 3.00 | 3.10  | 3.33 | 3.44 | 3.77 | 4.10 | 4.64 | 4.85  | 5.16 | 5.45 | 5.67 | 6.17 | 6.46 | 6.66 |
| 54.0  |     | 1.58  | 1.84  | 2.04  | 2.29  | 2.56  | 2.93  | 3.05  | 3.19 | 3.30  | 3.54 | 3.65 | 4.01 | 4.36 | 4.93 | 5.16  | 5.49 | 5.80 | 6.04 | 6.58 | 6.89 | 7.10 |
| 57.0  |     |       | 1.94  | 2.19  | 2.45  | 2.71  | 3.10  | 3.23  | 3.36 | 3.49  | 3.74 | 3.87 | 4.25 | 4.62 | 5.23 | 5.47  | 5.83 | 6.18 | 6.41 | 6.98 | 7.32 | 7.55 |
| 60.3  |     |       | 2.06  | 2.31  | 2.57  | 2.85  | 3.29  | 3.43  | 3.58 | 3.70  | 3.97 | 4.10 | 4.51 | 4.90 | 5.55 | 5.81  | 6.19 | 6.57 | 6.82 | 7.43 | 7.80 | 8.03 |
| 60.5  |     |       | 2.06  | 2.32  | 2.61  | 2.89  | 3.30  | 3.44  | 3.58 | 3.71  | 3.98 | 4.12 | 4.52 | 4.92 | 5.57 | 5.83  | 6.21 | 6.59 | 6.84 | 7.46 | 7.82 | 8.06 |
| 63.5  |     |       | 2.17  | 2.41  | 2.74  | 3.03  | 3.47  | 3.62  | 3.76 | 3.90  | 4.19 | 4.33 | 4.76 | 5.18 | 5.87 | 6.14  | 6.55 | 6.95 | 7.21 | 7.87 | 8.25 | 8.51 |
| 65.0  |     |       | 2.22  | 2.47  | 2.81  | 3.11  | 3.56  | 3.70  | 3.85 | 4.00  | 4.29 | 4.44 | 4.88 | 5.31 | 6.02 | 6.30  | 6.71 | 7.13 | 7.40 | 8.07 | 8.47 | 8.73 |
| 70.0  |     |       |       | 2.70  | 3.03  | 3.35  | 3.84  | 4.00  | 4.16 | 4.32  | 4.64 | 4.80 | 5.27 | 5.74 | 6.51 | 6.82  | 7.27 | 7.72 | 8.01 | 8.75 | 9.18 | 9.47 |
| 73.0  |     |       |       | 2.82  | 3.16  | 3.47  | 4.03  | 4.18  | 4.37 | 4.51  | 4.85 | 5.01 | 5.51 | 6.00 | 6.81 | 7.13  | 7.60 | 8.04 | 8.38 | 9.16 | 9.61 | 9.91 |
| 75.0  |     |       |       | 2.90  | 3.25  | 3.57  | 4.14  | 4.30  | 4.49 | 4.64  | 4.99 | 5.16 | 5.67 | 6.17 | 7.00 | 7.33  | 7.82 | 8.28 | 8.63 | 9.43 | 9.90 | 10.2 |
| 76.2  |     |       |       | 2.94  | 3.30  | 3.63  | 4.19  | 4.37  | 4.56 | 4.72  | 5.07 | 5.24 | 5.76 | 6.27 | 7.12 | 7.46  | 7.96 | 8.42 | 8.78 | 9.59 | 10.1 | 10.4 |
| 76.3  |     |       |       | 2.95  | 3.31  | 3.66  | 4.20  | 4.37  | 4.55 | 4.73  | 5.08 | 5.25 | 5.77 | 6.28 | 7.13 | 7.47  | 7.97 | 8.46 | 8.79 | 9.60 | 10.1 | 10.4 |
| 82.6  |     |       |       | 3.20  | 3.59  | 3.94  | 4.57  | 4.75  | 4.96 | 5.13  | 5.51 | 5.70 | 6.27 | 6.83 | 7.75 | 8.12  | 8.67 | 9.18 | 9.57 | 10.5 | 11.0 | 11.3 |
| 88.9  |     |       |       | 3.44  | 3.87  | 4.25  | 4.93  | 5.12  | 5.35 | 5.52  | 5.95 | 6.15 | 6.76 | 7.37 | 8.37 | 8.77  | 9.37 | 9.92 | 10.3 | 11.3 | 11.9 | 12.3 |
| 89.1  |     |       |       | 3.45  | 3.88  | 4.30  | 4.92  | 5.13  | 5.34 | 5.55  | 5.96 | 6.16 | 6.78 | 7.39 | 8.39 | 8.79  | 9.39 | 9.98 | 10.4 | 11.3 | 11.9 | 12.3 |
| 101.6 |     |       |       |       |       | 4.91  | 5.63  | 5.87  | 6.11 | 6.35  | 6.82 | 7.06 | 7.76 | 8.47 | 9.63 | 10.1  | 10.8 | 11.5 | 11.9 | 13.0 | 13.7 | 14.1 |
| 114.3 |     |       |       |       |       | 5.54  | 6.37  | 6.62  | 6.89 | 7.16  | 7.70 | 7.97 | 8.77 | 9.56 | 10.9 | 11.4  | 12.2 | 13.0 | 13.5 | 14.8 | 15.5 | 16.0 |
| 127.0 |     |       |       |       |       | 6.16  | 7.07  | 7.37  | 7.68 | 7.98  | 8.58 | 8.86 | 9.78 | 10.7 | 12.1 | 12.7  | 13.6 | 14.4 | 15.0 | 16.5 | 17.3 | 17.9 |
| 139.8 |     |       |       |       |       | 6.80  | 7.80  | 8.13  | 8.46 | 8.80  | 9.46 | 9.79 | 10.8 | 11.8 | 13.4 | 14.0  | 15.0 | 16.0 | 16.6 | 18.2 | 19.2 | 19.8 |
| 141.3 |     |       |       |       |       | 6.87  | 7.88  | 8.22  | 8.53 | 8.89  | 9.47 | 9.80 | 10.8 | 11.8 | 13.4 | 14.1  | 15.0 | 16.0 | 16.6 | 18.2 | 19.2 | 19.8 |
| 152.4 |     |       |       |       |       | 7.42  | 8.51  | 8.88  | 9.24 | 93.60 | 10.3 | 10.7 | 11.7 | 12.8 | 14.6 | 15.3  | 16.4 | 17.4 | 18.2 | 19.9 | 21.0 | 21.7 |
| 165.2 |     |       |       |       |       | 8.05  | 9.24  | 9.64  | 10.0 | 10.4  | 11.2 | 11.6 | 12.8 | 14.0 | 15.9 | 16.7  | 17.8 | 19.0 | 19.8 | 21.7 | 22.8 | 23.6 |
| 168.3 |     |       |       |       |       | 8.20  | 9.42  | 9.82  | 10.2 | 10.6  | 11.4 | 11.8 | 13.0 | 14.2 | 16.2 | 17.0  | 18.2 | 19.4 | 20.1 | 22.1 | 23.2 | 24.0 |
| 177.8 |     |       |       |       |       | 8.67  | 9.95  | 10.4  | 10.8 | 11.2  | 12.1 | 12.5 | 13.8 | 15.0 | 17.1 | 18.0  | 19.2 | 20.5 | 21.3 | 23.4 | 24.6 | 25.4 |
| 190.7 |     |       |       |       |       |       |       |       |      |       | 13.0 | 13.4 | 14.8 | 16.2 | 18.4 | 19.3  | 20.7 | 22.0 | 22.9 | 25.1 | 26.4 | 27.3 |
| 216.3 |     |       |       |       |       |       |       |       |      |       | 14.7 | 15.3 | 16.8 | 18.4 | 20.9 | 22.0  | 23.5 | 25.0 | 25.9 | 28.6 | 30.1 | 31.1 |
| 219.1 |     |       |       |       |       |       |       |       |      |       | 14.9 | 15.5 | 17.0 | 18.7 | 21.2 | 22.3  | 23.8 | 25.4 | 26.3 | 29.0 | 30.5 | 31.5 |
| 244.5 |     |       |       |       |       |       |       |       |      |       |      |      |      | 20.8 | 23.7 | 24.9  | 26.6 | 28.2 | 29.4 | 32.4 | 34.1 | 35.3 |
| 267.4 |     |       |       |       |       |       |       |       |      |       |      |      |      | 22.8 | 26.0 | 27.3  | 29.2 | 31.1 | 32.2 | 32.5 | 37.4 | 38.7 |
| 273.1 |     |       |       |       |       |       |       |       |      |       |      |      |      | 23.2 | 26.5 | 27.8  | 29.8 | 31.6 | 32.9 | 36.3 | 48.2 | 39.5 |
| 318.5 |     |       |       |       |       |       |       |       |      |       |      |      |      |      | 31.0 | 32.63 | 34.8 | 37.1 | 38.5 | 42.5 | 44.7 | 46.2 |
| 323.9 |     |       |       |       |       |       |       |       |      |       |      |      |      |      | 31.6 | 33.1  | 35.4 | 37.8 | 39.2 | 43.3 | 45.5 | 47.0 |
| 339.7 |     |       |       |       |       |       |       |       |      |       |      |      |      |      | 33.1 | 34.7  | 37.2 | 39.6 | 41.3 | 45.3 | 57.8 | 49.4 |
| 355.6 |     |       |       |       |       |       |       |       |      |       |      |      |      |      |      |       | 39.0 | 41.5 | 43.1 | 47.6 | 50.0 | 51.7 |
| 406.4 |     |       |       |       |       |       |       |       |      |       |      |      |      |      |      |       | 44.6 | 47.0 | 49.5 | 54.5 | 57.3 | 59.2 |
| 457.2 |     |       |       |       |       |       |       |       |      |       |      |      |      |      |      |       | 50.2 | 53.5 | 55.8 | 61.4 | 64.6 | 66.7 |
| 508.0 |     |       |       |       |       |       |       |       |      |       |      |      |      |      |      |       | 55.9 | 59.6 | 62.0 | 68.2 | 71.8 | 74.3 |
| 558.8 |     |       |       |       |       |       |       |       |      |       |      |      |      |      |      |       |      |      |      | 75.0 | 79.1 | 81.8 |
| 609.6 |     |       |       |       |       |       |       |       |      |       |      |      |      |      |      |       |      |      |      | 81.9 | 86.4 | 89.3 |

Weight kg/m



## General Catalogue





# Large Diameter Arc Welded Steel Pipe

Weight kg/m

| Nominal O.D. |    | Diameter (mm) |      | Wall Thickness |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|--------------|----|---------------|------|----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| A            | B  | O.D.          | I.D. | 6.0            | 6.4  | 7.0  | 7.9  | 8.0  | 9.0  | 9.5  | 10.0 | 11.0 | 12.0 | 12.7 | 13.0 | 14.0 | 15.0 | 16.0 | 17   | 18   | 19   |      |
|              | 16 | 400.0         |      | 58.3           | 62.2 | 67.8 | 76.4 | 77.3 | 86.8 | 91.5 | 96.2 | 106  | 115  | 121  |      |      |      |      |      |      |      |      |
| 400          |    | 406.4         |      | 59.2           | 63.1 | 66.9 | 77.6 | 78.6 | 88.2 | 93.5 | 97.8 | 107  | 117  | 123  | 126  | 135  | 145  | 154  | 163  | 172  | 182  |      |
| 450          | 18 | 457.2         |      | 66.8           | 71.1 | 77.7 | 87.5 | 88.6 | 99.5 | 105  | 110  | 121  | 132  | 139  | 142  | 153  | 164  | 174  | 185  | 195  | 205  |      |
|              |    | 500           |      | 73.1           | 77.9 | 85.1 | 95.9 | 97.1 | 109  | 115  | 121  | 133  | 144  | 153  | 156  | 168  | 179  | 191  | 202  | 211  | 225  |      |
| 500          | 20 | 508.0         |      | 74.3           | 79.2 | 86.5 | 97.4 | 98.6 | 111  | 117  | 123  | 135  | 147  | 155  | 159  | 171  | 182  | 194  | 206  | 218  | 229  |      |
|              |    |               | 500  | 74.9           | 79.9 | 87.5 | 98.9 | 100  | 113  | 119  | 126  | 139  | 152  | 161  | 164  | 177  | 190  | 204  | 217  | 230  | 243  |      |
| 550          | 22 | 558.8         |      | 81.8           | 87.2 | 95.3 | 107  | 109  | 122  | 129  | 135  | 149  | 162  | 171  | 175  | 188  | 201  | 214  | 227  | 240  | 253  |      |
|              |    | 600           |      | 87.9           | 93.7 | 102  | 115  | 117  | 131  | 138  | 145  | 160  | 174  | 184  | 188  | 202  | 216  | 230  | 244  | 258  | 272  |      |
| 600          | 24 | 609.6         |      | 89.3           | 95.2 | 104  | 117  | 119  | 133  | 141  | 148  | 162  | 177  | 187  | 191  | 206  | 220  | 234  | 248  | 263  | 277  |      |
|              |    |               | 600  | 89.7           | 95.7 | 105  | 118  | 120  | 135  | 143  | 150  | 166  | 181  | 192  | 197  | 212  | 227  | 243  | 258  | 274  | 290  |      |
| 650          | 26 | 660.4         |      | 96.8           | 103  | 113  | 127  | 129  | 145  | 152  | 160  | 176  | 192  | 203  | 207  | 223  | 239  | 254  | 270  | 285  | 301  |      |
|              |    | 700           |      | 103            | 109  | 120  | 135  | 137  | 153  | 161  | 170  | 17   | 204  | 215  | 220  | 237  | 253  | 270  | 286  | 303  | 319  |      |
| 700          | 28 | 711.2         |      | 104            | 111  | 12   | 137  | 139  | 156  | 164  | 173  | 196  | 207  | 219  | 224  | 241  | 258  | 274  | 291  | 308  | 324  |      |
|              |    |               | 700  | 104            | 111  | 122  | 138  | 140  | 157  | 166  | 175  | 193  | 211  | 223  | 229  | 247  | 264  | 283  | 301  | 319  | 337  |      |
| 750          | 30 | 762.0         |      | 112            | 119  | 130  | 147  | 149  | 167  | 176  | 185  | 204  | 222  | 235  | 240  | 258  | 276  | 294  | 312  | 330  | 348  |      |
|              |    | 800           |      | 117            | 125  | 137  | 155  | 156  | 176  | 185  | 195  | 214  | 233  | 247  | 22   | 271  | 290  | 309  | 328  | 347  | 366  |      |
| 800          | 32 | 812.8         |      | 119            | 127  | 139  | 157  | 159  | 178  | 188  | 198  | 217  | 237  | 251  | 256  | 276  | 295  | 314  | 334  | 353  | 372  |      |
|              |    |               | 800  | 119            | 127  | 139  | 157  | 159  | 180  | 190  | 200  | 220  | 240  | 255  | 261  | 281  | 301  | 322  | 343  | 363  | 384  |      |
| 850          | 34 | 863.6         |      | 127            | 135  | 148  | 167  | 169  | 190  | 200  | 210  | 231  | 252  | 266  | 273  | 293  | 314  | 334  | 355  | 375  | 396  |      |
| 900          | 36 | 914.4         |      | 134            | 143  | 154  | 177  | 179  | 201  | 212  | 223  | 245  | 267  | 282  | 289  | 311  | 333  | 354  | 376  | 398  | 420  |      |
|              |    |               | 900  | 134            | 143  | 157  | 177  | 179  | 202  | 213  | 224  | 247  | 270  | 286  | 293  | 316  | 338  | 361  | 384  | 407  | 431  |      |
|              | 38 | 965.2         |      | 142            | 151  | 165  | 181  | 189  | 212  | 224  | 236  | 259  | 282  | 298  | 305  | 328  | 351  | 375  | 398  | 420  | 443  |      |
| 1000         | 40 | 1016.0        |      | 149            | 159  | 174  | 196  | 199  | 223  | 236  | 248  | 273  | 297  | 314  | 322  | 346  | 370  | 395  | 419  | 443  | 467  |      |
|              |    |               | 1000 | 149            | 159  | 174  | 196  | 199  | 224  | 236  | 249  | 274  | 299  | 317  | 325  | 350  | 375  | 401  | 426  | 452  | 477  |      |
|              | 42 | 1066.8        |      | 157            | 167  | 183  | 206  | 209  | 235  | 248  | 261  | 286  | 312  | 330  | 338  | 363  | 389  | 415  | 440  | 466  | 491  |      |
| 1000         | 44 | 1117.6        |      | 164            | 175  | 192  | 216  | 219  | 246  | 260  | 273  | 300  | 327  | 346  | 354  | 381  | 408  | 435  | 461  | 488  | 515  |      |
|              |    |               | 1100 | 164            | 175  | 191  | 216  | 219  | 246  | 260  | 274  | 301  | 329  | 348  | 357  | 385  | 4512 | 440  | 468  | 496  | 524  |      |
|              | 46 | 1168.4        |      | 177            | 183  | 200  | 226  | 229  | 257  | 271  | 286  | 314  | 342  | 362  | 370  | 399  | 427  | 455  | 483  | 511  | 539  |      |
| 1200         | 48 | 1219.2        |      |                |      | 209  | 236  | 239  | 269  | 283  | 298  | 328  | 357  | 378  | 387  | 416  | 445  | 475  | 504  | 533  | 562  |      |
|              |    |               | 1200 |                |      | 208  | 235  | 238  | 268  | 283  | 298  | 328  | 359  | 380  | 389  | 469  | 449  | 480  | 510  | 541  | 571  |      |
| 1350         | 50 | 1371.6        |      |                |      | 236  | 266  | 269  | 302  | 319  | 336  | 369  | 402  | 426  | 436  | 469  | 502  | 535  | 568  | 601  | 634  |      |
|              |    |               | 1350 |                |      | 234  | 265  | 268  | 302  | 318  | 335  | 369  | 403  | 427  | 437  | 471  | 505  | 539  | 573  | 607  | 641  |      |
| 1500         | 60 | 1524.0        |      |                |      |      |      | 299  | 336  | 355  | 373  | 410  | 447  | 473  | 454  | 521  | 558  | 595  | 632  | 668  | 702  |      |
|              |    |               | 1500 |                |      |      |      | 297  | 335  | 354  | 372  | 410  | 447  | 474  | 485  | 523  | 560  | 598  | 636  | 674  | 712  |      |
| 1600         | 64 | 1625.6        |      |                |      |      |      |      | 359  | 379  | 398  | 438  | 477  | 505  | 517  | 556  | 596  | 635  | 674  | 714  | 753  |      |
|              |    |               | 1600 |                |      |      |      |      | 357  | 377  | 397  | 437  | 477  | 505  | 517  | 557  | 597  | 638  | 678  | 718  | 759  |      |
| 1800         | 72 | 1828.8        |      |                |      |      |      |      | 404  | 426  | 449  | 493  | 538  | 569  | 582  | 627  | 671  | 715  | 760  | 804  | 848  |      |
|              |    |               | 1800 |                |      |      |      |      | 401  | 424  | 446  | 491  | 536  | 568  | 581  | 626  | 671  | 717  | 762  | 807  | 852  |      |
|              |    |               | 2000 |                |      |      |      |      |      |      |      |      | 546  | 595  | 630  | 645  | 696  | 745  | 795  | 846  | 896  | 946  |
|              |    |               | 2100 |                |      |      |      |      |      |      |      |      | 573  | 625  | 662  | 677  | 730  | 782  | 835  | 887  | 940  | 993  |
|              |    |               | 2200 |                |      |      |      |      |      |      |      |      |      | 655  | 693  | 709  | 764  | 819  | 874  | 929  | 985  | 1040 |
|              |    |               | 2300 |                |      |      |      |      |      |      |      |      |      | 684  | 724  | 742  | 799  | 856  | 914  | 971  | 1029 | 1087 |
|              |    |               | 2400 |                |      |      |      |      |      |      |      |      |      |      | 756  | 774  | 833  | 893  | 953  | 1013 | 103  | 1133 |
|              |    |               | 2500 |                |      |      |      |      |      |      |      |      |      |      | 787  | 806  | 868  | 930  | 993  | 1055 | 1118 | 1180 |
|              |    |               | 2600 |                |      |      |      |      |      |      |      |      |      |      | 818  | 838  | 902  | 967  | 1032 | 1097 | 1162 | 1227 |
|              |    |               | 2700 |                |      |      |      |      |      |      |      |      |      |      |      |      | 937  | 1004 | 1072 | 1139 | 1206 | 1274 |
|              |    |               | 2800 |                |      |      |      |      |      |      |      |      |      |      |      |      | 972  | 1041 | 1111 | 1181 | 1251 | 1321 |
|              |    |               | 2900 |                |      |      |      |      |      |      |      |      |      |      |      |      | 1006 | 1078 | 1151 | 1223 | 1295 | 1368 |
|              |    |               | 3000 |                |      |      |      |      |      |      |      |      |      |      |      |      | 1041 | 1115 | 1190 | 1265 | 1340 | 1415 |

# Large Diameter Arc Welded Steel Pipe

Weight kg/m



|  | 20   | 21   | 22   | 23   | 24   | 25   | 26   | 27   | 28   | 29   | 30   | 32   | 34   | 36   | 38   | 40   | 42   | 44   | 46   | 48   | 50   |
|--|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|  | 216  | 226  | 236  | 246  | 256  | 266  | 276  | 286  | 296  | 306  | 316  | 336  | 355  |      |      |      |      |      |      |      |      |
|  | 237  | 248  | 259  | 271  | 282  | 293  | 304  | 315  | 326  | 337  | 348  | 369  | 391  |      |      |      |      |      |      |      |      |
|  | 241  | 252  | 264  | 275  | 286  | 298  | 309  | 320  | 331  | 343  | 354  | 376  | 397  | 419  | 440  |      |      |      |      |      |      |
|  | 256  | 268  | 283  | 297  | 310  | 324  | 337  | 352  | 365  | 378  | 392  | 420  | 448  | 476  | 504  |      |      |      |      |      |      |
|  | 266  | 278  | 291  | 304  | 317  | 329  | 342  | 354  | 366  | 379  | 391  | 416  | 440  | 464  | 488  | 512  |      |      |      |      |      |
|  | 286  | 300  | 314  | 327  | 341  | 354  | 368  | 382  | 395  | 408  | 422  | 448  | 475  | 501  | 527  | 552  |      |      |      |      |      |
|  | 291  | 305  | 319  | 333  | 347  | 360  | 374  | 388  | 402  | 415  | 429  | 456  | 483  | 509  | 536  | 562  | 588  | 614  |      |      |      |
|  | 305  | 321  | 337  | 353  | 369  | 385  | 401  | 417  | 434  | 450  | 466  | 499  | 532  | 565  | 598  | 631  | 665  | 669  |      |      |      |
|  | 316  | 331  | 346  | 362  | 377  | 392  | 407  | 422  | 437  | 452  | 466  | 496  | 525  | 554  | 583  | 612  | 640  | 669  | 697  |      |      |
|  | 335  | 352  | 368  | 384  | 400  | 416  | 432  | 448  | 464  | 480  | 489  | 527  | 560  | 589  | 620  | 651  | 682  | 712  | 742  |      |      |
|  | 341  | 357  | 374  | 390  | 407  | 43   | 439  | 456  | 472  | 488  | 504  | 536  | 568  | 599  | 631  | 662  | 693  | 724  | 755  | 785  | 815  |
|  | 355  | 373  | 392  | 410  | 428  | 447  | 465  | 484  | 503  | 521  | 540  | 578  | 615  | 653  | 692  | 730  | 769  | 807  | 846  | 885  | 925  |
|  | 366  | 384  | 401  | 419  | 437  | 454  | 472  | 489  | 507  | 524  | 542  | 576  | 610  | 645  | 678  | 712  | 746  | 779  | 812  | 845  | 878  |
|  | 385  | 403  | 422  | 441  | 459  | 478  | 496  | 515  | 533  | 551  | 570  | 609  | 642  | 678  | 714  | 750  | 785  | 820  | 855  | 890  | 925  |
|  | 391  | 410  | 429  | 448  | 467  | 486  | 504  | 523  | 542  | 561  | 579  | 616  | 653  | 690  | 726  | 762  | 798  | 834  | 870  | 905  | 991  |
|  | 404  | 425  | 446  | 467  | 488  | 509  | 530  | 551  | 572  | 593  | 614  | 657  | 699  | 742  | 785  | 829  | 872  | 916  | 960  | 1004 | 1148 |
|  | 416  | 436  | 457  | 477  | 497  | 517  | 537  | 557  | 577  | 597  | 617  | 656  | 696  | 735  | 774  | 812  | 851  | 889  | 927  | 965  | 1003 |
|  | 441  | 463  | 484  | 506  | 527  | 548  | 570  | 591  | 612  | 633  | 654  | 696  | 738  | 780  | 821  | 862  | 904  | 944  | 985  | 1026 | 1066 |
|  | 454  | 477  | 500  | 524  | 547  | 570  | 594  | 617  | 641  | 644  | 688  | 735  | 783  | 831  | 879  | 927  | 976  | 1024 | 1073 | 1122 | 1171 |
|  | 466  | 489  | 512  | 534  | 557  | 580  | 602  | 625  | 641  | 670  | 691  | 736  | 781  | 825  | 869  | 913  | 956  | 1000 | 1147 | 1199 | 1128 |
|  | 491  | 515  | 539  | 563  | 587  | 611  | 635  | 658  | 682  | 706  | 729  | 776  | 823  | 870  | 916  | 963  | 1009 | 1055 | 1100 | 1146 | 1191 |
|  | 503  | 529  | 554  | 580  | 606  | 632  | 658  | 684  | 710  | 736  | 762  | 814  | 867  | 920  | 973  | 1026 | 1079 | 1133 | 1187 | 1241 | 1295 |
|  | 516  | 542  | 567  | 593  | 617  | 642  | 667  | 692  | 717  | 742  | 767  | 817  | 866  | 915  | 964  | 1013 | 1061 | 1110 | 1158 | 1206 | 1254 |
|  | 541  | 568  | 594  | 621  | 647  | 674  | 700  | 726  | 752  | 779  | 805  | 857  | 909  | 960  | 1012 | 1063 | 1114 | 1165 | 1216 | 1266 | 1316 |
|  | 552  | 580  | 609  | 637  | 665  | 694  | 722  | 750  | 779  | 807  | 836  | 893  | 951  | 1008 | 1066 | 1124 | 1183 | 1241 | 1300 | 1359 | 1418 |
|  | 566  | 594  | 622  | 650  | 677  | 705  | 732  | 760  | 787  | 815  | 842  | 897  | 951  | 1005 | 1059 | 1113 | 1167 | 1220 | 1273 | 1326 | 1379 |
|  | 591  | 620  | 650  | 678  | 707  | 736  | 765  | 794  | 822  | 851  | 880  | 937  | 994  | 1050 | 1107 | 1163 | 1219 | 1275 | 1331 | 1386 | 1442 |
|  | 602  | 632  | 663  | 694  | 724  | 755  | 786  | 817  | 848  | 879  | 910  | 972  | 1035 | 1097 | 1161 | 1223 | 1286 | 1350 | 1413 | 1477 | 1541 |
|  | 667  | 699  | 732  | 765  | 798  | 830  | 862  | 895  | 928  | 960  | 993  | 1057 | 1121 | 1186 | 1250 | 1313 | 1377 | 1440 | 1504 | 1567 | 1630 |
|  | 676  | 710  | 744  | 779  | 813  | 848  | 882  | 917  | 951  | 986  | 1021 | 1091 | 1160 | 1230 | 1301 | 1371 | 1442 | 1513 | 1584 | 1655 | 1726 |
|  | 741  | 778  | 815  | 851  | 888  | 924  | 960  | 997  | 1033 | 1069 | 1105 | 1178 | 1249 | 1321 | 1393 | 1464 | 1535 | 1606 | 1677 | 1747 | 1817 |
|  | 750  | 788  | 826  | 864  | 902  | 940  | 678  | 1017 | 1055 | 1093 | 1132 | 1209 | 1286 | 1364 | 1441 | 1519 |      |      |      |      |      |
|  | 792  | 831  | 870  | 909  | 948  | 987  | 1026 | 1064 | 1103 | 1142 | 1180 | 1258 | 1334 | 1411 | 1488 | 1564 |      |      |      |      |      |
|  | 799  | 839  | 880  | 921  | 961  | 1002 | 1043 | 1083 | 1124 | 1165 | 1206 | 1288 | 1370 | 1452 | 1535 | 1618 |      |      |      |      |      |
|  | 892  | 936  | 980  | 1024 | 1068 | 1112 | 1156 | 1200 | 1253 | 1287 | 1331 | 1418 | 1505 | 1592 | 1678 | 1764 |      |      |      |      |      |
|  | 898  | 943  | 988  | 1034 | 1080 | 1125 | 1171 | 1216 | 1262 | 1308 | 1354 | 1446 | 1538 | 1630 | 1722 | 1815 |      |      |      |      |      |
|  | 996  | 1047 | 1097 | 1147 | 1198 | 1248 | 1299 | 1350 | 1400 | 1451 | 1502 | 1603 | 1705 | 1807 | 1910 | 2012 | 2115 |      |      |      |      |
|  | 1046 | 1098 | 1151 | 1204 | 1257 | 1310 | 1363 | 1416 | 1469 | 1523 | 1576 | 1682 | 1789 | 1896 | 2003 | 2111 | 2219 |      |      |      |      |
|  | 1095 | 1150 | 1205 | 1261 | 1316 | 1372 | 1427 | 1483 | 1538 | 1594 | 1650 | 1761 | 1873 | 1985 | 2097 | 2210 | 2322 |      |      |      |      |
|  | 1144 | 1202 | 1260 | 1318 | 1375 | 1433 | 1491 | 1549 | 1607 | 1666 | 1724 | 1840 | 1957 | 2074 | 2191 | 2308 | 2426 |      |      |      |      |
|  | 1194 | 1254 | 1314 | 1374 | 1435 | 1495 | 1555 | 1616 | 1676 | 1737 | 1798 | 1919 | 2041 | 2163 | 2285 | 2407 | 2529 |      |      |      |      |
|  | 1243 | 1306 | 1368 | 1431 | 1494 | 1557 | 1620 | 1683 | 1746 | 1809 | 1872 | 1998 | 2125 | 2251 | 2378 | 2505 | 2633 |      |      |      |      |
|  | 1292 | 1357 | 1422 | 1488 | 1553 | 1618 | 1684 | 1749 | 1815 | 1880 | 1946 | 2077 | 2208 | 2340 | 2472 | 2604 | 2736 |      |      |      |      |
|  | 1342 | 1409 | 1477 | 1544 | 1612 | 1680 | 1748 | 1816 | 1884 | 1952 | 2020 | 2156 | 2292 | 2429 | 2566 | 2703 | 2840 | 2977 |      |      |      |
|  | 1391 | 1460 | 1531 | 1601 | 1671 | 1742 | 1812 | 1882 | 1953 | 2023 | 2094 | 2235 | 2376 | 2518 | 2659 | 2801 | 2944 | 3086 |      |      |      |
|  | 1440 | 1513 | 1582 | 1658 | 1731 | 1803 | 1876 | 1949 | 2022 | 2095 | 2168 | 2314 | 2460 | 2606 | 2753 | 2900 | 3047 | 3194 |      |      |      |
|  | 1489 | 1564 | 1639 | 1715 | 1790 | 1865 | 1940 | 2015 | 2091 | 2166 | 2242 | 2393 | 2544 | 2695 | 2847 | 2999 | 3151 | 3303 |      |      |      |



# Butt Welded Steel Pipe (Hot ERW Steel Pipe)

| Nominal<br>O.D. |       | Outside<br>Diameter |       | Wall Thickness |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
|-----------------|-------|---------------------|-------|----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                 |       |                     |       | (mm)           | 2,0   | 2,5   | 3,0   | 3,5   | 4,0   | 4,5   | 5,0   | 5,5   | 6,0   | 6,5   | 7,0   | 7,5   | 8,0   | 8,5   | 9,0   |
| A               | B     | mm                  | in    | (in)           | 0,079 | 0,098 | 0,118 | 0,138 | 0,157 | 0,177 | 0,197 | 0,217 | 0,236 | 0,256 | 0,276 | 0,295 | 0,315 | 0,335 | 0,354 |
| 15              | 1/2   | 21,7                | 0,854 |                |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 20              | 3/4   | 27,2                | 1,07  |                |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 25              | 1     | 34,0                | 1,34  |                |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 32              | 1 1/4 | 42,7                | 1,68  |                |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 40              | 1 1/2 | 48,6                | 1,91  |                |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 50              | 2     | 60,5                | 2,38  |                |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 65              | 2 1/2 | 76,3                | 3,00  |                |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 80              | 3     | 89,1                | 3,19  |                |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 90              | 3 1/2 | 101,6               | 4,00  |                |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 100             | 4     | 114,3               | 4,50  |                |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |

REMARKS:  Prior Consultation with the manufacturer is necessary





## Standards:

Seamless ASTM B 466  
Welded ASTM B 467

| Outside diameter of pipe ØD |                |              | Wall thickness |              | Theoretical weight |        |
|-----------------------------|----------------|--------------|----------------|--------------|--------------------|--------|
| nominal<br>inch             | actual<br>inch | actual<br>mm | actual<br>inch | actual<br>mm | lb/ft              | kg/    |
| SEAMLESS                    |                |              |                |              |                    |        |
| 1/8                         | 0.405          | 10.29        | 0.058          | 1.147        | 0.24               | 0.36   |
| 1/4                         | 0.540          | 13.72        | 0.065          | 1.65         | 0.38               | 0.56   |
| 3/8                         | 0.675          | 17.15        |                |              | 0.48               | 0.72   |
| 1/2                         | 0.840          | 21.34        |                |              | 0.61               | 0.91   |
| 3/4                         | 1.050          | 26.67        |                |              | 0.78               | 1.16   |
| 1                           | 1.315          | 33.4         |                |              | 0.99               | 1.47   |
| 1 1/4                       | 1.660          | 42.16        |                |              | 0.072              | 1.83   |
| 1 1/2                       | 1.900          | 48.27        | 1.60           | 2.39         |                    |        |
| 2                           | 2.375          | 60.32        | 0.083          | 2.11         |                    |        |
| 2 1/2                       | 2.875          | 73.03        |                |              | 2.82               | 4.20   |
| 3                           | 3.500          | 88.90        | 0.095          | 2.41         | 3.93               | 5.85   |
| 3 1/2                       | 4.000          | 101.60       |                |              | 4.51               | 6.71   |
| 4                           | 4.500          | 114.30       | 0.109          | 2.77         | 5.83               | 8.68   |
| 5                           | 5.563          | 141.30       | 0.125          | 3.18         | 8.29               | 12.34  |
| 6                           | 6.625          | 168.30       | 0.134          | 3.40         | 10.58              | 15.75  |
| 8                           | 8.625          | 219.1        |                |              | 13.83              | 20.59  |
| SEAMLESS OR SEAM WELD       |                |              |                |              |                    |        |
| 10                          | 10.750         | 273.05       | 0.134          | 3.40         | 17.29              | 25.74  |
| 12                          | 12.750         | 323.90       | 0.156          | 3.96         | 23.90              | 35.58  |
| 14                          | 14.000         | 355.60       | 0.165          | 4.19         | 27.78              | 41.35  |
| 16                          | 16.000         | 406.40       |                |              | 31.80              | 47.33  |
| 18                          | 18.000         | 257.20       | 0.180          | 4.57         | 39.03              | 58.10  |
| 20                          | 20.000         | 508.00       |                |              | 43.41              | 64.62  |
| SEAM WELDED                 |                |              |                |              |                    |        |
| 24                          | 24.000         | 609.60       | 0.180          | 4.57         | 52.17              | 77.66  |
| 30                          | 30.000         | 762.00       | 0.250          | 6.35         | 90.54              | 134.77 |

- Pipes in other wallthickness available upon request
- Fittings and Flanges available upon request
- Materials Alloy 706. Alloy 715. Alloy 687. Alloy 443



# Piping System CUPRONICKEL + BRASS

Dimension: ANSI/ASME B 36.19M

| Outside diameter of pipe<br>ØD |        |        | Schedule 5S    |      |                    |       | Schedule 10S   |      |                    |       |
|--------------------------------|--------|--------|----------------|------|--------------------|-------|----------------|------|--------------------|-------|
| Nominal<br>inch                | actual |        | Wall thickness |      | Theoretical weight |       | Wall thickness |      | Theoretical weight |       |
|                                | inch   | mm     | actual<br>inch | mm   | lb/ft              | kg/m  | actual<br>inch | mm   | lb/ft              | kg/m  |
|                                |        |        | SEAMLESS       |      |                    |       |                |      |                    |       |
| 1/8                            | 0.405  | 10.29  |                |      |                    |       | 0.049          | 1.24 | 0.19               | 0.28  |
| 1/4                            | 0.540  | 13.75  |                |      |                    |       | 0.065          | 1.65 | 0.33               | 0.49  |
| 3/8                            | 0.675  | 17.75  |                |      |                    |       | 0.065          | 1.65 | 0.42               | 0.63  |
| 1/2                            | 0.840  | 21.34  | 0.065          | 1.65 | 0.54               | 0.80  | 0.083          | 2.11 | 0.67               | 1.00  |
| 3/4                            | 1.050  | 26.67  | 0.065          | 1.65 | 0.69               | 1.03  | 0.083          | 2.11 | 0.86               | 1.28  |
| 1                              | 1.315  | 33.40  | 0.065          | 1.65 | 0.87               | 1.30  | 0.109          | 2.77 | 1.40               | 2.09  |
| 1 1/4                          | 1.660  | 42.16  | 0.065          | 1.65 | 1.11               | 1.65  | 0.109          | 2.77 | 1.81               | 2.70  |
| 1 1/2                          | 1.900  | 48.27  | 0.065          | 1.65 | 1.28               | 1.91  | 0.109          | 2.77 | 2.09               | 3.11  |
| 2                              | 2.375  | 60.32  | 0.065          | 1.65 | 1.61               | 2.40  | 0.109          | 2.77 | 2.64               | 3.93  |
| 2 1/2                          | 2.875  | 73.03  | 0.083          | 2.11 | 2.48               | 3.69  | 0.120          | 3.05 | 3.53               | 5.26  |
| 3                              | 3.500  | 88.90  | 0.083          | 2.11 | 3.03               | 4.51  | 0.120          | 3.05 | 4.33               | 6.45  |
| 3 1/2                          | 4.00   | 101.60 | 0.083          | 2.11 | 3.48               | 5.18  | 0.120          | 3.05 | 4.97               | 7.40  |
| 4                              | 4.500  | 114.30 | 0.083          | 2.11 | 3.92               | 5.84  | 0.120          | 3.05 | 5.61               | 8.36  |
| 5                              | 5.563  | 141.30 | 0.109          | 2.77 | 6.36               | 9.47  | 0.134          | 3.40 | 7.77               | 11.57 |
| 6                              | 6.625  | 168.30 | 0.109          | 2.77 | 7.60               | 11.32 | 0.134          | 3.40 | 9.29               | 13.84 |
| 8                              | 8.625  | 219.10 | 0.109          | 2.77 | 9.93               | 14.79 | 0.148          | 3.76 | 13.40              | 19.96 |
| 10                             | 10.750 | 273.05 | 0.134          | 3.40 | 15.19              | 22.63 | 0.165          | 4.19 | 18.65              | 27.78 |
| 12                             | 12.750 | 323.90 | 0.156          | 3.96 | 20.98              | 31.25 | 0.180          | 4.57 | 24.17              | 36.00 |

| Outside diameter of pipe<br>ØD |        |        | Schedule 40S   |      |                    |       | Schedule 80S   |       |                    |        |
|--------------------------------|--------|--------|----------------|------|--------------------|-------|----------------|-------|--------------------|--------|
| Nominal<br>inch                | actual |        | Wall thickness |      | Theoretical weight |       | Wall thickness |       | Theoretical weight |        |
|                                | inch   | mm     | actual<br>inch | mm   | lb/ft              | kg/m  | actual<br>inch | mm    | lb/ft              | kg/m   |
|                                |        |        | SEAMLESS       |      |                    |       |                |       |                    |        |
| 1/8                            | 0.405  | 10.29  | 0.068          | 1.73 | 0.24               | 0.37  | 0.095          | 2.41  | 0.31               | 0.47   |
| 1/4                            | 0.540  | 13.72  | 0.088          | 2.24 | 0.42               | 0.63  | 0.119          | 3.02  | 0.54               | 0.80   |
| 3/8                            | 0.675  | 17.15  | 0.091          | 2.31 | 0.57               | 0.84  | 0.126          | 3.20  | 0.74               | 1.10   |
| 1/2                            | 0.840  | 21.34  | 0.109          | 2.77 | 0.85               | 1.27  | 0.147          | 3.73  | 1.09               | 1.62   |
| 3/4                            | 1.050  | 26.67  | 0.113          | 2.87 | 1.13               | 1.69  | 0.154          | 3.91  | 1.47               | 2.20   |
| 1                              | 1.315  | 33.40  | 0.133          | 3.38 | 1.68               | 2.50  | 0.179          | 4.55  | 2.17               | 3.24   |
| 1 1/4                          | 1.660  | 42.16  | 0.140          | 3.56 | 2.27               | 3.39  | 0.191          | 4.85  | 3.00               | 4.47   |
| 1 1/2                          | 1.900  | 48.27  | 0.145          | 3.68 | 2.72               | 4.05  | 0.200          | 5.08  | 3.63               | 5.41   |
| 2                              | 2.375  | 60.32  | 0.154          | 3.91 | 3.65               | 5.44  | 0.218          | 5.54  | 5.02               | 7.48   |
| 2 1/2                          | 2.875  | 73.03  | 0.203          | 5.16 | 5.079              | 8.63  | 0.276          | 7.01  | 7.66               | 11.41  |
| 3                              | 3.500  | 88.90  | 0.216          | 5.49 | 7.58               | 11.29 | 0.300          | 7.62  | 10.25              | 15.27  |
| 3 1/2                          | 4.000  | 101.60 | 0.226          | 5.74 | 9.11               | 13.57 | 0.318          | 8.08  | 12.51              | 18.63  |
| 4                              | 4.500  | 114.30 | 0.237          | 6.02 | 10.79              | 16.07 | 0.337          | 8.56  | 14.98              | 22.32  |
| 5                              | 5.563  | 141.30 | 0.258          | 6.55 | 14.62              | 21.77 | 0.375          | 9.53  | 20.78              | 30.97  |
| 6                              | 6.625  | 168.30 | 0.280          | 7.11 | 18.97              | 28.26 | 0.432          | 10.97 | 28.57              | 42.56  |
| 8                              | 8.625  | 219.10 | 0.322          | 8.18 | 28.55              | 42.55 | 0.500          | 12.70 | 43.39              | 64.64  |
| 10                             | 10.750 | 273.05 | 0.365          | 9.27 | 40.48              | 60.31 | 0.500          | 12.70 | 54.74              | 96.01  |
| 12                             | 12.750 | 323.90 | 0.375          | 9.53 | 49.56              | 73.88 | 0.500          | 12.70 | 65.42              | 132.08 |

# Dimensional Tolerances and Welding Ends for Fittings

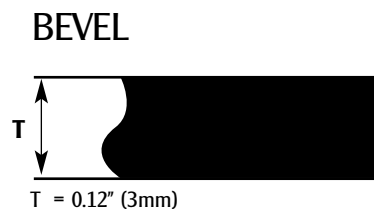
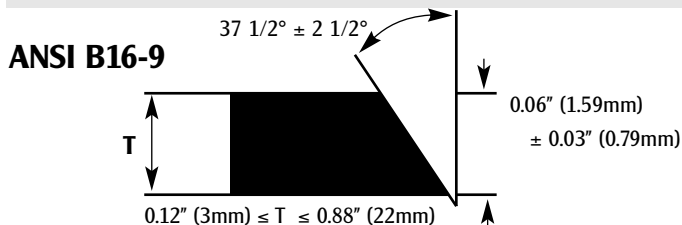


## MSS SP-43

| Nominal Pipe Size | All Fittings                    |                                          | 90° Elbows<br>45 Elbows<br>Tees | Reducers<br>Lap Joint<br>Stub Ends | 180° Returns                 |                          |                    | Caps          | Lap-Joint<br>Stub Ends |                           |
|-------------------|---------------------------------|------------------------------------------|---------------------------------|------------------------------------|------------------------------|--------------------------|--------------------|---------------|------------------------|---------------------------|
|                   | Outside Diameter at Welding End | Wall Thickness                           | Center-to-End Dimension ABCM    | Overall Length FH                  | Center-to-Centre Dimension P | Back-to-Face Dimension K | Alignment of End U | Over Length E | Fillet Radius of Lap A | Outside Diameter of Lap G |
| 1/2 to 11/2       | ± 0.76                          | Not less than 87.5% of nominal thickness | ± 1.52                          | ± 1.52                             | ± 6.35                       | ± 6.35                   | ± 0.76             | ± 3.05        | +0<br>-0.76            | +0<br>-0.76               |
| 2 to 3 1/2        | ±0.76                           |                                          | ±1.52                           | ±1.52                              | ±6.35                        | ±6.35                    | ±0.76              | ±3.05         | +0<br>-0.76            | +0<br>-0.76               |
| 4                 | ±0.76                           |                                          | ±1.52                           | ±1.52                              | ±6.35                        | ±6.35                    | ±0.76              | ±3.05         | +0<br>-1.52            | +0<br>-0.76               |
| 5 to 8            | +1.52<br>-0.76                  |                                          | ±1.52                           | ±1.52                              | ±6.35                        | ±6.35                    | ±0.76              | ±6.35         | +0<br>-1.52            | +0<br>-0.76               |
| 10 to 18          | +2.29<br>-0.76                  |                                          | ±2.29                           | ±2.29                              | ±9.65                        | ±6.35                    | ±1.52              | ±6.35         | +0<br>-1.52            | +0<br>-1.52               |
| 20 to 24          | +3.05<br>-0.76                  |                                          | ±2.29                           | ±2.29                              | ±9.65                        | ±6.35                    | ±1.52              | ±6.35         | +0<br>-1.52            | +0<br>-1.52               |

## ANSI B16-9

| All Fittings      |                           |                        |                                          | 90° and 45° Elbows and Tees     | Reducers and Lap Joint Stub Ends | Caps             | 180° Returns                 |                          |                    | Lap-Joint Stub Ends       |                    |                        |
|-------------------|---------------------------|------------------------|------------------------------------------|---------------------------------|----------------------------------|------------------|------------------------------|--------------------------|--------------------|---------------------------|--------------------|------------------------|
| Nominal Pipe Size | Outside Diameter at Bevel | Inside Diameter at End | Wall Thickness                           | Center-to-End Dimension A B C M | Overall Length F H               | Overall Length E | Center-to-Centre Dimension P | Back-to-Face Dimension K | Alignment of End U | Outside Diameter of Lap G | Thickness of Lap T | Fillet Radius of Lap R |
| 1/2 to 21/2       | +1.52<br>-0.76            | ±0.76                  | Not less than 87.5% of nominal thickness | ±1.52                           | ±1.52                            | ±3.05            | ±6.35                        | ±6.35                    | ±0.76              | +0<br>-0.76               | +1.52<br>-0        | +0<br>-0.76            |
| 3 to 3 1/2        | ±1.52                     | ±1.52                  |                                          | ±1.52                           | ±1.52                            | ±3.05            | ±6.35                        | ±6.35                    | ±0.76              | +0<br>-0.76               | +1.52<br>-0        | +0<br>-0.76            |
| 4+1.52            | ±1.52                     | ±1.52                  |                                          | ±1.52                           | ±3.05                            | ±6.35            | ±6.35                        | ±0.76                    | +0<br>-0.76        | +1.52<br>-0               | +0<br>-1.52        |                        |
| 5 to 8            | +2.29<br>-1.52            | ±1.52                  |                                          | ±1.52                           | ±1.52                            | ±6.35            | ±6.35                        | ±6.35                    | ±0.76              | +0<br>-0.76               | +1.52<br>-0        | +0<br>-1.52            |
| 10 to 18          | +4.06<br>-3.05            | ±3.05                  |                                          | ±2.29                           | ±2.29                            | ±6.35            | ±9.65                        | ±6.35                    | ±1.52              | +0<br>-1.52               | +1.52<br>-0        | +0<br>-1.52            |
| 20 to 24          | +6.35<br>-4.83            | ±4.83                  |                                          | ±2.29                           | ±2.29                            | ±6.35            | ±9.65                        | ±6.35                    | ±1.52              | +0<br>-1.52               | +1.52<br>-0        | +0<br>-1.52            |
| 26 to 30          | +6.35<br>-4.83            | ±4.83                  |                                          | ±3.05                           | ±4.83                            | ±9.65            |                              |                          |                    |                           |                    |                        |
| 32 to 48          | +6.35<br>-4.83            | ±4.83                  |                                          | ±4.83                           | ±4.83                            | ±9.65            |                              |                          |                    |                           |                    |                        |





# 90° Elbows Butt Weld Long Radius

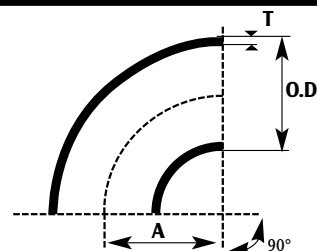
ASME/ASTM SA/A 403 WPS (Seamless) ANSI B-16-9

ASME/ASTM SA/A 403 WPW (Welded) ANSI B16-9

ASME/ASTM SA/A 403 WPWX (Welded/100% x Ray) ANSI B16-9

Dimensions (unit: mm)

Weights (unit: kg)



| Nominal<br>Pipe<br>Size | Outside<br>Dia.<br>(OD) | Wall Thickness (T) |          |                 |                 | Centre<br>to End<br>(A) |
|-------------------------|-------------------------|--------------------|----------|-----------------|-----------------|-------------------------|
|                         |                         | Sch. 5S            | Sch. 10S | STD<br>Sch. 40S | XS<br>Sch. 80 S |                         |
| 1/2                     | 21.34                   | 1.65               | 2.11     | 2.77            | 3.73            | 38.10                   |
| 3/4                     | 26.67                   | 1.65               | 2.11     | 2.87            | 3.91            | 28.45                   |
| 1                       | 33.4                    | 1.65               | 2.77     | 3.38            | 4.55            | 38.10                   |
| 1 1/4                   | 42.16                   | 1.65               | 2.77     | 3.56            | 4.85            | 47.75                   |
| 1 1/2                   | 48.26                   | 1.65               | 2.77     | 3.68            | 5.08            | 5.15                    |
| 2                       | 60.32                   | 1.65               | 2.77     | 3.91            | 5.54            | 76.20                   |
| 2 1/2                   | 73.02                   | 2.11               | 3.05     | 5.16            | 7.01            | 95.25                   |
| 3                       | 88.90                   | 2.11               | 3.05     | 5.49            | 7.62            | 114.3                   |
| 3 1/2                   | 106.0                   | 2.11               | 3.05     | 5.74            | 8.08            | 133.35                  |
| 4                       | 114.30                  | 2.11               | 3.05     | 6.02            | 8.56            | 152.4                   |
| 5                       | 141.30                  | 2.77               | 3.40     | 6.55            | 9.53            | 190.50                  |
| 6                       | 168.27                  | 2.77               | 3.40     | 7.11            | 10.97           | 228.60                  |
| 8                       | 219.08                  | 2.77               | 3.796    | 8.18            | 12.7            | 304.80                  |
| 10                      | 273.05                  | 3.40               | 4.19     | 9.27            | 12.70           | 381.00                  |
| 12                      | 323.85                  | 3.96               | 4.57     | 9.53            | 12.70           | 457.20                  |
| 14                      | 355.60                  | 4.78               | 7.92     | 9.53            | 12.70           | 533.40                  |
| 16                      | 406.40                  | 4.78               | 7.92     | 9.53            | 12.70           | 609.60                  |
| 18                      | 457.20                  | 4.78               | 7.92     | 9.53            | 12.70           | 685.80                  |
| 20                      | 508.00                  | 5.54               | 9.53     | 9.53            | 12.70           | 762.00                  |
| 22                      | 558.80                  | 5.54               | 9.53     | 9.53            | 12.70           | 838.20                  |
| 24                      | 609.60                  | 6.35               | 9.53     | 9.53            | 12.70           | 914.40                  |
| 26                      | 660.40                  | 7.92               | 12.70    | 9.53            | 12.70           | 990.60                  |
| 28                      | 711.20                  | 7.92               | 12.70    | 9.53            | 12.70           | 1066.80                 |
| 30                      | 762.00                  | 7.92               | 12.70    | 9.53            | 12.70           | 1143.00                 |
| 32                      | 812.80                  | 7.92               | 12.70    | 9.53            | 12.70           | 1219.20                 |
| 34                      | 863.60                  | 7.92               | 12.70    | 9.53            | 12.70           | 1295.40                 |
| 36                      | 914.40                  | 7.92               | 12.70    | 9.53            | 12.70           | 1371.60                 |
| 38                      | 965.20                  | 7.92               |          | 9.53            | 12.70           | 1447.80                 |
| 40                      | 1016.00                 | 7.92               |          | 9.53            | 12.70           | 1524.00                 |
| 42                      | 1066.80                 | 7.92               |          | 9.53            | 12.0            | 1600.20                 |
| 44                      | 1117.60                 | 7.92               |          | 9.53            | 12.70           | 1676.40                 |
| 46                      | 1168.40                 | 7.92               |          | 9.53            | 12.70           | 1752.60                 |
| 48                      | 1219.20                 | 7.92               |          | 9.53            | 12.70           | 1828.80                 |

| Nominal<br>Pipe<br>Size | STD<br>Sch. 5S | XS<br>Sch. 10S | Sch. 40S | Sch. 80S |
|-------------------------|----------------|----------------|----------|----------|
| 1/2                     | 0.049          | 0.061          | 0.078    | 0.100    |
| 3/4                     | 0.062          | 0.078          | 0.103    | 0.104    |
| 1                       | 0.078          | 0.128          | 0.154    | 0.204    |
| 1 1/4                   | 0.125          | 0.206          | 0.260    | 0.349    |
| 1 1/2                   | 0.170          | 0.283          | 0.368    | 0.507    |
| 2                       | 0.286          | 0.478          | 0.652    | 0.938    |
| 2 1/2                   | 0.576          | 0.812          | 1.37     | 1.79     |
| 3                       | 0.810          | 1.140          | 2.04     | 2.87     |
| 3 1/2                   | 1.08           | 1.53           | 2.82     | 4.10     |
| 4                       | 1.39           | 1.97           | 3.84     | 5.62     |
| 5                       | 2.83           | 3.42           | 6.48     | 9.69     |
| 6                       | 4.06           | 4.87           | 9.94     | 15.99    |
| 8                       | 7.06           | 10.00          | 20.10    | 32.16    |
| 10                      | 13.20          | 15.50          | 35.40    | 49.83    |
| 12                      | 22.30          | 25.90          | 56.20    | 72.48    |
| 14                      | 34.60          | 57.58          | 66.36    | 85.53    |
| 16                      | 45.20          | 70.03          | 87.11    | 112.34   |
| 18                      | 57.30          | 89.01          | 110.67   | 142.79   |
| 20                      | 82.00          | 136.99         | 136.99   | 176.90   |
| 22                      | 99.40          | 163.03         | 163.03   | 210.83   |
| 24                      | 136.00         | 198.05         | 198.05   | 256.13   |
| 26                      | 198.00         | 296.76         | 229.17   | 296.53   |
| 28                      | 230.00         | 345.05         | 266.50   | 344.96   |
| 30                      | 264.00         | 397.15         | 306.59   | 396.74   |
| 32                      | 301.00         | 453.00         | 349.53   | 452.68   |
| 34                      | 339.00         | 512.16         | 395.24   | 511.98   |
| 36                      | 381.00         | 575.13         | 443.71   | 574.95   |
| 38                      | 425.00         |                | 497.71   | 644.75   |
| 40                      | 471.00         |                | 551.98   | 715.51   |
| 42                      | 520.00         |                | 606.16   | 785.77   |
| 44                      | 571.00         |                | 669.04   | 867.40   |
| 46                      | 624.00         |                | 731.69   | 948.81   |
| 48                      | 679.00         |                | 797.28   | 1033.84  |

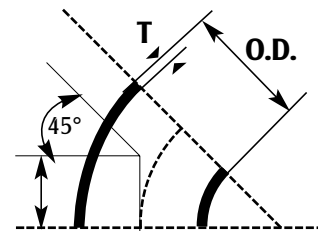
Note: Sch40S and 80S apply up to 12" only



# 45° Elbows Butt Weld Long Radius



ASME/ASTM SA/A 403 WPS (Seamless) ANSI B-16-9  
ASME/ASTM SA/A 403 WPW (Welded) ANSI B16-9  
ASME/ASTM SA/A 403 WPWX (Welded/100% x Ray) ANSI B16-9



**Dimensions (unit: mm)**

**Weights (unit: kg)**

| Nominal<br>Pipe<br>Size | Outside<br>Dia.<br>(OD) | Wall Thickness (T) |          |                 |                 | Centre<br>to End<br>(A) |
|-------------------------|-------------------------|--------------------|----------|-----------------|-----------------|-------------------------|
|                         |                         | Sch. 5S            | Sch. 10S | STD<br>Sch. 40S | XS<br>Sch. 80 S |                         |
| 1/2                     | 21.34                   | 1.65               | 2.11     | 2.77            | 3.73            | 15.88                   |
| 3/4                     | 26.67                   | 1.65               | 2.11     | 2.87            | 3.91            | 11.13                   |
| 1                       | 33.40                   | 1.65               | 2.77     | 3.38            | 4.55            | 22.22                   |
| 1 1/4                   | 42.16                   | 1.65               | 2.77     | 3.56            | 4.85            | 25.40                   |
| 1 1/2                   | 48.26                   | 1.65               | 2.77     | 3.68            | 5.08            | 28.45                   |
| 2                       | 60.32                   | 1.65               | 2.77     | 3.91            | 5.54            | 35.05                   |
| 2 1/2                   | 73.02                   | 2.11               | 3.05     | 5.16            | 7.01            | 44.45                   |
| 3                       | 88.90                   | 2.11               | 3.05     | 5.49            | 7.62            | 50.80                   |
| 3 1/2                   | 101.60                  | 2.11               | 3.05     | 5.74            | 8.08            | 57.15                   |
| 4                       | 114.30                  | 2.11               | 3.05     | 6.02            | 8.56            | 63.50                   |
| 5                       | 141.30                  | 2.77               | 3.40     | 6.55            | 9.53            | 79.25                   |
| 6                       | 168.27                  | 2.77               | 3.40     | 7.11            | 10.97           | 95.25                   |
| 8                       | 219.08                  | 2.77               | 3.76     | 8.18            | 12.70           | 127.00                  |
| 10                      | 273.05                  | 3.40               | 4.19     | 9.27            | 12.70           | 158.75                  |
| 12                      | 323.85                  | 3.96               | 4.57     | 9.53            | 12.70           | 190.50                  |
| 14                      | 355.60                  | 4.78               | 7.92     | 9.53            | 12.70           | 222.25                  |
| 16                      | 406.40                  | 4.78               | 7.92     | 9.53            | 12.70           | 254.00                  |
| 18                      | 457.20                  | 4.78               | 7.92     | 9.53            | 12.70           | 285.75                  |
| 20                      | 508.00                  | 5.54               | 9.53     | 9.53            | 12.70           | 317.50                  |
| 22                      | 558.80                  | 5.54               | 9.53     | 9.53            | 12.70           | 342.90                  |
| 24                      | 609.60                  | 6.35               | 9.53     | 9.53            | 12.70           | 381.00                  |
| 26                      | 660.40                  | 7.92               | 12.70    | 9.53            | 12.70           | 406.40                  |
| 28                      | 711.20                  | 7.92               | 12.70    | 9.53            | 12.70           | 438.15                  |
| 30                      | 762.00                  | 7.92               | 12.70    | 9.53            | 12.70           | 469.90                  |
| 32                      | 812.80                  | 7.92               | 12.70    | 9.53            | 12.70           | 501.65                  |
| 34                      | 863.60                  | 7.92               | 12.70    | 9.53            | 12.70           | 533.40                  |
| 36                      | 914.40                  | 7.92               | 12.70    | 9.53            | 12.70           | 565.15                  |
| 38                      | 965.20                  | 7.92               |          | 9.53            | 12.70           | 599.95                  |
| 40                      | 1016.00                 | 7.92               |          | 9.53            | 12.70           | 631.95                  |
| 42                      | 1066.80                 | 7.92               |          | 9.53            | 12.70           | 660.40                  |
| 44                      | 1117.60                 | 7.92               |          | 9.53            | 12.70           | 695.45                  |
| 46                      | 1168.40                 | 7.92               |          | 9.53            | 12.70           | 726.95                  |
| 48                      | 1219.20                 | 7.92               |          | 9.53            | 12.70           | 758.95                  |

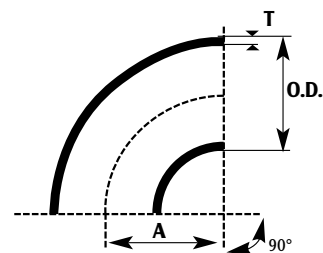
| Nominal<br>Pipe<br>Size | STD<br>Sch. 5S | XS<br>Sch. 10S | Sch. 40S | Sch. 80S |
|-------------------------|----------------|----------------|----------|----------|
| 1/2                     | 0.024          | 0.030          | 0.039    | 0.050    |
| 3/4                     | 0.031          | 0.039          | 0.052    | 0.078    |
| 1                       | 0.039          | 0.064          | 0.077    | 0.100    |
| 1 1/4                   | 0.063          | 0.103          | 0.130    | 0.177    |
| 1 1/2                   | 0.085          | 0.142          | 0.184    | 0.254    |
| 2                       | 0.143          | 0.239          | 0.326    | 0.471    |
| 2 1/2                   | 0.288          | 0.406          | 0.683    | 0.897    |
| 3                       | 0.405          | 0.571          | 1.02     | 1.44     |
| 3 1/2                   | 0.540          | 0.764          | 1.41     | 2.05     |
| 4                       | 0.696          | 0.985          | 1.92     | 2.81     |
| 5                       | 1.42           | 1.71           | 3.24     | 4.85     |
| 6                       | 2.01           | 2.43           | 4.97     | 8.02     |
| 8                       | 3.53           | 5.01           | 10.10    | 16.22    |
| 10                      | 6.62           | 7.77           | 17.70    | 25.37    |
| 12                      | 11.10          | 12.50          | 28.10    | 36.69    |
| 14                      | 17.30          | 28.63          | 32.93    | 42.40    |
| 16                      | 22.60          | 34.84          | 43.31    | 55.76    |
| 18                      | 28.70          | 44.21          | 54.99    | 70.94    |
| 20                      | 41.00          | 68.13          | 68.13    | 88.02    |
| 22                      | 49.70          | 81.13          | 81.13    | 104.87   |
| 24                      | 68.00          | 98.57          | 98.57    | 127.52   |
| 26                      | 99.00          | 147.63         | 114.11   | 147.68   |
| 28                      | 115.00         | 171.82         | 132.73   | 171.82   |
| 30                      | 132.00         | 197.78         | 152.75   | 197.78   |
| 32                      | 151.00         | 225.59         | 156.24   | 225.59   |
| 34                      | 170.00         | 255.22         | 196.96   | 255.13   |
| 36                      | 191.00         | 286.66         | 221.20   | 286.57   |
| 38                      | 213.00         |                | 248.15   | 321.58   |
| 40                      | 236.00         |                | 257.35   | 356.69   |
| 42                      | 260.00         |                | 301.34   | 391.85   |
| 44                      | 286.00         |                | 333.68   | 432.66   |
| 46                      | 312.00         |                | 365.07   | 473.25   |
| 48                      | 340.00         |                | 397.69   | 515.74   |

Note: Sch40S and 80S apply up to 12" only



# 90° Elbows But Weld short Radius

ASME/ASTM SA/A 403 WPS (Seamless) ANSI B-16-9  
ASME/ASTM SA/A 403 WPW (Welded) ANSI B16-9  
ASME/ASTM SA/A 403 WPWX (Welded/100% x Ray) ANSI B16-9



**Dimensions (unit: mm)**

**Weights (unit: kg)**

| Nominal<br>Pipe<br>Size | Outside<br>Dia.<br>(OD) | Wall Thickness (T) |          |                 |                 | Centre<br>to End<br>(A) |
|-------------------------|-------------------------|--------------------|----------|-----------------|-----------------|-------------------------|
|                         |                         | Sch. 5S            | Sch. 10S | STD<br>Sch. 40S | XS<br>Sch. 80 S |                         |
| 1                       | 33,40                   | 1,65               | 2,77     | 3,38            | 4,55            | 25,40                   |
| 1 1/4                   | 42,16                   | 1,65               | 2,77     | 3,56            | 4,85            | 31,75                   |
| 1 1/2                   | 48,26                   | 1,65               | 2,77     | 3,68            | 5,08            | 38,10                   |
| 2                       | 60,32                   | 1,65               | 2,77     | 3,91            | 5,54            | 50,80                   |
| 2 1/2                   | 73,02                   | 2,11               | 3,05     | 5,16            | 7,01            | 63,50                   |
| 3                       | 88,90                   | 2,11               | 3,05     | 5,49            | 7,62            | 76,20                   |
| 3 1/2                   | 101,60                  | 2,11               | 3,05     | 5,74            | 8,08            | 88,90                   |
| 4                       | 114,30                  | 2,11               | 3,05     | 6,02            | 8,56            | 101,60                  |
| 5                       | 141,30                  | 2,77               | 3,40     | 6,55            | 9,53            | 127,00                  |
| 6                       | 168,27                  | 2,77               | 3,40     | 7,11            | 10,97           | 152,40                  |
| 8                       | 219,08                  | 2,77               | 3,76     | 8,18            | 12,70           | 203,20                  |
| 10                      | 273,05                  | 3,40               | 4,19     | 9,27            | 12,70           | 254,00                  |
| 12                      | 323,85                  | 3,96               | 4,57     | 9,53            | 12,70           | 304,80                  |
| 14                      | 355,60                  | 3,96               | 4,78     | 9,53            | 12,70           | 355,60                  |
| 16                      | 406,40                  | 3,96               | 4,78     | 9,53            | 12,70           | 406,40                  |
| 18                      | 457,20                  | 3,96               | 4,78     | 9,53            | 12,70           | 457,20                  |
| 20                      | 508,00                  | 4,78               | 5,54     | 9,53            | 12,70           | 508,00                  |
| 22                      | 558,80                  | 4,78               | 5,54     | 9,53            | 12,70           | 558,80                  |
| 24                      | 609,60                  | 5,54               | 6,35     | 9,53            | 12,70           | 609,60                  |

| Nominal<br>Pipe<br>Size | STD<br>Sch. 5S | XS<br>Sch. 10S | Sch. 40S | Sch. 80S |
|-------------------------|----------------|----------------|----------|----------|
|                         |                |                |          |          |
| 1                       | 0,077          | 0,094          | 0,118    | 0,122    |
| 1 1/4                   | 0,101          | 0,152          | 0,204    | 0,217    |
| 1 1/2                   | 0,114          | 0,189          | 0,245    | 0,317    |
| 2                       | 0,191          | 0,318          | 0,434    | 0,593    |
| 2 1/2                   | 0,383          | 0,541          | 0,909    | 1,13     |
| 3                       | 0,540          | 0,761          | 1,36     | 1,82     |
| 3 1/2                   | 0,719          | 1,02           | 1,88     | 2,61     |
| 4                       | 0,928          | 1,31           | 2,56     | 3,56     |
| 5                       | 1,89           | 2,28           | 4,32     | 6,20     |
| 6                       | 2,68           | 3,24           | 6,63     | 10,26    |
| 8                       | 4,71           | 6,68           | 12,40    | 20,84    |
| 10                      | 8,83           | 10,40          | 23,60    | 32,94    |
| 12                      | 14,80          | 16,70          | 37,50    | 47,30    |
| 14                      | 15,21          | 24,55          | 48,33    | 59,25    |
| 16                      | 25,60          | 32,00          | 63,37    | 81,81    |
| 18                      | 40,40          | 40,40          | 73,57    | 103,96   |
| 20                      | 40,42          | 60,25          | 99,66    | 128,79   |
| 22                      | 61,06          | 73,02          | 120,83   | 156,29   |
| 24                      | 86,98          | 101,56         | 144,06   | 186,41   |

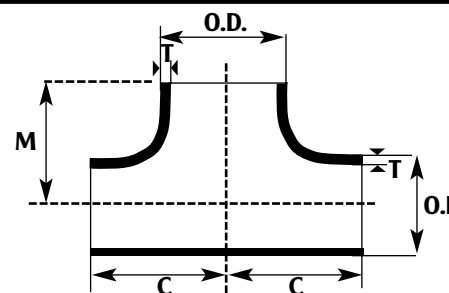
Note: Sch40S and 80S apply up to 12" only



# Equal Tees



ASME/ASTM SA/A 403 WPS (Seamless) ANSI B-16-9  
 ASME/ASTM SA/A 403 WPW (Welded) ANSI B16-9  
 ASME/ASTM SA/A 403 WPWX (Welded/100% x Ray) ANSI B16-9



## Dimensions (unit: mm)

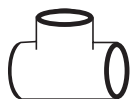
## Weights (unit: kg)

| Nominal<br>Pipe<br>Size | Outside<br>Dia.<br>(OD) | Wall Thickness (T) |          |                 |                 | Centre<br>to End<br>(A) |
|-------------------------|-------------------------|--------------------|----------|-----------------|-----------------|-------------------------|
|                         |                         | Sch. 5S            | Sch. 10S | STD<br>Sch. 40S | XS<br>Sch. 80 S |                         |
| 1/2                     | 21,34                   | 1,65               | 2,11     | 2,77            | 3,73            | 25,40                   |
| 3/4                     | 26,67                   | 1,65               | 2,11     | 2,87            | 3,91            | 28,70                   |
| 1                       | 33,40                   | 1,65               | 2,77     | 3,38            | 4,55            | 38,10                   |
| 1 1/4                   | 42,16                   | 1,65               | 2,77     | 3,56            | 4,85            | 47,75                   |
| 1 1/2                   | 48,26                   | 1,65               | 2,77     | 3,68            | 5,08            | 57,15                   |
| 2                       | 60,32                   | 1,65               | 2,77     | 3,91            | 5,54            | 63,50                   |
| 2 1/2                   | 73,02                   | 2,11               | 3,05     | 5,16            | 7,01            | 76,20                   |
| 3                       | 88,90                   | 2,11               | 3,05     | 5,49            | 7,62            | 85,85                   |
| 4                       | 114,30                  | 2,11               | 3,05     | 6,02            | 8,56            | 104,90                  |
| 5                       | 141,30                  | 2,77               | 3,40     | 6,55            | 9,53            | 123,95                  |
| 6                       | 168,27                  | 2,77               | 3,40     | 7,11            | 10,97           | 143,00                  |
| 8                       | 219,08                  | 2,77               | 3,76     | 8,18            | 12,70           | 177,80                  |
| 10                      | 273,05                  | 3,40               | 4,19     | 9,27            | 12,70           | 215,90                  |
| 12                      | 323,85                  | 3,96               | 4,57     | 9,53            | 12,70           | 254,00                  |
| 14                      | 355,60                  | 3,96               | 4,78     | 9,53            | 12,70           | 279,40                  |
| 16                      | 406,40                  | 3,96               | 4,78     | 9,53            | 12,70           | 304,80                  |
| 18                      | 457,20                  | 3,96               | 4,78     | 9,53            | 12,70           | 342,90                  |
| 20                      | 508,00                  | 4,78               | 5,54     | 9,53            | 12,70           | 381,00                  |
| 22                      | 558,80                  | 4,78               | 5,54     | 9,53            | 12,70           | 419,10                  |
| 24                      | 609,60                  | 5,54               | 6,35     | 9,53            | 12,70           | 431,80                  |

| Nominal<br>Pipe<br>Size | STD<br>Sch. 5S | XS<br>Sch. 10S | Sch. 40S | Sch. 80S |
|-------------------------|----------------|----------------|----------|----------|
| 1/2                     | 0,090          | 0,090          | 0,181    | 0,204    |
| 3/4                     | 0,129          | 0,128          | 0,258    | 0,294    |
| 1                       | 0,223          | 0,223          | 0,256    | 0,399    |
| 1 1/4                   | 0,356          | 0,356          | 0,463    | 0,725    |
| 1 1/2                   | 0,497          | 0,497          | 0,648    | 1,02     |
| 2                       | 0,681          | 0,681          | 0,893    | 1,81     |
| 2 1/2                   | 1,20           | 1,20           | 1,98     | 3,17     |
| 3                       | 1,57           | 1,57           | 2,61     | 3,85     |
| 4                       | 2,46           | 2,46           | 4,76     | 7,11     |
| 5                       | 4,04           | 4,04           | 7,84     | 11,78    |
| 6                       | 5,50           | 5,50           | 9,54     | 18,12    |
| 8                       | 11,07          | 11,07          | 19,56    | 33,98    |
| 10                      | 19,87          | 19,87          | 32,61    | 47,57    |
| 12                      | 27,86          | 27,86          | 56,65    | 72,48    |
| 14                      | 28,74          | 35,98          | 71,21    | 91,78    |
| 16                      | 35,69          | 44,69          | 88,56    | 114,23   |
| 18                      | 45,21          | 56,62          | 112,33   | 144,98   |
| 20                      | 69,97          | 83,69          | 138,99   | 179,66   |
| 22                      | 84,72          | 101,35         | 170,07   | 217,46   |
| 24                      | 113,23         | 132,24         | 192,66   | 243,13   |

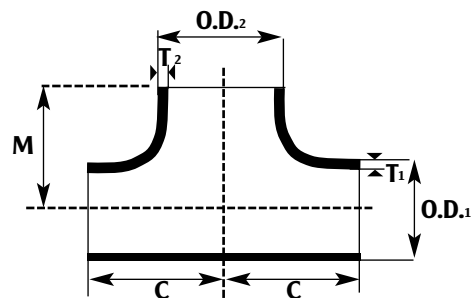
Note: Sch40S and 80S apply up to 12" only





# Reducing Tees

ASME/ASTM SA/A 403 WPS (Seamless) ANSI B-16-9  
 ASME/ASTM SA/A 403 WPW (Welded) ANSI B16-9  
 ASME/ASTM SA/A 403 WPWX (Welded/100% x Ray) ANSI B16-9



## Dimensions (unit: mm)

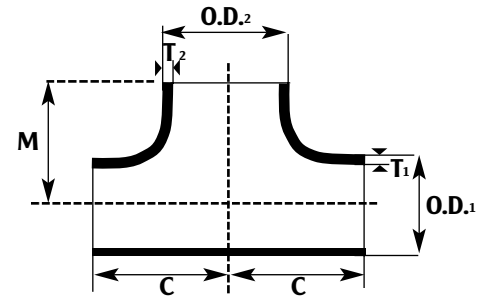
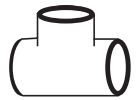
| Nom. Pipe Size Run | Out let | Out-Side Dia. OD1 | Out-Side Dia. OD2 | Wall Thickness (T1, T2) |      |      |      |          |      |       |      | Center to End C | Center to End M |          |  |          |  |
|--------------------|---------|-------------------|-------------------|-------------------------|------|------|------|----------|------|-------|------|-----------------|-----------------|----------|--|----------|--|
|                    |         |                   |                   | Sch. 5S                 |      |      |      | Sch. 10S |      |       |      |                 |                 | STD      |  | XS       |  |
|                    |         |                   |                   |                         |      |      |      |          |      |       |      |                 |                 | Sch. 40S |  | Sch. 80S |  |
| T1                 | T2      | T1                | T2                | T1                      | T2   | T1   | T2   | T1       | T2   | C     | M    |                 |                 |          |  |          |  |
| 3/4                | 1/2     | 26,67             | 21,34             | 1,65                    | 1,65 | 2,11 | 2,11 | 2,87     | 2,77 | 3,91  | 3,73 | 28,70           | 28,70           |          |  |          |  |
| 1                  | 1/2     | 33,40             | 21,34             | 1,65                    | 1,65 | 2,77 | 2,11 | 3,38     | 2,77 | 4,55  | 3,73 | 38,10           | 38,10           |          |  |          |  |
| 1                  | 3/4     | 33,40             | 26,67             | 1,65                    | 1,65 | 2,77 | 2,11 | 3,38     | 2,87 | 4,55  | 3,91 | 38,10           | 38,10           |          |  |          |  |
| 1 1/4              | 3/4     | 42,16             | 26,67             | 1,65                    | 1,65 | 2,77 | 2,11 | 9,56     | 2,87 | 4,85  | 3,91 | 47,75           | 47,75           |          |  |          |  |
| 1 1/4              | 1       | 42,16             | 33,40             | 1,65                    | 1,65 | 2,77 | 2,77 | 3,56     | 3,38 | 4,85  | 4,55 | 47,75           | 47,75           |          |  |          |  |
| 1 1/2              | 1/2     | 48,26             | 21,34             | 1,65                    | 1,65 | 2,77 | 2,11 | 3,68     | 2,77 | 5,08  | 3,73 | 57,15           | 57,15           |          |  |          |  |
| 1 1/2              | 3/4     | 48,26             | 26,67             | 1,65                    | 1,65 | 2,77 | 2,11 | 3,68     | 2,87 | 5,08  | 3,91 | 57,15           | 57,15           |          |  |          |  |
| 1 1/2              | 1       | 48,26             | 33,40             | 1,65                    | 1,65 | 2,77 | 2,77 | 3,68     | 3,38 | 5,08  | 4,55 | 57,15           | 57,15           |          |  |          |  |
| 1 1/2              | 1 1/4   | 48,26             | 42,16             | 1,65                    | 1,65 | 2,77 | 2,77 | 3,68     | 3,56 | 5,08  | 4,85 | 57,15           | 57,15           |          |  |          |  |
| 2                  | 3/4     | 60,32             | 26,67             | 1,65                    | 1,65 | 2,77 | 0,84 | 3,91     | 2,87 | 5,54  | 3,91 | 63,50           | 44,45           |          |  |          |  |
| 2                  | 1       | 60,32             | 33,40             | 1,65                    | 1,65 | 2,77 | 2,77 | 3,91     | 3,38 | 5,54  | 4,55 | 63,50           | 50,80           |          |  |          |  |
| 2                  | 1 1/4   | 60,32             | 42,16             | 1,65                    | 1,65 | 2,77 | 2,77 | 3,91     | 3,56 | 5,54  | 4,85 | 63,50           | 57,15           |          |  |          |  |
| 2                  | 1 1/2   | 60,32             | 48,26             | 1,65                    | 1,65 | 2,77 | 2,77 | 3,91     | 3,68 | 5,54  | 5,08 | 63,50           | 60,45           |          |  |          |  |
| 2 1/2              | 1 1/2   | 73,02             | 48,26             | 2,11                    | 1,65 | 3,05 | 2,77 | 5,16     | 3,68 | 7,01  | 5,08 | 76,20           | 66,80           |          |  |          |  |
| 2 1/2              | 2       | 73,02             | 60,32             | 2,11                    | 1,65 | 3,05 | 2,77 | 5,16     | 3,91 | 7,01  | 5,54 | 76,20           | 69,85           |          |  |          |  |
| 3                  | 1 1/2   | 88,90             | 48,26             | 2,11                    | 1,65 | 3,05 | 2,77 | 5,49     | 3,68 | 7,62  | 5,08 | 79,50           | 73,15           |          |  |          |  |
| 3                  | 2       | 88,90             | 60,32             | 2,11                    | 1,65 | 3,05 | 2,77 | 5,49     | 3,91 | 7,62  | 5,54 | 85,85           | 76,20           |          |  |          |  |
| 3                  | 2 1/2   | 88,90             | 73,02             | 2,11                    | 2,11 | 3,05 | 3,05 | 5,49     | 5,16 | 7,62  | 7,01 | 85,85           | 82,55           |          |  |          |  |
| 4                  | 1 1/2   | 114,30            | 48,26             | 2,11                    | 1,65 | 3,05 | 2,77 | 6,02     | 3,68 | 8,56  | 5,08 | 104,90          | 85,85           |          |  |          |  |
| 4                  | 2       | 114,30            | 60,32             | 2,11                    | 1,65 | 3,05 | 2,77 | 6,02     | 3,91 | 8,56  | 5,54 | 104,90          | 88,90           |          |  |          |  |
| 4                  | 2 1/2   | 114,30            | 73,02             | 2,11                    | 2,11 | 3,05 | 3,05 | 6,02     | 5,16 | 8,56  | 7,01 | 104,90          | 95,25           |          |  |          |  |
| 4                  | 3       | 114,30            | 88,90             | 2,11                    | 2,11 | 3,05 | 3,05 | 6,02     | 5,49 | 8,56  | 7,62 | 104,90          | 98,55           |          |  |          |  |
| 5                  | 3       | 141,30            | 88,90             | 2,77                    | 2,11 | 3,40 | 3,05 | 6,55     | 5,49 | 9,53  | 7,62 | 123,95          | 111,25          |          |  |          |  |
| 5                  | 4       | 141,30            | 114,30            | 2,77                    | 2,11 | 3,40 | 3,05 | 6,55     | 6,02 | 9,53  | 8,56 | 123,95          | 117,60          |          |  |          |  |
| 6                  | 2 1/2   | 168,27            | 73,02             | 2,77                    | 2,11 | 3,40 | 3,05 | 7,11     | 5,16 | 10,97 | 7,01 | 143,00          | 120,65          |          |  |          |  |
| 6                  | 3       | 168,27            | 88,90             | 2,77                    | 2,11 | 3,40 | 3,05 | 7,11     | 5,49 | 10,97 | 7,62 | 143,00          | 123,95          |          |  |          |  |
| 6                  | 4       | 168,27            | 114,30            | 2,77                    | 2,11 | 3,40 | 3,05 | 7,11     | 6,02 | 10,97 | 8,56 | 143,00          | 130,30          |          |  |          |  |
| 6                  | 5       | 168,27            | 141,30            | 2,77                    | 2,77 | 3,40 | 9,40 | 7,11     | 6,55 | 10,97 | 9,53 | 143,00          | 136,65          |          |  |          |  |

## Weights (unit: kg)

| Nominal Pipe Size Run | Out-let | Sch. 5S | Sch. 10S | STD Sch. 40S | XS Sch. 80S |
|-----------------------|---------|---------|----------|--------------|-------------|
|                       |         |         |          |              |             |
| 3/4                   | 1/2     | 0,083   | 0,123    | 0,200        | 0,230       |
| 1                     | 1/2     | 0,187   | 0,204    | 0,234        | 0,349       |
| 1                     | 3/4     | 0,187   | 0,212    | 0,244        | 0,353       |
| 1 1/4                 | 3/4     | 0,290   | 0,327    | 0,423        | 0,612       |
| 1 1/4                 | 1       | 0,312   | 0,339    | 0,441        | 0,643       |
| 1 1/2                 | 1/2     | 0,397   | 0,431    | 0,561        | 0,897       |
| 1 1/2                 | 3/4     | 0,397   | 0,446    | 0,578        | 0,901       |
| 1 1/2                 | 1       | 0,421   | 0,461    | 0,600        | 0,929       |
| 1 1/2                 | 1 1/4   | 0,422   | 0,482    | 0,629        | 0,978       |
| 2                     | 3/4     | 0,625   | 0,702    | 1,11         | 1,44        |
| 2                     | 1       | 0,643   | 0,725    | 1,14         | 1,46        |
| 2                     | 1 1/4   | 0,680   | 0,747    | 1,18         | 1,51        |
| 2                     | 1 1/2   | 0,734   | 0,766    | 1,23         | 1,57        |
| 2 1/2                 | 1 1/2   | 0,824   | 1,18     | 2,08         | 2,61        |
| 2 1/2                 | 2       | 0,838   | 1,21     | 2,12         | 2,66        |
| 3                     | 1 1/2   | 1,33    | 1,60     | 2,98         | 3,84        |
| 3                     | 2       | 1,42    | 1,63     | 3,01         | 3,86        |
| 3                     | 2 1/2   | 1,58    | 1,69     | 3,15         | 3,97        |
| 4                     | 1 1/2   | 2,45    | 2,51     | 5,04         | 6,63        |
| 4                     | 2       | 2,47    | 2,53     | 5,08         | 6,70        |
| 4                     | 2 1/2   | 2,52    | 2,59     | 5,22         | 6,79        |
| 4                     | 3       | 2,55    | 2,61     | 5,27         | 6,93        |
| 5                     | 3       | 3,38    | 4,17     | 8,13         | 10,95       |
| 5                     | 4       | 3,43    | 4,24     | 8,36         | 11,18       |
| 6                     | 2 1/2   | 4,62    | 5,69     | 11,87        | 17,05       |
| 6                     | 3       | 4,67    | 5,075    | 11,92        | 17,07       |
| 6                     | 4       | 4,75    | 5,85     | 12,10        | 17,19       |
| 6                     | 5       | 4,80    | 5,92     | 12,34        | 17,47       |

Note: Sch40S and 80S apply up to 12" only

# Reducing Tees



ASME/ASTM SA/A403 WPS (Seamless) ANSI B 16.9  
 ASME/ASTM SA/A403 WPW (Welded) ANSI B 16.9  
 ASME/ASTM SA/A403 WPWX (Welded/100% X Ray) ANSI B 16.9

## Dimensions (unit: mm)

| Nom.<br>Pipe<br>Size<br>Run | Out-<br>let | Out-<br>Side<br>Dia.<br>OD <sub>1</sub> | Out-<br>Side<br>Dia.<br>OD <sub>2</sub> | Wall Thickness (T <sub>1</sub> , T <sub>2</sub> ) |                |                |                |                |                |                |                | Center<br>to<br>End<br>C | Center<br>to<br>End<br>M |
|-----------------------------|-------------|-----------------------------------------|-----------------------------------------|---------------------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------------------|--------------------------|
|                             |             |                                         |                                         | Sch.5S                                            |                | Sch.10S        |                | STD            |                | XS             |                |                          |                          |
|                             |             |                                         |                                         | T <sub>1</sub>                                    | T <sub>2</sub> | T <sub>1</sub> | T <sub>2</sub> | T <sub>1</sub> | T <sub>2</sub> | T <sub>1</sub> | T <sub>2</sub> |                          |                          |
| 8                           | 4           | 219.08                                  | 114.30                                  | 2.77                                              | 2.11           | 3.76           | 3.05           | 8.18           | 6.02           | 12.70          | 8.56           | 177.80                   | 155.70                   |
| 8                           | 5           | 219.08                                  | 141.30                                  | 2.77                                              | 2.77           | 3.76           | 3.40           | 8.18           | 6.55           | 12.70          | 9.53           | 177.80                   | 162.05                   |
| 8                           | 6           | 219.08                                  | 168.27                                  | 2.77                                              | 2.77           | 3.76           | 3.40           | 8.18           | 7.11           | 12.70          | 10.97          | 177.80                   | 168.40                   |
| 10                          | 5           | 273.05                                  | 141.30                                  | 3.40                                              | 2.77           | 4.19           | 3.40           | 9.27           | 6.55           | 12.70          | 9.53           | 215.90                   | 190.50                   |
| 10                          | 6           | 273.05                                  | 168.27                                  | 3.40                                              | 2.77           | 4.19           | 3.40           | 9.27           | 7.11           | 12.70          | 10.97          | 215.90                   | 193.80                   |
| 10                          | 8           | 273.05                                  | 219.08                                  | 3.40                                              | 2.77           | 4.19           | 3.76           | 9.27           | 8.18           | 12.70          | 12.70          | 215.90                   | 203.20                   |
| 12                          | 6           | 323.85                                  | 168.27                                  | 3.96                                              | 2.77           | 4.57           | 3.40           | 9.53           | 7.11           | 12.70          | 10.97          | 254.00                   | 219.20                   |
| 12                          | 10          | 323.85                                  | 273.05                                  | 3.96                                              | 2.64           | 4.57           | 4.19           | 9.53           | 9.27           | 12.70          | 12.70          | 254.00                   | 241.30                   |
| 14                          | 8           | 355.60                                  | 219.08                                  | 4.78                                              | 3.76           | 7.92           | 6.35           | 9.53           | 8.18           | 12.70          | 12.70          | 279.40                   | 247.65                   |
| 14                          | 10          | 355.60                                  | 273.05                                  | 4.78                                              | 4.09           | 7.92           | 6.35           | 9.53           | 9.27           | 12.70          | 12.70          | 279.40                   | 257.30                   |
| 14                          | 12          | 355.60                                  | 323.85                                  | 4.78                                              | 4.57           | 7.92           | 6.35           | 9.53           | 9.53           | 12.70          | 12.70          | 279.40                   | 270.00                   |
| 16                          | 10          | 406.40                                  | 273.05                                  | 4.78                                              | 4.19           | 7.92           | 6.35           | 9.53           | 9.27           | 12.70          | 12.70          | 304.80                   | 282.70                   |
| 16                          | 12          | 406.40                                  | 323.85                                  | 4.78                                              | 4.57           | 7.92           | 6.35           | 9.53           | 9.53           | 12.70          | 12.70          | 304.80                   | 295.40                   |
| 16                          | 14          | 406.40                                  | 335.60                                  | 4.78                                              | 4.78           | 7.92           | 7.92           | 9.53           | 9.53           | 12.70          | 12.70          | 304.80                   | 304.80                   |
| 18                          | 12          | 457.20                                  | 323.85                                  | 4.78                                              | 4.57           | 7.92           | 6.35           | 9.53           | 9.53           | 12.70          | 12.70          | 342.90                   | 320.80                   |
| 18                          | 14          | 457.20                                  | 355.60                                  | 4.78                                              | 4.78           | 7.92           | 7.92           | 9.53           | 9.53           | 12.70          | 12.70          | 342.90                   | 330.20                   |
| 18                          | 16          | 457.20                                  | 406.40                                  | 4.78                                              | 4.78           | 7.92           | 7.92           | 9.53           | 9.53           | 12.70          | 12.70          | 342.90                   | 330.20                   |
| 20                          | 14          | 508.00                                  | 355.60                                  | 5.54                                              | 4.78           | 9.53           | 7.92           | 9.53           | 9.53           | 12.70          | 12.70          | 381.00                   | 355.60                   |
| 20                          | 16          | 508.00                                  | 406.40                                  | 5.54                                              | 4.78           | 9.53           | 7.92           | 9.53           | 9.53           | 12.70          | 12.70          | 381.00                   | 355.60                   |
| 20                          | 18          | 508.00                                  | 457.20                                  | 5.54                                              | 4.78           | 9.53           | 7.92           | 9.53           | 9.53           | 12.70          | 12.70          | 381.00                   | 368.30                   |
| 22                          | 16          | 558.80                                  | 406.40                                  | 5.54                                              | 4.78           | 9.53           | 7.92           | 9.53           | 9.53           | 12.70          | 12.70          | 419.10                   | 381.00                   |
| 22                          | 18          | 558.80                                  | 457.20                                  | 5.54                                              | 4.78           | 9.53           | 7.92           | 9.53           | 9.53           | 12.70          | 12.70          | 419.10                   | 393.70                   |
| 22                          | 20          | 558.80                                  | 508.00                                  | 5.54                                              | 5.54           | 9.53           | 9.53           | 9.53           | 9.53           | 12.70          | 12.70          | 419.10                   | 406.40                   |
| 24                          | 16          | 609.60                                  | 406.40                                  | 6.35                                              | 4.78           | 9.53           | 7.92           | 9.53           | 9.53           | 12.70          | 12.70          | 431.80                   | 406.40                   |
| 24                          | 18          | 609.60                                  | 457.20                                  | 6.35                                              | 4.78           | 9.53           | 7.92           | 9.53           | 9.53           | 12.70          | 12.70          | 431.80                   | 419.10                   |
| 24                          | 20          | 609.60                                  | 508.00                                  | 6.35                                              | 5.54           | 9.53           | 9.53           | 9.53           | 9.53           | 12.70          | 12.70          | 431.80                   | 431.80                   |
| 24                          | 22          | 609.60                                  | 558.80                                  | 6.35                                              | 5.54           | 9.53           | 9.53           | 9.53           | 9.53           | 12.70          | 12.70          | 431.80                   | 431.80                   |

## Weights (unit: kg)

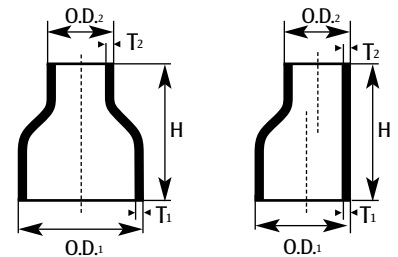
| Nominal<br>Pipe Size<br>Run | Out-<br>let |       |        |          |          |
|-----------------------------|-------------|-------|--------|----------|----------|
|                             |             | Sch.  | Sch.   | STD      | XS       |
|                             |             | 5S    | 10S    | Sch. 40S | Sch. 80S |
| 8                           | 4           | 7.35  | 9.80   | 21.26    | 30.76    |
| 8                           | 5           | 7.41  | 9.83   | 21.36    | 30.85    |
| 8                           | 6           | 7.44  | 9.90   | 21.62    | 31.25    |
| 10                          | 5           | 13.43 | 16.47  | 36.14    | 47.47    |
| 10                          | 6           | 13.49 | 16.58  | 36.27    | 47.95    |
| 10                          | 8           | 13.54 | 16.69  | 36.85    | 48.39    |
| 12                          | 6           | 22.93 | 25.10  | 51.96    | 67.43    |
| 12                          | 10          | 23.13 | 25.48  | 53.72    | 68.81    |
| 14                          | 8           | 28.79 | 52.00  | 57.88    | 75.22    |
| 14                          | 10          | 28.96 | 52.37  | 58.34    | 75.89    |
| 14                          | 12          | 29.14 | 52.73  | 58.81    | 76.57    |
| 16                          | 10          | 34.26 | 61.89  | 68.88    | 89.51    |
| 16                          | 12          | 34.47 | 62.32  | 69.43    | 90.32    |
| 16                          | 14          | 34.67 | 62.76  | 69.98    | 91.12    |
| 18                          | 12          | 43.37 | 78.33  | 87.17    | 113.28   |
| 18                          | 14          | 43.62 | 78.88  | 87.87    | 114.30   |
| 18                          | 16          | 43.89 | 79.43  | 88.57    | 115.33   |
| 20                          | 14          | 64.47 | 107.63 | 107.63   | 139.86   |
| 20                          | 16          | 64.85 | 108.38 | 108.38   | 141.12   |
| 20                          | 18          | 65.24 | 109.24 | 109.14   | 142.39   |
| 22                          | 16          | 78.00 | 130.23 | 130.23   | 169.22   |
| 22                          | 18          | 78.47 | 131.14 | 131.14   | 170.74   |
| 22                          | 20          | 78.94 | 132.06 | 132.06   | 172.88   |
| 24                          | 16          | 96.84 | 138.24 | 138.24   | 179.64   |
| 24                          | 18          | 97.69 | 139.21 | 139.21   | 181.25   |
| 24                          | 20          | 98.00 | 140.18 | 140.18   | 182.89   |
| 24                          | 22          | 98.59 | 141.16 | 141.16   | 184.53   |

Note: Sch 40S and 80S apply up to 12" only



# Concentric & Eccentric Reducers Buttweld

ASME/ASTM SA/A403 WPS (Seamless) ANSI B 16.9  
ASME/ASTM SA/A403 WPW (Welded) ANSI B 16.9  
ASME/ASTM SA/A403 WPWX (Welded/100% X Ray) ANSI B 16.9



## Dimensions (unit: mm)

| Nominal<br>Pipe<br>Size |                | Out-<br>Side<br>Dia.<br>OD <sub>1</sub> | Out-<br>Side<br>Dia.<br>OD <sub>2</sub> | Wall Thickness |                |                |                |          |       |          |        | Length<br><br>H |
|-------------------------|----------------|-----------------------------------------|-----------------------------------------|----------------|----------------|----------------|----------------|----------|-------|----------|--------|-----------------|
|                         |                |                                         |                                         | STD            |                |                |                | XS       |       |          |        |                 |
|                         |                |                                         |                                         | Sch. 5S        |                | Sch. 10S       |                | Sch. 40S |       | Sch. 80S |        |                 |
| T <sub>1</sub>          | T <sub>2</sub> | T <sub>1</sub>                          | T <sub>2</sub>                          | T <sub>1</sub> | T <sub>2</sub> | T <sub>1</sub> | T <sub>2</sub> |          |       |          |        |                 |
| 3/4 1/2                 | 26.67          | 21.34                                   | 1.65                                    | 1.65           | 2.11           | 2.11           | 2.87           | 2.77     | 3.91  | 3.73     | 38.10  |                 |
| 1 1/2                   | 33.40          | 21.34                                   | 1.65                                    | 1.65           | 2.77           | 2.11           | 3.38           | 2.77     | 4.55  | 3.73     | 50.80  |                 |
| 1 3/4                   | 33.40          | 26.67                                   | 1.65                                    | 1.65           | 2.77           | 2.11           | 3.38           | 2.87     | 4.55  | 3.91     | 50.80  |                 |
| 1 1/4 1                 | 42.16          | 33.40                                   | 1.65                                    | 1.65           | 2.77           | 2.77           | 3.56           | 3.38     | 4.85  | 4.55     | 50.80  |                 |
| 1 1/2 1/2               | 48.26          | 21.34                                   | 1.65                                    | 1.65           | 2.77           | 2.11           | 3.68           | 2.77     | 5.08  | 3.73     | 63.50  |                 |
| 1 1/2 3/4               | 48.26          | 26.67                                   | 1.65                                    | 1.65           | 2.77           | 2.11           | 3.68           | 2.87     | 5.008 | 3.91     | 63.50  |                 |
| 1 1/2 1                 | 48.26          | 33.40                                   | 1.65                                    | 1.65           | 2.77           | 2.77           | 3.68           | 3.38     | 5.08  | 4.55     | 63.50  |                 |
| 1 1/2 1 1/4             | 48.26          | 42.16                                   | 1.65                                    | 1.65           | 2.77           | 2.77           | 3.68           | 3.56     | 5.08  | 4.85     | 63.50  |                 |
| 2 3/4                   | 60.32          | 26.67                                   | 1.65                                    | 1.65           | 2.77           | 2.11           | 3.91           | 2.87     | 5.54  | 3.91     | 76.20  |                 |
| 2 1                     | 60.32          | 33.40                                   | 1.65                                    | 1.65           | 2.77           | 2.77           | 3.91           | 3.38     | 5.54  | 4.55     | 76.20  |                 |
| 2 1 1/4                 | 60.32          | 42.16                                   | 1.65                                    | 1.65           | 2.77           | 2.77           | 3.91           | 3.56     | 5.54  | 4.85     | 76.20  |                 |
| 2 1 1/2                 | 60.32          | 48.26                                   | 1.65                                    | 1.65           | 2.77           | 2.77           | 3.91           | 3.68     | 5.54  | 5.08     | 76.20  |                 |
| 2 1/2 1                 | 73.02          | 33.40                                   | 2.11                                    | 1.65           | 3.05           | 2.77           | 5.16           | 3.38     | 7.01  | 4.55     | 88.90  |                 |
| 2 1/2 1 1/4             | 73.02          | 42.16                                   | 2.11                                    | 1.65           | 3.05           | 2.77           | 5.16           | 3.56     | 7.01  | 4.85     | 88.90  |                 |
| 2 1/2 1 1/2             | 73.02          | 48.26                                   | 2.11                                    | 1.65           | 3.05           | 2.77           | 5.16           | 3.68     | 7.01  | 5.08     | 88.90  |                 |
| 2 1/2 2                 | 73.02          | 60.32                                   | 2.11                                    | 1.65           | 3.05           | 2.77           | 5.16           | 3.91     | 7.01  | 5.54     | 88.90  |                 |
| 3 1                     | 88.90          | 33.40                                   | 2.11                                    | 1.65           | 3.05           | 2.77           | 5.49           | 3.38     | 7.62  | 4.55     | 88.90  |                 |
| 3 1 1/4                 | 88.90          | 42.16                                   | 2.11                                    | 1.65           | 3.05           | 2.77           | 5.49           | 3.56     | 7.62  | 4.85     | 88.90  |                 |
| 3 1 1/2                 | 88.90          | 48.26                                   | 2.11                                    | 1.65           | 3.05           | 2.77           | 5.49           | 3.68     | 7.62  | 5.08     | 88.90  |                 |
| 3 2                     | 88.90          | 60.32                                   | 2.11                                    | 1.65           | 3.05           | 2.77           | 5.49           | 3.91     | 7.62  | 5.54     | 88.90  |                 |
| 3 2 1/2                 | 88.90          | 73.02                                   | 2.11                                    | 2.11           | 3.05           | 3.05           | 5.49           | 5.16     | 7.62  | 7.01     | 88.90  |                 |
| 4 1 1/2                 | 114.30         | 48.26                                   | 2.11                                    | 1.65           | 3.05           | 2.77           | 6.02           | 3.68     | 8.56  | 5.08     | 101.60 |                 |
| 4 2                     | 114.30         | 60.32                                   | 2.11                                    | 1.65           | 3.05           | 2.77           | 6.02           | 3.91     | 8.56  | 5.54     | 101.60 |                 |
| 4 2 1/2                 | 114.30         | 73.02                                   | 2.11                                    | 2.11           | 3.05           | 3.05           | 6.02           | 5.16     | 8.56  | 7.01     | 101.60 |                 |
| 4 3                     | 114.30         | 88.90                                   | 2.11                                    | 2.11           | 3.05           | 3.05           | 6.02           | 5.49     | 8.56  | 7.62     | 101.60 |                 |
| 5 3                     | 141.30         | 88.90                                   | 2.77                                    | 2.11           | 3.40           | 3.05           | 6.55           | 5.49     | 9.53  | 7.62     | 127.00 |                 |
| 5 4                     | 141.30         | 114.30                                  | 2.77                                    | 2.11           | 3.40           | 3.05           | 6.55           | 6.02     | 9.53  | 8.56     | 127.00 |                 |
| 6 2 1/2                 | 168.27         | 73.02                                   | 2.77                                    | 2.11           | 3.40           | 3.05           | 7.11           | 5.16     | 10.97 | 7.01     | 139.70 |                 |
| 3 3                     | 168.27         | 88.90                                   | 2.77                                    | 2.11           | 3.40           | 3.05           | 7.11           | 5.49     | 10.97 | 7.62     | 139.70 |                 |
| 6 4                     | 168.27         | 114.30                                  | 2.77                                    | 2.11           | 3.40           | 3.05           | 7.11           | 6.02     | 10.97 | 8.56     | 139.70 |                 |
| 6 5                     | 168.27         | 141.30                                  | 2.77                                    | 2.77           | 3.40           | 3.40           | 7.11           | 6.55     | 10.97 | 9.53     | 139.70 |                 |
| 8 4                     | 219.08         | 114.30                                  | 2.77                                    | 2.11           | 3.76           | 3.05           | 0.18           | 6.02     | 12.70 | 8.56     | 152.40 |                 |
| 8 5                     | 219.08         | 141.30                                  | 2.77                                    | 2.77           | 3.76           | 3.40           | 0.18           | 6.55     | 12.70 | 9.53     | 152.40 |                 |
| 8 6                     | 219.08         | 168.27                                  | 2.77                                    | 2.77           | 3.76           | 3.40           | 0.18           | 7.11     | 12.70 | 10.97    | 152.40 |                 |
| 10 5                    | 273.05         | 141.30                                  | 3.40                                    | 2.77           | 4.19           | 3.40           | 9.27           | 6.55     | 12.70 | 9.53     | 177.80 |                 |
| 10 6                    | 273.05         | 168.27                                  | 3.40                                    | 2.77           | 4.19           | 3.40           | 9.27           | 7.11     | 12.70 | 10.97    | 177.80 |                 |
| 10 8                    | 273.05         | 219.08                                  | 3.40                                    | 2.77           | 4.19           | 3.76           | 9.27           | 8.18     | 12.70 | 12.70    | 177.80 |                 |
| 12 6                    | 323.85         | 168.27                                  | 3.96                                    | 2.77           | 4.57           | 3.40           | 9.53           | 7.11     | 12.70 | 10.97    | 203.20 |                 |
| 12 8                    | 323.85         | 219.08                                  | 3.96                                    | 2.77           | 4.57           | 3.76           | 9.53           | 8.18     | 12.70 | 12.70    | 203.20 |                 |
| 12 10                   | 323.85         | 273.05                                  | 3.96                                    | 3.40           | 4.57           | 4.19           | 9.53           | 9.27     | 12.70 | 12.70    | 203.20 |                 |

Note: Sch 40S and 80S apply up to 12" only

## Weights (unit: kg)

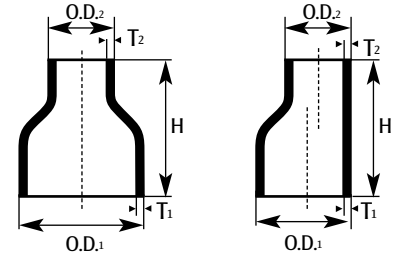
| Nominal<br>Pipe<br>Size |       | STD        |             |             |             |
|-------------------------|-------|------------|-------------|-------------|-------------|
|                         |       | Sch.<br>5S | Sch.<br>10S | Sch.<br>40S | Sch.<br>80S |
| 3/4                     | 1/2   | 0.054      | 0.090       | 0.105       | 0.159       |
| 1                       | 1/2   | 0.060      | 0.089       | 0.105       | 0.163       |
| 1                       | 3/4   | 0.060      | 0.098       | 0.116       | 0.168       |
| 1 1/4                   | 1     | 0.066      | 0.125       | 0.157       | 0.245       |
| 1 1/2                   | 1/2   | 0.091      | 0.154       | 0.204       | 0.276       |
| 1 1/2                   | 3/4   | 0.095      | 0.156       | 0.201       | 0.294       |
| 1 1/2                   | 1     | 0.103      | 0.170       | 0.219       | 0.308       |
| 1 1/2                   | 1 1/4 | 0.118      | 0.195       | 0.263       | 0.331       |
| 2                       | 3/4   | 0.121      | 0.214       | 0.298       | 0.458       |
| 2                       | 1     | 0.143      | 0.237       | 0.322       | 0.458       |
| 2                       | 1 1/4 | 0.156      | 0.258       | 0.352       | 0.525       |
| 2                       | 1 1/2 | 0.164      | 0.273       | 0.372       | 0.544       |
| 2 1/2                   | 1     | 0.453      | 0.349       | 0.793       | 0.793       |
| 2 1/2                   | 1 1/4 | 0.276      | 0.394       | 0.670       | 0.825       |
| 2 1/2                   | 1 1/2 | 0.281      | 0.396       | 0.661       | 0.856       |
| 2 1/2                   | 2     | 0.307      | 0.432       | 0.724       | 0.938       |
| 3                       | 1     | 0.281      | 0.408       | 0.716       | 0.888       |
| 3                       | 1 1/4 | 0.299      | 0.430       | 0.775       | 1.037       |
| 3                       | 1 1/2 | 0.315      | 0.444       | 0.783       | 1.105       |
| 3                       | 2     | 0.339      | 0.478       | 0.846       | 1.178       |
| 3                       | 2 1/2 | 0.376      | 0.548       | 0.983       | 1.291       |
| 4                       | 1 1/2 | 0.435      | 0.630       | 1.241       | 1.730       |
| 4                       | 2     | 0.464      | 0.656       | 1.27        | 1.780       |
| 4                       | 2 1/2 | 0.499      | 0.706       | 1.37        | 2.007       |
| 4                       | 3     | 0.528      | 0.748       | 1.45        | 2.129       |
| 5                       | 3     | 0.991      | 1.20        | 2.27        | 3.547       |
| 5                       | 4     | 1.107      | 1.32        | 2.50        | 3.769       |
| 6                       | 2 1/2 | 1.12       | 1.35        | 2.74        | 4.51        |
| 6                       | 3     | 1.24       | 1.50        | 3.04        | 5.03        |
| 6                       | 4     | 1.34       | 1.62        | 3.30        | 5.44        |
| 6                       | 5     | 1.45       | 1.75        | 3.57        | 5.71        |
| 8                       | 4     | 1.80       | 2.56        | 5.10        | 8.43        |
| 8                       | 5     | 1.90       | 2.70        | 5.40        | 8.83        |
| 8                       | 6     | 2.01       | 2.85        | 5.71        | 9.24        |
| 10                      | 5     | 2.82       | 3.30        | 8.21        | 13.00       |
| 10                      | 6     | 3.30       | 3.87        | 8.78        | 13.50       |
| 10                      | 8     | 3.59       | 4.21        | 9.58        | 14.22       |
| 12                      | 6     | 4.97       | 5.73        | 12.40       | 18.39       |
| 12                      | 8     | 5.45       | 6.11        | 13.70       | 19.07       |
| 12                      | 10    | 5.83       | 6.55        | 14.70       | 19.48       |



# Concentric & Eccentric Reducers Buttweld



ASME/ASTM SA/A403 WPS (Seamless) ANSI B 16.9  
ASME/ASTM SA/A403 WPW (Welded) ANSI B 16.9  
ASME/ASTM SA/A403 WPWX (Welded/100% X Ray) ANSI B 16.9



## Dimensions (unit: mm)

| Nominal<br>Pipe<br>Size | Out-<br>Side<br>Dia.<br>OD <sub>1</sub> | Out-<br>Side<br>Dia.<br>OD <sub>2</sub> | Wall Thickness (T <sub>1</sub> , T <sub>2</sub> ) |                |                |                |                |                |                |                | Length<br><br>H |        |  |  |  |
|-------------------------|-----------------------------------------|-----------------------------------------|---------------------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|--------|--|--|--|
|                         |                                         |                                         | Sch. 10S                                          |                |                |                | STD            |                |                |                |                 | XS     |  |  |  |
|                         |                                         |                                         | T <sub>1</sub>                                    | T <sub>2</sub> | T <sub>1</sub> | T <sub>2</sub> | T <sub>1</sub> | T <sub>2</sub> | T <sub>1</sub> | T <sub>2</sub> |                 |        |  |  |  |
| 14                      | 12                                      | 355.60                                  | 323.85                                            | 4.78           | 4.57           | 792            | 6.35           | 9.53           | 9.53           | 12.70          | 12.70           | 330.20 |  |  |  |
| 14                      | 10                                      | 355.60                                  | 273.05                                            | 4.78           | 4.19           | 792            | 6.35           | 9.53           | 9.27           | 12.70          | 12.70           | 330.20 |  |  |  |
| 14                      | 8                                       | 355.60                                  | 219.08                                            | 4.78           | 3.76           | 792            | 6.35           | 9.53           | 8.18           | 12.70          | 12.70           | 330.20 |  |  |  |
| 14                      | 6                                       | 355.60                                  | 168.27                                            | 4.78           | 3.40           | 792            | -              | 9.53           | 711            | 12.70          | 10.97           | 330.20 |  |  |  |
| 16                      | 14                                      | 406.40                                  | 355.60                                            | 4.78           | 4.78           | 792            | 792            | 9.53           | 9.53           | 12.70          | 12.70           | 355.60 |  |  |  |
| 16                      | 12                                      | 406.40                                  | 323.85                                            | 4.78           | 4.57           | 792            | 6.35           | 9.53           | 9.53           | 12.70          | 12.70           | 355.60 |  |  |  |
| 16                      | 10                                      | 406.40                                  | 273.05                                            | 4.78           | 4.19           | 792            | 6.35           | 9.53           | 9.27           | 12.70          | 12.70           | 355.60 |  |  |  |
| 16                      | 8                                       | 406.40                                  | 219.08                                            | 4.78           | 3.76           | 792            | 6.35           | 9.53           | 8.18           | 12.70          | 12.70           | 355.60 |  |  |  |
| 18                      | 16                                      | 457.20                                  | 406.40                                            | 4.78           | 4.78           | 792            | 792            | 9.53           | 9.53           | 12.70          | 12.70           | 381.00 |  |  |  |
| 18                      | 14                                      | 457.20                                  | 355.60                                            | 4.78           | 4.78           | 792            | 792            | 9.53           | 9.53           | 12.70          | 12.70           | 381.00 |  |  |  |
| 18                      | 12                                      | 457.20                                  | 323.85                                            | 4.78           | 4.57           | 792            | 6.35           | 9.53           | 9.53           | 12.70          | 12.70           | 381.00 |  |  |  |
| 18                      | 10                                      | 457.20                                  | 273.05                                            | 4.78           | 4.19           | 792            | 6.35           | 9.53           | 9.27           | 12.70          | 12.70           | 381.00 |  |  |  |
| 20                      | 18                                      | 508.00                                  | 457.20                                            | 5.54           | 4.78           | 9.53           | 792            | 9.53           | 9.53           | 12.70          | 12.70           | 508.00 |  |  |  |
| 20                      | 16                                      | 508.00                                  | 406.40                                            | 5.54           | 4.78           | 9.53           | 792            | 9.53           | 9.53           | 12.70          | 12.70           | 508.00 |  |  |  |
| 20                      | 14                                      | 508.00                                  | 355.60                                            | 5.54           | 4.78           | 9.53           | 792            | 9.53           | 12.70          | 12.70          | 12.70           | 508.00 |  |  |  |
| 20                      | 12                                      | 508.00                                  | 323.85                                            | 5.54           | 4.57           | 9.53           | 6.35           | 9.53           | 9.53           | 12.70          | 12.70           | 508.00 |  |  |  |
| 22                      | 20                                      | 558.80                                  | 508.00                                            | 5.54           | 5.54           | 9.53           | 9.53           | 9.53           | 9.53           | 12.70          | 12.70           | 508.00 |  |  |  |
| 20                      | 18                                      | 558.80                                  | 457.20                                            | 5.54           | 4.78           | 9.53           | 792            | 9.53           | 9.53           | 12.70          | 12.70           | 508.00 |  |  |  |
| 22                      | 16                                      | 558.80                                  | 406.40                                            | 5.54           | 4.78           | 9.53           | 792            | 9.53           | 9.53           | 12.70          | 12.70           | 508.00 |  |  |  |
| 22                      | 14                                      | 558.80                                  | 355.60                                            | 5.54           | 4.78           | 9.53           | 792            | 9.53           | 9.53           | 12.70          | 12.70           | 508.00 |  |  |  |
| 24                      | 22                                      | 609.60                                  | 558.80                                            | 6.35           | 5.54           | 9.53           | 9.53           | 9.53           | 9.53           | 12.70          | 12.70           | 508.00 |  |  |  |
| 24                      | 20                                      | 609.60                                  | 508.00                                            | 6.35           | 5.54           | 9.53           | 9.53           | 9.53           | 9.53           | 12.70          | 12.70           | 508.00 |  |  |  |
| 24                      | 18                                      | 609.60                                  | 457.20                                            | 6.35           | 4.78           | 9.53           | 792            | 9.53           | 9.53           | 12.70          | 12.70           | 508.00 |  |  |  |
| 24                      | 16                                      | 609.60                                  | 406.40                                            | 6.35           | 4.78           | 9.53           | 792            | 9.53           | 9.53           | 12.70          | 12.70           | 508.00 |  |  |  |
| 24                      | 14                                      | 609.60                                  | 355.60                                            | 6.35           | 4.78           | 9.53           | 792            | 9.53           | 9.53           | 12.70          | 12.70           | 508.00 |  |  |  |
| 26                      | 24                                      | 660.40                                  | 609.60                                            |                |                | 12.70          | 9.53           | 9.53           | 9.53           | 12.70          | 12.70           | 609.60 |  |  |  |
| 26                      | 20                                      | 660.40                                  | 508.00                                            |                |                | 12.70          | 9.53           | 9.53           | 9.53           | 12.70          | 12.70           | 609.60 |  |  |  |
| 26                      | 18                                      | 660.40                                  | 457.20                                            |                |                | 12.70          | 792            | 9.53           | 9.53           | 12.70          | 12.70           | 609.60 |  |  |  |
| 26                      | 16                                      | 660.40                                  | 406.40                                            |                |                | 12.70          | 792            | 9.53           | 9.53           | 12.70          | 12.70           | 609.60 |  |  |  |
| 28                      | 26                                      | 711.20                                  | 660.40                                            |                |                | 12.70          | 12.70          | 9.53           | 9.53           | 12.70          | 12.70           | 609.60 |  |  |  |
| 28                      | 24                                      | 711.20                                  | 609.60                                            |                |                | 12.70          | 9.53           | 9.53           | 9.53           | 12.70          | 12.70           | 609.60 |  |  |  |
| 28                      | 20                                      | 711.20                                  | 508.00                                            |                |                | 12.70          | 9.53           | 9.53           | 9.53           | 12.70          | 12.70           | 609.60 |  |  |  |
| 28                      | 18                                      | 711.20                                  | 457.20                                            |                |                | 12.70          | 792            | 9.53           | 9.53           | 12.70          | 12.70           | 609.60 |  |  |  |
| 30                      | 28                                      | 762.00                                  | 711.20                                            |                |                | 12.70          | 12.70          | 9.53           | 9.53           | 12.70          | 12.70           | 609.60 |  |  |  |
| 30                      | 26                                      | 762.00                                  | 660.40                                            |                |                | 12.70          | 12.70          | 9.53           | 9.53           | 12.70          | 12.70           | 609.60 |  |  |  |
| 30                      | 24                                      | 762.00                                  | 609.60                                            |                |                | 12.70          | 9.53           | 9.53           | 9.53           | 12.70          | 12.70           | 609.60 |  |  |  |
| 30                      | 20                                      | 762.00                                  | 508.00                                            |                |                | 12.70          | 9.53           | 9.53           | 9.53           | 12.70          | 12.70           | 609.60 |  |  |  |
| 32                      | 30                                      | 812.80                                  | 762.00                                            |                |                | 12.70          | 12.70          | 9.53           | 9.53           | 12.70          | 12.70           | 609.60 |  |  |  |
| 32                      | 28                                      | 812.80                                  | 711.20                                            |                |                | 12.70          | 12.70          | 9.53           | 9.53           | 12.70          | 12.70           | 609.60 |  |  |  |

Note: Sch 40S and 80S apply up to 12" only

## Weights (unit: kg)

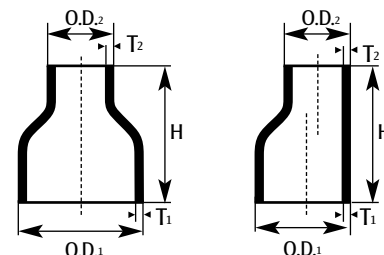
| Nominal<br>Pipe<br>Size |    |             |            |                    |                   |
|-------------------------|----|-------------|------------|--------------------|-------------------|
|                         |    | Sch.<br>10S | Sch.<br>20 | STD<br>Sch.<br>40S | XS<br>Sch.<br>80S |
| 14                      | 12 | 14.27       | 25.65      | 28.55              | 37.18             |
| 14                      | 10 | 13.21       | 23.73      | 26.41              | 34.40             |
| 14                      | 8  | 12.07       | 21.70      | 24.15              | 31.44             |
| 14                      | 6  | 11.01       | 19.78      | 22.01              | 28.66             |
| 16                      | 14 | 17.24       | 30.98      | 34.48              | 44.90             |
| 16                      | 12 | 16.52       | 29.69      | 33.05              | 43.03             |
| 16                      | 10 | 15.37       | 27.62      | 30.75              | 40.04             |
| 16                      | 8  | 14.15       | 25.43      | 28.30              | 36.86             |
| 18                      | 16 | 20.94       | 37.62      | 41.87              | 54.52             |
| 18                      | 14 | 19.71       | 35.41      | 39.41              | 51.32             |
| 18                      | 12 | 18.94       | 34.02      | 37.87              | 49.32             |
| 18                      | 10 | 17.70       | 31.81      | 35.41              | 46.11             |
| 20                      | 18 | 38.01       | 62.40      | 62.40              | 81.25             |
| 20                      | 16 | 36.01       | 59.11      | 59.11              | 76.97             |
| 20                      | 14 | 33.98       | 55.83      | 55.83              | 72.70             |
| 20                      | 12 | 32.76       | 53.78      | 53.78              | 70.02             |
| 22                      | 20 | 42.01       | 68.96      | 68.96              | 89.80             |
| 22                      | 15 | 40.01       | 65.68      | 65.68              | 85.53             |
| 22                      | 16 | 38.01       | 62.40      | 62.40              | 81.25             |
| 22                      | 14 | 36.01       | 59.08      | 59.08              | 76.97             |
| 24                      | 22 | 52.91       | 75.53      | 75.53              | 98.36             |
| 24                      | 20 | 50.61       | 72.25      | 72.25              | 94.08             |
| 24                      | 18 | 48.31       | 68.96      | 68.96              | 89.80             |
| 24                      | 16 | 46.01       | 65.68      | 65.68              | 85.53             |
| 24                      | 14 | 43.71       | 62.40      | 62.40              | 81.25             |
| 26                      | 24 |             | 128.28     | 98.53              | 128.03            |
| 26                      | 20 |             | 118.02     | 90.65              | 117.79            |
| 26                      | 18 |             | 112.88     | 86.70              | 112.66            |
| 26                      | 16 |             | 107.76     | 82.76              | 107.54            |
| 28                      | 26 |             | 138.54     | 106.41             | 138.27            |
| 28                      | 24 |             | 133.41     | 102.47             | 133.15            |
| 28                      | 20 |             | 123.15     | 94.59              | 122.91            |
| 28                      | 18 |             | 118.02     | 90.65              | 117.78            |
| 30                      | 28 |             | 148.80     | 114.29             | 148.51            |
| 30                      | 26 |             | 143.67     | 110.35             | 143.39            |
| 30                      | 24 |             | 138.54     | 106.41             | 138.27            |
| 30                      | 20 |             | 128.28     | 98.53              | 128.03            |
| 32                      | 30 |             | 159.07     | 122.17             | 158.75            |
| 32                      | 28 |             | 153.93     | 118.23             | 153.63            |





# Concentric & Eccentric Reducers Buttweld

ASME/ASTM SA/A403 WPS (Seamless) ANSI B 16.9  
ASME/ASTM SA/A403 WPW (Welded) ANSI B 16.9  
ASME/ASTM SA/A403 WPWX (Welded/100% X Ray) ANSI B 16.9



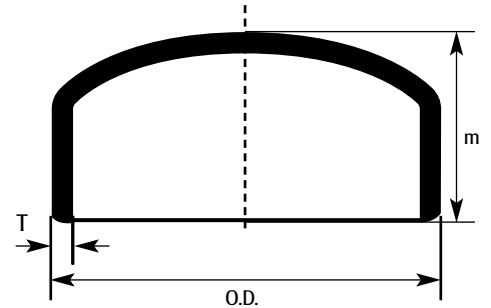
## Dimensions (unit: mm)

| Nominal<br>Pipe<br>Size |    | Out-<br>Side<br>Dia.<br>OD <sub>1</sub> | Out-<br>Side<br>Dia.<br>OD <sub>2</sub> | Wall Thickness (T <sub>1</sub> , T <sub>2</sub> ) |                |                |                |                |                |                |                | Length<br><br>H |
|-------------------------|----|-----------------------------------------|-----------------------------------------|---------------------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|
|                         |    |                                         |                                         | STD                                               |                |                |                |                |                | XS             |                |                 |
|                         |    |                                         |                                         | Sch. 10S                                          |                | Sch. 20        |                | Sch. 40S       |                | Sch. 80S       |                |                 |
|                         |    |                                         |                                         | T <sub>1</sub>                                    | T <sub>2</sub> | T <sub>1</sub> | T <sub>2</sub> | T <sub>1</sub> | T <sub>2</sub> | T <sub>1</sub> | T <sub>2</sub> |                 |
| 32                      | 26 | 812.80                                  | 660.40                                  |                                                   |                | 12.70          | 12.70          | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 32                      | 24 | 812.80                                  | 609.60                                  |                                                   |                | 12.70          | 9.53           | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 34                      | 32 | 863.60                                  | 812.80                                  |                                                   |                | 12.70          | 12.70          | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 34                      | 30 | 863.60                                  | 762.00                                  |                                                   |                | 12.70          | 12.70          | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 34                      | 28 | 863.60                                  | 711.20                                  |                                                   |                | 12.70          | 12.70          | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 34                      | 26 | 863.60                                  | 660.40                                  |                                                   |                | 12.70          | 12.70          | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 36                      | 34 | 914.40                                  | 863.60                                  |                                                   |                | 12.70          | 12.70          | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 36                      | 32 | 914.40                                  | 812.80                                  |                                                   |                | 12.70          | 12.70          | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 36                      | 30 | 914.40                                  | 762.00                                  |                                                   |                | 12.70          | 12.70          | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 36                      | 28 | 914.40                                  | 711.20                                  |                                                   |                | 12.70          | 12.70          | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 38                      | 36 | 965.20                                  | 914.40                                  |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 38                      | 34 | 965.20                                  | 863.60                                  |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 38                      | 32 | 965.20                                  | 812.80                                  |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 38                      | 30 | 965.20                                  | 762.00                                  |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 38                      | 28 | 965.20                                  | 711.20                                  |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 38                      | 26 | 965.20                                  | 660.40                                  |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 40                      | 38 | 1016.00                                 | 965.20                                  |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 40                      | 36 | 1016.00                                 | 914.40                                  |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 40                      | 34 | 1016.00                                 | 863.60                                  |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 40                      | 32 | 1016.00                                 | 812.80                                  |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 40                      | 30 | 1016.00                                 | 762.00                                  |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 42                      | 40 | 1066.80                                 | 1016.00                                 |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 42                      | 38 | 1066.80                                 | 965.20                                  |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 42                      | 36 | 1066.80                                 | 914.40                                  |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 42                      | 34 | 1066.80                                 | 863.60                                  |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 42                      | 32 | 1066.80                                 | 812.80                                  |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 42                      | 30 | 1066.80                                 | 762.00                                  |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 44                      | 42 | 1117.60                                 | 1066.80                                 |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 44                      | 40 | 1117.60                                 | 1016.00                                 |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 44                      | 38 | 1117.60                                 | 965.20                                  |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 44                      | 36 | 1117.60                                 | 914.40                                  |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 609.60          |
| 46                      | 44 | 1168.40                                 | 1117.60                                 |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 711.20          |
| 46                      | 42 | 1168.40                                 | 1066.80                                 |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 711.20          |
| 46                      | 40 | 1168.40                                 | 1016.00                                 |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 711.20          |
| 46                      | 38 | 1168.40                                 | 965.20                                  |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 711.20          |
| 46                      | 36 | 1168.40                                 | 914.40                                  |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 711.20          |
| 48                      | 44 | 1219.20                                 | 1117.60                                 |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 711.20          |
| 48                      | 42 | 1219.20                                 | 1066.80                                 |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 711.20          |
| 48                      | 40 | 1219.20                                 | 1016.00                                 |                                                   |                |                |                | 9.53           | 9.53           | 12.70          | 12.70          | 711.20          |
|                         |    |                                         |                                         |                                                   |                |                |                |                |                |                |                |                 |

Note: Sch 40S and 80S apply up to 12" only

## Weights (unit: kg)

| Nominal<br>Pipe<br>Size | Sch.<br>10S | Sch.<br>20 | STD<br>Sch.<br>40S | XS<br>Sch.<br>80S |
|-------------------------|-------------|------------|--------------------|-------------------|
|                         |             |            |                    |                   |
|                         |             |            |                    |                   |
| 32 26                   |             | 148.80     | 114.29             | 148.51            |
| 32 24                   |             | 143.67     | 110.40             | 143.39            |
| 34 32                   |             | 169.33     | 130.06             | 168.99            |
| 34 30                   |             | 164.20     | 126.12             | 163.88            |
| 34 28                   |             | 159.07     | 122.17             | 158.75            |
| 34 26                   |             | 153.93     | 118.51             | 153.63            |
| 36 34                   |             | 179.59     | 137.94             | 179.24            |
| 36 32                   |             | 174.46     | 133.99             | 174.12            |
| 36 30                   |             | 169.33     | 130.06             | 168.99            |
| 36 28                   |             | 164.20     | 126.12             | 163.88            |
| 38 36                   |             |            | 145.82             | 189.48            |
| 38 34                   |             |            | 141.88             | 184.36            |
| 38 32                   |             |            | 137.94             | 179.24            |
| 38 30                   |             |            | 133.99             | 174.12            |
| 38 28                   |             |            | 130.06             | 168.99            |
| 38 26                   |             |            | 126.12             | 163.88            |
| 40 38                   |             |            | 153.70             | 199.72            |
| 40 36                   |             |            | 149.76             | 194.60            |
| 40 34                   |             |            | 145.82             | 189.46            |
| 40 32                   |             |            | 141.88             | 184.36            |
| 40 30                   |             |            | 137.94             | 179.24            |
| 42 40                   |             |            | 161.59             | 209.97            |
| 42 38                   |             |            | 157.64             | 204.85            |
| 42 36                   |             |            | 153.70             | 199.72            |
| 42 34                   |             |            | 149.76             | 194.60            |
| 42 32                   |             |            | 145.82             | 189.48            |
| 42 30                   |             |            | 141.88             | 184.36            |
| 44 42                   |             |            | 169.47             | 220.21            |
| 44 40                   |             |            | 165.53             | 215.09            |
| 44 38                   |             |            | 161.59             | 209.97            |
| 44 36                   |             |            | 157.64             | 204.85            |
| 46 44                   |             |            | 177.35             | 230.45            |
| 46 42                   |             |            | 173.41             | 225.33            |
| 46 40                   |             |            | 169.47             | 220.21            |
| 46 38                   |             |            | 165.53             | 215.09            |
| 46 36                   |             |            | 165.53             | 215.09            |
| 48 44                   |             |            | 181.29             | 235.57            |
| 48 42                   |             |            | 177.35             | 230.45            |
| 48 40                   |             |            | 173.41             | 225.33            |



ASME/ASTM SA/A403 WPS (Seamless) ANSI B 16-9.

## Dimensions (unit: mm)

| Nominal<br>Pipe<br>Size | Outside<br>Dia.<br>(OD) | Wall Thickness (T) |         |                |               | Centre<br>to End<br>E |
|-------------------------|-------------------------|--------------------|---------|----------------|---------------|-----------------------|
|                         |                         | Sch.5S             | Sch.10S | STD<br>Sch.40S | XS<br>Sch.80S |                       |
| 1/2                     | 21.34                   | 1.65               | 2.11    | 2.77           | 3.73          | 25.40                 |
| 3/4                     | 26.67                   | 1.65               | 2.11    | 2.87           | 3.91          | 25.40                 |
| 1                       | 33.40                   | 1.65               | 2.77    | 3.38           | 4.55          | 38.10                 |
| 1 1/4                   | 42.16                   | 1.65               | 2.77    | 3.56           | 4.85          | 38.10                 |
| 1 1/2                   | 48.26                   | 1.65               | 2.77    | 3.68           | 5.08          | 38.10                 |
| 2                       | 60.32                   | 1.65               | 2.77    | 3.91           | 5.54          | 38.10                 |
| 2 1/2                   | 73.02                   | 2.11               | 3.05    | 5.16           | 7.01          | 50.80                 |
| 3                       | 88.90                   | 2.11               | 3.05    | 5.49           | 7.62          | 63.50                 |
| 4                       | 114.30                  | 2.11               | 3.05    | 6.02           | 8.56          | 76.20                 |
| 5                       | 141.30                  | 2.77               | 3.40    | 6.55           | 9.53          | 88.90                 |
| 6                       | 168.27                  | 2.77               | 3.40    | 7.11           | 10.97         | 101.60                |
| 8                       | 219.08                  | 2.77               | 3.76    | 8.18           | 12.70         | 127.00                |
| 10                      | 273.00                  | 3.40               | 4.19    | 9.53           | 12.70         | 152.40                |
| 12                      | 323.85                  | 3.96               | 4.57    | 9.53           | 12.70         | 177.80                |
| 14                      | 355.60                  |                    | 4.78    | 9.53           | 12.70         | 190.50                |
| 16                      | 406.40                  |                    | 4.78    | 9.53           | 12.70         | 203.20                |
| 18                      | 457.20                  |                    | 4.78    | 9.53           | 12.70         | 228.60                |
| 20                      | 508.00                  |                    | 5.54    | 9.53           | 12.70         | 254.00                |
| 24                      | 609.60                  |                    | 6.35    | 9.53           | 12.70         | 304.80                |

Note: Sch 40S and 80S apply up to 12" only

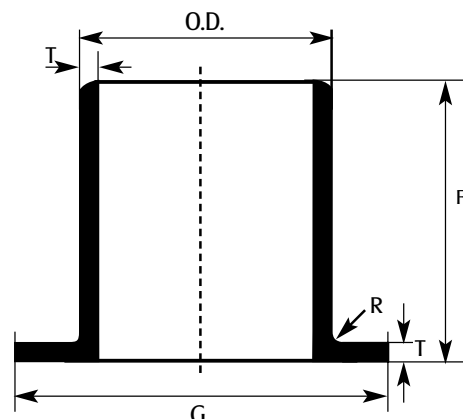
## Weights (unit: kg)

| Nominal<br>Pipe<br>Size | Sch.5S | Sch.10S | STD<br>Sch.40S | XS<br>Sch.80S |
|-------------------------|--------|---------|----------------|---------------|
| 1/2                     | 0.036  | 0.040   | 0.046          | 0.045         |
| 3/4                     | 0.049  | 0.052   | 0.059          | 0.086         |
| 1                       | 0.053  | 0.090   | 0.109          | 0.109         |
| 1 1/4                   | 0.066  | 0.113   | 0.145          | 0.159         |
| 1 1/2                   | 0.076  | 0.130   | 0.171          | 0.222         |
| 2                       | 0.099  | 0.168   | 0.234          | 0.344         |
| 2 1/2                   | 0.169  | 0.242   | 0.420          | 0.512         |
| 3                       | 0.253  | 0.362   | 0.664          | 0.888         |
| 4                       | 0.409  | 0.585   | 1.17           | 1.51          |
| 5                       | 0.805  | 0.978   | 1.90           | 2.89          |
| 6                       | 1.11   | 1.35    | 2.83           | 4.24          |
| 8                       | 1.74   | 2.49    | 5.11           | 7.76          |
| 10                      | 3.26   | 3.84    | 8.92           | 13.11         |
| 12                      | 5.47   | 6.15    | 14.10          | 17.94         |
| 14                      | 7.19   | 7.85    | 16.35          | 21.11         |
| 16                      | 10.99  | 9.56    | 18.60          | 25.73         |
| 18                      | 13.92  | 12.10   | 23.54          | 32.57         |
| 20                      | 17.19  | 17.90   | 29.06          | 40.21         |
| 24                      | 27.43  | 30.15   | 41.85          | 57.86         |



# Stub Ends, Type A. B

ASME/ASTM SA/A403 WPS (Seamless) ANSI B 16-9  
 ASME/ASTM SA/A403 WPW (Welded) ANSI B 16-9  
 ASME/ASTM SA/A403 WPWX (Welded/100% X Ray) ANSI B 16-9



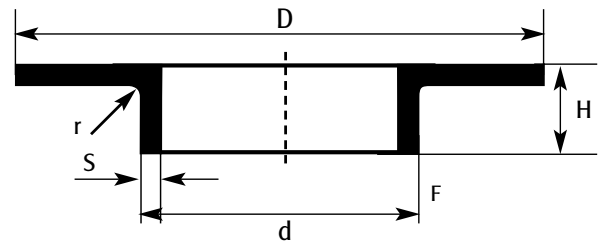
## Dimensions (unit: mm)

| Nom. Pipe Size | Out-Side Dia. (OD) | Wall Thickness (T) |          |             |            | Dia. of Lap (G) | Length F |        | Radius R     |              |
|----------------|--------------------|--------------------|----------|-------------|------------|-----------------|----------|--------|--------------|--------------|
|                |                    | Sch.5S             | Sch. 10S | STD Sch.40S | XS Sch.80S |                 | ANSI     | MSS    | Type A (Max) | Type B (Max) |
| 1/2            | 21.34              | 1.65               | 2.11     | 2.77        | 3.73       | 34.93           | 76.20    | 50.80  | 3.30         | 0.76         |
| 3/4            | 26.67              | 1.65               | 2.11     | 2.87        | 3.91       | 42.88           | 76.20    | 50.80  | 3.30         | 0.76         |
| 1              | 33.40              | 1.65               | 2.77     | 3.38        | 4.55       | 50.80           | 101.60   | 50.80  | 3.30         | 0.76         |
| 1 1/4          | 42.16              | 1.65               | 2.77     | 3.56        | 4.85       | 63.50           | 101.60   | 50.80  | 4.83         | 0.76         |
| 1 1/2          | 48.26              | 1.65               | 2.77     | 3.68        | 5.08       | 73.02           | 101.60   | 50.80  | 6.35         | 0.76         |
| 2              | 60.32              | 1.65               | 2.77     | 3.91        | 5.54       | 92.07           | 152.40   | 63.50  | 7.87         | 0.76         |
| 2 1/2          | 73.02              | 2.11               | 3.05     | 5.16        | 7.01       | 104.77          | 152.40   | 63.50  | 7.87         | 0.76         |
| 3              | 88.90              | 2.11               | 3.05     | 5.49        | 7.62       | 127.00          | 152.40   | 63.50  | 9.65         | 0.76         |
| 4              | 114.30             | 2.11               | 3.05     | 6.02        | 8.56       | 157.18          | 152.40   | 76.20  | 11.18        | 0.76         |
| 5              | 141.30             | 2.77               | 3.40     | 6.55        | 9.53       | 185.75          | 203.20   | 76.20  | 11.18        | 1.52         |
| 6              | 168.27             | 2.77               | 3.40     | 7.11        | 10.97      | 215.90          | 203.20   | 88.90  | 12.70        | 1.52         |
| 8              | 219.08             | 2.77               | 3.76     | 8.18        | 12.70      | 269.88          | 203.20   | 101.60 | 12.70        | 1.52         |
| 10             | 273.05             | 3.40               | 4.19     | 9.27        | 12.70      | 323.85          | 254.00   | 127.00 | 12.70        | 1.52         |
| 12             | 323.85             | 3.96               | 4.57     | 9.53        | 12.70      | 381.00          | 254.00   | 152.40 | 12.70        | 1.52         |
| 14             | 355.60             | 3.96               | 4.78     | 9.53        | 12.70      | 412.75          | 304.80   | 152.40 | 12.70        | 1.52         |
| 16             | 406.40             | 4.19               | 4.78     | 9.53        | 12.70      | 469.90          | 304.80   | 152.40 | 12.70        | 1.52         |
| 18             | 457.20             | 4.19               | 4.78     | 9.53        | 12.70      | 533.40          | 304.80   | 152.40 | 12.70        | 1.52         |
| 20             | 508.00             | 4.78               | 5.54     | 9.53        | 12.70      | 584.20          | 304.80   | 152.40 | 12.70        | 1.52         |
| 22             | 558.80             | 4.78               | 5.54     | 9.53        | 12.70      | 641.35          | 304.80   | -      | 12.70        | 1.52         |
| 24             | 609.60             | 5.54               | 6.35     | 9.53        | 12.70      | 692.15          | 304.80   | 152.40 | 12.70        | 1.52         |

Note: Sch 40S and 80S apply up to 12" only

## Weights (unit: kg)

| Nominal Pipe Size | F   | Sch. 5S | Sch. 10S | STD Sch. 40S | XS Sch. 80S |
|-------------------|-----|---------|----------|--------------|-------------|
| 1/2               | MSS | 0.059   | 0.077    | 0.118        | 0.127       |
| 3/4               | MSS | 0.068   | 0.086    | 0.154        | 0.168       |
| 1                 | MSS | 0.091   | 0.140    | 0.186        | 0.240       |
| 1 1/4             | MSS | 0.131   | 0.208    | 0.263        | 0.349       |
| 1 1/2             | MSS | 0.159   | 0.249    | 0.376        | 0.458       |
| 2                 | MSS | 0.245   | 0.376    | 0.539        | 0.743       |
| 2 1/2             | MSS | 0.349   | 0.471    | 0.797        | 1.060       |
| 3                 | MSS | 0.467   | 0.638    | 1.133        | 1.508       |
| 4                 | MSS | 0.711   | 0.978    | 1.812        | 2.523       |
| 5                 | MSS | 1.046   | 1.237    | 2.537        | 3.601       |
| 6                 | MSS | 1.62    | 1.95     | 3.72         | 5.57        |
| 8                 | MSS | 2.45    | 3.10     | 5.89         | 10.12       |
| 10                | MSS | 4.04    | 4.86     | 10.42        | 13.95       |
| 12                | MSS | 6.60    | 7.11     | 14.95        | 19.93       |
| 14                | MSS | 6.43    | 7.75     | 15.46        | 20.62       |
| 16                | MSS | 7.91    | 9.02     | 17.98        | 23.98       |
| 18                | MSS | 9.24    | 10.53    | 21.00        | 28.00       |
| 20                | MSS | 11.68   | 13.54    | 23.30        | 31.07       |
| 22                | MSS |         |          |              |             |
| 24                | MSS | 16.52   | 18.94    | 28.41        | 37.88       |

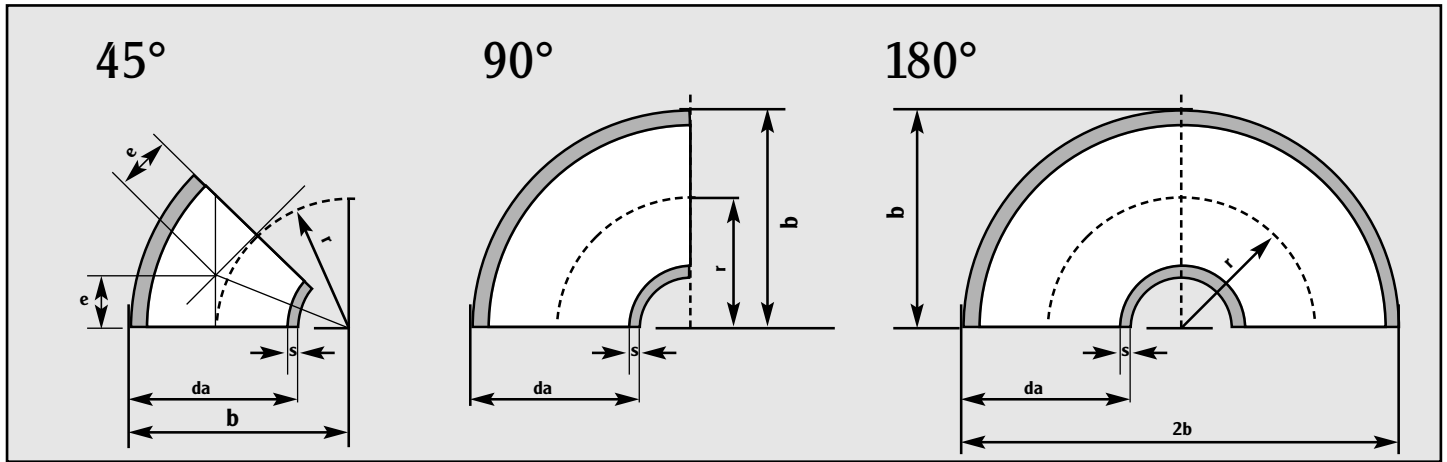


| Nominal diameter | Diameter in inches | d      | D    | r | H  | s                                                   |
|------------------|--------------------|--------|------|---|----|-----------------------------------------------------|
| 10               | 3/8"               | 17.2   | 40   | 3 | 9  | As per ANSI B36-10/B36-19 or customer specification |
| 15               | 1/2"               | 21.3   | 45   | 3 | 9  |                                                     |
| 20               | 1/2"               | 26.9   | 58   | 3 | 12 |                                                     |
| 25               | 1"                 | 33.7   | 68   | 4 | 15 |                                                     |
| 32               | 1 1/4"             | 42.4   | 78   | 4 | 15 |                                                     |
| 40               | 1 1/2"             | 48.3   | 88   | 4 | 17 |                                                     |
| 50               | 2"                 | 60.3   | 102  | 5 | 23 |                                                     |
| 65               | 2 1/2"             | 73     | 122  | 5 | 23 |                                                     |
| 80               | 3"                 | 88.9   | 138  | 5 | 23 |                                                     |
| 100              | 4"                 | 114.3  | 158  | 5 | 28 |                                                     |
| 125              | 5"                 | 141.3  | 188  | 5 | 30 |                                                     |
| 150              | 6"                 | 168.3  | 212  | 5 | 30 |                                                     |
| 200              | 8"                 | 219.1  | 268  | 5 | 30 |                                                     |
| 250              | 10"                | 273.2  | 320  | 5 | 30 |                                                     |
| 300              | 12"                | 323.9  | 370  | 6 | 35 |                                                     |
| 350              | 14"                | 355.6  | 430  | 6 | -  |                                                     |
| 400              | 16"                | 406.4  | 482  | 6 | -  |                                                     |
| 450              | 18"                | 457.2  | 532  | 6 | -  |                                                     |
| 500              | 20"                | 508    | 585  | 6 | -  |                                                     |
| 600              | 24"                | 609.6  | 685  | 7 | -  |                                                     |
| 700              | 28"                | 711.2  | 800  | 7 | -  |                                                     |
| 800              | 32"                | 812.8  | 905  | 7 | -  |                                                     |
| 900              | 36"                | 914.4  | 1005 | 7 | -  |                                                     |
| 1000             | 40"                | 1016   | 1110 | 8 | -  |                                                     |
| 1200             | 48"                | 1219.2 | 1330 | 8 | -  |                                                     |

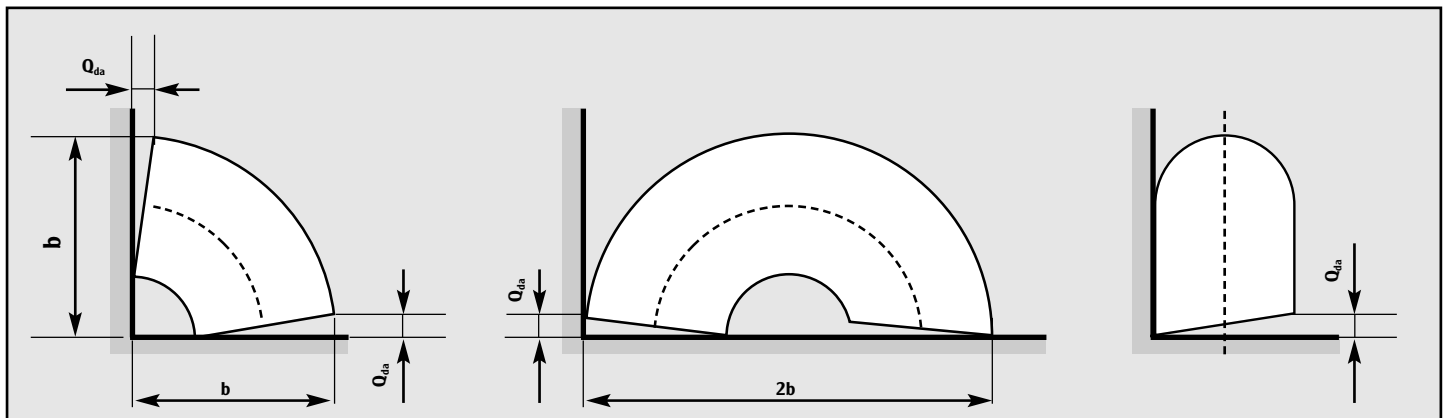


# Elbows Design 2, 3, 5

DIN 2605 PART 1



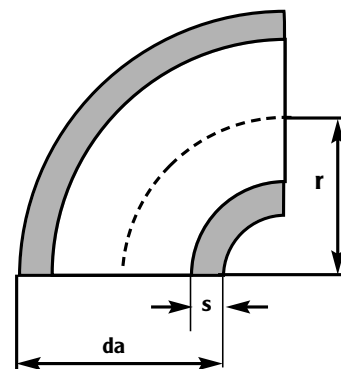
## Tolerances



| Outside Ø   | Standard |        |        |       |            |                        |                 |        |           | Special Requirements |        |
|-------------|----------|--------|--------|-------|------------|------------------------|-----------------|--------|-----------|----------------------|--------|
|             | da       | Q      | b      |       | 2b<br>180° | Wall<br>thickness<br>S | Ovality         |        | di        | da                   | Q      |
|             |          |        | 45°    | 90°   |            |                        | Welding<br>edge | body   |           |                      |        |
| mm          | mm       |        | mm     | mm    | mm         |                        |                 |        |           |                      |        |
| 21,3 - 76,1 | ± 1%     | 1%     | ± 6    | ± 2,5 | ± 8,0      | Smin                   | perm.           | 4%     | di min:   | ± 0,4 mm             | 0,5%   |
| - 114,3     | min.     | v. da  | ± 7    | ± 7   | ± 9,0      | (Body):                | da              | 4%     | 0,8 x     | ± 0,4 mm             | v. da  |
| - 219,1     | 0,5 mm   | min.   | ± 8,5  | ± 3,5 | ± 10,0     | - 12,5%                | tolerance       | 4%     | di-Tube   | ± 0,5%               | min.   |
| - 273       |          | 1,0 mm | ± 9,5  | ± 4,0 | ± 14,0     |                        | 2%              | 4%     | theor. di | ± 0,6%               | 0,5 mm |
| - 457       |          |        | ± 12,0 | ± 5,0 | ± 14,0     | Smax                   | 2%              | 4%     | ± 0,6%    |                      |        |
| - 610       |          |        | ± 14,5 | ± 6,0 | ± 16,0     | (Welding               | 2%              | 4%     | ± 0,6%    |                      |        |
| - 711       |          |        | ± 14,5 | ± 6,0 | edge)      | 2%                     | 4%              | ± 0,6% |           |                      |        |
| - 1016      |          |        | ± 19,0 | ± 8,0 |            | + 15%                  | 2%              | 4%     |           | ± 0,6%               |        |

# Elbows

## DIN 2605 90°



### Dimensions (unit: mm)

| Outside<br>Ø da mm | Radius r mm   | Wall Thickn.<br>s mm | Weight/kg<br>Design |      |      |
|--------------------|---------------|----------------------|---------------------|------|------|
|                    |               |                      | 2                   | 3    | 5    |
| 21.3               |               | 2                    | 0.03                | 0.04 | 0.06 |
|                    | 2: 17.5 ± 2.5 | 2.3                  | 0.03                | 0.05 | 0.07 |
|                    | 3: 28 ± 2.5   | 2.6                  | 0.03                | 0.05 | 0.08 |
|                    | 5: 42.5 ± 2.5 | 3.2                  | 0.04                | 0.06 | 0.10 |
| 26.9               |               | 2.3                  | 0.05                | 0.06 | 0.13 |
|                    | 2: 25 ± 2.5   | 2.9                  | 0.06                | 0.08 | 0.16 |
|                    | 3: 29 ± 2.5   | 3.2                  | 0.07                | 0.08 | 0.17 |
|                    | 5: 57.5 ± 2.5 | 4                    | 0.09                | 0.10 | 0.20 |
| 31.8               |               | 2.6                  | 0.08                | 0.10 | 0.20 |
|                    | 2: 27.5 ± 2.5 | 2.9                  | 0.09                | 0.11 | 0.22 |
|                    | 3: 35 ± 2.5   | 3.2                  | 0.10                | 0.12 | 0.24 |
|                    | 5: 67.5 ± 2.5 | 3.6                  | 0.11                | 0.14 | 0.27 |
| 33.7               |               | 2.6                  | 0.09                | 0.12 | 0.23 |
|                    | 2: 25 ± 2.5   | 3.2                  | 0.11                | 0.14 | 0.27 |
|                    | 3: 38 ± 2.5   | 3.6                  | 0.13                | 0.16 | 0.30 |
|                    | 5: 72.5 ± 2.5 | 4                    | 0.14                | 0.17 | 0.33 |
| 38                 |               | 2.6                  | 0.13                | 0.16 | 0.29 |
|                    | 2: 32.5 ± 2.5 | 2.9                  | 0.13                | 0.18 | 0.33 |
|                    | 3: 45 ± 2.5   | 3.2                  | 0.14                | 0.19 | 0.36 |
|                    | 5: 82.5 ± 2.5 | 3.6                  | 0.16                | 0.22 | 0.40 |
| 42.4               |               | 2.6                  | 0.15                | 0.19 | 0.37 |
|                    | 2: 32 ± 2.5   | 3.6                  | 0.20                | 0.26 | 0.50 |
|                    | 3: 48 ± 2.5   | 4                    | 0.22                | 0.28 | 0.55 |
|                    | 5: 92.5 ± 2.5 | 4.5                  | 0.25                | 0.31 | 0.61 |
|                    |               | 5                    | 0.27                | 0.34 | 0.67 |
| 44.5               |               | 2.6                  | 0.17                | 0.22 | 0.41 |
|                    | 2: 40 ± 2.5   | 2.9                  | 0.19                | 0.24 | 0.46 |
|                    | 3: 51 ± 2.5   | 3.2                  | 0.20                | 0.26 | 0.50 |
|                    | 5: 97.5 ± 2.5 | 3.6                  | 0.23                | 0.29 | 0.56 |
| 48.3               |               | 2.6                  | 0.20                | 0.26 | 0.49 |
|                    | 2: 38 ± 3     | 3.2                  | 0.24                | 0.32 | 0.60 |
|                    | 3: 57 ± 3     | 3.6                  | 0.26                | 0.36 | 0.67 |
|                    | 5: 107.5 ± 3  | 4                    | 0.29                | 0.39 | 0.74 |
|                    |               | 4.5                  | 0.32                | 0.44 | 0.82 |
|                    |               | 5                    | 0.36                | 0.48 | 0.90 |

### Weights (unit: kg)

| Outside<br>Ø da mm | Radius r mm  | Wall Thickn.<br>s mm | Weight/kg<br>Design |      |      |
|--------------------|--------------|----------------------|---------------------|------|------|
|                    |              |                      | 2                   | 3    | 5    |
| 57                 |              | 2.9                  | 0.33                | 0.44 | 0.77 |
|                    | 2: 52.5 ± 3  | 3.2                  | 0.35                | 0.48 | 0.85 |
|                    | 3: 72.0 ± 3  | 3.6                  | 0.39                | 0.54 | 0.95 |
|                    | 5: 127.5 ± 3 | 4                    | 0.43                | 0.59 | 1.05 |
| 60.3               |              | 2.9                  | 0.35                | 0.49 | 0.87 |
|                    | 2: 51 ± 3    | 3.2                  | 0.39                | 0.54 | 0.96 |
|                    | 3: 76 ± 3    | 3.6                  | 0.43                | 0.60 | 1.07 |
|                    | 5: 135 ± 3   | 4                    | 0.48                | 0.66 | 1.18 |
|                    |              | 4.5                  | 0.53                | 0.74 | 1.31 |
|                    |              | 5                    | 0.59                | 0.81 | 1.45 |
|                    |              | 5.6                  | 0.65                | 0.90 | 1.60 |
|                    |              | 6.3                  | 0.72                | 1.00 | 1.78 |
| 63.5               |              | 2.9                  | 0.39                | 0.56 | 0.97 |
|                    | 2: 57.5 ± 3  | 3.2                  | 0.43                | 0.62 | 1.07 |
|                    | 3: 82.5 ± 3  | 3.6                  | 0.48                | 0.69 | 1.19 |
|                    | 5: 142.5 ± 3 | 4                    | 0.53                | 0.76 | 1.31 |
| 70                 |              | 2.9                  | 0.49                | 0.69 | 1.21 |
|                    | 2: 65 ± 3    | 3.2                  | 0.54                | 0.76 | 1.32 |
|                    | 3: 92 ± 3    | 3.6                  | 0.60                | 0.85 | 1.48 |
|                    | 5: 160 ± 3   | 4                    | 0.66                | 0.94 | 1.64 |
| 76.1               |              | 2.9                  | 0.58                | 0.78 | 1.44 |
|                    | 2: 63 ± 3    | 3.6                  | 0.71                | 0.96 | 1.77 |
|                    | 3: 95 ± 3    | 4                    | 0.78                | 1.06 | 1.96 |
|                    | 5: 175 ± 3   | 4.5                  | 0.87                | 1.19 | 2.18 |
|                    |              | 5                    | 0.96                | 1.31 | 2.41 |
|                    |              | 5.6                  | 1.07                | 1.45 | 2.68 |
|                    |              | 6.3                  | 1.19                | 1.62 | 2.98 |
|                    |              | 7.1                  | 1.33                | 1.80 | 3.32 |
| 88.9               |              | 3.2                  | 0.88                | 1.22 | 2.18 |
|                    | 2: 76 ± 3    | 4                    | 1.09                | 1.51 | 2.70 |
|                    | 3: 114 ± 3   | 4.5                  | 1.21                | 1.68 | 3.02 |
|                    | 5: 205 ± 3   | 5                    | 1.34                | 1.86 | 3.33 |
|                    |              | 5.6                  | 1.49                | 2.07 | 3.70 |
|                    |              | 6.3                  | 1.66                | 2.31 | 4.13 |
| 108                |              | 8                    | 2.07                | 2.87 | 5.14 |
|                    | 2: 100 ± 3   | 3.6                  | 1.46                | 2.07 | 3.68 |
|                    | 3: 142.5 ± 3 | 4                    | 1.61                | 2.30 | 4.07 |
|                    | 5: 252.5 ± 3 | 4.5                  | 1.80                | 2.57 | 4.56 |
|                    |              | 5                    | 2.00                | 2.84 | 5.04 |



# Elbows

## DIN 2605 90°

### Dimensions (unit: mm)

| Outside<br>Ø da mm | Radius r mm                              | Wall Thickn.<br>s mm | Weight/kg<br>Design |      |      |
|--------------------|------------------------------------------|----------------------|---------------------|------|------|
|                    |                                          |                      | 2                   | 3    | 5    |
| 114.3              | 2: 102 ± 3<br>3: 152 ± 3<br>5: 270 ± 3   | 3.6                  | 1.62                | 2.35 | 4.17 |
|                    |                                          | 4                    | 1.79                | 2.61 | 4.61 |
|                    |                                          | 4.5                  | 2.01                | 2.92 | 5.17 |
|                    |                                          | 5.6                  | 2.48                | 3.60 | 6.37 |
|                    |                                          | 6.3                  | 2.77                | 4.02 | 7.12 |
|                    |                                          | 7.1                  | 3.10                | 4.50 | 7.96 |
| 133                | 2: 125 ± 4<br>3: 181 ± 4<br>5: 312.5 ± 4 | 8.8                  | 3.78                | 5.48 | 9.71 |
|                    |                                          | 4                    | 2.50                | 3.62 | 6.25 |
|                    |                                          | 4.5                  | 2.80                | 4.05 | 7.00 |
|                    |                                          | 5                    | 3.10                | 4.49 | 7.75 |
|                    |                                          | 6.3                  | 3.87                | 5.60 | 9.66 |
|                    |                                          |                      |                     |      |      |
| 139.7              | 2: 127 ± 4<br>3: 190 ± 4<br>5: 330 ± 4   | 4                    | 2.79                | 4.01 | 6.94 |
|                    |                                          | 4.5                  | 3.12                | 4.49 | 7.78 |
|                    |                                          | 5                    | 3.46                | 4.97 | 8.61 |
|                    |                                          | 6.3                  | 4.31                | 6.20 | 10.7 |
|                    |                                          | 7.1                  | 4.83                | 6.95 | 12.0 |
|                    |                                          | 8                    | 5.41                | 7.78 | 13.5 |
| 159                | 2: 150 ± 4<br>3: 216 ± 4<br>5: 375 ± 4   | 10                   | 6.66                | 9.57 | 16.6 |
|                    |                                          | 4.5                  | 4.04                | 5.82 | 10.1 |
|                    |                                          | 5                    | 4.47                | 6.44 | 11.2 |
|                    |                                          | 5.6                  | 4.99                | 7.19 | 12.5 |
|                    |                                          | 6.3                  | 5.59                | 8.05 | 14.0 |
|                    |                                          |                      |                     |      |      |
| 168.3              | 2: 152 ± 4<br>3: 229 ± 4<br>5: 390 ± 4   | 4.5                  | 4.43                | 6.52 | 11.1 |
|                    |                                          | 5.6                  | 5.47                | 8.06 | 13.8 |
|                    |                                          | 6.3                  | 6.13                | 9.03 | 15.4 |
|                    |                                          | 7.1                  | 6.87                | 10.1 | 17.3 |
|                    |                                          | 8                    | 7.70                | 11.4 | 19.4 |
|                    |                                          | 11                   | 10.4                | 15.3 | 26.1 |
| 193.7              | 2: 180 ± 4<br>3: 270 ± 4<br>5: 455 ± 4   | 5.4                  | 7.09                | 10.6 | 17.9 |
|                    |                                          | 5.6                  | 7.35                | 11.0 | 18.6 |
|                    |                                          | 6.3                  | 8.23                | 12.4 | 20.8 |
|                    |                                          | 7.1                  | 9.24                | 13.9 | 23.4 |
|                    |                                          |                      |                     |      |      |
|                    |                                          |                      |                     |      |      |
| 219.1              | 2: 203 ± 4<br>3: 305 ± 4<br>5: 510 ± 4   | 5.4                  | 7.09                | 10.6 | 17.9 |
|                    |                                          | 5.6                  | 7.35                | 11.0 | 18.6 |
|                    |                                          | 6.3                  | 8.23                | 12.4 | 20.8 |
|                    |                                          | 7.1                  | 9.24                | 13.9 | 23.4 |
|                    |                                          |                      |                     |      |      |
|                    |                                          |                      |                     |      |      |
| 273                | 2: 254 ± 5<br>3: 381 ± 5<br>5: 650 ± 5   | 6.3                  | 16.5                | 24.8 | 42.3 |
|                    |                                          | 7.1                  | 18.6                | 27.9 | 47.5 |
|                    |                                          | 8.8                  | 22.9                | 34.3 | 58.4 |
|                    |                                          | 10                   | 25.9                | 38.8 | 66.2 |
|                    |                                          | 12.5                 | 32.0                | 48.1 | 82.0 |
|                    |                                          |                      |                     |      |      |

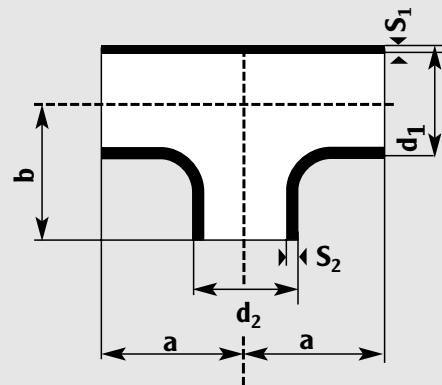
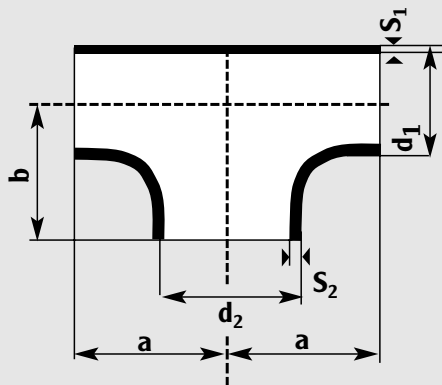
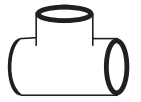
### Weights (unit: kg)

| Outside<br>Ø da mm | Radius r mm                                 | Wall Thickn.<br>s mm | Weight/kg<br>Design |      |      |
|--------------------|---------------------------------------------|----------------------|---------------------|------|------|
|                    |                                             |                      | 2                   | 3    | 5    |
| 323.9              | 2: 305 ± 5<br>3: 457 ± 5<br>5: 775 ± 5      | 7.1                  | 26.6                | 39.8 | 67.5 |
|                    |                                             | 8                    | 29.9                | 44.7 | 75.9 |
|                    |                                             | 10                   | 37.1                | 55.6 | 94.2 |
|                    |                                             | 12.5                 | 46.0                | 68.9 | 117  |
| 355.6              | 2: 356 ± 10<br>3: 533 ± 10<br>5: 850 ± 10   | 8                    | 38.2                | 57.5 | 91.6 |
|                    |                                             | 47.5                 | 71.4                | 114  |      |
|                    |                                             | 11                   | 52.1                | 78.3 | 125  |
|                    |                                             | 12.5                 | 59.0                | 88.6 | 141  |
| 406.4              | 2: 406 ± 10<br>3: 610 ± 10<br>5: 970 ± 10   | 8.8                  | 55.1                | 82.6 | 131  |
|                    |                                             | 10                   | 62.4                | 93.6 | 149  |
|                    |                                             | 12.5                 | 77.5                | 116  | 185  |
|                    |                                             | 14.2                 | 87.7                | 131  | 209  |
| 457.2              | 2: 457 ± 15<br>3: 686 ± 15<br>5: 1122 ± 15  | 10                   | 119                 | 194  |      |
|                    |                                             | 11                   | 86.5                | 130  | 213  |
|                    |                                             | 12.5                 | 98.0                | 148  | 242  |
|                    |                                             | 14.2                 | 111                 | 167  | 274  |
| 508                | 2: 508 ± 25<br>3: 762 ± 25<br>5: 1245 ± 25  | 11                   | 107                 | 161  | 264  |
|                    |                                             | 12.5                 | 121                 | 183  | 299  |
|                    |                                             | 14.2                 | 137                 | 207  | 338  |
|                    |                                             | 16                   | 154                 | 232  | 380  |
| 609.6              | 2: 610 ± 25<br>3: 914 ± 25<br>5: 1525 ± 25  | 12.5                 | 176                 | 264  | 434  |
|                    |                                             | 14.2                 | 200                 | 299  | 491  |
|                    |                                             | 16                   | 224                 | 336  | 552  |
|                    |                                             | 17.5                 | 245                 | 367  | 602  |
| 711.2              | 2: 711 ± 30<br>3: 1067 ± 30<br>5: 1778 ± 30 | 12.5                 | 237                 | 355  | 592  |
|                    |                                             | 14.2                 | 268                 | 403  | 671  |
|                    |                                             | 16                   | 302                 | 452  | 754  |
|                    |                                             | 17.5                 | 329                 | 494  | 823  |
| 812.8              | 2: 813 ± 35<br>3: 1219 ± 35<br>5: 2033 ± 35 | 12.5                 | 314                 | 465  | 775  |
|                    |                                             | 14.2                 | 356                 | 527  | 879  |
|                    |                                             | 16                   | 400                 | 593  | 988  |
|                    |                                             | 17.5                 | 437                 | 647  | 1078 |
| 914.4              | 2: 914 ± 40<br>3: 1372 ± 40<br>5: 2285 ± 40 | 14.2                 | 451                 | 678  | 1114 |
|                    |                                             | 16                   | 507                 | 763  | 1253 |
|                    |                                             | 17.5                 | 555                 | 833  | 1389 |
|                    |                                             | 20                   | 632                 | 949  | 1583 |

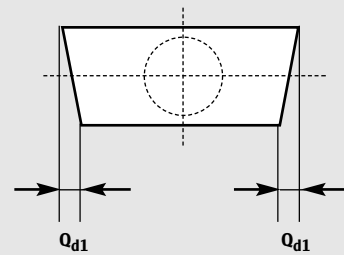
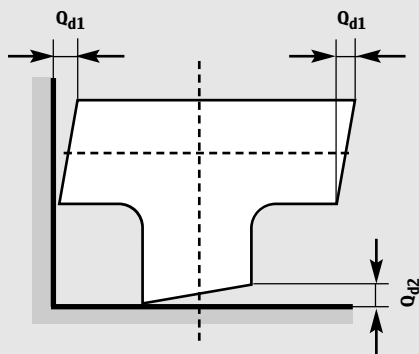


# Tees equal and unequal

DIN 2615 PART 1



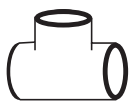
## Tolerances



| Outside Ø<br>da<br>mm | d <sub>1+2</sub> | Q      | a, b<br>mm | Standard | Wall<br>thickness<br>S <sub>1+2</sub> | Ovality         |      | di          | Special<br>Requirements |        |
|-----------------------|------------------|--------|------------|----------|---------------------------------------|-----------------|------|-------------|-------------------------|--------|
|                       |                  |        |            |          |                                       | Welding<br>edge | body |             | d <sub>1+2</sub>        | Q      |
| 21.3 - 76.1           | ± 1%             | 1%     | ± 2.0      |          | S <sub>min</sub>                      | perm.           | 4%   | di min:     | ± 0.4 mm                | 0.5%   |
| - 114.3               | min.             | v. da  | ± 2.0      |          | (Body):                               | da              | 4%   | 0.8 x       | ± 0.4 mm                | v. da  |
| - 219.1               | 0.5 mm           | min.   | ± 2.0      |          | - 12.5%                               | tolerance       | 4%   | di-Tube     | ± 0.5%                  | min.   |
| - 273                 |                  | 1.0 mm | ± 3.0      |          |                                       | 2%              | 4%   | (theor. di) | ± 0.6%                  | 0.5 mm |
| - 323.9               |                  |        | ± 3.0      |          | S <sub>max</sub>                      | 2%              | 4%   |             | ± 0.6%                  |        |
|                       |                  |        |            |          | (Welding<br>edge):                    |                 |      |             |                         |        |
|                       |                  |        |            |          | + 15%                                 |                 |      |             |                         |        |

d<sub>1+2</sub> = Outside Diameter on welding edge

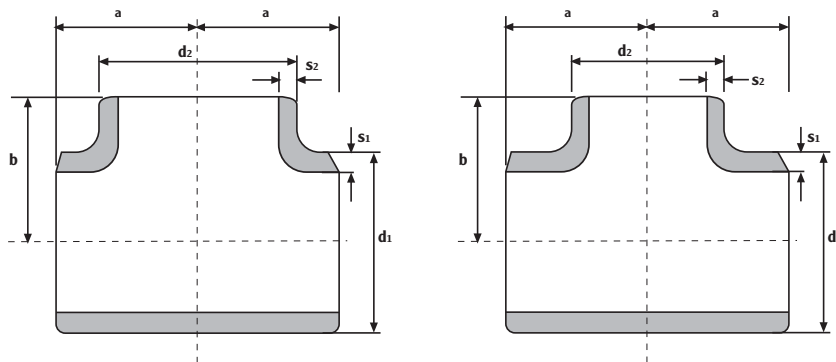
S<sub>1+2</sub> = Wall thickness on welding edge



# Tees

## DIN 2615

Standard Execution  
Bevel to DIN 2559, Shape 22 up to 3,2 mm

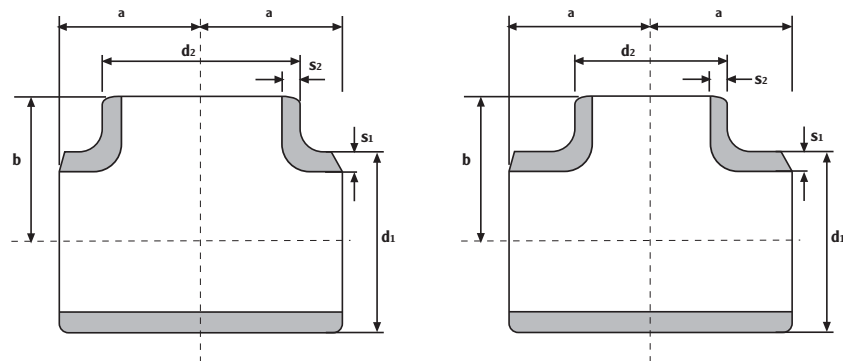
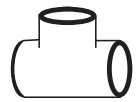


| Run Size              |                          | Branch                |                            | a<br>mm | b<br>mm | Weight<br>approx.<br>kg |
|-----------------------|--------------------------|-----------------------|----------------------------|---------|---------|-------------------------|
| Outside<br>Ø<br>d1 mm | Wall<br>thickn.<br>s1 mm | Outside<br>Ø<br>d2 mm | Wall<br>thickness<br>s2 mm |         |         |                         |
| 21.3                  | 2.0                      | 21.3                  | 2.0                        | 25      | 25      | 0.09                    |
|                       |                          | 17.2                  | 1.8                        | 25      | 25      | 0.09                    |
|                       | 3.2                      | 21.3                  | 3.2                        | 25      | 25      | 0.15                    |
|                       |                          | 17.2                  | 2.9                        | 25      | 25      | 0.15                    |
| 26.9                  | 2.3                      | 21.3                  | 4.0                        | 25      | 25      | 0.18                    |
|                       |                          | 26.9                  | 2.3                        | 29      | 29      | 0.15                    |
|                       |                          | 21.3                  | 2.0                        | 29      | 29      | 0.15                    |
|                       | 3.2                      | 17.2                  | 1.8                        | 29      | 29      | 0.15                    |
|                       |                          | 26.9                  | 3.2                        | 29      | 29      | 0.21                    |
|                       |                          | 21.3                  | 3.2                        | 29      | 29      | 0.21                    |
| 33.7                  | 2.6                      | 26.9                  | 4.0                        | 29      | 29      | 0.25                    |
|                       |                          | 21.3                  | 4.0                        | 29      | 29      | 0.25                    |
|                       |                          | 33.7                  | 2.6                        | 38      | 38      | 0.29                    |
|                       | 3.2                      | 26.9                  | 2.3                        | 38      | 38      | 0.29                    |
|                       |                          | 21.3                  | 2.0                        | 38      | 38      | 0.29                    |
|                       |                          | 33.7                  | 3.2                        | 38      | 38      | 0.35                    |
|                       |                          | 26.9                  | 3.2                        | 38      | 38      | 0.35                    |
|                       |                          | 21.3                  | 3.2                        | 38      | 38      | 0.35                    |
|                       | 4.0                      | 33.7                  | 4.0                        | 38      | 38      | 0.42                    |
|                       |                          | 26.9                  | 4.0                        | 38      | 38      | 0.42                    |
|                       |                          | 21.3                  | 4.0                        | 38      | 38      | 0.42                    |

| Run Size              |                          | Branch                |                            | a<br>mm | b<br>mm | Weight<br>approx.<br>kg |
|-----------------------|--------------------------|-----------------------|----------------------------|---------|---------|-------------------------|
| Outside<br>Ø<br>d1 mm | Wall<br>thickn.<br>s1 mm | Outside<br>Ø<br>d2 mm | Wall<br>thickness<br>s2 mm |         |         |                         |
| 42.4                  | 2.6                      | 42.4                  | 2.6                        | 48      | 48      | 0.42                    |
|                       |                          | 33.7                  | 2.6                        | 48      | 48      | 0.42                    |
|                       |                          | 26.9                  | 2.3                        | 48      | 48      | 0.42                    |
|                       | 3.6                      | 42.4                  | 3.6                        | 48      | 48      | 0.57                    |
|                       |                          | 33.7                  | 3.2                        | 48      | 48      | 0.57                    |
|                       |                          | 26.9                  | 3.2                        | 48      | 48      | 0.57                    |
|                       | 4.0                      | 42.4                  | 4.0                        | 48      | 48      | 0.63                    |
|                       |                          | 33.7                  | 4.0                        | 48      | 48      | 0.63                    |
|                       |                          | 26.9                  | 4.0                        | 48      | 48      | 0.63                    |
|                       |                          | 48.3                  | 2.6                        | 57      | 57      | 0.59                    |
| 48.3                  | 2.6                      | 42.4                  | 2.6                        | 57      | 57      | 0.59                    |
|                       |                          | 33.7                  | 2.6                        | 57      | 57      | 0.59                    |
|                       |                          | 26.9                  | 2.3                        | 57      | 57      | 0.59                    |
|                       |                          | 48.3                  | 4.0                        | 57      | 57      | 0.90                    |
|                       | 4.0                      | 42.4                  | 3.6                        | 57      | 57      | 0.90                    |
|                       |                          | 33.7                  | 3.2                        | 57      | 57      | 0.90                    |
|                       |                          | 26.9                  | 3.2                        | 57      | 57      | 0.90                    |
|                       |                          | 48.3                  | 5.0                        | 57      | 57      | 1.10                    |
|                       | 5.0                      | 42.4                  | 4.0                        | 57      | 57      | 1.10                    |
|                       |                          | 33.7                  | 4.0                        | 57      | 57      | 1.10                    |

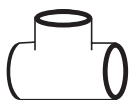
# Tees

## DIN 2615



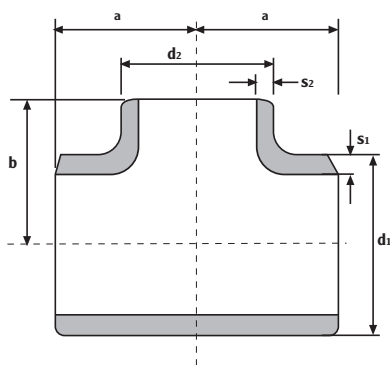
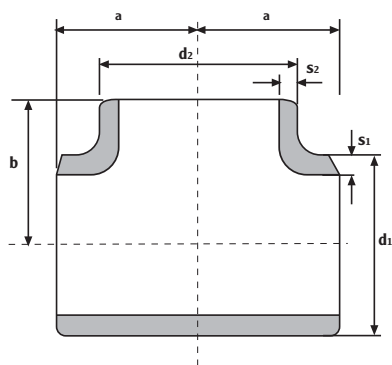
| Run Size              |                          | Branch                |                            | a<br>mm | b<br>mm | Weight<br>approx.<br>kg |
|-----------------------|--------------------------|-----------------------|----------------------------|---------|---------|-------------------------|
| Outside<br>Ø<br>d1 mm | Wall<br>thickn.<br>s1 mm | Outside<br>Ø<br>d2 mm | Wall<br>thickness<br>s2 mm |         |         |                         |
| 57.0                  | 2.9                      | 57.0                  | 2.9                        | 60      | 60      | 0.85                    |
| 60.3                  | 2.9                      | 60.3                  | 2.9                        | 64      | 64      | 0.90                    |
|                       |                          | 48.3                  | 2.6                        | 64      | 60      | 0.90                    |
|                       |                          | 42.4                  | 2.6                        | 64      | 57      | 0.90                    |
|                       |                          | 33.7                  | 2.6                        | 64      | 51      | 0.90                    |
|                       |                          |                       |                            |         |         |                         |
|                       | 4.5                      | 60.3                  | 4.5                        | 64      | 64      | 1.35                    |
|                       |                          | 48.3                  | 4.0                        | 64      | 60      | 1.35                    |
|                       |                          | 42.4                  | 3.6                        | 64      | 57      | 1.35                    |
|                       |                          | 33.7                  | 3.2                        | 64      | 51      | 1.35                    |
|                       |                          |                       |                            |         |         |                         |
|                       | 5.6                      | 60.3                  | 5.6                        | 64      | 64      | 1.65                    |
|                       |                          | 48.3                  | 5.0                        | 64      | 60      | 1.65                    |
|                       |                          | 42.4                  | 4.0                        | 64      | 57      | 1.65                    |
|                       |                          | 33.7                  | 4.0                        | 64      | 51      | 1.65                    |
|                       |                          |                       |                            |         |         |                         |
| 76.1                  | 2.9                      | 76.1                  | 2.9                        | 76      | 76      | 1.35                    |
|                       |                          | 60.3                  | 2.9                        | 76      | 70      | 1.35                    |
|                       |                          | 48.3                  | 2.6                        | 76      | 67      | 1.35                    |
|                       |                          | 42.4                  | 2.6                        | 76      | 64      | 1.35                    |
|                       |                          |                       |                            |         |         |                         |
|                       | 5.0                      | 76.1                  | 5.0                        | 76      | 76      | 2.30                    |
|                       |                          | 60.3                  | 4.5                        | 76      | 70      | 2.30                    |
|                       |                          | 48.3                  | 4.0                        | 76      | 67      | 2.30                    |
|                       |                          | 42.4                  | 3.6                        | 76      | 64      | 2.3                     |
|                       |                          |                       |                            |         |         |                         |
|                       | 7.1                      | 76.1                  | 7.1                        | 76      | 76      | 3.15                    |
|                       |                          | 60.3                  | 5.6                        | 76      | 70      | 3.15                    |
|                       |                          | 48.3                  | 5.0                        | 76      | 67      | 3.15                    |
|                       |                          | 42.4                  | 4.0                        | 76      | 64      | 3.15                    |
|                       |                          |                       |                            |         |         |                         |
| 88.9                  | 3.2                      | 88.9                  | 3.2                        | 86      | 86      | 1.95                    |
|                       |                          | 76.1                  | 2.9                        | 86      | 83      | 1.95                    |
|                       |                          | 60.3                  | 2.9                        | 86      | 76      | 1.95                    |
|                       |                          | 48.3                  | 2.6                        | 86      | 73      | 1.95                    |
|                       |                          | 42.4                  | 2.6                        | 86      | 70      | 1.95                    |
|                       | 5.6                      | 88.9                  | 5.6                        | 86      | 86      | 3.70                    |
|                       |                          | 76.1                  | 5.0                        | 86      | 83      | 3.70                    |
|                       |                          | 60.3                  | 4.5                        | 86      | 76      | 3.70                    |
|                       |                          | 48.3                  | 4.0                        | 86      | 73      | 3.70                    |
|                       |                          | 42.4                  | 3.6                        | 86      | 70      | 3.70                    |
|                       | 8.0                      | 88.9                  | 8.0                        | 86      | 86      | 4.60                    |
|                       |                          | 76.1                  | 7.1                        | 86      | 83      | 4.60                    |
|                       |                          | 60.3                  | 5.6                        | 86      | 76      | 4.60                    |
|                       |                          | 48.3                  | 5.0                        | 86      | 73      | 4.60                    |
|                       |                          | 42.4                  | 4.0                        | 86      | 70      | 4.60                    |
| 108.0                 | 3.6                      | 108.0                 | 3.6                        | 100     | 100     | 3.15                    |

| Run Size              |                          | Branch                |                            | a<br>mm | b<br>mm | Weight<br>approx.<br>kg |
|-----------------------|--------------------------|-----------------------|----------------------------|---------|---------|-------------------------|
| Outside<br>Ø<br>d1 mm | Wall<br>thickn.<br>s1 mm | Outside<br>Ø<br>d2 mm | Wall<br>thickness<br>s2 mm |         |         |                         |
| 114.3                 | 3.6                      | 114.3                 | 3.6                        | 105     | 105     | 3.30                    |
|                       |                          | 88.9                  | 3.2                        | 105     | 98      | 3.30                    |
|                       |                          | 76.1                  | 2.9                        | 105     | 95      | 3.30                    |
|                       |                          | 60.3                  | 2.9                        | 105     | 89      | 3.30                    |
|                       |                          |                       |                            |         |         |                         |
|                       | 6.3                      | 114.3                 | 6.3                        | 105     | 105     | 5.70                    |
|                       |                          | 88.9                  | 5.6                        | 105     | 98      | 5.70                    |
|                       |                          | 76.1                  | 5.0                        | 105     | 95      | 5.70                    |
|                       |                          | 60.3                  | 4.5                        | 105     | 89      | 5.70                    |
|                       |                          |                       |                            |         |         |                         |
|                       | 8.8                      | 114.3                 | 8.8                        | 105     | 105     | 7.70                    |
|                       |                          | 88.9                  | 8.0                        | 105     | 98      | 7.70                    |
|                       |                          | 76.1                  | 7.1                        | 105     | 95      | 7.70                    |
|                       |                          | 60.3                  | 5.6                        | 105     | 89      | 7.70                    |
|                       |                          |                       |                            |         |         |                         |
| 133.0                 | 4.0                      | 133.0                 | 4.0                        | 120     | 120     | 4.60                    |
| 139.7                 | 4.0                      | 139.7                 | 4.0                        | 124     | 124     | 5.10                    |
|                       |                          | 114.3                 | 3.6                        | 124     | 117     | 5.10                    |
|                       |                          | 88.9                  | 3.2                        | 124     | 111     | 5.10                    |
|                       |                          | 76.1                  | 2.9                        | 124     | 108     | 5.10                    |
|                       |                          |                       |                            |         |         |                         |
|                       | 6.3                      | 139.7                 | 6.3                        | 124     | 124     | 7.90                    |
|                       |                          | 114.3                 | 6.3                        | 124     | 117     | 7.90                    |
|                       |                          | 88.9                  | 5.6                        | 124     | 111     | 7.90                    |
|                       |                          | 76.1                  | 5.0                        | 124     | 108     | 7.90                    |
|                       |                          |                       |                            |         |         |                         |
|                       | 10.0                     | 139.7                 | 10.0                       | 124     | 124     | 12.0                    |
|                       |                          | 114.3                 | 8.8                        | 124     | 117     | 12.0                    |
|                       |                          | 88.9                  | 8.0                        | 124     | 111     | 12.0                    |
|                       |                          | 76.1                  | 7.1                        | 124     | 108     | 12.0                    |
|                       |                          |                       |                            |         |         |                         |
| 159.0                 | 4.5                      | 159.0                 | 4.5                        | 138     | 138     | 7.50                    |
| 168.3                 | 4.5                      | 168.3                 | 4.5                        | 143     | 143     | 8.10                    |
|                       |                          | 139.7                 | 4.0                        | 143     | 137     | 8.10                    |
|                       |                          | 114.3                 | 3.6                        | 143     | 130     | 8.10                    |
|                       |                          | 88.9                  | 3.2                        | 143     | 124     | 8.10                    |
|                       |                          |                       |                            |         |         |                         |
|                       | 7.1                      | 168.3                 | 7.1                        | 143     | 143     | 13.0                    |
|                       |                          | 139.7                 | 6.3                        | 143     | 137     | 13.0                    |
|                       |                          | 114.3                 | 6.3                        | 143     | 130     | 13.0                    |
|                       |                          | 88.9                  | 5.6                        | 143     | 124     | 13.0                    |
|                       |                          |                       |                            |         |         |                         |
|                       | 11.0                     | 168.3                 | 11.0                       | 143     | 143     | 19.0                    |
|                       |                          | 139.7                 | 10.0                       | 143     | 137     | 19.0                    |
|                       |                          | 114.3                 | 8.8                        | 143     | 130     | 19.0                    |
|                       |                          | 88.9                  | 8.0                        | 143     | 124     | 19.0                    |
|                       |                          |                       |                            |         |         |                         |



# Tees

## DIN 2615

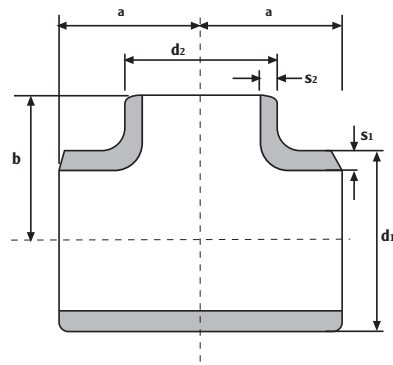
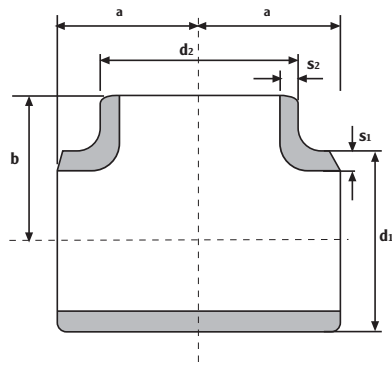
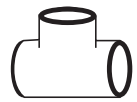


| Run Size        |                   | Branch          |                      | a mm      b mm |     | Weight approx. kg |
|-----------------|-------------------|-----------------|----------------------|----------------|-----|-------------------|
| Outside Ø d1 mm | Wall thckn. s1 mm | Outside Ø d2 mm | Wall thickness s2 mm |                |     |                   |
| 219.1           | 6.3               | 219.1           | 6.3                  | 178            | 178 | 18.0              |
|                 |                   | 168.3           | 4.5                  | 178            | 168 | 18.0              |
|                 |                   | 139.7           | 4.0                  | 178            | 162 | 18.0              |
|                 |                   | 114.3           | 3.6                  | 178            | 156 | 18.0              |
|                 |                   | 88.9            | 3.2                  | 178            | 152 | 18.0              |
|                 | 8.0               | 219.1           | 8.0                  | 178            | 178 | 23.5              |
|                 |                   | 168.3           | 7.1                  | 178            | 168 | 23.5              |
|                 |                   | 139.7           | 6.3                  | 178            | 162 | 23.5              |
|                 |                   | 114.3           | 6.3                  | 178            | 156 | 23.5              |
|                 |                   | 88.9            | 5.6                  | 178            | 152 | 23.5              |
|                 | 12.5              | 219.1           | 12.5                 | 178            | 178 | 35.5              |
|                 |                   | 168.3           | 11.0                 | 178            | 168 | 35.5              |
|                 |                   | 139.7           | 10.0                 | 178            | 162 | 35.5              |
|                 |                   | 114.3           | 8.8                  | 178            | 156 | 35.5              |
|                 |                   | 88.9            | 8.0                  | 178            | 152 | 35.5              |
| 267.0           | 6.3               | 267.0           | 6.3                  | 210            | 210 | 25.5              |
| 273.0           | 6.3               | 273.0           | 6.3                  | 216            | 216 | 26.5              |
|                 |                   | 219.1           | 6.3                  | 216            | 203 | 26.5              |
|                 |                   | 168.3           | 4.5                  | 216            | 194 | 26.5              |
|                 |                   | 139.7           | 4.0                  | 216            | 191 | 26.5              |
|                 |                   | 114.3           | 3.6                  | 216            | 184 | 26.5              |
|                 | 8.8               | 273.0           | 8.8                  | 216            | 216 | 36.5              |
|                 |                   | 219.1           | 8.0                  | 216            | 203 | 36.5              |
|                 |                   | 168.3           | 7.1                  | 216            | 194 | 36.5              |
|                 |                   | 139.7           | 6.3                  | 216            | 191 | 36.5              |
|                 |                   | 114.3           | 6.3                  | 216            | 184 | 36.5              |
|                 | 14.2              | 273.0           | 14.2                 | 216            | 216 | 58.0              |
|                 |                   | 219.1           | 12.5                 | 216            | 203 | 58.0              |
|                 |                   | 168.3           | 11.0                 | 216            | 194 | 58.0              |
|                 |                   | 139.7           | 10.0                 | 216            | 191 | 58.0              |
|                 |                   | 114.3           | 8.8                  | 216            | 184 | 58.0              |

| Run Size        |                   | Branch          |                      | a mm      b mm |     | Weight approx. kg |
|-----------------|-------------------|-----------------|----------------------|----------------|-----|-------------------|
| Outside Ø d1 mm | Wall thckn. s1 mm | Outside Ø d2 mm | Wall thickness s2 mm |                |     |                   |
| 323.9           | 7.1               | 323.9           | 7.1                  | 254            | 254 | 42.0              |
|                 |                   | 273.0           | 6.3                  | 254            | 241 | 42.0              |
|                 |                   | 219.1           | 6.3                  | 254            | 229 | 42.0              |
|                 |                   | 168.3           | 4.5                  | 254            | 219 | 42.0              |
|                 |                   | 139.7           | 4.0                  | 254            | 216 | 42.0              |
|                 | 10.0              | 323.9           | 10.0                 | 254            | 254 | 59.0              |
|                 |                   | 273.0           | 8.8                  | 254            | 241 | 59.0              |
|                 |                   | 219.1           | 8.0                  | 254            | 229 | 59.0              |
|                 |                   | 168.3           | 7.1                  | 254            | 219 | 59.0              |
|                 |                   | 139.7           | 6.3                  | 254            | 216 | 59.0              |
|                 | 16.0              | 323.9           | 16.0                 | 254            | 254 | 92.0              |
|                 |                   | 273.0           | 14.2                 | 254            | 241 | 92.0              |
|                 |                   | 219.1           | 12.5                 | 254            | 229 | 92.0              |
|                 |                   | 168.3           | 11.0                 | 254            | 219 | 92.0              |
|                 |                   | 139.7           | 10.0                 | 254            | 216 | 92.0              |
| 355.6           | 8.0               | 355.6           | 8.0                  | 279            | 279 | 60.0              |
|                 |                   | 323.9           | 7.1                  | 279            | 270 | 60.0              |
|                 |                   | 273.0           | 6.3                  | 279            | 257 | 60.0              |
|                 |                   | 219.1           | 6.3                  | 279            | 248 | 54.0              |
|                 |                   | 168.3           | 4.5                  | 279            | 238 | 54.0              |
|                 | 11.0              | 355.6           | 11.0                 | 279            | 279 | 86.0              |
|                 |                   | 323.9           | 10.0                 | 279            | 270 | 86.0              |
|                 |                   | 273.0           | 8.8                  | 279            | 257 | 86.0              |
|                 |                   | 219.1           | 8.0                  | 279            | 248 | 76.0              |
|                 |                   | 168.3           | 7.1                  | 279            | 238 | 76.0              |
|                 | 17.5              | 355.6           | 17.5                 | 279            | 279 | 130.0             |
|                 |                   | 323.9           | 16.0                 | 279            | 270 | 130.0             |
|                 |                   | 273.0           | 14.2                 | 279            | 257 | 130.0             |
|                 |                   | 219.1           | 12.5                 | 279            | 248 | 116.0             |
|                 |                   | 168.3           | 11.0                 | 279            | 238 | 116.0             |

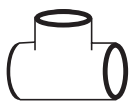
# Tees

## DIN 2615



| Run Size              |                          | Branch                |                            | a<br>mm | b<br>mm | Weight<br>approx.<br>kg |
|-----------------------|--------------------------|-----------------------|----------------------------|---------|---------|-------------------------|
| Outside<br>Ø<br>d1 mm | Wall<br>thickn.<br>s1 mm | Outside<br>Ø<br>d2 mm | Wall<br>thickness<br>s2 mm |         |         |                         |
| 406.4                 | 8.8                      | 406.4                 | 8.8                        | 305     | 305     | 82.0                    |
|                       |                          | 355.6                 | 8.0                        | 305     | 305     | 82.0                    |
|                       |                          | 323.9                 | 7.1                        | 305     | 295     | 82.0                    |
|                       |                          | 273.0                 | 6.3                        | 305     | 283     | 82.0                    |
|                       |                          | 219.1                 | 6.3                        | 305     | 273     | 74.0                    |
|                       |                          | 168.3                 | 4.5                        | 305     | 264     | 74.0                    |
|                       | 12.5                     | 406.4                 | 12.5                       | 305     | 305     | 118.0                   |
|                       |                          | 355.6                 | 11.0                       | 305     | 305     | 118.0                   |
|                       |                          | 323.9                 | 10.0                       | 305     | 295     | 118.0                   |
|                       |                          | 273.0                 | 8.8                        | 305     | 283     | 118.0                   |
|                       |                          | 219.1                 | 8.0                        | 305     | 273     | 106.0                   |
|                       |                          | 168.3                 | 7.1                        | 305     | 264     | 106.0                   |
|                       | 20.0                     | 406.4                 | 20.0                       | 305     | 305     | 182.0                   |
|                       |                          | 355.6                 | 17.5                       | 305     | 305     | 182.0                   |
|                       |                          | 323.9                 | 16.0                       | 305     | 295     | 182.0                   |
|                       |                          | 273.0                 | 14.2                       | 305     | 283     | 182.0                   |
|                       |                          | 219.1                 | 12.5                       | 305     | 273     | 132.0                   |
|                       |                          | 168.3                 | 11.0                       | 305     | 264     | 132.0                   |
| 457.0                 | 10.0                     | 457.0                 | 10.0                       | 343     | 343     | 131.0                   |
|                       |                          | 406.4                 | 8.8                        | 343     | 330     | 131.0                   |
|                       |                          | 355.6                 | 8.0                        | 343     | 330     | 131.0                   |
|                       |                          | 323.9                 | 7.1                        | 343     | 321     | 131.0                   |
|                       | 14.2                     | 457.0                 | 14.2                       | 343     | 343     | 183.0                   |
|                       |                          | 406.4                 | 12.5                       | 343     | 330     | 183.0                   |
|                       |                          | 355.6                 | 11.0                       | 343     | 330     | 183.0                   |
|                       |                          | 323.9                 | 10.0                       | 343     | 321     | 183.0                   |
|                       | 22.2                     | 457.0                 | 22.2                       | 343     | 343     | 268.0                   |
|                       |                          | 406.4                 | 20.0                       | 343     | 330     | 268.0                   |
|                       |                          | 355.6                 | 17.5                       | 343     | 330     | 226.0                   |
|                       |                          | 323.9                 | 16.0                       | 343     | 321     | 226.0                   |
|                       |                          | 273.0                 | 14.2                       | 343     | 308     | 226.0                   |

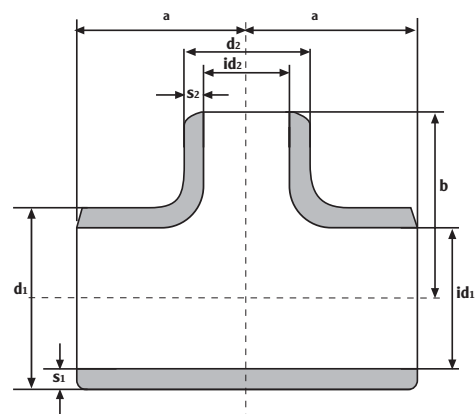
| Run Size              |                          | Branch                |                            | a<br>mm | b<br>mm | Weight<br>approx.<br>kg |
|-----------------------|--------------------------|-----------------------|----------------------------|---------|---------|-------------------------|
| Outside<br>Ø<br>d1 mm | Wall<br>thickn.<br>s1 mm | Outside<br>Ø<br>d2 mm | Wall<br>thickness<br>s2 mm |         |         |                         |
| 508.0                 | 11.0                     | 508.0                 | 11.0                       | 381     | 381     | 160.0                   |
|                       |                          | 457.0                 | 10.0                       | 381     | 368     | 160.0                   |
|                       |                          | 406.4                 | 8.8                        | 381     | 356     | 160.0                   |
|                       |                          | 355.6                 | 8.0                        | 381     | 356     | 160.0                   |
|                       |                          | 323.9                 | 7.1                        | 381     | 346     | 160.0                   |
|                       |                          | 273.0                 | 6.3                        | 381     | 333     | 160.0                   |
|                       | 16.0                     | 508.0                 | 16.0                       | 381     | 381     | 245.0                   |
|                       |                          | 457.0                 | 14.2                       | 381     | 368     | 245.0                   |
|                       |                          | 406.4                 | 12.5                       | 381     | 356     | 195.0                   |
|                       |                          | 355.6                 | 11.0                       | 381     | 356     | 195.0                   |
|                       |                          | 323.9                 | 10.0                       | 381     | 346     | 195.0                   |
|                       |                          | 273.0                 | 8.8                        | 381     | 333     | 195.0                   |
|                       | 25.0                     | 508.0                 | 25.0                       | 381     | 381     | 348.0                   |
|                       |                          | 457.0                 | 22.2                       | 381     | 368     | 348.0                   |
|                       |                          | 406.4                 | 20.0                       | 381     | 356     | 306.0                   |
|                       |                          | 355.6                 | 17.5                       | 381     | 356     | 306.0                   |
|                       |                          | 323.9                 | 16.0                       | 381     | 346     | 306.0                   |
|                       |                          | 273.0                 | 14.2                       | 381     | 333     | 306.0                   |
| 610.0                 | 12.5                     | 610.0                 | 12.5                       | 432     | 432     | 242.0                   |
|                       |                          | 508.0                 | 11.0                       | 432     | 432     | 242.0                   |
|                       |                          | 457.0                 | 10.0                       | 432     | 419     | 242.0                   |
|                       |                          | 406.4                 | 8.8                        | 432     | 406     | 242.0                   |
|                       |                          | 355.6                 | 8.0                        | 432     | 406     | 242.0                   |
|                       |                          | 323.9                 | 7.1                        | 432     | 397     | 242.0                   |
|                       | 17.5                     | 610.0                 | 17.5                       | 432     | 432     | 333.0                   |
|                       |                          | 508.0                 | 16.0                       | 432     | 432     | 333.0                   |
|                       |                          | 457.0                 | 14.2                       | 432     | 419     | 333.0                   |
|                       |                          | 406.4                 | 12.5                       | 432     | 406     | 333.0                   |
|                       |                          | 355.6                 | 11.0                       | 432     | 406     | 333.0                   |
|                       |                          | 323.9                 | 10.0                       | 432     | 397     | 333.0                   |
|                       | 30.0                     | 610.0                 | 30.0                       | 432     | 432     | 470.0                   |
|                       |                          | 508.0                 | 25.0                       | 432     | 432     | 470.0                   |
|                       |                          | 457.0                 | 22.2                       | 432     | 419     | 470.0                   |
|                       |                          | 406.4                 | 20.0                       | 432     | 406     | 470.0                   |
|                       |                          | 355.6                 | 17.5                       | 432     | 406     | 470.0                   |
|                       |                          | 323.9                 | 16.0                       | 432     | 397     | 470.0                   |
|                       |                          | 273.0                 | 14.2                       | 432     | 384     | 470.0                   |



# Reduced Tees

DIN 2615

s = seamless, w = welded

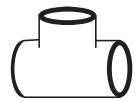


| Size |   |     |      |   |     |    | Pieces |    |    |
|------|---|-----|------|---|-----|----|--------|----|----|
| d1   | x | s1  | d2   | x | s2  |    | kg     | a  | b  |
| 21.3 | x | 2.0 | 172  | x | 1.8 | s  | 0.09   | 25 | 25 |
| 21.3 | x | 3.2 | 172  | x | 2.9 | s  | 0.12   | 25 | 25 |
| 26.9 | x | 2.3 | 21.3 | x | 2.0 | s  | 0.15   | 29 | 29 |
| 26.9 | x | 3.2 | 21.3 | x | 3.2 | s  | 0.18   | 29 | 29 |
| 26.9 | x | 4.0 | 21.3 | x | 4.0 | s  | 0.22   | 29 | 29 |
| 33.7 | x | 2.0 | 26.9 | x | 1.6 | w* | 0.20   | 38 | 38 |
| 33.7 | x | 2.0 | 21.3 | x | 1.6 | w* | 0.20   | 38 | 38 |
| 33.7 | x | 2.6 | 26.9 | x | 2.3 | s  | 0.26   | 38 | 38 |
| 33.7 | x | 2.6 | 21.3 | x | 2.0 | s  | 0.26   | 38 | 38 |
| 33.7 | x | 3.2 | 26.9 | x | 3.2 | s  | 0.30   | 38 | 38 |
| 33.7 | x | 3.2 | 21.3 | x | 3.2 | s  | 0.30   | 38 | 38 |
| 33.7 | x | 4.0 | 26.9 | x | 4.0 | s  | 0.38   | 38 | 38 |
| 33.7 | x | 4.0 | 21.3 | x | 4.0 | s  | 0.38   | 38 | 38 |
| 42.4 | x | 2.0 | 33.7 | x | 2.0 | w  | 0.32   | 48 | 48 |
| 42.4 | x | 2.0 | 21.3 | x | 1.6 | w* | 0.32   | 48 | 48 |
| 42.4 | x | 2.6 | 33.7 | x | 2.6 | s  | 0.42   | 48 | 48 |
| 42.4 | x | 2.6 | 26.9 | x | 2.3 | s  | 0.42   | 48 | 48 |
| 42.4 | x | 3.6 | 33.7 | x | 3.2 | s  | 0.57   | 48 | 48 |
| 42.4 | x | 3.6 | 26.9 | x | 3.2 | s  | 0.57   | 48 | 48 |
| 42.4 | x | 4.0 | 33.7 | x | 4.0 | s  | 0.64   | 48 | 48 |
| 42.4 | x | 4.0 | 26.9 | x | 4.0 | s  | 0.64   | 48 | 48 |
| 48.3 | x | 2.0 | 42.4 | x | 2.0 | w  | 0.46   | 57 | 57 |
| 48.3 | x | 2.0 | 33.7 | x | 2.0 | w  | 0.46   | 57 | 57 |
| 48.3 | x | 2.6 | 42.4 | x | 2.6 | s  | 0.59   | 57 | 57 |
| 48.3 | x | 2.6 | 33.7 | x | 2.6 | s  | 0.59   | 57 | 57 |
| 48.3 | x | 2.6 | 26.9 | x | 2.3 | s  | 0.59   | 57 | 57 |
| 48.3 | x | 4.0 | 42.4 | x | 3.6 | s  | 0.85   | 57 | 57 |
| 48.3 | x | 4.0 | 33.7 | x | 3.2 | s  | 0.85   | 57 | 57 |
| 48.3 | x | 4.0 | 26.9 | x | 3.2 | s  | 0.85   | 57 | 57 |
| 48.3 | x | 5.0 | 42.4 | x | 4.0 | s  | 1.05   | 57 | 57 |
| 48.3 | x | 5.0 | 33.7 | x | 4.0 | s  | 1.05   | 57 | 57 |
| 48.3 | x | 5.0 | 26.9 | x | 4.0 | s  | 1.05   | 57 | 57 |
| 60.3 | x | 2.0 | 48.3 | x | 2.0 | w  | 0.57   | 64 | 60 |
| 60.3 | x | 2.0 | 42.4 | x | 2.0 | w  | 0.54   | 64 | 57 |
| 60.3 | x | 2.0 | 33.7 | x | 2.0 | w  | 0.50   | 64 | 51 |
| 60.3 | x | 2.0 | 26.9 | x | 1.6 | w* | 0.50   | 64 | 44 |
| 60.3 | x | 2.0 | 21.3 | x | 1.6 | w* | 0.48   | 64 | 42 |
| 60.3 | x | 2.9 | 48.3 | x | 2.6 | s  | 0.79   | 64 | 60 |
| 60.3 | x | 2.9 | 42.4 | x | 2.6 | s  | 0.76   | 64 | 57 |
| 60.3 | x | 2.9 | 33.7 | x | 2.6 | s  | 0.72   | 64 | 51 |
| 60.3 | x | 2.9 | 26.9 | x | 2.3 | s  | 0.72   | 64 | 44 |
| 60.3 | x | 2.9 | 21.3 | x | 2.0 | s  | 0.72   | 64 | 42 |
| 60.3 | x | 4.0 | 48.3 | x | 4.0 | s  | 1.25   | 64 | 60 |
| 60.3 | x | 4.0 | 42.4 | x | 3.6 | s  | 1.20   | 64 | 57 |
| 60.3 | x | 4.0 | 33.7 | x | 3.2 | s  | 1.20   | 64 | 51 |
| 60.3 | x | 4.5 | 48.3 | x | 4.0 | s  | 1.40   | 64 | 60 |

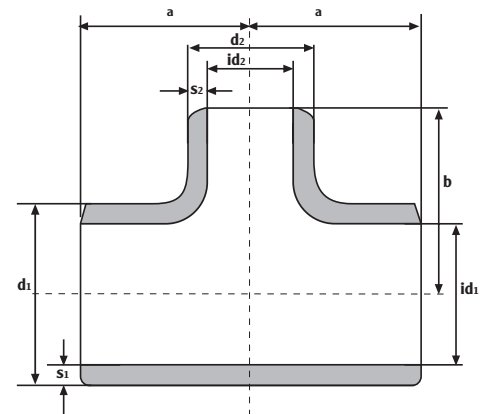
| Size  |   |     |       |   |     | Pieces |      |     |     |
|-------|---|-----|-------|---|-----|--------|------|-----|-----|
| d1    | x | s1  | d2    | x | s2  | kg     | a    | b   |     |
| 60.3  | x | 4.5 | 42.4  | x | 3.6 | s      | 1.35 | 64  | 57  |
| 60.3  | x | 4.5 | 33.7  | x | 3.2 | s      | 1.35 | 64  | 51  |
| 76.1  | x | 2.3 | 60.3  | x | 2.0 | w      | 1.00 | 76  | 70  |
| 76.1  | x | 2.3 | 48.3  | x | 2.0 | w      | 0.95 | 76  | 67  |
| 76.1  | x | 2.3 | 42.4  | x | 2.0 | w      | 0.95 | 76  | 64  |
| 76.1  | x | 2.3 | 33.7  | x | 2.0 | w      | 0.90 | 76  | 57  |
| 76.1  | x | 2.9 | 60.3  | x | 2.9 | s      | 1.25 | 76  | 70  |
| 76.1  | x | 2.9 | 48.3  | x | 2.6 | s      | 1.16 | 76  | 67  |
| 76.1  | x | 2.9 | 42.4  | x | 2.6 | s      | 1.12 | 76  | 64  |
| 76.1  | x | 5.0 | 60.3  | x | 4.5 | s      | 1.90 | 76  | 70  |
| 76.1  | x | 5.0 | 60.3  | x | 4.0 | s      | 1.80 | 76  | 70  |
| 76.1  | x | 5.0 | 48.3  | x | 4.0 | s      | 1.85 | 76  | 67  |
| 76.1  | x | 5.0 | 42.4  | x | 3.6 | s      | 1.85 | 76  | 64  |
| 76.1  | x | 7.1 | 60.3  | x | 5.6 | s      | 2.70 | 76  | 70  |
| 76.1  | x | 7.1 | 48.3  | x | 5.0 | s      | 2.65 | 76  | 67  |
| 76.1  | x | 7.1 | 42.4  | x | 4.0 | s      | 2.65 | 76  | 64  |
| 88.9  | x | 2.3 | 76.1  | x | 2.3 | w      | 1.40 | 86  | 83  |
| 88.9  | x | 2.3 | 60.3  | x | 2.0 | w      | 1.35 | 86  | 76  |
| 88.9  | x | 2.3 | 48.3  | x | 2.0 | w      | 1.30 | 86  | 73  |
| 88.9  | x | 2.3 | 42.4  | x | 2.0 | w      | 1.30 | 86  | 70  |
| 88.9  | x | 3.2 | 76.1  | x | 2.9 | s      | 1.85 | 86  | 83  |
| 88.9  | x | 3.2 | 60.3  | x | 2.9 | s      | 1.80 | 86  | 76  |
| 88.9  | x | 3.2 | 48.3  | x | 2.6 | s      | 1.70 | 86  | 73  |
| 88.9  | x | 5.6 | 76.1  | x | 5.0 | s      | 3.10 | 86  | 83  |
| 88.9  | x | 5.6 | 60.3  | x | 4.5 | s      | 2.90 | 86  | 76  |
| 88.9  | x | 5.6 | 60.3  | x | 4.0 | s      | 2.85 | 86  | 76  |
| 88.9  | x | 5.6 | 48.3  | x | 4.0 | s      | 2.80 | 86  | 73  |
| 88.9  | x | 8.0 | 76.1  | x | 7.1 | s      | 4.20 | 86  | 83  |
| 88.9  | x | 8.0 | 60.3  | x | 5.6 | s      | 4.00 | 86  | 76  |
| 88.9  | x | 8.0 | 48.3  | x | 5.0 | s      | 4.00 | 86  | 73  |
| 114.3 | x | 2.6 | 88.9  | x | 2.3 | w      | 2.25 | 105 | 98  |
| 114.3 | x | 2.6 | 76.1  | x | 2.3 | w      | 2.15 | 105 | 95  |
| 114.3 | x | 2.6 | 60.3  | x | 2.0 | w      | 2.15 | 105 | 89  |
| 114.3 | x | 2.6 | 48.3  | x | 2.0 | w      | 2.15 | 105 | 86  |
| 114.3 | x | 2.6 | 42.4  | x | 2.0 | w      | 2.15 | 105 | 84  |
| 114.3 | x | 3.6 | 88.9  | x | 3.2 | s      | 3.00 | 105 | 98  |
| 114.3 | x | 3.6 | 76.1  | x | 3.6 | s      | 2.90 | 105 | 95  |
| 114.3 | x | 3.6 | 60.3  | x | 2.9 | s      | 2.90 | 105 | 89  |
| 114.3 | x | 6.3 | 88.9  | x | 5.6 | s      | 5.10 | 105 | 98  |
| 114.3 | x | 6.3 | 76.1  | x | 5.0 | s      | 5.00 | 105 | 95  |
| 114.3 | x | 6.3 | 60.3  | x | 4.5 | s      | 4.85 | 105 | 89  |
| 114.3 | x | 6.3 | 60.3  | x | 4.0 | s      | 4.80 | 105 | 89  |
| 139.7 | x | 2.6 | 114.3 | x | 2.6 | w      | 3.30 | 124 | 117 |
| 139.7 | x | 2.6 | 88.9  | x | 2.3 | w      | 3.10 | 124 | 111 |
| 139.7 | x | 2.6 | 76.1  | x | 2.3 | w      | 3.10 | 124 | 108 |
| 139.7 | x | 2.6 | 60.3  | x | 2.0 | w      | 3.00 | 124 | 105 |

# Reduced Tees

DIN 2615



s = seamless, w = welded



| Size  |   |      |       |   |        | Pieces |     |     |
|-------|---|------|-------|---|--------|--------|-----|-----|
| d1    | x | s1   | d2    | x | s2     | kg     | a   | b   |
| 139.7 | x | 4.0  | 114.3 | x | 3.6 s  | 4.70   | 124 | 117 |
| 139.7 | x | 4.0  | 88.9  | x | 3.2 s  | 4.60   | 124 | 111 |
| 139.7 | x | 6.3  | 114.3 | x | 6.3 s  | 7.20   | 124 | 117 |
| 139.7 | x | 6.3  | 88.9  | x | 5.6 s  | 7.00   | 124 | 111 |
| 139.7 | x | 6.3  | 76.1  | x | 5.0 s  | 6.80   | 124 | 108 |
| 139.7 | x | 10.0 | 114.3 | x | 8.8 s  | 11.30  | 124 | 117 |
| 139.7 | x | 10.0 | 88.9  | x | 8.0 s  | 11.00  | 124 | 111 |
| 139.7 | x | 10.0 | 76.1  | x | 7.1 s  | 10.90  | 124 | 108 |
| 168.3 | x | 2.6  | 139.7 | x | 2.6 w* | 5.30   | 143 | 137 |
| 168.3 | x | 2.6  | 114.3 | x | 2.6 w* | 5.30   | 143 | 130 |
| 168.3 | x | 2.6  | 88.9  | x | 2.3 w* | 5.00   | 143 | 124 |
| 168.3 | x | 4.5  | 139.7 | x | 4.5 s  | 6.90   | 143 | 137 |
| 168.3 | x | 4.5  | 114.3 | x | 3.6 s  | 6.70   | 143 | 130 |
| 168.3 | x | 4.5  | 88.9  | x | 3.2 s  | 6.60   | 143 | 124 |
| 168.3 | x | 7.1  | 139.7 | x | 6.3 s  | 10.80  | 143 | 137 |
| 168.3 | x | 7.1  | 114.3 | x | 6.3 s  | 10.70  | 143 | 130 |
| 168.3 | x | 7.1  | 88.9  | x | 5.6 s  | 10.40  | 143 | 124 |
| 168.3 | x | 11.0 | 139.7 | x | 11.0 s | 16.60  | 143 | 137 |
| 168.3 | x | 11.0 | 114.3 | x | 8.8 s  | 16.30  | 143 | 130 |
| 168.3 | x | 11.0 | 88.9  | x | 8.0 s  | 16.00  | 143 | 124 |
| 219.1 | x | 2.9  | 168.3 | x | 2.6 w* | 7.20   | 178 | 168 |
| 219.1 | x | 2.9  | 139.7 | x | 2.6 w* | 7.20   | 178 | 162 |
| 219.1 | x | 2.9  | 114.3 | x | 2.6 w* | 7.00   | 178 | 156 |
| 219.1 | x | 6.3  | 168.3 | x | 4.5 s  | 14.40  | 178 | 168 |
| 219.1 | x | 6.3  | 139.7 | x | 4.0 s  | 13.60  | 178 | 162 |
| 219.1 | x | 6.3  | 114.3 | x | 3.6 s  | 13.60  | 178 | 156 |
| 219.1 | x | 6.3  | 88.9  | x | 3.2 s  | 13.60  | 178 | 152 |
| 219.1 | x | 8.0  | 168.3 | x | 7.1 s  | 18.40  | 178 | 168 |
| 219.1 | x | 8.0  | 139.7 | x | 6.3 s  | 17.40  | 178 | 162 |
| 219.1 | x | 8.0  | 114.3 | x | 6.3 s  | 17.40  | 178 | 156 |
| 219.1 | x | 8.0  | 88.9  | x | 5.6 s  | 17.40  | 178 | 152 |
| 219.1 | x | 12.5 | 168.3 | x | 11.0 s | 28.80  | 178 | 168 |
| 219.1 | x | 12.5 | 139.7 | x | 10.0 s | 27.60  | 178 | 162 |
| 219.1 | x | 12.5 | 114.3 | x | 8.8 s  | 27.60  | 178 | 156 |
| 219.1 | x | 12.5 | 88.9  | x | 8.0 s  | 27.60  | 178 | 152 |

The \* marked items are manufactured with following wall thicknesses

21.3 with 2.0  
 26.9 with 2.0  
 88.9 with 2.6  
 139.7 with 2.9  
 168.3 with 2.9

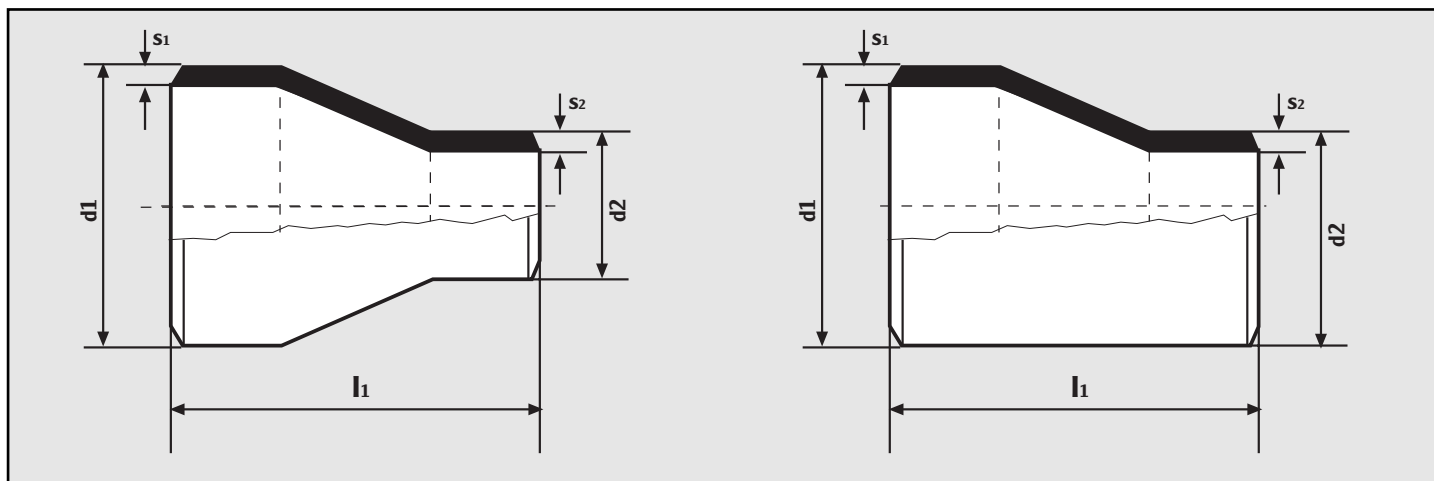




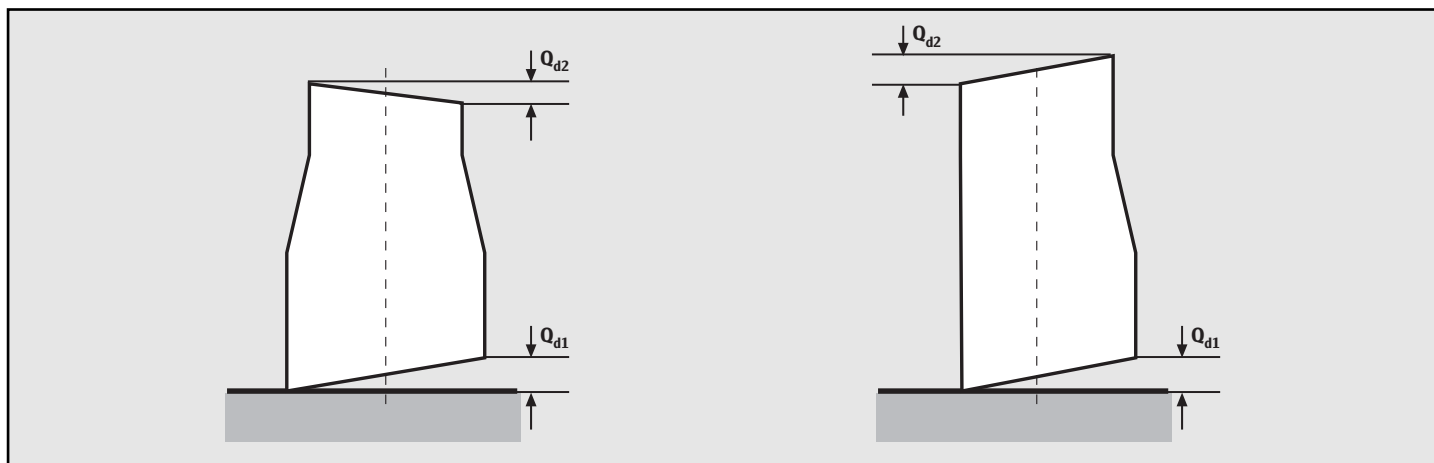


# REDUCER, concentric and eccentric

DIN 2616 – FEB. 91, PART 2 (CONC.), PART 1 (EXC.) CARBON STEEL



## Tolerances



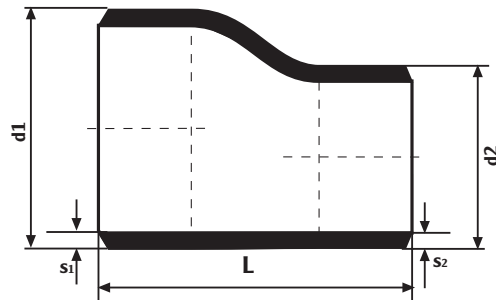
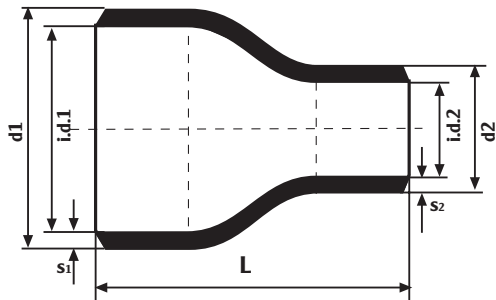
| Outside Ø<br><br>da<br><br>mm | Standard         |        |                          |  |                                    |              |      |            | Special Requirements |        |
|-------------------------------|------------------|--------|--------------------------|--|------------------------------------|--------------|------|------------|----------------------|--------|
|                               | d <sub>1+2</sub> | Q      | l <sub>1</sub><br><br>mm |  | Wall thickness<br>S <sub>1+2</sub> | Ovality      |      | di         |                      |        |
|                               |                  |        |                          |  |                                    | Welding edge | body |            |                      |        |
| 21,3 - 76,1                   | ± 1 %            | 1 %    | ±2,5                     |  | S <sub>min</sub>                   |              | 4 %  | di min:    | ± 0,4 mm             | 0,5 %  |
| - 114,3                       | min.             | v.da   | ±3,0                     |  | (Body)                             | da           | 4 %  | 0,8x       | ± 0,4 mm             | v.da   |
| - 219,1                       | 0,5 mm           | min.   | ± 3,5                    |  | -12,5 %                            | Tolerance    | 4 %  | di-tube    | ± 0,5 %              | min.   |
| - 273                         |                  | 1,0 mm | ± 4,0                    |  |                                    | 2 %          | 4 %  | (theor.di) | ± 0,6 %              | 0,5 mm |
| - 323,9                       |                  |        | ± 5,0                    |  | S <sub>max</sub>                   | 2 %          | 4 %  | des        | ± 0,6 %              |        |
|                               |                  |        |                          |  | (Welding - edge):                  |              |      |            |                      |        |
|                               |                  |        |                          |  | + 15 %                             |              |      |            |                      |        |

d<sub>1+2</sub> = OD at welding edge

S<sub>1+2</sub> = WT at welding edge

# REDUCER

CONCENTRIC DIN 2616 PART 2 ECCENTRIC DIN 2616 PART 1



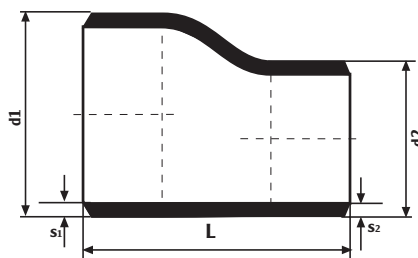
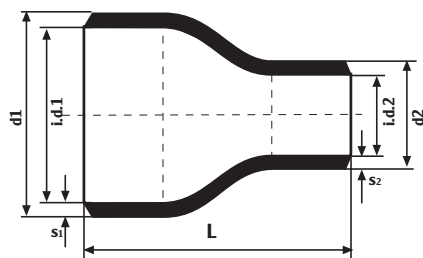
| Tube outside d1 mm | WT s1 mm | Tube outside d2 mm | WT s2 mm | Length conc/ecc L mm | Weight approx. kg |
|--------------------|----------|--------------------|----------|----------------------|-------------------|
| 21.3               | 2.0      | 17.2               | 1.8      | 38                   | 0.03              |
|                    | 3.2      | 17.2               | 2.9      | 38                   | 0.05              |
|                    | 4.0      | 17.2               | 2.9      | 38                   | 0.06              |
| 26.9               | 2.3      | 21.3               | 2.0      | 38                   | 0.05              |
|                    |          | 17.2               | 1.8      | 38                   | 0.05              |
|                    | 3.2      | 21.3               | 3.2      | 38                   | 0.06              |
|                    |          | 17.2               | 2.9      | 38                   | 0.06              |
|                    | 4.0      | 21.3               | 4.0      | 38                   | 0.08              |
|                    |          | 17.2               | 3.2      | 38                   | 0.08              |
| 30.0               | 2.6      | 26.9               | 2.3      | 50                   | 0.08              |
|                    |          | 25.0               | 2.0      | 50                   | 0.08              |
|                    |          | 21.3               | 2.0      | 50                   | 0.08              |
|                    |          | 20.0               | 2.0      | 50                   | 0.08              |
| 33.7               | 2.6      | 26.9               | 2.3      | 50                   | 0.09              |
|                    |          | 21.3               | 2.0      | 50                   | 0.09              |
|                    | 3.2      | 26.9               | 3.2      | 50                   | 0.11              |
|                    |          | 21.3               | 3.2      | 50                   | 0.11              |
|                    | 4.0      | 26.9               | 4.0      | 50                   | 0.18              |
|                    |          | 21.3               | 4.0      | 50                   | 0.18              |
| 38.0               | 2.6      | 33.7               | 2.6      | 50                   | 0.10              |
|                    |          | 30.0               | 2.6      | 50                   | 0.10              |
|                    |          | 26.9               | 2.3      | 50                   | 0.10              |
|                    |          | 25.0               | 2.0      | 50                   | 0.10              |
|                    |          | 21.3               | 2.0      | 50                   | 0.10              |
|                    |          | 20.0               | 2.0      | 50                   | 0.10              |
|                    |          | 20.0               | 2.0      | 50                   | 0.10              |
| 42.4               | 2.6      | 33.7               | 2.6      | 50                   | 0.11              |
|                    |          | 26.9               | 2.3      | 50                   | 0.11              |
|                    |          | 21.3               | 2.0      | 50                   | 0.11              |
|                    | 3.6      | 33.7               | 3.2      | 50                   | 0.14              |
|                    |          | 26.9               | 3.2      | 50                   | 0.14              |
|                    |          | 21.3               | 3.2      | 50                   | 0.14              |
|                    |          | 21.3               | 3.2      | 50                   | 0.14              |
|                    | 4.0      | 33.7               | 4.0      | 50                   | 0.17              |
|                    |          | 26.9               | 4.0      | 50                   | 0.17              |
|                    |          | 21.3               | 4.0      | 50                   | 0.17              |

| Tube outside d1 mm | WT s1 mm | Tube outside d2 mm | WT s2 mm | Length conc/ecc L mm | Weight approx. kg |
|--------------------|----------|--------------------|----------|----------------------|-------------------|
| 44.5               | 2.6      | 38.0               | 2.6      | 64                   | 0.15              |
|                    |          | 33.7               | 2.6      | 64                   | 0.15              |
|                    |          | 30.0               | 2.6      | 64                   | 0.15              |
|                    |          | 26.9               | 2.3      | 64                   | 0.15              |
|                    |          | 25.0               | 2.0      | 64                   | 0.15              |
|                    |          | 21.3               | 2.0      | 64                   | 0.15              |
|                    |          | 20.0               | 2.0      | 64                   | 0.15              |
|                    |          | 20.0               | 2.0      | 64                   | 0.15              |
| 48.3               | 2.6      | 42.4               | 2.6      | 64                   | 0.17              |
|                    |          | 33.7               | 2.6      | 64                   | 0.17              |
|                    |          | 26.9               | 2.3      | 64                   | 0.17              |
|                    | 4.0      | 42.4               | 3.6      | 64                   | 0.27              |
|                    |          | 33.7               | 3.2      | 64                   | 0.27              |
|                    |          | 26.9               | 3.2      | 64                   | 0.27              |
|                    | 5.0      | 42.4               | 4.0      | 64                   | 0.31              |
|                    |          | 33.7               | 4.0      | 64                   | 0.31              |
|                    |          | 26.9               | 4.0      | 64                   | 0.31              |
| 57.0               | 2.9      | 48.3               | 2.6      | 76                   | 0.26              |
|                    |          | 44.5               | 2.6      | 76                   | 0.26              |
|                    |          | 42.4               | 2.6      | 76                   | 0.26              |
|                    |          | 38.0               | 2.6      | 76                   | 0.26              |
|                    |          | 33.7               | 2.6      | 76                   | 0.26              |
|                    |          | 30.0               | 2.6      | 76                   | 0.26              |
|                    |          | 26.9               | 2.3      | 76                   | 0.26              |
|                    |          | 25.0               | 2.0      | 76                   | 0.26              |
|                    |          | 21.3               | 2.0      | 76                   | 0.26              |
|                    |          | 20.0               | 2.0      | 76                   | 0.26              |
|                    |          | 20.0               | 2.0      | 76                   | 0.26              |
|                    |          | 20.0               | 2.0      | 76                   | 0.26              |
| 60.3               | 2.9      | 48.3               | 2.6      | 76                   | 0.28              |
|                    |          | 42.4               | 2.6      | 76                   | 0.28              |
|                    |          | 33.7               | 2.6      | 76                   | 0.28              |
|                    |          | 26.9               | 2.3      | 76                   | 0.28              |
|                    |          | 21.3               | 2.0      | 76                   | 0.28              |
|                    |          | 21.3               | 2.0      | 76                   | 0.28              |
|                    | 4.5      | 48.3               | 4.0      | 76                   | 0.37              |
|                    |          | 42.4               | 3.6      | 76                   | 0.37              |
|                    |          | 33.7               | 3.2      | 76                   | 0.37              |
|                    |          | 26.9               | 3.2      | 76                   | 0.37              |
|                    |          | 21.3               | 3.2      | 76                   | 0.37              |
|                    |          | 21.3               | 3.2      | 76                   | 0.37              |



# REDUCER

DIN 2616

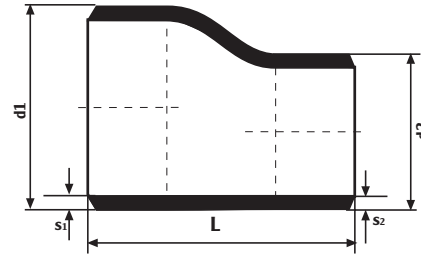
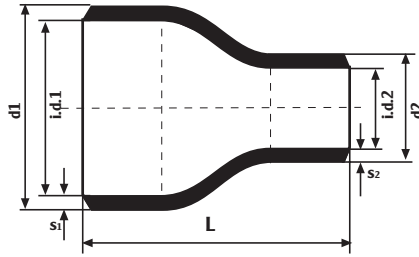


| Tube outside d1 mm | WT s1 mm | Tube outside d2 mm | WT s2 mm | Length conc/ecc L mm | Weight approx. kg |
|--------------------|----------|--------------------|----------|----------------------|-------------------|
|                    | 5.6      | 48.3               | 5.0      | 76                   | 0.52              |
|                    |          | 42.4               | 4.0      | 76                   | 0.52              |
|                    |          | 33.7               | 4.0      | 76                   | 0.52              |
|                    |          | 26.9               | 4.0      | 76                   | 0.52              |
| 70.0               | 2.9      | 60.3               | 2.9      | 90                   | 0.39              |
|                    |          | 57.0               | 2.9      | 90                   | 0.39              |
|                    |          | 48.3               | 2.6      | 90                   | 0.39              |
|                    |          | 44.5               | 2.6      | 90                   | 0.39              |
|                    |          | 42.4               | 2.6      | 90                   | 0.39              |
|                    |          | 38.0               | 2.6      | 90                   | 0.39              |
|                    |          | 33.7               | 2.6      | 90                   | 0.39              |
|                    |          | 30.0               | 2.6      | 90                   | 0.39              |
| 76.1               | 2.9      | 60.3               | 2.9      | 90                   | 0.42              |
|                    |          | 57.0               | 2.9      | 90                   | 0.42              |
|                    |          | 48.3               | 2.6      | 90                   | 0.42              |
|                    |          | 42.4               | 2.6      | 90                   | 0.42              |
|                    |          | 38.0               | 2.6      | 90                   | 0.42              |
|                    |          | 33.7               | 2.6      | 90                   | 0.42              |
|                    |          | 30.0               | 2.6      | 90                   | 0.42              |
|                    |          |                    |          |                      |                   |
|                    | 5.0      | 60.3               | 4.5      | 90                   | 0.71              |
|                    |          | 48.3               | 4.0      | 90                   | 0.71              |
|                    |          | 42.4               | 3.6      | 90                   | 0.71              |
|                    |          | 33.7               | 3.2      | 90                   | 0.71              |
|                    | 7.1      | 60.3               | 5.6      | 90                   | 0.98              |
|                    |          | 48.3               | 5.0      | 90                   | 0.98              |
|                    |          | 42.4               | 4.0      | 90                   | 0.98              |
|                    |          | 33.7               | 4.0      | 90                   | 0.98              |
| 88.9               | 3.2      | 76.1               | 2.9      | 90                   | 0.55              |
|                    |          | 70.0               | 2.9      | 90                   | 0.55              |
|                    |          | 60.3               | 2.9      | 90                   | 0.55              |
|                    |          | 57.0               | 2.9      | 90                   | 0.55              |
|                    |          | 48.3               | 2.6      | 90                   | 0.55              |
|                    |          | 44.5               | 2.6      | 90                   | 0.55              |
|                    |          | 42.4               | 2.6      | 90                   | 0.55              |
|                    |          | 33.7               | 2.6      | 90                   | 0.55              |
|                    | 5.6      | 76.1               | 5.0      | 90                   | 0.93              |
|                    |          | 60.3               | 4.5      | 90                   | 0.93              |
|                    |          | 48.3               | 4.0      | 90                   | 0.93              |
|                    |          | 42.4               | 3.6      | 90                   | 0.93              |
|                    | 8.0      | 76.1               | 7.1      | 90                   | 1.30              |
|                    |          | 60.3               | 5.6      | 90                   | 1.30              |
|                    |          | 48.3               | 5.0      | 90                   | 1.30              |
|                    |          | 42.4               | 4.0      | 90                   | 1.30              |
| 101.6              | 3.6      | 88.9               | 3.2      | 100                  | 0.78              |
|                    |          | 76.1               | 2.9      | 100                  | 0.78              |
|                    |          | 60.3               | 2.9      | 100                  | 0.78              |
|                    |          | 57.0               | 2.9      | 100                  | 0.78              |
|                    |          | 48.3               | 2.6      | 100                  | 0.78              |

| Tube outside d1 mm | WT s1 mm | Tube outside d2 mm | WT s2 mm | Length conc/ecc L mm | Weight approx. kg |
|--------------------|----------|--------------------|----------|----------------------|-------------------|
| 108.0              | 3.6      | 88.9               | 3.2      | 100                  | 0.85              |
|                    |          | 76.1               | 2.9      | 100                  | 0.85              |
|                    |          | 70.0               | 2.9      | 100                  | 0.85              |
|                    |          | 60.3               | 2.9      | 100                  | 0.85              |
|                    |          | 57.0               | 2.9      | 100                  | 0.85              |
|                    |          | 48.3               | 2.6      | 100                  | 0.85              |
|                    |          | 44.5               | 2.6      | 100                  | 0.85              |
|                    |          | 42.4               | 2.6      | 100                  | 0.85              |
|                    |          | 38.0               | 2.6      | 100                  | 0.85              |
|                    |          | 30.0               | 2.6      | 100                  | 0.85              |
| 114.3              | 3.6      | 101.6              | 3.6      | 100                  | 0.98              |
|                    |          | 88.9               | 3.2      | 100                  | 0.98              |
|                    |          | 76.1               | 2.9      | 100                  | 0.98              |
|                    |          | 60.3               | 2.9      | 100                  | 0.98              |
|                    |          | 57.0               | 2.9      | 100                  | 0.98              |
|                    |          | 48.3               | 2.6      | 100                  | 0.98              |
|                    |          | 44.5               | 2.6      | 100                  | 0.98              |
|                    |          | 42.4               | 2.6      | 100                  | 0.98              |
|                    | 6.3      | 88.9               | 5.6      | 100                  | 1.68              |
|                    |          | 76.1               | 5.0      | 100                  | 1.68              |
|                    |          | 60.3               | 4.5      | 100                  | 1.68              |
|                    |          | 48.3               | 4.0      | 100                  | 1.68              |
|                    | 8.8      | 88.9               | 8.0      | 100                  | 2.29              |
|                    |          | 76.1               | 7.1      | 100                  | 2.29              |
|                    |          | 60.3               | 5.6      | 100                  | 2.29              |
|                    |          | 48.3               | 5.0      | 100                  | 2.29              |
| 133.0              | 4.0      | 114.3              | 3.6      | 127                  | 1.61              |
|                    |          | 108.0              | 3.6      | 127                  | 1.61              |
|                    |          | 88.9               | 3.2      | 127                  | 1.61              |
|                    |          | 76.1               | 2.9      | 127                  | 1.61              |
|                    |          | 60.3               | 2.9      | 127                  | 1.61              |
|                    |          | 57.0               | 2.9      | 127                  | 1.61              |
| 139.7              | 4.0      | 114.3              | 3.6      | 127                  | 1.70              |
|                    |          | 108.0              | 3.6      | 127                  | 1.70              |
|                    |          | 101.6              | 3.6      | 127                  | 1.70              |
|                    |          | 88.9               | 3.2      | 127                  | 1.70              |
|                    |          | 76.1               | 2.9      | 127                  | 1.70              |
|                    |          | 60.3               | 2.9      | 127                  | 1.70              |
|                    | 6.3      | 114.3              | 6.3      | 127                  | 2.63              |
|                    |          | 88.9               | 5.6      | 127                  | 2.63              |
|                    |          | 76.1               | 5.0      | 127                  | 2.63              |
|                    |          | 60.3               | 4.5      | 127                  | 2.63              |
|                    | 10       | 114.3              | 8.8      | 127                  | 4.06              |
|                    |          | 88.9               | 8.0      | 127                  | 4.06              |
|                    |          | 76.1               | 7.1      | 127                  | 4.06              |
|                    |          | 60.3               | 5.6      | 127                  | 4.06              |

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DIN 2616



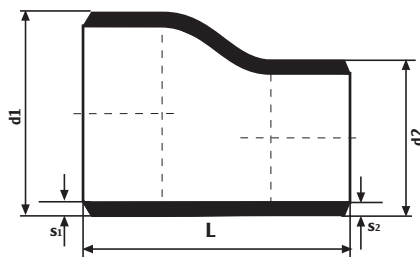
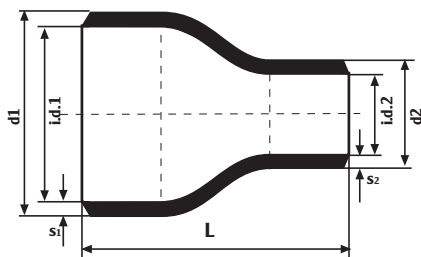
| Tube outside d1 mm | WT s1 mm | Tube outside d2 mm | WT s2 mm | Length conc/ecc L mm | Weight approx. kg |
|--------------------|----------|--------------------|----------|----------------------|-------------------|
| 159.0              | 4.5      | 139.7              | 4.0      | 140                  | 2.39              |
|                    |          | 133.0              | 4.0      | 140                  | 2.39              |
|                    |          | 114.3              | 3.6      | 140                  | 2.39              |
|                    |          | 108.0              | 3.6      | 140                  | 2.39              |
|                    |          | 88.9               | 3.2      | 140                  | 2.39              |
|                    |          | 76.1               | 2.9      | 140                  | 2.39              |
|                    |          | 60.3               | 2.9      | 140                  | 2.39              |
|                    |          | 57.0               | 2.9      | 140                  | 2.39              |
| 168.3              | 4.5      | 139.7              | 4.0      | 140                  | 2.55              |
|                    |          | 133.0              | 4.0      | 140                  | 2.55              |
|                    |          | 114.3              | 3.6      | 140                  | 2.55              |
|                    |          | 108.0              | 3.6      | 140                  | 2.55              |
|                    |          | 88.9               | 3.2      | 140                  | 2.55              |
|                    |          | 76.1               | 2.9      | 140                  | 2.55              |
|                    |          | 60.3               | 2.9      | 140                  | 2.55              |
|                    |          | 57.0               | 2.9      | 140                  | 2.55              |
|                    | 7.1      | 139.7              | 6.3      | 140                  | 3.95              |
|                    |          | 114.3              | 6.3      | 140                  | 3.95              |
|                    |          | 88.9               | 5.6      | 140                  | 3.95              |
|                    |          | 76.1               | 5.0      | 140                  | 3.95              |
|                    | 11.0     | 139.7              | 10.0     | 140                  | 5.98              |
|                    |          | 114.3              | 8.8      | 140                  | 5.98              |
|                    |          | 88.9               | 8.0      | 140                  | 5.98              |
|                    |          | 76.1               | 7.1      | 140                  | 5.98              |
| 193.7              | 5.6      | 168.3              | 4.5      | 152                  | 3.95              |
|                    |          | 139.7              | 4.0      | 152                  | 3.95              |
|                    |          | 133.0              | 4.0      | 152                  | 3.95              |
|                    |          | 114.3              | 3.6      | 152                  | 3.95              |
|                    |          | 108.0              | 3.6      | 152                  | 3.95              |
| 219.1              | 6.3      | 193.7              | 5.6      | 152                  | 5.03              |
|                    |          | 168.3              | 4.5      | 152                  | 5.03              |
|                    |          | 159.0              | 4.5      | 152                  | 5.03              |
|                    |          | 139.7              | 4.0      | 152                  | 5.03              |
|                    |          | 133.0              | 4.0      | 152                  | 5.03              |
|                    |          | 114.3              | 3.6      | 152                  | 5.03              |
|                    |          | 108.0              | 3.6      | 152                  | 5.03              |
|                    |          | 88.9               | 3.2      | 152                  | 5.03              |
|                    | 8.0      | 168.3              | 7.1      | 152                  | 6.32              |
|                    |          | 139.7              | 6.3      | 152                  | 6.32              |
|                    |          | 114.3              | 6.3      | 152                  | 6.32              |
|                    |          | 88.9               | 5.6      | 152                  | 6.32              |
|                    | 12.5     | 168.3              | 11.0     | 152                  | 9.68              |
|                    |          | 139.7              | 10.0     | 152                  | 9.68              |
|                    |          | 114.3              | 8.8      | 152                  | 9.68              |
|                    |          | 88.9               | 8.0      | 152                  | 9.68              |
| 267.0              | 6.3      | 219.1              | 6.3      | 178                  | 7.36              |
|                    |          | 193.7              | 6.3      | 178                  | 7.36              |
|                    |          | 168.3              | 4.5      | 178                  | 7.36              |
|                    |          | 159.0              | 4.5      | 178                  | 7.36              |
|                    |          | 139.7              | 4.0      | 178                  | 7.36              |

| Tube outside d1 mm | WT s1 mm | Tube outside d2 mm | WT s2 mm | Length conc/ecc L mm | Weight approx. kg |
|--------------------|----------|--------------------|----------|----------------------|-------------------|
| 273.0              | 6.3      | 219.1              | 6.3      | 178                  | 7.36              |
|                    |          | 193.7              | 6.3      | 178                  | 7.36              |
|                    |          | 168.3              | 4.5      | 178                  | 7.36              |
|                    |          | 159.0              | 4.5      | 178                  | 7.36              |
|                    |          | 139.7              | 4.0      | 178                  | 7.36              |
|                    |          | 133.0              | 4.0      | 178                  | 7.36              |
|                    |          | 114.3              | 3.6      | 178                  | 7.36              |
|                    |          | 108.0              | 3.6      | 178                  | 7.36              |
|                    | 8.8      | 219.1              | 8.0      | 178                  | 10.2              |
|                    |          | 168.3              | 7.1      | 178                  | 10.2              |
|                    |          | 139.7              | 6.3      | 178                  | 10.2              |
|                    |          | 114.3              | 6.3      | 178                  | 10.2              |
|                    | 14.2     | 219.1              | 12.5     | 178                  | 16.1              |
|                    |          | 168.3              | 11.0     | 178                  | 16.1              |
|                    |          | 139.7              | 10.0     | 178                  | 16.1              |
|                    |          | 114.3              | 8.8      | 178                  | 16.1              |
| 323.9              | 7.1      | 273.0              | 6.3      | 203                  | 11.1              |
|                    |          | 219.1              | 6.3      | 203                  | 11.1              |
|                    |          | 193.7              | 5.6      | 203                  | 11.1              |
|                    |          | 168.3              | 4.5      | 203                  | 11.1              |
|                    |          | 159.0              | 4.5      | 203                  | 11.1              |
|                    |          | 139.7              | 4.0      | 203                  | 11.1              |
|                    |          | 133.0              | 4.0      | 203                  | 11.1              |
|                    |          | 114.3              | 3.6      | 203                  | 11.1              |
|                    | 10.0     | 273.0              | 8.0      | 203                  | 15.7              |
|                    |          | 219.1              | 8.0      | 203                  | 15.7              |
|                    |          | 168.3              | 7.1      | 203                  | 15.7              |
|                    |          | 139.7              | 6.3      | 203                  | 15.7              |
|                    | 16.0     | 273.0              | 14.2     | 203                  | 24.5              |
|                    |          | 219.1              | 12.5     | 203                  | 24.5              |
|                    |          | 168.3              | 11.0     | 203                  | 24.5              |
|                    |          | 139.7              | 10.0     | 203                  | 24.5              |
| 355.6              | 8.0      | 323.9              | 7.1      | 330                  | 22.6              |
|                    |          | 273.0              | 6.3      | 330                  | 22.6              |
|                    |          | 219.1              | 6.3      | 330                  | 22.6              |
|                    |          | 168.3              | 4.5      | 330                  | 22.6              |
|                    |          | 159.0              | 4.5      | 330                  | 22.6              |
|                    |          | 139.7              | 4.0      | 330                  | 22.6              |
|                    |          | 133.0              | 4.0      | 330                  | 22.6              |
|                    |          | 114.3              | 3.6      | 330                  | 22.6              |
|                    | 11.0     | 323.9              | 10.0     | 330                  | 30.8              |
|                    |          | 273.0              | 8.8      | 330                  | 30.8              |
|                    |          | 219.1              | 8.0      | 330                  | 30.8              |
|                    |          | 168.3              | 7.1      | 330                  | 30.8              |
|                    | 17.5     | 323.9              | 16.0     | 330                  | 48.1              |
|                    |          | 273.0              | 14.2     | 330                  | 48.1              |
|                    |          | 219.1              | 12.5     | 330                  | 48.1              |
|                    |          | 168.3              | 11.0     | 330                  | 48.1              |



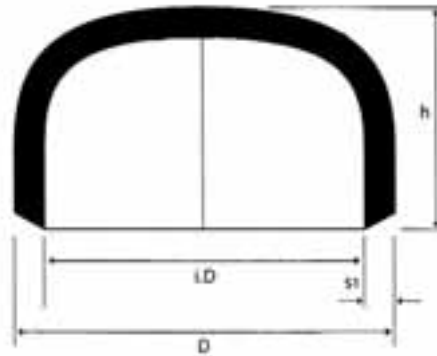
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DIN 2616



| Tube outside d1 mm | WT s1 mm | Tube outside d2 mm | WT s2 mm | Length conc/ecc L mm | Weight approx. kg |
|--------------------|----------|--------------------|----------|----------------------|-------------------|
| 406.4              | 8.8      | 355.6              | 8.0      | 355                  | 30.6              |
|                    |          | 323.9              | 7.1      | 355                  | 30.6              |
|                    |          | 273.0              | 6.3      | 355                  | 30.6              |
|                    |          | 219.1              | 6.3      | 355                  | 30.6              |
|                    | 12.5     | 355.6              | 11.0     | 355                  | 42.9              |
|                    |          | 323.9              | 10.0     | 355                  | 42.9              |
|                    |          | 273.0              | 8.8      | 355                  | 42.9              |
|                    |          | 219.1              | 8.0      | 355                  | 42.9              |
|                    | 20.0     | 355.6              | 17.5     | 355                  | 67.8              |
|                    |          | 323.9              | 16.0     | 355                  | 67.8              |
|                    |          | 273.0              | 14.2     | 355                  | 67.8              |
|                    |          | 219.1              | 12.5     | 355                  | 67.8              |
| 419.0              | 10.0     | 368.0              | 8.0      | 355                  | 35.8              |
|                    |          | 355.6              | 8.0      | 355                  | 35.8              |
|                    |          | 323.9              | 7.1      | 355                  | 35.8              |
|                    |          | 273.0              | 6.3      | 355                  | 35.8              |
|                    |          | 267.0              | 6.3      | 355                  | 35.8              |
|                    |          | 219.1              | 6.3      | 355                  | 35.8              |
| 457.0              | 10.0     | 419.0              | 10.0     | 381                  | 41.9              |
|                    |          | 406.4              | 8.8      | 381                  | 41.9              |
|                    |          | 355.6              | 8.0      | 381                  | 41.9              |
|                    |          | 323.9              | 7.1      | 381                  | 41.9              |
|                    |          | 273.0              | 6.3      | 381                  | 41.9              |
|                    |          | 219.1              | 6.3      | 381                  | 41.9              |
|                    | 14.2     | 406.4              | 12.5     | 381                  | 59.0              |
|                    |          | 355.6              | 11.0     | 381                  | 59.0              |
|                    |          | 323.9              | 10.0     | 381                  | 59.0              |
|                    |          | 273.0              | 8.8      | 381                  | 59.0              |
|                    | 22.2     | 406.4              | 20.0     | 381                  | 90.6              |
|                    |          | 355.6              | 17.5     | 381                  | 90.6              |
|                    |          | 323.9              | 16.0     | 381                  | 90.6              |
|                    |          | 273.0              | 14.2     | 381                  | 90.6              |
|                    |          |                    |          |                      |                   |

| Tube outside d1 mm | WT s1 mm | Tube outside d2 mm | WT s2 mm | Length conc/ecc L mm | Weight approx. kg |
|--------------------|----------|--------------------|----------|----------------------|-------------------|
| 508.0              | 11.0     | 457.0              | 10.0     | 508                  | 68.5              |
|                    |          | 406.4              | 8.8      | 508                  | 68.5              |
|                    |          | 355.6              | 8.0      | 508                  | 68.5              |
|                    |          | 323.9              | 7.1      | 508                  | 68.5              |
|                    |          | 273.0              | 6.3      | 508                  | 68.5              |
|                    |          | 219.1              | 6.3      | 508                  | 68.5              |
|                    | 16.0     | 457.0              | 14.2     | 508                  | 98.5              |
|                    |          | 406.4              | 12.5     | 508                  | 98.5              |
|                    |          | 355.6              | 11.0     | 508                  | 98.5              |
|                    |          | 323.9              | 10.0     | 508                  | 98.5              |
|                    |          | 273.0              | 8.8      | 508                  | 98.5              |
|                    |          | 219.1              | 8.0      | 508                  | 98.5              |
|                    | 25.0     | 457.0              | 22.2     | 508                  | 151               |
|                    |          | 406.4              | 20.0     | 508                  | 151               |
|                    |          | 355.6              | 17.5     | 508                  | 151               |
|                    |          | 323.9              | 16.0     | 508                  | 151               |
|                    |          | 273.0              | 14.2     | 508                  | 151               |
|                    |          | 219.1              | 12.5     | 508                  | 151               |
| 610.0              | 12.5     | 508.0              | 11.0     | 508                  | 93.4              |
|                    |          | 457.0              | 10.0     | 508                  | 93.4              |
|                    |          | 406.4              | 8.8      | 508                  | 93.4              |
|                    |          | 355.6              | 8.0      | 508                  | 93.4              |
|                    |          | 323.9              | 7.1      | 508                  | 93.4              |
|                    |          |                    |          |                      |                   |
|                    | 17.5     | 508.0              | 16.0     | 508                  | 130               |
|                    |          | 457.0              | 14.2     | 508                  | 130               |
|                    |          | 406.4              | 12.5     | 508                  | 130               |
|                    |          | 355.6              | 11.0     | 508                  | 130               |
|                    |          | 323.9              | 10.0     | 508                  | 130               |
|                    |          |                    |          |                      |                   |
|                    | 30.0     | 508.0              | 25.0     | 508                  | 217               |
|                    |          | 457.0              | 22.2     | 508                  | 217               |
|                    |          | 406.4              | 20.0     | 508                  | 217               |
|                    |          | 355.6              | 17.5     | 508                  | 217               |
|                    |          | 323.9              | 16.0     | 508                  | 217               |



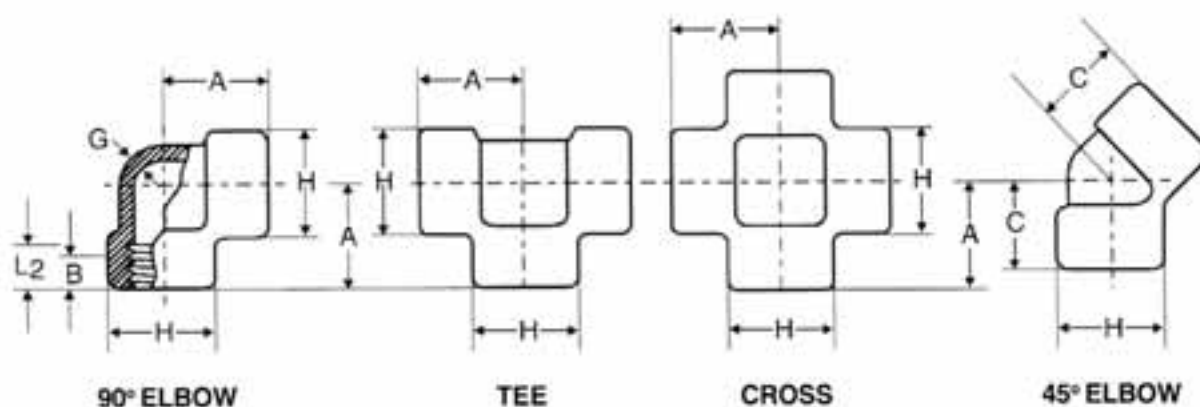
| Tube<br>OD<br>Ø D mm | Wallthickness |               |               | Height<br>h approx. mm | Weight              |                     |                     |
|----------------------|---------------|---------------|---------------|------------------------|---------------------|---------------------|---------------------|
|                      | Row 3<br>s mm | Row 4<br>s mm | Row 5<br>s mm |                        | Row 3<br>approx. kg | Row 4<br>approx. kg | Row 5<br>approx. kg |
| 21.3                 | 2.0           | 3.2           | 4.0           | 25                     | 0.06                | 0.10                | 0.13                |
| 26.9                 | 2.3           | 3.2           | 4.0           | 25                     | 0.07                | 0.11                | 0.14                |
| 33.7                 | 2.6           | 3.2           | 4.0           | 38                     | 0.09                | 0.13                | 0.15                |
| 42.4                 | 2.6           | 3.6           | 4.0           | 38                     | 0.11                | 0.14                | 0.16                |
| 48.3                 | 2.6           | 4.0           | 5.0           | 38                     | 0.20                | 0.22                | 0.23                |
| 60.3                 | 2.9           | 4.5           | 5.6           | 38                     | 0.28                | 0.30                | 0.34                |
| 76.1                 | 2.9           | 5.0           | 7.1           | 38                     | 0.34                | 0.50                | 0.71                |
| 88.9                 | 3.2           | 5.6           | 8.0           | 51                     | 0.53                | 0.70                | 0.95                |
| 114.3                | 3.6           | 6.3           | 8.8           | 64                     | 1.00                | 1.50                | 1.72                |
| 139.7                | 4.0           | 6.3           | 10.0          | 76                     | 1.14                | 1.60                | 2.86                |
| 168.3                | 4.5           | 7.1           | 11.0          | 89                     | 2.65                | 3.55                | 5.30                |
| 219.1                | 6.3           | 8.0           | 12.5          | 102                    | 5.55                | 6.70                | 10.35               |
| 273.0                | 6.3           | 8.8           | 14.2          | 127                    | 8.00                | 8.80                | 14.00               |
| 323.9                | 7.1           | 10.0          | 16.0          | 152                    | 9.90                | 14.00               | 22.50               |
| 355.6                | 8.0           | 11.0          | 17.5          | 165                    | 13.50               | 18.50               | 29.50               |
| 406.4                | 8.8           | 12.5          | 20.0          | 178                    | 18.20               | 26.60               | 42.50               |
| 457.0                | 10.0          | 14.2          | 22.0          | 203                    | 26.00               | 38.50               | 60.00               |
| 508.0                | 11.0          | 16.0          | 25.0          | 229                    | 38.00               | 54.00               | 84.00               |
| 610.0                | 12.5          | 17.5          | 30.0          | 267                    | 60.80               | 83.00               | 143.00              |





# Threaded fittings

ASME B 16.11



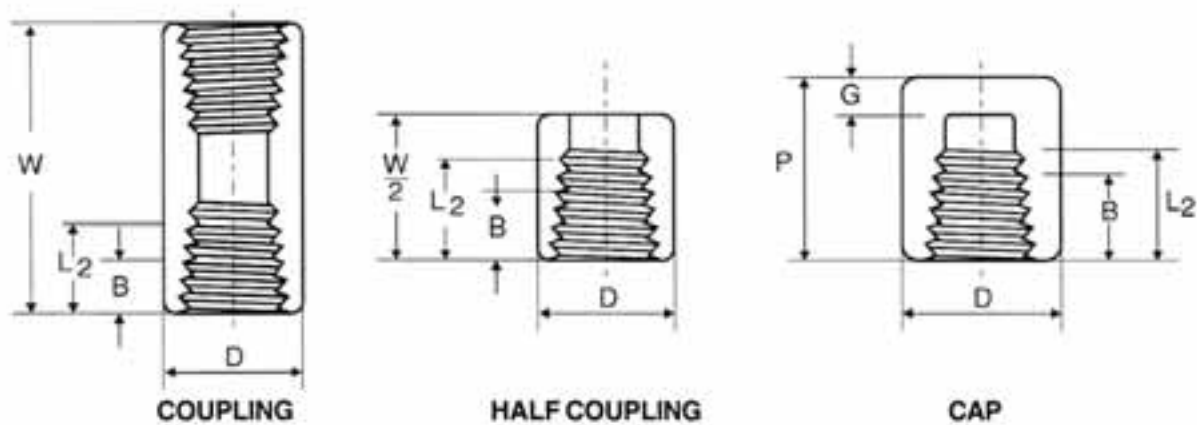
| DN  | Nom.<br>Pipe<br>Size | Centre to End<br>Elbows, Tees, Cross<br>A |      |      | Centre to End<br>45° Elbow<br>C |      |      | Outside Diameter<br>of Band<br>H |      |      | Minimum Wall<br>Thickness<br>G |       |       | Length of<br>Thread<br>Min.(1) |      |
|-----|----------------------|-------------------------------------------|------|------|---------------------------------|------|------|----------------------------------|------|------|--------------------------------|-------|-------|--------------------------------|------|
|     |                      | 2000                                      | 3000 | 6000 | 2000                            | 3000 | 6000 | 2000                             | 3000 | 6000 | 2000                           | 3000  | 6000  | B                              | L2   |
| 6   | 1/8                  | 21                                        | 21   | 25   | 17                              | 17   | 19   | 22                               | 22   | 25   | 3.18                           | 3.18  | 6.35  | 6.4                            | 6.7  |
| 8   | 1/4                  | 21                                        | 25   | 28   | 17                              | 19   | 22   | 22                               | 25   | 33   | 3.18                           | 3.30  | 6.60  | 8.1                            | 10.2 |
| 10  | 3/8                  | 25                                        | 28   | 33   | 19                              | 22   | 25   | 25                               | 33   | 38   | 3.18                           | 3.51  | 6.98  | 9.1                            | 10.4 |
| 15  | 1/2                  | 28                                        | 33   | 38   | 22                              | 25   | 28   | 33                               | 38   | 46   | 3.18                           | 4.09  | 8.15  | 10.9                           | 13.6 |
| 20  | 3/4                  | 33                                        | 38   | 44   | 25                              | 28   | 33   | 38                               | 46   | 56   | 3.18                           | 4.32  | 8.53  | 12.7                           | 13.9 |
| 25  | 1                    | 38                                        | 44   | 51   | 28                              | 33   | 35   | 46                               | 56   | 62   | 3.68                           | 4.98  | 9.93  | 14.7                           | 17.3 |
| 32  | 1-1/4                | 44                                        | 51   | 60   | 33                              | 35   | 43   | 56                               | 62   | 75   | 3.89                           | 5.28  | 10.59 | 17.0                           | 18.0 |
| 40  | 1-1/2                | 51                                        | 60   | 64   | 35                              | 43   | 44   | 62                               | 75   | 84   | 4.01                           | 5.56  | 11.07 | 17.8                           | 18.4 |
| 50  | 2                    | 60                                        | 64   | 83   | 43                              | 44   | 52   | 75                               | 84   | 102  | 4.27                           | 7.14  | 12.09 | 19.0                           | 19.2 |
| 65  | 2-1/2                | 76                                        | 83   | 95   | 52                              | 52   | 64   | 92                               | 102  | 121  | 5.61                           | 7.65  | 15.29 | 23.6                           | 28.9 |
| 80  | 3                    | 86                                        | 95   | 106  | 64                              | 64   | 79   | 109                              | 121  | 146  | 5.99                           | 8.84  | 16.64 | 25.9                           | 30.5 |
| 100 | 4                    | 106                                       | 114  | 114  | 79                              | 79   | 79   | 146                              | 152  | 152  | 6.55                           | 11.18 | 18.67 | 27.7                           | 33.0 |

1. Dimension B is minimum length of perfect thread. The length of useful thread (B plus threads with fully normed roots and flat crests) shall not be less than L2 (effective length of external thread) required by American National Standard for Pipe Threads (ANSI/ASME B1.20.1).



# Threaded fittings

ASME B 16.11



Dimensions in mm

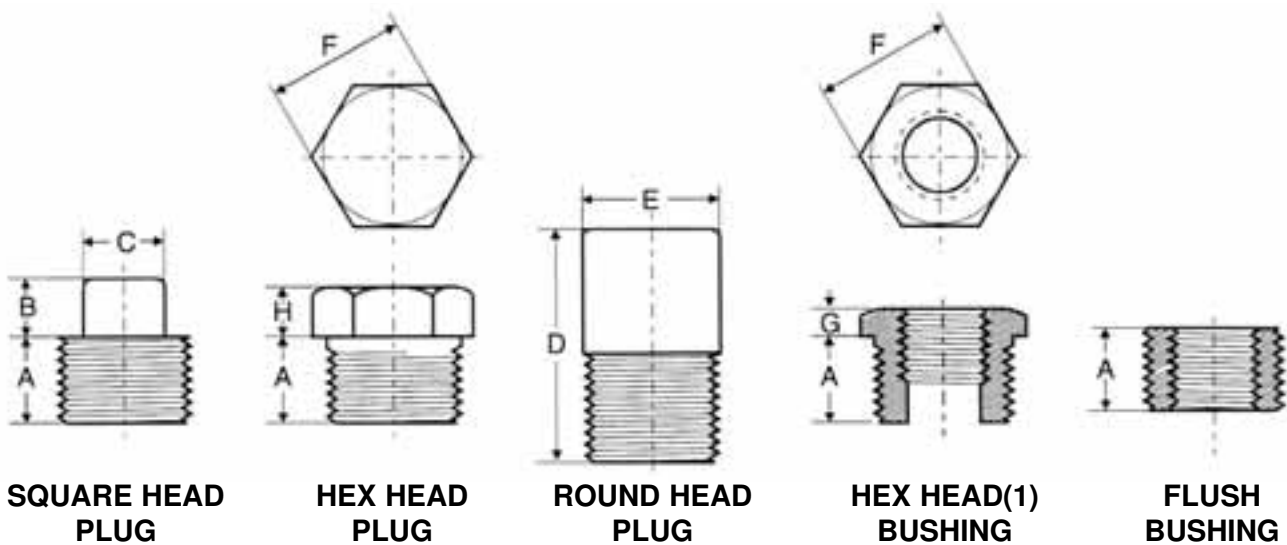
| DN  | Nom.<br>Pipe<br>Size | End to End<br>Couplings<br>W | End to End<br>Couplings<br>P |      | Outside<br>Diameter<br>D |      | End Wall<br>Thickness<br>G |      | Length of<br>Thread<br>Min.(1) |      |
|-----|----------------------|------------------------------|------------------------------|------|--------------------------|------|----------------------------|------|--------------------------------|------|
|     |                      | 3000&6000                    | 3000                         | 6000 | 3000                     | 6000 | 3000                       | 6000 | B                              | L2   |
| 6   | 1/8                  | 32                           | 19                           | ...  | 16                       | 22   | 4.8                        | ...  | 6.4                            | 6.7  |
| 8   | 1/4                  | 35                           | 25                           | 27   | 19                       | 25   | 4.8                        | 6.4  | 8.1                            | 10.2 |
| 10  | 3/8                  | 38                           | 25                           | 27   | 22                       | 32   | 4.8                        | 6.4  | 9.1                            | 10.4 |
| 15  | 1/2                  | 48                           | 32                           | 33   | 28                       | 38   | 6.4                        | 7.9  | 10.9                           | 13.6 |
| 20  | 3/4                  | 51                           | 37                           | 38   | 35                       | 44   | 6.4                        | 7.9  | 12.7                           | 13.9 |
| 25  | 1                    | 60                           | 41                           | 43   | 44                       | 57   | 9.7                        | 11.2 | 14.7                           | 17.3 |
| 32  | 1-1/4                | 67                           | 44                           | 46   | 57                       | 64   | 9.7                        | 11.2 | 17.0                           | 18.0 |
| 40  | 1-1/2                | 79                           | 44                           | 48   | 64                       | 76   | 11.2                       | 12.7 | 17.8                           | 18.4 |
| 50  | 2                    | 86                           | 48                           | 51   | 76                       | 92   | 12.7                       | 15.7 | 19.0                           | 19.2 |
| 65  | 2-1/2                | 92                           | 60                           | 64   | 92                       | 108  | 15.7                       | 19.0 | 23.6                           | 28.9 |
| 80  | 3                    | 108                          | 65                           | 68   | 108                      | 127  | 19.0                       | 22.4 | 25.9                           | 30.5 |
| 100 | 4                    | 121                          | 68                           | 75   | 140                      | 159  | 22.4                       | 28.4 | 27.7                           | 33.0 |

1. Dimension B is minimum length of perfect thread. The length of useful thread (B plus threads with fully normed roots and flat crests) shall not be less than L2 (effective length of external thread) required by American National Standard for Pipe Threads (ANSI/ASME B1.20.1).
2. Class 2000 and NPS 1/8 (DN6) class 6000 couplings, half couplings, and caps are not included in this standard.



# Threaded fittings

ASME B 16.11



Dimensions in mm

| DN  | Nom. Pipe Size | Length (Min.)<br>A | Plugs Square Head            |                         | Plugs Square Head             |                    | Hex Plugs & Bushings    |                   |           |
|-----|----------------|--------------------|------------------------------|-------------------------|-------------------------------|--------------------|-------------------------|-------------------|-----------|
|     |                |                    | Height of Square (Min.)<br>B | Width Flats (Min.)<br>C | Nominal Diameter of Head<br>E | Length (Min.)<br>D | Width Flats (Nom.)<br>F | Hex Height (Min.) |           |
|     |                |                    |                              |                         |                               |                    |                         | Bushing<br>G      | Plug<br>H |
| 6   | 1/8            | 10                 | 6                            | 7                       | 10                            | 35                 | 11                      | ...               | 6         |
| 8   | 1/4            | 11                 | 6                            | 10                      | 14                            | 41                 | 16                      | 3                 | 6         |
| 10  | 3/8            | 13                 | 8                            | 11                      | 18                            | 41                 | 18                      | 4                 | 8         |
| 15  | 1/2            | 14                 | 10                           | 14                      | 21                            | 44                 | 22                      | 5                 | 8         |
| 20  | 3/4            | 16                 | 11                           | 16                      | 27                            | 44                 | 27                      | 6                 | 10        |
| 25  | 1              | 19                 | 13                           | 21                      | 33                            | 51                 | 36                      | 6                 | 10        |
| 32  | 1-1/4          | 21                 | 14                           | 24                      | 43                            | 51                 | 46                      | 7                 | 14        |
| 40  | 1-1/2          | 21                 | 16                           | 28                      | 48                            | 51                 | 50                      | 8                 | 16        |
| 50  | 2              | 22                 | 18                           | 32                      | 60                            | 64                 | 65                      | 9                 | 18        |
| 65  | 2-1/2          | 27                 | 19                           | 36                      | 73                            | 70                 | 75                      | 10                | 19        |
| 80  | 3              | 28                 | 21                           | 41                      | 89                            | 70                 | 90                      | 10                | 21        |
| 100 | 4              | 32                 | 25                           | 65                      | 114                           | 76                 | 115                     | 13                | 25        |

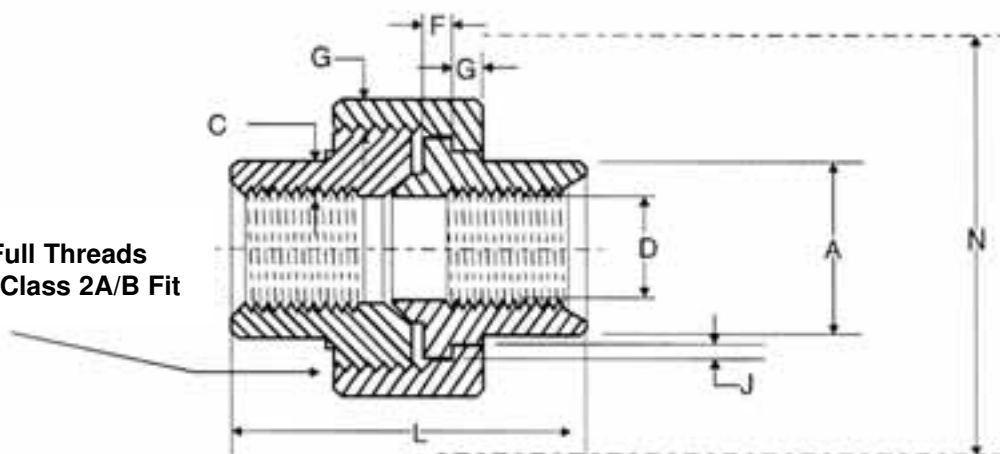
1. CAUTIONARY NOTE REGARDING HEX BRUSHINGS. Hex Head Brushings of one-size reduction should not be used in services wherein they might be subject to harmful loads and forces other than external pressures.

# Threaded Union

MSS SP-83



**H-Threads**  
Minimum 4 Full Threads  
Engagement Class 2A/B Fit



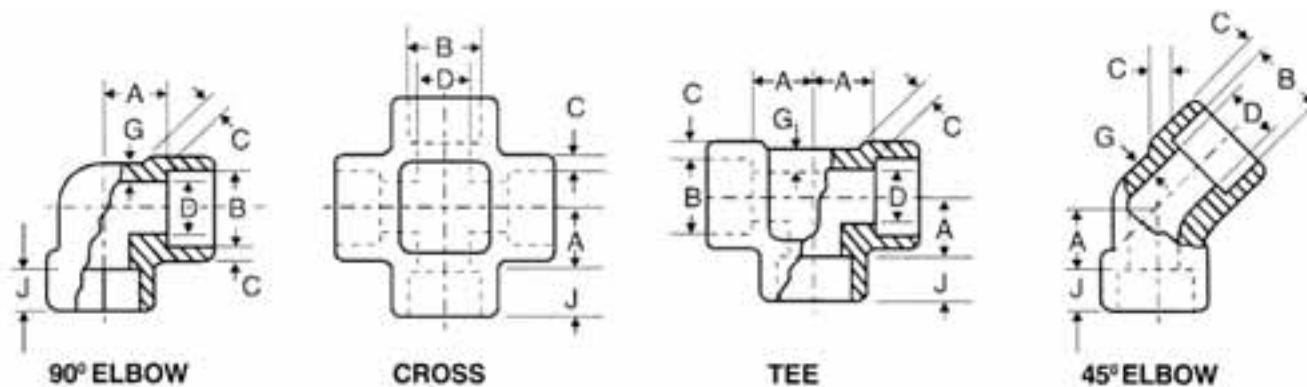
Dimensions in mm

| Nom.<br>Pipe<br>Size | Pipe<br>End<br>Min.<br>A | Wall<br>Min.<br>C | Water<br>Way<br>Bore<br>D | Male<br>Flange<br>Min.<br>F | Nut<br>Min.<br>G | Threads<br>Per<br>25.4 mm<br>Max.<br>H | Bearing<br>Min.<br>J | Length<br>Assem.<br>Nom.<br>L | Clear<br>Assem.<br>Nut<br>N |
|----------------------|--------------------------|-------------------|---------------------------|-----------------------------|------------------|----------------------------------------|----------------------|-------------------------------|-----------------------------|
| 1/8                  | 14.7                     | 2.41              | 6.83<br>6.43              | 3.17                        | 3.2              | 16                                     | 1.24                 | 41.4                          | 49.0                        |
| 1/4                  | 19.0                     | 3.02              | 9.85<br>9.45              | 3.17                        | 3.2              | 16                                     | 1.24                 | 41.4                          | 49.0                        |
| 3/8                  | 22.9                     | 3.20              | 13.92<br>13.51            | 3.43                        | 3.4              | 14                                     | 1.37                 | 46.0                          | 55.0                        |
| 1/2                  | 27.7                     | 3.73              | 17.47<br>17.07            | 3.68                        | 3.7              | 14                                     | 1.50                 | 49.0                          | 57.0                        |
| 3/4                  | 33.5                     | 3.91              | 21.79<br>21.39            | 4.06                        | 4.1              | 11                                     | 1.68                 | 56.9                          | 67.0                        |
| 1                    | 41.4                     | 4.55              | 28.14<br>27.74            | 4.57                        | 4.4              | 11                                     | 1.85                 | 62.0                          | 79.0                        |
| 1-1/4                | 50.5                     | 4.85              | 35.76<br>35.36            | 5.33                        | 5.2              | 11                                     | 2.13                 | 71.1                          | 94.0                        |
| 1-1/2                | 57.2                     | 5.08              | 41.61<br>41.20            | 5.84                        | 5.6              | 10                                     | 2.31                 | 76.4                          | 111.0                       |
|                      | 70.1                     | 5.54              | 52.53<br>52.12            | 6.60                        | 6.4              | 10                                     | 2.69                 | 86.1                          | 132.0                       |
| 2-1/2                | 85.3                     | 7.01              | 64.72<br>64.31            | 7.49                        | 7.1              | 8                                      | 3.07                 | 102.4                         | 148.0                       |
| 3                    | 102.4                    | 7.62              | 77.67<br>77.27            | 8.25                        | 8.0              | 8                                      | 3.53                 | 109.0                         | 175.0                       |



# Socket-welding fittings

ASME B16-11



Dimensions in mm

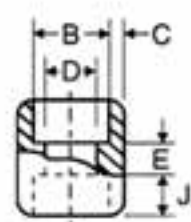
|     | Nom.<br>DN<br>Size | Socket<br>Pipe<br>Dia.(2)<br>B | Bore Diameter of<br>Fitting (2) |              |              | Socket Wall Thickness (1)<br>C |       |             |        |                   |       | Body Wall Thickness<br>G |      |       | Depth<br>of |      |      |      |      |      |
|-----|--------------------|--------------------------------|---------------------------------|--------------|--------------|--------------------------------|-------|-------------|--------|-------------------|-------|--------------------------|------|-------|-------------|------|------|------|------|------|
|     |                    |                                | Bore                            | D            | Class        | Designation                    | Class | Designation | Socket |                   |       |                          |      |       |             |      |      |      |      |      |
|     |                    |                                |                                 |              |              |                                |       |             |        | Class Designation |       |                          |      | 3000  |             |      | 6000 |      | 9000 |      |
|     |                    |                                |                                 |              |              |                                |       |             |        |                   |       |                          |      |       |             |      |      |      |      |      |
|     |                    |                                |                                 |              |              |                                |       |             |        | 3000              | 6000  | 9000                     |      | Ave.  | Min.        | Ave. | Min. | Ave. | Min. | Min. |
| 6   | 1/8                | 11.2<br>10.8                   | 7.6<br>6.1                      | 4.8<br>3.2   |              | 3.18                           | 3.18  | 3.96        | 3.43   |                   |       | 2.41                     | 3.15 |       | 9.5         |      |      |      |      |      |
| 8   | 1/4                | 14.6<br>14.2                   | 10.0<br>8.5                     | 7.1<br>5.6   |              | 3.78                           | 3.30  | 4.60        | 4.01   |                   |       | 3.02                     | 3.68 |       | 9.5         |      |      |      |      |      |
| 10  | 3/8                | 18.0<br>17.6                   | 13.3<br>11.8                    | 9.9<br>8.4   |              | 4.01                           | 3.50  | 5.03        | 4.37   |                   |       | 3.20                     | 4.01 |       | 9.5         |      |      |      |      |      |
| 15  | 1/2                | 22.2<br>21.8                   | 16.6<br>15.0                    | 12.5<br>11.0 | 72<br>5.6    | 4.67                           | 4.09  | 5.97        | 5.18   | 9.35              | 8.18  | 3.73                     | 4.78 | 7.47  | 9.5         |      |      |      |      |      |
| 20  | 3/4                | 27.6<br>27.2                   | 21.7<br>20.2                    | 16.3<br>14.8 | 11.8<br>10.3 | 4.90                           | 4.27  | 6.96        | 6.04   | 9.78              | 8.56  | 3.91                     | 5.56 | 7.82  | 12.5        |      |      |      |      |      |
| 25  | 1                  | 34.3<br>33.9                   | 27.4<br>25.9                    | 21.5<br>19.9 | 16.0<br>14.5 | 5.69                           | 4.98  | 7.92        | 6.93   | 11.38             | 9.96  | 4.55                     | 6.35 | 9.09  | 12.5        |      |      |      |      |      |
| 32  | 1-1/4              | 43.1<br>42.7                   | 35.8<br>34.3                    | 30.2<br>28.7 | 23.5<br>22.0 | 6.07                           | 5.28  | 7.92        | 6.93   | 12.14             | 10.62 | 4.85                     | 6.35 | 9.70  | 12.5        |      |      |      |      |      |
| 40  | 1-1/2              | 49.2<br>48.8                   | 41.6<br>40.1                    | 34.7<br>33.2 | 28.7<br>27.2 | 6.35                           | 5.54  | 8.92        | 7.80   | 12.7              | 11.12 | 5.08                     | 7.14 | 10.15 | 12.5        |      |      |      |      |      |
| 50  | 2                  | 61.7<br>61.2                   | 53.3<br>51.7                    | 43.6<br>42.1 | 38.9<br>37.4 | 6.93                           | 6.04  | 10.92       | 9.50   | 13.84             | 12.12 | 5.54                     | 8.74 | 11.07 | 16.0        |      |      |      |      |      |
| 65  | 2-1/2              | 74.4<br>73.9                   | 64.2<br>61.2                    |              |              | 8.76                           | 7.67  |             |        |                   |       | 7.01                     |      |       | 16.0        |      |      |      |      |      |
| 80  | 3                  | 90.3<br>89.8                   | 79.4<br>76.4                    |              |              | 9.52                           | 8.30  |             |        |                   |       | 7.62                     |      |       | 16.0        |      |      |      |      |      |
| 100 | 4                  | 115.7<br>115.2                 | 103.8<br>100.7                  |              |              | 10.69                          | 9.35  |             |        |                   |       | 8.56                     |      |       | 19.0        |      |      |      |      |      |
|     |                    |                                |                                 |              |              |                                |       |             |        |                   |       |                          |      |       |             |      |      |      |      |      |

## Notes:

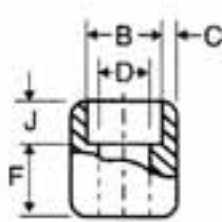
1. Average of Socket Wall Thickness around periphery shall be no less than listed values. The minimum values are permitted in localized areas.
2. Upper and lower values for each size are the respective maximum and minimum dimensions.

# Socket-welding fittings

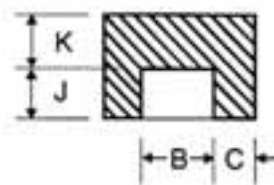
ASME B16-11



COUPLING



HALF COUPLING



CAP

Dimensions in mm

| DN  | Nom.<br>Pipe<br>Size | Centre to Bottom of Socket-A |      |      |                   |      |      | Laying Lengths |                 | Tolerances± |     |     | End Wall<br>Thickness<br>K Min. |      |      |
|-----|----------------------|------------------------------|------|------|-------------------|------|------|----------------|-----------------|-------------|-----|-----|---------------------------------|------|------|
|     |                      | 90° Elbows<br>Tees, Crosses  |      |      | 45° Elbows        |      |      | C-lings        | Half<br>C-lings | A           | E   | F   |                                 |      |      |
|     |                      | Class Designation            |      |      | Class Designation |      |      |                |                 |             |     |     | E                               | F    |      |
|     |                      | 3000                         | 6000 | 9000 | 3000              | 6000 | 9000 | 3000           | 6000            | 9000        |     |     |                                 |      |      |
| 6   | 1/8                  | 11.0                         | 11.0 |      | 8.0               | 8.0  |      | 6.5            | 16.0            | 1.0         | 1.5 | 1.0 | 4.8                             | 6.4  |      |
| 8   | 1/4                  | 11.0                         | 13.5 |      | 8.0               | 8.0  |      | 6.5            | 16.0            | 1.0         | 1.5 | 1.0 | 4.8                             | 6.4  |      |
| 10  | 3/8                  | 13.5                         | 15.5 |      | 8.0               | 11.0 |      | 6.5            | 17.5            | 1.5         | 3.0 | 1.5 | 4.8                             | 6.4  |      |
| 15  | 1/2                  | 15.5                         | 19.0 | 25.5 | 11.0              | 12.5 | 15.5 | 9.5            | 22.5            | 1.5         | 3.0 | 1.5 | 6.4                             | 7.9  | 11.2 |
| 20  | 3/4                  | 19.0                         | 22.5 | 28.5 | 13.0              | 14.0 | 19.0 | 9.5            | 24.0            | 1.5         | 3.0 | 1.5 | 6.4                             | 7.9  | 12.7 |
| 25  | 1                    | 22.5                         | 27.0 | 32.0 | 14.0              | 17.5 | 20.5 | 12.5           | 28.5            | 2.0         | 4.0 | 2.0 | 9.6                             | 11.2 | 14.2 |
| 32  | 1-3/4                | 27.0                         | 32.0 | 35.0 | 17.5              | 20.5 | 22.5 | 12.5           | 30.0            | 2.0         | 4.0 | 2.0 | 9.6                             | 11.2 | 14.2 |
| 40  | 1-1/2                | 32.0                         | 38.0 | 38.0 | 20.5              | 25.5 | 25.5 | 12.5           | 32.0            | 2.0         | 4.0 | 2.0 | 11.2                            | 12.7 | 15.7 |
| 50  | 2                    | 38.0                         | 41.0 | 54.0 | 25.5              | 28.5 | 28.5 | 19.0           | 41.0            | 2.0         | 4.0 | 2.0 | 12.7                            | 15.7 | 19.0 |
| 65  | 2-1/2                | 41.0                         |      |      | 28.5              |      |      | 19.0           | 43.0            | 2.5         | 5.0 | 2.5 | 15.7                            | 19.0 |      |
| 80  | 3                    | 57.0                         |      |      | 32.0              |      |      | 19.0           | 44.5            | 2.5         | 5.0 | 2.5 | 19.0                            | 22.4 |      |
| 100 | 4                    | 66.5                         |      |      | 41.0              |      |      | 19.0           | 48.0            | 2.5         | 5.0 | 2.5 | 22.4                            | 28.4 |      |

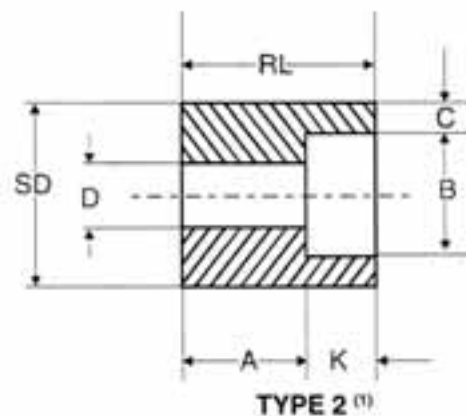
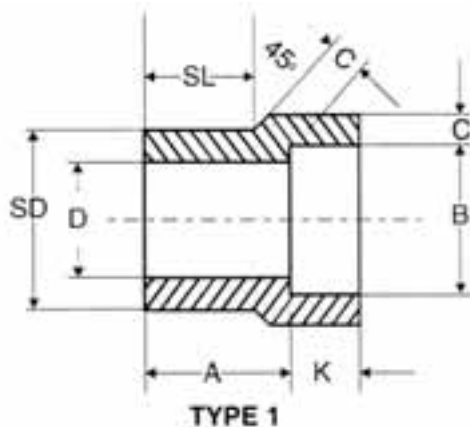
## Notes:

1. Average of Socket Wall Thickness around periphery shall be no less than listed values. The minimum values are permitted in localized areas.
2. Upper and lower values for each size are the respective maximum and minimum dimensions.



# Socket-Welding Reducers inserts

MSS SP-79



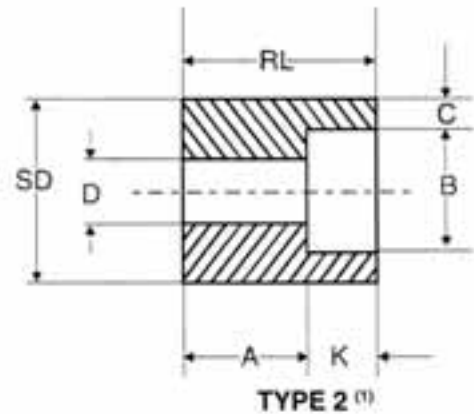
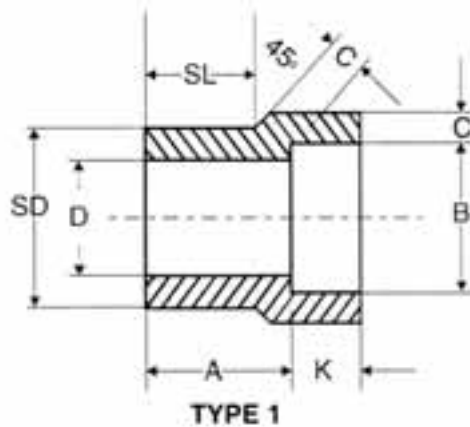
Dimensions in mm

| Nom.<br>Pipe<br>Size | Type (2) |    | Socket |                    | Shank<br>Dia.<br>SD | Laying      |    | Bore      |      | Wall |      | Length    |    |    |    |
|----------------------|----------|----|--------|--------------------|---------------------|-------------|----|-----------|------|------|------|-----------|----|----|----|
|                      |          |    | Dia    | Depth<br>Min.<br>K |                     | Length<br>A | D  | Min.<br>C |      | SL   |      | RL (Min.) |    |    |    |
|                      | B        | K  |        |                    |                     |             |    |           |      |      |      |           |    |    |    |
|                      | 3M       | 6M | B      | K                  | 3M                  | 6M          | 3M | 6M        | 3M   | 6M   | 3M   | 6M        | 3M | 6M | 3M |
| 3/8 x 1/4            | 1        | 1  | 14.35  | 10                 | 17.15               | 19          | 21 | 9.0       | 6.5  | 3.78 | 4.60 | 14        | 16 |    |    |
| 1/2 x 3/8            | 1        | 1  | 17.78  | 10                 | 21.34               | 21          | 23 | 12.5      | 9.0  | 4.01 | 5.03 | 16        | 16 |    |    |
| 1/2 x 1/4            | 1        | 1  | 14.35  | 10                 | 21.34               | 21          | 21 | 9.0       | 6.5  | 3.78 | 4.60 | 16        | 16 |    |    |
| 3/4 x 1/2            | 1        | 1  | 21.97  | 10                 | 26.67               | 22          | 25 | 16.0      | 11.5 | 4.67 | 5.97 | 17        | 19 |    |    |
| 3/4 x 3/8            | 2        | 1  | 17.78  | 10                 | 26.67               | 16          | 22 | 12.5      | 9.0  | 4.01 | 5.03 |           | 19 | 27 |    |
| 3/4 x 1/4            | 2        | 2  | 14.35  | 10                 | 26.67               | 18          | 22 | 9.0       | 6.5  | 3.78 | 4.60 |           |    | 27 | 32 |
| 1 x 3/4              | 1        | 1  | 27.31  | 13                 | 33.49               | 24          | 28 | 21.0      | 15.5 | 4.90 | 6.96 | 19        | 21 |    |    |
| 1 x 1/2              | 2        | 1  | 21.97  | 10                 | 33.40               | 16          | 28 | 16.0      | 11.5 | 4.67 | 5.97 |           | 21 | 28 |    |
| 1 x 3/8              | 2        | 2  | 17.78  | 10                 | 33.40               | 18          | 22 | 12.5      | 9.0  | 4.01 | 5.03 |           |    | 28 | 33 |
| 1 x 1/4              | 2        | 2  | 14.35  | 10                 | 33.40               | 19          | 24 | 9.0       | 6.5  | 3.78 | 4.60 |           |    | 28 | 33 |
| 1-1/4 x 1            | 1        | 1  | 34.04  | 13                 | 42.16               | 25          | 30 | 26.5      | 20.5 | 5.69 | 7.92 | 21        | 22 |    |    |
| 1-1/4 x 3/4          | 2        | 2  | 27.31  | 13                 | 42.16               | 18          | 21 | 21.0      | 15.5 | 4.90 | 6.96 |           |    | 32 | 35 |
| 1-1/4 x 1/2          | 2        | 2  | 21.97  | 10                 | 42.16               | 19          | 22 | 16.0      | 11.5 | 4.67 | 5.97 |           |    | 32 | 35 |
| 1-1/4 x 3/8          | 2        | 2  | 17.78  | 10                 | 42.16               | 21          | 24 | 12.5      | 9.0  | 4.01 | 5.03 |           |    | 32 | 35 |
| 1-1/4 x 1/4          | 2        | 2  | 14.35  | 10                 | 42.16               | 22          | 25 | 9.0       | 6.5  | 3.78 | 4.60 |           |    | 32 | 35 |
| 1-1/2 x 1-1/4        | 1        | 1  | 42.80  | 13                 | 48.26               | 28          | 35 | 35.0      | 29.5 | 6.07 | 7.92 | 22        | 25 |    |    |
| 1-1/2 x 1            | 2        | 1  | 34.04  | 13                 | 48.26               | 18          | 29 | 26.5      | 20.5 | 5.69 | 7.92 |           | 25 | 33 |    |
| 1-1/2 x 3/4          | 2        | 2  | 27.31  | 13                 | 48.26               | 19          | 25 | 21.0      | 15.5 | 4.90 | 6.96 |           |    | 33 | 40 |
| 1-1/2 x 1/2          | 2        | 2  | 21.97  | 10                 | 48.26               | 21          | 27 | 16.0      | 11.5 | 4.67 | 5.97 |           |    | 33 | 40 |
| 1-1/2 x 3/8          | 2        | 2  | 17.78  | 10                 | 48.26               | 22          | 28 | 12.5      | 9.0  | 4.01 | 5.03 |           |    | 33 | 40 |
| 2 x 1-1/2            | 1        | 1  | 48.90  | 13                 | 60.32               | 32          | 39 | 41.0      | 34.0 | 6.35 | 8.9  | 25        | 28 |    |    |
| 2 x 1-1/4            | 2        | 2  | 42.80  | 13                 | 60.32               | 21          | 24 | 35.0      | 29.5 | 6.07 | 7.92 |           |    | 38 | 41 |
| 2 x 1                | 2        | 2  | 34.04  | 13                 | 60.32               | 22          | 25 | 26.5      | 21.0 | 5.69 | 7.92 |           |    | 38 | 41 |
| 2 x 3/4              | 2        | 2  | 27.31  | 13                 | 60.32               | 24          | 27 | 21.0      | 15.5 | 4.90 | 6.96 |           |    | 38 | 41 |
| 2 x 1/2              | 2        | 2  | 21.97  | 10                 | 60.32               | 25          | 28 | 16.0      | 11.5 | 4.67 | 5.97 |           |    | 38 | 41 |

1. At the option of the manufacturer Type 2 Reducers may be furnished in Type 1 configuration.
2. 3M & 6M symbols denote 3000 and 6000 classes.

# Socket-Welding Reducers inserts

MSS SP-79



Dimensions in mm

| Nom.<br>Pipe<br>Size | Type (2) |    | Socket |               | Shank<br>Dia.<br>SD | Laying<br>Length<br>A |    | Bore<br>D |      | Wall<br>Min.<br>C |       | Length |    |           |    |
|----------------------|----------|----|--------|---------------|---------------------|-----------------------|----|-----------|------|-------------------|-------|--------|----|-----------|----|
|                      |          |    | Dia    | Depth<br>Min. |                     |                       |    |           |      |                   |       | SL     |    | RL (Min.) |    |
|                      | 3M       | 6M | B      | K             |                     | 3M                    | 6M | 3M        | 6M   | 3M                | 6M    | 3M     | 6M | 3M        | 6M |
| 2-1/2 x 2            | 1        | 1  | 61.37  | 16            | 73.02               | 46                    | 43 | 52.5      | 43.0 | 6.93              | 10.92 | 38     | 32 |           |    |
| 2-1/2 x 1-1/2        | 2        | 2  | 48.90  | 13            | 73.02               | 35                    |    | 41.0      |      | 6.35              |       |        |    | 54        |    |
| 2-1/2 x 1-1/4        | 2        | 2  | 42.80  | 13            | 73.02               | 37                    |    | 35.0      |      | 6.07              |       |        |    | 54        |    |
| 2-1/2 x 1            | 2        | 2  | 34.04  | 13            | 73.02               | 38                    |    | 26.5      |      | 5.69              |       |        |    | 54        |    |
| 2-1/2 x 3/4          | 2        | 2  | 27.31  | 13            | 73.02               | 40                    |    | 21.0      |      | 4.90              |       |        |    | 54        |    |
| 3 x 2-1/2            | 1        |    | 74.07  | 16            | 88.90               | 38                    |    | 62.5      |      | 8.76              |       | 32     |    |           |    |
| 3 X 2                |          |    | 61.37  | 16            | 88.90               | 25                    |    | 52.5      |      | 6.93              |       |        |    | 48        |    |
| 3 x 1-1/2            | 2        |    | 48.90  | 13            | 88.90               | 29                    |    | 41.0      |      | 6.35              |       |        |    | 48        |    |
| 3 x 1-1/4            | 2        |    | 42.80  | 13            | 88.90               | 30                    |    | 35.0      |      | 6.07              |       |        |    | 48        |    |
| 3 x 1                | 2        |    | 34.04  | 13            | 88.90               | 32                    |    | 26.5      |      | 5.69              |       |        |    | 48        |    |
| 4 x 3                | 2        |    | 90.04  | 16            | 114.30              | 33                    |    | 78.0      |      | 9.5               |       |        |    | 60        |    |
| 4 x 2-1/2            | 2        |    | 74.07  | 16            | 114.30              | 38                    |    | 62.5      |      | 8.76              |       |        |    | 60        |    |
| 4 x 2                |          |    | 61.37  | 16            | 114.30              | 38                    |    | 52.5      |      | 6.93              |       |        |    | 60        |    |
| 4 x 1-1/2            | 2        |    | 48.90  | 13            | 114.30              | 42                    |    | 41.0      |      | 6.35              |       |        |    | 60        |    |
| 4 x 1-1/4            | 2        |    | 42.80  | 13            | 114.30              | 43                    |    | 35.0      |      | 6.07              |       |        |    | 60        |    |

1. At the option of the manufacturer Type 2 Reducers may be furnished in Type 1 configuration.
2. 3M & 6M symbols denote 3000 and 6000 classes.

## TOLERANCES

Laying length A- Sizes 3/8" thru 3/4" + 1.5 mm / - 0.0 mm  
 Sizes 1" thru 2" + 2.0 mm / - 0.0 mm  
 Sizes 2-1/2" thru 4" + 2.5 mm / - 0.0 mm  
 Laying length B- Sizes 1/4" thru 2" ± 0.25 mm  
 Sizes 2-1/2" thru 3" + 0.4 mm / - 0.25 mm

Bore D -Sizes 1/4" thru 2" ± 0.8 mm  
 -Sizes 2-1/2" thru 3" ± 1.5 mm  
 Shank Dia SD -Sizes 3/8" thru 1-1/2" ± 0.50 mm  
 -Sizes 2" thru 3" ± 0.75 mm  
 -Sizes 4" ± 0.75 mm  
 Shank Lg. SL -Sizes 3/8" thru 3/4" + 0.0 mm/-1.5 mm  
 -Sizes 1" thru 2" + 0.0 mm/-2.0 mm  
 -Sizes 2-1/2" thru 4" + 0.0 mm/-2.5 mm

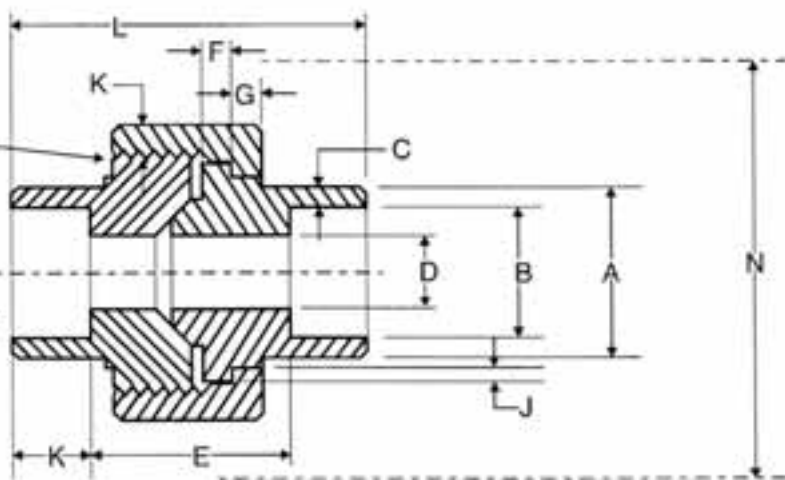




# Socket-Welding Union

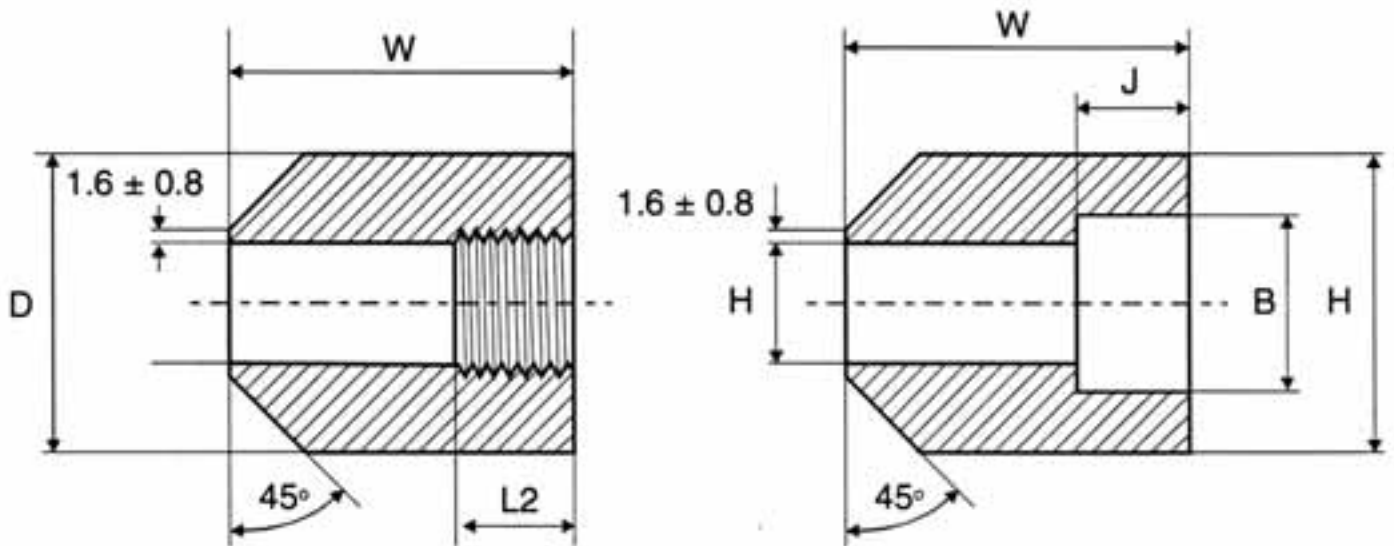
MSS SP-83

**H-Threads**  
Minimum 4 Full Threads  
Engagement Class 2A/B Fit



Dimensions in mm

| Nom.<br>Pipe<br>Size | Pipe<br>End<br>Min.<br>A | Socket<br>Bore<br>Dia<br>B | Socket<br>Wall<br>Min.<br>C | Water<br>Way<br>Bore<br>D | Laying<br>Length<br>E | Male<br>Flange<br>Min.<br>F | Nut<br>Min.<br>G | Thrds<br>Per<br>25.4 mm<br>Max.<br>H | Bearing<br>Min.<br>J | Depth<br>of<br>Socket<br>Min.<br>K | Length<br>Assem.<br>Nom.<br>L | Clear<br>Assem.<br>Nut<br>N |
|----------------------|--------------------------|----------------------------|-----------------------------|---------------------------|-----------------------|-----------------------------|------------------|--------------------------------------|----------------------|------------------------------------|-------------------------------|-----------------------------|
| 1/8                  | 21.8                     | 10.92<br>10.67             | 3.17                        | 6.83<br>6.43              | 22.4<br>19.0          | 3.17                        | 3.17             | 16                                   | 1.24                 | 9.6                                | 41.4                          | 49.0                        |
| 1/4                  | 21.8                     | 14.22<br>13.97             | 3.30                        | 9.85<br>9.45              | 22.4<br>19.0          | 3.17                        | 3.17             | 16                                   | 1.24                 | 9.6                                | 41.4                          | 49.0                        |
| 3/8                  | 25.9                     | 17.78<br>17.53             | 3.48                        | 13.92<br>13.51            | 26.9<br>20.6          | 3.43                        | 3.43             | 14                                   | 1.37                 | 9.6                                | 46.0                          | 55.0                        |
| 1/2                  | 31.2                     | 21.84<br>21.59             | 4.06                        | 17.47<br>17.07            | 26.9<br>20.6          | 3.68                        | 3.68             | 14                                   | 1.50                 | 9.6                                | 49.0                          | 57.0                        |
| 3/4                  | 37.1                     | 27.18<br>26.92             | 4.27                        | 21.79<br>21.39            | 31.8<br>25.4          | 4.06                        | 4.06             | 11                                   | 1.68                 | 12.7                               | 56.9                          | 67.0                        |
| 1                    | 45.5                     | 34.04<br>33.78             | 4.95                        | 28.14<br>27.74            | 34.3<br>26.2          | 4.57                        | 4.44             | 11                                   | 1.85                 | 12.7                               | 62.0                          | 79.0                        |
| 1-1/4                | 54.9                     | 42.67<br>42.42             | 5.28                        | 35.76<br>35.36            | 40.6<br>32.5          | 5.33                        | 5.21             | 11                                   | 2.13                 | 12.7                               | 71.1                          | 94.0                        |
| 1-1/2                | 61.5                     | 48.77<br>48.51             | 5.54<br>5.54                | 41.61<br>41.20            | 42.2<br>34.0          | 5.84                        | 5.59             | 10                                   | 2.31                 | 12.7                               | 76.5                          | 111.0                       |
| 2                    | 75.2                     | 61.47<br>61.21             | 6.05                        | 52.53<br>52.12            | 45.5<br>37.3          | 6.60                        | 6.35             | 10                                   | 2.69                 | 15.8                               | 86.1                          | 132.0                       |
| 2-1/2                | 91.7                     | 74.17<br>73.66             | 7.65                        | 64.72<br>64.31            | 61.7<br>52.1          | 7.49                        | 7.11             | 8                                    | 3.07                 | 15.8                               | 102.4                         | 148.0                       |
| 3                    | 109.2                    | 90.17<br>89.66             | 8.31                        | 77.67<br>77.27            | 63.8<br>53.6          | 8.25                        | 8.00             | 8                                    | 3.53                 | 15.8                               | 109.0                         | 175.0                       |



**THREADED**  
Dimensions in Millimeters

| Size (in)      | D    | W    | L2 (Min) |
|----------------|------|------|----------|
| <b>3000Lbs</b> |      |      |          |
| 1/4            | 22.1 | 39.9 | 10.0     |
| 3/8            | 25.9 | 50.0 | 10.5     |
| 1/2            | 34.0 | 50.0 | 13.5     |
| 3/4            | 39.1 | 50.0 | 14.0     |
| 1              | 48.0 | 50.0 | 17.5     |
| 1-1/4          | 59.9 | 50.0 | 18.0     |
| 1-1/2          | 65.0 | 50.0 | 18.5     |
| 2              | 80.0 | 59.9 | 19.0     |
| <b>6000Lbs</b> |      |      |          |
| 1/4            | 25.9 | 39.9 | 10.0     |
| 3/8            | 36.0 | 50.0 | 10.5     |
| 1/2            | 43.9 | 50.0 | 13.5     |
| 3/4            | 50.0 | 50.0 | 14.0     |
| 1              | 59.9 | 50.0 | 17.5     |
| 1-1/4          | 65.0 | 50.0 | 18.0     |
| 1-1/2          | 80.0 | 50.0 | 18.5     |
| 2              | 95.0 | 59.9 | 19.0     |

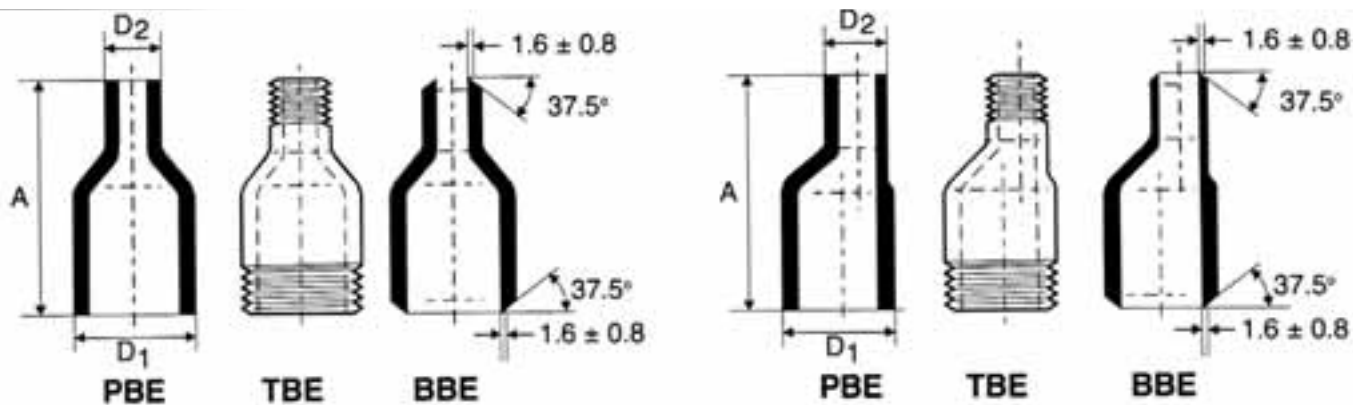
**SOCKET-WELDING**  
Dimensions in Millimeters

| Size (in)      | B    | D    | J (Min) | W    | H    |
|----------------|------|------|---------|------|------|
| <b>3000Lbs</b> |      |      |         |      |      |
| 1/4            | 14.3 | 9.2  | 9.9     | 39.9 | 22.3 |
| 3/8            | 17.8 | 12.5 | 10.9    | 50.0 | 26.5 |
| 1/2            | 21.9 | 15.8 | 13.0    | 50.0 | 34.2 |
| 3/4            | 27.3 | 20.9 | 14.0    | 50.0 | 39.5 |
| 1              | 34.0 | 26.6 | 16.0    | 50.0 | 46.3 |
| 1-1/4          | 42.8 | 35.0 | 18.0    | 50.0 | 55.2 |
| 1-1/2          | 48.9 | 40.9 | 19.1    | 50.0 | 65.1 |
| 2              | 61.3 | 52.6 | 22.1    | 59.9 | 80.2 |
| <b>6000Lbs</b> |      |      |         |      |      |
| 1/2            | 21.9 | 11.7 | 14.0    | 50.0 | 43.3 |
| 3/4            | 27.3 | 15.5 | 16.0    | 50.0 | 49.1 |
| 1              | 34.0 | 20.7 | 18.0    | 50.0 | 56.0 |
| 1-1/4          | 42.8 | 29.4 | 19.1    | 50.0 | 65.2 |
| 1-1/2          | 48.9 | 33.9 | 22.0    | 50.0 | 80.1 |
| 2              | 61.3 | 42.8 | 25.9    | 59.5 | 95.1 |



# Swaged Nipples

MSS SP-95



## Concentric

## Eccentric

Dimensions in Millimeters

| Nominal<br>End | Pipe<br>Size<br>(NPS) | Outside Diameter   |                    | End<br>To<br>End<br>"A" |
|----------------|-----------------------|--------------------|--------------------|-------------------------|
|                |                       | Large<br>End<br>D1 | Small<br>End<br>D2 |                         |
|                | 1/4 x 1/8             | 13.7               | 10.3               | 57                      |
|                | 3/8 x 1/8             | 17.1               | 10.3               | 64                      |
|                | 3/8 x 1/4             | 17.1               | 13.7               | 64                      |
|                | 1/2 x 1/8             | 21.3               | 10.3               | 70                      |
|                | 1/2 x 1/4             | 21.3               | 13.7               | 70                      |
|                | 1/2 x 3/8             | 21.3               | 17.1               | 70                      |
|                | 3/4 x 1/8             | 26.7               | 10.3               | 76                      |
|                | 3/4 x 1/4             | 26.7               | 13.7               | 76                      |
|                | 3/4 x 3/8             | 26.7               | 17.1               | 76                      |
|                | 3/4 x 1/2             | 26.7               | 21.3               | 76                      |
|                | 1 x 1/8               | 33.4               | 10.3               | 89                      |
|                | 1 x 1/4               | 33.4               | 13.7               | 89                      |
|                | 1 x 3/8               | 33.4               | 17.1               | 89                      |
|                | 1 x 1/2               | 33.4               | 21.3               | 89                      |
|                | 1 x 3/4               | 33.4               | 26.7               | 89                      |
|                | 1-1/4 x 1/8           | 42.2               | 10.3               | 102                     |
|                | 1 1/4 x 1/4           | 42.2               | 13.7               | 102                     |
|                | 1-1/4 x 3/8           | 42.2               | 17.1               | 102                     |
|                | 1-1/4 x 1/2           | 42.2               | 21.3               | 102                     |
|                | 1-1/4 x 3/4           | 42.2               | 26.7               | 102                     |
|                | 1-1/4 x 1             | 42.2               | 33.4               | 102                     |
|                | 1-1/2 x 1/8           | 48.3               | 10.3               | 114                     |
|                | 1-1/2 x 1/4           | 48.3               | 13.7               | 114                     |
|                | 1-1/2 x 3/8           | 48.3               | 17.1               | 114                     |
|                | 1-1/2 x 1/2           | 48.3               | 21.3               | 114                     |
|                | 1-1/2 x 3/4           | 48.3               | 26.7               | 114                     |
|                | 1-1/2 x 1             | 48.3               | 33.4               | 114                     |
|                | 1-1/2 x 1-1/4         | 48.3               | 42.2               | 114                     |

| Nominal | Pipe<br>Size<br>(NPS) | Outside Diameter   |                    | To<br>End<br>"A" |
|---------|-----------------------|--------------------|--------------------|------------------|
|         |                       | Large<br>End<br>D1 | Small<br>End<br>D2 |                  |
|         | 2 x 1/8               | 60.3               | 10.3               | 165              |
|         | 2 x 1/4               | 60.3               | 13.7               | 165              |
|         | 2 x 3/8               | 60.3               | 17.1               | 165              |
|         | 2 x 1/2               | 60.3               | 21.3               | 165              |
|         | 2 x 3/4               | 60.3               | 26.7               | 165              |
|         | 2 x 1                 | 60.3               | 33.4               | 165              |
|         | 2 x 1-1/4             | 60.3               | 42.2               | 165              |
|         | 2 x 1-1/2             | 60.3               | 48.3               | 165              |
|         | 2-1/2 x 1/8           | 73.0               | 10.3               | 178              |
|         | 2-1/2 x 1/4           | 73.0               | 13.7               | 178              |
|         | 2-1/2 x 3/8           | 73.0               | 17.1               | 178              |
|         | 2-1/2 x 1/2           | 73.0               | 21.3               | 178              |
|         | 2-1/2 x 3/4           | 73.0               | 26.7               | 178              |
|         | 2-1/2 x 1             | 73.0               | 33.4               | 178              |
|         | 2-1/2 x 1-1/4         | 73.0               | 42.2               | 178              |
|         | 2-1/2 x 1-1/2         | 73.0               | 48.3               | 178              |
|         | 2-1/2 x 2             | 73.0               | 60.3               | 178              |
|         | 3 x 1/8               | 88.9               | 10.3               | 203              |
|         | 3 x 1/4               | 88.9               | 13.7               | 203              |
|         | 3 x 3/8               | 88.9               | 17.1               | 203              |
|         | 3 x 1/2               | 88.9               | 21.3               | 203              |
|         | 3 x 3/4               | 88.9               | 26.7               | 203              |
|         | 3 x 1                 | 88.9               | 33.4               | 203              |
|         | 3 x 1-1/4             | 88.9               | 42.2               | 203              |
|         | 3 x 1-1/2             | 88.9               | 48.3               | 203              |
|         | 3 x 2                 | 88.9               | 60.3               | 203              |
|         | 3 x 2-1/2             | 88.9               | 73.0               | 203              |
|         | 3-1/2 x 1/8           | 101.6              | 10.3               | 203              |

# Swaged Nipples

MSS SP-95



Dimensions in Millimeters

## Concentric

| Nominal<br>Pipe<br>Size<br>(NPS) | Outside Diameter   |                    | End<br>To<br>End<br>"A" |
|----------------------------------|--------------------|--------------------|-------------------------|
|                                  | Large<br>End<br>D1 | Small<br>End<br>D2 |                         |
| 3-1/2 x 1/4                      | 101,6              | 13,7               | 203                     |
| 3-1/2 x 3/8                      | 101,6              | 17,1               | 203                     |
| 3-1/2 x 1/2                      | 101,6              | 21,3               | 203                     |
| 3-1/3 x 3/4                      | 101,6              | 26,7               | 203                     |
| 3-1/2 x 1                        | 101,6              | 33,4               | 203                     |
| 3-1/2 x 1-1/4                    | 101,6              | 42,2               | 203                     |
| 3-1/2 x 1-1/2                    | 101,6              | 48,3               | 203                     |
| 3-1/2 x 1                        | 101,6              | 60,3               | 203                     |
| 3-1/2 x 2-1/2                    | 101,6              | 73,0               | 203                     |
| 3-1/2 x 3                        | 101,6              | 88,9               | 203                     |
| 4 x 1/4                          | 114,3              | 13,7               | 229                     |

## Eccentric

| Nominal<br>Pipe<br>Size<br>(NPS) | Outside Diameter   |                    | End<br>To<br>End<br>"A" |
|----------------------------------|--------------------|--------------------|-------------------------|
|                                  | Large<br>End<br>D1 | Small<br>End<br>D2 |                         |
| 4 x 3/8                          | 114,3              | 17,1               | 229                     |
| 4 x 1/2                          | 114,3              | 21,3               | 229                     |
| 4 x 3/4                          | 114,3              | 26,7               | 229                     |
| 4 x 1                            | 114,3              | 33,4               | 229                     |
| 4 x 1-1/4                        | 114,3              | 42,2               | 229                     |
| 4 x 1-1/2                        | 114,3              | 48,3               | 229                     |
| 4 x 2                            | 114,3              | 60,3               | 229                     |
| 4 x 2-1/2                        | 114,3              | 73,0               | 229                     |
| 4 x 3                            | 114,3              | 88,9               | 229                     |
| 4 x 3-1/2                        | 114,3              | 101,6              | 229                     |

PBE: PLAIN BOTH ENDS  
PSE: PLAIN SMALL ENDS  
PLE: PLAIN LARGE ENDS

BBE: BEVEL BOTH ENDS  
BSE: BEVEL SMALL ENDS  
BLE: BEVEL LARGE ENDS

TBE: THREAD BOTH ENDS  
TSE: THREAD SMALL ENDS  
TLE: THREAD LARGE ENDS

## TOLERANCES

| Nominal<br>Pipe Size<br>(NPS) | Overall<br>length<br>(mm) | Outside Diameter at End    |                                  | Wall<br>Thickness<br>(see Note 1)                            |
|-------------------------------|---------------------------|----------------------------|----------------------------------|--------------------------------------------------------------|
|                               |                           | Square Cut<br>Ends<br>(mm) | Other End<br>Connections<br>(mm) |                                                              |
| 1/8 - 3/8                     | ± 2                       | + 0.40<br>- 0.80           | ± 0.80                           | Not<br>less than<br>87.5% of<br>nominal<br>wall<br>Thickness |
| 1/2 - 1-1/2                   | ± 2                       | + 0.40<br>- 0.80           | + 1.50<br>- 0.80                 |                                                              |
| 2 - 2-1/2                     | ± 3                       | ± 0.80                     | + 1.50<br>- 0.80                 |                                                              |
| 3 - 4                         | ± 3                       | ± 0.80                     | ± 1.50                           |                                                              |

Dimensions in Millimeters.

Note 1: Prior to threading or grooving



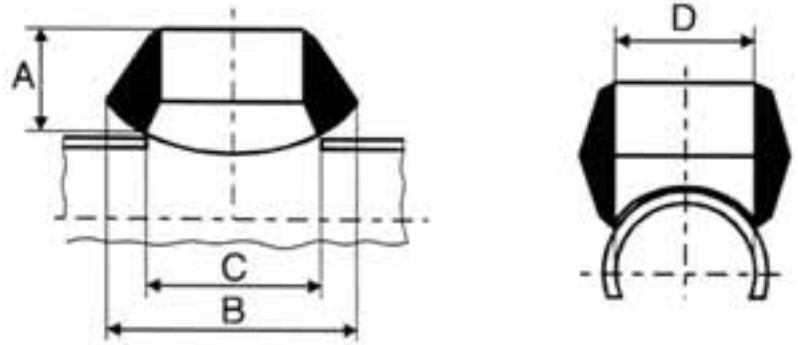
# Weight List

(Unit kg)

| WEIGHT (KGS) SIZE            | 1/8" | 1/4" | 3/8" | 1/2" | 3/4" | 1"   | 1-1/4" | 1-1/2" | 2"   | 2-1/2" | 3"    | 4"    |
|------------------------------|------|------|------|------|------|------|--------|--------|------|--------|-------|-------|
| <b>2000LBS SCREWED</b>       |      |      |      |      |      |      |        |        |      |        |       |       |
| 90° ELBOW                    | 0.10 | 0.08 | 0.13 | 0.22 | 0.32 | 0.47 | 0.74   | 0.93   | 1.53 | 2.98   | 4.54  | 10.21 |
| 45° ELBOW                    | 0.08 | 0.06 | 0.10 | 0.20 | 0.27 | 0.41 | 0.64   | 0.75   | 1.19 | 3.46   | 5.44  | 8.9   |
| TEE                          | 0.13 | 0.12 | 0.15 | 0.31 | 0.43 | 0.61 | 0.95   | 1.25   | 1.93 | 4.11   | 6.12  | 14.74 |
| <b>3000LBS SCREWED</b>       |      |      |      |      |      |      |        |        |      |        |       |       |
| 90° ELBOW                    | 0.10 | 0.14 | 0.27 | 0.41 | 0.72 | 1.03 | 1.31   | 2.21   | 2.47 | 4.53   | 7.77  | 13.27 |
| 45° ELBOW                    | 0.08 | 0.12 | 0.24 | 0.34 | 0.54 | 0.92 | 0.97   | 1.84   | 1.93 | 3.46   | 5.44  | 8.96  |
| TEE                          | 0.13 | 0.13 | 0.38 | 0.56 | 0.84 | 1.70 | 1.95   | 3.18   | 3.63 | 6.24   | 9.53  | 17.24 |
| COUPLING                     | 0.05 | 0.05 | 0.06 | 0.13 | 0.19 | 0.39 | 0.68   | 0.99   | 1.37 | 2.07   | 3.08  | 5.44  |
| HALF COUPLING                | 0.03 | 0.03 | 0.03 | 0.06 | 0.10 | 0.20 | 0.34   | 0.50   | 0.68 | 1.03   | 1.54  | 2.72  |
| RED-COUPLING                 | 0.05 | 0.05 | 0.06 | 0.13 | 0.19 | 0.39 | 0.68   | 0.99   | 1.37 | 2.07   | 3.08  | 5.44  |
| CAP                          | 0.04 | 0.04 | 0.05 | 0.11 | 0.18 | 0.35 | 0.60   | 0.70   | 1.06 | 1.84   | 2.65  | 4.57  |
| STREET ELBOW                 | 0.10 | 0.14 | 0.27 | 0.41 | 0.66 | 0.97 | 1.31   | 2.21   | 2.47 |        |       |       |
| UNION                        | 0.28 | 0.28 | 0.28 | 0.31 | 0.46 | 0.67 | 1.03   | 1.51   | 2.43 | 3.48   | 5.25  | 12    |
| <b>6000 LBS SCREWED</b>      |      |      |      |      |      |      |        |        |      |        |       |       |
| 90° ELBOW                    | 0.17 | 0.30 | 0.45 | 0.72 | 1.15 | 1.61 | 2.67   | 3.20   | 5.90 | 9.88   | 16.43 |       |
| 45° ELBOW                    | 0.11 | 0.27 | 0.39 | 0.61 | 1.02 | 1.17 | 2.67   | 2.61   | 4.37 | 7.01   | 14.16 |       |
| TEE                          | 0.20 | 0.42 | 0.63 | 0.98 | 1.65 | 2.19 | 3.52   | 4.42   | 7.88 | 13.11  | 22.50 |       |
| COUPLING                     | 0.08 | 0.06 | 0.18 | 0.31 | 0.41 | 0.85 | 1.05   | 1.87   | 3.40 | 4.20   | 6.10  | 10.04 |
| HALF COUPLING                | 0.04 | 0.04 | 0.09 | 0.16 | 0.20 | 0.43 | 0.53   | 0.91   | 1.70 | 2.10   | 3.05  | 5.02  |
| RED-COUPLING                 | 0.08 | 0.06 | 0.18 | 0.31 | 0.41 | 0.85 | 1.05   | 1.81   | 3.40 | 4.20   | 6.10  | 10.04 |
| CAP                          | 0.06 | 0.06 | 0.09 | 0.14 | 0.20 | 0.34 | 0.59   | 0.77   | 1.47 |        |       |       |
| <b>PLUGS &amp; BUSHING</b>   |      |      |      |      |      |      |        |        |      |        |       |       |
| <b>2000 / 3000 / 6000LBS</b> |      |      |      |      |      |      |        |        |      |        |       |       |
| SQUARE HEAD                  | 0.01 | 0.01 | 0.03 | 0.05 | 0.09 | 0.16 | 0.27   | 0.38   | 0.63 | 0.96   | 1.53  | 3.83  |
| HEX HEAD                     | 0.01 | 0.03 | 0.05 | 0.07 | 0.14 | 0.25 | 0.47   | 0.62   | 1.10 | 1.73   | 2.15  | 5.90  |
| ROUND HEAD                   | 0.02 | 0.05 | 0.07 | 0.12 | 0.20 | 0.34 | 0.55   | 0.72   | 1.41 | 2.21   | 3.26  | 6.01  |
| BUSHING                      |      | 0.01 | 0.01 | 0.03 | 0.05 | 0.09 | 0.25   | 0.34   | 0.45 | 0.60   | 1.16  | 3.20  |
| <b>3000LBS SOCKET WELD</b>   |      |      |      |      |      |      |        |        |      |        |       |       |
| 90° ELBOW                    | 0.09 | 0.10 | 0.10 | 0.22 | 0.31 | 0.53 | 0.72   | 0.97   | 1.71 | 3.80   | 5.50  | 10.95 |
| 45° ELBOW                    | 0.07 | 0.06 | 0.09 | 0.20 | 0.26 | 0.40 | 0.64   | 0.77   | 1.22 | 3.57   | 5.10  | 9.41  |
| TEE                          | 0.11 | 0.09 | 0.15 | 0.32 | 0.42 | 0.65 | 0.99   | 1.35   | 2.07 | 3.90   | 5.90  | 14.20 |
| COUPLING                     | 0.04 | 0.05 | 0.07 | 0.13 | 0.19 | 0.27 | 0.49   | 0.59   | 0.97 | 1.42   | 1.88  | 3.31  |
| HALF COUPLING                | 0.04 | 0.05 | 0.07 | 0.13 | 0.19 | 0.27 | 0.49   | 0.59   | 0.97 | 1.42   | 1.88  | 3.31  |
| RED COUPLING                 | 0.04 | 0.05 | 0.07 | 0.13 | 0.19 | 0.27 | 0.49   | 0.59   | 0.97 | 1.42   | 1.88  | 3.31  |
| CAP                          | 0.03 | 0.04 | 0.05 | 0.10 | 0.16 | 0.22 | 0.41   | 0.51   | 0.85 | 1.24   | 1.94  | 3.31  |
| UNION                        | 0.28 | 0.28 | 0.28 | 0.31 | 0.46 | 0.67 | 1.03   | 1.51   | 2.43 | 3.48   | 5.25  | 12    |
| <b>6000LBS SOCKET WELD</b>   |      |      |      |      |      |      |        |        |      |        |       |       |
| 90° ELBOW                    |      |      |      | 0.40 | 0.63 | 1.19 | 1.36   | 2.41   | 2.72 | 4.75   | 8.55  | 14.31 |
| 45° ELBOW                    |      |      |      | 0.30 | 0.57 | 0.88 | 1.11   | 2.01   | 2.15 | 4.05   | 6.02  | 11.17 |
| TEE                          |      |      |      | 0.54 | 0.88 | 1.44 | 1.85   | 3.27   | 3.60 | 6.94   | 10.61 | 16.92 |
| COUPLING                     |      |      |      | 0.24 | 0.33 | 0.65 | 0.75   | 1.20   | 2.12 | 2.86   | 4.01  | 6.35  |
| HALF COUPLING                |      |      |      | 0.24 | 0.33 | 0.65 | 0.75   | 1.20   | 2.12 | 2.86   | 4.01  | 6.35  |
| RED COUPLING                 |      |      |      | 0.24 | 0.33 | 0.65 | 0.75   | 1.20   | 2.12 | 2.86   | 4.01  | 6.35  |
| CAP                          |      |      |      | 0.19 | 0.26 | 0.53 | 0.64   | 0.97   | 1.64 | 2.22   | 3.45  | 6.03  |



Outlet, full sizes and reducing sizes  
Sch 40S, 80S, 160 and XXS

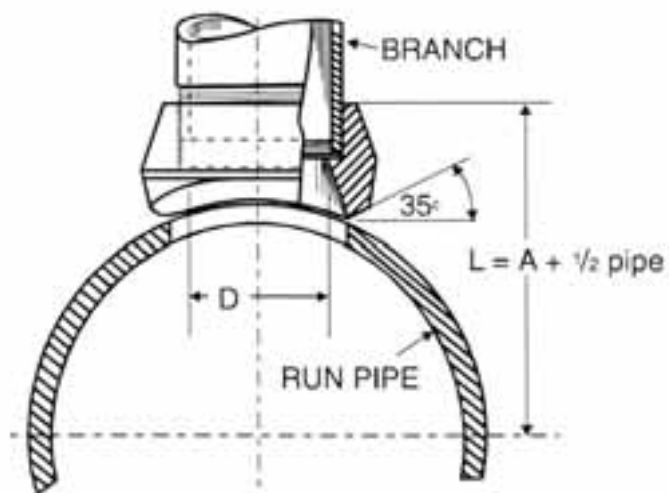
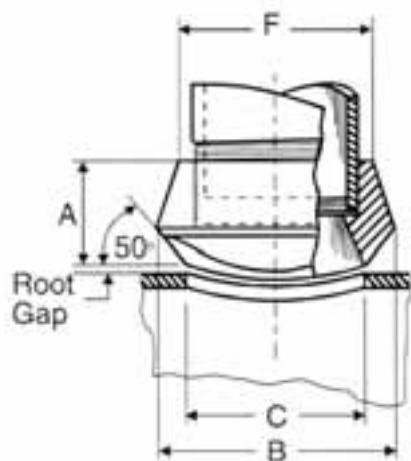


| Outlet size in          | Nominal run pipe size in | Dimensions A mm | B mm  | C mm  | D mm  | Weight kg |
|-------------------------|--------------------------|-----------------|-------|-------|-------|-----------|
| <b>Schedule 40S-80S</b> |                          |                 |       |       |       |           |
| 1/8                     | 3/8 to 36                | 14.3            | 25.4  | 15.9  | -     | 0.04      |
| 1/4                     | 3/8 to 36                | 14.3            | 5.4   | 15.9  | -     | 0.04      |
| 3/8                     | 1/2 to 36                | 19.1            | 31.8  | 19.1  | -     | 0.07      |
| 1/2                     | 1/2 to 36                | 19.1            | 34.9  | 23.8  | 15.9  | 0.07      |
| 3/4                     | 3/4 to 36                | 22.2            | 41.3  | 30.2  | 20.6  | 0.11      |
| 1                       | 1 to 36                  | 27.0            | 50.8  | 36.5  | 26.2  | 0.18      |
| 1-1/4                   | 1-1/4 to 36              | 31.8            | 60.3  | 44.5  | 34.9  | 0.32      |
| 1-1/2                   | 1-1/2 to 36              | 33.3            | 73.0  | 50.8  | 41.3  | 0.36      |
| 2                       | 2 to 36                  | 38.1            | 88.9  | 65.1  | 52.4  | 0.68      |
| 2-1/2                   | 2-1/2 to 36              | 41.3            | 103.2 | 76.2  | 61.9  | 1.02      |
| 3                       | 3 to 36                  | 44.5            | 122.2 | 93.7  | 77.8  | 1.70      |
| 4                       | 4 to 36                  | 50.8            | 152.4 | 120.7 | 101.6 | 3.04      |
| 5                       | 5 to 36                  | 54.0            | 181.0 | 147.6 | 128.6 | 3.8       |
| 6                       | 6 to 36                  | 60.3            | 215.9 | 169.9 | 154.0 | 5.58      |
| 8                       | 8 to 36                  | 69.9            | 263.5 | 220.7 | 201.6 | 9.53      |
| 10                      | 10 to 36                 | 77.8            | 319.1 | 274.6 | 254.0 | 15.88     |
| 12                      | 12 to 36                 | 85.7            | 377.8 | 325.8 | 304.8 | 26.30     |
| <b>Schedule 160-XXS</b> |                          |                 |       |       |       |           |
| 1/2                     | 1/2 to 24                | 28.6            | 34.9  | 14.3  | -     | 0.11      |
| 3/4                     | 3/4 to 24                | 31.8            | 44.5  | 19.1  | -     | 0.32      |
| 1                       | 1 to 24                  | 38.1            | 50.8  | 25.4  | -     | 0.38      |
| 1-1/4                   | 1-1/4 to 24              | 44.5            | 61.9  | 33.3  | -     | 0.57      |
| 1-1/2                   | 1-1/2 to 24              | 50.8            | 69.9  | 38.1  | -     | 0.79      |
| 2                       | 2 to 24                  | 55.6            | 81.0  | 42.9  | -     | 0.97      |
| 2-1/2                   | 2-1/2 to 24              | 61.9            | 96.8  | 54.0  | -     | 1.53      |
| 3                       | 3 to 24                  | 73.0            | 120.7 | 73.0  | -     | 2.87      |
| 4                       | 4 to 24                  | 84.1            | 152.4 | 98.4  | -     | 4.76      |
| 5                       | 5 to 24                  | 93.7            | 187.3 | 122.2 | -     | 6.46      |
| 6                       | 6 to 24                  | 104.8           | 220.7 | 146.1 | -     | 12.70     |
| 8                       | 8 to 24                  | 111.1           | 284.2 | 173.0 | -     | 20.41     |
| 10                      | 10 to 24                 | 136.5           | 342.9 | 215.9 | -     | 39.46     |
| 12                      | 12 to 24                 | 158.8           | 422.3 | 257.2 | -     | 62.14     |



# Threadolets

3000 LBS AND 6000 LBS

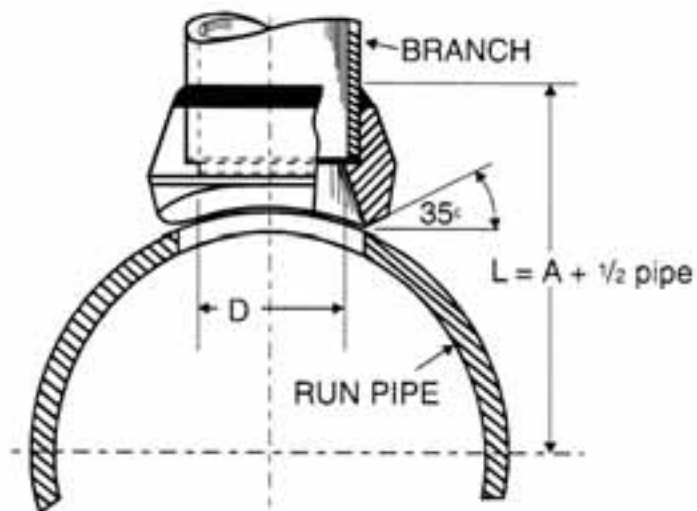
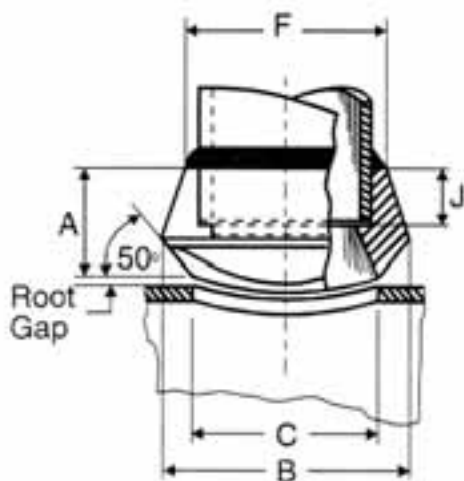


| Run Pipe Size (in)                                 |       | Out-Let Pipe NPS | A    | B     | C     | F     |
|----------------------------------------------------|-------|------------------|------|-------|-------|-------|
| <b>3000Lb Standard and extra strong</b>            |       |                  |      |       |       |       |
| 36-                                                | 3/8   | 1/8              | 19.1 | 25.4  | 15.9  | 173   |
|                                                    | 3/8   | 1/4              | 19.1 | 25.4  | 15.9  | 22.0  |
|                                                    | 1/2   | 3/8              | 20.6 | 31.8  | 19.1  | 25.8  |
|                                                    | 3/4   | 1/2              | 25.4 | 34.9  | 23.8  | 31.3  |
|                                                    | 1     | 3/4              | 26.9 | 44.5  | 30.2  | 37.1  |
|                                                    | 1-1/4 | 1                | 33.3 | 54.0  | 36.5  | 45.5  |
|                                                    | 1-1/2 | 1-1/4            | 33.3 | 65.1  | 44.5  | 54.9  |
|                                                    | 2     | 1-1/2            | 35.1 | 73.0  | 50.8  | 61.6  |
|                                                    | 2-1/2 | 2                | 38.1 | 88.9  | 65.1  | 75.3  |
|                                                    | 3     | 2-1/2            | 46.0 | 103.2 | 76.2  | 91.7  |
|                                                    | 4     | 3                | 50.8 | 122.4 | 93.7  | 109.1 |
|                                                    | 6     | 4                | 57.2 | 152.4 | 120.7 | 137.2 |
| <b>6000Lb Schedule 160 and double extra strong</b> |       |                  |      |       |       |       |
| 36-                                                | 3/4   | 1/2              | 31.8 | 44.5  | 19.1  | 33.9  |
|                                                    | 1     | 3/4              | 36.6 | 50.8  | 25.4  | 41.2  |
|                                                    | 1-1/4 | 1                | 39.6 | 61.9  | 33.3  | 49.9  |
|                                                    | 1-1/2 | 1-1/4            | 41.2 | 69.9  | 38.1  | 58.6  |
|                                                    | 2     | 1-1/2            | 42.9 | 82.6  | 49.2  | 66.7  |
|                                                    | 2-1/2 | 2                | 52.3 | 103.2 | 69.9  | 83.2  |



# Socketlets

3000 LBS AND 6000 LBS



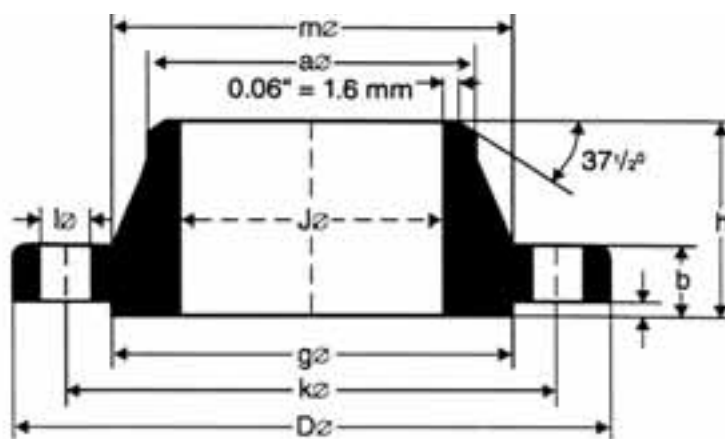
Dimensions in Millimeters.

| Run Pipe Size (in)                                 | Out-Let (Pipe NPS) | A     | B    | C     | D     | F     | J    |
|----------------------------------------------------|--------------------|-------|------|-------|-------|-------|------|
| <b>3000Lb Standard and extra strong</b>            |                    |       |      |       |       |       |      |
| 36-                                                | 3/8                | 1/8   | 19.1 | 25.4  | 15.9  | 10.9  | 9.5  |
|                                                    | 3/8                | 1/4   | 19.1 | 25.4  | 15.9  | 14.4  | 9.5  |
|                                                    | 1/2                | 3/8   | 20.6 | 31.8  | 19.1  | 17.8  | 9.5  |
|                                                    | 3/4                | 1/2   | 25.4 | 34.9  | 23.8  | 22.0  | 11.1 |
|                                                    | 1                  | 3/4   | 26.9 | 44.5  | 30.2  | 27.3  | 12.7 |
|                                                    | 1-1/4              | 1     | 33.3 | 54.0  | 36.5  | 34.1  | 13.5 |
|                                                    | 1-1/2              | 1-1/4 | 33.3 | 65.1  | 44.5  | 42.8  | 15.1 |
|                                                    | 2                  | 1-1/2 | 35.1 | 73.1  | 50.8  | 48.9  | 15.9 |
|                                                    | 2-1/2              | 2     | 38.1 | 88.9  | 65.1  | 61.4  | 17.5 |
|                                                    | 3                  | 2-1/2 | 39.6 | 103.2 | 76.2  | 74.2  | 23.8 |
|                                                    | 4                  | 3     | 44.5 | 122.2 | 93.7  | 90.1  | 28.6 |
|                                                    | 6                  | 4     | 47.8 | 152.4 | 120.7 | 115.8 | 29.4 |
| <b>6000Lb Schedule 160 and double extra strong</b> |                    |       |      |       |       |       |      |
| 36-                                                | 3/4                | 1/2   | 31.8 | 44.5  | 19.1  | 22.0  | 9.5  |
|                                                    | 1                  | 3/4   | 36.6 | 50.8  | 25.4  | 27.3  | 14.3 |
|                                                    | 1-1/4              | 1     | 39.6 | 61.9  | 33.3  | 34.1  | 15.9 |
|                                                    | 1-1/2              | 1-1/4 | 41.2 | 69.9  | 38.1  | 42.8  | 20.6 |
|                                                    | 2                  | 1-1/2 | 42.9 | 82.6  | 49.2  | 48.9  | 20.6 |
|                                                    | 2-1/2              | 2     | 52.3 | 103.2 | 58.7  | 61.4  | 22.2 |



# Dimensional Tolerances

## WELDING NECK FLANGES



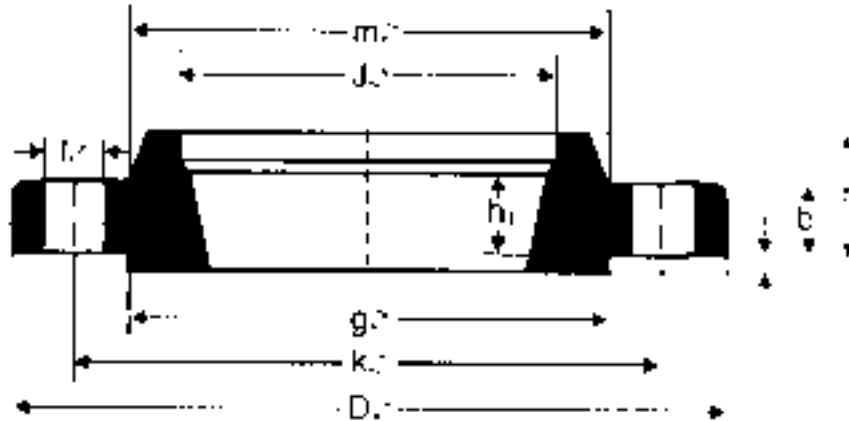
ANSI B 16.5

|   |                                     |                                                                                                                                                                                                                |                                                                                          |                                              |
|---|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|----------------------------------------------|
| D | Outside Diameter_                   | When OD is 24" or less<br>When OD is over 24"                                                                                                                                                                  | $\pm 0.06"$<br>$\pm 0.12"$                                                               | $\pm 1.6$ mm<br>$\pm 3.2$ mm                 |
| J | Inside Diameter                     | 10" and smaller<br>12" to 18"<br>20" and larger                                                                                                                                                                | $+0.03"$<br>$+0.06"$<br>$+0.12" - 0.06"$<br>$+0.8$ mm<br>$+1.6$ mm<br>$+3.2$ mm - 1.6 mm |                                              |
| g | Diameter of Contact Face            | 0.03" Raised Face<br>0.25" Raised Face<br>Tongue and Groove, Male and Female                                                                                                                                   | $\pm 0.03"$<br>$\pm 0.02"$<br>$\pm 0.02"$                                                | $\pm 0.8$ mm<br>$\pm 0.5$ mm<br>$\pm 0.5$ mm |
| a | Diameter of Hub at Point of Welding | 5" and smaller<br>6" and larger                                                                                                                                                                                | $+0.09" - 0.03"$<br>$+0.16" - 0.03"$<br>$+2.4$ mm - 0.8 mm<br>$+4.0$ mm - 0.8 mm         |                                              |
| m | Diameter of Hub at Base_            | When Hub Base is 24" or less<br>When OD is over 24"                                                                                                                                                            | $\pm 0.06"$<br>$\pm 0.12"$                                                               | $\pm 1.6$ mm<br>$\pm 3.2$ mm                 |
| l | Drilling and Facing                 | Bolt Circle Diameter $k \pm 0.06"$<br>Center-to-center of adjacent bolt holes<br>Max. eccentricity between bolt circle dia.k and machined facing diameters:<br>sizes 2-1/2" and smaller<br>sizes 3" and larger | $\pm 1.6$ mm<br>$\pm 0.03"$<br><br>$0.03"$<br>$0.06"$                                    | $\pm 0.8$ mm<br><br><br>0.8 mm<br>1.6 mm     |
| h | Overall Length of Hub               | 10" and smaller<br>12" and larger                                                                                                                                                                              | $\pm 0.06"$<br>$\pm 0.12"$                                                               | $\pm 1.6$ mm<br>$\pm 3.2$ mm                 |
| b | Thickness                           | 18" and smaller<br>20" and larger                                                                                                                                                                              | $+0.12"$<br>$+0.19"$                                                                     | $+3.2$ mm<br>$+4.8$ mm                       |

1) This tolerance is not covered by ANSI B 16.5.

# Dimensional Tolerances

## LAP JOINT, SLIP-ON, THREADED AND BLIND FLANGES



ANSI B 16.5

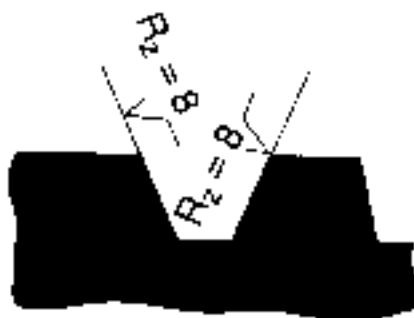
|                    |                                                     |                                                                                                                                                                                                    |                                                                                  |                                                          |
|--------------------|-----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|----------------------------------------------------------|
| D                  | Outside Diameter                                    | When OD is 24" or less<br>When OD is over 24"                                                                                                                                                      | $\pm 0.06"$<br>$\pm 0.12"$                                                       | $\pm 1.6$ mm<br>$\pm 3.2$ mm                             |
| J <sub>1,2,3</sub> | Inside Diameter                                     | Slip-on and Lap Joint 10" and smaller<br>12" and larger<br>Threaded                                                                                                                                | $+0.03"$<br>$+0.06"$<br>Within limits on boring gauge                            | $+0.8$ mm<br>$+1.6$ mm                                   |
| g                  | Diameter of Counterbore<br>Diameter of Contact Face | Same as for inside Diameter<br>0.03" Raised Face<br>0.25" Raised Face<br>Tongue and Groove, Male and Female                                                                                        | $\pm 0.03"$<br>$\pm 0.02"$<br>$\pm 0.02"$<br>not for flanges with ring joint     | $\pm 0.8$ mm<br>$\pm 0.5$ mm<br>$\pm 0.5$ mm             |
| m                  | Outside Diameter of Hub <sup>1)</sup>               | 12" and smaller<br>14" and larger                                                                                                                                                                  | $+0.09" - 0.06"$<br>$\pm 0.12"$<br>$+2.4$ mm - 1.6 mm<br>$\pm 3.2$ mm            |                                                          |
| l                  | Drilling and Facing                                 | Bolt Circle Diameter k<br>Center-to-center of adjacent bolt holes<br>Max. eccentricity between bolt circle dia.k and machined facing diameters:<br>sizes 2-1/2" and smaller<br>sizes 3" and larger | $\pm 0.06"$<br>$\pm 0.03"$<br><br>$0.03"$<br>$0.06"$                             | $\pm 1.6$ mm<br>$\pm 0.8$ mm<br><br>$0.8$ mm<br>$1.6$ mm |
| L <sub>1,2,3</sub> | Overall Length of Hub                               | 18" and smaller<br>20" and larger                                                                                                                                                                  | $+0.12" - 0.03"$<br>$+0.19" - 0.03"$<br>$+3.2$ mm - 0.8 mm<br>$+4.8$ mm - 1.6 mm |                                                          |
| b                  | Thickness                                           | 18" and smaller<br>20" and larger                                                                                                                                                                  | $+0.12"$<br>$+0.19"$                                                             | $+3.2$ mm<br>$+4.8$ mm                                   |

1) This tolerance is not covered by ANSI B 16.5.

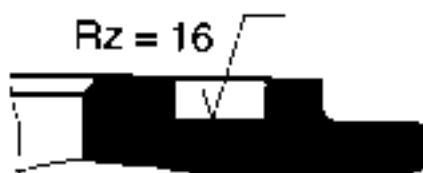


# Facing

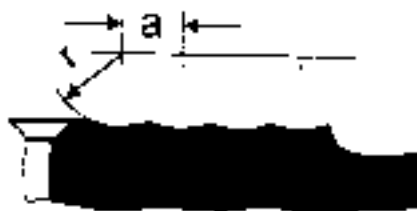
## Ring Joint Facings



## Tongue/Groove Small Male/Female Facings



## Stock Finish Large Male/Female Facings

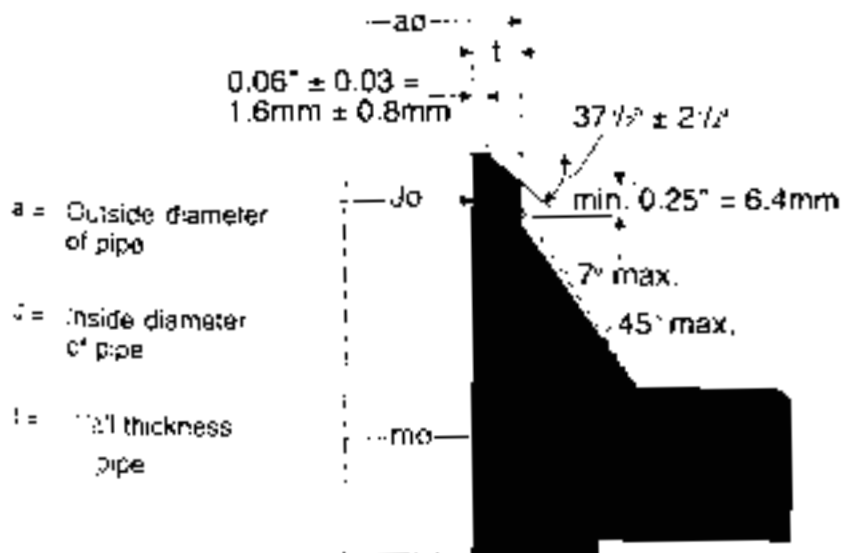


Facings in other designs on enquiry

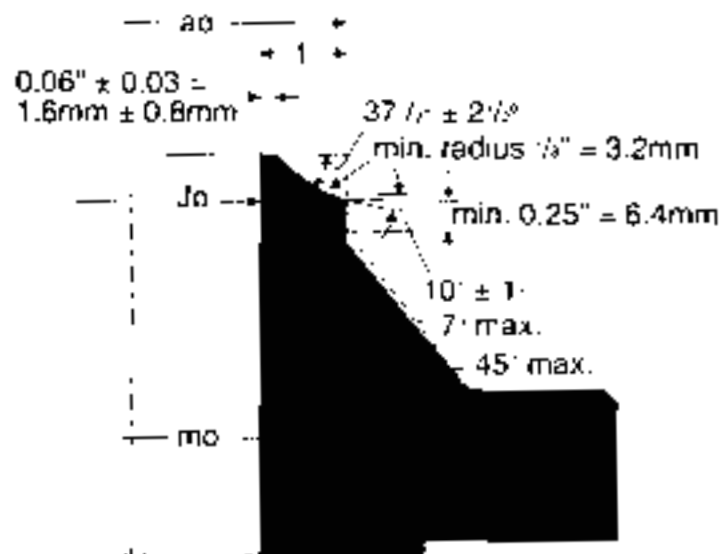
|          | ≤ 12"<br>≤ 300 mm | > 12"<br>> 300 mm |
|----------|-------------------|-------------------|
| r (mm)   | 1.2 - 1.6         | 1.6 - 3.2         |
| a (mm/U) | 0.75 - 0.9        | 0.8 - 1.0)        |



## Welding Ends ANSI B 16.25



Bevel for Wall Thicknesses (t) 0.19" to 0.88" inclusive



Bevel for Wall Thicknesses (t) greater than 0.88"

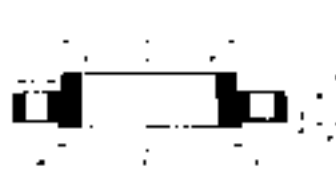


# Flanges 150lb/sq.in.

ANSI B16-5



WELDING NECK



SLIP-ON

| Pipe      |                | Flange         |                                                                                                         |                |                |                                                                                                  |              |              |              |               |              |               |
|-----------|----------------|----------------|---------------------------------------------------------------------------------------------------------|----------------|----------------|--------------------------------------------------------------------------------------------------|--------------|--------------|--------------|---------------|--------------|---------------|
| Nom. Size | O.D. in.<br>mm | D in.<br>mm    | J in.<br>mm                                                                                             | J1 in.<br>mm   | J2 in.<br>mm   | J3 in.<br>mm                                                                                     | p in.<br>mm  | r in.<br>mm  | b in.<br>mm  | h in.<br>mm   | h1 in.<br>mm | h2 in.<br>mm  |
| 1/2"      | 0.84<br>21.3   | 3.50<br>88.9   | *1 = Refer to ANSI B36-10 / B36-19 or as specified by purchaser (Bitte horizontal einfügen in Spalte J) | 0.88<br>22.4   | 0.90<br>22.9   | *2 = No counter bore required on 150lb threaded flanges (Bitte horizontal einfügen in Spalte J3) | 0.38<br>9.7  | 0.12<br>3.0  | 0.44<br>11.2 | 1.88<br>47.8  | 0.62<br>15.7 | 0.62<br>15.7  |
| 3/4"      | 1.05<br>26.7   | 3.88<br>98.6   |                                                                                                         | 1.09<br>27.7   | 1.11<br>28.2   |                                                                                                  | 0.44<br>11.2 | 0.12<br>3.0  | 0.50<br>12.7 | 2.06<br>52.3  | 0.62<br>15.7 | 0.62<br>15.7  |
| 1"        | 1.315<br>33.4  | 4.25<br>108.0  |                                                                                                         | 1.36<br>34.5   | 1.38<br>35.1   |                                                                                                  | 0.50<br>12.7 | 0.12<br>3.0  | 0.56<br>14.2 | 2.19<br>55.6  | 0.69<br>17.5 | 0.69<br>17.5  |
| 1 1/4"    | 1.66<br>42.2   | 4.62<br>117.3  |                                                                                                         | 1.70<br>43.2   | 1.72<br>43.7   |                                                                                                  | 0.56<br>14.2 | 0.19<br>4.8  | 0.62<br>15.7 | 2.25<br>57.2  | 0.81<br>20.6 | 0.81<br>20.6  |
| 1 1/2"    | 1.90<br>48.3   | 5.00<br>127.0  |                                                                                                         | 1.95<br>49.5   | 1.97<br>50.0   |                                                                                                  | 0.62<br>15.7 | 0.25<br>6.4  | 0.69<br>17.5 | 2.44<br>62.0  | 0.88<br>22.4 | 0.88<br>22.4  |
| 2"        | 2.375<br>60.3  | 6.00<br>152.4  |                                                                                                         | 2.44<br>62.0   | 2.46<br>62.5   |                                                                                                  | 0.69<br>17.5 | 0.31<br>7.9  | 0.75<br>19.1 | 2.50<br>63.5  | 1.00<br>25.4 | 1.00<br>25.4  |
| 2 1/2"    | 2.875<br>73.0  | 7.00<br>177.8  |                                                                                                         | 2.94<br>74.7   | 2.97<br>75.4   |                                                                                                  | 0.75<br>19.1 | 0.31<br>7.9  | 0.88<br>22.4 | 2.75<br>69.9  | 1.42<br>28.4 | 1.42<br>28.4  |
| 3"        | 3.50<br>88.9   | 7.5<br>190.5   |                                                                                                         | 3.57<br>90.7   | 3.60<br>91.4   |                                                                                                  | 0.81<br>20.6 | 0.38<br>9.7  | 0.94<br>23.9 | 2.75<br>69.6  | 1.19<br>30.2 | 1.19<br>30.2  |
| 3 1/2"    | 4.00<br>101.6  | 8.50<br>215.9  |                                                                                                         | 4.07<br>103.4  | 4.10<br>104.1  |                                                                                                  |              | 0.38<br>9.7  | 0.94<br>23.9 | 2.81<br>71.4  | 1.25<br>31.8 | 1.25<br>31.8  |
| 4"        | 4.50<br>114.3  | 9.00<br>228.6  |                                                                                                         | 4.57<br>116.1  | 4.60<br>116.8  |                                                                                                  |              | 0.44<br>11.2 | 0.94<br>23.9 | 3.00<br>76.2  | 1.31<br>33.3 | 1.31<br>33.3  |
| 5"        | 5.563<br>141.3 | 10.00<br>254.0 |                                                                                                         | 5.66<br>143.8  | 5.69<br>144.5  |                                                                                                  |              | 0.44<br>11.2 | 0.94<br>23.9 | 3.50<br>88.9  | 1.44<br>36.6 | 1.44<br>36.6  |
| 6"        | 6.625<br>168.3 | 11.00<br>279.4 |                                                                                                         | 6.72<br>170.7  | 6.75<br>171.5  |                                                                                                  |              | 0.50<br>12.7 | 1.00<br>25.4 | 3.50<br>88.9  | 1.56<br>39.6 | 1.56<br>39.6  |
| 8"        | 8.625<br>219.1 | 13.50<br>342.9 |                                                                                                         | 8.72<br>221.5  | 8.75<br>222.3  |                                                                                                  |              | 0.50<br>12.7 | 1.12<br>28.4 | 4.00<br>101.6 | 1.75<br>44.5 | 1.75<br>44.5  |
| 10"       | 10.75<br>273   | 16.00<br>406.4 |                                                                                                         | 10.88<br>276.4 | 10.92<br>277.4 |                                                                                                  |              | 0.50<br>12.7 | 1.19<br>30.2 | 4.00<br>101.6 | 1.94<br>49.3 | 1.94<br>49.3  |
| 12"       | 12.75<br>323.8 | 19.00<br>482.6 |                                                                                                         | 12.88<br>327.2 | 12.92<br>328.2 |                                                                                                  |              | 0.50<br>12.7 | 1.25<br>31.8 | 4.50<br>114.3 | 2.19<br>55.6 | 2.19<br>55.6  |
| 14"       | 14.0<br>355.6  | 21.00<br>533.4 |                                                                                                         | 14.14<br>359.2 | 14.18<br>360.2 |                                                                                                  |              | 0.50<br>12.7 | 1.38<br>35.1 | 5.00<br>127.0 | 2.25<br>57.2 | 3.12<br>79.2  |
| 16"       | 16.0<br>406.4  | 23.50<br>596.9 |                                                                                                         | 16.16<br>410.5 | 16.19<br>411.2 |                                                                                                  |              | 0.50<br>12.7 | 1.44<br>36.6 | 5.00<br>127.0 | 2.50<br>62.5 | 3.44<br>87.4  |
| 18"       | 18.0<br>457.2  | 25.00<br>635.0 |                                                                                                         | 18.18<br>461.8 | 18.20<br>462.3 |                                                                                                  |              | 0.50<br>12.7 | 1.56<br>39.6 | 5.50<br>139.7 | 2.69<br>68.3 | 3.81<br>96.8  |
| 20"       | 20.0<br>508.0  | 27.5<br>698.5  |                                                                                                         | 20.20<br>513.1 | 20.25<br>514.4 |                                                                                                  |              | 0.50<br>12.7 | 1.69<br>42.9 | 5.69<br>144.5 | 2.88<br>73.2 | 4.06<br>103.1 |
| 24"       | 24.0<br>609.6  | 32.00<br>812.8 |                                                                                                         | 24.25<br>616.0 | 24.25<br>616.0 |                                                                                                  |              | 0.50<br>12.7 | 1.88<br>47.8 | 6.00<br>152.4 | 3.25<br>82.6 | 4.38<br>111.3 |

Note: Socket weld flanges up to 3" in this pressure rating

# Flanges 150lb/sq.in.

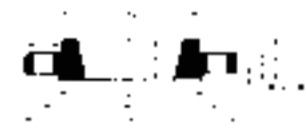
ANSI B16-5



BLIND



SOCKET WELD



THREADED

| Hub             |                |                | Raised Face    |            | Drilling Template |                |                  | Approx Weight    |                  |                    |                  |                   |
|-----------------|----------------|----------------|----------------|------------|-------------------|----------------|------------------|------------------|------------------|--------------------|------------------|-------------------|
| h3<br>in.<br>mm | a<br>in.<br>mm | m<br>in.<br>mm | g<br>in.<br>mm | Num<br>ber | l<br>in.<br>mm    | k<br>in.<br>mm | W/N<br>lbs<br>kg | S/O<br>lbs<br>kg | L/J<br>lbs<br>kg | Blind<br>lbs<br>kg | S/W<br>lbs<br>kg | Thrd<br>lbs<br>kg |
|                 | 0.84<br>21.3   | 1.19<br>30.2   | 1.38<br>35.1   | 4          | 0.62<br>15.7      | 2.38<br>60.5   | 1.1<br>0.48      | 0.9<br>0.39      | 0.8<br>0.38      | 0.9<br>0.42        | 0.9<br>0.42      | 0.9<br>0.39       |
|                 | 1.05<br>26.7   | 1.50<br>38.1   | 1.69<br>42.9   | 4          | 0.62<br>15.7      | 2.75<br>69.9   | 1.6<br>0.17      | 1.2<br>0.56      | 1.2<br>0.55      | 1.3<br>0.61        | 1.3<br>0.59      | 1.2<br>0.56       |
|                 | 1.32<br>33.5   | 1.94<br>49.3   | 2.00<br>50.8   | 4          | 0.62<br>15.7      | 3.12<br>79.2   | 2.2<br>1.01      | 1.7<br>0.78      | 1.7<br>0.76      | 1.9<br>0.86        | 1.8<br>0.81      | 1.7<br>0.78       |
|                 | 1.66<br>42.2   | 2.31<br>58.7   | 2.50<br>63.5   | 4          | 0.62<br>15.7      | 3.50<br>88.9   | 2.9<br>1.33      | 2.3<br>1.03      | 2.2<br>1.01      | 2.6<br>1.17        | 2.4<br>1.07      | 2.3<br>1.03       |
|                 | 1.90<br>48.3   | 2.56<br>65.0   | 2.88<br>73.2   | 4          | 0.62<br>15.7      | 3.88<br>98.6   | 3.8<br>1.72      | 2.9<br>1.32      | 2.9<br>1.30      | 3.4<br>1.53        | 3.0<br>1.36      | 2.9<br>1.32       |
|                 | 2.38<br>60.5   | 3.06<br>77.7   | 3.62<br>91.9   | 4          | 0.75<br>19.1      | 4.75<br>120.7  | 5.7<br>2.58      | 4.5<br>2.06      | 4.5<br>2.03      | 5.3<br>2.42        | 4.6<br>2.10      | 4.5<br>2.06       |
|                 | 2.88<br>73.2   | 3.56<br>90.4   | 4.12<br>104.6  | 4          | 0.75<br>19.1      | 5.50<br>139.7  | 9.1<br>4.11      | 7.2<br>3.28      | 7.2<br>3.25      | 8.7<br>3.94        | 7.3<br>3.90      | 7.2<br>3.28       |
|                 | 3.5<br>88.9    | 4.25<br>108.0  | 5.00<br>127.0  | 4          | 0.75<br>19.1      | 6.00<br>152.4  | 10.8<br>4.92     | 8.5<br>3.85      | 8.4<br>3.81      | 10.9<br>4.93       | 8.6<br>3.90      | 8.5<br>3.28       |
|                 | 4.00<br>101.6  | 4.81<br>122.2  | 5.50<br>139.7  | 8          | 0.75<br>19.1      | 7.00<br>177.8  | 13.4<br>6.08     | 10.6<br>4.81     | 10.5<br>4.76     | 13.6<br>6.17       |                  | 10.6<br>4.81      |
|                 | 4.50<br>114.3  | 5.31<br>134.9  | 6.19<br>157.2  | 8          | 0.75<br>19.1      | 7.50<br>190.5  | 15.1<br>6.84     | 11.7<br>5.30     | 11.6<br>5.25     | 15.4<br>7.00       |                  | 11.7<br>5.30      |
|                 | 5.56<br>141.2  | 6.44<br>163.6  | 7.31<br>185.7  | 8          | 0.88<br>22.4      | 8.50<br>215.9  | 18.9<br>8.56     | 13.4<br>6.07     | 13.3<br>6.02     | 19.9<br>8.63       |                  | 13.4<br>6.07      |
|                 | 6.63<br>168.4  | 7.56<br>192.0  | 8.50<br>215.9  | 8          | 0.88<br>22.4      | 9.50<br>241.3  | 23.3<br>10.6     | 16.4<br>7.45     | 16.3<br>7.40     | 24.9<br>11.3       |                  | 16.4<br>7.45      |
|                 | 8.63<br>219.2  | 9.69<br>246.1  | 10.62<br>269.7 | 8          | 0.88<br>22.4      | 11.75<br>298.5 | 38.8<br>17.6     | 26.7<br>12.1     | 26.7<br>12.1     | 43.2<br>19.6       |                  | 26.7<br>12.1      |
|                 | 10.75<br>273.1 | 12.00<br>304.8 | 12.75<br>323.9 | 12         | 1.00<br>25.4      | 14.25<br>362.0 | 53.0<br>24.0     | 36.3<br>16.5     | 36.1<br>16.4     | 63.4<br>28.8       |                  | 36.3<br>16.5      |
|                 | 12.75<br>323.9 | 14.38<br>365.3 | 15.00<br>381.0 | 12         | 1.00<br>25.4      | 17.00<br>431.8 | 80.4<br>36.5     | 57.7<br>26.2     | 57.5<br>26.1     | 95.2<br>43.2       |                  | 57.7<br>26.2      |
|                 | 14.00<br>355.6 | 15.75<br>400.1 | 16.25<br>412.8 | 12         | 1.12<br>28.4      | 18.75<br>476.3 | 107<br>48.4      | 76.2<br>34.6     | 76.0<br>34.5     | 128.0<br>58.1      |                  | 76.2<br>34.6      |
|                 | 16.00<br>406.4 | 18.00<br>457.2 | 18.50<br>469.9 | 16         | 1.12<br>28.4      | 21.25<br>539.8 | 134<br>60.6      | 98.7<br>44.8     | 98.2<br>44.6     | 167.0<br>76.0      |                  | 98.7<br>44.8      |
|                 | 18.00<br>457.2 | 19.88<br>505.0 | 21.00<br>533.4 | 16         | 1.25<br>31.8      | 22.75<br>577.9 | 151<br>68.3      | 108.0<br>48.9    | 107.0<br>48.7    | 206.0<br>93.7      |                  | 108.0<br>48.9     |
|                 | 20.00<br>508.0 | 22.00<br>558.8 | 23.00<br>584.2 | 20         | 1.25<br>31.8      | 25.00<br>635.0 | 186<br>84.5      | 136.0<br>61.9    | 136.0<br>61.6    | 269.0<br>122.0     |                  | 136.0<br>61.9     |
|                 | 24.00<br>609.6 | 26.12<br>663.4 | 27.25<br>692.2 | 20         | 1.38<br>35.1      | 29.50<br>749.3 | 253<br>115       | 191.0<br>86.9    | 191.0<br>86.6    | 408.0<br>185.0     |                  | 191.0<br>86.9     |





# Flanges 300lb/sq.in.

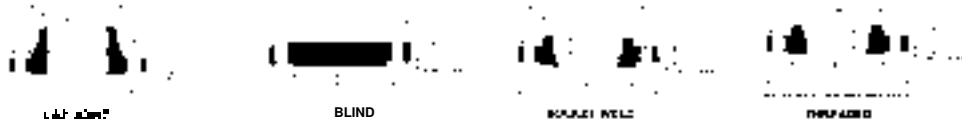
ANSI B16-5



| Pipe      |                | Flange         |                                                                                                         |                |                |                |              |              |              |               |               |               |
|-----------|----------------|----------------|---------------------------------------------------------------------------------------------------------|----------------|----------------|----------------|--------------|--------------|--------------|---------------|---------------|---------------|
| Nom. Size | O.D. in.<br>mm | D in.<br>mm    | J in.<br>mm                                                                                             | J1 in.<br>mm   | J2 in.<br>mm   | J3 in.<br>mm   | p in.<br>mm  | r in.<br>mm  | b in.<br>mm  | h in.<br>mm   | h1 in.<br>mm  | h2 in.<br>mm  |
| 1/2"      | 0.84<br>21.3   | 3.75<br>95.2   | *1 = Refer to ANSI B36-10 / B36-19 or as specified by purchaser (Bitte horizontal einfügen in Spalte J) | 0.88<br>22.3   | 0.90<br>22.9   | 0.93<br>26.3   | 0.38<br>9.6  | 0.12<br>3.0  | 0.56<br>14.2 | 2.06<br>52.3  | 0.88<br>22.3  | 0.88<br>22.3  |
| 3/4"      | 1.05<br>26.7   | 4.62<br>117.3  |                                                                                                         | 1.09<br>27.7   | 1.11<br>28.2   | 1.14<br>29.0   | 0.44<br>11.1 | 0.12<br>3.0  | 0.62<br>15.7 | 2.25<br>57.1  | 1.00<br>25.4  | 1.00<br>25.4  |
| 1"        | 1.315<br>33.4  | 4.88<br>123.9  |                                                                                                         | 1.36<br>34.5   | 1.38<br>35.0   | 1.41<br>35.8   | 0.5<br>12.7  | 0.12<br>3.0  | 0.69<br>17.5 | 2.44<br>62.0  | 1.06<br>26.9  | 1.06<br>26.9  |
| 1 1/4"    | 1.66<br>42.2   | 5.25<br>133.3  |                                                                                                         | 1.70<br>43.2   | 1.72<br>43.7   | 1.75<br>44.4   | 0.56<br>14.2 | 0.19<br>4.8  | 0.75<br>19.0 | 2.56<br>65.0  | 1.06<br>26.9  | 1.06<br>26.9  |
| 1 1/2"    | 1.90<br>48.3   | 6.12<br>155.4  |                                                                                                         | 1.95<br>49.5   | 1.97<br>50.0   | 1.99<br>50.5   | 0.62<br>15.7 | 0.25<br>6.4  | 0.81<br>20.6 | 2.69<br>68.3  | 1.19<br>30.2  | 1.19<br>30.2  |
| 2"        | 2.375<br>60.3  | 6.50<br>165.1  |                                                                                                         | 2.44<br>62.0   | 2.46<br>62.5   | 2.50<br>63.5   | 0.69<br>17.5 | 0.31<br>7.8  | 0.88<br>22.3 | 2.75<br>69.8  | 1.31<br>33.2  | 1.31<br>33.2  |
| 2 1/2"    | 2.875<br>73.0  | 7.50<br>190.5  |                                                                                                         | 2.94<br>74.7   | 2.97<br>75.4   | 3.00<br>76.2   | 0.75<br>19.0 | 0.31<br>7.8  | 1.00<br>25.4 | 3.00<br>76.2  | 1.50<br>38.1  | 1.50<br>38.1  |
| 3"        | 3.50<br>88.9   | 8.25<br>209.5  |                                                                                                         | 3.57<br>90.7   | 3.60<br>91.4   | 3.63<br>92.2   | 0.81<br>20.5 | 0.38<br>9.6  | 1.12<br>28.4 | 3.12<br>79.2  | 1.69<br>42.9  | 1.69<br>42.9  |
| 3 1/2"    | 4.00<br>101.6  | 9.00<br>228.6  |                                                                                                         | 4.07<br>103.4  | 4.10<br>104.1  | 4.13<br>104.9  |              | 0.38<br>9.6  | 1.19<br>30.2 | 3.19<br>81.0  | 1.75<br>44.4  | 1.75<br>44.4  |
| 4"        | 4.50<br>114.3  | 10.00<br>254.0 |                                                                                                         | 4.57<br>116.1  | 4.60<br>116.8  | 4.63<br>117.6  |              | 0.44<br>11.1 | 1.25<br>31.7 | 3.38<br>85.8  | 1.88<br>47.7  | 1.88<br>47.7  |
| 5"        | 5.563<br>141.3 | 11.00<br>279.4 |                                                                                                         | 5.66<br>143.8  | 5.69<br>144.5  | 5.69<br>144.5  |              | 0.44<br>11.1 | 1.38<br>35.0 | 3.88<br>98.5  | 2.00<br>50.8  | 2.00<br>50.8  |
| 6"        | 6.625<br>168.3 | 12.50<br>317.5 |                                                                                                         | 6.72<br>170.7  | 6.75<br>171.4  | 6.75<br>171.4  |              | 0.50<br>12.7 | 1.44<br>36.5 | 3.88<br>98.5  | 2.06<br>52.3  | 2.06<br>52.3  |
| 8"        | 8.625<br>219.1 | 15.00<br>381.0 |                                                                                                         | 8.72<br>221.5  | 8.75<br>222.2  | 8.75<br>222.2  |              | 0.50<br>12.7 | 1.62<br>41.1 | 4.38<br>111.2 | 2.44<br>61.9  | 2.44<br>61.9  |
| 10"       | 10.75<br>273   | 17.50<br>444.5 |                                                                                                         | 10.88<br>276.3 | 10.92<br>277.4 | 10.88<br>276.3 |              | 0.50<br>12.7 | 1.88<br>47.7 | 4.62<br>117.3 | 2.62<br>66.5  | 3.75<br>95.2  |
| 12"       | 12.75<br>323.8 | 20.50<br>520.7 |                                                                                                         | 12.88<br>327.1 | 12.92<br>328.2 | 12.94<br>328.7 |              | 0.50<br>12.7 | 2.00<br>50.8 | 5.12<br>130.0 | 2.88<br>73.1  | 4.00<br>101.6 |
| 14"       | 14.0<br>355.6  | 23.00<br>584.2 |                                                                                                         | 14.14<br>359.1 | 14.18<br>360.2 | 14.19<br>360.4 |              | 0.50<br>12.7 | 2.12<br>53.8 | 5.62<br>142.7 | 3.00<br>76.2  | 4.38<br>111.2 |
| 16"       | 16.0<br>406.4  | 25.50<br>647.7 |                                                                                                         | 16.16<br>410.5 | 16.19<br>411.2 | 16.19<br>411.2 |              | 0.50<br>12.7 | 2.25<br>57.1 | 5.75<br>146.0 | 3.25<br>82.5  | 4.75<br>120.6 |
| 18"       | 18.0<br>457.2  | 28.00<br>711.2 |                                                                                                         | 18.18<br>461.8 | 18.20<br>462.3 | 18.19<br>462.0 |              | 0.50<br>12.7 | 2.38<br>60.4 | 6.25<br>158.7 | 3.50<br>88.9  | 5.12<br>130.6 |
| 20"       | 20.0<br>508.0  | 30.50<br>774.7 |                                                                                                         | 20.20<br>513.1 | 20.25<br>514.3 | 20.19<br>512.8 |              | 0.50<br>12.7 | 2.50<br>63.5 | 6.38<br>162.0 | 3.75<br>95.2  | 5.50<br>139.7 |
| 24"       | 24.0<br>609.6  | 36.00<br>914.4 |                                                                                                         | 24.25<br>615.9 | 24.25<br>615.9 | 24.19<br>614.4 |              | 0.50<br>12.7 | 2.75<br>69.8 | 6.62<br>168.1 | 4.19<br>106.4 | 6.00<br>152.4 |

Note: Socket weld flanges up to 3" in this pressure rating

# Flanges 300lb/sq.in. ANSI B16-5

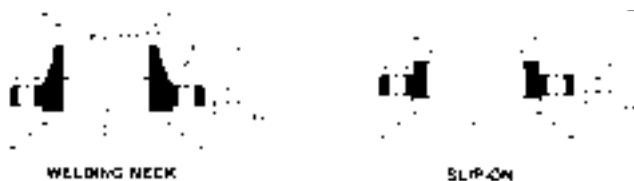


| h3<br>in.<br>mm | Hub            |                | Raised<br>Face<br>g<br>in.<br>mm | Drilling Template |                |                | Approx<br>Weight |                  |                  |                    |                  |                   |
|-----------------|----------------|----------------|----------------------------------|-------------------|----------------|----------------|------------------|------------------|------------------|--------------------|------------------|-------------------|
|                 | a<br>in.<br>mm | m<br>in.<br>mm |                                  | Num<br>ber        | l<br>in.<br>mm | k<br>in.<br>mm | W/N<br>lbs<br>kg | S/O<br>lbs<br>kg | L/J<br>lbs<br>kg | Blind<br>lbs<br>kg | S/W<br>lbs<br>kg | Thrd<br>lbs<br>kg |
| 0.62<br>15.7    | 0.84<br>21.3   | 1.50<br>38.1   | 1.38<br>35.0                     | 4                 | 0.62<br>15.7   | 2.62<br>66.5   | 1.7<br>0.75      | 1.4<br>0.64      | 1.4<br>0.62      | 1.40<br>0.64       | 1.50<br>0.66     | 1.40<br>0.64      |
| 0.62<br>15.7    | 1.05<br>26.7   | 1.88<br>47.7   | 1.69<br>42.9                     | 4                 | 0.75<br>19.0   | 3.25<br>82.5   | 2.8<br>1.26      | 2.5<br>1.12      | 2.4<br>1.10      | 2.40<br>1.11       | 2.50<br>1.15     | 2.50<br>1.12      |
| 0.69<br>17.5    | 1.32<br>33.5   | 2.12<br>53.8   | 2.00<br>50.8                     | 4                 | 0.75<br>19.0   | 3.50<br>88.9   | 3.5<br>1.52      | 3.0<br>1.36      | 2.9<br>1.33      | 3.10<br>1.39       | 3.10<br>1.40     | 3.00<br>1.36      |
| 0.81<br>20.5    | 1.66<br>42.2   | 2.50<br>63.5   | 2.50<br>63.5                     | 4                 | 0.75<br>19.0   | 3.88<br>98.5   | 4.5<br>2.03      | 3.7<br>1.68      | 3.6<br>1.65      | 3.90<br>1.79       | 3.90<br>1.75     | 3.70<br>1.68      |
| 0.88<br>22.3    | 1.90<br>48.3   | 2.75<br>69.8   | 2.88<br>73.1                     | 4                 | 0.88<br>22.3   | 4.50<br>114.3  | 6.4<br>2.89      | 5.5<br>2.49      | 5.4<br>2.44      | 5.90<br>2.66       | 5.60<br>2.55     | 5.50<br>2.49      |
| 1.12<br>28.4    | 2.38<br>60.4   | 3.31<br>84.0   | 3.62<br>91.9                     | 8                 | 0.75<br>19.0   | 5.00<br>127.0  | 7.5<br>3.40      | 6.3<br>2.87      | 6.2<br>2.83      | 7.00<br>3.18       | 6.5<br>2.93      | 6.30<br>2.87      |
| 1.25<br>31.7    | 2.88<br>73.1   | 3.94<br>100.0  | 4.12<br>104.6                    | 8                 | 0.88<br>22.3   | 5.88<br>149.3  | 11.4<br>5.17     | 9.5<br>4.32      | 9.4<br>4.25      | 10.70<br>4.85      | 9.70<br>4.40     | 9.50<br>4.32      |
| 1.25<br>31.7    | 3.50<br>88.9   | 4.62<br>117.3  | 5.00<br>127.0                    | 8                 | 0.88<br>22.3   | 6.62<br>168.1  | 15.3<br>6.93     | 12.9<br>5.85     | 12.7<br>5.78     | 15.0<br>6.81       | 13.0<br>3.92     | 12.90<br>5.85     |
| 1.44<br>36.5    | 4.00<br>101.6  | 5.25<br>133.3  | 5.50<br>139.7                    | 8                 | 0.88<br>22.3   | 7.25<br>184.1  | 19.1<br>8.67     | 16.2<br>7.34     | 16.0<br>7.27     | 19.2<br>8.71       |                  | 16.20<br>7.34     |
| 1.44<br>36.5    | 4.50<br>114.3  | 5.75<br>146.0  | 6.19<br>157.2                    | 8                 | 0.88<br>22.3   | 7.88<br>200.1  | 24.7<br>11.2     | 21.2<br>9.61     | 21.0<br>9.55     | 25.3<br>11.5       |                  | 21.20<br>9.61     |
| 1.69<br>42.9    | 5.56<br>141.2  | 7.00<br>177.8  | 7.31<br>185.6                    | 8                 | 0.88<br>22.3   | 9.25<br>234.9  | 33.3<br>15.1     | 27.1<br>12.3     | 26.9<br>12.2     | 34.4<br>15.6       |                  | 27.10<br>12.30    |
| 1.81<br>45.9    | 6.63<br>168.4  | 8.12<br>206.2  | 8.50<br>215.9                    | 12                | 0.88<br>22.3   | 10.62<br>269.7 | 42.4<br>19.1     | 34.4<br>15.6     | 34.1<br>15.5     | 46.0<br>20.9       |                  | 34.40<br>15.60    |
| 2.00<br>50.8    | 8.63<br>219.2  | 10.25<br>260.3 | 10.62<br>269.7                   | 12                | 1.00<br>25.4   | 13.00<br>330.2 | 65.9<br>29.9     | 53.3<br>24.2     | 53.1<br>24.1     | 75.6<br>34.3       |                  | 53.30<br>24.20    |
| 2.19<br>55.6    | 10.75<br>273   | 12.62<br>320.5 | 12.75<br>323.8                   | 16                | 1.12<br>28.4   | 15.25<br>387.3 | 94.1<br>42.7     | 75.1<br>34.1     | 75.8<br>34.4     | 117.0<br>53.3      |                  | 75.10<br>34.10    |
| 2.38<br>60.4    | 12.75<br>323.8 | 14.75<br>374.6 | 15.00<br>381.0                   | 16                | 1.25<br>31.7   | 17.75<br>450.8 | 136<br>61.8      | 110.0<br>49.8    | 111.0<br>50.4    | 174.0<br>78.8      |                  | 110.00<br>49.80   |
| 2.50<br>63.5    | 14.00<br>355.6 | 16.75<br>425.4 | 16.25<br>412.7                   | 20                | 1.25<br>31.7   | 20.25<br>514.3 | 189<br>85.8      | 154.0<br>69.9    | 156.0<br>70.9    | 231.0<br>105.0     |                  | 154.00<br>69.9    |
| 2.69<br>68.3    | 16.00<br>406.4 | 19.00<br>482.6 | 18.50<br>469.9                   | 20                | 1.38<br>35.0   | 22.5<br>571.5  | 234<br>106       | 194.0<br>88.1    | 197.0<br>89.5    | 302.0<br>137.0     |                  | 194.00<br>88.10   |
| 2.75<br>69.8    | 18.00<br>457.2 | 21.00<br>533.4 | 21.00<br>533.4                   | 24                | 1.38<br>35.0   | 24.75<br>628.6 | 289<br>131       | 240.0<br>109.0   | 245.0<br>111.0   | 386.0<br>175.0     |                  | 240.0<br>109.0    |
| 2.88<br>73.1    | 20.00<br>508   | 23.12<br>587.2 | 23.00<br>584.2                   | 24                | 1.38<br>35.0   | 27.00<br>685.8 | 348<br>158       | 295.0<br>134.0   | 302.0<br>137.0   | 487.0<br>221.0     |                  | 295.0<br>134.0    |
| 3.25<br>82.5    | 24.00<br>609.6 | 27.62<br>701.5 | 27.25<br>692.1                   | 24                | 1.62<br>41.1   | 32.00<br>812.8 | 507<br>230       | 443.0<br>201.0   | 449.0<br>204.0   | 747.0<br>339.0     |                  | 443.0<br>201.0    |



# Flanges 400 lb/sq.in.

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| Pipe      |                | Flange         |          |                |                |                                    |          |              |              |               |               |               |
|-----------|----------------|----------------|----------|----------------|----------------|------------------------------------|----------|--------------|--------------|---------------|---------------|---------------|
| Nom. Size | O.D. in. mm    | D in. mm       | J in. mm | J1 in. mm      | J2 in. mm      | J3 in. mm                          | p in. mm | r in. mm     | b in. mm     | h in. mm      | h1 in. mm     | h2 in. mm     |
| 1/2"      | 0.84<br>21.3   |                |          |                |                |                                    |          |              |              |               |               |               |
| 3/4"      | 1.05<br>26.7   |                |          |                |                |                                    |          |              |              |               |               |               |
| 1"        | 1.315<br>33.4  |                |          |                |                |                                    |          |              |              |               |               |               |
| 1 1/4"    | 1.66<br>42.2   |                |          |                |                | USE 600LB DIMENSIONS FOR THE SIZES |          |              |              |               |               |               |
| 1 1/2"    | 1.90<br>48.3   |                |          |                |                |                                    |          |              |              |               |               |               |
| 2"        | 2.375<br>60.3  |                |          |                |                |                                    |          |              |              |               |               |               |
| 2 1/2"    | 2.875<br>73.0  |                |          |                |                |                                    |          |              |              |               |               |               |
| 3"        | 3.50<br>88.9   |                |          |                |                |                                    |          |              |              |               |               |               |
| 3 1/2"    | 4.00<br>101.6  |                |          |                |                |                                    |          |              |              |               |               |               |
| 4"        | 4.50<br>114.3  | 10.00<br>254.0 |          | 4.57<br>116.1  | 4.60<br>116.8  | 4.63<br>117.6                      |          | 0.44<br>11.2 | 1.38<br>35.1 | 3.50<br>88.9  | 2.00<br>50.8  | 2.00<br>50.8  |
| 5"        | 5.563<br>141.3 | 11.00<br>279.4 |          | 5.66<br>143.8  | 5.69<br>144.5  | 5.69<br>144.5                      |          | 0.44<br>11.2 | 1.50<br>38.1 | 4.00<br>101.6 | 2.12<br>53.8  | 2.12<br>53.8  |
| 6"        | 6.625<br>168.3 | 12.50<br>317.5 |          | 6.72<br>170.7  | 6.75<br>171.5  | 6.75<br>171.5                      |          | 0.50<br>12.7 | 1.62<br>41.1 | 4.06<br>103.1 | 2.25<br>57.2  | 2.25<br>57.2  |
| 8"        | 8.625<br>219.1 | 15.00<br>381.0 |          | 8.72<br>221.5  | 8.75<br>222.3  | 8.75<br>222.3                      |          | 0.50<br>12.7 | 1.88<br>47.8 | 4.62<br>117.3 | 2.69<br>68.3  | 2.69<br>68.3  |
| 10"       | 10.75<br>273   | 17.50<br>444.5 |          | 10.88<br>276.4 | 10.92<br>277.4 | 10.88<br>276.4                     |          | 0.50<br>12.7 | 2.12<br>53.8 | 4.88<br>124.0 | 2.88<br>73.2  | 4.00<br>101.6 |
| 12"       | 12.75<br>323.8 | 20.50<br>520.7 |          | 12.88<br>327.2 | 12.92<br>328.2 | 12.94<br>328.7                     |          | 0.50<br>12.7 | 2.25<br>57.2 | 5.38<br>136.7 | 3.12<br>79.2  | 4.25<br>108.0 |
| 14"       | 14.0<br>355.6  | 23.00<br>584.2 |          | 14.14<br>359.2 | 14.18<br>360.2 | 14.19<br>360.4                     |          | 0.50<br>12.7 | 2.38<br>60.5 | 5.88<br>149.4 | 3.31<br>84.1  | 4.62<br>117.3 |
| 16"       | 16.0<br>406.4  | 25.50<br>647.7 |          | 16.16<br>410.5 | 16.19<br>411.2 | 16.19<br>411.2                     |          | 0.50<br>12.7 | 2.50<br>63.5 | 6.00<br>152.4 | 3.69<br>93.7  | 5.00<br>127.0 |
| 18"       | 18.0<br>457.2  | 28.00<br>711.2 |          | 18.18<br>461.8 | 18.2<br>462.3  | 18.19<br>462.0                     |          | 0.50<br>12.7 | 2.62<br>66.5 | 6.50<br>165.1 | 3.88<br>98.6  | 5.38<br>136.7 |
| 20"       | 20.0<br>508.0  | 30.50<br>774.7 |          | 20.20<br>513.1 | 20.25<br>514.4 | 20.19<br>512.8                     |          | 0.50<br>12.7 | 2.75<br>69.9 | 6.62<br>168.1 | 4.00<br>101.6 | 5.75<br>146.1 |
| 24"       | 24.0<br>609.6  | 36.00<br>914.4 |          | 24.25<br>616.0 | 24.25<br>616.0 | 24.19<br>614.4                     |          | 0.50<br>12.7 | 3.00<br>76.2 | 6.88<br>174.8 | 4.50<br>114.3 | 6.25<br>158.8 |

Note: Socket weld flanges are not available in this pressure rating.

# Flanges 400 lb/sq.in.

ANSI B16-5



LAP JOINT

BLIND

SOCKET WELD

THREADED

|                | Hub            |                | Raised Face    | Drilling Template |                |                | Approx Weight    |                  |                  |                    |                  |                   |
|----------------|----------------|----------------|----------------|-------------------|----------------|----------------|------------------|------------------|------------------|--------------------|------------------|-------------------|
| h<br>in.<br>mm | a<br>in.<br>mm | m<br>in.<br>mm | g<br>in.<br>mm | Num<br>ber        | l<br>in.<br>mm | k<br>in.<br>mm | W/N<br>lbs<br>kg | S/O<br>lbs<br>kg | L/J<br>lbs<br>kg | Blind<br>lbs<br>kg | S/W<br>lbs<br>kg | Thrd<br>lbs<br>kg |
|                |                |                |                |                   |                |                |                  |                  |                  |                    |                  |                   |
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|                |                |                |                |                   |                |                |                  |                  |                  |                    |                  |                   |
|                |                |                |                |                   |                |                |                  |                  |                  |                    |                  |                   |
|                |                |                |                |                   |                |                |                  |                  |                  |                    |                  |                   |
|                |                |                |                |                   |                |                |                  |                  |                  |                    |                  |                   |
|                |                |                |                |                   |                |                |                  |                  |                  |                    |                  |                   |
|                |                |                |                |                   |                |                |                  |                  |                  |                    |                  |                   |
|                |                |                |                |                   |                |                |                  |                  |                  |                    |                  |                   |
|                |                |                |                |                   |                |                |                  |                  |                  |                    |                  |                   |
|                |                |                |                |                   |                |                |                  |                  |                  |                    |                  |                   |
|                |                |                |                |                   |                |                |                  |                  |                  |                    |                  |                   |
|                |                |                |                |                   |                |                |                  |                  |                  |                    |                  |                   |
|                |                |                |                |                   |                |                |                  |                  |                  |                    |                  |                   |
|                |                |                |                |                   |                |                |                  |                  |                  |                    |                  |                   |
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|                |                |                |                |                   |                |                |                  |                  |                  | </                 |                  |                   |

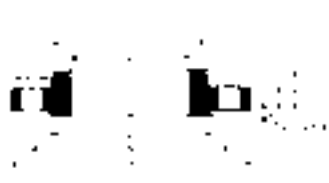


# Flanges 600 lb/sq.in.

ANSI B 16-5



WELDING NECK



SLIP-ON

| Pipe      |                | Flange         |                                                                                                         |                |                |                |               |              |               |               |               |               |
|-----------|----------------|----------------|---------------------------------------------------------------------------------------------------------|----------------|----------------|----------------|---------------|--------------|---------------|---------------|---------------|---------------|
| Nom. Size | O.D. in. mm    | D in. mm       | J in. mm                                                                                                | J1 in. mm      | J2 in. mm      | J3 in. mm      | p in. mm      | r in. mm     | b in. mm      | h in. mm      | h1 in. mm     | h in. mm      |
| 1/2"      | 0.84<br>21.3   | 3.75<br>95.3   | *1 = Refer to ANSI B36-10 / B36-19 or as specified by purchaser (Bitte horizontal einfügen in Spalte J) | 0.88<br>22.4   | 0.90<br>22.9   | 0.93<br>23.6   | 0.38<br>9.60  | 0.12<br>3.0  | 0.56<br>14.2  | 2.06<br>52.3  | 0.88<br>22.4  | 0.88<br>22.4  |
| 3/4"      | 1.05<br>26.7   | 4.62<br>117.3  |                                                                                                         | 1.09<br>27.7   | 1.11<br>28.2   | 1.14<br>29.0   | 0.44<br>11.11 | 0.12<br>3.0  | 0.62<br>15.7  | 2.25<br>57.2  | 1.00<br>25.4  | 1.00<br>25.4  |
| 1"        | 1.315<br>33.4  | 4.88<br>124.0  |                                                                                                         | 1.36<br>34.5   | 1.38<br>35.1   | 1.41<br>35.8   | 0.50<br>12.7  | 0.12<br>3.0  | 0.69<br>17.5  | 2.44<br>62.0  | 1.06<br>26.9  | 1.06<br>26.9  |
| 1 1/4"    | 1.66<br>42.2   | 5.25<br>133.4  |                                                                                                         | 1.70<br>43.2   | 1.72<br>43.7   | 1.75<br>44.5   | 0.56<br>14.2  | 0.19<br>4.8  | 0.81<br>20.6  | 2.62<br>66.5  | 1.12<br>28.4  | 1.12<br>28.4  |
| 1 1/2"    | 1.90<br>48.3   | 6.12<br>155.4  |                                                                                                         | 1.95<br>49.5   | 1.97<br>50.0   | 1.99<br>50.5   | 0.62<br>15.7  | 0.25<br>6.4  | 0.88<br>22.4  | 2.75<br>69.9  | 1.25<br>31.8  | 1.25<br>31.8  |
| 2"        | 2.375<br>60.3  | 6.50<br>165.1  |                                                                                                         | 2.44<br>62.0   | 2.46<br>62.5   | 2.50<br>63.5   | 0.69<br>17.5  | 0.31<br>7.9  | 1.00<br>25.4  | 2.88<br>73.2  | 1.44<br>36.6  | 1.44<br>36.6  |
| 2 1/2"    | 2.875<br>73.0  | 7.50<br>190.5  |                                                                                                         | 2.94<br>74.7   | 2.97<br>75.4   | 3.00<br>76.2   | 0.75<br>19.0  | 0.31<br>7.9  | 1.12<br>28.4  | 3.12<br>79.2  | 1.62<br>41.1  | 1.62<br>41.1  |
| 3"        | 3.50<br>88.9   | 8.25<br>209.6  |                                                                                                         | 3.57<br>90.7   | 3.60<br>91.4   | 3.63<br>92.2   | 0.81<br>20.6  | 0.38<br>9.7  | 1.25<br>31.8  | 3.25<br>82.6  | 1.81<br>46.0  | 1.81<br>46.0  |
| 3 1/2"    | 4.00<br>101.6  | 9.00<br>228.6  |                                                                                                         | 4.07<br>103.4  | 4.10<br>104.1  | 4.13<br>104.9  |               | 0.38<br>9.7  | 1.38<br>35.1  | 3.38<br>85.9  | 1.94<br>49.3  | 1.94<br>49.3  |
| 4"        | 4.50<br>114.3  | 10.75<br>273.1 |                                                                                                         | 4.57<br>116.1  | 4.60<br>116.8  | 4.63<br>117.6  |               | 0.44<br>11.2 | 1.50<br>38.1  | 4.00<br>101.6 | 2.12<br>53.8  | 2.12<br>53.8  |
| 5"        | 5.563<br>141.3 | 13.00<br>330.2 |                                                                                                         | 5.66<br>143.8  | 5.69<br>144.5  | 5.69<br>144.5  |               | 0.44<br>11.2 | 1.75<br>44.5  | 4.50<br>114.3 | 2.38<br>60.5  | 2.38<br>60.5  |
| 6"        | 6.625<br>168.3 | 14.00<br>355.6 |                                                                                                         | 6.72<br>170.7  | 6.75<br>171.5  | 6.75<br>171.5  |               | 0.50<br>12.7 | 1.88<br>47.8  | 4.62<br>117.3 | 2.62<br>66.5  | 2.62<br>66.5  |
| 8"        | 8.625<br>219.1 | 16.50<br>419.1 |                                                                                                         | 8.72<br>221.8  | 8.75<br>222.3  | 8.75<br>222.3  |               | 0.50<br>12.7 | 2.19<br>55.6  | 5.25<br>133.4 | 3.00<br>76.2  | 3.00<br>76.2  |
| 10"       | 10.75<br>273   | 20.00<br>508.0 |                                                                                                         | 10.88<br>276.4 | 10.92<br>277.4 | 10.88<br>276.4 |               | 0.50<br>12.7 | 2.50<br>63.5  | 6.00<br>152.4 | 3.38<br>85.9  | 4.38<br>111.3 |
| 12"       | 12.75<br>323.8 | 22.00<br>558.8 |                                                                                                         | 12.88<br>327.2 | 12.92<br>328.2 | 12.94<br>328.7 |               | 0.50<br>12.7 | 2.62<br>66.5  | 6.12<br>155.4 | 3.62<br>91.9  | 4.62<br>117.3 |
| 14"       | 14.0<br>355.6  | 23.75<br>603.3 |                                                                                                         | 14.14<br>359.2 | 14.18<br>360.2 | 14.19<br>360.4 |               | 0.50<br>12.7 | 2.75<br>69.9  | 6.50<br>165.1 | 3.69<br>93.7  | 5.00<br>127.0 |
| 16"       | 16.0<br>406.4  | 27.00<br>685.8 |                                                                                                         | 16.16<br>410.5 | 16.19<br>411.2 | 16.19<br>411.2 |               | 0.50<br>12.7 | 3.00<br>76.2  | 7.00<br>177.8 | 4.19<br>106.4 | 5.50<br>139.7 |
| 18"       | 18.0<br>457.2  | 29.25<br>743.0 |                                                                                                         | 18.18<br>461.8 | 18.20<br>462.3 | 18.19<br>462.0 |               | 0.50<br>12.7 | 3.25<br>82.6  | 7.25<br>184.2 | 4.62<br>117.3 | 6.00<br>152.4 |
| 20"       | 20.0<br>508.0  | 32.00<br>812.8 |                                                                                                         | 20.20<br>513.1 | 20.25<br>514.4 | 20.19<br>512.8 |               | 0.50<br>12.7 | 3.50<br>88.9  | 7.50<br>190.5 | 5.00<br>127.0 | 6.50<br>165.1 |
| 24"       | 24.0<br>609.6  | 37.00<br>939.8 |                                                                                                         | 24.25<br>616.0 | 24.25<br>616.0 | 24.19<br>614.4 |               | 0.50<br>12.7 | 4.00<br>101.6 | 8.00<br>203.2 | 5.50<br>139.7 | 7.25<br>184.2 |

Note: Socket weld flanges up to 3" in this pressure rating

# Flanges 600 lb/sq.in.

ANSI B 16-5



LAP JOINT

BLIND

SOCKET WELD

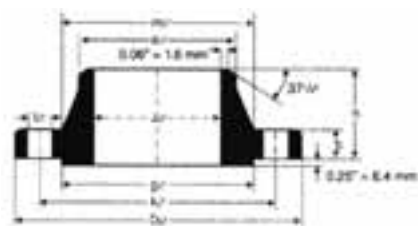
THREADED

| Hub            |                |                | Raised Face    | Drilling Template |                |                | Approx. Weight   |                  |                  |                    |                  |                   |
|----------------|----------------|----------------|----------------|-------------------|----------------|----------------|------------------|------------------|------------------|--------------------|------------------|-------------------|
| h<br>in.<br>mm | a<br>in.<br>mm | m<br>in.<br>mm |                | Num-<br>ber       | l<br>in.<br>mm | k<br>in.<br>mm | W/N<br>lbs<br>kg | S/O<br>lbs<br>kg | L/J<br>lbs<br>kg | Blind<br>lbs<br>kg | S/W<br>lbs<br>kg | Thrd<br>lbs<br>kg |
| 0.62<br>15.7   | 0.84<br>21.3   | 1.50<br>38.1   | 1.38<br>35.1   | 4                 | 0.62<br>15.7   | 2.62<br>66.5   | 1.9<br>0.87      | 1.6<br>0.74      | 1.6<br>0.72      | 1.7<br>0.76        | 1.7<br>0.76      | 1.6<br>0.74       |
| 0.62<br>15.7   | 1.05<br>26.7   | 1.88<br>47.8   | 1.69<br>42.9   | 4                 | 0.75<br>19.1   | 3.25<br>82.6   | 3.2<br>1.45      | 2.8<br>1.27      | 2.8<br>1.25      | 2.8<br>1.28        | 2.8<br>1.29      | 2.8<br>1.27       |
| 0.69<br>17.5   | 1.32<br>33.5   | 2.12<br>53.8   | 2.00<br>50.8   | 4                 | 0.75<br>19.1   | 3.50<br>88.9   | 3.9<br>1.76      | 3.3<br>1.52      | 3.3<br>1.50      | 3.5<br>1.60        | 3.4<br>1.55      | 3.3<br>1.52       |
| 0.81<br>20.6   | 1.66<br>42.2   | 2.50<br>63.5   | 2.50<br>63.5   | 4                 | 0.75<br>19.1   | 3.88<br>98.6   | 5.5<br>2.49      | 4.5<br>2.03      | 4.4<br>2.00      | 4.9<br>2.23        | 4.5<br>2.06      | 4.5<br>2.03       |
| 0.88<br>22.4   | 1.90<br>48.3   | 2.75<br>69.9   | 2.88<br>73.2   | 4                 | 0.88<br>22.4   | 4.50<br>114.3  | 7.7<br>3.49      | 6.5<br>2.96      | 6.4<br>2.92      | 7.2<br>3.25        | 6.60<br>3.00     | 6.5<br>2.96       |
| 1.12<br>28.4   | 2.38<br>60.5   | 3.31<br>84.1   | 3.62<br>91.9   | 8                 | 0.75<br>19.1   | 5.00<br>127.0  | 9.6<br>4.36      | 8.0<br>3.62      | 7.8<br>3.55      | 9.1<br>4.15        | 8.1<br>3.67      | 8.0<br>3.62       |
| 1.25<br>31.8   | 2.88<br>73.2   | 3.94<br>100.1  | 4.12<br>104.6  | 8                 | 0.88<br>22.4   | 5.88<br>149.4  | 14.2<br>6.43     | 11.6<br>5.28     | 11.5<br>5.23     | 13.5<br>6.13       | 11.8<br>5.35     | 11.6<br>5.28      |
| 1.38<br>35.1   | 3.50<br>88.9   | 4.62<br>117.3  | 5.00<br>127.0  | 8                 | 0.88<br>22.4   | 6.60<br>168.1  | 18.8<br>8.53     | 15.4<br>7.00     | 15.3<br>6.95     | 18.6<br>8.44       | 15.6<br>7.06     | 15.4<br>7.00      |
| 1.56<br>39.6   | 4.00<br>101.6  | 5.25<br>133.4  | 5.50<br>139.7  | 8                 | 1.00<br>25.4   | 7.25<br>184.2  | 23.6<br>10.7     | 19.5<br>8.84     | 19.3<br>8.78     | 24.2<br>11.0       |                  | 19.5<br>8.84      |
| 1.62<br>41.1   | 4.50<br>114.3  | 6.00<br>152.4  | 6.19<br>157.2  | 8                 | 1.00<br>25.4   | 8.50<br>215.9  | 38.3<br>17.4     | 31.9<br>14.5     | 31.7<br>14.4     | 38.1<br>17.3       |                  | 31.9<br>14.5      |
| 1.88<br>47.8   | 5.56<br>141.2  | 7.44<br>189.0  | 7.31<br>185.7  | 8                 | 1.12<br>28.4   | 10.50<br>266.7 | 64.3<br>29.2     | 53.7<br>24.4     | 53.5<br>24.3     | 64.8<br>29.4       |                  | 53.7<br>24.4      |
| 2.00<br>50.8   | 6.63<br>168.4  | 8.75<br>222.3  | 8.50<br>215.9  | 12                | 1.12<br>28.4   | 11.50<br>292.1 | 76.9<br>34.9     | 63.2<br>28.7     | 62.8<br>28.5     | 79.5<br>36.1       |                  | 63.2<br>28.7      |
| 2.25<br>57.2   | 8.63<br>219.2  | 10.75<br>273.1 | 10.62<br>269.7 | 12                | 1.25<br>31.8   | 13.75<br>349.3 | 119<br>53.9      | 95.6<br>43.4     | 94.9<br>43.1     | 130<br>58.9        |                  | 95.6<br>43.4      |
| 2.56<br>65.0   | 10.75<br>273.1 | 13.50<br>342.9 | 12.75<br>323.9 | 16                | 1.38<br>35.1   | 17.00<br>431.8 | 191<br>86.5      | 155<br>70.3      | 155<br>70.5      | 215<br>97.5        |                  | 155<br>70.3       |
| 2.75<br>69.9   | 12.75<br>323.9 | 15.75<br>400.1 | 15.00<br>381.0 | 20                | 1.38<br>35.1   | 19.25<br>489.0 | 227<br>103       | 186<br>84.2      | 190<br>86.1      | 273<br>124         |                  | 186<br>84.2       |
| 2.88<br>73.2   | 14.00<br>355.6 | 17.00<br>431.8 | 16.25<br>412.8 | 20                | 1.50<br>38.1   | 20.75<br>527.1 | 269<br>122       | 217<br>98.7      | 220<br>100       | 333<br>151         |                  | 217<br>98.7       |
| 3.06<br>77.7   | 16.00<br>406.4 | 19.50<br>495.3 | 18.50<br>469.9 | 20                | 1.62<br>41.1   | 23.75<br>603.3 | 374<br>170       | 313<br>142       | 319<br>145       | 471<br>214         |                  | 313<br>142        |
| 3.12<br>79.2   | 18.00<br>457.2 | 21.50<br>546.1 | 21.00<br>533.4 | 20                | 1.75<br>44.5   | 25.75<br>654.1 | 449<br>204       | 381<br>173       | 390<br>177       | 599<br>272         |                  | 381<br>173        |
| 3.25<br>82.6   | 20.00<br>508.0 | 24.00<br>609.6 | 23.00<br>584.2 | 24                | 1.75<br>44.5   | 28.50<br>723.9 | 560<br>254       | 485<br>220       | 496<br>225       | 769<br>349         |                  | 485<br>220        |
| 3.62<br>91.9   | 24.00<br>609.6 | 28.25<br>717.6 | 27.25<br>692.2 | 24                | 2.00<br>50.8   | 33.00<br>838.2 | 789<br>358       | 687<br>312       | 700<br>318       | 1174<br>533        |                  | 687<br>312        |

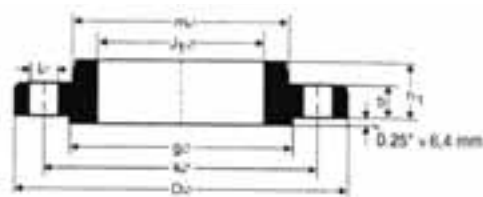


# Flanges 900 lb/sq.in.

ANSI B16-5



WELDING NECK



SLIP-ON

| Pipe      |                | Flange          |          |                |                |                |          |              |               |                |               |                |
|-----------|----------------|-----------------|----------|----------------|----------------|----------------|----------|--------------|---------------|----------------|---------------|----------------|
| Nom. Size | OD in. mm      | D in. mm        | J in. mm | J1 in. mm      | J2 in. mm      | J3 in. mm      | p in. mm | r in. mm     | b in. mm      | h in. mm       | h1 in. mm     | h2 in. mm      |
| 1/2"      | 0.84<br>21.3   |                 |          |                |                |                |          |              |               |                |               |                |
| 3/4"      | 1.05<br>26.7   |                 |          |                |                |                |          |              |               |                |               |                |
| 1"        | 1.315<br>33.4  |                 |          |                |                |                |          |              |               |                |               |                |
| 1.1/4"    | 1.66<br>42.2   |                 |          |                |                |                |          |              |               |                |               |                |
| 1.1/2"    | 1.90<br>48.3   |                 |          |                |                |                |          |              |               |                |               |                |
| 2"        | 2.375<br>60.3  |                 |          |                |                |                |          |              |               |                |               |                |
| 2.1/2"    | 2.875<br>73.0  |                 |          |                |                |                |          |              |               |                |               |                |
| 3"        | 3.50<br>88.9   | 9.50<br>241.3   |          | 3.57<br>90.7   | 3.60<br>91.4   | 3.63<br>92.2   |          | 0.38<br>9.6  | 1.50<br>38.1  | 4.00<br>101.6  | 2.12<br>53.8  | 2.12<br>53.8   |
| 4"        | 4.50<br>114.3  | 11.50<br>292.1  |          | 4.57<br>116.1  | 4.66<br>116.8  | 4.63<br>117.6  |          | 0.44<br>11.1 | 1.75<br>44.4  | 4.50<br>114.3  | 2.75<br>69.8  | 2.75<br>69.8   |
| 5"        | 5.563<br>141.3 | 12.75<br>349.2  |          | 5.66<br>143.8  | 5.69<br>144.5  | 5.63<br>144.5  |          | 0.44<br>11.1 | 2.00<br>50.8  | 5.00<br>127.0  | 3.12<br>79.2  | 3.12<br>79.2   |
| 6"        | 6.625<br>168.3 | 15.00<br>381.0  |          | 6.72<br>170.7  | 6.75<br>171.4  | 6.75<br>171.4  |          | 0.50<br>12.7 | 2.19<br>55.6  | 5.50<br>139.7  | 3.38<br>85.8  | 3.38<br>85.8   |
| 8"        | 8.625<br>219.1 | 18.50<br>469.9  |          | 8.72<br>221.5  | 8.75<br>222.2  | 8.75<br>222.2  |          | 0.50<br>12.7 | 2.50<br>63.5  | 6.38<br>162.0  | 4.00<br>101.6 | 4.50<br>114.3  |
| 10"       | 10.75<br>273   | 21.50<br>546.1  |          | 10.88<br>276.3 | 10.92<br>277.4 | 10.88<br>276.3 |          | 0.50<br>12.7 | 2.75<br>69.8  | 7.25<br>184.1  | 4.25<br>107.9 | 5.00<br>127.0  |
| 12"       | 12.75<br>323.8 | 24.00<br>609.6  |          | 12.88<br>327.1 | 12.92<br>328.2 | 12.94<br>328.7 |          | 0.50<br>12.7 | 3.12<br>79.2  | 7.88<br>200.1  | 4.62<br>117.3 | 5.62<br>142.7  |
| 14"       | 14.0<br>355.6  | 25.25<br>641.3  |          | 14.14<br>359.1 | 14.18<br>360.2 | 14.19<br>360.4 |          | 0.50<br>12.7 | 3.38<br>85.8  | 8.38<br>212.8  | 5.12<br>130.0 | 6.12<br>155.4  |
| 16"       | 16.0<br>406.4  | 27.75<br>704.8  |          | 16.16<br>410.5 | 16.19<br>411.2 | 16.19<br>411.2 |          | 0.50<br>12.7 | 3.50<br>88.9  | 8.50<br>215.9  | 5.25<br>133.3 | 6.50<br>165.1  |
| 18"       | 18.0<br>457.2  | 31.00<br>787.4  |          | 18.18<br>461.8 | 18.20<br>462.3 | 18.19<br>462.0 |          | 0.50<br>12.7 | 4.00<br>101.6 | 9.00<br>228.6  | 6.00<br>152.4 | 7.50<br>190.5  |
| 20"       | 20.0<br>508.0  | 33.75<br>857.2  |          | 20.20<br>513.1 | 20.25<br>514.3 | 20.19<br>512.8 |          | 0.50<br>12.7 | 4.25<br>107.9 | 9.75<br>247.6  | 6.25<br>158.7 | 8.25<br>209.5  |
| 24"       | 24.0<br>609.6  | 41.00<br>1041.4 |          | 24.25<br>615.9 | 24.25<br>615.9 | 24.19<br>614.4 |          | 0.50<br>12.7 | 5.50<br>139.7 | 11.50<br>292.1 | 8.00<br>203.2 | 10.50<br>266.7 |

Refer to ANSI B36-10/ B36-19 or as specified by purchaser

USE 1500LB DIMENSIONS FOR THESE SIZES

Note: Socket weld flanges are not available in the pressure rating





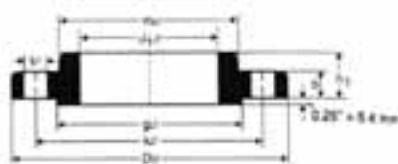


# Flanges 1500 lb/sq.in.

ANSI B16-5



WELDING NECK



SLIP-ON

| Pipe      |                | Flange          |                                                           |              |                |                |              |              |               |                |                |                |
|-----------|----------------|-----------------|-----------------------------------------------------------|--------------|----------------|----------------|--------------|--------------|---------------|----------------|----------------|----------------|
| Nom. Size | OD in. mm      | D in. mm        | J in. mm                                                  | J1 in. mm    | J2 in. mm      | J3 in. mm      | p in. mm     | r in. mm     | b in. mm      | h in. mm       | h1 in. mm      | h2 in. mm      |
| 1/2"      | 0.84<br>21.3   | 4.75<br>12.6    | Refer to ANSI B36-10/ B36-19 or as specified by purchaser | 0.88<br>22.3 | 0.90<br>22.9   | 0.93<br>23.6   | 0.38<br>9.6  | 0.12<br>3.0  | 0.88<br>22.3  | 2.38<br>60.4   | 1.25<br>31.7   | 1.25<br>31.7   |
| 3/4"      | 1.05<br>26.7   | 5.12<br>130.0   |                                                           | 1.09<br>27.7 | 1.11<br>28.2   | 1.14<br>29.0   | 0.44<br>11.1 | 0.12<br>3.0  | 1.00<br>25.4  | 2.75<br>69.8   | 1.38<br>35.0   | 1.38<br>35.0   |
| 1"        | 1.315<br>33.4  | 5.88<br>149.3   |                                                           | 1.36<br>34.5 | 1.38<br>35.0   | 1.41<br>35.8   | 0.50<br>12.7 | 0.12<br>3.0  | 1.12<br>28.4  | 2.88<br>73.1   | 1.62<br>41.1   | 1.62<br>41.1   |
| 1.1/4"    | 1.66<br>42.2   | 6.25<br>158.7   |                                                           | 1.70<br>43.2 | 1.72<br>43.7   | 1.75<br>44.4   | 0.56<br>14.2 | 0.19<br>4.8  | 1.12<br>28.4  | 2.88<br>73.1   | 1.62<br>41.1   | 1.62<br>41.1   |
| 1.1/2"    | 1.90<br>48.3   | 7.00<br>177.8   |                                                           | 1.95<br>49.5 | 1.97<br>50.0   | 1.99<br>50.5   | 0.62<br>15.7 | 0.25<br>6.4  | 1.25<br>31.7  | 3.25<br>82.5   | 1.75<br>44.5   | 1.75<br>44.5   |
| 2"        | 2.375<br>60.3  | 8.50<br>215.9   |                                                           | 2.44<br>62.0 | 2.46<br>62.5   | 2.50<br>63.5   | 0.69<br>17.5 | 0.31<br>7.8  | 1.50<br>38.1  | 4.00<br>101.6  | 2.25<br>57.1   | 2.25<br>57.1   |
| 2.1/2"    | 2.875<br>73.0  | 9.62<br>244.3   |                                                           | 2.94<br>74.7 | 2.97<br>75.4   | 3.00<br>76.2   | 0.75<br>19.0 | 0.31<br>7.8  | 1.62<br>41.1  | 4.12<br>104.6  | 2.50<br>63.5   | 2.50<br>63.5   |
| 3"        | 3.50<br>88.9   | 10.50<br>266.7  |                                                           |              | 3.60<br>91.4   | 3.63<br>92.2   |              | 0.38<br>9.6  | 1.88<br>47.7  | 4.62<br>117.3  | 2.88<br>73.15  | 2.88<br>73.15  |
| 4"        | 4.50<br>114.3  | 12.25<br>311.1  |                                                           |              | 4.60<br>116.8  | 4.63<br>117.6  |              | 0.44<br>11.1 | 2.12<br>53.8  | 4.88<br>123.9  | 3.56<br>90.42  | 3.56<br>90.42  |
| 5"        | 5.563<br>141.3 | 14.75<br>374.6  |                                                           |              | 5.69<br>144.5  | 5.69<br>144.5  |              | 0.44<br>11.1 | 2.88<br>73.1  | 6.12<br>155.4  | 4.12<br>104.65 | 4.12<br>104.65 |
| 6"        | 6.625<br>168.3 | 15.50<br>393.7  |                                                           |              | 6.75<br>171.4  | 6.75<br>171.4  |              | 0.50<br>12.7 | 3.25<br>82.5  | 6.75<br>171.4  | 4.69<br>119.13 | 4.69<br>119.13 |
| 8"        | 8.625<br>219.1 | 19.00<br>482.6  |                                                           |              | 8.75<br>222.2  | 8.75<br>222.2  |              | 0.50<br>12.7 | 3.62<br>91.9  | 8.38<br>212.8  | 5.62<br>142.75 | 5.62<br>142.75 |
| 10"       | 10.75<br>273   | 23.00<br>584.2  |                                                           |              | 10.92<br>277.4 | 10.88<br>276.3 |              | 0.50<br>12.7 | 4.25<br>107.9 | 10.00<br>254.0 | 6.25<br>158.75 | 7.00<br>177.8  |
| 12"       | 12.75<br>323.8 | 26.50<br>673.1  |                                                           |              | 12.92<br>328.2 | 12.94<br>328.7 |              | 0.50<br>12.7 | 4.88<br>123.9 | 11.12<br>282.4 | 7.12<br>180.85 | 8.62<br>218.9  |
| 14"       | 14.0<br>355.6  | 29.50<br>749.3  |                                                           |              | 14.8<br>360.2  |                |              | 0.50<br>12.7 | 5.25<br>133.3 | 11.75<br>298.4 |                | 9.50<br>241.3  |
| 16"       | 16.0<br>406.4  | 32.50<br>825.5  |                                                           |              | 16.19<br>411.2 |                |              | 0.50<br>12.7 | 5.75<br>146.0 | 12.25<br>311.1 |                | 10.25<br>260.3 |
| 18"       | 18.0<br>457.2  | 36.00<br>914.4  |                                                           |              | 18.20<br>462.3 |                |              | 0.50<br>12.7 | 6.38<br>162.0 | 12.88<br>327.1 |                | 10.88<br>276.3 |
| 20"       | 20.0<br>508.0  | 38.75<br>984.2  |                                                           |              | 20.25<br>514.3 |                |              | 0.50<br>12.7 | 7.00<br>177.8 | 14.00<br>355.6 |                | 11.50<br>292.1 |
| 24"       | 24.0<br>609.6  | 46.00<br>1168.4 |                                                           |              | 24.25<br>615.9 |                |              | 0.50<br>12.7 | 8.00<br>203.2 | 16.00<br>406.4 |                | 13.00<br>330.2 |

Note: Slip-on and socket weld flanges up to 2.1/2" in this pressure rating  
Threaded flanges up to 12" in this pressure rating

# Flanges 1500 lb/sq.in.

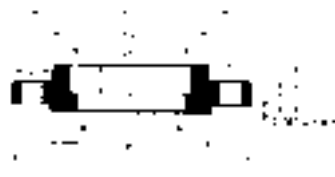
## ANSI B16-5



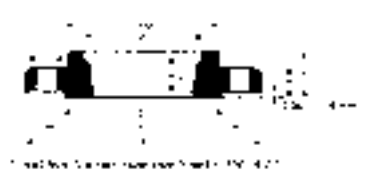
LAP JOINT



BLIND



SOCKET WELD



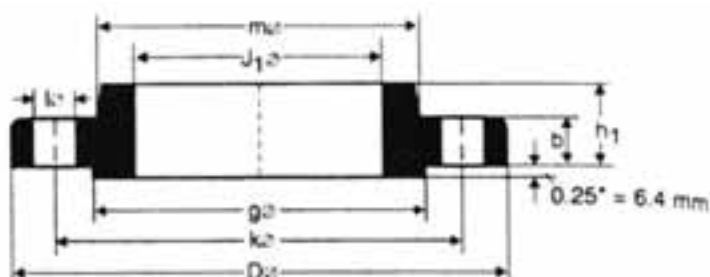
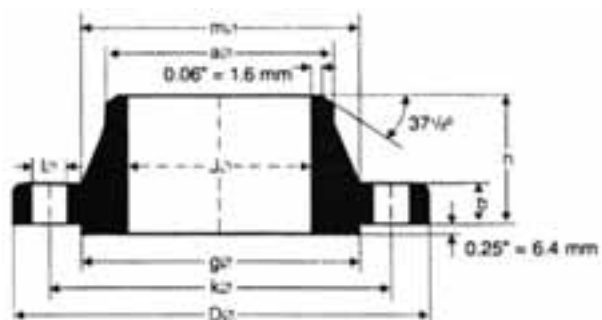
THREADED

| h3<br>in.<br>mm | Hub            |                | Raised<br>Face<br>g<br>in.<br>mm | Drilling Template |                |                | Approx.<br>Weight |                  |                  |                    |                  |                   |
|-----------------|----------------|----------------|----------------------------------|-------------------|----------------|----------------|-------------------|------------------|------------------|--------------------|------------------|-------------------|
|                 | a<br>in.<br>mm | m<br>in.<br>mm |                                  | Num-<br>ber       | l<br>in.<br>mm | k<br>in.<br>mm | W/N<br>lbs<br>kg  | S/O<br>lbs<br>kg | L/J<br>lbs<br>kg | Blind<br>lbs<br>kg | S/W<br>lbs<br>kg | Thrd<br>lbs<br>kg |
| 0.88<br>22.3    | 0.84<br>21.3   | 1.50<br>38.1   | 1.38<br>35.0                     | 4                 | 0.88<br>22.3   | 3.25<br>82.5   | 4.1<br>1.87       | 3.8<br>1.74      | 3.8<br>1.71      | 3.9<br>1.77        | 4.0<br>1.80      | 3.9<br>1.74       |
| 1.00<br>25.4    | 1.05<br>26.7   | 1.75<br>44.4   | 0.69<br>42.9                     | 4                 | 0.88<br>22.3   | 3.50<br>88.9   | 5.6<br>2.56       | 5.2<br>2.34      | 5.1<br>2.30      | 5.3<br>2.42        | 5.3<br>2.41      | 5.2<br>2.34       |
| 1.12<br>28.4    | 1.32<br>33.4   | 2.06<br>52.3   | 2.00<br>50.8                     | 4                 | 1.00<br>25.4   | 4.00<br>101.6  | 8.2<br>3.74       | 7.6<br>3.44      | 7.5<br>3.40      | 7.9<br>3.57        | 7.8<br>3.55      | 7.6<br>3.44       |
| 1.19<br>30.2    | 1.66<br>42.2   | 2.50<br>63.5   | 2.50<br>63.5                     | 4                 | 1.00<br>25.4   | 4.38<br>111.2  | 9.5<br>4.33       | 8.6<br>3.91      | 8.4<br>3.85      | 9.1<br>4.14        | 8.9<br>4.02      | 8.6<br>3.91       |
| 1.25<br>31.7    | 1.90<br>48.3   | 2.75<br>69.8   | 2.88<br>73.1                     | 4                 | 1.12<br>28.4   | 4.88<br>123.9  | 13.1<br>5.94      | 11.8<br>5.36     | 11.6<br>5.28     | 12.7<br>5.75       | 12.0<br>5.45     | 11.8<br>5.36      |
| 1.50<br>38.1    | 2.38<br>60.3   | 4.12<br>104.6  | 3.62<br>91.9                     | 8                 | 1.00<br>25.4   | 6.50<br>165.1  | 23.8<br>10.8      | 21.7<br>9.85     | 21.5<br>9.78     | 22.2<br>10.1       | 22.5<br>10.2     | 21.7<br>9.85      |
| 1.88<br>47.7    | 2.88<br>73.0   | 4.88<br>123.9  | 4.12<br>104.6                    | 8                 | 1.12<br>28.4   | 7.50<br>190.5  | 33.0<br>15.0      | 30.2<br>13.7     | 30.0<br>13.6     | 30.8<br>14.0       | 30.6<br>13.9     | 30.2<br>13.7      |
| 2.00<br>50.8    | 3.50<br>88.9   | 5.25<br>133.3  | 5.00<br>127.0                    | 8                 | 1.25<br>31.7   | 8.00<br>203.2  | 43.8<br>19.9      |                  | 39.2<br>17.8     | 42.1<br>19.1       |                  | 39.4<br>17.9      |
| 2.25<br>57.1    | 4.50<br>114    | 6.38<br>162.0  | 6.19<br>157.2                    | 8                 | 1.38<br>35.0   | 9.50<br>241.3  | 65.9<br>29.9      |                  | 60.6<br>27.5     | 65.9<br>29.9       |                  | 61.2<br>27.8      |
| 2.50<br>63.5    | 5.56<br>141.2  | 7.75<br>196.8  | 7.31<br>185.6                    | 8                 | 1.62<br>41.1   | 11.50<br>292.1 | 122<br>55.4       |                  | 113<br>51.5      | 129<br>58.4        |                  | 114<br>51.8       |
| 2.75<br>69.8    | 6.63<br>168.4  | 9.00<br>228.6  | 8.50<br>215.9                    | 12                | 1.50<br>38.1   | 12.50<br>317.5 | 151<br>68.4       |                  | 137<br>62.0      | 158<br>71.8        |                  | 134<br>61.0       |
| 3.00<br>76.2    | 8.63<br>219.2  | 11.50<br>292.1 | 10.62<br>269.7                   | 12                | 1.75<br>44.4   | 15.50<br>393.7 | 258<br>117        |                  | 231<br>105       | 269<br>122         |                  | 227<br>103        |
| 3.31<br>84.0    | 10.75<br>273   | 14.50<br>368.3 | 12.75<br>323.8                   | 12                | 2.00<br>50.8   | 19.00<br>482.6 | 427<br>194        |                  | 304<br>179       | 463<br>210         |                  | 386<br>175        |
| 3.62<br>91.9    | 12.75<br>323.8 | 17.75<br>450.8 | 15.00<br>381.0                   | 16                | 2.12<br>53.8   | 22.50<br>571.5 | 634<br>288        |                  | 593<br>269       | 696<br>316         |                  | 582<br>264        |
|                 | 14.00<br>355.6 | 19.50<br>495.3 | 16.25<br>412.7                   | 16                | 2.38<br>60.4   | 25.00<br>635.0 | 837<br>380        |                  | 804<br>365       | 925<br>420         |                  |                   |
|                 | 16.00<br>406.4 | 21.75<br>552.4 | 18.50<br>469.9                   | 16                | 2.62<br>66.5   | 27.75<br>704.8 | 1068<br>485       |                  | 1011<br>459      | 1229<br>558        |                  |                   |
|                 | 18.00<br>457.2 | 23.50<br>596.9 | 21.00<br>533.4                   | 16                | 2.88<br>73.1   | 30.50<br>774.7 | 1419<br>644       |                  | 1317<br>598      | 1674<br>760        |                  |                   |
|                 | 20.00<br>508   | 25.25<br>641.3 | 23.00<br>584.2                   | 16                | 3.12<br>79.2   | 32.75<br>831.8 | 1707<br>775       |                  | 1568<br>712      | 2126<br>965        |                  |                   |
|                 | 24.00<br>609.6 | 30.00<br>762.0 | 27.25<br>692.1                   | 16                | 3.62<br>91.9   | 39.00<br>990.6 | 2714<br>1232      |                  | 2401<br>1090     | 3432<br>1558       |                  |                   |



# Flanges 2500 lb/sq.in.

ANSI B16-5

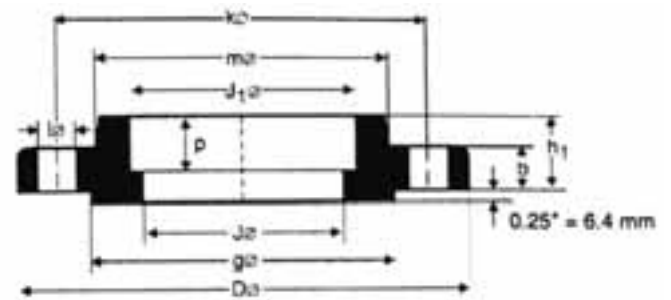
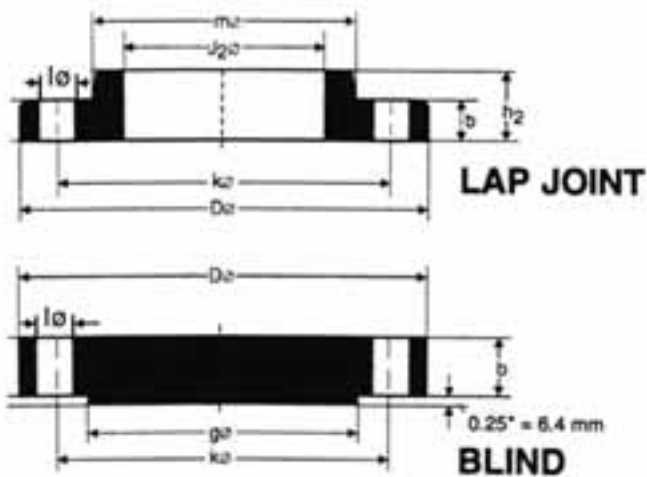


| Pipe      |                | Flange         |                                                           |           |                |                |          |              |               |                |                |                |
|-----------|----------------|----------------|-----------------------------------------------------------|-----------|----------------|----------------|----------|--------------|---------------|----------------|----------------|----------------|
| Nom. Size | OD in. mm      | D in. mm       | J in. mm *                                                | J1 in. mm | J2 in. mm      | J3 in. mm      | p in. mm | r in. mm     | b in. mm      | h in. mm       | h1 in. mm      | h2 in. mm      |
| 1/2"      | 0.84<br>21.3   | 5.25<br>133.4  | Refer to ANSI B36-10/ B36-19 or as specified by purchaser |           | 0.90<br>22.9   | 0.93<br>23.6   |          | 0.12<br>3.0  | 1.19<br>30.2  | 2.88<br>73.2   | 1.56<br>39.6   | 1.56<br>39.6   |
| 3/4"      | 1.05<br>26.7   | 5.50<br>139.7  |                                                           |           | 1.11<br>28.2   | 1.14<br>29.0   |          | 0.12<br>3.0  | 1.25<br>31.8  | 3.12<br>79.2   | 1.69<br>42.9   | 1.69<br>42.9   |
| 1"        | 1.315<br>33.4  | 6.25<br>158.8  |                                                           |           | 1.38<br>35.1   | 1.41<br>35.8   |          | 0.12<br>3.0  | 1.38<br>35.1  | 3.50<br>88.9   | 1.88<br>47.8   | 1.88<br>47.8   |
| 1 1/4"    | 1.66<br>42.2   | 7.25<br>184.2  |                                                           |           | 1.72<br>43.7   | 1.75<br>44.5   |          | 0.19<br>4.8  | 1.50<br>38.1  | 3.75<br>95.3   | 2.06<br>52.3   | 2.00<br>52.3   |
| 1 1/2"    | 1.90<br>48.3   | 8.00<br>203.2  |                                                           |           | 1.97<br>50.0   | 1.99<br>50.5   |          | 0.25<br>6.4  | 1.75<br>44.5  | 4.38<br>111.3  | 2.38<br>60.5   | 2.38<br>60.5   |
| 2"        | 2.375<br>60.3  | 9.25<br>235.0  |                                                           |           | 2.46<br>62.5   | 2.50<br>63.5   |          | 0.31<br>7.9  | 2.00<br>50.8  | 5.00<br>127.0  | 2.75<br>69.9   | 2.75<br>69.9   |
| 2 1/2"    | 2.875<br>73.0  | 10.50<br>266.7 |                                                           |           | 2.97<br>75.4   | 3.00<br>76.2   |          | 0.31<br>7.9  | 2.25<br>57.2  | 5.62<br>142.7  | 3.12<br>79.2   | 3.12<br>79.2   |
| 3"        | 3.50<br>88.9   | 12.00<br>304.8 |                                                           |           | 3.60<br>91.4   | 3.63<br>92.2   |          | 0.38<br>9.7  | 2.62<br>66.5  | 6.62<br>168.1  | 3.62<br>91.9   | 3.62<br>91.9   |
| 4"        | 4.50<br>114.3  | 14.00<br>355.6 |                                                           |           | 4.60<br>116.8  | 4.63<br>117.6  |          | 0.44<br>11.2 | 3.00<br>76.2  | 7.50<br>190.5  | 4.25<br>108.0  | 4.25<br>108.0  |
| 5"        | 5.563<br>141.3 | 16.50<br>419.1 |                                                           |           | 5.69<br>144.5  | 5.69<br>144.5  |          | 0.44<br>11.2 | 3.62<br>91.9  | 9.00<br>228.6  | 5.12<br>130.0  | 5.12<br>130.0  |
| 6"        | 6.625<br>168.3 | 19.00<br>482.6 |                                                           |           | 6.75<br>171.5  | 6.75<br>171.5  |          | 0.50<br>12.7 | 4.25<br>108.0 | 10.75<br>273.1 | 6.00<br>152.4  | 6.00<br>152.4  |
| 8"        | 8.625<br>219.1 | 21.75<br>552.5 |                                                           |           | 8.75<br>222.3  | 8.75<br>222.3  |          | 0.50<br>12.7 | 5.00<br>127.0 | 12.50<br>317.5 | 7.00<br>177.8  | 7.00<br>177.8  |
| 10"       | 10.75<br>273   | 26.50<br>673.1 |                                                           |           | 10.92<br>277.4 | 10.88<br>276.4 |          | 0.50<br>12.7 | 6.50<br>165.1 | 16.50<br>419.1 | 9.00<br>228.6  | 9.00<br>228.6  |
| 12"       | 12.75<br>323.8 | 30.00<br>762.0 |                                                           |           | 12.92<br>328.2 | 12.94<br>328.7 |          | 0.50<br>12.7 | 7.25<br>184.2 | 18.25<br>463.6 | 10.00<br>254.0 | 10.00<br>254.0 |

Note: Slip-on and Socket weld flanges are not available in this pressure rating.  
Weld necks, Lap joint, Blind and Threaded flanges up to 12" in this pressure rating.

# Flanges 2500 lb/sq.in.

ANSI B16-5



**SOCKET WELD**

| Hub             |                | Raised Face    |                | Drilling Template |                |                | Approx.          |                  | Weight           |                    |                  |                   |
|-----------------|----------------|----------------|----------------|-------------------|----------------|----------------|------------------|------------------|------------------|--------------------|------------------|-------------------|
| h3<br>in.<br>mm | a<br>in.<br>mm | m<br>in.<br>mm | g<br>in.<br>mm | Num-<br>ber       | l<br>in.<br>mm | k<br>in.<br>mm | W/N<br>lbs<br>kg | S/O<br>lbs<br>kg | L/J<br>lbs<br>kg | Blind<br>lbs<br>kg | S/W<br>lbs<br>kg | Thrd<br>lbs<br>kg |
| 1.12<br>28.4    | 0.84<br>21.3   | 1.69<br>42.9   | 1.38<br>35.1   | 4                 | 0.88<br>22.4   | 3.50<br>88.5   | 6.9<br>3.12      |                  | 6.4<br>2.92      | 6.6<br>2.99        |                  | 6.5<br>2.95       |
| 1.25<br>31.8    | 1.05<br>26.7   | 2.00<br>50.8   | 1.69<br>42.9   | 4                 | 0.88<br>22.4   | 3.75<br>95.3   | 8.1<br>3.70      |                  | 7.5<br>3.40      | 7.7<br>3.50        |                  | 7.6<br>3.44       |
| 1.38<br>35.1    | 1.32<br>33.5   | 2.25<br>57.2   | 2.00<br>50.8   | 4                 | 1.00<br>25.4   | 4.25<br>108.0  | 11.5<br>5.24     |                  | 10.5<br>4.77     | 10.9<br>4.96       |                  | 10.6<br>4.82      |
| 1.50<br>38.1    | 1.66<br>42.2   | 2.88<br>73.2   | 2.50<br>63.5   | 4                 | 1.12<br>28.4   | 5.12<br>130.0  | 17.0<br>7.74     |                  | 15.6<br>7.08     | 16.2<br>7.35       |                  | 15.7<br>7.14      |
| 1.75<br>44.5    | 1.90<br>48.3   | 3.12<br>79.2   | 2.88<br>73.2   | 4                 | 1.25<br>31.8   | 5.75<br>146.1  | 24.0<br>10.9     |                  | 21.9<br>9.93     | 22.9<br>10.4       |                  | 22.0<br>10.0      |
| 2.00<br>50.8    | 2.38<br>60.5   | 3.75<br>95.3   | 3.62<br>91.9   | 8                 | 1.12<br>28.4   | 6.75<br>171.5  | 35.7<br>16.2     |                  | 32.4<br>14.7     | 34.4<br>15.6       |                  | 32.6<br>14.8      |
| 2.25<br>57.2    | 2.88<br>73.2   | 4.50<br>114.3  | 4.12<br>104.6  | 8                 | 1.25<br>31.8   | 7.75<br>196.9  | 52.2<br>23.7     |                  | 46.9<br>21.3     | 49.8<br>22.6       |                  | 47.4<br>21.5      |
| 2.50<br>63.5    | 3.50<br>88.9   | 5.25<br>133.4  | 5.00<br>127.0  | 8                 | 1.38<br>35.1   | 9.00<br>228.6  | 79.7<br>36.2     |                  | 71.1<br>32.3     | 76.7<br>34.8       |                  | 71.8<br>32.6      |
| 2.75<br>69.9    | 4.50<br>114.3  | 6.50<br>165.1  | 6.19<br>157.2  | 8                 | 1.62<br>41.1   | 10.75<br>273.1 | 122<br>55.3      |                  | 116<br>52.5      | 119<br>53.9        |                  | 117<br>52.9       |
| 3.00<br>76.2    | 5.56<br>141.2  | 8.00<br>203.2  | 7.31<br>185.7  | 8                 | 1.88<br>47.8   | 12.75<br>323.9 | 204<br>92.5      |                  | 182<br>82.6      | 200<br>90.8        |                  | 183<br>83.1       |
| 3.25<br>82.6    | 6.63<br>168.4  | 9.25<br>235.0  | 8.50<br>215.9  | 8                 | 2.12<br>53.8   | 14.50<br>368.3 | 315<br>143       |                  | 280<br>127       | 311<br>141         |                  | 282<br>128        |
| 3.75<br>95.3    | 8.63<br>219.2  | 12.00<br>304.8 | 10.62<br>269.7 | 12                | 2.12<br>53.8   | 17.25<br>438.2 | 474<br>215       |                  | 410<br>186       | 471<br>214         |                  | 414<br>188        |
| 4.25<br>108.0   | 10.75<br>273.1 | 14.75<br>374.7 | 12.75<br>323.9 | 12                | 2.62<br>66.5   | 21.25<br>539.8 | 894<br>406       |                  | 775<br>352       | 905<br>411         |                  | 782<br>355        |
| 4.75<br>120.7   | 12.75<br>323.9 | 17.38<br>441.5 | 15.00<br>381.0 | 12                | 2.88<br>73.2   | 24.38<br>619.3 | 1260<br>572      |                  | 1104<br>501      | 1304<br>592        |                  | 1110<br>504       |



# 150 lb/sq.in. Welding Neck Flanges

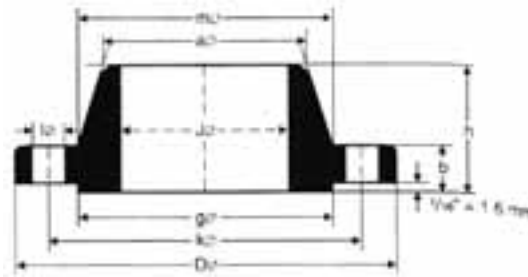
MSS SP-44



| Pipe      |                | Flange         |                              |                 |                  | Hub                          |                  | Raised Face    | Drilling Template |               |                | Appr. Weight                 |
|-----------|----------------|----------------|------------------------------|-----------------|------------------|------------------------------|------------------|----------------|-------------------|---------------|----------------|------------------------------|
| Nom. Size | OD in. mm      | D in. mm       | J in. mm                     | b in. mm        | h in. mm         | a in. mm                     | m in. mm         | g in. mm       | Number            | l in. mm      | k in. mm       | Pounds Kilo                  |
| 26"       | 26.0<br>660.4  | 34 _<br>869.9  | To be specified by purchaser | 2 11/16<br>68.3 | 4 _<br>120.6     | To be specified by purchaser | 26 5/8<br>676.3  | 29 _<br>749.3  | 24                | 1 3/8<br>34.9 | 31 _<br>806.4  | To be specified by purchaser |
| 28"       | 28.0<br>711.2  | 36 _<br>927.1  |                              | 2 11/16<br>71.4 | 4 15/16<br>125.4 |                              | 28 5/8<br>727.1  | 31 _<br>800.1  | 28                | 1 3/8<br>34.9 | 34 _<br>863.6  |                              |
| 30"       | 30.0<br>762.0  | 38 _<br>984.2  |                              | 2 15/16<br>74.6 | 5 3/8<br>136.5   |                              | 30 _<br>781.0    | 33 _<br>857.2  | 28                | 1 3/8<br>34.9 | 36 _<br>914.4  |                              |
| 32"       | 32.0<br>812.8  | 41 _<br>1060.4 |                              | 3 3/16<br>81.0  | 5 11/16<br>144.5 |                              | 32 _<br>831.8    | 36 _<br>914.4  | 28                | 1 5/8<br>41.3 | 38 _<br>977.9  |                              |
| 34"       | 34.0<br>863.6  | 43 _<br>1111.2 |                              | 3 _<br>82.5     | 5 7/8<br>149.2   |                              | 34 _<br>882.6    | 38 _<br>965.2  | 32                | 1 5/8<br>41.3 | 40 _<br>1028.7 |                              |
| 36"       | 36.0<br>914.4  | 46 _<br>1168.4 |                              | 3 9/16<br>90.5  | 6 3/16<br>157.2  |                              | 36 _<br>933.4    | 40 _<br>1022.3 | 32                | 1 5/8<br>41.3 | 42 _<br>1085.8 |                              |
| 38"       | 38.0<br>965.2  | 48 _<br>1238.2 |                              | 3 7/16<br>87.3  | 6 3/16<br>157.1  |                              | 39 _<br>990.6    | 42 _<br>1073.1 | 32                | 1 5/8<br>41.3 | 45 _<br>1149.3 |                              |
| 40"       | 40.0<br>1016.0 | 50 _<br>1289.0 |                              | 3 9/16<br>90.5  | 6 7/16<br>163.5  |                              | 41 _<br>1041.4   | 44 _<br>1123.9 | 36                | 1 5/8<br>41.3 | 47 _<br>1200.1 |                              |
| 42"       | 42.0<br>1066.8 | 53 _<br>1346.2 |                              | 3 13/16<br>96.8 | 6 _<br>171.4     |                              | 43 _<br>1092.2   | 47 _<br>1193.8 | 36                | 1 5/8<br>41.3 | 49 _<br>1257.3 |                              |
| 44"       | 44.0<br>1117.6 | 55 _<br>1403.3 |                              | 4 _<br>101.6    | 7 _<br>177.8     |                              | 45 _<br>1143.0   | 49 _<br>1244.6 | 40                | 1 5/8<br>41.3 | 51 _<br>1314.4 |                              |
| 46"       | 46.0<br>1168.4 | 57 _<br>1454.1 |                              | 4 1/16<br>103.1 | 7 5/16<br>185.7  |                              | 47 1/8<br>1196.9 | 51 _<br>1295.4 | 40                | 1 5/8<br>41.3 | 53 _<br>1365.2 |                              |
| 48"       | 48.0<br>1219.2 | 59 _<br>1511.3 |                              | 4 _<br>107.9    | 7 9/16<br>192.0  |                              | 49 1/8<br>1247.6 | 53 _<br>1358.9 | 44                | 1 5/8<br>41.3 | 56 _<br>1422.4 |                              |
| 50"       | 50.0<br>1270.0 | 61 _<br>1568.4 |                              | 4 3/8<br>111.1  | 8 _<br>203.2     |                              | 51 _<br>1301.7   | 55 _<br>1409.7 | 44                | 1 7/8<br>47.7 | 58 _<br>1479.5 |                              |
| 52"       | 52.0<br>1320.8 | 64 _<br>1625.6 |                              | 4 9/16<br>115.8 | 8 _<br>209.5     |                              | 53 _<br>1352.5   | 57 _<br>1460.5 | 44                | 1 7/8<br>47.7 | 60 _<br>1536.7 |                              |
| 54"       | 54.0<br>1371.6 | 66 _<br>1682.7 |                              | 4 _<br>120.6    | 8 _<br>215.9     |                              | 55 _<br>1403.3   | 59 _<br>1511.3 | 44                | 1 7/8<br>47.7 | 62 _<br>1593.8 |                              |
| 56"       | 56.0<br>1422.4 | 68 _<br>1746.2 |                              | 4 7/8<br>123.8  | 9 _<br>228.6     |                              | 57 3/8<br>1457.4 | 62 _<br>1574.8 | 48                | 1 7/8<br>47.7 | 65 _<br>1651.0 |                              |
| 58"       | 58.0<br>1473.2 | 71 _<br>1803.4 |                              | 5 1/16<br>128.5 | 9 _<br>234.9     |                              | 59 3/8<br>1508.2 | 64 _<br>1625.6 | 48                | 1 7/8<br>47.7 | 67 _<br>1708.1 |                              |
| 60"       | 60.0<br>1524.0 | 73 _<br>1854.2 |                              | 5 3/16<br>131.7 | 9 7/16<br>239.7  |                              | 61 3/8<br>1559.0 | 66 _<br>1676.4 | 52                | 1 7/8<br>47.7 | 69 _<br>1758.9 |                              |

# 300 lb/sq.in. Welding Neck Flanges

MSS SP-44



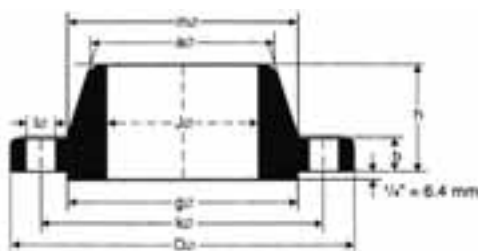
| Pipe      |                | Flange         |                              |                  |                  | Hub                          |                   | Raised Face    | Drilling Template |                |                | Appr. Weight                 |
|-----------|----------------|----------------|------------------------------|------------------|------------------|------------------------------|-------------------|----------------|-------------------|----------------|----------------|------------------------------|
| Nom. Size | OD in. mm      | D in. mm       | J in. mm*                    | b in. mm         | h in. mm         | a in. mm*                    | m in. mm          | g in. mm       | Number            | l in. mm       | k in. mm       | Pounds Kilo *                |
| 26"       | 26.0<br>660.4  | 38 _<br>971.5  | To be specified by purchaser | 3 1/8<br>79.4    | 7 _<br>184.1     | To be specified by purchaser | 28 3/8<br>720.7   | 29 _<br>749.3  | 28                | 1 _<br>44.3    | 34 _<br>876.3  | To be specified by purchaser |
| 28"       | 28.0<br>711.2  | 40 _<br>1035.0 |                              | 3 1/8<br>85.7    | 7 _<br>196.8     |                              | 30 _<br>774.7     | 31 _<br>800.0  | 28                | 1 _<br>44.4    | 37 _<br>939.8  |                              |
| 30"       | 30.0<br>762    | 43 _<br>1092.2 |                              | 3 5/8<br>92.1    | 8 _<br>209.5     |                              | 32 9/16<br>827.1  | 33 _<br>857.2  | 28                | 1 7/8<br>47.6  | 39 _<br>996.9  |                              |
| 32"       | 32.0<br>812.8  | 45 _<br>1149.3 |                              | 3 7/8<br>98.4    | 8 _<br>222.2     |                              | 34 11/16<br>881.1 | 36 _<br>914.4  | 28                | 2 42 _<br>50.8 | 1054.1         |                              |
| 34"       | 34.0<br>863.6  | 47 _<br>1206.5 |                              | 4<br>101.6       | 9 1/8<br>231.8   |                              | 36 7/8<br>936.6   | 38 _<br>965.2  | 28                | 2 43 _<br>50.8 | 1104.9         |                              |
| 36"       | 36.0<br>914.4  | 50 _<br>1270.0 |                              | 4 1/8<br>104.8   | 9 _<br>241.3     |                              | 39 _<br>990.6     | 40 _<br>1022.3 | 32                | 2 1/8<br>54    | 46 _<br>1168.4 |                              |
| 38"       | 38.0<br>965.2  | 46 _<br>1168.4 |                              | 4 _<br>107.9     | 7 1/8<br>180.9   |                              | 39 1/8<br>993.7   | 40 _<br>1028.7 | 32                | 1 5/8<br>41.2  | 43 _<br>1092.2 |                              |
| 40"       | 40.0<br>1016.0 | 48 _<br>1238.2 |                              | 4 _<br>114.3     | 7 5/8<br>193.6   |                              | 41 _<br>1047.7    | 42 _<br>1085.8 | 32                | 1 _<br>44.4    | 45 _<br>1155.7 |                              |
| 42"       | 42.0<br>1066.8 | 50 _<br>1289.0 |                              | 4 11/16<br>119.1 | 7 7/8<br>200.1   |                              | 43 _<br>1098.5    | 44 _<br>1136.6 | 32                | 1 _<br>44.4    | 47 _<br>1206.5 |                              |
| 44"       | 44.0<br>1117.6 | 53 _<br>1352.5 |                              | 4 7/8<br>123.9   | 8 1/8<br>206.3   |                              | 45 _<br>1149.3    | 47 _<br>1193.8 | 32                | 1 7/8<br>47.6  | 49 _<br>1263.6 |                              |
| 46"       | 46.0<br>1168.4 | 55 _<br>1416.0 |                              | 5 1/16<br>128.5  | 8 _<br>215.9     |                              | 47 3/8<br>1203.4  | 49 _<br>1244.6 | 28                | 2 52<br>50.8   | 1320.8         |                              |
| 48"       | 48.0<br>1219.2 | 57 _<br>1466.8 |                              | 5 _<br>133.4     | 8 13/16<br>223.8 |                              | 49 3/8<br>1254.1  | 51 _<br>1301.7 | 32                | 2 54<br>50.8   | 1371.6         |                              |
| 50"       | 50.0<br>1270.0 | 60 _<br>1530.3 |                              | 5 _<br>139.7     | 9 1/8<br>231.7   |                              | 51 3/8<br>1304.9  | 53 _<br>1358.9 | 32                | 2 1/8<br>53.9  | 56 _<br>1428.7 |                              |
| 52"       | 52.0<br>1320.8 | 62 _<br>1581.1 |                              | 5 11/16<br>144.5 | 9 3/8<br>238.1   |                              | 53 3/8<br>1355.7  | 55 _<br>1409.7 | 32                | 2 1/8<br>53.9  | 58 _<br>1479.5 |                              |
| 54"       | 54.0<br>1371.6 | 65 _<br>1657.3 |                              | 6<br>152.4       | 9 15/16<br>252.4 |                              | 55 _<br>1409.7    | 57 _<br>1466.8 | 28                | 2 3/8<br>60.3  | 61 _<br>1549.4 |                              |
| 56"       | 56.0<br>1422.4 | 67 _<br>1708.1 |                              | 6 1/16<br>153.9  | 10 _<br>260.3    |                              | 57 5/8<br>1463.6  | 59 _<br>1517.6 | 28                | 2 3/8<br>60.3  | 63 _<br>1600.2 |                              |
| 58"       | 58.0<br>1473.2 | 69 _<br>1758.9 |                              | 6 _<br>158.7     | 10 _<br>266.7    |                              | 59 5/8<br>1514.4  | 62 _<br>1574.8 | 32                | 2 3/8<br>60.3  | 65 _<br>1651.0 |                              |
| 60"       | 60.0<br>1524.0 | 71 _<br>1809.7 |                              | 6 7/16<br>163.5  | 10 _<br>273.0    |                              | 61 5/8<br>1565.2  | 64 _<br>1625.6 | 32                | 2 3/8<br>60.3  | 67 _<br>1701.8 |                              |





# 400 lb/sq.in. Welding Neck Flanges

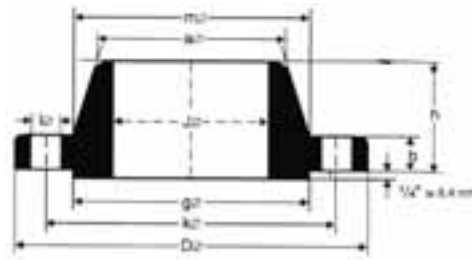
MSS SP-44



| Pipe      |                | Flange         |                              |                  |                  | Hub                          |                   | Raised Face      | Drilling Template |                |                | Appr. Weight                 |
|-----------|----------------|----------------|------------------------------|------------------|------------------|------------------------------|-------------------|------------------|-------------------|----------------|----------------|------------------------------|
| Nom. Size | OD in. mm      | D in. mm       | J in. mm                     | b in. mm         | h in. mm         | a in. mm                     | m in. mm          | g in. mm         | Number            | l in. mm       | k in. mm       | Pounds Kilo                  |
| 26"       | 26.0<br>660.4  | 38 _<br>971.5  | To be specified by purchaser | 3 _<br>88.9      | 7 5/8<br>193.7   | To be specified by purchaser | 28 5/8<br>727.1   | 29 _<br>749.3    | 28                | 1 7/8<br>47.6  | 34 _<br>846.3  | To be specified by purchaser |
| 28"       | 28.0<br>711.2  | 40 _<br>1035.0 |                              | 3 _<br>95.2      | 8 1/8<br>206.4   |                              | 30 13/16<br>782.6 | 31 _<br>800.1    | 28                | 2 3/7<br>50.8  | 939.8          |                              |
| 30"       | 30.0<br>762    | 43<br>1092.2   |                              | 4<br>101.6       | 8 5/8<br>219.1   |                              | 32 15/16<br>836.6 | 33 _<br>857.2    | 28                | 2 1/8<br>54.0  | 39 _<br>996.9  |                              |
| 32"       | 32.0<br>812.8  | 45 _<br>1149.3 |                              | 4 _<br>107.9     | 9 1/8<br>231.8   |                              | 35<br>889.0       | 36<br>914.4      | 28                | 2 1/8<br>54.0  | 41 _<br>1054.1 |                              |
| 34"       | 34.0<br>863.6  | 47 _<br>1206.5 |                              | 4 3/8<br>111.1   | 9 _<br>241.3     |                              | 37 3/16<br>944.6  | 38<br>965.2      | 28                | 2 1/8<br>54.0  | 43 _<br>1104.9 |                              |
| 36"       | 36.0<br>914.4  | 50<br>1270.0   |                              | 4 _<br>114.3     | 9 7/8<br>250.8   |                              | 39 1/8<br>1000.1  | 40 _<br>1022.3   | 32                | 2 1/8<br>54.0  | 46<br>1168.4   |                              |
| 38"       | 38.0<br>965.2  | 47 _<br>1206.5 |                              | 4 7/8<br>123.8   | 8 1/8<br>206.3   |                              | 39 _<br>1003.3    | 40 _<br>1035.0   | 32                | 1 7/8<br>47.6  | 44<br>1117.6   |                              |
| 40"       | 40.0<br>1016.0 | 50<br>1270.0   |                              | 5 1/8<br>130.1   | 8 _<br>215.9     |                              | 41 _<br>1054.1    | 43<br>1092.2     | 32                | 2 46 _<br>50.8 | 1174.7         |                              |
| 42"       | 42.0<br>1066.8 | 52<br>1320.8   |                              | 5 _<br>133.3     | 8 13/16<br>223.8 |                              | 43 5/8<br>1108.0  | 45<br>1143.0     | 32                | 2 48 _<br>50.8 | 1225.5         |                              |
| 44"       | 44.0<br>1117.6 | 54 _<br>1384.3 |                              | 5 _<br>139.7     | 9 3/16<br>233.3  |                              | 45 5/8<br>1158.8  | 47 _<br>1200.1   | 32                | 2 1/8<br>53.9  | 50 _<br>1282.7 |                              |
| 46"       | 46.0<br>1168.4 | 56 _<br>1441.4 |                              | 5 _<br>146.0     | 9 5/8<br>244.0   |                              | 47 _<br>1212.8    | 49 _<br>1257.3   | 36                | 2 1/8<br>53.9  | 52 _<br>1339.8 |                              |
| 48"       | 48.0<br>1219.2 | 59 _<br>1511.3 |                              | 6<br>152.4       | 10 1/8<br>257.1  |                              | 49 7/8<br>1266.8  | 51 _<br>1308.1   | 28                | 2 3/8<br>60.3  | 55 _<br>1403.3 |                              |
| 50"       | 50.0<br>1270.0 | 61 _<br>1568.4 |                              | 6 3/16<br>157.2  | 10 9/16<br>268.2 |                              | 52<br>1320.8      | 53 5/8<br>1362.0 | 32                | 2 3/8<br>60.3  | 57 _<br>1460.5 |                              |
| 52"       | 52.0<br>1320.8 | 63 _<br>1619.2 |                              | 6 3/8<br>161.9   | 10 7/8<br>276.2  |                              | 54<br>1371.6      | 55 5/8<br>1412.8 | 32                | 2 3/8<br>60.3  | 59 _<br>1511.3 |                              |
| 54"       | 54.0<br>1371.6 | 67<br>1701.8   |                              | 6 11/16<br>169.9 | 11 3/8<br>288.9  |                              | 56 1/8<br>1425.5  | 57 7/8<br>1470.0 | 28                | 2 5/8<br>66.6  | 62 _<br>1581.1 |                              |
| 56"       | 56.0<br>1422.4 | 69<br>1752.6   |                              | 6 7/8<br>174.6   | 11 _<br>298.4    |                              | 58 _<br>1479.5    | 60 1/8<br>1527.1 | 32                | 2 5/8<br>66.6  | 64 _<br>1631.9 |                              |
| 58"       | 58.0<br>1473.2 | 71<br>1803.4   |                              | 7<br>177.8       | 12 1/16<br>306.3 |                              | 60 _<br>1530.3    | 62 1/8<br>1577.9 | 32                | 2 5/8<br>66.6  | 66 _<br>1682.7 |                              |
| 60"       | 60.0<br>1524.0 | 74 _<br>1885.9 |                              | 7 5/16<br>185.7  | 12 9/16<br>319.0 |                              | 62 3/8<br>1584.3  | 64 3/8<br>1635.1 | 32                | 2 7/8<br>73.0  | 69<br>1752.6   |                              |

# 600 lb/sq.in. Welding Neck Flanges

MSS SP-44

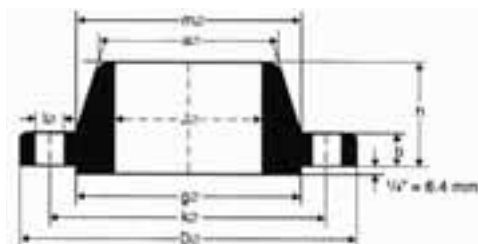


| Pipe      |                | Flange         |                              |                  |                   | Hub                          |                  | Raised Face     | Drilling Template |               |                | Appr. Weight                 |
|-----------|----------------|----------------|------------------------------|------------------|-------------------|------------------------------|------------------|-----------------|-------------------|---------------|----------------|------------------------------|
| Nom. Size | OD in. mm      | D in. mm       | J in. mm                     | b in. mm         | h in. mm          | a in. mm                     | m in. mm         | g in. mm        | Number            | l in. mm      | k in. mm       | Pounds Kilo                  |
| 26"       | 26.0<br>660.4  | 40<br>1016.0   | To be specified by purchaser | 4 _<br>107.9     | 8 _<br>222.2      | To be specified by purchaser | 7/16<br>747.7    | 29 _<br>749.3   | 28                | 2<br>50.8     | 36<br>914.4    | To be specified by purchaser |
| 28"       | 28.0<br>711.2  | 42 _<br>1073.1 |                              | 4 3/8<br>111.1   | 9 _<br>234.9      |                              | 5/8<br>803.3     | 31 _<br>800.1   | 28                | 2 1/8<br>54.0 | 38<br>965.2    |                              |
| 30"       | 30.0<br>762    | 44 _<br>1130.3 |                              | 4 _<br>114.3     | 9 _<br>247.6      |                              | 16/16<br>862.0   | 33 _<br>857.2   | 28                | 2 1/8<br>54.0 | 40 _<br>1022.3 |                              |
| 32"       | 32.0<br>812.8  | 47<br>1193.8   |                              | 4 5/8<br>117.5   | 10 _<br>260.3     |                              | 36 1/8<br>917.6  | 36<br>914.4     | 28                | 2 3/8<br>60.3 | 42 _<br>1079.5 |                              |
| 34"       | 34.0<br>863.6  | 49<br>1244.6   |                              | 4 _<br>120.6     | 10 5/8<br>269.9   |                              | 38 5/16<br>973.1 | 38<br>965.2     | 28                | 2 3/8<br>60.3 | 44 _<br>1130.3 |                              |
| 36"       | 36.0<br>914.4  | 51 _<br>1314.4 |                              | 4 7/8<br>123.8   | 11 1/8<br>282.6   |                              | 40 5/8<br>1031.9 | 40 _<br>1022.3  | 28                | 2 5/8<br>66.7 | 47<br>1193.8   |                              |
| 38"       | 38.0<br>965.2  | 50<br>1270.0   |                              | 6<br>152.4       | 10<br>254.0       |                              | 40 _<br>1022.3   | 41 _<br>1054.1  | 28                | 2 3/8<br>60.3 | 45 _<br>1162.0 |                              |
| 40"       | 40.0<br>1016.0 | 52<br>1320.8   |                              | 6 _<br>158.7     | 10 3/8<br>263.5   |                              | 42 _<br>1073.1   | 43 _<br>1111.2  | 32                | 2 3/8<br>60.3 | 47 _<br>1212.8 |                              |
| 42"       | 42.0<br>1066.8 | 55 _<br>1403.3 |                              | 6 5/8<br>168.2   | 11<br>279.4       |                              | 44 3/8<br>1127.1 | 46<br>1168.4    | 28                | 2 5/8<br>66.7 | 50 _<br>1282.7 |                              |
| 44"       | 44.0<br>1117.6 | 57 _<br>1554.1 |                              | 6 13/16<br>173.0 | 11 3/8<br>288.9   |                              | 46 _<br>1181.1   | 48 _<br>1225.5  | 32                | 2 5/8<br>66.7 | 52 _<br>1333.5 |                              |
| 46"       | 46.0<br>1168.4 | 59 _<br>1511.3 |                              | 7 1/16<br>179.3  | 11 13/15<br>300.0 |                              | 8 5/8<br>1235.1  | 50 _<br>1276.3  | 32                | 2 5/8<br>66.7 | 54 _<br>1390.6 |                              |
| 48"       | 48.0<br>1219.2 | 62 _<br>1593.8 |                              | 7 7/16<br>188.9  | 12 7/16<br>315.9  |                              | 50 _<br>1289.0   | 52 _<br>1333.5  | 32                | 2 7/8<br>73.0 | 57 _<br>1460.5 |                              |
| 50"       | 50.0<br>1270.0 | 65 _<br>1670.0 |                              | 7 _<br>196.8     | 12 15/16<br>328.6 |                              | 50 7/8<br>1292.2 | 54 _<br>1384.3  | 28                | 3 1/8<br>79.3 | 60<br>1524.0   |                              |
| 52"       | 52.0<br>1320.8 | 67 _<br>1720.8 |                              | 8<br>203.2       | 13 _<br>336.5     |                              | 54 7/8<br>1393.8 | 56 _<br>1435.1  | 32                | 3 1/8<br>79.3 | 62<br>1574.8   |                              |
| 54"       | 54.0<br>1371.6 | 70<br>1778.0   |                              | 8 _<br>209.5     | 13 _<br>349.2     |                              | 57<br>1447.8     | 58 _<br>1492.21 | 32                | 3 1/8<br>79.3 | 64 _<br>1631.9 |                              |
| 56"       | 56.0<br>1422.4 | 73<br>1854.2   |                              | 8 9/16<br>217.4  | 14 _<br>361.9     |                              | 59 1/8<br>1501.7 | 60 _<br>1543.0  | 32                | 3 3/8<br>85.7 | 66 _<br>1695.4 |                              |
| 58"       | 58.0<br>1473.2 | 75<br>1905.0   |                              | 8 _<br>222.2     | 14 9/16<br>369.8  |                              | 61 1/8<br>1552.5 | 63<br>1600.2    | 32                | 3 3/8<br>85.7 | 68 _<br>1746.2 |                              |
| 60"       | 60.0<br>1524.0 | 78 _<br>1993.9 |                              | 9 3/16<br>233.4  | 15 5/16<br>388.9  |                              | 63 3/8<br>1609.7 | 65 _<br>1657.3  | 28                | 3 5/8<br>92.0 | 71 _<br>1822.4 |                              |



# 900 lb/sq.in. Welding Neck Flanges

MSS SP-44



| Pipe      |                | Flange           |                              |                 |                  | Hub                          |                   | Raised Face    | Drilling Template |                |                  | Appr. Weight                 |
|-----------|----------------|------------------|------------------------------|-----------------|------------------|------------------------------|-------------------|----------------|-------------------|----------------|------------------|------------------------------|
| Nom. Size | OD in. mm      | D in. mm         | J in. mm                     | b in. mm        | h in. mm         | a in. mm                     | m in. mm          | g in. mm       | Number            | l in. mm       | k in. mm         | Pounds Kilo                  |
| 26"       | 26.0<br>660.4  | 42 _<br>1085.8   | To be specified by purchaser | 5 _<br>139.7    | 11 _<br>285.7    | To be specified by purchaser | 30 _<br>774.4     | 29 _<br>749.3  | 20                | 2 7/8<br>73.0  | 37 _<br>952.5    | To be specified by purchaser |
| 28"       | 28.0<br>711.2  | 46 _<br>1168.4   |                              | 5 5/8<br>142.9  | 11 _<br>298.4    |                              | 32 _<br>831.8     | 31 _<br>800.1  | 20                | 3 1/8<br>79.4  | 40 _<br>1022.3   |                              |
| 30"       | 30.0<br>762    | 48 _<br>1231.9   |                              | 5 7/8<br>149.2  | 12 _<br>311.1    |                              | 35 _<br>889.0     | 33 _<br>857.2  | 20                | 3 1/8<br>79.4  | 42 _<br>1085.8   |                              |
| 32"       | 32.0<br>812.8  | 51 _<br>1314.4   |                              | 6 _<br>158.7    | 13 _<br>330.2    |                              | 37 _<br>946.1     | 36 _<br>914.4  | 20                | 3 3/8<br>85.7  | 45 _<br>1155.7   |                              |
| 34"       | 34.0<br>863.6  | 55 _<br>1397.0   |                              | 6 _<br>165.1    | 13 _<br>349.2    |                              | 39 5/8<br>1006.5  | 38 _<br>965.2  | 20                | 3 5/8<br>92.1  | 48 _<br>1225.5   |                              |
| 36"       | 36.0<br>914.4  | 57 _<br>1460.5   |                              | 6 _<br>171.4    | 14 _<br>361.9    |                              | 41 7/8<br>1063.6  | 40 _<br>1022.3 | 20                | 3 5/8<br>92.1  | 50 _<br>1289.0   |                              |
| 38"       | 38.0<br>965.2  | 57 _<br>1460.5   |                              | 7 _<br>190.5    | 13 7/8<br>352.4  |                              | 42 _<br>1073.1    | 43 _<br>1098.5 | 20                | 3 5/8<br>92.1  | 50 _<br>1289.0   |                              |
| 40"       | 40.0<br>1016.0 | 59 _<br>1511.3   |                              | 7 _<br>196.8    | 14 5/16<br>363.5 |                              | 44 3/8<br>1127.1  | 45 _<br>1162.0 | 24                | 3 5/8<br>92.1  | 52 _<br>1339.8   |                              |
| 42"       | 42.0<br>1066.8 | 61 _<br>1562.1   |                              | 8 1/8<br>206.3  | 14 5/8<br>371.4  |                              | 46 5/16<br>1176.3 | 47 _<br>1212.8 | 24                | 3 5/8<br>92.1  | 54 _<br>1390.6   |                              |
| 44"       | 44.0<br>1117.6 | 64 7/8<br>1647.8 |                              | 8 7/16<br>214.3 | 15 3/8<br>390.5  |                              | 48 5/8<br>1235.0  | 50 _<br>1270.0 | 24                | 3 7/8<br>98.4  | 57 5/8<br>1463.6 |                              |
| 46"       | 46.0<br>1168.4 | 68 _<br>1733.5   |                              | 8 7/8<br>225.4  | 16 3/16<br>411.1 |                              | 50 7/8<br>1292.2  | 52 _<br>1333.5 | 24                | 4 1/8<br>104.7 | 60 _<br>1536.7   |                              |
| 48"       | 48.0<br>1219.2 | 70 _<br>1784.3   |                              | 9 3/16<br>233.4 | 16 _<br>419.1    |                              | 52 7/8<br>1343.0  | 54 _<br>1384.3 | 24                | 4 1/8<br>104.7 | 62 _<br>1587.5   |                              |

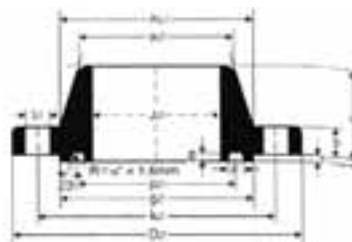
# Welding Neck Flanges, Ring Joint Type

MSS SP-44



## 300 lb/sq.in.

1) f=Height of raised portion and depth of groove dimensions »E« but not covered by tolerances for »E«.



| Pipe      |               | Flange           |                              |                |                | Hub                          |                   | Raised Face      | Drilling Template |               |                  | Ring Joint       |              |               | Approx.                      |
|-----------|---------------|------------------|------------------------------|----------------|----------------|------------------------------|-------------------|------------------|-------------------|---------------|------------------|------------------|--------------|---------------|------------------------------|
| Nom. Size | OD in.<br>mm  | D in.<br>mm      | J in.<br>mm                  | b in.<br>mm    | h in.<br>mm    | a in.<br>mm                  | m in.<br>mm       | g in.<br>mm      | Number            | l in.<br>mm   | k in.<br>mm      | p in.<br>mm      | E in.<br>mm  | F in.<br>kilo | Pounds                       |
| 26"       | 26.0<br>660.4 | 38<br>971.5      | To be specified by purchaser | 3 1/8<br>79.4  | 7 1/4<br>184.1 | To be specified by purchaser | 28 3/8<br>720.7   | 31 7/8<br>809.6  | 28                | 1 3/4<br>44.4 | 34 1/2<br>876.3  | 29 1/2<br>749.3  | 1/2<br>12.7  | 25/32<br>19.8 | To be specified by purchaser |
| 28"       | 28.0<br>711.2 | 40 3/4<br>1035.0 |                              | 3 3/8<br>85.7  | 7 3/4<br>196.8 |                              | 30 1/2<br>774.7   | 33 7/8<br>860.4  | 28                | 1 3/4<br>44.4 | 37<br>939.8      | 31 1/2<br>800.1  | 1/2<br>12.7  | 25/32<br>19.8 |                              |
| 30"       | 30.0<br>762   | 43<br>1092.2     |                              | 3 5/8<br>92.1  | 8 1/4<br>209.5 |                              | 32 9/16<br>827.1  | 36 1/8<br>917.6  | 28                | 1 7/8<br>47.6 | 39 1/4<br>996.9  | 33 3/4<br>857.2  | 1/2<br>12.7  | 25/32<br>19.8 |                              |
| 32"       | 32.0<br>812.8 | 45 1/4<br>1149.3 |                              | 3 7/8<br>98.4  | 8 3/4<br>222.2 |                              | 34 11/16<br>881.1 | 38 3/4<br>984.2  | 28                | 2<br>50.8     | 41 1/2<br>1054.1 | 36<br>914.4      | 9/16<br>14.3 | 29/32<br>23.0 |                              |
| 34"       | 34.0<br>863.6 | 47 1/2<br>1206.5 |                              | 4<br>101.6     | 9 1/8<br>231.8 |                              | 36 7/8<br>936.6   | 40 3/4<br>1035.0 | 28                | 2<br>50.8     | 43 1/2<br>1104.9 | 38<br>965.2      | 9/16<br>14.3 | 29/32<br>23.0 |                              |
| 36"       | 36.0<br>914.4 | 50<br>1270.0     |                              | 4 1/8<br>104.8 | 9 1/2<br>241.3 |                              | 39<br>990.6       | 43<br>1092.2     | 32                | 2 1/8<br>54.0 | 46<br>1168.4     | 40 1/4<br>1022.3 | 9/16<br>14.3 | 29/32<br>23.0 |                              |

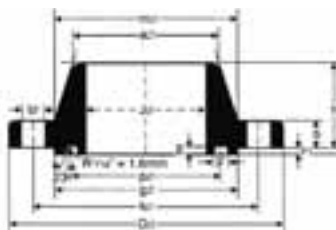
## 400 lb/sq.in.

| Pipe      |               | Flange           |                              |                |                | Hub                          |                   | Raised Face      | Drilling Template |               |                  | Ring Joint       |              |               | Approx.                      |
|-----------|---------------|------------------|------------------------------|----------------|----------------|------------------------------|-------------------|------------------|-------------------|---------------|------------------|------------------|--------------|---------------|------------------------------|
| Nom. Size | OD in.<br>mm  | D in.<br>mm      | J in.<br>mm                  | b in.<br>mm    | h in.<br>mm    | a in.<br>mm                  | m in.<br>mm       | g in.<br>mm      | Number            | l in.<br>mm   | k in.<br>mm      | p in.<br>mm      | E in.<br>mm  | F in.<br>kilo | Pounds                       |
| 26"       | 26.0<br>660.4 | 38<br>971.5      | To be specified by purchaser | 3 1/2<br>88.9  | 7 5/8<br>193.7 | To be specified by purchaser | 28 5/8<br>727.1   | 31 7/8<br>809.6  | 28                | 1 7/8<br>47.6 | 34 1/2<br>876.3  | 29 1/2<br>749.3  | 1/2<br>12.7  | 25/32<br>19.8 | To be specified by purchaser |
| 28"       | 28.0<br>711.2 | 40 3/4<br>1035.0 |                              | 3 3/4<br>95.2  | 8 1/8<br>206.4 |                              | 30 13/16<br>782.6 | 33 7/8<br>860.4  | 28                | 2<br>50.8     | 37<br>939.8      | 31 1/2<br>800.1  | 1/2<br>12.7  | 25/32<br>19.8 |                              |
| 30"       | 30.0<br>762   | 43<br>1092.2     |                              | 4<br>101.6     | 8 5/8<br>219.1 |                              | 32 15/16<br>836.6 | 36 1/8<br>917.6  | 28                | 2 1/8<br>54.0 | 39 1/4<br>996.9  | 33 3/4<br>857.2  | 1/2<br>12.7  | 25/32<br>19.8 |                              |
| 32"       | 32.0<br>812.8 | 45 1/4<br>1149.3 |                              | 4 1/4<br>107.9 | 9 1/8<br>231.8 |                              | 35<br>889.0       | 38 3/4<br>984.2  | 28                | 2 1/8<br>54.0 | 41 1/2<br>1054.1 | 36<br>914.4      | 9/16<br>14.3 | 29/32<br>23.0 |                              |
| 34"       | 34.0<br>863.6 | 47 1/2<br>1206.5 |                              | 4 3/8<br>111.1 | 9 1/2<br>241.3 |                              | 37 3/16<br>944.6  | 40 3/4<br>1035.0 | 28                | 2 1/8<br>54.0 | 43 1/2<br>1104.9 | 38<br>965.2      | 9/16<br>14.3 | 29/32<br>23.0 |                              |
| 36"       | 36.0<br>914.4 | 50<br>1270.0     |                              | 4 1/2<br>114.3 | 9 7/8<br>250.8 |                              | 39 3/8<br>1000.1  | 43<br>1092.2     | 32                | 2 1/8<br>54.0 | 46<br>1168.4     | 40 1/4<br>1022.3 | 9/16<br>14.3 | 29/32<br>23.0 |                              |



# Welding Neck Flanges, Ring Joint Type

MSS SP-44



**600 lb/sq.in.**

1) f=Height of raised portion and depth of groove dimensions »E« but not covered by tolerances for »E«.

| Pipe      |               | Flange           |                              |                |                 | Hub                          |                   | Raised Face      | Drilling Template |               |                  | Ring Joint       |              |               | Approx.                      |
|-----------|---------------|------------------|------------------------------|----------------|-----------------|------------------------------|-------------------|------------------|-------------------|---------------|------------------|------------------|--------------|---------------|------------------------------|
| Nom. Size | OD in.<br>mm  | D in.<br>mm      | J in.<br>mm                  | b in.<br>mm    | h in.<br>mm     | a in.<br>mm                  | m in.<br>mm       | g in.<br>mm      | Number            | l in.<br>mm   | k in.<br>mm      | p in.<br>mm      | E in.<br>mm  | F in.<br>kilo | Pounds                       |
| 26"       | 26.0<br>660.4 | 40<br>1016.0     | To be specified by purchaser | 4 1/4<br>107.9 | 8 3/4<br>222.2  | To be specified by purchaser | 29 7/16<br>747.7  | 31 7/8<br>809.6  | 28                | 2<br>50.8     | 36<br>914.4      | 29 1/2<br>749.3  | 1/2<br>12.7  | 25/32<br>19.8 | To be specified by purchaser |
| 28"       | 28.0<br>711.2 | 42 1/4<br>1073.1 |                              | 4 3/8<br>111.1 | 9 1/4<br>234.9  |                              | 31 5/8<br>803.3   | 33 7/8<br>860.4  | 28                | 2 1/8<br>54.0 | 38<br>965.2      | 31 1/2<br>800.1  | 1/2<br>12.7  | 25/32<br>19.8 |                              |
| 30"       | 30.0<br>762   | 44 1/2<br>1130.3 |                              | 4 1/2<br>114.3 | 9 3/4<br>247.6  |                              | 33 15/16<br>862.0 | 36 1/8<br>917.6  | 28                | 2 1/8<br>54.0 | 40 1/4<br>1022.3 | 33 3/4<br>857.2  | 1/2<br>12.7  | 25/32<br>19.8 |                              |
| 32"       | 32.0<br>812.8 | 47<br>1193.8     |                              | 4 5/8<br>117.5 | 10 1/4<br>260.3 |                              | 36 1/8<br>917.6   | 38 3/4<br>984.2  | 28                | 2 3/8<br>60.3 | 42 1/2<br>1079.5 | 36<br>914.4      | 9/16<br>14.3 | 29/32<br>23.0 |                              |
| 34"       | 34.0<br>863.6 | 49<br>1244.6     |                              | 4 3/4<br>120.6 | 10 5/8<br>269.9 |                              | 38 5/16<br>973.1  | 40 3/4<br>1035.0 | 28                | 2 3/8<br>60.3 | 44 1/2<br>1130.3 | 38<br>965.2      | 9/16<br>14.3 | 29/32<br>23.0 |                              |
| 36"       | 36.0<br>914.4 | 51 3/4<br>1314.4 |                              | 4 7/8<br>123.8 | 11 1/8<br>282.6 |                              | 40 5/8<br>1031.9  | 43<br>1092.2     | 28                | 2 5/8<br>66.7 | 47<br>1193.8     | 40 1/4<br>1022.3 | 9/16<br>14.3 | 29/32<br>23.0 |                              |

**900 lb/sq.in.**

| Pipe      |               | Flange           |                              |                |                 | Hub                          |                  | Raised Face      | Drilling Template |               |                  | Ring Joint       |               |                | Approx.                      |
|-----------|---------------|------------------|------------------------------|----------------|-----------------|------------------------------|------------------|------------------|-------------------|---------------|------------------|------------------|---------------|----------------|------------------------------|
| Nom. Size | OD in.<br>mm  | D in.<br>mm      | J in.<br>mm                  | b in.<br>mm    | h in.<br>mm     | a in.<br>mm                  | m in.<br>mm      | g in.<br>mm      | Number            | l in.<br>mm   | k in.<br>mm      | p in.<br>mm      | E in.<br>mm   | F in.<br>kilo  | Pounds                       |
| 26"       | 26.0<br>660.4 | 42 3/4<br>1085.8 | To be specified by purchaser | 5 1/2<br>139.7 | 11 1/4<br>285.7 | To be specified by purchaser | 31 1/2<br>774.4  | 32 3/4<br>831.8  | 20                | 2 7/8<br>73.0 | 37 1/2<br>952.5  | 29 1/2<br>749.3  | 11/16<br>17.5 | 1 3/16<br>30.2 | To be specified by purchaser |
| 28"       | 28.0<br>711.2 | 46<br>1168.4     |                              | 5 5/8<br>142.9 | 11 3/4<br>298.4 |                              | 32 3/4<br>831.8  | 35<br>889.0      | 20                | 3 1/8<br>79.4 | 40 1/4<br>1022.3 | 31 1/2<br>800.1  | 11/16<br>17.5 | 1 5/16<br>33.3 |                              |
| 30"       | 30.0<br>762   | 48 1/2<br>1231.9 |                              | 5 7/8<br>149.2 | 12 1/4<br>311.1 |                              | 35<br>889.0      | 37 1/4<br>946.1  | 20                | 3 1/8<br>79.4 | 42 3/4<br>1085.8 | 33 3/4<br>857.2  | 11/16<br>17.5 | 1 5/16<br>33.3 |                              |
| 32"       | 32.0<br>812.8 | 51 3/4<br>1314.4 |                              | 6 1/4<br>158.7 | 13<br>330.2     |                              | 37 1/4<br>946.1  | 39 1/2<br>1003.3 | 20                | 3 3/8<br>85.7 | 45 1/2<br>1155.7 | 36<br>914.4      | 11/16<br>17.5 | 1 5/16<br>33.3 |                              |
| 34"       | 34.0<br>863.6 | 55<br>1397.0     |                              | 6 1/2<br>165.1 | 13 3/4<br>349.2 |                              | 39 5/8<br>1006.5 | 42<br>1066.8     | 20                | 3 5/8<br>92.1 | 48 1/4<br>1225.5 | 38<br>965.2      | 13/16<br>20.6 | 1 7/16<br>36.5 |                              |
| 36"       | 36.0<br>914.4 | 57 1/2<br>1460.5 |                              | 6 3/4<br>171.4 | 14 1/4<br>361.9 |                              | 41 7/8<br>1063.6 | 44 1/4<br>1123.9 | 20                | 3 5/8<br>92.1 | 50 3/4<br>1289.0 | 40 1/4<br>1022.3 | 13/16<br>20.6 | 1 7/16<br>36.5 |                              |



Nominal Sizes from 26" to 60"

Standard for large diameter carbon steel flanges  
for nominal pressure ratings of 150 and 300 lb/sq.in.

### General Survey

|                            |                    |      |                                                                                        |
|----------------------------|--------------------|------|----------------------------------------------------------------------------------------|
| Nominal Pressure lb/sq.in. | 150                | 300  | Attention!<br>Flanges to API Standard 605 are not identical with MSS SP 44 and BS 3293 |
| kp/cm <sup>2</sup>         | 10.6               | 21.1 |                                                                                        |
| N/cm <sup>2</sup>          | 104                | 207  |                                                                                        |
| Type of Flange             | max. Nominal Sizes |      |                                                                                        |
| Welding Neck Flanges       | 60"                | 60"  |                                                                                        |

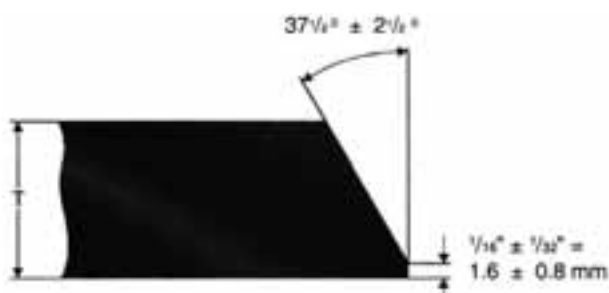
**Facings and Dimensional  
Tolerances acc. to  
ANSI B 16.5**

### Example of Marking

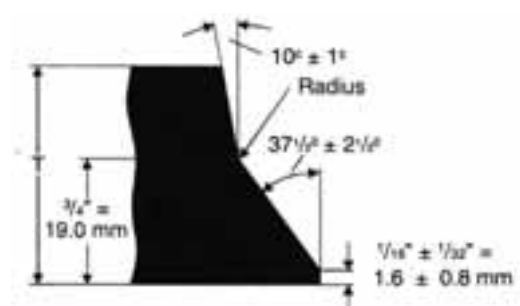
The Flanges are marked with the following information:

Manufacturer/s name or trade mark  
Nominal size  
Primary service pressure  
Material designation  
Heat code  
Schedule No.  
recognition letter x before  
Primary service pressure

### Welding Ends:



Bevel for Wall Thickness (T) 3/16" to 7/8" inclusive

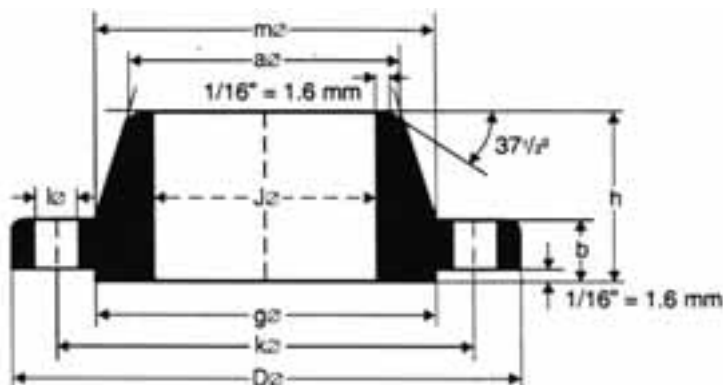


Bevel for Wall Thickness (T) greater than 7/8"



# 150 lb/sq.in. Welding Neck Flanges

API STANDARD 605

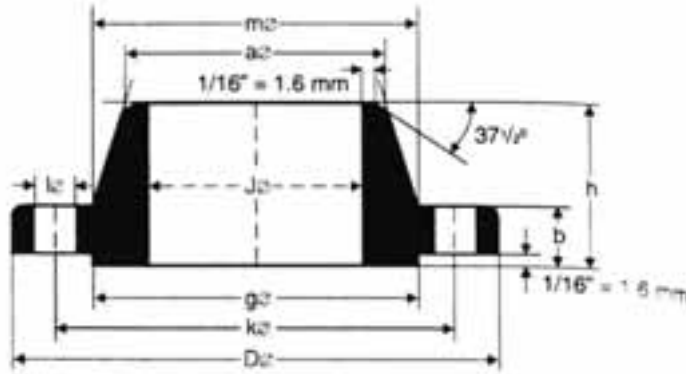


| Pipe      |                | Flange             |                              |                 |                  | Hub              |                    | Raised Face      | Number | Drilling Template  |                   | Appr. Weight |
|-----------|----------------|--------------------|------------------------------|-----------------|------------------|------------------|--------------------|------------------|--------|--------------------|-------------------|--------------|
| Nom. Size | OD in. mm      | D in. mm           | J in. mm                     | b in. mm        | h in. mm         | a in. mm         | m in. mm           | g in. mm         |        | l in. mm           | k in. mm          | Pounds Kilo  |
| 26"       | 26.0<br>660.4  | 34 15/16<br>785.8  | To be specified by purchaser | 1 5/8<br>41.3   | 3 1/2<br>88.9    | 26 1/16<br>662.0 | 26 15/16<br>684.2  | 28<br>711.2      | 36     | 7/8<br>22.2        | 29 5/16<br>744.5  | 139<br>63    |
| 28"       | 28.0<br>711.2  | 32 15/16<br>836.6  |                              | 1 3/4<br>44.4   | 3 3/4<br>95.2    | 28 1/16<br>712.8 | 28 15/16<br>735.0  | 30<br>762.0      | 40     | 7/8<br>22.2        | 31 5/16<br>795.3  | 163<br>74    |
| 30"       | 30.0<br>762    | 34 15/16<br>887.4  |                              | 1 3/4<br>44.4   | 3 15/16<br>100.0 | 30 1/16<br>763.6 | 31<br>787.4        | 32<br>812.8      | 44     | 7/8<br>22.2        | 33 5/16<br>846.1  | 176<br>80    |
| 32"       | 32.0<br>812.8  | 37 1/16<br>941.4   |                              | 1 13/16<br>46   | 4 1/4<br>107.9   | 32 1/16<br>814.4 | 33 1/16<br>839.8   | 34<br>863.6      | 48     | 7/8<br>22.2        | 35 7/16<br>900.1  | 203<br>92    |
| 34"       | 34.0<br>863.6  | 39 9/16<br>1004.9  |                              | 1 15/16<br>49.2 | 4 11/32<br>110.3 | 34 1/16<br>865.2 | 35 1/8<br>892.2    | 36 1/4<br>920.7  | 40     | 1 37 11/16<br>25.4 | 957.3             | 249<br>113   |
| 36"       | 36.0<br>914.4  | 41 5/8<br>1057.3   |                              | 2 1/16<br>52.4  | 4 5/8<br>117.5   | 36 1/16<br>916.0 | 37 3/16<br>944.6   | 38 1/4<br>971.5  | 44     | 1 39 3/4<br>25.4   | 284<br>1009.6     | 129          |
| 42"       | 42.0<br>1066.8 | 48 1/4<br>1225.5   |                              | 2 5/16<br>58.7  | 5 1/4<br>133.3   | 42 1/8<br>1070.0 | 43 3/8<br>1101.7   | 44 1/2<br>1130.3 | 48     | 1 1/8<br>28.6      | 46 1/8<br>1171.6  | 406<br>184   |
| 48"       | 48.0<br>1219.2 | 54 13/16<br>1392.2 |                              | 2 9/16<br>65.1  | 5 7/8<br>149.2   | 48 1/8<br>1222.4 | 49 1/2<br>1257.3   | 50 3/4<br>1289.0 | 44     | 1 1/4<br>31.7      | 52 9/16<br>1335.1 | 509<br>231   |
| 54"       | 54.0<br>1371.6 | 61<br>1549.4       |                              | 2 13/16<br>71.4 | 6 3/8<br>161.9   | 54 1/8<br>1374.8 | 55 5/8<br>1412.9   | 56 3/4<br>1441.9 | 56     | 1 1/4<br>31.7      | 58 3/4<br>1492.2  | 632<br>287   |
| 60"       | 60.0<br>1524   | 67 15/16<br>1725.6 |                              | 3<br>76.2       | 7 1/16<br>179.4  | 60 1/8<br>1527.2 | 61 13/16<br>1570.0 | 63<br>1600.2     | 52     | 1 3/8<br>34.9      | 66 7/16<br>1662.1 | 855<br>388   |



# 300 lb/sq.in. Welding Neck Flanges

API STANDARD 605

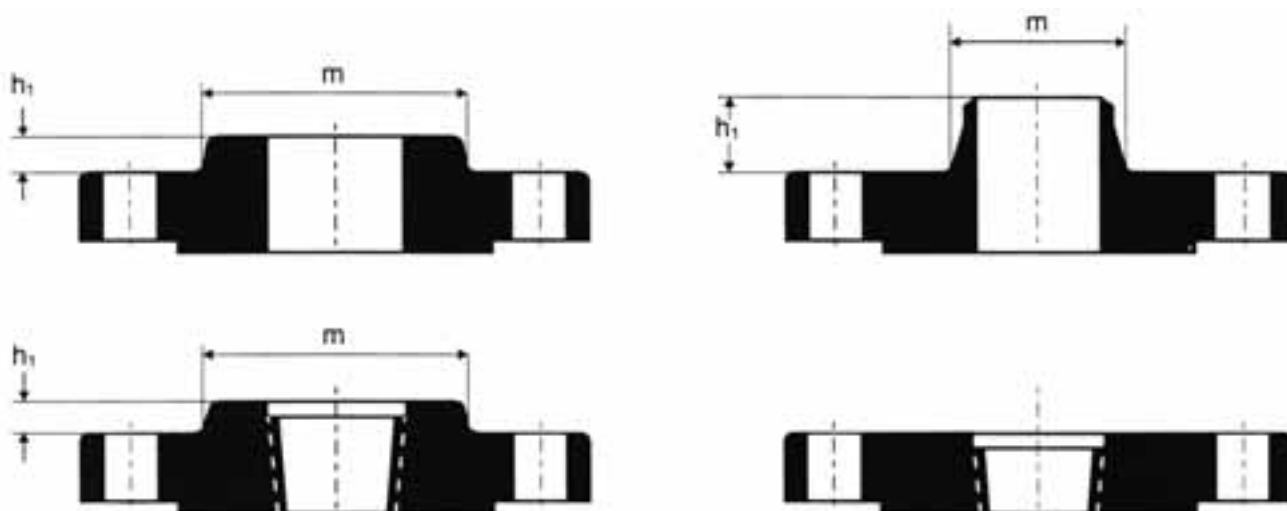


| Pipe      |                | Flange             |                              |                  |                   | Hub               |                    | Raised Face      | Number | Drilling Template |                   | Appr. Weight |
|-----------|----------------|--------------------|------------------------------|------------------|-------------------|-------------------|--------------------|------------------|--------|-------------------|-------------------|--------------|
| Nom. Size | OD in. mm      | D in. mm           | J in. mm                     | b in. mm         | h in. mm          | a in. mm          | m in. mm           | g in. mm         |        | l in. mm          | k in. mm          | Pounds Kilo  |
| 26"       | 26.0<br>660.4  | 34 1/8<br>866.8    | To be specified by purchaser | 3 1/2<br>88.9    | 5 11/16<br>144.5  | 26 3/16<br>665.2  | 27 5/8<br>701.7    | 29<br>736.6      | 32     | 1 3/8<br>34.9     | 31 5/8<br>803.3   | 399<br>181   |
| 28"       | 28.0<br>711.2  | 36 1/4<br>920.7    |                              | 3 1/2<br>88.9    | 5 7/8<br>149.2    | 28 3/16<br>716.0  | 29 3/4<br>755.6    | 31<br>787.4      | 36     | 1 3/8<br>34.9     | 33 3/4<br>857.2   | 447<br>203   |
| 30"       | 30.0<br>762    | 39<br>990.6        |                              | 3 11/16<br>93.7  | 3 7/32<br>158.0   | 30 1/4<br>768.4   | 32<br>812.8        | 33 1/4<br>844.5  | 36     | 1 1/2<br>38.1     | 36 1/4<br>920.7   | 590<br>268   |
| 32"       | 32.0<br>812.8  | 41 1/2<br>1054.1   |                              | 4 1/16<br>103.2  | 6 5/8<br>168.3    | 32 1/4<br>819.2   | 34<br>863.6        | 35 1/2<br>901.7  | 32     | 1 5/8<br>41.3     | 38 1/2<br>977.9   | 727<br>330   |
| 34"       | 34.0<br>863.6  | 43 5/8<br>1108.1   |                              | 4 1/16<br>103.2  | 6 13/16<br>173.0  | 34 1/4<br>869.9   | 36 1/8<br>917.6    | 37 1/2<br>952.5  | 36     | 1 5/8<br>41.3     | 40 5/8<br>1031.9  | 787<br>357   |
| 36"       | 36.0<br>914.4  | 46 1/8<br>1171.6   |                              | 4 1/16<br>103.2  | 7 1/8<br>181.0    | 36 1/4<br>920.7   | 38<br>965.2        | 39 3/4<br>109.6  | 32     | 1 3/4<br>44.4     | 42 7/8<br>1089.0  | 893<br>405   |
| 42"       | 42.0<br>1066.8 | 52 1/2<br>1333.5   |                              | 4 11/16<br>119.1 | 8 1/16<br>204.8   | 42 5/16<br>1074.7 | 44<br>1117.6       | 46<br>1168.4     | 36     | 1 7/8<br>47.6     | 49<br>1244.6      | 1252<br>568  |
| 48"       | 48.0<br>1219.2 | 59 1/2<br>1511.3   |                              | 5 1/16<br>128.6  | 8 13/16<br>223.8  | 48 5/16<br>1227.1 | 50 5/16<br>1277.9  | 52 1/4<br>1327.1 | 40     | 2 55 3/4<br>50.8  | 1611<br>1416.0    | 731          |
| 54"       | 54.0<br>1371.6 | 55 7/8<br>1673.2   |                              | 5 3/8<br>136.5   | 9 7/16<br>239.7   | 54 5/16<br>1379.5 | 56 1/2<br>1435.1   | 58 1/4<br>1479.5 | 48     | 2 62 1/8<br>50.8  | 1979<br>1578.0    | 898          |
| 60"       | 60.0<br>1524   | 73 15/16<br>1878.0 |                              | 5 15/16<br>150.8 | 10 11/16<br>271.5 | 60 5/16<br>1531.9 | 62 15/16<br>1598.6 | 65<br>1651.0     | 40     | 2 3/8<br>60.3     | 69 7/16<br>1763.7 | 2890<br>1311 |



# 150-2500 lb/sq.in. Reducing Flanges

ANSI B 16.5



| Nominal Pipe Size | Minimum Bore or tapping of Hub Flange | Nominal Pipe Size | Minimum Bore or tapping of Hub Flange | Nominal Pipe Size | Minimum Bore or tapping of Hub Flange |
|-------------------|---------------------------------------|-------------------|---------------------------------------|-------------------|---------------------------------------|
|                   | 3 1/2"                                | 1 1/2"            | 3 1/2"                                | 3 1/2"            |                                       |
| 1"                | 1/2"                                  | 4"                | 1 1/2"                                | 14"               | 4"                                    |
| 1 1/4"            | 1/2"                                  | 5"                | 1 1/2"                                | 16"               | 4"                                    |
| 1 1/2"            | 1/2"                                  | 6"                | 2 1/2"                                | 18"               | 4"                                    |
| 2"                | 1"                                    | 8"                | 3"                                    | 20"               | 4"                                    |
| 2 1/2"            | 1 1/4"                                | 10"               | 3 1/2"                                |                   |                                       |
| 3"                | 1 1/4"                                | 12"               |                                       | 24"               | 4"                                    |

## Reducing Flanges

### Drilling, OD, Thickness and Facing Dimensions

Flange drilling, OD, thickness and facing are the same as those of the standard flange of the size from which the reduction is being made.

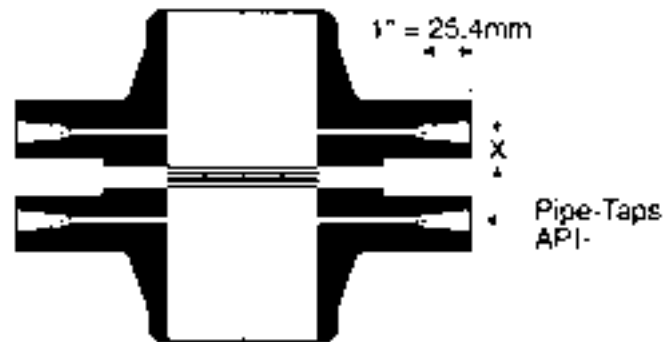
## Hub Dimensions

### Threaded and Slip-on Flanges

The hub dimensions shall be at least as large as those of the standard flange of the size to which the reduction is being made. The hub may be larger or omitted.

### Welding Neck Flanges

The hub dimensions shall be the same as those of the standard flange of the size to which the reduction is being made.



Orifice flanges are manufactured in sizes from 1" to 24" as welding neck, slip-on or threaded flanges.  
The two tap holes of each orifice flanges are provided with plugs.  
All orifice flanges are drilled and machined for the installation of a jack screw.

### **Dimensions:**

The dimensions are in accordance with those of the flanges standardized to ANSI B 16.5.

### **Tap Holes:**

1/2" API-thread for flanges class 300, 400 and 600.  
3/4" API-thread for flanges class 900 and 1500.

### **Tap hole diameters:**

0.250" for DN 2 1/2" and smaller  
0.375" for DN 3"  
0.500" for DN 4" and larger

### **Distance of holes "x"**

0.938" for all flanges with raised faces.

The distance from the centerline of the tap hole to the face of the flange is 0.750" for flanges ring type joint with a groove depth of 0.375" and smaller. In case of a groove depth of 0.438" and larger an alteration of the diameter or type of the tap hole is necessary.

### **Minimum flange thickness:**

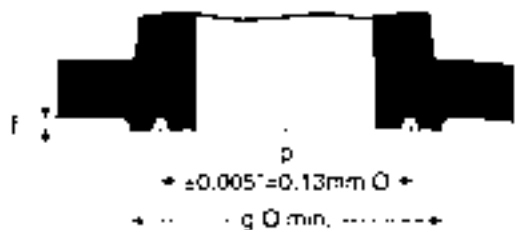
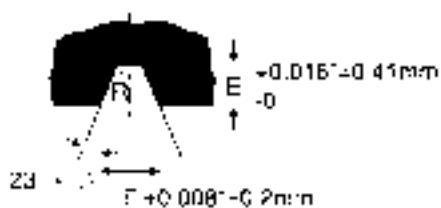
In order to obtain space for the tap holes the thickness of the flanges in the range of the small sizes is as follows:

1.500" for raised face flanges class 300-600  
1.375" for raised face flanges class 900-1500  
1.250" for ring type joint flanges class 300-1500.



# Flanges: Ring Joint Facings

ANSI B 16.5

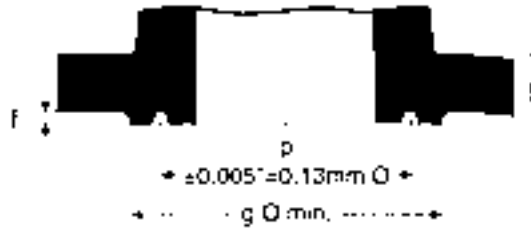
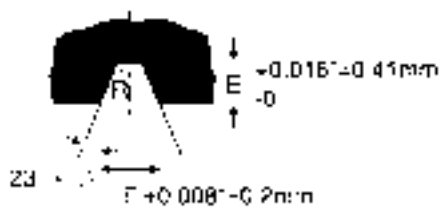


| Nominal Size       |                    |                                                      |                    |                                                       |                     |                     | Ring<br>No. | Groove Dimensions              |                |                |                                     | Diameter of Raised Face |                                  |                   |                    |                    |
|--------------------|--------------------|------------------------------------------------------|--------------------|-------------------------------------------------------|---------------------|---------------------|-------------|--------------------------------|----------------|----------------|-------------------------------------|-------------------------|----------------------------------|-------------------|--------------------|--------------------|
| 150<br>lb/sq<br>in | 300<br>lb/sq<br>in | 400<br>lb/sq<br>in                                   | 600<br>lb/sq<br>in | 900<br>lb/sq<br>in                                    | 1500<br>lb/sq<br>in | 2500<br>lb/sq<br>in |             | Pitch<br>Dia<br>meter<br><br>P | Depth<br><br>E | Width<br><br>F | Radius at<br>Bottom<br>max<br><br>R | 150<br>lb/sq<br>in      | 300<br>400<br>600<br>lb/sq<br>in | 900<br>b/sq<br>in | 1500<br>b/sq<br>in | 2500<br>b/sq<br>in |
|                    | 1/2"               | For sizes 1/2" to 3.1/2" data for 600 lb to be used. | 1/2"               | For sizes 1/2" to 2.1/2" data for 1500 lb to be used. |                     |                     | R11         | 1.344<br>34.1                  | 0.219<br>5.6   | 0.281<br>7.1   | 0.03<br>0.8                         |                         | 2.00<br>50.8                     |                   |                    |                    |
|                    |                    |                                                      |                    |                                                       | 1/2"                |                     | R12         | 1.562<br>39.7                  | 0.250<br>6.4   | 0.344<br>8.7   | 0.03<br>0.8                         |                         |                                  |                   | 2.38<br>60.5       |                    |
|                    | 3/4"               |                                                      | 3/4"               |                                                       |                     | 1/2"                | R13         | 1.688<br>42.9                  | 0.250<br>6.4   | 0.344<br>8.7   | 0.03<br>0.8                         |                         | 2.50<br>63.5                     |                   |                    | 2.56<br>65.0       |
|                    |                    |                                                      |                    |                                                       | 3/4"                |                     | R14         | 1.750<br>44.5                  | 0.250<br>6.4   | 0.344<br>8.7   | 0.03<br>0.8                         |                         |                                  |                   | 2.62<br>66.5       |                    |
| 1"                 |                    |                                                      |                    |                                                       |                     |                     | R15         | 1.875<br>47.6                  | 0.250<br>6.4   | 0.344<br>8.7   | 0.03<br>0.08                        | 2.50<br>63.5            |                                  |                   |                    |                    |
|                    | 1"                 |                                                      | 1"                 |                                                       | 1"                  | 3/4"                | R16         | 2.000<br>50.8                  | 0.250<br>6.4   | 0.344<br>8.7   | 0.03<br>0.8                         |                         | 2.75<br>69.9                     |                   | 2.81<br>71.4       | 2.88<br>73.2       |
| 1 1/4"             |                    |                                                      |                    |                                                       |                     |                     | R17         | 2.250<br>57.2                  | 0.250<br>6.4   | 0.344<br>8.7   | 0.03<br>0.88                        | 2.88<br>73.2            |                                  |                   |                    |                    |
|                    | 1 1/4"             |                                                      | 1 1/4"             |                                                       | 1 1/4"              | 1"                  | R18         | 2.375<br>60.3                  | 0.250<br>6.4   | 0.344<br>8.7   | 0.03<br>0.8                         |                         | 3.12<br>79.2                     |                   | 3.19<br>81.0       | 3.25<br>82.6       |
| 1 1/2"             |                    |                                                      |                    |                                                       |                     |                     | R19         | 2.562<br>65.1                  | 0.250<br>6.4   | 0.344<br>8.7   | 0.03<br>0.8                         | 3.25<br>82.5            |                                  |                   |                    |                    |
|                    | 1 1/2"             |                                                      | 1 1/2"             |                                                       | 1 1/2"              |                     | R20         | 2.688<br>68.3                  | 0.250<br>6.4   | 0.344<br>8.7   | 0.03<br>0.8                         |                         | 3.55<br>90.4                     |                   | 3.62<br>91.9       |                    |
|                    |                    |                                                      |                    |                                                       |                     | 1 1/4"              | R21         | 2.844<br>72.2                  | 0.312<br>7.9   | 0.469<br>11.9  | 0.03<br>0.8                         |                         |                                  |                   |                    | 4.00<br>101.6      |
| 2"                 |                    |                                                      |                    |                                                       |                     |                     | R22         | 3.250<br>82.6                  | 0.250<br>6.4   | 0.344<br>8.7   | 0.03<br>0.8                         | 4.00<br>101.6           |                                  |                   |                    |                    |
|                    | 2"                 |                                                      | 2"                 |                                                       |                     | 1 1/2"              | R23         | 3.250<br>82.6                  | 0.312<br>7.9   | 0.469<br>11.9  | 0.03<br>0.8                         |                         | 4.25<br>108.0                    |                   |                    | 4.50<br>114.3      |
|                    |                    |                                                      |                    |                                                       | 2"                  |                     | R24         | 3.750<br>95.3                  | 0.312<br>7.9   | 0.469<br>11.9  | 0.03<br>0.8                         |                         |                                  |                   | 4.88<br>124.0      |                    |
| 2 1/2"             |                    |                                                      |                    |                                                       |                     |                     | R25         | 4.000<br>101.6                 | 0.250<br>6.4   | 0.344<br>8.7   | 0.03<br>0.08                        | 4.75<br>120.7           |                                  |                   |                    |                    |
| 2 1/2"             |                    |                                                      | 2 1/2"             |                                                       |                     | 2"                  | R26         | 4.000<br>101.6                 | 0.312<br>7.9   | 0.460<br>11.9  | 0.03<br>0.8                         |                         | 5.00<br>127.0                    |                   |                    | 5.25<br>133.4      |
|                    |                    |                                                      |                    |                                                       | 2 1/2"              |                     | R27         | 4.250<br>108.0                 | 0.312<br>7.9   | 0.469<br>11.9  | 0.03<br>0.8                         |                         |                                  |                   | 5.38<br>136.7      |                    |
|                    |                    |                                                      |                    |                                                       |                     | 2 1/2"              | R28         | 4.375<br>111.1                 | 0.375<br>9.5   | 0.531<br>13.5  | 0.06<br>1.5                         |                         |                                  |                   |                    | 5.88<br>149.4      |

1) F= Height of raised portion and depth of grooved dimensions »E« but not covered by tolerances for »E«

# Flanges: Ring Joint Facings

ANSI B 16.5



| Nominal Size |              |                                                      |              |              |               |               | Ring No. | Groove Dimensions |               |               |                      | Diameter of Raised Face |               |               |               |               |
|--------------|--------------|------------------------------------------------------|--------------|--------------|---------------|---------------|----------|-------------------|---------------|---------------|----------------------|-------------------------|---------------|---------------|---------------|---------------|
| 150 lb/sq in | 300 lb/sq in | 400 lb/sq in                                         | 600 lb/sq in | 900 lb/sq in | 1500 lb/sq in | 2500 lb/sq in |          | Pitch Dia meter   | Depth         | Width         | Radius at Bottom max | 150 lb/sq in            | 300 lb/sq in  | 400 lb/sq in  | 600 lb/sq in  | 900 lb/sq in  |
|              |              |                                                      |              |              |               |               |          | P                 | E             | F             | R                    |                         |               |               |               |               |
| 3"           |              | For sizes 1/2" to 3 1/2" data for 600 lb to be used. |              |              |               |               | R29      | 4.500<br>114.3    | 0.250<br>6.4  | 0.344<br>8.7  | 0.03<br>0.8          | 5.25<br>133.4           |               |               |               |               |
|              | *)           |                                                      | *)           |              |               |               | R30      | 4.625<br>117.5    | 0.312<br>7.9  | 0.469<br>11.9 | 0.03<br>0.8          |                         |               |               |               |               |
|              | *)3"         |                                                      | *)3"         | 3"           |               |               | R31      | 4.875<br>123.8    | 0.312<br>7.9  | 0.469<br>11.9 | 0.03<br>0.8          |                         | 5.75<br>146.1 | 6.12<br>155   |               |               |
|              |              |                                                      |              |              |               | 3"            | R32      | 5.000<br>127.0    | 0.375<br>9.5  | 0.531<br>13.5 | 0.06<br>0.8          |                         |               |               |               | 6.62<br>168.1 |
| 3 1/2"       |              |                                                      |              |              |               |               | R33      | 5.188<br>131.8    | 0.250<br>6.4  | 0.344<br>8.7  | 0.06<br>0.8          | 6.06<br>153.9           |               |               |               |               |
|              | 3 1/2"       |                                                      | 3 1/2"       |              |               |               | R34      | 5.188<br>131.8    | 0.312<br>7.9  | 0.469<br>11.9 | 0.03<br>0.8          | 6.25<br>158.8           |               |               |               |               |
|              |              |                                                      |              |              | 3"            |               | R35      | 5.375<br>136.5    | 0.312<br>7.9  | 0.469<br>11.9 | 0.03<br>0.8          |                         |               |               | 6.62<br>168.1 |               |
| 4"           |              |                                                      |              |              |               |               | R36      | 5.875<br>149.2    | 0.250<br>6.4  | 0.344<br>8.7  | 0.03<br>0.8          | 6.75<br>171.5           |               |               |               |               |
|              | 4"           | 4"                                                   | 4"           | 4"           |               |               | R37      | 5.875<br>149.2    | 0.312<br>7.9  | 0.469<br>11.9 | 0.03<br>0.8          |                         | 6.88<br>174.8 | 7.12<br>180.8 |               |               |
|              |              |                                                      |              |              |               | 4"            | R38      | 6.188<br>157.2    | 0.438<br>11.1 | 0.656<br>16.7 | 0.06<br>1.5          |                         |               |               |               | 8.00<br>203.2 |
|              |              |                                                      |              |              | 4"            |               | R39      | 6.375<br>161.9    | 0.312<br>7.9  | 0.469<br>11.9 | 0.03<br>0.8          |                         |               | 7.62<br>193.5 |               |               |
| 5"           |              |                                                      |              |              |               |               | R40      | 6.750<br>149.2    | 0.250<br>6.4  | 0.344<br>8.7  | 0.03<br>0.8          | 7.75<br>171.5           |               |               |               |               |
|              | 5"           | 5"                                                   | 5"           | 5"           |               |               | R41      | 7.125<br>149.2    | 0.312<br>7.9  | 0.469<br>11.9 | 0.03<br>0.8          |                         | 8.25<br>209.5 | 8.50<br>215.9 |               |               |
|              |              |                                                      |              |              |               | 5"            | R42      | 7.500<br>190.5    | 0.500<br>12.7 | 0.781<br>19.8 | 0.06<br>1.5          |                         |               |               |               | 9.50<br>241.3 |
| 6"           |              |                                                      |              |              |               |               | R43      | 7.625<br>193.7    | 0.250<br>6.4  | 0.344<br>8.7  | 0.03<br>0.8          | 8.62<br>218.9           |               |               |               |               |
|              |              |                                                      |              |              | 5"            |               | R44      | 7.625<br>193.7    | 0.312<br>7.9  | 0.469<br>11.9 | 0.03<br>0.8          |                         |               |               | 9.00<br>228.6 |               |
|              | 6"           | 6"                                                   | 6"           | 6"           |               |               | R45      | 8.312<br>211.1    | 0.312<br>7.9  | 0.469<br>11.9 | 0.03<br>0.8          |                         | 9.50<br>241.3 | 9.50<br>241.3 |               |               |

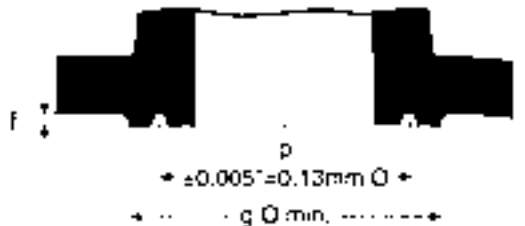
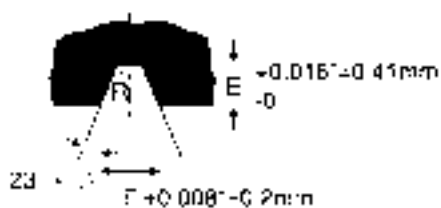
1) F = Height of raised portion and depth of grooved dimensions »E« but not covered by tolerances for »E«

\*) For ring joint with lapped flanges in the 300 and 600 lb standards, nng and groove number R 30 are used instead of R 31.



# Flanges: Ring Joint Facings

ANSI B 16.5

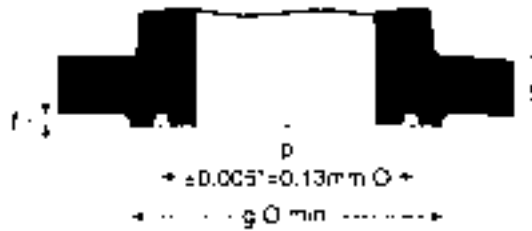
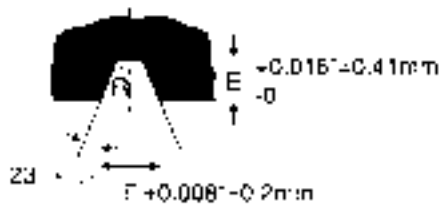


| Nominal Size |              |              |              |              |               |               | Ring No. | Groove Dimensions |               |                |                      | Diameter of Raised Face |                      |                |                |                |
|--------------|--------------|--------------|--------------|--------------|---------------|---------------|----------|-------------------|---------------|----------------|----------------------|-------------------------|----------------------|----------------|----------------|----------------|
| 150 lb/sq in | 300 lb/sq in | 400 lb/sq in | 600 lb/sq in | 900 lb/sq in | 1500 lb/sq in | 2500 lb/sq in |          | Pitch Dia meter   | Depth         | Width          | Radius at Bottom max | 150 lb/sq in            | 300 400 600 lb/sq in | 900 b/sq in    | 1500 b/sq in   | 2500 b/sq in   |
|              |              |              |              |              |               |               |          | P                 | E             | F              | R                    |                         |                      |                |                |                |
|              |              |              |              |              | 6"            |               | R46      | 8.312<br>211.1    | 0.375<br>9.5  | 0.531<br>13.5  | 0.06<br>1.5          |                         |                      |                | 9.75<br>247.7  |                |
|              |              |              |              |              |               | 6"            | R47      | 9.000<br>228.6    | 0.500<br>12.7 | 0.781<br>19.8  | 0.06<br>1.5          |                         |                      |                |                | 11.0<br>279.4  |
| 8"           |              |              |              |              |               |               | R48      | 9.750<br>247.7    | 0.450<br>6.4  | 0.344<br>8.7   | 0.03<br>0.8          | 10.75<br>273.1          |                      |                |                |                |
|              | 8"           | 8"           | 8"           | 8"           |               |               | R49      | 10.625<br>269.9   | 0.312<br>7.9  | 0.469<br>11.9  | 0.03<br>0.8          |                         | 11.88<br>301.8       | 12.12<br>307.8 |                |                |
|              |              |              |              |              | 8"            |               | R50      | 10.625<br>269.9   | 0.438<br>11.1 | 0.656<br>16.7  | 0.06<br>1.5          |                         |                      |                | 12.50<br>317.5 |                |
|              |              |              |              |              |               | 8"            | R51      | 11.000<br>279.4   | 0.562<br>14.3 | 0.906<br>23.0  | 0.06<br>1.5          |                         |                      |                |                | 13.38<br>339.9 |
| 10"          |              |              |              |              |               |               | R52      | 12.750<br>304.8   | 0.250<br>6.4  | 0.344<br>8.7   | 0.03<br>0.8          | 13.00<br>330.2          |                      |                |                |                |
|              | 10"          | 10"          | 10"          | 10"          |               |               | R53      | 12.750<br>323.9   | 0.312<br>7.9  | 0.469<br>11.9  | 0.03<br>0.8          |                         | 14.00<br>355.6       | 14.25<br>362.0 |                |                |
|              |              |              |              |              | 10"           |               | R54      | 12.750<br>323.9   | 0.438<br>11.1 | 0.656<br>16.7  | 0.06<br>1.5          |                         |                      |                | 14.62<br>371.5 |                |
|              |              |              |              |              |               | 10"           | R55      | 13.500<br>342.90  | 0.688<br>17.5 | 1.188<br>30.2  | 0.09<br>2.30         |                         |                      |                |                | 16.75<br>425.5 |
| 12"          |              |              |              |              |               |               | R56      | 15.000<br>381.0   | 0.250<br>6.4  | 0.344<br>8.7   | 0.03<br>0.8          | 16.00<br>406.4          |                      |                |                |                |
|              | 12"          | 12"          | 12"          | 12"          |               |               | R57      | 15.000<br>381.0   | 0.312<br>7.9  | 0.469<br>11.9  | 0.03<br>0.8          |                         | 16.25<br>412.8       | 16.50<br>419.1 |                |                |
|              |              |              |              |              | 12"           |               | R58      | 15.000<br>381.0   | 0.562<br>14.3 | 0.906<br>23.0  | 0.06<br>1.5          |                         |                      |                | 17.25<br>438.2 |                |
| 14"          |              |              |              |              |               |               | R59      | 15.625<br>396.9   | 0.250<br>6.4  | 0.344<br>8.7   | 0.03<br>0.8          | 16.75<br>425.5          |                      |                |                |                |
|              |              |              |              |              |               | 12"           | R60      | 16.000<br>406.4   | 0.688<br>17.5 | 1.312<br>33.30 | 0.09<br>2.3          |                         |                      |                |                | 19.50<br>495.3 |
|              | 14"          | 14"          | 14"          |              |               |               | R61      | 16.500<br>419.1   | 0.312<br>7.9  | 0.469<br>11.9  | 0.03<br>0.8          |                         | 18.00<br>457.2       |                |                |                |
|              |              |              |              | 14"          |               |               | R62      | 16.500<br>419.1   | 0.438<br>7.9  | 0.656<br>11.9  | 0.06<br>0.8          |                         |                      | 13.38<br>466.9 |                |                |
|              |              |              |              |              | 14"           |               | R63      | 16.500<br>419.1   | 0.625<br>15.9 | 1.062<br>27.0  | 0.09<br>2.3          |                         |                      |                | 19.50<br>489.0 |                |

1) f= Height of raised portion and depth of grooved dimensions »E« but not covered by tolerances for »E«

# Flanges: Ring Joint Facings

ANSI B 16.5



| Nominal Size       |                    |                    |                    |                    |                     |               | Ring<br>No. | Groove Dimensions     |               |                |                            | Diameter of Raised Face |                                  |                   |                    |                    |
|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------|---------------|-------------|-----------------------|---------------|----------------|----------------------------|-------------------------|----------------------------------|-------------------|--------------------|--------------------|
| 150<br>lb/sq<br>in | 300<br>lb/sq<br>in | 400<br>lb/sq<br>in | 600<br>lb/sg<br>in | 900<br>lb/sq<br>in | 1500<br>lb/sq<br>in | 2500<br>lb/sq |             | Pitch<br>Dia<br>meter | Depth         | Width          | Radius at<br>Bottom<br>max | 150<br>lb/sq<br>in      | g                                |                   |                    |                    |
|                    |                    |                    |                    |                    |                     |               |             |                       |               |                |                            |                         | 300<br>400<br>600<br>lb/sq<br>in | 900<br>b/sq<br>in | 1500<br>b/sq<br>in | 2500<br>b/sq<br>in |
| P                  | E                  | F                  | R                  |                    |                     |               |             |                       |               |                |                            |                         |                                  |                   |                    |                    |
| 16"                |                    |                    |                    |                    |                     |               | R64         | 17875<br>454.0        | 0.250<br>6.4  | 0.344<br>8.7   | 0.03<br>0.8                | 19.00<br>482.6          |                                  |                   |                    |                    |
|                    | 16"                | 16"                | 16"                |                    |                     |               | R65         | 18.500<br>469.9       | 0.312<br>7.9  | 0.469<br>11.9  | 0.03<br>0.8                |                         | 20.00<br>508.0                   |                   |                    |                    |
|                    |                    |                    |                    | 16"                |                     |               | R66         | 18.500<br>469.9       | 0.438<br>11.1 | 0.656<br>16.7  | 0.06<br>1.5                |                         |                                  | 20.62<br>523.7    |                    |                    |
|                    |                    |                    |                    |                    | 16"                 |               | R67         | 18.500<br>469.9       | 0.688<br>11.1 | 1.188<br>16.7  | 0.09<br>1.5                |                         |                                  | 523.7             | 21.50              |                    |
| 18"                |                    |                    |                    |                    |                     |               | R68         | 20.375<br>517.5       | 0.250<br>6.4  | 0.344<br>8.7   | 0.03<br>0.8                | 21.50<br>546.1          |                                  |                   |                    |                    |
|                    | 18"                | 18"                | 18"                |                    |                     |               | R69         | 21.000<br>533.4       | 0.312<br>7.9  | 0.469<br>11.9  | 0.03<br>0.8                |                         | 22.62<br>574.5                   |                   |                    |                    |
|                    |                    |                    |                    | 18"                |                     |               | R70         | 21.000<br>533.4       | 0.500<br>12.7 | 0.781<br>19.8  | 0.06<br>1.5                |                         |                                  | 23.38<br>593.9    |                    |                    |
|                    |                    |                    |                    |                    | 18"                 |               | R71         | 21.000<br>533.4       | 0.688<br>17.5 | 1.188<br>30.2  | 0.09<br>2.3                |                         |                                  |                   | 24.12<br>612.6     |                    |
| 20"                |                    |                    |                    |                    |                     |               | R72         | 22.000<br>558.86      | 0.250<br>6.4  | 0.344<br>8.7   | 0.03<br>0.8                | 23.50<br>596.9          |                                  |                   |                    |                    |
|                    | 20"                | 20"                | 20"                |                    |                     |               | R73         | 23.000<br>584.2       | 0.375<br>9.5  | 0.531<br>13.5  | 0.06<br>1.5                |                         | 25.00<br>635.0                   |                   |                    |                    |
|                    |                    |                    |                    | 20"                |                     |               | R74         | 23.000<br>584.2       | 0.500<br>12.7 | 0.781<br>19.8  | 0.06<br>1.5                |                         |                                  | 25.50<br>647.7    |                    |                    |
|                    |                    |                    |                    |                    | 20"                 |               | R75         | 23.000<br>584.2       | 0.688<br>17.5 | 1.312<br>33.3  | 0.09<br>2.3                |                         |                                  |                   | 26.50<br>673.1     |                    |
| 24"                |                    |                    |                    |                    |                     |               | R76         | 26.500<br>673.1       | 0.250<br>6.4  | 0.344<br>8.7   | 0.03<br>0.8                | 28.20<br>711.2          |                                  |                   |                    |                    |
|                    | 24"                | 24"                | 24"                |                    |                     |               | R77         | 27.250<br>692.2       | 0.438<br>11.1 | 0.656<br>16.7  | 0.06<br>1.5                |                         | 29.50<br>749.3                   |                   |                    |                    |
|                    |                    |                    |                    | 24"                |                     |               | R78         | 27.250<br>692.2       | 0.625<br>15.9 | 1.062<br>27.0  | 0.09<br>2.3                |                         |                                  | 30.38<br>771.7    |                    |                    |
|                    |                    |                    |                    |                    | 24"                 |               | R79         | 27.250<br>692.2       | 0.812<br>20.6 | 1.438<br>36.50 | 0.09<br>2.3                |                         |                                  |                   | 31.75<br>793.8     |                    |

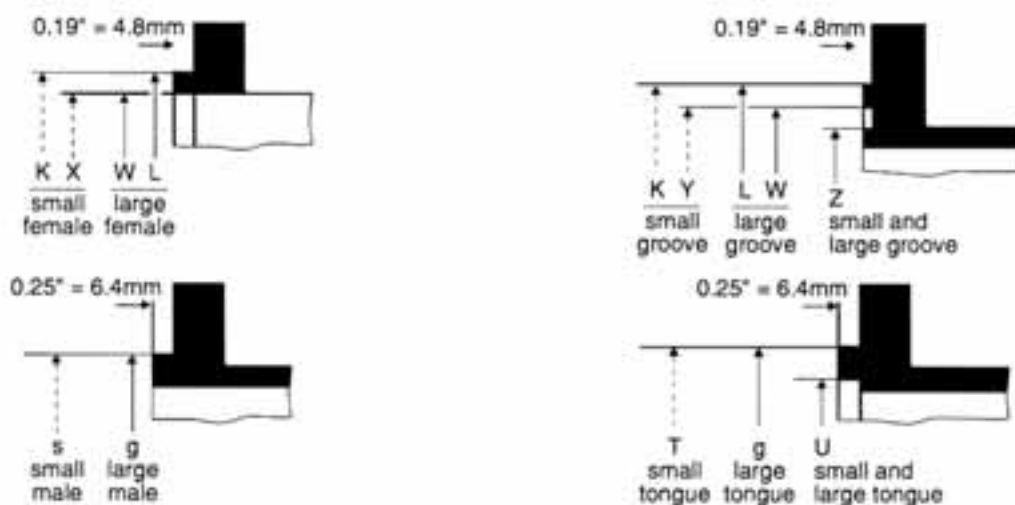
1) f= Height of raised portion and depth of grooved dimensions »E« but not covered by tolerances for »E«





# Large and Small Male / Female Facings Large and Small Tongue / Groove Facings

150 – 2500 LB/SQ.IN. ANSI B 16-5

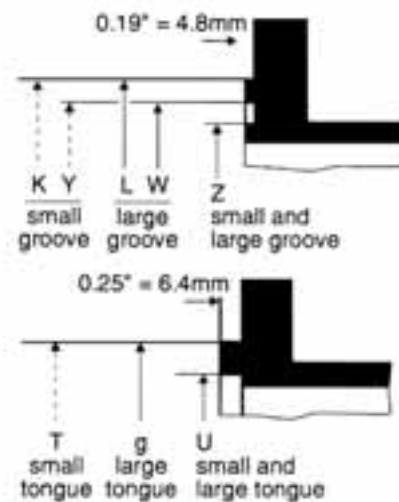
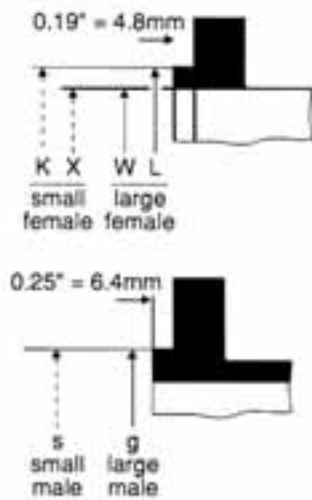


| Nom.<br>Pipe<br>Size | Outside Diameter                       |                    |                      | Inside Dia.<br>of Large<br>and Small<br>Tongue | Outside Diameter                  |                      |                      | Inside Diam.<br>of Large<br>and Small<br>Groove | Diameter<br>of Raised Face min.    |                                    |
|----------------------|----------------------------------------|--------------------|----------------------|------------------------------------------------|-----------------------------------|----------------------|----------------------|-------------------------------------------------|------------------------------------|------------------------------------|
|                      | Large Male<br>and Large<br>Tongue<br>g | Small<br>Male<br>S | Small<br>Tongue<br>T |                                                | Large<br>Female<br>and Large<br>W | Small<br>Female<br>X | Small<br>Groove<br>Y |                                                 | Small<br>Female<br>and Groove<br>K | Large<br>Female<br>and Groove<br>L |
| 1/2"                 | 1.38                                   | 0.72               | 1.38                 | 1.00                                           | 1.44                              | 0.78                 | 1.44                 | 0.94                                            | 1.75                               | 1.81                               |
|                      | 35.1                                   | 18.3               | 35.1                 | 25.4                                           | 36.61                             | 19.8                 | 36.6                 | 23.9                                            | 44.5                               | 46.0                               |
| 3/4"                 | 1.69                                   | 0.94               | 1.69                 | 1.31                                           | 1.75                              | 1.00                 | 1.75                 | 1.25                                            | 2.06                               | 2.12                               |
|                      | 42.9                                   | 23.9               | 42.9                 | 33.3                                           | 44.5                              | 25.4                 | 44.5                 | 31.8                                            | 52.3                               | 53.8                               |
| 1"                   | 2.00                                   | 1.19               | 1.88                 | 1.50                                           | 2.06                              | 1.25                 | 1.94                 | 1.44                                            | 2.25                               | 2.44                               |
|                      | 50.8                                   | 30.2               | 47.8                 | 38.1                                           | 52.3                              | 31.8                 | 49.3                 | 36.6                                            | 57.2                               | 62.0                               |
| 1 1/4"               | 2.50                                   | 1.50               | 2.25                 | 1.88                                           | 2.56                              | 1.56                 | 2.31                 | 1.81                                            | 2.62                               | 2.94                               |
|                      | 63.5                                   | 38.1               | 57.2                 | 47.8                                           | 65.0                              | 39.6                 | 58.7                 | 46.0                                            | 66.5                               | 74.7                               |
| 1 1/2"               | 2.88                                   | 1.75               | 2.50                 | 2.12                                           | 2.94                              | 1.81                 | 2.56                 | 2.06                                            | 2.88                               | 3.31                               |
|                      | 73.2                                   | 44.5               | 63.5                 | 53.8                                           | 74.7                              | 46.0                 | 65.0                 | 52.3                                            | 73.2                               | 84.1                               |
| 2"                   | 3.62                                   | 2.25               | 3.25                 | 2.88                                           | 3.69                              | 2.31                 | 3.31                 | 2.81                                            | 3.62                               | 4.06                               |
|                      | 91.9                                   | 57.2               | 82.6                 | 73.2                                           | 93.7                              | 58.7                 | 84.1                 | 71.4                                            | 91.9                               | 103.1                              |
| 2 1/2"               | 4.12                                   | 2.69               | 3.75                 | 3.38                                           | 4.19                              | 2.75                 | 3.81                 | 3.31                                            | 4.12                               | 4.56                               |
|                      | 104.6                                  | 68.3               | 95.3                 | 85.9                                           | 106.4                             | 69.9                 | 96.8                 | 84.1                                            | 104.6                              | 115.8                              |
| 3"                   | 5.00                                   | 3.31               | 4.62                 | 4.25                                           | 5.06                              | 3.38                 | 4.69                 | 4.19                                            | 5.00                               | 5.44                               |
|                      | 127.0                                  | 84.1               | 117.3                | 108.0                                          | 128.5                             | 85.9                 | 119.1                | 106.4                                           | 127.0                              | 138.2                              |
| 3 1/2"               | 5.50                                   | 3.81               | 5.12                 | 4.75                                           | 5.56                              | 3.88                 | 5.19                 | 4.69                                            | 5.50                               | 5.94                               |
|                      | 139.7                                  | 96.8               | 130.0                | 120.7                                          | 141.2                             | 98.6                 | 131.8                | 119.1                                           | 139.7                              | 150.9                              |
| 4"                   | 6.19                                   | 4.31               | 5.69                 | 5.19                                           | 6.25                              | 4.38                 | 5.75                 | 5.12                                            | 6.19                               | 6.62                               |
|                      | 157.2                                  | 109.5              | 144.5                | 131.8                                          | 158.8                             | 111.3                | 146.1                | 130.0                                           | 157.2                              | 168.1                              |

Large male and female face and large tongue and groove are not applicable to Class 150 because of potential dimensional conflicts.

# Large and Small Male / Female Facings Large and Small Tongue / Groove Facings

150 – 2500 LB/SQ.IN. ANSI B 16-5



| Nom.<br>Pipe<br>Size | Outside Diameter                       |                    |                      | Inside Dia.<br>of Large<br>and Small<br>Tongue | Outside Diameter                  |                      |                      | Inside Diam.<br>of Large<br>and Small<br>Groove | Diameter<br>of Raised Face min.    |                                    |
|----------------------|----------------------------------------|--------------------|----------------------|------------------------------------------------|-----------------------------------|----------------------|----------------------|-------------------------------------------------|------------------------------------|------------------------------------|
|                      | Large Male<br>and Large<br>Tongue<br>g | Small<br>Male<br>S | Small<br>Tongue<br>T |                                                | Large<br>Female<br>and Large<br>W | Small<br>Female<br>X | Small<br>Groove<br>Y |                                                 | Small<br>Female<br>and Groove<br>K | Large<br>Female<br>and Groove<br>L |
| 5"                   | 731                                    | 538                | 681                  | 631                                            | 738                               | 544                  | 688                  | 625                                             | 731                                | 775                                |
|                      | 185.7                                  | 136.7              | 173.0                | 160.3                                          | 187.5                             | 138.2                | 174.8                | 158.8                                           | 185.7                              | 196.9                              |
| 6"                   | 850                                    | 638                | 800                  | 750                                            | 856                               | 644                  | 806                  | 744                                             | 850                                | 894                                |
|                      | 215.9                                  | 162.1              | 203.2                | 190.5                                          | 217.4                             | 163.6                | 204.7                | 189.0                                           | 215.9                              | 227.1                              |
| 8"                   | 1062                                   | 838                | 1000                 | 938                                            | 1069                              | 844                  | 1006                 | 931                                             | 1062                               | 1106                               |
|                      | 269.7                                  | 212.9              | 254.0                | 238.3                                          | 217.5                             | 214.4                | 255.5                | 236.5                                           | 269.7                              | 280.9                              |
| 10"                  | 1275                                   | 1050               | 1200                 | 1125                                           | 1281                              | 1056                 | 1206                 | 1119                                            | 1275                               | 1319                               |
|                      | 323.9                                  | 266.7              | 304.8                | 285.8                                          | 325.4                             | 268.3                | 306.3                | 284.2                                           | 323.9                              | 335.0                              |
| 12"                  | 1500                                   | 1250               | 1425                 | 1350                                           | 1506                              | 1256                 | 1431                 | 1344                                            | 1500                               | 1544                               |
|                      | 381.0                                  | 317.5              | 362.0                | 342.9                                          | 382.5                             | 319.0                | 363.5                | 341.4                                           | 381.0                              | 392.2                              |
| 14"                  | 1625                                   | 1375               | 1550                 | 1475                                           | 1631                              | 1381                 | 1556                 | 1469                                            | 1625                               | 1669                               |
|                      | 412.8                                  | 349.3              | 393.7                | 374.7                                          | 414.3                             | 350.8                | 395.2                | 373.1                                           | 412.8                              | 423.9                              |
| 16"                  | 1850                                   | 1575               | 1762                 | 1675                                           | 1856                              | 1581                 | 1769                 | 1669                                            | 1850                               | 1894                               |
|                      | 469.9                                  | 400.1              | 447.5                | 425.5                                          | 471.4                             | 401.6                | 449.3                | 423.9                                           | 469.9                              | 481.1                              |
| 18"                  | 2100                                   | 1775               | 2012                 | 1925                                           | 2106                              | 1781                 | 2019                 | 1919                                            | 2100                               | 2144                               |
|                      | 533.4                                  | 450.9              | 511.0                | 489.0                                          | 534.9                             | 452.4                | 512.8                | 487.4                                           | 533.4                              | 544.6                              |
| 20"                  | 2300                                   | 1975               | 2200                 | 2100                                           | 2306                              | 1981                 | 2206                 | 2094                                            | 2300                               | 2344                               |
|                      | 584.2                                  | 501.7              | 558.8                | 533.4                                          | 585.7                             | 503.2                | 560.3                | 531.9                                           | 584.2                              | 595.4                              |
| 24"                  | 2725                                   | 2375               | 2625                 | 2525                                           | 2731                              | 2381                 | 2631                 | 2519                                            | 2725                               | 2769                               |
|                      | 692.2                                  | 603.3              | 666.8                | 641.4                                          | 693.7                             | 604.8                | 668.3                | 639.8                                           | 692.2                              | 703.3                              |

Large male and female face and large tongue and groove are not applicable to Class 150 because of potential dimensional conflicts.



# Flanges

Flanges corresponding to German standards for tubing and piping to DIN and ISO

| Types of flange                                 | DIN-tables, pressure and nominal widths |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
|-------------------------------------------------|-----------------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|---------------------------------|------------------|--------------|---------------|--------------|--------------|--------------|
| Welding neck Flanges                            | 2631<br>(PN 6)<br>DN<br>10-100          | 2632<br>(PN 10)<br>DN<br>10-100  | 2633<br>(PN 16)<br>DN<br>10-100  | 2634<br>(PN 25)<br>DN<br>10-100  | 2635<br>(PN 40)<br>DN<br>10-500  | 2636<br>(PN 64)<br>DN<br>10-400 |                  |              |               |              |              |              |
|                                                 | 2637<br>(PN 160)<br>DN<br>10-350        | 2638<br>(PN 160)<br>DN<br>10-300 | 2628<br>(PN 250)<br>DN<br>10-250 | 2629<br>(PN 320)<br>DN<br>10-250 | 2627<br>(PN 400)<br>DN<br>10-200 |                                 |                  |              |               |              |              |              |
|                                                 |                                         |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
|                                                 | Block Flanges                           |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
|                                                 | 28117<br>(PN 10-40)<br>DN<br>15-500     |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
|                                                 |                                         |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
|                                                 | Plain Flanges and threaded flanges      |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
|                                                 | 2573<br>(PN 6)<br><br>DN<br>10-500      |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
| 2576<br>(PN 10)<br><br>DN<br>10-500             |                                         |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
| 2566<br>(PN 10-16)<br><br>DN<br>6-100           |                                         |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
|                                                 |                                         |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
| Plain Collars with loose langes                 |                                         |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
| 2641<br>(PN 6)<br><br>DN<br>10-1000             |                                         |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
| 2642<br>(PN 10)<br><br>DN<br>10-800             |                                         |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
| 2655<br>(PN 25)<br><br>DN<br>200-500            |                                         |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
| 2656<br>(PN 40)<br><br>DN<br>10-400             |                                         |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
|                                                 |                                         |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
| Welding neck Collars with loose Flanges         |                                         |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
| 2673<br>(PN 10)<br>DN<br>10-1000                |                                         |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
| 2674<br>(PN 16)<br>DN<br>10-500                 |                                         |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
| 2675<br>(PN 25)<br>DN<br>200-500                |                                         |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
| 2676<br>(PN 40)<br>DN<br>10-500                 |                                         |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
|                                                 |                                         |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
| Seamless long/Welding neck for pressure vessels | 28115<br>(PN 10-40)<br><br>DN<br>25-500 | 28031<br><br>DN<br>300-1100      | 28032<br><br>DN<br>300-1100      | 28034<br><br>DN<br>300-1100      | 28036<br><br>DN<br>300-1100      | 28038<br><br>DN<br>1000-1100    |                  |              |               |              |              |              |
|                                                 | 2527<br>(PN 6)                          | 2527<br>(PN 10)                  | 2527<br>(PN 16)                  | 2527<br>(PN 25)                  | 2527<br>(PN 40)                  | 2527<br>(PN 64)                 | 2527<br>(PN 100) |              |               |              |              |              |
|                                                 |                                         |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
|                                                 | Blind Flanges                           |                                  |                                  |                                  |                                  |                                 |                  |              |               |              |              |              |
| DN<br>10-300                                    |                                         |                                  |                                  |                                  |                                  |                                 | DN<br>200-500    | DN<br>10-500 | DN<br>175-500 | DN<br>10-500 | DN<br>50-400 | DN<br>10-350 |

# Weld-Neck-Flange

DIN 2631 PN 06



| Nominal Bore |        |        | Flange |    |      |     | Meck |     |    |    | RF   |   | Stud Bolt |        |    | Weight of     |
|--------------|--------|--------|--------|----|------|-----|------|-----|----|----|------|---|-----------|--------|----|---------------|
| NB           | d1     |        |        |    |      |     |      |     |    |    |      |   | pc.       | thread | D2 | a Flange      |
|              | Part 1 | Part 2 | D      | b  | k    | h1  | d3   | s   | r  | h2 | d4   | f |           |        |    | (7,85 kg/dm3) |
| 10           | -      | 14     | 75     | 12 | 50   | 28  | 22   | 1.8 | 4  | 6  | 35   | 2 | 4         | M10    | 11 | 0.335         |
| 10           | 17.2   | -      | 75     | 12 | 50   | 28  | 26   | 1.8 | 4  | 6  | 35   | 2 | 4         | M10    | 11 | 0.335         |
| 15           | -      | 20     | 80     | 12 | 55   | 30  | 28   | 2   | 4  | 6  | 40   | 2 | 4         | M10    | 11 | 0.392         |
| 15           | 21.3   | -      | 80     | 12 | 55   | 30  | 30   | 2   | 4  | 6  | 40   | 2 | 4         | M10    | 11 | 0.392         |
| 20           | -      | 25     | 90     | 14 | 65   | 32  | 35   | 2.3 | 4  | 6  | 50   | 2 | 4         | M10    | 11 | 0.592         |
| 20           | 26.9   | -      | 90     | 14 | 65   | 32  | 38   | 2.3 | 4  | 6  | 50   | 2 | 4         | M10    | 11 | 0.592         |
| 25           | -      | 30     | 100    | 14 | 75   | 35  | 40   | 2.6 | 4  | 6  | 60   | 2 | 4         | M10    | 11 | 0.747         |
| 25           | 33.7   | -      | 100    | 14 | 75   | 35  | 42   | 2.6 | 4  | 6  | 60   | 2 | 4         | M10    | 11 | 0.747         |
| 32           | -      | 38     | 120    | 14 | 90   | 35  | 50   | 2.6 | 6  | 6  | 70   | 2 | 4         | M12    | 14 | 1.050         |
| 32           | 42.4   | -      | 120    | 14 | 90   | 35  | 55   | 2.6 | 6  | 6  | 70   | 2 | 4         | M12    | 14 | 1.050         |
| 40           | -      | 44.5   | 130    | 14 | 100  | 38  | 58   | 2.6 | 6  | 7  | 80   | 3 | 4         | M12    | 14 | 1.180         |
| 40           | 48.3   | -      | 130    | 14 | 100  | 38  | 62   | 2.6 | 6  | 7  | 80   | 3 | 4         | M12    | 14 | 1.180         |
| 50           | -      | 57     | 140    | 14 | 110  | 38  | 70   | 2.9 | 6  | 8  | 90   | 3 | 4         | M12    | 14 | 1.340         |
| 50           | 60.3   | -      | 140    | 14 | 110  | 38  | 74   | 2.9 | 6  | 8  | 90   | 3 | 4         | M12    | 14 | 1.340         |
| 65           | 76.1   | -      | 160    | 14 | 130  | 38  | 88   | 2.9 | 6  | 9  | 110  | 3 | 4         | M12    | 14 | 1.670         |
| 80           | 88.9   | -      | 190    | 16 | 150  | 42  | 102  | 3.2 | 8  | 10 | 128  | 3 | 4         | M16    | 18 | 2.710         |
| 100          | -      | 108    | 210    | 16 | 170  | 45  | 122  | 3.6 | 8  | 10 | 148  | 3 | 4         | M16    | 18 | 3.240         |
| 100          | 114.3  | -      | 210    | 16 | 170  | 45  | 130  | 3.6 | 8  | 10 | 148  | 3 | 4         | M16    | 18 | 3.240         |
| 125          | -      | 133    | 240    | 18 | 200  | 48  | 148  | 4   | 8  | 10 | 178  | 3 | 8         | M16    | 18 | 4.490         |
| 125          | 139.7  | -      | 240    | 18 | 200  | 48  | 155  | 4   | 8  | 10 | 178  | 3 | 8         | M16    | 18 | 4.490         |
| 150          | -      | 159    | 265    | 18 | 225  | 48  | 172  | 4.5 | 10 | 12 | 202  | 3 | 8         | M16    | 18 | 5.150         |
| 150          | 168.3  | -      | 265    | 18 | 225  | 48  | 184  | 4.5 | 10 | 12 | 202  | 3 | 8         | M16    | 18 | 5.150         |
| 200          | 219.1  | -      | 320    | 20 | 280  | 55  | 236  | 5.9 | 10 | 15 | 258  | 3 | 8         | M16    | 18 | 7.780         |
| 250          | -      | 267    | 375    | 22 | 335  | 60  | 282  | 6.3 | 12 | 15 | 312  | 3 | 12        | M16    | 18 | 10.80         |
| 250          | 273    | -      | 375    | 22 | 335  | 60  | 290  | 6.3 | 12 | 15 | 312  | 3 | 12        | M16    | 18 | 10.80         |
| 300          | 323.9  | -      | 440    | 22 | 395  | 62  | 342  | 7.1 | 12 | 15 | 365  | 4 | 12        | M20    | 22 | 14.00         |
| 350          | 355.6  | -      | 490    | 22 | 445  | 62  | 385  | 7.1 | 12 | 15 | 415  | 4 | 12        | M20    | 22 | 18.50         |
| 350          | -      | 368    | 490    | 22 | 445  | 62  | 385  | 7.1 | 12 | 15 | 415  | 4 | 12        | M20    | 22 | 16.70         |
| 400          | 406.4  | -      | 540    | 22 | 495  | 65  | 438  | 7.1 | 12 | 15 | 465  | 4 | 16        | M20    | 22 | 21.20         |
| 400          | -      | 419    | 540    | 22 | 495  | 65  | 438  | 7.1 | 12 | 15 | 465  | 4 | 16        | M20    | 22 | 19.00         |
| 500          | 508    | -      | 645    | 24 | 600  | 68  | 538  | 7.1 | 12 | 15 | 570  | 4 | 20        | M20    | 22 | 28.60         |
| 600          | 610    | -      | 755    | 24 | 705  | 70  | 640  | 7.1 | 12 | 16 | 670  | 5 | 20        | M24    | 26 | 31.50         |
| 700          | 711    | -      | 860    | 24 | 810  | 70  | 740  | 7.1 | 12 | 16 | 775  | 5 | 24        | M24    | 26 | 37.40         |
| 800          | 813    | -      | 975    | 24 | 920  | 70  | 842  | 7.1 | 12 | 16 | 880  | 5 | 24        | M27    | 30 | 46.10         |
| 900          | 914    | -      | 1075   | 26 | 1020 | 70  | 942  | 7.1 | 12 | 16 | 980  | 5 | 24        | M27    | 30 | 55.60         |
| 1000         | 1016   | -      | 1175   | 26 | 1120 | 70  | 1045 | 7.1 | 16 | 16 | 1080 | 5 | 28        | M27    | 30 | 61.90         |
| 1200         | 1220   | -      | 1405   | 28 | 1340 | 90  | 1248 | 8   | 16 | 20 | 1295 | 5 | 32        | M30    | 33 | 100.0         |
| 1400         | 1420   | -      | 1630   | 32 | 1560 | 90  | 1452 | 8   | 16 | 20 | 1510 | 5 | 36        | M33    | 36 | 149.0         |
| 1600         | 1620   | -      | 1830   | 34 | 1760 | 90  | 1655 | 9   | 16 | 20 | 1710 | 5 | 40        | M33    | 36 | 180.0         |
| 1800         | 1820   | -      | 2045   | 36 | 1970 | 100 | 1855 | 10  | 16 | 20 | 1920 | 5 | 44        | M36    | 39 | 225.0         |
| 2000         | 2020   | -      | 2265   | 38 | 2180 | 110 | 2058 | 11  | 16 | 25 | 2125 | 5 | 48        | M39    | 42 | 295.0         |
| 2200         | 2220   | -      | 2475   | 42 | 2390 | 115 | 2260 | 12  | 18 | 25 | 2335 | 6 | 52        | M39    | 42 | 361.0         |
| 2400         | 2420   | -      | 2685   | 44 | 2600 | 125 | 2462 | 13  | 18 | 25 | 2545 | 6 | 56        | M39    | 42 | 415.0         |
| 2600         | 2620   | -      | 2905   | 46 | 2810 | 130 | 2665 | 14  | 18 | 25 | 2750 | 6 | 60        | M45    | 48 | 530.0         |
| 2800         | 2820   | -      | 3115   | 48 | 3020 | 135 | 2865 | 15  | 18 | 30 | 2960 | 6 | 64        | M45    | 48 | 643.0         |
| 3000         | 3020   | -      | 3315   | 50 | 3220 | 140 | 3068 | 16  | 18 | 30 | 3160 | 6 | 68        | M45    | 48 | 777.0         |
| 3200         | 3220   | -      | 3525   | 54 | 3430 | 150 | 3272 | 16  | 20 | 30 | 3370 | 6 | 72        | M45    | 48 | 851.0         |
| 3400         | 3420   | -      | 3735   | 56 | 3640 | 160 | 3475 | 18  | 20 | 35 | 3580 | 6 | 76        | M45    | 48 | 993.0         |
| 3600         | 3620   | -      | 3970   | 60 | 3860 | 165 | 3678 | 18  | 20 | 35 | 3790 | 6 | 80        | M52    | 56 | 1001          |

The values in Part 2 are applicable for German standard.



# Weld-Neck-Flange

DIN 2632 PN 10



| Nominal Bore |        |        | Flange |    |      |     | Meck |     |    |    | RF   |   | Stud Bolt |        |    | Weight of<br>a Flange<br>(7,85 kg/dm3) |
|--------------|--------|--------|--------|----|------|-----|------|-----|----|----|------|---|-----------|--------|----|----------------------------------------|
| NB           | d1     |        | D      | b  | k    | h1  | d3   | s   | r  | h2 | d4   | f | pc.       | thread | D2 |                                        |
|              | Part 1 | Part 2 |        |    |      |     |      |     |    |    |      |   |           |        |    |                                        |
| 200          | 219.1  | -      | 340    | 24 | 295  | 62  | 235  | 5.9 | 10 | 16 | 268  | 3 | 8         | M20    | 22 | 11.3                                   |
| 250          | -      | 267    | 395    | 26 | 350  | 68  | 285  | 6.3 | 12 | 16 | 320  | 3 | 12        | M20    | 22 | 14.7                                   |
| 250          | 273    | -      | 395    | 26 | 350  | 68  | 292  | 6.3 | 12 | 16 | 320  | 3 | 12        | M20    | 22 | 14.7                                   |
| 300          | 323.9  | -      | 445    | 26 | 400  | 68  | 344  | 7.1 | 12 | 16 | 370  | 4 | 12        | M20    | 22 | 17.4                                   |
| 350          | 355.6  | -      | 505    | 26 | 460  | 68  | 385  | 7.1 | 12 | 16 | 430  | 4 | 16        | M20    | 22 | 23.6                                   |
| 350          | -      | 368    | 505    | 26 | 460  | 68  | 385  | 7.1 | 12 | 16 | 430  | 4 | 16        | M20    | 22 | 21.6                                   |
| 400          | 406.4  | -      | 565    | 26 | 515  | 72  | 440  | 7.1 | 12 | 16 | 482  | 4 | 16        | M24    | 26 | 28.6                                   |
| 400          | -      | 419    | 565    | 26 | 515  | 72  | 440  | 7.1 | 12 | 16 | 482  | 4 | 16        | M24    | 26 | 26.2                                   |
| 500          | 508    | -      | 670    | 28 | 620  | 75  | 542  | 7.1 | 12 | 16 | 585  | 4 | 20        | M24    | 26 | 38.1                                   |
| 600          | 610    | -      | 780    | 28 | 725  | 80  | 642  | 7.1 | 12 | 18 | 685  | 5 | 20        | M27    | 30 | 44.6                                   |
| 700          | 711    | -      | 895    | 30 | 840  | 80  | 745  | 8   | 12 | 18 | 800  | 5 | 24        | M27    | 30 | 62.4                                   |
| 800          | 813    | -      | 1015   | 32 | 950  | 90  | 850  | 8   | 12 | 18 | 905  | 5 | 24        | M30    | 33 | 84.1                                   |
| 900          | 914    | -      | 1115   | 34 | 1050 | 95  | 950  | 10  | 12 | 20 | 1005 | 5 | 28        | M30    | 33 | 98.5                                   |
| 1000         | 1016   | -      | 1230   | 34 | 1160 | 95  | 1052 | 10  | 16 | 20 | 1110 | 5 | 28        | M33    | 36 | 115.0                                  |
| 1200         | 1220   | -      | 1455   | 38 | 1380 | 115 | 1255 | 11  | 16 | 25 | 1330 | 5 | 32        | M36    | 39 | 182.0                                  |
| 1400         | 1420   | -      | 1675   | 42 | 1590 | 120 | 1460 | 12  | 16 | 25 | 1535 | 5 | 36        | M39    | 42 | 248.0                                  |
| 1600         | 1620   | -      | 1915   | 46 | 1820 | 130 | 1665 | 14  | 16 | 25 | 1760 | 5 | 40        | M45    | 48 | 347.0                                  |
| 1800         | 1820   | -      | 2115   | 50 | 2020 | 140 | 1868 | 15  | 16 | 30 | 1960 | 5 | 44        | M45    | 48 | 430.0                                  |
| 2000         | 2020   | -      | 2325   | 54 | 2230 | 150 | 2072 | 16  | 16 | 30 | 2170 | 5 | 48        | M45    | 48 | 539.0                                  |
| 2200         | 2220   | -      | 2550   | 58 | 2440 | 160 | 2275 | 18  | 18 | 35 | 2370 | 6 | 52        | M52    | 56 | 658.0                                  |
| 2400         | 2420   | -      | 2760   | 62 | 2650 | 170 | 2478 | 20  | 18 | 35 | 2570 | 6 | 56        | M52    | 56 | 825.0                                  |
| 2600         | 2620   | -      | 2960   | 66 | 2850 | 180 | 2680 | 22  | 18 | 40 | 2780 | 6 | 60        | M52    | 56 | 979.0                                  |
| 2800         | 2820   | -      | 3180   | 70 | 3070 | 190 | 2882 | 22  | 18 | 40 | 3000 | 6 | 64        | M52    | 56 | 1156.0                                 |
| 3000         | 3020   | -      | 3405   | 75 | 3290 | 200 | 3085 | 24  | 18 | 45 | 3210 | 6 | 68        | M56    | 62 | 1402.0                                 |

From NB 10 up to NB 150 Weld-Neck-Flange acc.to DIN 2633, use nominal pressure 16.

The values in Part 2 are applicable for German standards.

The values in Part 2 are applicable for German standard.

# Weld-Neck-Flange

DIN 2633 PN 16



| Nominal Bore |        |        | Flange |    |      |     | Meck |      |    |    | RF   |   | Stud Bolt |        |    | Weight of     |
|--------------|--------|--------|--------|----|------|-----|------|------|----|----|------|---|-----------|--------|----|---------------|
| NB           | d1     |        |        |    |      |     |      |      |    |    |      |   | pc.       | thread | D2 | a Flange      |
|              | Part 1 | Part 2 | D      | b  | k    | h1  | d3   | s    | r  | h2 | d4   | f |           |        |    | (7,85 kg/dm3) |
| 10           | -      | 14     | 90     | 14 | 60   | 35  | 25   | 1.8  | 4  | 6  | 40   | 2 | 4         | M12    | 14 | 0.580         |
| 10           | 17.2   | -      | 90     | 14 | 60   | 35  | 28   | 1.8  | 4  | 6  | 40   | 2 | 4         | M12    | 14 | 0.580         |
| 15           | -      | 20     | 95     | 14 | 65   | 35  | 30   | 2    | 4  | 6  | 45   | 2 | 4         | M12    | 14 | 0.648         |
| 15           | 21.3   | -      | 95     | 14 | 65   | 35  | 32   | 2    | 4  | 6  | 45   | 2 | 4         | M12    | 14 | 0.648         |
| 20           | -      | 25     | 105    | 16 | 75   | 38  | 38   | 2.3  | 4  | 6  | 58   | 2 | 4         | M12    | 14 | 0.952         |
| 20           | 26.9   | -      | 105    | 16 | 75   | 38  | 40   | 2.3  | 4  | 6  | 58   | 2 | 4         | M12    | 14 | 0.952         |
| 25           | -      | 30     | 115    | 16 | 85   | 38  | 42   | 2.6  | 4  | 6  | 68   | 2 | 4         | M12    | 14 | 1.140         |
| 25           | 33.7   | -      | 115    | 16 | 85   | 38  | 45   | 2.6  | 4  | 6  | 68   | 2 | 4         | M12    | 14 | 1.140         |
| 32           | -      | 38     | 140    | 16 | 100  | 40  | 52   | 2.6  | 6  | 6  | 78   | 2 | 4         | M16    | 18 | 1.690         |
| 32           | 42.4   | -      | 140    | 16 | 100  | 40  | 56   | 2.6  | 6  | 6  | 78   | 2 | 4         | M16    | 18 | 1.690         |
| 40           | -      | 44.5   | 150    | 16 | 110  | 42  | 60   | 2.6  | 6  | 7  | 88   | 3 | 4         | M16    | 18 | 1.860         |
| 40           | 48.3   | -      | 150    | 16 | 110  | 42  | 64   | 2.6  | 6  | 7  | 88   | 3 | 4         | M16    | 18 | 1.860         |
| 50           | -      | 57     | 165    | 18 | 125  | 45  | 72   | 2.9  | 6  | 8  | 102  | 3 | 4         | M16    | 18 | 2.530         |
| 50           | 63.3   | -      | 165    | 18 | 125  | 45  | 75   | 2.9  | 6  | 8  | 102  | 3 | 4         | M16    | 18 | 2.530         |
| 65           | 76.1   | -      | 185    | 18 | 145  | 45  | 90   | 2.9  | 6  | 10 | 122  | 3 | 4         | M16    | 18 | 3.060         |
| 80           | 88.9   | -      | 200    | 20 | 160  | 50  | 105  | 3.2  | 8  | 10 | 138  | 3 | 8         | M16    | 18 | 3.700         |
| 100          | -      | 108    | 220    | 20 | 180  | 52  | 125  | 3.6  | 8  | 12 | 158  | 3 | 8         | M16    | 18 | 4.620         |
| 100          | 114.3  | -      | 220    | 20 | 180  | 52  | 131  | 3.6  | 8  | 12 | 158  | 3 | 8         | M16    | 18 | 4.620         |
| 125          | -      | 133    | 250    | 22 | 210  | 55  | 150  | 4    | 8  | 12 | 188  | 3 | 8         | M16    | 18 | 6.300         |
| 125          | 139.7  | -      | 250    | 22 | 210  | 55  | 156  | 4    | 8  | 12 | 188  | 3 | 8         | M16    | 18 | 6.300         |
| 150          | -      | 159    | 285    | 22 | 240  | 55  | 175  | 4.5  | 10 | 12 | 212  | 3 | 8         | M20    | 22 | 7.750         |
| 150          | 168.3  | -      | 285    | 22 | 240  | 55  | 184  | 4.5  | 10 | 12 | 212  | 3 | 8         | M20    | 22 | 7.750         |
| 175          | 193.7  | -      | 315    | 24 | 270  | 60  | 210  | 5.4  | 10 | 12 | 242  | 3 | 8         | M20    | 22 | 9.850         |
| 200          | 219.1  | -      | 340    | 24 | 295  | 62  | 235  | 5.9  | 10 | 16 | 268  | 3 | 12        | M20    | 22 | 11.00         |
| 250          | -      | 267    | 405    | 26 | 355  | 70  | 285  | 6.3  | 12 | 16 | 320  | 3 | 12        | M24    | 26 | 15.60         |
| 250          | 273    | -      | 405    | 26 | 355  | 70  | 292  | 6.3  | 12 | 16 | 320  | 3 | 12        | M24    | 26 | 15.60         |
| 300          | 323.9  | -      | 460    | 28 | 410  | 78  | 344  | 7.1  | 12 | 16 | 378  | 4 | 12        | M24    | 26 | 22.00         |
| 350          | 355.6  | -      | 520    | 30 | 470  | 82  | 390  | 8    | 12 | 16 | 438  | 4 | 16        | M24    | 26 | 31.20         |
| 350          | -      | 368    | 520    | 30 | 470  | 82  | 390  | 8    | 12 | 16 | 438  | 4 | 16        | M24    | 26 | 28.80         |
| 400          | 406.4  | -      | 580    | 32 | 525  | 85  | 445  | 8    | 12 | 16 | 490  | 4 | 16        | M27    | 30 | 39.30         |
| 500          | 508    | -      | 715    | 34 | 650  | 90  | 548  | 8    | 12 | 16 | 610  | 4 | 20        | M30    | 33 | 61.00         |
| 600          | 610    | -      | 840    | 36 | 770  | 95  | 652  | 8.8  | 12 | 18 | 725  | 5 | 20        | M33    | 36 | 75.40         |
| 700          | 711    | -      | 910    | 36 | 840  | 100 | 755  | 8.8  | 12 | 18 | 795  | 5 | 24        | M33    | 36 | 77.00         |
| 800          | 813    | -      | 1025   | 38 | 950  | 105 | 855  | 10   | 12 | 20 | 900  | 5 | 24        | M36    | 39 | 101.0         |
| 900          | 914    | -      | 1125   | 40 | 1050 | 110 | 955  | 10   | 12 | 20 | 1000 | 5 | 28        | M36    | 39 | 122.0         |
| 1000         | 1016   | -      | 1255   | 42 | 1170 | 120 | 1058 | 10   | 16 | 22 | 1115 | 5 | 28        | M39    | 42 | 162.0         |
| 1200         | 1220   | -      | 1485   | 48 | 1390 | 130 | 1262 | 12.5 | 16 | 30 | 1330 | 5 | 32        | M45    | 48 | 243.0         |
| 1400         | 1420   | -      | 1685   | 52 | 1590 | 145 | 1465 | 14.2 | 16 | 30 | 1530 | 5 | 36        | M45    | 48 | 323.0         |
| 1600         | 1620   | -      | 1930   | 58 | 1820 | 160 | 1668 | 16   | 16 | 35 | 1750 | 5 | 40        | M52    | 56 | 479.0         |
| 1800         | 1820   | -      | 2130   | 62 | 2020 | 170 | 1870 | 17.5 | 16 | 35 | 1950 | 5 | 44        | M52    | 56 | 599.0         |
| 2000         | 2020   | -      | 2345   | 66 | 2230 | 180 | 2072 | 20   | 16 | 40 | 2150 | 5 | 48        | M56    | 62 | 719.0         |

The values in Part 2 are applicable for German standards.



# Weld-Neck-Flange

DIN 2634 PN 25



| Nominal Bore |        |        | Flange |    |      |     | Meck |      |    |    | RF   |   | Stud Bolt |        |    | Weight of<br>a Flange<br>(7,85 kg/dm3) |
|--------------|--------|--------|--------|----|------|-----|------|------|----|----|------|---|-----------|--------|----|----------------------------------------|
| NB           | d1     |        | D      | b  | k    | h1  | d3   | s    | r  | h2 | d4   | f | pc.       | thread | D2 |                                        |
|              | Part 1 | Part 2 |        |    |      |     |      |      |    |    |      |   |           |        |    |                                        |
| 175          | 193    | -      | 330    | 28 | 280  | 75  | 218  | 5.6  | 10 | 15 | 248  | 3 | 12        | M24    | 26 | 13.40                                  |
| 200          | 219.1  | -      | 360    | 30 | 310  | 80  | 244  | 6.3  | 10 | 16 | 278  | 3 | 12        | M24    | 26 | 17.00                                  |
| 250          | -      | 267    | 425    | 32 | 370  | 88  | 292  | 7.1  | 12 | 18 | 335  | 3 | 12        | M27    | 30 | 24.40                                  |
| -            | 273    | -      | 425    | 32 | 370  | 88  | 298  | 7.1  | 12 | 18 | 335  | 3 | 12        | M27    | 30 | 24.40                                  |
| 300          | 323.9  | -      | 485    | 34 | 430  | 92  | 352  | 8    | 12 | 18 | 395  | 4 | 16        | M27    | 30 | 31.20                                  |
| 350          | 355.6  | -      | 555    | 38 | 490  | 100 | 398  | 8    | 12 | 20 | 450  | 4 | 16        | M30    | 33 | 47.20                                  |
| -            | -      | 368    | 555    | 38 | 490  | 100 | 398  | 8    | 12 | 20 | 450  | 4 | 16        | M30    | 33 | 44.20                                  |
| 400          | 406.4  | -      | 620    | 40 | 550  | 110 | 452  | 8.8  | 12 | 20 | 505  | 4 | 16        | M33    | 36 | 61.70                                  |
| -            | -      | 419    | 620    | 40 | 550  | 110 | 452  | 8.8  | 12 | 20 | 505  | 4 | 16        | M33    | 36 | 57.90                                  |
| 500          | 508    | -      | 730    | 44 | 660  | 125 | 558  | 10   | 12 | 20 | 615  | 4 | 20        | M33    | 36 | 89.60                                  |
| 600          | 510    | -      | 845    | 46 | 770  | 125 | 660  | 11   | 12 | 20 | 720  | 5 | 20        | M36    | 39 | 104.0                                  |
| 700          | 711    | -      | 960    | 46 | 875  | 125 | 760  | 12.5 | 12 | 20 | 820  | 5 | 24        | M39    | 42 | 136.0                                  |
| 800          | 813    | -      | 1085   | 50 | 990  | 135 | 865  | 14.2 | 12 | 22 | 930  | 5 | 24        | M45    | 48 | 186.0                                  |
| 900          | 914    | -      | 1185   | 54 | 1090 | 145 | 968  | 16   | 12 | 24 | 1030 | 5 | 28        | M45    | 48 | 236.0                                  |
| 1000         | 1016   | -      | 1320   | 58 | 1210 | 155 | 1070 | 17.5 | 16 | 24 | 1140 | 5 | 28        | m52    | 56 | 307.0                                  |

From NB 10 up to NB 150 Weld-neck-Flange to DIN 2635, use nominal pressure 40.  
The values in Part 2 are applicable for German standards.



# Weld-Neck-Flange

DIN 2635 PN 40



| Nominal Bore |              |        | Flange |    |     |     | Meck |      |    |    | RF  |   | Stud Bolt |        |    | Weight of<br>a Flange<br>(7,85 kg/dm3) |
|--------------|--------------|--------|--------|----|-----|-----|------|------|----|----|-----|---|-----------|--------|----|----------------------------------------|
| NB           | d1<br>Part 1 | Part 2 | D      | b  | k   | h1  | d3   | s    | r  | h2 | d4  | f | pc.       | thread | D2 |                                        |
| 10           | -            | 14     | 90     | 16 | 60  | 35  | 25   | 1.8  | 4  | 6  | 40  | 2 | 4         | M12    | 14 | 0.661                                  |
| 10           | 17.2         | -      | 90     | 16 | 60  | 35  | 28   | 1.8  | 4  | 6  | 40  | 2 | 4         | M12    | 14 | 0.661                                  |
| 15           | -            | 20     | 95     | 16 | 65  | 38  | 30   | 2    | 4  | 6  | 45  | 2 | 4         | M12    | 14 | 0.746                                  |
| 15           | 21.3         | -      | 95     | 16 | 65  | 38  | 32   | 2    | 4  | 6  | 45  | 2 | 4         | M12    | 14 | 0.746                                  |
| 20           | -            | 25     | 105    | 18 | 75  | 40  | 38   | 2.3  | 4  | 6  | 58  | 2 | 4         | M12    | 14 | 1.060                                  |
| 20           | 26.9         | -      | 105    | 18 | 75  | 40  | 40   | 2.3  | 4  | 6  | 58  | 2 | 4         | M12    | 14 | 1.060                                  |
| 25           | -            | 30     | 115    | 18 | 85  | 40  | 42   | 2.6  | 4  | 6  | 68  | 2 | 4         | M12    | 14 | 1.290                                  |
| 25           | 33.7         | -      | 115    | 18 | 85  | 40  | 46   | 2.6  | 4  | 6  | 68  | 2 | 4         | M12    | 14 | 1.290                                  |
| 32           | -            | 38     | 140    | 18 | 100 | 42  | 52   | 2.6  | 6  | 6  | 78  | 2 | 4         | M16    | 18 | 1.880                                  |
| 32           | 42.4         | -      | 140    | 18 | 100 | 42  | 56   | 2.6  | 6  | 6  | 78  | 2 | 4         | M16    | 18 | 1.880                                  |
| 40           | -            | 44.5   | 150    | 18 | 110 | 45  | 60   | 2.6  | 6  | 7  | 88  | 3 | 4         | M16    | 18 | 2.330                                  |
| 40           | 48.3         | -      | 150    | 18 | 110 | 45  | 64   | 2.6  | 6  | 7  | 88  | 3 | 4         | M16    | 18 | 2.330                                  |
| 50           | -            | 57     | 165    | 20 | 125 | 48  | 72   | 2.9  | 6  | 8  | 102 | 3 | 4         | M16    | 18 | 2.820                                  |
| 50           | 60.3         | -      | 165    | 20 | 125 | 48  | 75   | 2.9  | 6  | 8  | 102 | 3 | 4         | M16    | 18 | 2.820                                  |
| 65           | 76.1         | -      | 185    | 22 | 145 | 52  | 90   | 2.9  | 6  | 10 | 122 | 3 | 8         | M16    | 18 | 3.740                                  |
| 80           | 88.9         | -      | 200    | 24 | 160 | 58  | 105  | 3.2  | 8  | 12 | 138 | 3 | 8         | M16    | 18 | 4.750                                  |
| 100          | 108          | 235    | 235    | 24 | 190 | 65  | 128  | 3.6  | 8  | 12 | 162 | 3 | 8         | M20    | 22 | 6.520                                  |
| 100          | 114.3        | -      | 235    | 24 | 190 | 65  | 134  | 3.6  | 8  | 12 | 162 | 3 | 8         | M20    | 22 | 6.520                                  |
| 125          | -            | 133    | 270    | 26 | 220 | 68  | 155  | 4    | 8  | 12 | 188 | 3 | 8         | M24    | 26 | 9.070                                  |
| 125          | 139.7        | -      | 270    | 26 | 220 | 68  | 162  | 4    | 8  | 12 | 188 | 3 | 8         | M24    | 26 | 9.070                                  |
| 150          | -            | 159    | 300    | 28 | 250 | 75  | 182  | 4.5  | 10 | 12 | 218 | 3 | 8         | M24    | 26 | 11.80                                  |
| 150          | 168.3        | -      | 300    | 28 | 250 | 75  | 192  | 4.5  | 10 | 12 | 218 | 3 | 8         | M24    | 26 | 11.80                                  |
| (175)        | 193.7        | -      | 350    | 32 | 295 | 82  | 218  | 5.6  | 10 | 15 | 260 | 3 | 12        | M27    | 30 | 18.20                                  |
| 200          | 219.1        | -      | 375    | 34 | 320 | 88  | 244  | 6.3  | 10 | 16 | 285 | 3 | 12        | M27    | 30 | 21.50                                  |
| 250          | -            | 267    | 450    | 38 | 385 | 105 | 298  | 7.1  | 12 | 18 | 345 | 3 | 12        | M30    | 33 | 34.90                                  |
| 250          | 273          | -      | 450    | 38 | 385 | 105 | 306  | 7.1  | 12 | 18 | 345 | 3 | 12        | M30    | 33 | 34.90                                  |
| 300          | 323.9        | -      | 515    | 42 | 450 | 115 | 362  | 8    | 12 | 18 | 410 | 4 | 16        | M30    | 33 | 49.70                                  |
| 350          | 355.6        | -      | 580    | 46 | 510 | 125 | 408  | 8.8  | 12 | 20 | 465 | 4 | 16        | M33    | 36 | 68.10                                  |
| 350          | -            | 368    | 580    | 46 | 510 | 125 | 408  | 8.8  | 12 | 20 | 465 | 4 | 16        | M33    | 36 | 68.10                                  |
| 400          | 406.4        | -      | 660    | 50 | 585 | 135 | 462  | 11   | 12 | 20 | 535 | 4 | 16        | M36    | 39 | 96.50                                  |
| 400          | -            | 419    | 660    | 50 | 585 | 135 | 462  | 11   | 12 | 20 | 535 | 4 | 16        | M36    | 39 | 96.50                                  |
| 500          | 508          | -      | 755    | 52 | 670 | 140 | 562  | 14.2 | 12 | 20 | 615 | 4 | 20        | M39    | 42 | 117.0                                  |

The values in Part 2 are applicable for Germany standards.



# Weld-Neck-Flange

DIN 2636 PN 64



| Nominal Bore |              |        | Flange |    |     |     | Meck |      |    |    | RF  |   | Stud Bolt |        |    | Weight of<br>a Flange<br>(7,85 kg/dm3) |
|--------------|--------------|--------|--------|----|-----|-----|------|------|----|----|-----|---|-----------|--------|----|----------------------------------------|
| NB           | d1<br>Part 1 | Part 2 | D      | b  | k   | h1  | d3   | s    | r  | h2 | d4  | f | pc.       | thread | D2 |                                        |
| 50           | -            | 57     | 180    | 26 | 135 | 62  | 78   | 2.9  | 6  | 10 | 102 | 3 | 4         | M20    | 22 | 4.550                                  |
|              | 60.3         | -      | 180    | 26 | 135 | 62  | 82   | 2.9  | 6  | 10 | 102 | 3 | 4         | M20    | 22 | 4.550                                  |
| 65           | 76.1         | -      | 205    | 26 | 160 | 68  | 98   | 3.2  | 6  | 12 | 122 | 3 | 8         | M20    | 22 | 5.730                                  |
| 80           | 88.9         | -      | 215    | 28 | 170 | 72  | 112  | 3.6  | 8  | 12 | 138 | 3 | 8         | M20    | 22 | 6.690                                  |
| 100          | -            | 108    | 250    | 30 | 200 | 78  | 132  | 4    | 8  | 12 | 162 | 3 | 8         | M24    | 26 | 9.660                                  |
|              | 114.3        | -      | 250    | 30 | 200 | 78  | 138  | 4    | 8  | 12 | 162 | 3 | 8         | M24    | 26 | 9.660                                  |
| 125          | -            | 133    | 295    | 34 | 240 | 88  | 162  | 4.5  | 8  | 12 | 188 | 3 | 8         | M27    | 30 | 15.10                                  |
|              | 139.7        | -      | 295    | 34 | 240 | 88  | 168  | 4.5  | 8  | 12 | 188 | 3 | 8         | M27    | 30 | 15.10                                  |
| 150          | -            | 159    | 345    | 36 | 280 | 95  | 192  | 5.6  | 10 | 12 | 218 | 3 | 8         | M30    | 33 | 21.90                                  |
|              | 168.3        | -      | 345    | 36 | 280 | 95  | 202  | 5.6  | 10 | 12 | 218 | 3 | 8         | M30    | 33 | 21.90                                  |
| (175)        | 193.7        | -      | 375    | 40 | 310 | 105 | 228  | 6.3  | 10 | 16 | 260 | 3 | 12        | M30    | 33 | 23.70                                  |
| 200          | 219.1        | -      | 415    | 42 | 345 | 110 | 256  | 7.1  | 10 | 16 | 285 | 3 | 12        | M33    | 36 | 34.90                                  |
| 250          | -            | 267    | 470    | 46 | 400 | 125 | 310  | 8.8  | 12 | 18 | 345 | 3 | 12        | M33    | 36 | 49.60                                  |
|              | 273          | -      | 470    | 46 | 400 | 125 | 316  | 8.8  | 12 | 18 | 345 | 3 | 12        | M33    | 36 | 49.60                                  |
| 300          | 323.9        | -      | 530    | 12 | 460 | 140 | 372  | 11   | 12 | 18 | 410 | 4 | 16        | M33    | 36 | 68.70                                  |
| 350          | 355.6        | -      | 600    | 56 | 525 | 150 | 420  | 12.5 | 12 | 20 | 465 | 4 | 16        | M36    | 39 | 94.60                                  |
|              | -            | 368    | 600    | 56 | 525 | 150 | 420  | 12.5 | 12 | 20 | 465 | 4 | 16        | M36    | 39 | 94.60                                  |
| 400          | 406.4        | -      | 670    | 60 | 585 | 160 | 475  | 14.2 | 12 | 20 | 535 | 4 | 16        | M39    | 42 | 124.0                                  |
|              | -            | 419    | 670    | 60 | 585 | 160 | 475  | 14.2 | 12 | 20 | 535 | 4 | 16        | M39    | 42 | 124.0                                  |

The values in Part 2 are applicable for German standards.

# Weld-Neck-Flange

DIN 2637 PN 100



| Nominal Bore |              |        | Flange |    |     |     | Meck |      |    |    | RF  |   | Stud Bolt |        |    | Weight of<br>a Flange<br>(7,85 kg/dm <sup>3</sup> ) |
|--------------|--------------|--------|--------|----|-----|-----|------|------|----|----|-----|---|-----------|--------|----|-----------------------------------------------------|
| NB           | d1<br>Part 1 | Part 2 | D      | b  | k   | h1  | d3   | s    | r  | h2 | d4  | f | pc.       | thread | D2 |                                                     |
| 10           | -            | 14     | 100    | 20 | 70  | 45  | 28   | 1.8  | 4  | 6  | 40  | 2 | 4         | M12    | 14 | 1.090                                               |
|              | 17.2         | -      | 100    | 20 | 70  | 45  | 32   | 1.8  | 4  | 6  | 40  | 2 | 4         | M12    | 14 | 1.090                                               |
| 15           | -            | 20     | 105    | 20 | 75  | 45  | 32   | 2    | 4  | 6  | 45  | 2 | 4         | M12    | 14 | 1.190                                               |
|              | 21.3         | -      | 105    | 20 | 75  | 45  | 34   | 2    | 4  | 6  | 45  | 2 | 4         | M12    | 14 | 1.190                                               |
| 25           | -            | 30     | 140    | 24 | 100 | 58  | 48   | 2.6  | 4  | 8  | 68  | 2 | 4         | M16    | 18 | 2.660                                               |
|              | 33.7         | -      | 140    | 24 | 100 | 58  | 52   | 2.6  | 4  | 8  | 68  | 2 | 4         | M16    | 18 | 2.660                                               |
| 40           | -            | 44.5   | 170    | 26 | 125 | 62  | 65   | 2.9  | 6  | 10 | 88  | 3 | 4         | M20    | 22 | 4.090                                               |
|              | 48.3         | -      | 170    | 26 | 125 | 62  | 70   | 2.9  | 6  | 10 | 88  | 3 | 4         | M20    | 22 | 4.090                                               |
| 50           | -            | 57     | 195    | 28 | 145 | 68  | 86   | 3.2  | 6  | 10 | 102 | 3 | 4         | M24    | 26 | 5.980                                               |
|              | 60.3         | -      | 195    | 28 | 145 | 68  | 90   | 3.2  | 6  | 10 | 102 | 3 | 4         | M24    | 26 | 5.980                                               |
| 65           | 76.1         | -      | 220    | 30 | 170 | 76  | 108  | 3.6  | 6  | 12 | 122 | 3 | 8         | M24    | 26 | 7.910                                               |
| 80           | 88.9         | -      | 230    | 32 | 180 | 78  | 120  | 4    | 8  | 12 | 138 | 3 | 8         | M24    | 26 | 8.950                                               |
| 100          | -            | 108    | 265    | 36 | 210 | 90  | 145  | 5    | 8  | 12 | 162 | 3 | 8         | M27    | 30 | 13.70                                               |
|              | 114.3        | -      | 265    | 36 | 210 | 90  | 150  | 5    | 8  | 12 | 162 | 3 | 8         | M27    | 30 | 13.70                                               |
| 125          | -            | 133    | 315    | 40 | 250 | 105 | 180  | 6.3  | 8  | 12 | 188 | 3 | 8         | M30    | 33 | 22.70                                               |
|              | 139.7        | -      | 315    | 40 | 250 | 105 | 180  | 6.3  | 8  | 12 | 188 | 3 | 8         | M30    | 33 | 22.70                                               |
| 150          | -            | 159    | 355    | 44 | 290 | 115 | 210  | 7.1  | 10 | 12 | 218 | 3 | 12        | M30    | 33 | 30.20                                               |
|              | 168.3        | -      | 355    | 44 | 290 | 115 | 210  | 7.1  | 10 | 12 | 218 | 3 | 12        | M30    | 33 | 30.20                                               |
| 175          | 193.7        | -      | 385    | 48 | 320 | 127 | 245  | 8.8  | 10 | 16 | 260 | 3 | 12        | M30    | 33 | 38.90                                               |
| 200          | 219.1        | -      | 430    | 52 | 360 | 130 | 278  | 10   | 10 | 16 | 285 | 3 | 12        | M33    | 36 | 52.80                                               |
| 250          | -            | 267    | 505    | 60 | 430 | 157 | 340  | 12.5 | 12 | 18 | 345 | 3 | 12        | M36    | 39 | 81.40                                               |
|              | 273          | -      | 505    | 60 | 430 | 157 | 340  | 12.5 | 12 | 18 | 345 | 3 | 12        | M36    | 39 | 81.40                                               |
| 300          | 323.9        | -      | 585    | 68 | 500 | 170 | 400  | 14.2 | 12 | 18 | 410 | 4 | 16        | M39    | 42 | 122.0                                               |
| 350          | 355.6        | -      | 655    | 74 | 560 | 189 | 460  | 16   | 12 | 20 | 465 | 4 | 16        | M45    | 48 | 165.0                                               |
|              | -            | 368    | 655    | 74 | 560 | 189 | 460  | 16   | 12 | 20 | 465 | 4 | 16        | M45    | 48 | 165.0                                               |

The values in Part 2 are applicable for German standards.



# Weld-Neck-Flange

DIN 2638 PN 160

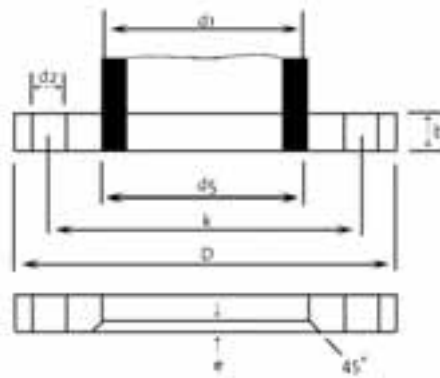


| Nominal Bore |              |        | Flange |    |     |     | Neck |      |    |    | RF  |   | Stud Bolt |        |    | Weight of<br>a Flange<br>(7,85 kg/dm <sup>3</sup> ) |
|--------------|--------------|--------|--------|----|-----|-----|------|------|----|----|-----|---|-----------|--------|----|-----------------------------------------------------|
| NB           | d1<br>Part 1 | Part 2 | D      | b  | k   | h1  | d3   | s    | r  | h2 | d4  | f | pc.       | thread | D2 |                                                     |
| 10           | -            | 14     | 100    | 20 | 70  | 45  | 28   | 2    | 4  | 6  | 40  | 2 | 4         | M12    | 14 | 1.090                                               |
| 10           | 17.2         | -      | 100    | 20 | 70  | 45  | 32   | 2    | 4  | 6  | 40  | 2 | 4         | M12    | 14 | 1.090                                               |
| 15           | -            | 20     | 105    | 20 | 75  | 45  | 32   | 2    | 4  | 6  | 45  | 2 | 4         | M12    | 14 | 1.190                                               |
| 15           | 21.3         | -      | 105    | 20 | 75  | 45  | 34   | 2    | 4  | 6  | 45  | 2 | 4         | M12    | 14 | 1.190                                               |
| 25           | -            | 30     | 140    | 24 | 100 | 58  | 48   | 2.9  | 4  | 8  | 68  | 2 | 4         | M16    | 18 | 2.660                                               |
| 25           | 33.7         | -      | 140    | 24 | 100 | 58  | 52   | 2.9  | 4  | 8  | 68  | 2 | 4         | M16    | 18 | 2.660                                               |
| 40           | -            | 44.5   | 170    | 28 | 125 | 64  | 65   | 3.6  | 6  | 10 | 88  | 3 | 4         | M20    | 22 | 4.300                                               |
| 40           | 48.3         | -      | 170    | 28 | 125 | 64  | 70   | 3.6  | 6  | 10 | 88  | 3 | 4         | M20    | 22 | 4.300                                               |
| 50           | -            | 57     | 195    | 30 | 145 | 75  | 86   | 4    | 6  | 10 | 102 | 3 | 4         | M24    | 26 | 6.250                                               |
| 50           | 60.3         | -      | 195    | 30 | 145 | 75  | 90   | 4    | 6  | 10 | 102 | 3 | 4         | M24    | 26 | 6.250                                               |
| 65           | 76.1         | -      | 220    | 34 | 170 | 82  | 108  | 5    | 6  | 12 | 122 | 3 | 8         | M24    | 26 | 8.350                                               |
| 80           | 88.9         | -      | 230    | 36 | 180 | 86  | 120  | 6.3  | 8  | 12 | 138 | 3 | 8         | M24    | 26 | 9.750                                               |
| 100          | -            | 108    | 265    | 40 | 210 | 100 | 145  | 8    | 8  | 12 | 162 | 3 | 8         | M27    | 30 | 14.80                                               |
| 100          | 114.3        | -      | 265    | 40 | 210 | 100 | 150  | 8    | 8  | 12 | 162 | 3 | 8         | M27    | 30 | 14.80                                               |
| 125          | -            | 133    | 315    | 44 | 250 | 115 | 180  | 10   | 8  | 14 | 188 | 3 | 8         | M30    | 33 | 23.00                                               |
| 125          | 139.7        | -      | 315    | 44 | 250 | 115 | 180  | 10   | 8  | 14 | 188 | 3 | 8         | M30    | 33 | 23.00                                               |
| 150          | -            | 159    | 355    | 50 | 290 | 128 | 210  | 12.5 | 10 | 14 | 218 | 3 | 12        | M30    | 33 | 32.50                                               |
| 150          | 168.3        | -      | 355    | 50 | 290 | 128 | 210  | 12.5 | 10 | 14 | 218 | 3 | 12        | M30    | 33 | 32.50                                               |
| 175          | 193.7        | -      | 390    | 54 | 320 | 138 | 245  | 14.2 | 10 | 16 | 260 | 3 | 12        | M33    | 36 | 43.50                                               |
| 200          | 219.1        | -      | 430    | 60 | 360 | 140 | 278  | 16   | 10 | 16 | 285 | 3 | 12        | M33    | 36 | 59.40                                               |
| 250          | -            | 267    | 515    | 68 | 430 | 155 | 340  | 20   | 12 | 18 | 345 | 3 | 12        | M39    | 42 | 94.50                                               |
| 250          | 273          | -      | 515    | 68 | 430 | 155 | 340  | 20   | 12 | 18 | 345 | 3 | 12        | M39    | 42 | 94.50                                               |
| 300          | 323.9        | -      | 585    | 78 | 500 | 175 | 400  | 22.2 | 12 | 18 | 410 | 4 | 16        | M39    | 42 | 136.0                                               |

The values in Part 2 are applicable for German standards.

# Plain Flanges

DIN 2573 PN 06

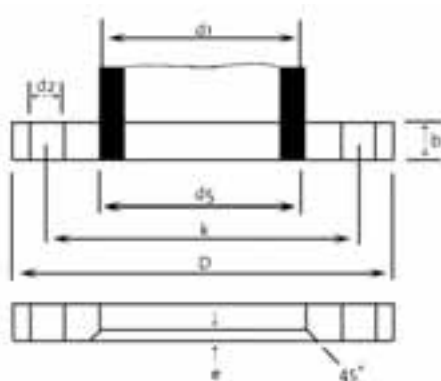


| Nominal Bore |              |        | Flange |     |    |   |     | Stud Bolt |        |    | Weight of<br>a Flange<br>(7,85 kg/dm <sup>3</sup> ) |
|--------------|--------------|--------|--------|-----|----|---|-----|-----------|--------|----|-----------------------------------------------------|
| NB           | d1<br>Part 1 | Part 2 | d5     | D   | b  | e | k   | pc.       | thread | d2 |                                                     |
| 10           | -            | 14     | 14.5   | 75  | 12 | 5 | 50  | 4         | M10    | 11 | 0.363                                               |
|              | 17.2         | -      | 17.7   |     |    |   |     |           |        |    |                                                     |
| 15           | -            | 20     | 21     | 80  | 12 | 5 | 55  | 4         | M10    | 11 | 0.410                                               |
|              | 21.3         | -      | 22     |     |    |   |     |           |        |    |                                                     |
| 20           | -            | 25     | 26     | 90  | 14 | 5 | 65  | 4         | M10    | 11 | 0.600                                               |
|              | 26.9         | -      | 27.6   |     |    |   |     |           |        |    |                                                     |
| 25           | -            | 30     | 31     | 100 | 14 | 5 | 75  | 4         | M10    | 11 | 0.740                                               |
|              | 33.7         | -      | 34.4   |     |    |   |     |           |        |    |                                                     |
| 32           | -            | 38     | 39     | 120 | 16 | 5 | 90  | 4         | M12    | 14 | 1.190                                               |
|              | 42.4         | -      | 43.1   |     |    |   |     |           |        |    |                                                     |
| 40           | -            | 44.5   | 45.5   | 130 | 16 | 5 | 100 | 4         | M12    | 14 | 1.390                                               |
|              | 48.3         | -      | 49     |     |    |   |     |           |        |    |                                                     |
| 50           | -            | 57     | 58.1   | 140 | 16 | 6 | 110 | 4         | M12    | 14 | 1.530                                               |
|              | 60.3         | -      | 61.1   |     |    |   |     |           |        |    |                                                     |
| 65           | 76.1         | -      | 77.1   | 160 | 16 | 6 | 130 | 4         | M12    | 14 | 1.890                                               |
| 80           | 88.9         | -      | 90.3   | 190 | 18 | 7 | 150 | 4         | M16    | 18 | 2.980                                               |
| 100          | -            | 108    | 109.6  | 210 | 18 | 7 | 170 | 4         | M16    | 18 | 3.460                                               |
|              | 114.3        |        | 115.9  |     |    |   |     |           |        |    |                                                     |
| 125          | -            | 133    | 134.8  | 240 | 20 | 7 | 200 | 8         | M16    | 18 | 4.600                                               |
|              | 139.7        | -      | 141.6  |     |    |   |     |           |        |    |                                                     |
| 150          | -            | 159    | 161.1  | 265 | 20 | 7 | 225 | 8         | M16    | 18 | 5.220                                               |
|              | 168.3        | -      | 170.5  |     |    |   |     |           |        |    |                                                     |
| 200          | 219.1        | -      | 221.8  | 320 | 22 | 7 | 280 | 8         | M16    | 18 | 7.150                                               |
| 250          | -            | 267    | 270.2  | 375 | 24 | 7 | 335 | 12        | M16    | 18 | 9.610                                               |
|              | 273          | -      | 276.2  |     |    |   |     |           |        |    |                                                     |
| 300          | 323.9        | -      | 327.6  | 440 | 24 | 7 | 395 | 12        | M20    | 22 | 12.60                                               |
| 350          | 355.6        | -      | 359.7  | 490 | 26 | 7 | 445 | 12        | M20    | 22 | 15.60                                               |
|              | -            | 369    | 372.2  |     |    |   |     |           |        |    |                                                     |
| 400          | 406.4        | -      | 411    | 540 | 28 | 7 | 495 | 16        | M20    | 22 | 18.40                                               |
|              | -            | 419    | 423.7  |     |    |   |     |           |        |    |                                                     |
| 450          | 457          | -      | 462.3  | 595 | 30 | 7 | 550 | 16        | M20    | 22 | 21.40                                               |
| 500          | 508          | -      | 513.6  | 645 | 30 | 7 | 600 | 20        | M20    | 22 | 24.60                                               |



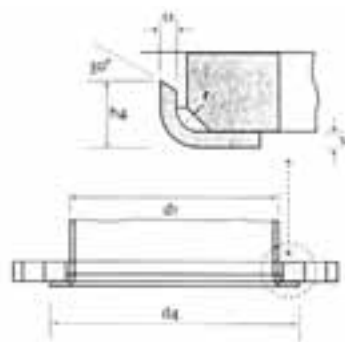
# Plain Flanges

DIN 2576 PN 10



| Nominal Bore |              |        | Flange |       |    |   |     | Stud Bolt |        |    | Weight of<br>a Flange<br>(7,85 kg/dm <sup>3</sup> ) |
|--------------|--------------|--------|--------|-------|----|---|-----|-----------|--------|----|-----------------------------------------------------|
| NB           | d1<br>Part 1 | Part 2 | d5     | D     | b  | e | k   | pc.       | thread | d2 |                                                     |
| 10           | -            | 14     | 14.5   | 90    | 14 | 5 | 60  | 4         | M12    | 14 | 0.613                                               |
|              | 17.2         | -      | 17.7   | 0.605 |    |   |     |           |        |    |                                                     |
| 15           | -            | 20     | 21     | 95    | 14 | 5 | 65  | 4         | M12    | 14 | 0.675                                               |
|              | 21.3         | -      | 22     | 0.669 |    |   |     |           |        |    |                                                     |
| 20           | -            | 25     | 26     | 105   | 16 | 5 | 75  | 4         | M12    | 14 | 0.749                                               |
|              | 26.9         | -      | 27.6   | 0.936 |    |   |     |           |        |    |                                                     |
| 25           | -            | 30     | 31     | 115   | 16 | 5 | 85  | 4         | M12    | 14 | 1.140                                               |
|              | 33.7         | -      | 34.4   | 1.110 |    |   |     |           |        |    |                                                     |
| 32           | -            | 38     | 39     | 140   | 16 | 5 | 100 | 4         | M16    | 18 | 1.660                                               |
|              | 42.4         | -      | 43.1   | 1.620 |    |   |     |           |        |    |                                                     |
| 40           | -            | 44.5   | 45.5   | 150   | 16 | 5 | 110 | 4         | M16    | 18 | 1.890                                               |
|              | 48.3         | -      | 49     | 1.860 |    |   |     |           |        |    |                                                     |
| 50           | -            | 57.0   | 58.1   | 165   | 18 | 6 | 125 | 4         | M16    | 18 | 2.510                                               |
|              | 60.3         | -      | 61.1   | 2.470 |    |   |     |           |        |    |                                                     |
| 65           | 76.1         | -      | 77.1   | 185   | 18 | 6 | 145 | 4         | M16    | 18 | 3.000                                               |
| 80           | 88.9         | -      | 90.3   | 200   | 20 | 7 | 160 | 8         | M16    | 18 | 3.790                                               |
| 100          | -            | 108    | 109.6  | 220   | 20 | 7 | 180 | 8         | M16    | 18 | 4.200                                               |
|              | 114.3        | -      | 115.9  | 4.030 |    |   |     |           |        |    |                                                     |
| 125          | -            | 133    | 134.8  | 250   | 22 | 7 | 210 | 8         | M16    | 18 | 5.710                                               |
|              | 139.70       | -      | 141.6  | 5.460 |    |   |     |           |        |    |                                                     |
| 150          | -            | 159    | 161.1  | 285   | 22 | 7 | 240 | 8         | M20    | 22 | 6.720                                               |
|              | 168.30       | -      | 170.5  | 6.570 |    |   |     |           |        |    |                                                     |
| 175          | 193.7        | -      | 196.1  | 315   | 24 | 7 | 270 | 8         | M20    | 22 | 8.450                                               |
| 200          | 219.1        | -      | 221.8  | 340   | 24 | 7 | 295 | 8         | M20    | 22 | 9.310                                               |
| 250          | -            | 267    | 270.2  | 395   | 26 | 7 | 350 | 12        | M20    | 22 | 12.50                                               |
|              | 273          | -      | 276.2  | 11.90 |    |   |     |           |        |    |                                                     |
| 300          | 323.9        | -      | 327.6  | 445   | 26 | 7 | 400 | 12        | M20    | 22 | 13.80                                               |
| 350          | 355.6        | -      | 359.7  | 505   | 28 | 7 | 460 | 16        | M20    | 22 | 20.60                                               |
|              | -            | 368    | 372.2  | 19.00 |    |   |     |           |        |    |                                                     |
| 400          | 406.4        | -      | 411    | 565   | 32 | 7 | 515 | 16        | M24    | 26 | 27.90                                               |
|              | -            | 419    | 423.7  | 25.90 |    |   |     |           |        |    |                                                     |
| 450          | 457.4        | -      | 462.3  | 615   | 38 | 7 | 565 | 20        | M24    | 26 | 35.60                                               |
| 500          | 508          | -      | 513.6  | 670   | 38 | 7 | 620 | 20        | M24    | 26 | 41.10                                               |

## DIN 2641 PN 06



### Weld Neck Flange

\*) Flange from Nominal Bore 350 not standardized.  
The pipe sizes of series 1 are international,  
those of series 2 are still used in Germany.





# Loose Flanges; Weld Neck Flanges, Plain Bundle

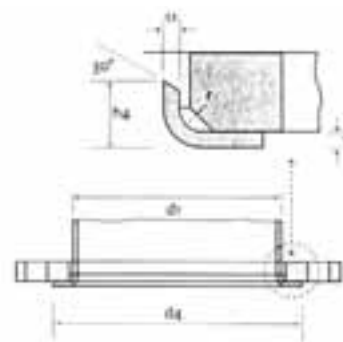
DIN 2642 PN 06



Plain Bundle



Loose Flange



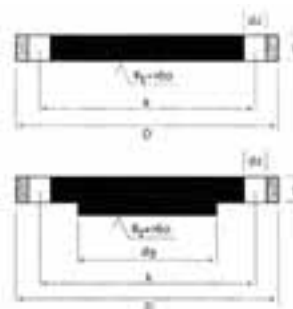
Weld Neck Flange

| Pipe Size<br>NB | Flange         |          | Screws |     |    |     |   | Bundle and Flange* |        |    |       |    |     |           |           |           |          | Weight kg<br>(7,85 kg/dm <sup>3</sup> ) |        |
|-----------------|----------------|----------|--------|-----|----|-----|---|--------------------|--------|----|-------|----|-----|-----------|-----------|-----------|----------|-----------------------------------------|--------|
|                 | d1<br>Series 1 | Series 2 | D      | d6  | b  | k   | e | No.                | Thread | d2 | d5    | h3 | d4  | h4<br>max | s1<br>min | s2<br>min | r<br>min | Flange                                  | Bundle |
| 10              | -              | 14       | 90     | 16  | 14 | 60  | 3 | 4                  | M12    | 14 | 14.5  | 10 | 40  | 9         | 1.8       | 3         | 3        | 0.599                                   | 0.087  |
| 10              | 17.2           | -        | 90     | 19  | 14 | 60  | 3 | 4                  | M12    | 14 | 17.7  | 10 | 40  | 9         | 1.8       | 3         | 3        | 0.599                                   | 0.087  |
| 15              | -              | 20       | 95     | 22  | 14 | 65  | 3 | 4                  | M12    | 14 | 21    | 10 | 45  | 9         | 2         | 3         | 3        | 0.689                                   | 0.105  |
| 15              | 21.3           | -        | 95     | 24  | 14 | 65  | 3 | 4                  | M12    | 14 | 22    | 10 | 45  | 9         | 2         | 3         | 3        | 0.689                                   | 0.105  |
| 20              | -              | 25       | 105    | 28  | 14 | 75  | 3 | 4                  | M12    | 14 | 26    | 12 | 58  | 12        | 2         | 3         | 3        | 0.806                                   | 0.203  |
| 20              | 26.9           | -        | 105    | 30  | 14 | 75  | 3 | 4                  | M12    | 14 | 27.6  | 12 | 58  | 12        | 2         | 3         | 3        | 0.806                                   | 0.203  |
| 25              | -              | 30       | 115    | 33  | 16 | 85  | 4 | 4                  | M12    | 14 | 31    | 12 | 68  | 15        | 2         | 3         | 4        | 1.11                                    | 0.276  |
| 25              | 33.7           | -        | 115    | 36  | 16 | 85  | 4 | 4                  | M12    | 14 | 34.4  | 12 | 68  | 15        | 2         | 3         | 4        | 1.11                                    | 0.276  |
| 32              | -              | 38       | 140    | 42  | 16 | 100 | 4 | 4                  | M16    | 18 | 39    | 12 | 78  | 15        | 2.6       | 3.5       | 4        | 1.64                                    | 0.343  |
| 32              | 42.4           | -        | 140    | 46  | 16 | 100 | 4 | 4                  | M16    | 18 | 43.1  | 12 | 78  | 15        | 2.6       | 3.5       | 4        | 1.64                                    | 0.343  |
| 40              | -              | 44.5     | 150    | 50  | 16 | 110 | 4 | 4                  | M16    | 18 | 45.5  | 12 | 88  | 17        | 2.6       | 3.5       | 4        | 1.86                                    | 0.426  |
| 40              | 48.3           | -        | 150    | 54  | 16 | 110 | 4 | 4                  | M16    | 18 | 49    | 12 | 88  | 17        | 2.6       | 3.5       | 4        | 1.86                                    | 0.426  |
| 50              | -              | 57       | 165    | 62  | 16 | 125 | 5 | 4                  | M16    | 18 | 58.1  | 14 | 102 | 23        | 2.6       | 3.5       | 5        | 2.20                                    | 0.618  |
| 50              | 60.3           | -        | 165    | 65  | 16 | 125 | 5 | 4                  | M16    | 18 | 61.1  | 14 | 102 | 23        | 2.6       | 3.5       | 5        | 2.20                                    | 0.618  |
| 65              | 76.1           | -        | 185    | 81  | 16 | 145 | 5 | 4                  | M16    | 18 | 77.1  | 14 | 122 | 23        | 2.6       | 3.5       | 5        | 2.62                                    | 0.786  |
| 80              | 88.9           | -        | 200    | 94  | 18 | 160 | 5 | 8                  | M16    | 18 | 90.3  | 16 | 138 | 23        | 3.2       | 4         | 5        | 3.32                                    | 1.10   |
| 100             | -              | 108      | 220    | 113 | 18 | 180 | 5 | 8                  | M16    | 18 | 109.6 | 16 | 158 | 28        | 3.2       | 4         | 5        | 3.67                                    | 1.31   |
| 100             | 114.3          | -        | 220    | 119 | 18 | 180 | 5 | 8                  | M16    | 18 | 115.9 | 16 | 158 | 28        | 3.2       | 4         | 5        | 3.67                                    | 1.31   |
| 125             | -              | 133      | 250    | 138 | 18 | 210 | 5 | 8                  | M16    | 18 | 134.8 | 18 | 188 | 30        | 3.2       | 4         | 5        | 4.54                                    | 1.96   |
| 125             | 139.7          | -        | 250    | 145 | 18 | 210 | 5 | 8                  | M16    | 18 | 141.6 | 18 | 188 | 30        | 3.2       | 4         | 5        | 4.54                                    | 1.96   |
| 150             | -              | 159      | 285    | 164 | 18 | 240 | 5 | 8                  | M20    | 22 | 161.1 | 18 | 212 | 30        | 3.2       | 4         | 5        | 5.60                                    | 2.18   |
| 150             | 168.3          | -        | 285    | 173 | 18 | 240 | 5 | 8                  | M20    | 22 | 170.5 | 18 | 212 | 30        | 3.2       | 4         | 5        | 5.60                                    | 2.18   |
| 200             | 219.1          | -        | 340    | 225 | 20 | 295 | 5 | 8                  | M20    | 22 | 221.8 | 20 | 268 | 30        | 3.2       | 4         | 5        | 7.46                                    | 3.10   |
| 250             | -              | 267      | 395    | 273 | 22 | 350 | 5 | 12                 | M20    | 22 | 270.2 | 22 | 320 | 30        | 4         | 5         | 5        | 10.3                                    | 4.22   |
| 250             | 273            | -        | 395    | 279 | 22 | 350 | 5 | 12                 | M20    | 22 | 276.2 | 22 | 320 | 30        | 4         | 5         | 5        | 10.3                                    | 4.22   |
| 300             | 323.9          | -        | 445    | 329 | 26 | 400 | 5 | 12                 | M20    | 22 | 327.6 | 22 | 370 | 35        | 4         | 5         | 5        | 14.0                                    | 4.85   |
| 350             | 355.6          | -        | 505    | 362 | 28 | 460 | 6 | 16                 | M20    | 22 | 359.7 | 22 | 430 | -         | -         | -         | 6        | 18.5                                    | 6.71   |
| 350             | -              | 368      | 505    | 374 | 28 | 460 | 6 | 16                 | M20    | -  | 372.2 | 22 | 430 | -         | -         | -         | 6        | 18.5                                    | 6.71   |
| 400             | 406.4          | -        | 565    | 413 | 32 | 515 | 6 | 16                 | M24    | 26 | 411   | 24 | 482 | -         | -         | -         | 6        | 25.0                                    | 8.28   |
| 400             | -              | 419      | 565    | 426 | 32 | 515 | 6 | 16                 | M24    | -  | 423.7 | 24 | 482 | -         | -         | -         | 6        | 25.0                                    | 8.28   |
| 500             | 508            | -        | 670    | 517 | 38 | 620 | 6 | 20                 | M24    | 26 | 513.6 | 26 | 585 | -         | -         | -         | 6        | 37.0                                    | 11.5   |
| 600             | 610            | -        | 780    | 618 | 44 | 725 | 7 | 20                 | M27    | 30 | 616.6 | 26 | 685 | -         | -         | -         | 7        | 56.3                                    | 15.6   |
| 700             | 711            | -        | 895    | 721 | 50 | 840 | 7 | 24                 | M27    | 30 | 718.6 | 28 | 800 | -         | -         | -         | 7        | 80.4                                    | 23.2   |
| 800             | 813            | -        | 1015   | 824 | 56 | 950 | 7 | 24                 | M30    | 33 | 821.5 | 30 | 905 | -         | -         | -         | 7        | 113.2                                   | 29.2   |

\*) Flange from Nominal Bore 350 not standardized.  
The pipe sizes of series 1 are international,  
those of series 2 are still used in Germany.



## Blind Flanges DIN 2527 PN 06



Form B

Form T

| Nominal Bore | Flange |    |     |         | Screws |        |                | Weight per Flange<br>(7,85 kg/dm <sup>3</sup> ) for |           |
|--------------|--------|----|-----|---------|--------|--------|----------------|-----------------------------------------------------|-----------|
|              | D      | b  | k   | dg max. | No.    | Thread | d <sub>2</sub> | Form B kg                                           | Form T kg |
| 10           | 75     | 12 | 50  |         | 4      | M10    | 11             | 0.38                                                |           |
| 15           | 80     | 12 | 55  |         |        |        |                | 0.44                                                |           |
| 20           | 90     | 14 | 65  |         |        |        |                | 0.65                                                |           |
| 25           | 100    | 14 | 75  |         |        |        |                | 0.82                                                |           |
| 32           | 120    | 14 | 90  |         |        | M12    | 14             | 1.17                                                |           |
| 40           | 130    | 14 | 100 |         |        |        |                | 1.39                                                |           |
| 50           | 140    | 14 | 110 |         |        |        |                | 1.62                                                |           |
| 65           | 160    | 14 | 130 | 55      |        |        |                | 2.44                                                | 2.48      |
| 80           | 190    | 16 | 150 | 70      |        | M16    | 18             | 3.43                                                | 3.49      |
| 100          | 210    | 16 | 170 | 90      |        |        |                | 4.76                                                | 4.86      |
| 125          | 240    | 18 | 200 | 115     | 8      |        |                | 6.11                                                | 6.28      |
| 150          | 265    | 18 | 225 | 140     |        |        |                | 7.51                                                | 7.75      |
| (175)        | 295    | 20 | 255 | 165     |        |        |                | 10.4                                                | 10.7      |
| 200          | 320    | 20 | 280 | 190     |        |        |                | 12.3                                                | 12.7      |
| 250          | 375    | 22 | 335 | 235     | 12     |        |                | 18.3                                                | 19.0      |
| 300          | 440    | 22 | 395 | 285     |        | M20    | 22             | 25.3                                                | 26.3      |
| 350          | 490    | 22 | 445 | 330     |        |        |                | 31.6                                                | 32.9      |
| 400          | 540    | 22 | 495 | 380     | 16     |        |                | 38.4                                                | 40.2      |
| 500          | 645    | 24 | 600 | 475     | 20     |        |                | 60.4                                                | 63.2      |

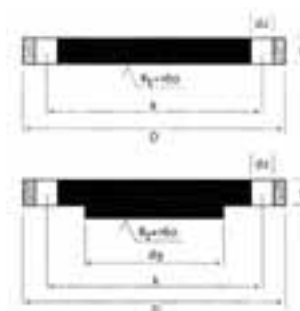
## Blind Flanges DIN 2527 PN 10

| Nominal Bore                                                                                 | Flange |    |     |         | Screws |        |                | Weight per Flange<br>(7,85 kg/dm <sup>3</sup> ) for |           |
|----------------------------------------------------------------------------------------------|--------|----|-----|---------|--------|--------|----------------|-----------------------------------------------------|-----------|
|                                                                                              | D      | b  | k   | dg max. | No.    | Thread | d <sub>2</sub> | Form B kg                                           | Form T kg |
| 10 up to 175: For Nominal Bore 10 up to 175 Blind Flanges of Nominal Bore 16 are to be used. |        |    |     |         |        |        |                |                                                     |           |
| 200                                                                                          | 340    | 24 | 295 | 190     | 8      | M20    | 22             | 16.5                                                | 16.9      |
| 250                                                                                          | 395    | 26 | 350 | 235     | 12     |        |                | 24.0                                                | 24.7      |
| 300                                                                                          | 445    | 26 | 400 | 285     |        |        |                | 30.9                                                | 31.9      |
| 350                                                                                          | 505    | 26 | 460 | 330     | 16     |        |                | 40.6                                                | 41.9      |
| 400                                                                                          | 565    | 26 | 515 | 380     |        | M24    | 26             | 49.4                                                | 51.2      |
| 500                                                                                          | 670    | 28 | 620 | 475     | 20     |        |                | 75.0                                                | 77.8      |



# Blind Flanges

## Blind Flanges DIN 2527 PN 16



Form B

Form T

| Nominal Bore | Flange |    |     |         | Screws |        |                | Weight per Flange<br>(7,85 kg/dm <sup>3</sup> ) for |           |
|--------------|--------|----|-----|---------|--------|--------|----------------|-----------------------------------------------------|-----------|
|              | D      | b  | k   | dg max. | No.    | Thread | d <sub>2</sub> | Form B kg                                           | Form T kg |
| 10           | 90     | 14 | 60  |         | 4      | M12    | 14             | 0.63                                                |           |
| 15           | 95     | 14 | 65  |         |        |        |                | 0.72                                                |           |
| 20           | 105    | 16 | 75  |         |        |        |                | 1.01                                                |           |
| 25           | 115    | 16 | 85  |         |        |        |                | 1.23                                                |           |
| 32           | 140    | 16 | 100 |         |        | M16    | 18             | 1.80                                                |           |
| 40           | 150    | 16 | 110 |         |        |        |                | 2.09                                                |           |
| 50           | 165    | 18 | 125 |         |        |        |                | 2.88                                                |           |
| 65           | 185    | 18 | 145 | 55      |        |        |                | 3.66                                                | 3.70      |
| 80           | 200    | 20 | 160 | 70      | 8      |        |                | 4.77                                                | 4.83      |
| 100          | 220    | 20 | 180 | 90      |        |        |                | 5.65                                                | 5.75      |
| 125          | 250    | 22 | 210 | 115     |        |        |                | 8.42                                                | 8.59      |
| 150          | 285    | 22 | 240 | 140     |        | M20    | 22             | 10.4                                                | 10.6      |
| (175)        | 315    | 24 | 270 | 165     |        |        |                | 14.0                                                | 14.3      |
| 200          | 340    | 24 | 295 | 190     | 12     |        |                | 16.1                                                | 16.5      |
| 250          | 405    | 26 | 355 | 235     |        | M24    | 26             | 24.9                                                | 25.6      |
| 300          | 460    | 28 | 410 | 285     |        |        |                | 35.1                                                | 36.1      |
| 350          | 520    | 30 | 470 | 330     | 16     |        |                | 47.8                                                | 49.1      |
| 400          | 580    | 32 | 525 | 380     |        | M27    | 30             | 63.5                                                | 65.3      |
| 500          | 715    | 36 | 650 | 475     | 20     | M30    | 33             | 102                                                 | 105       |

## Blind Flanges DIN 2527 PN 25

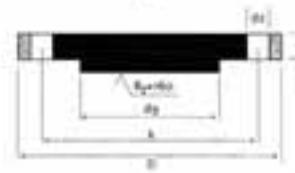
| Nominal Bore | Flange                                                                             |    |     |         | Screws |        |                | Weight per Flange<br>(7,85 kg/dm <sup>3</sup> ) for |           |
|--------------|------------------------------------------------------------------------------------|----|-----|---------|--------|--------|----------------|-----------------------------------------------------|-----------|
|              | D                                                                                  | b  | k   | dg max. | No.    | Thread | d <sub>2</sub> | Form B kg                                           | Form T kg |
| 10 up to 175 | For Nominal Bore 10 up to 175 Blind Flanges of Nominal Pressure 16 are to be used. |    |     |         |        |        |                |                                                     |           |
| (175)        | 330                                                                                | 28 | 280 | 165     | 12     | M24    | 26             | 17.3                                                | 17.6      |
| 200          | 360                                                                                | 30 | 310 | 190     |        |        |                | 22.3                                                | 22.7      |
| 250          | 425                                                                                | 32 | 370 | 237     |        | M27    | 30             | 33.5                                                | 34.2      |
| 300          | 485                                                                                | 34 | 430 | 285     | 16     |        |                | 46.3                                                | 47.3      |
| 350          | 555                                                                                | 38 | 490 | 332     |        | M30    | 33             | 68.0                                                | 69.3      |
| 400          | 620                                                                                | 40 | 550 | 380     |        | M33    | 36             | 89.7                                                | 91.5      |
| 500          | 730                                                                                | 45 | 660 | 475     | 20     |        |                | 138                                                 | 141       |



## Blind Flanges DIN 2527 PN 40



Form B



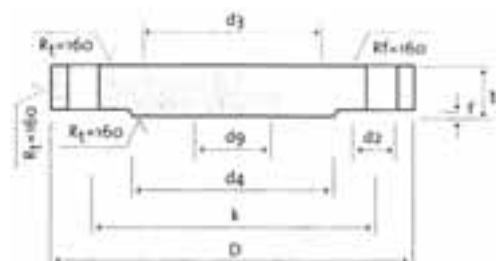
Form T

| Nominal Bore | Flange |    |     |         | Screws |        |                | Weight per Flange<br>(7,85 kg/dm <sup>3</sup> ) for |           |
|--------------|--------|----|-----|---------|--------|--------|----------------|-----------------------------------------------------|-----------|
|              | D      | b  | k   | dg max. | No.    | Thread | d <sub>2</sub> | Form B kg                                           | Form T kg |
| 10           | 90     | 16 | 60  |         | 4      | M12    | 14             | 0.72                                                |           |
| 15           | 95     | 16 | 65  |         |        |        |                | 0.81                                                |           |
| 20           | 105    | 18 | 75  |         |        |        |                | 1.24                                                |           |
| 25           | 115    | 18 | 85  |         |        |        |                | 1.38                                                |           |
| 32           | 140    | 18 | 100 |         |        | M16    | 18             | 2.03                                                |           |
| 40           | 150    | 18 | 110 |         |        |        |                | 2.35                                                |           |
| 50           | 165    | 20 | 125 |         |        |        |                | 3.20                                                |           |
| 65           | 185    | 22 | 145 | 55      | 8      |        |                | 4.29                                                | 4.33      |
| 80           | 200    | 24 | 160 | 70      |        |        |                | 5.88                                                | 5.94      |
| 100          | 235    | 24 | 190 | 90      |        | M20    | 22             | 7.54                                                | 7.64      |
| 125          | 270    | 26 | 220 | 115     |        | M24    | 26             | 10.8                                                | 11.0      |
| 150          | 300    | 28 | 250 | 140     |        |        |                | 14.5                                                | 14.7      |
| (175)        | 350    | 32 | 295 | 165     | 12     | M27    | 30             | 22.1                                                | 22.4      |
| 200          | 375    | 34 | 320 | 190     |        |        |                | 27.2                                                | 27.6      |
| 250          | 450    | 38 | 385 | 235     |        | M30    | 33             | 43.8                                                | 44.5      |
| 300          | 515    | 42 | 450 | 285     | 16     |        |                | 63.3                                                | 64.3      |
| 350          | 580    | 46 | 510 | 330     |        | M33    | 36             | 89.5                                                | 90.8      |
| 400          | 660    | 50 | 585 | 380     |        | M36    | 39             | 127                                                 | 129       |
| 500          | 755    | 56 | 670 | 475     | 20     | M39    | 42             | 172                                                 | 175       |



# Blind Flanges

## Blind Flanges DIN 2527 PN 64



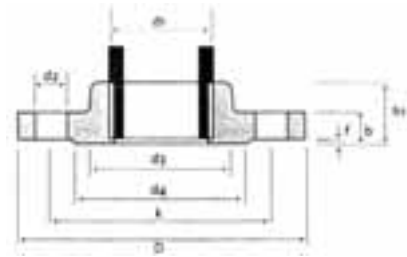
| Nominal Bore | Flange                                                                             |     |     |                |                |                |   | Screws |        |    | Weight per Flange<br>(7,85 kg/dm_) for |
|--------------|------------------------------------------------------------------------------------|-----|-----|----------------|----------------|----------------|---|--------|--------|----|----------------------------------------|
|              | D                                                                                  | b   | k   | d <sub>3</sub> | d <sub>4</sub> | d <sub>9</sub> | f | No.    | Thread | d2 |                                        |
| 10 up to 40  | For Nominal Bore 10 up to 40 Blind Flanges of Nominal Pressure 100 are to be used. |     |     |                |                |                |   |        |        |    |                                        |
| 50           | 180                                                                                | 26  | 135 | 82             | 102            | -              | 3 | 4      | M20    | 22 | 4.51                                   |
| 65           | 205                                                                                | 26  | 160 | 98             | 122            | 45             | 3 | 8      | M20    | 22 | 5.71                                   |
| 80           | 215                                                                                | 238 | 170 | 112            | 138            | 60             | 3 | 8      | M20    | 22 | 6.92                                   |
| 100          | 250                                                                                | 30  | 200 | 138            | 162            | 80             | 3 | 8      | M24    | 26 | 10.1                                   |
| 125          | 295                                                                                | 34  | 240 | 168            | 188            | 105            | 3 | 8      | M27    | 30 | 16.0                                   |
| 150          | 345                                                                                | 36  | 280 | 202            | 218            | 130            | 3 | 8      | M30    | 33 | 23.5                                   |
| (175)        | 375                                                                                | 40  | 310 | 228            | 260            | 155            | 3 | 12     | M30    | 33 | 30.8                                   |
| 200          | 415                                                                                | 42  | 345 | 256            | 285            | 180            | 3 | 12     | M33    | 36 | 39.7                                   |
| 250          | 470                                                                                | 46  | 400 | 316            | 345            | 220            | 3 | 12     | M33    | 36 | 57.4                                   |
| 300          | 530                                                                                | 52  | 460 | 372            | 410            | 270            | 4 | 16     | M33    | 36 | 81.0                                   |
| 350          | 600                                                                                | 56  | 525 | 420            | 465            | 310            | 4 | 16     | M36    | 39 | 114                                    |
| 400          | 670                                                                                | 60  | 585 | 475            | 535            | 360            | 4 | 16     | M39    | 42 | 153                                    |

## Blind Flanges DIN 2527 PN 100

| Nominal Bore | Flange |    |     |                |                |                |   | Screws |        |                | Weight per Flange<br>(7,85 kg/dm <sup>3</sup> ) for |
|--------------|--------|----|-----|----------------|----------------|----------------|---|--------|--------|----------------|-----------------------------------------------------|
|              | D      | b  | k   | d <sub>3</sub> | d <sub>4</sub> | d <sub>9</sub> | f | No.    | Thread | d <sub>2</sub> |                                                     |
| 10           | 100    | 20 | 70  | 32             | 40             | -              | 2 | 4      | M12    | 14             | 1.00                                                |
| 15           | 105    | 20 | 75  | 34             | 45             | -              | 2 | 4      | M12    | 14             | 1.22                                                |
| 25           | 140    | 24 | 100 | 52             | 68             | -              | 2 | 4      | M16    | 18             | 2.65                                                |
| 32           | 155    | 24 | 110 | 62             | 78             | -              | 2 | 4      | M20    | 22             | 3.24                                                |
| 40           | 170    | 26 | 125 | 70             | 88             | -              | 3 | 4      | M20    | 22             | 4.09                                                |
| 50           | 195    | 28 | 145 | 90             | 102            | -              | 3 | 4      | M24    | 26             | 5.84                                                |
| 65           | 220    | 30 | 170 | 108            | 122            | 45             | 3 | 8      | M24    | 26             | 8.03                                                |
| 80           | 230    | 32 | 180 | 120            | 138            | 60             | 3 | 8      | M24    | 26             | 9.43                                                |
| 100          | 265    | 36 | 210 | 150            | 162            | 80             | 3 | 8      | M27    | 30             | 14.3                                                |
| 125          | 315    | 40 | 250 | 180            | 188            | 105            | 3 | 8      | M30    | 33             | 22.6                                                |
| 150          | 355    | 44 | 290 | 210            | 218            | 130            | 3 | 12     | M30    | 33             | 31.8                                                |
| (175)        | 385    | 48 | 320 | 245            | 260            | 155            | 3 | 12     | M30    | 33             | 41.3                                                |
| 200          | 430    | 52 | 360 | 278            | 285            | 180            | 3 | 12     | M33    | 36             | 56.1                                                |
| 250          | 505    | 60 | 430 | 340            | 345            | 210            | 3 | 12     | M36    | 39             | 89.6                                                |
| 300          | 585    | 68 | 500 | 400            | 410            | 260            | 4 | 16     | M39    | 42             | 119                                                 |
| 350          | 655    | 74 | 560 | 460            | 465            | 300            | 4 | 16     | M45    | 48             | 175                                                 |



## Threaded Flange DIN 2565 PN 06



| NB   | d1    | Flange<br>Whitworth<br>Pipe Thread<br>DIN 2999 | D   | b  | k   | ht | Neck<br>d <sub>3</sub> | Sealing Groove<br>d <sub>4</sub> | f | Screws<br>No. | Thread | d <sub>2</sub> | Weight per<br>Flange<br>(7,85 kg/dm <sup>3</sup> )kg |
|------|-------|------------------------------------------------|-----|----|-----|----|------------------------|----------------------------------|---|---------------|--------|----------------|------------------------------------------------------|
| 6    | 10    | R1/8                                           | 65  | 10 | 40  | 18 | 18                     | 25                               | 2 | 4             | -      | 11.5           | 0.190                                                |
| 8    | 13.25 | R1/4                                           | 70  | 10 | 45  | 18 | 22                     | 30                               | 2 | 4             | -      | 11.5           | 0.227                                                |
| 10   | 15.75 | R3/8                                           | 75  | 12 | 50  | 20 | 25                     | 35                               | 2 | 4             | -      | 11.5           | 0.323                                                |
| 15   | 21.25 | R1/2                                           | 80  | 12 | 55  | 20 | 30                     | 40                               | 2 | 4             | -      | 11.5           | 0.373                                                |
| 20   | 26.75 | R3/4                                           | 90  | 14 | 65  | 24 | 40                     | 50                               | 2 | 4             | -      | 11.5           | 0.590                                                |
| 25   | 33.5  | R1                                             | 100 | 14 | 75  | 24 | 50                     | 60                               | 2 | 4             | -      | 11.5           | 0.743                                                |
| 32   | 42.25 | R1.1/4                                         | 120 | 14 | 90  | 26 | 60                     | 70                               | 2 | 4             | -      | 15             | 1.05                                                 |
| 40   | 48.25 | R1.1/2                                         | 130 | 14 | 100 | 26 | 70                     | 80                               | 3 | 4             | -      | 15             | 1.20                                                 |
| 50   | 60    | R2                                             | 140 | 14 | 110 | 28 | 80                     | 90                               | 3 | 4             | -      | 15             | 1.37                                                 |
| (60) | (66)  | R2.1/4                                         | 150 | 14 | 120 | 30 | 90                     | 100                              | 3 | 4             | -      | 15             | 1.57                                                 |
| 70   | 75.5  | R2.1/2                                         | 160 | 14 | 130 | 32 | 100                    | 110                              | 3 | 4             | -      | 15             | 1.92                                                 |
| 80   | 88.25 | R3                                             | 190 | 16 | 150 | 34 | 110                    | 128                              | 3 | 4             | -      | 18             | 2.85                                                 |
| (90) | (101) | R3.1/2                                         | 200 | 16 | 160 | 36 | 120                    | 138                              | 3 | 4             | -      | 18             | 3.04                                                 |
| 100  | 113.5 | R4                                             | 210 | 16 | 170 | 38 | 130                    | 148                              | 3 | 4*            | -      | 18             | 3.19                                                 |
| 125  | 139   | R5                                             | 240 | 18 | 200 | 40 | 160                    | 178                              | 3 | 8             | -      | 18             | 4.47                                                 |
| 150  | 164.5 | R6                                             | 265 | 18 | 225 | 44 | 185                    | 202                              | 3 | 8             | -      | 18             | 5.80                                                 |

\*) For Pipelines 8 Screws are recommended.

## Threaded Flange DIN 2566 PN 10

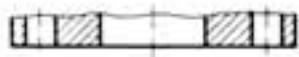
| NB  | d1    | Flange<br>Whitworth<br>Pipe Thread<br>DIN 2999 | D   | b  | k   | ht | Neck<br>d <sub>3</sub> | Sealing Groove<br>d <sub>4</sub> | f | Screws<br>No. | Thread | d <sub>2</sub> | Weight per<br>Flange<br>(7,85 kg/dm <sup>3</sup> )kg |
|-----|-------|------------------------------------------------|-----|----|-----|----|------------------------|----------------------------------|---|---------------|--------|----------------|------------------------------------------------------|
| 6   | 10.2  | R1/8                                           | 75  | 12 | 50  | 18 | 20                     | 32                               | 2 | 4             | M10    | 11             | 0.326                                                |
| 8   | 13.5  | R1/4                                           | 80  | 12 | 55  | 18 | 25                     | 38                               | 2 | 4             | M10    | 11             | 0.380                                                |
| 10  | 17.2  | R3/8                                           | 90  | 14 | 60  | 20 | 30                     | 40                               | 2 | 4             | M12    | 14             | 0.544                                                |
| 15  | 21.3  | R1/2                                           | 95  | 14 | 65  | 20 | 35                     | 45                               | 2 | 4             | M12    | 14             | 0.613                                                |
| 20  | 26.9  | R3/4                                           | 105 | 16 | 75  | 24 | 45                     | 58                               | 2 | 4             | M12    | 14             | 0.910                                                |
| 25  | 33.7  | R1                                             | 115 | 16 | 85  | 24 | 52                     | 68                               | 2 | 4             | M12    | 14             | 1.10                                                 |
| 32  | 42.4  | R1.1/4                                         | 140 | 16 | 100 | 26 | 60                     | 78                               | 2 | 4             | M16    | 18             | 1.60                                                 |
| 40  | 48.3  | R1.1/2                                         | 150 | 16 | 110 | 26 | 70                     | 88                               | 3 | 4             | M16    | 18             | 1.78                                                 |
| 50  | 60.3  | R2                                             | 165 | 18 | 125 | 28 | 85                     | 102                              | 3 | 4             | M16    | 18             | 2.43                                                 |
| 65  | 76.1  | R2.1/2                                         | 185 | 18 | 145 | 32 | 105                    | 122                              | 3 | 4             | M16    | 18             | 3.18                                                 |
| 80  | 88.9  | R3                                             | 200 | 20 | 160 | 34 | 118                    | 138                              | 3 | 8             | M16    | 18             | 4.12                                                 |
| 100 | 114.3 | R4                                             | 220 | 20 | 180 | 38 | 140                    | 158                              | 3 | 8             | M16    | 18             | 4.47                                                 |



# Flanges

## TYPES OF CONTACT FACES

### Flat Face Flange

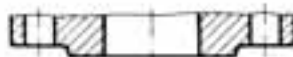


**Form A**  
Simple Face

### Form B

Face RZ = 160, machined (not finer than 40µm)

### Face Flange



### Form C

Face RZ = 160 (not finer than 40µm), machined

### Form D

Face RZ = 40, machined

### Form E

Face RZ = 16, machined

### Flange with Integrated Sealing

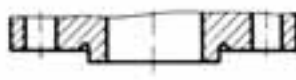
### Form F

Tongue as per DIN 2512



### Form V 14

Projection as per DIN 2514



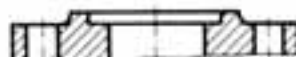
### Form N

Groove as per DIN 2512



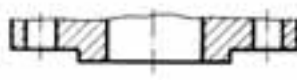
### Form R 14

Recess as per DIN 2514



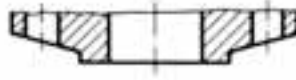
### Form V 13

Projection as per DIN 2513



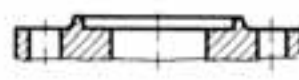
### Form M

Bevel for Diaphragm Seal as per DIN 2695



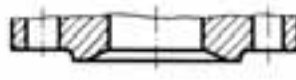
### Form R 13

Recess as per DIN 2513



### Form L

Lens Ring Face



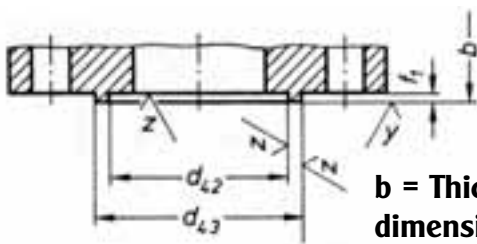


Flanges, groove and tongue, nominal pressures 10 to 160 design sizes, rings

Dimensions in mm

## Tongue

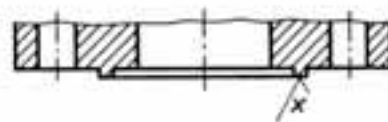
### Form F (normal case)



**b = Thickness as per dimension standard**

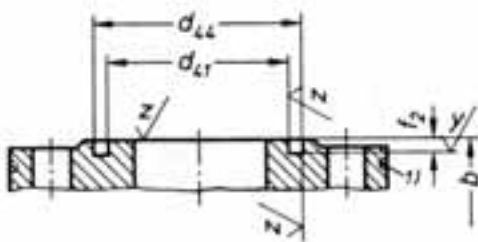
### Form FA (special case)

Other dimensions and indications as Form F



## Groove

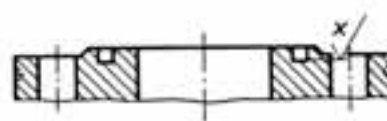
### Form N (normal case)



### Form V 14

### Form NA (special case)

Other dimensions and indications as Form N



$$z/\sqrt{\phantom{x}} = \sqrt{R_z} = 160$$

rotated

$$z/\sqrt{\phantom{x}} = \sqrt{R_z} = 160$$

rotated

$$z/\sqrt{\phantom{x}} = \sqrt{R_z} = 160$$





# Flanges Projection and Recess

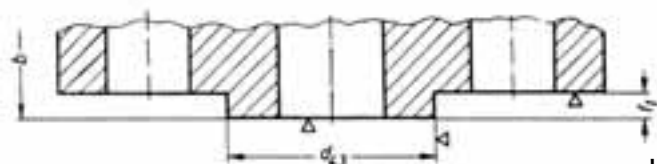
## Flanges

### Projection and Recess

Nominal Pressures 10 to 100

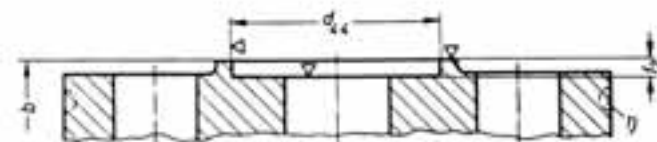
Dimensions in mm

#### Projection Flange Form V 13



b = Plate thickness as per standard

#### Recess Flange Form R 13



| Nominal<br>Bore | Projection              |                        | Recess                  |                        |
|-----------------|-------------------------|------------------------|-------------------------|------------------------|
|                 | d <sub>43</sub><br>-0.5 | f <sub>1</sub><br>+0.5 | d <sub>44</sub><br>+0.5 | f <sub>2</sub><br>-0.5 |
| 10              | 34                      | 4                      | 35                      | 3                      |
| 15              | 39                      | 4                      | 40                      | 3                      |
| 20              | 50                      | 4                      | 51                      | 3                      |
| 25              | 57                      | 4                      | 58                      | 3                      |
| 32              | 65                      | 4                      | 66                      | 3                      |
| 40              | 75                      | 4                      | 76                      | 3                      |
| 50              | 87                      | 4                      | 88                      | 3                      |
| 65              | 109                     | 4                      | 110                     | 3                      |
| 80              | 120                     | 4                      | 121                     | 3                      |
| 100             | 149                     | 4.5                    | 150                     | 3.5                    |
| 125             | 175                     | 4.5                    | 176                     | 3.5                    |
| 150             | 203                     | 4.5                    | 204                     | 3.5                    |
| (175)           | 233                     | 4.5                    | 234                     | 3.5                    |
| 200             | 259                     | 4.5                    | 260                     | 3.5                    |
| 250             | 312                     | 4.5                    | 313                     | 3.5                    |
| 300             | 363                     | 4.5                    | 364                     | 3.5                    |
| 350             | 421                     | 5                      | 422                     | 4                      |
| 400             | 473                     | 5                      | 474                     | 4                      |
| 500             | 575                     | 5                      | 576                     | 4                      |
| 600             | 675                     | 5                      | 676                     | 4                      |
| 700             | 777                     | 5                      | 778                     | 4                      |
| 800             | 882                     | 5                      | 883                     | 4                      |
| 900             | 987                     | 5                      | 988                     | 4                      |
| 1000            | 1091                    | 6                      | 1092                    | 5                      |

1) Recess Flanges can be marked with groove at outside if required

Flanges, Table see DIN 2500

Flanges, Types of contact faces see DIN 2526

Steel Flanges, technical delivery conditions see DIN 2519

Flat Ring Gasket for Flanges with projection and recess see DIN 2692

Nominal bore in brackets to be avoided if possible.

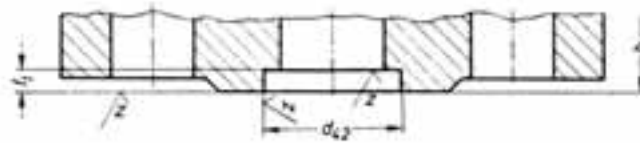


## Flanges groove for rubber seal ring Nominal Pressures 10 to 40 design sizes

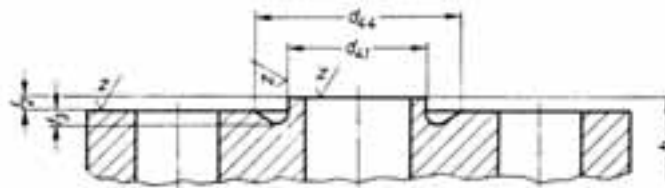
### Dimensions in mm

This norm is valid in connection with the corresponding dimensional standards for flanges.  
The lens ring face can be used also for plain flanges or flanges with sealing ring.

#### Recess Form R

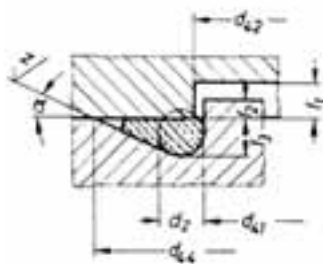


#### Projection Form V



$$\sqrt{z} = \sqrt{\overset{\text{rotated}}{R_z}} = 160$$

**Dimensions for assembly**  
**b** = plate thickness as per standard





## TYPES OF VALVE

### BOLTED BONNET VALVES

- GATE VALVE
- GLOBE VALVES
- SWING CHECK VALVES
- PISTON CHECK VALVES
- TILTING DISC CHECK VALVES
- Y PATTERN GLOBE VALVES

### PRESSURE SEAL VALVES

- GATE VALVES
- GLOBE VALVES
- SWING CHECK VALVES
- PISTON CHECK VALVES
- TILTING DISC CHECK VALVES
- Y PATTERN GLOBE VALVES

### API 6D VALVES

THROUGH CONDUIT GATE VALVES  
FULL-OPENING SWING CHECK VALVES  
REDUCED OPENING SWING CHECK VALVES

### WAFFER CHECK VALVES

### CRYOGENIC SERVICE VALVES

### SPECIAL SERVICES VALVES

- 3-WAYS GLOBE VALVES
- SLUICE GATE VALVES
- JACKETED VALVES
- BELLOW SEAL VALVES
- CAST STAINLESS STEEL GATES VALVES ACC. API 603
- BLOCK & BLOODED GATES VALVES



## GATE VALVES – Standard – Cryogenic – Bellow Seals

|              |       |                          |         |         |         |         |         |
|--------------|-------|--------------------------|---------|---------|---------|---------|---------|
| Cast Steel   | Type  | Bolted Bonnet, OS&Y      |         |         |         |         |         |
|              | Class | 150                      | 300     | 600     | 900     | 1500    | 2500    |
|              | Sizes | 2"- 56"                  | 2"- 48" | 2"- 48" | 2"- 24" | 2"- 24" | 2"- 12" |
|              | Ends  | RF - RTJ - BW            |         |         |         |         |         |
| Forged Steel | Type  | Bolted Bonnet, OS&Y      |         |         |         |         |         |
|              | Class | 150                      | 300     | 600     | 1500    | 2500    |         |
|              | Sizes | 1/2"- 2"                 |         |         |         |         |         |
|              | Ends  | RF - RTJ - BW            |         |         |         |         |         |
|              | Type  | Bolted Bonnet, OS&Y      |         |         |         |         |         |
|              | Class | 800                      |         | 1500    |         | 2500    |         |
|              | Sizes | 1/4"- 2"                 |         |         |         |         |         |
|              | Ends  | NPT - SW - BW            |         |         |         |         |         |
|              | Type  | Seal Weldet Bonnet, OS&Y |         |         |         |         |         |
|              | Class | 300                      | 600     | 1500    | 2500    |         |         |
|              | Sizes | 1/4"- 2"                 |         |         |         |         |         |
|              | Ends  | NPT - SW - RF - RTJ - BW |         |         |         |         |         |



## GLOBE VALVES – Straight Pattern, Standard – Cryogenic, Bellow Seal

|              |       |                     |         |         |                    |        |       |      |
|--------------|-------|---------------------|---------|---------|--------------------|--------|-------|------|
| Cast Steel   | Type  | Bolted Bonnet, OS&Y |         |         |                    |        |       |      |
|              | Class | 150                 | 300     | 600     | 900                | 1500   | 2500  |      |
|              | Sizes | 2"- 16"             | 2"- 16" | 2"- 12" | 2"- 10"            | 2"- 8" | 2"-8" |      |
|              | Ends  | RF – RTJ – BW       |         |         |                    |        |       |      |
| Forged Steel | Type  | Bolted Bonnet, OS&Y |         |         |                    |        |       |      |
|              | Class | 150                 | 300     | 600     | 1500               | 2500   |       |      |
|              | Sizes | 1/2"- 2"            |         |         |                    |        |       |      |
|              | Ends  | RF – RTJ – BW       |         |         |                    |        |       |      |
|              | Type  | Bolted Bonnet, OS&Y |         |         | Seal Welded Bonnet |        |       |      |
|              | Class | 800                 | 1500    | 2500    | 800                | 1500   | 2500  | 4500 |
|              | Sizes | 1/4"- 2"            |         |         | 1/4"- 2"           |        |       |      |
|              | Ends  | NPT – SW – BW       |         |         | NPT – SW – BW      |        |       |      |



## GLOBE VALVES – Y-Pattern, Standard & Bellow Seal

| CODE: WELVES      A Pattern, Standard & Below Seal |       |                          |      |      |      |  |
|----------------------------------------------------|-------|--------------------------|------|------|------|--|
| Forged Steel                                       | Type  | Seal Weldet Bonnet, OS&Y |      |      |      |  |
|                                                    | Class | 800                      | 1500 | 2500 | 4500 |  |
|                                                    | Sizes | 1/4"– 4"                 |      |      |      |  |
|                                                    | Ends  | NPT – SW – BW – RF – RTJ |      |      |      |  |



## SWING CHECK, PISTON CHECK, WAFER CHECK VALVES

|              |       |                       |         |         |                   |         |         |      |
|--------------|-------|-----------------------|---------|---------|-------------------|---------|---------|------|
| Cast Steel   | Type  | Bolted Cover          |         |         |                   |         |         |      |
|              | Class | 150                   | 300     | 600     | 900               | 1500    | 2500    |      |
|              | Sizes | 2"– 48"               | 2"– 36" | 2"– 36" | 2"– 24"           | 2"– 24" | 2"– 12" |      |
|              | Ends  | RF – RTJ – BW – WAFER |         |         |                   |         |         |      |
| Forged Steel | Type  | Bolted Cover          |         |         |                   |         |         |      |
|              | Class | 150                   | 300     | 600     | 1500              | 2500    |         |      |
|              | Sizes | 1/2"– 2"              |         |         |                   |         |         |      |
|              | Ends  | RE – RTJ – BW         |         |         |                   |         |         |      |
|              | Type  | Bolted Cover          |         |         | Seal Welded Cover |         |         |      |
|              | Class | 800                   | 1500    | 2500    | 800               | 1500    | 2500    | 4500 |
|              | Sizes | 1/4"– 2"              |         |         | 1/4"– 2"          |         |         |      |
|              | Ends  | NPT – SW – BW         |         |         | NPT – SW – BW     |         |         |      |



# VALVES



## PISTON CHECK, BALL CHECK & SWING CHECK VALVES

| Forged Steel | Type  | Straight-Bolted C |      |      | Y-Pattern, Seal Weld. Cover |      |      |      |
|--------------|-------|-------------------|------|------|-----------------------------|------|------|------|
|              | Class | 800               | 1500 | 2500 | 800                         | 1500 | 2500 | 4500 |
|              | Sizes | 1/4"- 2"          |      |      | 1/4"- 2"                    |      |      |      |
|              | Ends  | NPT - SW - BW     |      |      | NPT - SW - BW               |      |      |      |

## PRESSURE SEAL VALVES, CAST & FORGED STEEL

| Gate                             | Class | 600           | 900     | 1500    | 2500    | 4500   |
|----------------------------------|-------|---------------|---------|---------|---------|--------|
|                                  | Sizes | 2"- 24"       | 2"- 24" | 2"- 24" | 2"- 14" | 2"- 3" |
|                                  | Ends  | RF - RTJ - BW |         |         |         |        |
| Globe & Stop Check               | Class | 600           | 900     | 1500    | 2500    | 4500   |
|                                  | Sizes | 2"- 16"       | 2"- 16" | 2"- 12" | 2"- 12" | 2"- 3" |
|                                  | Ends  | RF - RTJ - BW |         |         |         |        |
| Swing Check & Tilting Disk Check | Class | 600           | 900     | 1500    | 2500    |        |
|                                  | Sizes | 2"- 16"       | 2"- 16" | 2"- 12" | 2"- 12" |        |
|                                  | Ends  | RF - RTJ - BW |         |         |         |        |
| Piston Check                     | Class | 600           | 900     | 1500    | 2500    | 4500   |
|                                  | Sizes | 2"- 12"       | 2"- 12" | 2"- 12" | 2"- 12" | 2"- 3" |

## THROUGH CONDUIT GATE VALVES, CAST STEEL

|                |                                                                                                                                                |               |         |         |         |         |         |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------|---------|---------|---------|---------|
| Slab Gate      | Class                                                                                                                                          | 150           | 300     | 600     | 900     | 1500    | 2500    |
|                | Sizes                                                                                                                                          | 2"- 48"       | 2"- 48" | 2"- 36" | 2"- 24" | 2"- 16" | 2"- 12" |
|                | Ends                                                                                                                                           | RF - RTJ - BW |         |         |         |         |         |
| Expanding Gate | Class                                                                                                                                          | 150           | 300     | 600     | 900     | 1500    | 2500    |
|                | Sizes                                                                                                                                          | 2"- 36"       | 2"- 36" | 2"- 36" | 2"- 24" | 2"- 16" | 2"- 12" |
|                | Ends                                                                                                                                           | RF - RTJ - BW |         |         |         |         |         |
| Options        | Gear Operator - Electric-Pneumatic, Hydraulic Actuators, Position Indicators - Stem Protection - Locking Devices, Soft Seals, Special Packings |               |         |         |         |         |         |

## BALL VALVES - FULL BORE & REDUCED BORE, CAST & FORGED STEEL

|                                          |       |               |     |     |           |           |           |          |
|------------------------------------------|-------|---------------|-----|-----|-----------|-----------|-----------|----------|
| Split Body, Bolted & Welded Construction | Class | 150           | 300 | 600 | 900       | 1500      | 2500      | API      |
|                                          | Sizes | 1/2"– 60"     |     |     | 1/2"– 48" | 1/2"– 42" | 1/2"– 20" | 1/2"–30" |
|                                          | Ends  | RF – RTJ – BW |     |     |           |           |           |          |
| 1-Pce. Body Side Entry                   | Class | 800           |     |     |           | 1500      |           |          |
|                                          | Sizes | 1/4"– 4"      |     |     |           | 1/4"– 4"  |           |          |
|                                          | Ends  | RF – RTJ – BW |     |     |           |           |           |          |
| 1-Pce. Body Top Entry                    | Class | 150           | 300 | 600 | 900       | 1500      | 2500      | API      |
|                                          | Sizes | 1/2"– 60"     |     |     | 1/2"– 42" | 1/2"– 40" | 1/2"– 20" | 1/2"–30" |
|                                          | Ends  | RF – RTJ – BW |     |     |           |           |           |          |

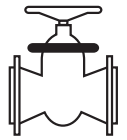
## BUTTERFLY VALVES - SOFT SEATED & METAL SEATED HIGH PERFORMANCE

| Materials | Cast Iron, Carbon Steel, Stainless Steel, Aluminium, Bronze & Alloys |
|-----------|----------------------------------------------------------------------|
| Classes   | ANSI 150 & ANSI 300                                                  |
| Sizes     | 1 1/2"- 32" Wafer Type, 1 1/2"- 16" Lug, 2"- 72" Flanged             |

## PLUG VALVES

| Lubricated 2-Way & 3-Way     | Class | 150           | 300       | 600       | 800/1500            | 900   | 1500  | 2500  |
|------------------------------|-------|---------------|-----------|-----------|---------------------|-------|-------|-------|
|                              | Sizes | 1/2"- 30"     | 1/2"- 24" | 1/2"- 24" | 1/4"- 2"            | 1-16" | 2-16" | 2-12" |
|                              | Ends  | RF - RTJ - BW |           |           | NPT - SW - RTJ - BW |       |       |       |
| Non Lubricated 2-Way & 3-Way | Class | 150 & 300     |           |           | 150 & 300           |       |       |       |
|                              | Sizes | 1/2"- 12"     |           |           | 1/2"- 2 1/2"        |       |       |       |
|                              | Ends  | RF - BW       |           |           | NPT SW              |       |       |       |

OTHER VALVES Diaphragm Valves; Needle/Gauge Valves, Cocks, Plastic Valves, Air Release & Vacuum Valves, Line Blinds, Traps, Strainers, Orifice Fittings



| VALVE TYPE      | PRESSURE CLASS | END CONNECTION  | BODY MATERIALS | TRIM MATERIALS | OPERATION        |
|-----------------|----------------|-----------------|----------------|----------------|------------------|
| Gate            | Class 150      | Flat Face       | A 216-WCB      | 13%Cr          | Handwheel        |
| Globe           | Class 300      | Raised Face     | A 216-WCC      | 304            | Impact Handwheel |
| Swing Check     | Class 600      | Large Male      | A 217-WC1      | 316            | Chain            |
| Piston Check    | Class 900      | Small Male      | A 217-WC6      | 304-L          | Bevel Gear       |
| Tilting Disc    | Class 1500     | Large Female    | A 217-WC9      | 316-L          | Spur Gear        |
| Globe Y Pattern | Class 2500     | Small Female    | A 217-C5       | 321            | Pneumatic        |
|                 | Class 4500     | Large Tongue    | A 217-C12      | 347            | Hydraulic        |
|                 |                | Small Tongue    | A 217-C12A     | 51             | Electric         |
|                 |                | Large Groove    | A 352-LCB      | 55             |                  |
|                 |                | Small Groove    | A 352-LCC      | Bronze         |                  |
|                 |                | R.T.J.          | A 352-LC2      | Monel          |                  |
|                 |                | Buttwelded Ends | A 352-LC3      | Hastelloy B    |                  |
|                 |                | Threaded End    | A 351-CF8      | Hastelloy C    |                  |
|                 |                |                 | A 351-CF8M     | B-473          |                  |
|                 |                |                 | A 351-CF3      | (Alloy 420)    |                  |
|                 |                |                 | A 351-CF3M     | Half Stellite  |                  |
|                 |                |                 | A 351-CF8C     | Stellite       |                  |
|                 |                |                 | A-351-CD4Mcu   |                |                  |
|                 |                |                 | A 890-5A       |                |                  |
|                 |                |                 | A 351-CN7M     |                |                  |
|                 |                |                 | Hastelloy B    |                |                  |
|                 |                |                 | Hastelloy C    |                |                  |



Pressure seal Gate valve



Gate valve



Swing Check valve



Globe valve



# CAST STEEL BOLTED BONNET VALVES

## MANUFACTURING PROGRAM

Sizes are in inches



Bolted Bonnet Gate Valve with Spur and Bevel actuator.  
Class: 1500#. Size: 16"



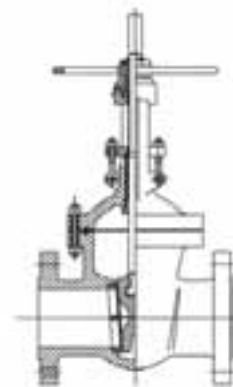
Bolted Bonnet Globe Valve with electric actuator.  
Class: 1500#. Size: 16"



Swing Check Valve with damper.  
Class: 150#. Size: 40"

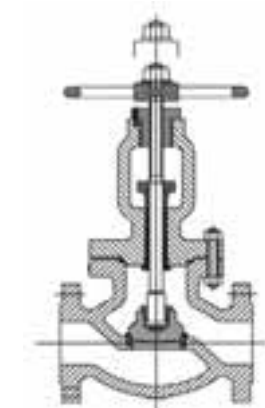
### GATE VALVES

| ANSI Class | SIZE |     |
|------------|------|-----|
|            | From | To  |
| 150        | 2"   | 72" |
| 300        | 2"   | 54" |
| 600        | 2"   | 54" |
| 900        | 2"   | 36" |
| 1500       | 2"   | 24" |
| 2500       | 2"   | 20" |



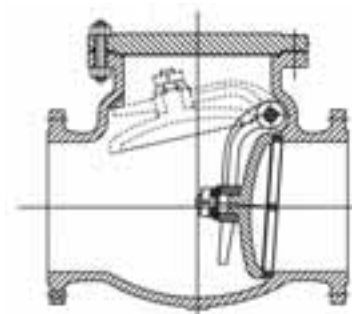
### GLOBE VALVES

| ANSI Class | SIZE |     |
|------------|------|-----|
|            | From | To  |
| 150        | 2"   | 24" |
| 300        | 2"   | 24" |
| 600        | 2"   | 24" |
| 900        | 2"   | 20" |
| 1500       | 2"   | 18" |
| 2500       | 2"   | 16" |



### SWING CHECK VALVES

| ANSI Class | SIZE |     |
|------------|------|-----|
|            | From | To  |
| 150        | 2"   | 64" |
| 300        | 2"   | 54" |
| 600        | 2"   | 54" |
| 900        | 2"   | 36" |
| 1500       | 2"   | 24" |
| 2500       | 2"   | 20" |







## MANUFACTURING PROGRAM

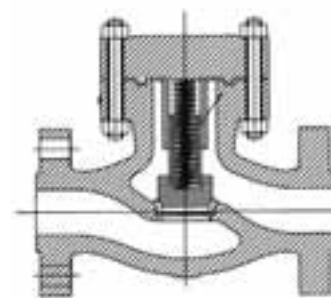
Sizes are in inches



Piston Check Valve.  
Class: 2500#. Size: 6"

### PISTON CHECK VALVES

| ANSI Class | SIZE |     |
|------------|------|-----|
|            | From | To  |
| 150        | 2"   | 10" |
| 300        | 2"   | 10" |
| 600        | 2"   | 10" |
| 900        | 2"   | 10" |
| 1500       | 2"   | 10" |
| 2500       | 2"   | 10" |

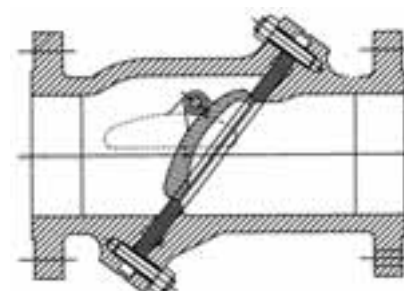


### TILTING DISC CHECK VALVES

| ANSI Class | SIZE |     |
|------------|------|-----|
|            | From | To  |
| 150        | 2"   | 24" |
| 300        | 2"   | 24" |
| 600        | 2"   | 24" |
| 900        | 2"   | 20" |
| 1500       | 2"   | 18" |
| 2500       | 2"   | 12" |



Tilting Disc Check Valve.  
Class: 150#. Size: 18"

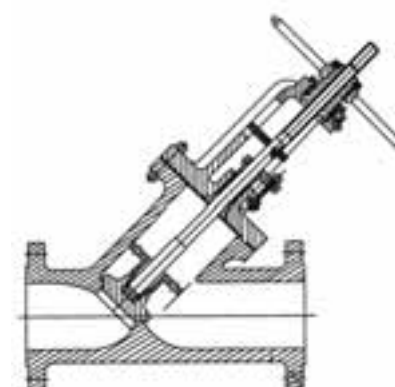


### Y-PATTERN GLOBE VALVES

| ANSI Class | SIZE |     |
|------------|------|-----|
|            | From | To  |
| 150        | 2"   | 16" |
| 300        | 2"   | 16" |
| 600        | 2"   | 14" |
| 900        | 2"   | 12" |
| 1500       | 2"   | 12" |
| 2500       | 2"   | 10" |



Y Pattern Globe Valve.  
Class: 150#. Size: 5"





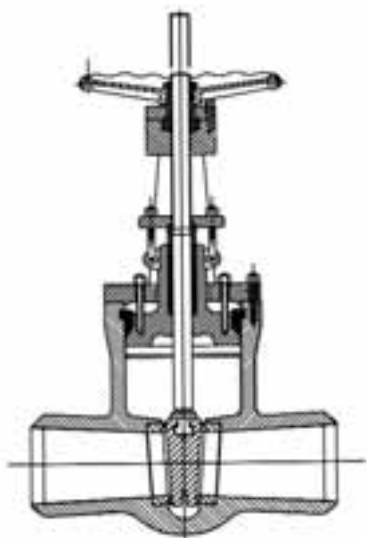


# CAST STEEL PRESSURE SEAL VALVES

## MANUFACTURING PROGRAM

Sizes are in inches

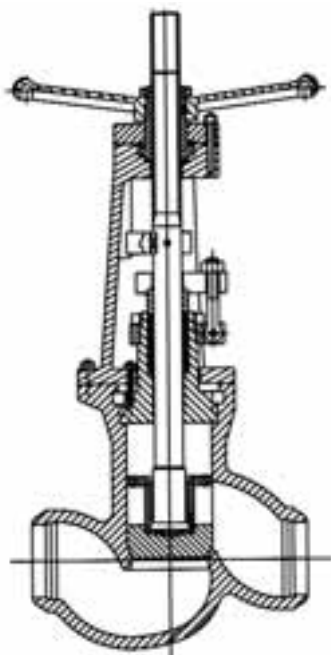
### GATE VALVES



| ANSI<br>Class | SIZE |     |
|---------------|------|-----|
|               | From | To  |
| 600           | 2"   | 30" |
| 900           | 2"   | 24" |
| 1500          | 2"   | 24" |
| 2500          | 2"   | 20" |
| 4500          | 2"   | 8"  |



Pressure Seal Gate Valve.  
Class: 600#. Size: 30"

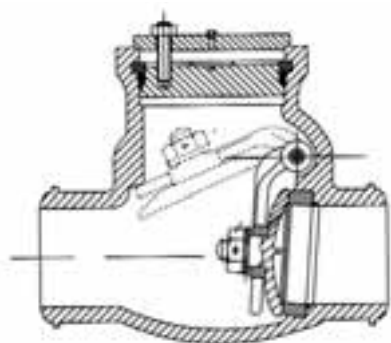


### GLOBE VALVES

| ANSI<br>Class | SIZE |     |
|---------------|------|-----|
|               | From | To  |
| 600           | 2"   | 16" |
| 900           | 2"   | 16" |
| 1500          | 2"   | 16" |
| 2500          | 2"   | 12" |
| 4500          | 2"   | 6"  |



Pressure Seal Globe Valve.  
Class: 600#. Size: 6"



### SWING CHECK VALVES

| ANSI<br>Class | SIZE |     |
|---------------|------|-----|
|               | From | To  |
| 600           | 2"   | 30" |
| 900           | 2"   | 24" |
| 1500          | 2"   | 24" |
| 2500          | 2"   | 20" |
| 4500          | 2"   | 8"  |



Pressure Seal Swing Check Valve.  
Class: 2500#. Size: 20"



## MANUFACTURING PROGRAM

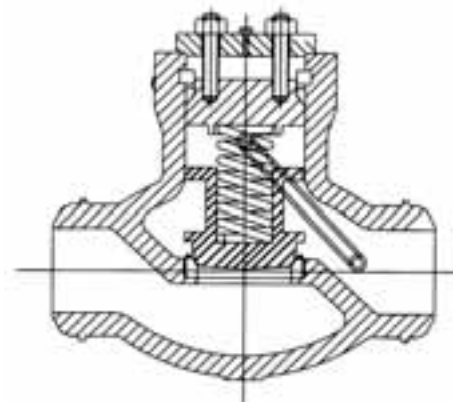
Sizes are in inches



Pressure Seal Piston check Valve.  
Class: 600#. Size: 6"

### PISTON CHECK VALVES

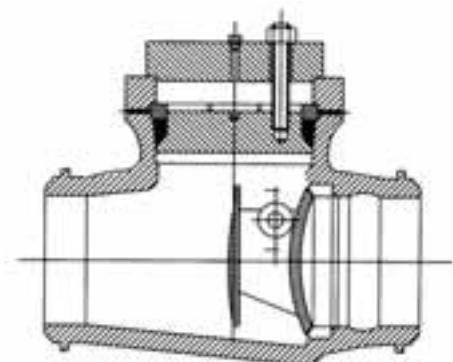
| ANSI<br>Class | SIZE |     |
|---------------|------|-----|
|               | From | To  |
| 600           | 2"   | 16" |
| 900           | 2"   | 16" |
| 1500          | 2"   | 16" |
| 2500          | 2"   | 12" |
| 4500          | 2"   | 8"  |



Pressure Seal Tilting disc check Valve.  
Class: 1500#. Size: 10"

### TILTING DISC VALVES

| ANSI<br>Class | SIZE |     |
|---------------|------|-----|
|               | From | To  |
| 600           | 2"   | 30" |
| 900           | 2"   | 24" |
| 1500          | 2"   | 24" |
| 2500          | 2"   | 16" |
| 4500          | 2"   | 8   |



Y Pattern Globe Valve.  
Class: 150#. Size: 6"

### Y PATTERN GLOBE VALVES

| ANSI<br>Class | SIZE |     |
|---------------|------|-----|
|               | From | To  |
| 600           | 2"   | 14" |
| 900           | 2"   | 12" |
| 1500          | 2"   | 12" |
| 2500          | 2"   | 10" |





## SPECIAL VALVES

### CAST STAINLESS STEEL GATE VALVES API 603

Grades of CF8M, CF8, CF3M, etc. are made to ANSI Class 150, with wall thicknesses to B 16.34.

Eventually we will be able to supply ANSI Class 300.

| ANSI<br>Class | SIZE |     |
|---------------|------|-----|
|               | From | To  |
| 150           | 2"   | 48" |

*Gate Valve, size 40", class 150, manufactured in stainless steel CF3M for Desalination Plant.*

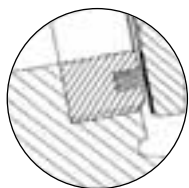


### BLOCK & BLEED GATE VALVES

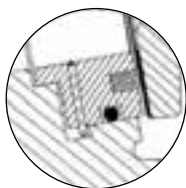
The Block and Bleed Gate Valves are used to prevent different types of fluids from mixing.

These valves provide a seal in both directions at pressures ranging from zero to maximum working pressure, regardless of fluctuations in pressure, pressure differentials or the direction of flow.

| ANSI<br>Class | SIZE |     |
|---------------|------|-----|
|               | From | To  |
| 150           | 2"   | 48" |
| 300           | 2"   | 36" |



*Detail of seal with Teflon insert for bores Of 2" to 12".*



*Detail of seal with floating rings for bores Of 14" and above.*

*Block & Bleed gate valve. Class: 150#. Size: 28".*





for use in critical applications in the chemical, petrochemical, oil and gas, nuclear power, cryogenic industries, etc.

## SPECIAL SERVICE VALVES:

JACKETED VALVES

3-WAY GLOBE VALVES

BELLOW SEAL VALVES

SLUICE GATE VALVES

CRYOGENIC SERVICE VALVES

WAFER TYPE GATE VALVES



*Gate Valve Wafer type. Size 36"*



*Bolted Bonnet Globe Valve with Bellow.  
Class: 600 #. Size: 3".*



*Swing check Valve with damper.*



*Jacketed Valves, Gate and swing check.*



## OTHER VALVES MANUFACTURED

*Gate Valves in stainless equipped  
with electric actuator*



*Bolted Bonnet Gate Valve.  
Class: 600 #. Size: 48".*



*Pressure Seal Gate valve.  
Class: 600 #. Size: 24"*



*Bolted Bonnet Gate Valve.  
Class: 900#. Size: 20".*



*CNC Machine  
Centre.*



*Pressure seal gate valve*







*Stress checking test*



*Dual plate wafer check valve. Class: 900#. Size: 36"*



*Dye penetrating inspection.*



*Vacuum test.*



*Bolted Bonnet swing check valve. Class: 1500#. Size: 4".*



*Globe Bellow Valves*



## OTHER TYPES OF VALVES

### DUAL PLATE WAFER CHECK VALVES

Is a check valve for general use, characterised by its reduced weight.

Due to the wide range of build materials (carbon, alloy or stainless steel, etc.) it can meet any service requirements.

The continuous spring force applied to the disc prevents any back-flow through the valve, providing a smooth, noise-free action.



*Dual plate wafer check valves.*

| ANSI<br>Class | SIZE |     |
|---------------|------|-----|
|               | From | To  |
| 125           | 2"   | 72" |
| 150           | 2"   | 54" |
| 300           | 2"   | 54" |
| 600           | 2"   | 36" |
| 900           | 2"   | 24" |
| 1500          | 2"   | 20" |
| 2500          | 2"   | 36" |

### CRYOGENIC SERVICE VALVES

Cryogenic valves, in gate, globe and check types for the production, storage and transfer of liquefied gases such as nitrogen, oxygen, natural gas, argon, hydrogen, methane, carbon dioxide, etc.

Lazaro Ituarte produce special extended bonnet stainless steel valves that offer excellent impact strength, minimal heat loss and protection against corrosion.



*Cryogenic Gate Valve.  
Class: 300#. Size: 16" in stainless steel CF8*

### CRYOGENIC GATE VALVES

| ANSI<br>Class | SIZE |     |
|---------------|------|-----|
|               | From | To  |
| 150           | 2"   | 24" |
| 300           | 2"   | 24" |
| 600           | 2"   | 24" |
| 900           | 2"   | 16" |

### CRYOGENIC GLOBE VALVES

| ANSI<br>Class | SIZE |     |
|---------------|------|-----|
|               | From | To  |
| 150           | 2"   | 12" |
| 300           | 2"   | 12" |
| 600           | 2"   | 8"  |
| 900           | 2"   | 8"  |



## Production range

### Type

Gate, Globe/Stop/Needle, Piston/Ball/Swing-check,  
Drop & Block check  
(Urea Service)  
Body joining  
Bolted and Welded bonnet (seal or full penetration),  
Bonnetless and  
Pressure seal  
Execution  
Straight, Y pattern & Angle, Bellows Seals, Cryogenic  
service, OS&Y, ISRS, ...  
Motorized  
with Electric, Pneumatic actuators, ...

### Sizes

1/4" to 2" reduced and full bore (Urea service up to 8")  
End connections  
SW, Threaded, BW, Hub and Flanged (integral type)  
Rating  
ANSI class 150 to 4500 lbs

### Materials

Carbon steel  
- ASTM A105  
Killed Carbon steel  
- ASTM A350 / LF2  
Alloy steel  
- ASTM A182 - F5, F9, F11, F22, F91  
Stainless steel  
- ASTM A182/F304(L), F316(L), F317, F321, F347, F44  
Special Alloy  
- Monel, Inconel, Incoloy, Hastelloy, UNS, Alloy 20,  
Sanicro 28, Titanium, ...  
Duplex  
- ASTM A 182/F51, F53, F55

### Material Test Report

NDE, Mechanical and Chemical Analysis

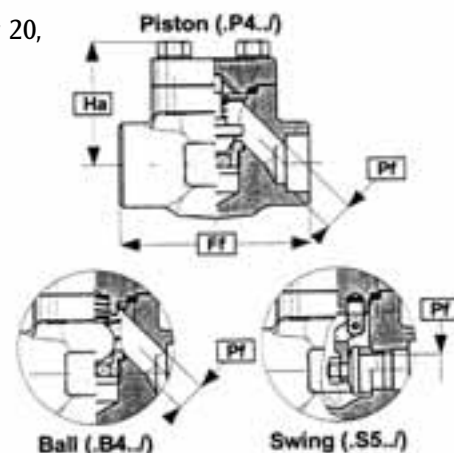
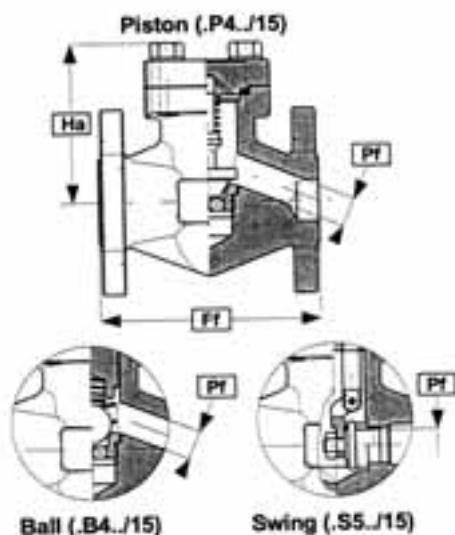
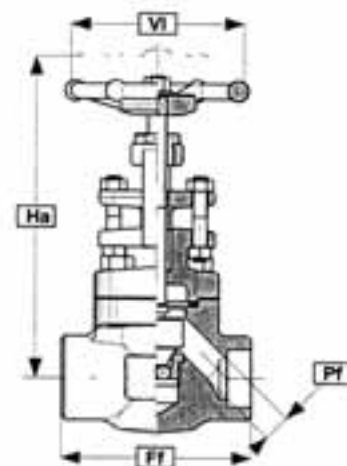
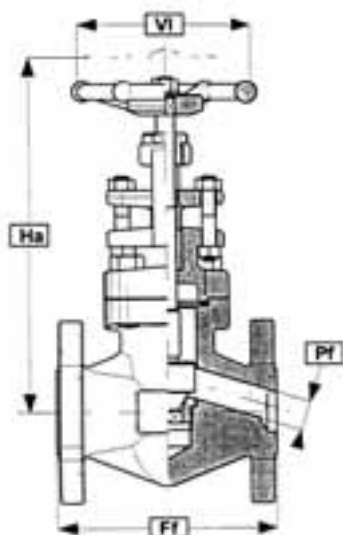
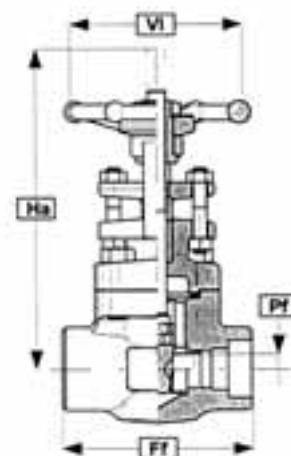
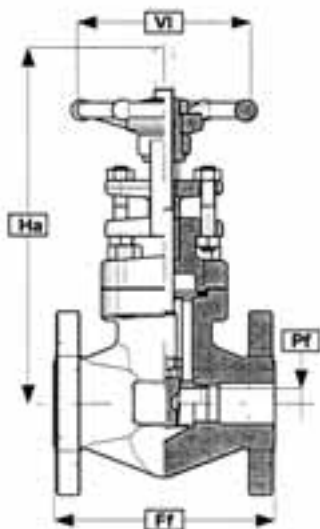
Hydro Test

Air Test

Performance Test

Cryogenic Test

Special tests available on request



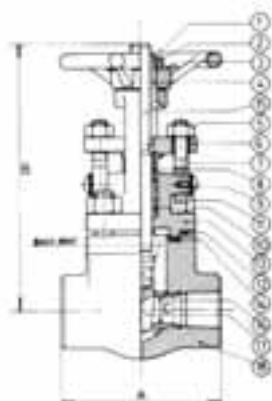




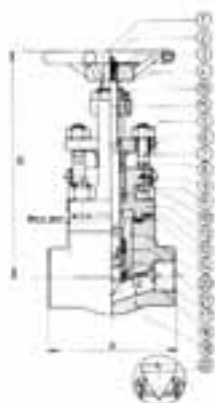
# BOLTED BONNET – O.S. & Y.

## CLASS 800 LBS

FORGED STEEL GATE, GLOBE, CHECK VALVES  
CARBON, ALLOY, STAINLESS STEEL AND SPECIAL MATERIALS  
SCREWED OR SOCKET WELD ENDS - FULL PORT

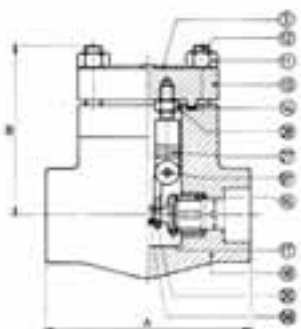


Gate Valves  
type BSC 800 FB



Globe & Needle Valves  
type BBD 0800 FB

\* Button head up to  
ND 25 size



Swing Check Valves  
type CKB 800 FB

or Piston Check Valves  
type CKP 800 FB  
or Ball Check Valves  
type CKS 800 FB

| CLASS                                      | ND<br>mm. | OUR TYPE           | END TO END<br>'A' mm. | PORT DIAM.<br>'C' mm. | BODY<br>MATERIAL | TRIM<br>MATERIAL |
|--------------------------------------------|-----------|--------------------|-----------------------|-----------------------|------------------|------------------|
| 800 Lbs<br><br>• 138 bar at<br>- 30 + 38°C | 8         | <b>BSC 801 FB</b>  | 60.3                  | 6.5                   | A A105           | A 13% CR         |
|                                            | 10        | <b>BSC 802 FB</b>  | 60.3                  | 8                     | B A182 GR F1     | B 13% Cr St      |
|                                            | 15        | <b>BSC 803 FB</b>  | 89                    | 12.7                  | C A182 GR F5     | H A182-F304      |
|                                            | 20        | <b>BSC 804 FB</b>  | 105                   | 19                    | D A182 Gr F9     | D A182-F304 St   |
|                                            | 25        | <b>BSC 805 FB</b>  | 127                   | 24                    | E A182 Gr F11    | L A182-F316      |
|                                            | 40        | <b>BSC 807 FB</b>  | 171.4                 | 38                    | F A182 Gr F12    | F A182-F316 St   |
|                                            | 50        | <b>BSC 808 FB</b>  | 184                   | 50                    | G A182 Gr F22    | N A182-F321      |
| 800 Lbs<br><br>• 138 bar at<br>- 30 + 38°C | 8         | <b>BBD 0801 FB</b> | 60.3                  | 06.5                  | H A182 Gr F304   | P A182-F321 St   |
|                                            | 10        | <b>BBD 0802 FB</b> | 60.3                  | 7                     | I A182 Gr F304L  | R Monel          |
|                                            | 15        | <b>BBD 0803 FB</b> | 89                    | 12                    | L A182 Gr F316   | S Inconel        |
|                                            | 20        | <b>BBD 0804 FB</b> | 105                   | 17.5                  | M A182 Gr F316L  | T Titanium       |
|                                            | 25        | <b>BBD 0805 FB</b> | 127                   | 22                    | N A182Gr F321    | U Incoloy 825    |
|                                            | 40        | <b>BBD 0807 FB</b> | 171.4                 | 32                    | O A182 Gr F347   | Y UNS N08904     |
|                                            | 50        | <b>BBD 0808 FB</b> | 184                   | 44.4                  | P A350 Gr LF2    | J UNS N08904 St  |
| 800 Lbs<br><br>• 138 bar at<br>- 30 + 38°C | 15        | <b>CKB 803 FB</b>  | 89                    | 12                    | Q A350 Gr LF3    | X Hastelloy C    |
|                                            | 20        | <b>CKB 804 FB</b>  | 105                   | 17.5                  | R Monel          | M A 182-F316L    |
|                                            | 25        | <b>CKB 805 FB</b>  | 127                   | 22                    | S Inconel        | C Bronze         |
|                                            | 40        | <b>CKB 807 FB</b>  | 171.4                 | 32                    | T Titanium       | Q Monel PTFE     |
|                                            | 50        | <b>CKB 808 FB</b>  | 184                   | 44.4                  | U Incoloy 825    | E Soft Seal      |
| 800 Lbs<br><br>• 138 bar at<br>-30 + 38°C  | 8         | <b>CKP 801 FB</b>  | 60.3                  | 6.5                   | Y UNS N08904     | K Duplex 2205    |
|                                            | 10        | <b>CKP 802 FB</b>  | 60.3                  | 7                     | K Duplex 2205    | V 254 SMO        |
|                                            | 15        | <b>CKP 803 FB</b>  | 89                    | 12                    | J 254 SMO        |                  |
|                                            | 20        | <b>CKP 804 FB</b>  | 105                   | 17.5                  |                  |                  |
|                                            | 25        | <b>CKP 805 FB</b>  | 127                   | 22                    |                  |                  |
|                                            | 40        | <b>CKP 807 FB</b>  | 171.4                 | 32                    |                  |                  |
|                                            | 50        | <b>CKP 808 FB</b>  | 184                   | 44.4                  |                  |                  |
| 800 Lbs<br><br>• 138 bar at<br>-30 + 38°C  | 8         | <b>CKS 801 FB</b>  | 60.3                  | 6.5                   |                  |                  |
|                                            | 15        | <b>CKS 802 FB</b>  | 60.3                  | 7                     |                  |                  |
|                                            | 20        | <b>CKS 803 FB</b>  | 89                    | 12                    |                  |                  |
|                                            | 25        | <b>CKS 804 FB</b>  | 105                   | 17.5                  |                  |                  |
|                                            | 30        | <b>CKS 805 FB</b>  | 127                   | 22                    |                  |                  |
|                                            | 40        | <b>CKS 807 FB</b>  | 171.4                 | 32                    |                  |                  |
|                                            | 50        | <b>CKS 808 FB</b>  | 184                   | 44.4                  |                  |                  |
|                                            |           |                    |                       |                       |                  |                  |
|                                            |           |                    |                       |                       |                  |                  |
|                                            |           |                    |                       |                       |                  |                  |
|                                            |           |                    |                       |                       |                  |                  |
|                                            |           |                    |                       |                       |                  |                  |

St = Stellite

| Ref. | Part. Name         |
|------|--------------------|
| 32   | REGULATING NEEDLE  |
| 21   | RING IN TWO HALVES |
| 20   | DISC NUT           |
| 19   | YOKE RETAINING NUT |
| 18   | BODY               |
| 17   | DISC               |
| 16   | SEAT               |
| 15   | STEM               |
| 14   | GASKET             |
| 13   | BONNET             |
| 12   | STUD BOLTS         |
| 11   | NUT                |
| 10   | PACKING            |
| 9    | EYEBOLTS UNIT      |
| 8    | PACKING GLAND      |
| 7    | EYEBOLTS           |
| 6    | GLAND FLANGE       |
| 5    | NUT                |
| 4    | YOKE NUT           |
| 3    | NAME PLATE         |
| 2    | BOLT               |
| 1    | HANDWHEEL          |

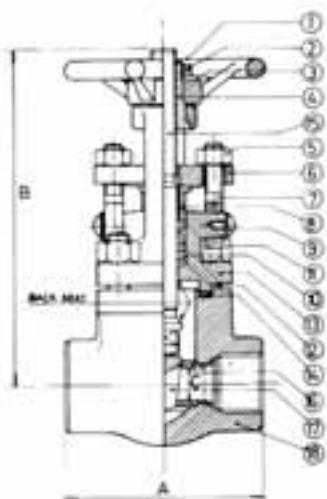
Note: For reference to items number add to the base drawing number a stroke then item no.  
i.e BSC 803 FB/18 means body for Gate Valve class 800 FB. Size 15 mm.  
• RATING FOR CARBON STEEL TO ANSI B 16.34 EDITION 1977  
Standard API 602 & BS 5352

# BOLTED BONNET – O.S. & Y.

## CLASS 800 LBS



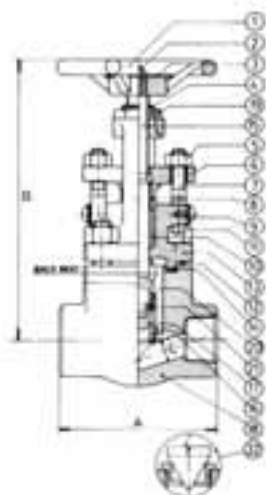
FORGED STEEL GATE, GLOBE, CHECK VALVES  
CARBON, ALLOY, STAINLESS STEEL AND SPECIAL MATERIALS  
SCREWED OR SOCKED WELD ENDS – REDUCED PORT



**Gate Valves**  
**Type BSC 800 RB**

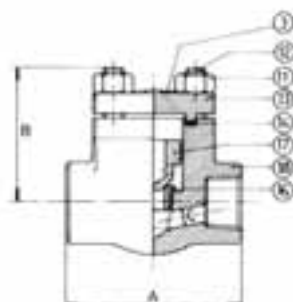
| CLASS                                   | ND<br>mm. | OUR TYPE           | END TO END<br>'A' mm. | PORT DIAM.<br>'C' mm. | BODY<br>MATERIAL | TRIM<br>MATERIAL |
|-----------------------------------------|-----------|--------------------|-----------------------|-----------------------|------------------|------------------|
| 800 Lbs<br>• 138 bar at<br>-30 + 38° C  | 15        | <b>BSC 803 RB</b>  | 70                    | 11                    | A 105            | A 13% CR         |
|                                         | 20        | <b>BSC 804 RB</b>  | 89                    | 12.7                  | B A182 GR F1     | B 13% Cr St      |
|                                         | 25        | <b>BSC 805 RB</b>  | 105                   | 19                    | C A182 GR F5     | H A182-F304      |
|                                         | 40        | <b>BSC 807 RB</b>  | 140                   | 30                    | D A182 Gr F9     | D A182-F304 St   |
|                                         | 50        | <b>BSC 808 RB</b>  | 171.4                 | 38                    | E 182 Gr. F11    | L A182-F316      |
| 800 Lbs<br>• 138 bar at<br>- 30 + 38° C | 15        | <b>BBD 0803 RB</b> | 70                    | 7                     | F A182 Gr F12    | F A182-F316 St   |
|                                         | 20        | <b>BBD 0804 RB</b> | 89                    | 12                    | G A182 Gr F22    | N A182-F321      |
|                                         | 25        | <b>BBD 0805 RB</b> | 105                   | 17.5                  | H A182 Gr F304   | P A182-F321 St   |
|                                         | 40        | <b>BBD 0807 RB</b> | 140                   | 29                    | I A182 Gr F304L  | R Monel          |
|                                         | 50        | <b>BBD 0808 RB</b> | 171.4                 | 32                    | L A182 Gr F316   | S Inconel        |
| 800 Lbs<br>• 138 bar at<br>- 30 + 38° C | 15        | <b>CKP 803 RB</b>  | 70                    | 7                     | M A182 Gr F316L  | T Titanium       |
|                                         | 20        | <b>CKP 804 RB</b>  | 89                    | 12                    | N A182Gr F321    | U Incoloy 825    |
|                                         | 25        | <b>CKP 805 RB</b>  | 105                   | 17.5                  | O A182 Gr F347   | Y UNS N08904     |
|                                         | 40        | <b>CKP 807 RB</b>  | 140                   | 29                    | P A350 Gr LF2    | J UNS N08904 St  |
|                                         | 50        | <b>CKP 808 RB</b>  | 171.4                 | 32                    | Q A350 Gr LF3    | X Hastelloy C    |
| 800 Lbs<br>• 138 bar at<br>-30 + 38° C  | 15        | <b>CKS 803 RB</b>  | 70                    | 7                     | R Monel          | M A 182-F316L    |
|                                         | 20        | <b>CKS 804 RB</b>  | 89                    | 12                    | S Inconel        | C Bronze         |
|                                         | 25        | <b>CKS 805 RB</b>  | 105                   | 17.5                  | T Titanium       | Q Monel PTFE     |
|                                         | 40        | <b>CKS 807 RB</b>  | 140                   | 29                    | U Incoloy 825    | E Soft Seal      |
|                                         | 50        | <b>CKS 808 RB</b>  | 171.4                 | 32                    | Y UNS N08904     | K Duplex 2205    |
|                                         |           |                    |                       |                       | K Duplex 2205    | V 254 SMO        |
|                                         |           |                    |                       |                       | J 254 SMO        |                  |

St = Stellite

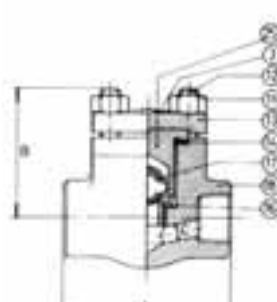


**Globe & Needle Valves**  
**type BBD 0800 RB**

\*Button head up to  
ND 25 size



**Piston Check Valves**  
**type CKP 800 RB**



**Ball Check Valves**  
**type CKS 800 RB**

| Ref. | Part. Name         |
|------|--------------------|
| 32   | REGULATING NEEDLE  |
| 21   | RING IN TWO HALVES |
| 20   | DISC NUT           |
| 19   | YOKE RETAINING NUT |
| 18   | BODY               |
| 17   | DISC               |
| 16   | SEAT               |
| 15   | STEM               |
| 14   | GASKET             |
| 13   | BONNET             |
| 12   | STUD BOLTS         |
| 11   | NUT                |
| 10   | PACKING            |
| 9    | EYEBOLTS UNIT      |
| 8    | PACKING GLAND      |
| 7    | EYEBOLTS           |
| 6    | GRAND FLANGE       |
| 5    | NUT                |
| 4    | YOKE NUT           |
| 3    | NAME PLATE         |
| 2    | BOLT               |
| 1    | HANDWHEEL          |

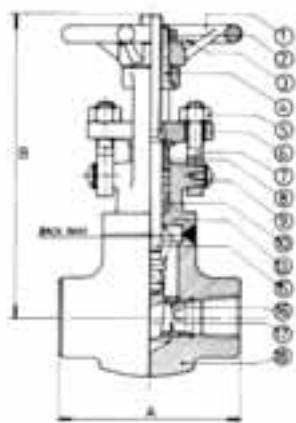
Note: For reference to items number add to the base drawing number a stroke then item no.  
i.e BSC 803 RB/18 means body for Gate Valve BSC 800 RB. Size 15 mm.

• RATING FOR CARBON STEEL TO ANSI B 16.34 EDITION 1977  
STANDARD API 602 & BS 5352

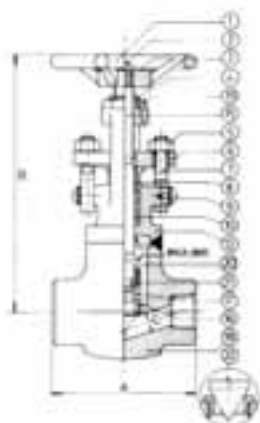


# WELDED BONNET – O.S. & Y. CLASS 800 LBS

FORGED STEEL GATE, GLOBE, CHECK VALVES  
CARBON, ALLOY, STAINLESS STEEL AND SPECIAL MATERIALS  
SCREWED OR SOCKET WELD ENDS  
FULL PENETRATION WELDED BONNET – REDUCED OR FULL PORT



**Gate Valves**  
**type WSC 800 RB**  
or WSC 800 FB



**Globe & Needle Valves**  
**type WBD 0800 RB**  
or WBD 0800 FB  
Button head up to  
ND 25 size

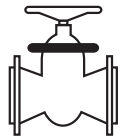


**Piston Check Valves**  
**type WCKP 800 RB**  
or WCKP 800 FB

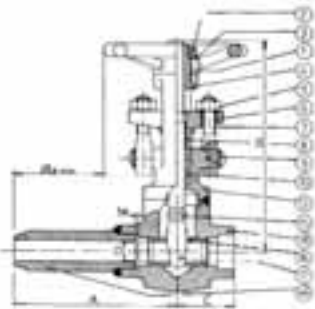
| CLASS                                       | ND<br>mm. | OUR TYPE    | END TO END<br>'A' mm. | PORT DIAM.<br>'C' mm. | BODY<br>MATERIAL |                    | TRIM<br>MATERIAL |                  |
|---------------------------------------------|-----------|-------------|-----------------------|-----------------------|------------------|--------------------|------------------|------------------|
| 800 Lbs<br><br>• 138 bar at<br>- 30 + 38° C | 15        | WSC 803 RB  | 70                    | 11                    | A                | A105               | A                | 13% CR           |
|                                             | 20        | WSC 804 RB  | 89                    | 12.7                  | B                | A182 GR F1         | B                | 13% Cr St        |
|                                             | 25        | WSC 805 RB  | 105                   | 19                    | C                | A182 GR F5         | H                | A182-F304        |
|                                             | 40        | WSC 807 RB  | 140                   | 30                    | D                | A182 Gr F9         | D                | A182-F304 St     |
|                                             | 50        | WSC 808 RB  | 171.4                 | 38                    | E                | A182 Gr. F11       | L                | A182-F316        |
| 800 Lbs<br><br>• 138 bar at<br>- 30 + 38° C |           |             |                       |                       | F                | A182 Gr F12        | F                | A182-F316 St     |
|                                             |           |             |                       |                       | G                | A182 Gr F22        | N                | A182-F321        |
|                                             | 8         | WSC 801 FB  | 60.3                  | 6.5                   | I                | A182 Gr F304L      | R                | Monel            |
|                                             | 10        | WSC 802 FB  | 60.3                  | 8                     | L                | A182 Gr F316       | S                | Inconel          |
|                                             | 15        | WSC 803 FB  | 89                    | 12.7                  | M                | A182 Gr F316L      | T                | Titanium         |
|                                             | 20        | WSC 804 FB  | 105                   | 19                    | N                | A182Gr F321        | U                | Incoloy 825      |
|                                             | 25        | WSC 805 FB  | 127                   | 24                    | O                | A182 Gr F347       | Y                | UNS N08904       |
|                                             | 40        | WSC 807 FB  | 171.4                 | 38                    | P                | A350 Gr LF2        | J                | UNS N08904<br>St |
| 800 Lbs<br><br>• 138 bar at<br>- 30 + 38° C | 50        | WSC 808 FB  | 184                   | 50                    | Q                | A350 Gr LF3        | X                | Hastelloy C      |
|                                             |           |             |                       |                       | R                | Monel              | M                | A 182-F316L      |
|                                             |           |             |                       |                       | S                | Inconel            | C                | Bronze           |
|                                             |           |             |                       |                       | T                | Titanium           | Q                | Monel PTFE       |
|                                             |           |             |                       |                       | U                | Incoloy 825        | E                | Soft Seal        |
|                                             |           |             |                       |                       | Y                | UNS N08904         | K                | Duplex 2205      |
|                                             |           |             |                       |                       | K                | Duplex 2205        | V                | 254 SMO          |
|                                             |           |             |                       |                       | J                | 254 SMO            |                  |                  |
| 800 Lbs<br><br>• 138 bar at<br>-30 + 38° C  | 8         | WBD 0801 FB | 60.3                  | 6.5                   | Ref.             | Part. Name         |                  |                  |
|                                             | 10        | WBD 0802 FB | 60.3                  | 7                     | 32               | REGULATING NEEDLE  |                  |                  |
|                                             | 15        | WBD 0803 FB | 89                    | 12                    | 21               | RING IN TWO HALVES |                  |                  |
|                                             | 20        | WBD 0804 FB | 105                   | 17.5                  | 20               | DISC NUT           |                  |                  |
|                                             | 25        | WBS 0805 FB | 127                   | 22                    | 19               | YOKE RETAINING NUT |                  |                  |
|                                             | 40        | WBD 0807 FB | 171.4                 | 32                    | 18               | BODY               |                  |                  |
|                                             | 50        | WBD 0808 FB | 184                   | 44.4                  | 17               | DISC               |                  |                  |
| 800 Lbs<br><br>• 138 bar at<br>-30 + 38° C  |           |             |                       |                       | 16               | SEAT               |                  |                  |
|                                             | 15        | WCKP 803 RB | 70                    | 7                     | 15               | STEM               |                  |                  |
|                                             | 20        | WCKP 804 RB | 89                    | 12                    | 13               | BONNET             |                  |                  |
|                                             | 25        | WCKP 805 RB | 105                   | 17.5                  | 10               | PACKING            |                  |                  |
|                                             | 40        | WCKP 807 RB | 140                   | 29                    | 9                | EYEBOLTS UNIT      |                  |                  |
|                                             | 50        | WCKP 808 RB | 172                   | 32                    | 8                | PACKING GLAND      |                  |                  |
|                                             |           |             |                       |                       | 7                | EYEBOLTS           |                  |                  |
| 800 Lbs<br><br>• 138 bar at<br>- 30 + 38° C |           |             |                       |                       | 6                | GRAND FLANGE       |                  |                  |
|                                             | 15        | WCKP 803 FB | 89                    | 12                    | 5                | NUT                |                  |                  |
|                                             | 20        | WCKP 804 FB | 105                   | 17.5                  | 4                | YOKE NUT           |                  |                  |
|                                             | 25        | WCKP 805 FB | 127                   | 22                    | 3                | NAME PLATE         |                  |                  |
|                                             | 40        | WCKP 807 FB | 172                   | 32                    | 2                | BOLT               |                  |                  |
|                                             | 50        | WCKP 808 FB | 184                   | 44                    | 1                | HANDWHEEL          |                  |                  |
|                                             |           |             |                       |                       |                  |                    |                  |                  |

Note: For reference to items number add to the base drawing number a stroke then item no.  
i.e WSC 803 RB/18 means body for Gate Valve WSC 800 RB. Size 15 mm.  
• RATING FOR CARBON STEEL TO ANSI B 16.34 EDITION 1977  
STANDARD API 602 & BS 5352

# WELDED BONNET – O.S. & Y. EXTENDED BODY – API 606

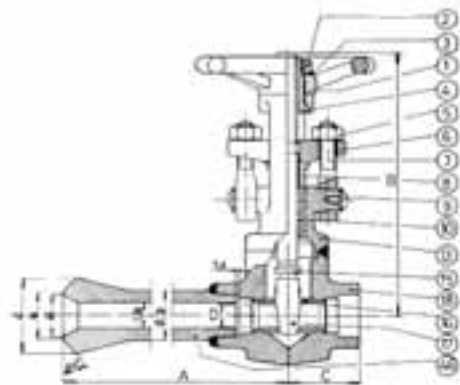


FORGED GATE VALVES  
CARBON, ALLOY, STAINLESS STEEL AND SPECIAL MATERIALS  
SCREWED, BEVELED END FOR WELDING, SOCKET WELD ENDS  
REINFORCED EXTENSION

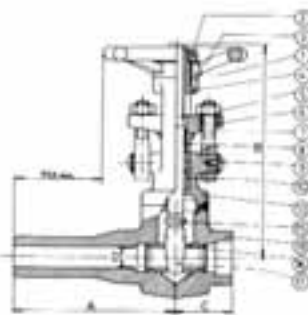


Gate Valves  
Type WSC 1506

| CLASS                                       | ND<br>mm. | OUR TYPE   | END TO END<br>'A' mm. | PORT DIAM.<br>'C' mm. | BODY<br>MATERIAL | TRIM<br>MATERIAL |
|---------------------------------------------|-----------|------------|-----------------------|-----------------------|------------------|------------------|
| 800 Lbs<br><br>• 138 bar at<br>-30 + 38° C  | 15        | WSC 6063   | 142                   | 11                    | A A 105          | A 13% CR         |
|                                             | 20        | WSC 6064   | 161.5                 | 12.7                  | B A182 GR F1     | B 13% Cr St      |
|                                             | 25        | WSC 6065   | 182.5                 | 19                    | C A182 GR F5     | H A182-F304      |
|                                             | 40        | WSC 6067   | 214                   | 30                    | D A182 Gr F9     | D A182-F304 St   |
| 800 Lbs<br><br>• 138 bar at<br>- 30 + 38° C | 15        | WSC 6063 R | 207                   | 11                    | E 182 Gr. F11    | L A182-F316      |
|                                             | 20        | WSC 6064 R | 218.5                 | 12.7                  | F A182 Gr F12    | F A182-F316 St   |
|                                             | 25        | WSC 6065 R | 243.5                 | 19                    | G A182 Gr F22    | N A182-F321      |
|                                             | 40        | WSC 6067 R | 263                   | 30                    | H A182 Gr F304   | P A182-F321 St   |
| 800 Lbs<br><br>• 255 bar at<br>- 30 + 38° C | 15        | WSC 15063  | 156                   | 11                    | I A182 Gr F304L  | R Monel          |
|                                             | 20        | WSC 15064  | 180                   | 12.7                  | L A182 Gr F316   | S Inconel        |
|                                             | 25        | WSC 15065  | 198.5                 | 19                    | M A182 Gr F316L  | T Titanium       |
|                                             | 40        | WSC 15067  | 236                   | 30                    | N A182Gr F321    | U Incoloy 825    |
|                                             |           |            |                       |                       | O A182 Gr F347   | Y UNS N08904     |
|                                             |           |            |                       |                       | P A350 Gr LF2    | J UNS N08904 St  |
|                                             |           |            |                       |                       | Q A350 Gr LF3    | X Hastelloy C    |
|                                             |           |            |                       |                       | R Monel          | M A 182-F316L    |
|                                             |           |            |                       |                       | S Inconel        | C Bronze         |
|                                             |           |            |                       |                       | T Titanium       | Q Monel PTFE     |
|                                             |           |            |                       |                       | U Incoloy 825    | E Soft Seal      |
|                                             |           |            |                       |                       | Y UNS N08904     | K Duplex 2205    |
|                                             |           |            |                       |                       | K Duplex 2205    | V 254 SMO        |
|                                             |           |            |                       |                       | J 254 SMO        |                  |



Gate Valves  
Reinforced  
type WSC 606 R



Gate Valves  
type WSC 606 I

| Ref. | Part. Name     |
|------|----------------|
| 46   | BODY EXTENSION |
| 18   | BODY           |
| 17   | DISC           |
| 16   | SEAT           |
| 15   | STEM           |
| 13   | BONNET         |
| 10   | PACKING        |
| 9    | EYEBOLTS UNIT  |
| 8    | PACKING GLAND  |
| 7    | EYEBOLTS       |
| 6    | GLAND FLANGE   |
| 5    | NUT            |
| 4    | YOKE NUT       |
| 3    | NAME PLATE     |
| 2    | BOLT           |
| 1    | HANDWHEEL      |
|      |                |
|      |                |
|      |                |

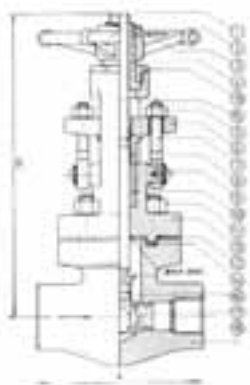
Note: For reference to items number add to the base drawing number a stroke then item no.  
i.e WSC 6063/18 means body for Gate Valves Extended Body API 606. Size 15 mm.  
• RATING FOR CARBON STEEL TO ANSI B 16.34 EDITION 1977  
STANDARD API 602 & BS 5352



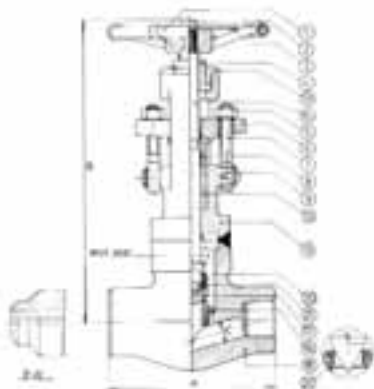
# BOLTED OR WELDED BONNET O.S. & Y.

## CLASS 1500 LBS

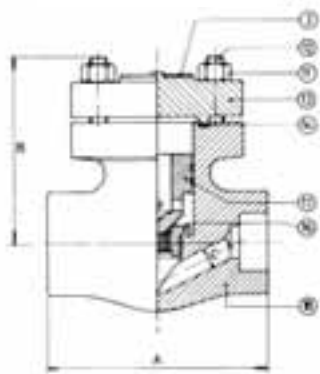
FORGED GATE, GLOBE, CHECK VALVES  
CARBON, ALLOY, STAINLESS STEEL AND SPECIAL MATERIALS  
SCREWED OR SOCKET WELD ENDS  
FULL PENETRATION WELDED BONNET



**Gate Valves**  
type **BSC 1500**  
or Globe Valves  
type **BBD 01500**



**Globe Valves**  
type **WBD 01500**  
\* Button head up to  
ND 20 size  
Gate Valves  
type **WSC 1500**



**Piston Check Valves**  
type **CKP 1500**  
or Swing Check Valves  
type **CKS 1500**  
or Ball Check Valves  
type **CKB 1500**

| CLASS                                                  | ND<br>mm. | OUR TYPE         | END TO END<br>'A' mm. | PORT DIAM.<br>'C' mm. | BODY<br>MATERIAL | TRIM<br>MATERIAL |
|--------------------------------------------------------|-----------|------------------|-----------------------|-----------------------|------------------|------------------|
| 1500 Lbs<br>BB-O.S.&Y.<br>• 255 bar at<br>- 30 + 38° C | 15        | <b>BSC 1503</b>  | 92                    | 11                    | A A105           | A 13% CR         |
|                                                        | 20        | <b>BSC 1504</b>  | 114.3                 | 13. 5                 | B A182 GR F1     | B 13% Cr St      |
|                                                        | 25        | <b>BSC 1505</b>  | 127                   | 19                    | C A182 GR F5     | H A182-F304      |
|                                                        | 40        | <b>BSC 1507</b>  | 171.4                 | 30                    | D A182 Gr F9     | D A182-F304 St   |
|                                                        | 50        | <b>BSC 1508</b>  | 228.6                 | 38                    | E A182 Gr F11    | L A182-F316      |
| 1500 Lbs<br>BB-O.S.&Y.<br>• 255 bar at<br>- 30 + 38° C | 15        | <b>BBD 01503</b> | 92                    | 12                    | F A182 Gr F12    | F A182-F316 St   |
|                                                        | 20        | <b>BBD 01504</b> | 114.3                 | 14. 3                 | G A182 Gr F22    | N A182-F321      |
|                                                        | 25        | <b>BBD 01505</b> | 127                   | 19                    | H A182 Gr F304   | P A182-F321 St   |
|                                                        | 40        | <b>BBD 01507</b> | 171.4                 | 28                    | I A182 Gr F304L  | R Monel          |
|                                                        | 50        | <b>BBD 01508</b> | 228.6                 | 40                    | L A182 Gr F316   | S Inconel        |
| 1500 Lbs<br>WB-O.S.&Y.<br>• 255 bar at<br>- 30 + 38° C | 15        | <b>WSC 01503</b> | 89                    | 11                    | M A182 Gr F316L  | T Titanium       |
|                                                        | 20        | <b>WSC 01504</b> | 105                   | 13. 5                 | N A182 Gr F321   | U Incoloy 825    |
|                                                        | 25        | <b>WSC 01505</b> | 127                   | 19                    | O A182 Gr F347   | Y UNS N08904     |
|                                                        | 40        | <b>WSC 01507</b> | 171.4                 | 30                    | P A350 Gr LF2    | J UNS N08904 St  |
|                                                        | 50        | <b>WSC 01508</b> | 184                   | 38                    | Q A350 Gr LF3    | X Hastelloy C    |
| 1500 Lbs<br>WB-O.S.&Y.<br>• 255 bar at<br>-30 + 38° C  | 15        | <b>WBD 01503</b> | 89                    | 12                    | R Monel          | M A 182-F316L    |
|                                                        | 20        | <b>WBD 01504</b> | 105                   | 14. 3                 | S Inconel        | C Bronze         |
|                                                        | 25        | <b>WBS 01505</b> | 127                   | 19                    | T Titanium       | Q Monel PTFE     |
|                                                        | 40        | <b>WBD 01507</b> | 171.4                 | 28                    | U Incoloy 825    | E Soft Seal      |
|                                                        | 50        | <b>WBD 01508</b> | 184                   | 40                    | Y UNS N08904     | K Duplex 2205    |
| 1500 Lbs<br>BB-O.S.&Y.<br>• 255 bar at<br>-30 + 38°C   | 15        | <b>CKP 1503</b>  | 92                    | 12                    | K Duplex 2205    | V 254 SMO        |
|                                                        | 20        | <b>CKP 1504</b>  | 114                   | 17. 5                 | J 254 SMO        |                  |
|                                                        | 25        | <b>CKP 1505</b>  | 127                   | 22                    |                  |                  |
|                                                        | 40        | <b>CKP 1507</b>  | 172                   | 32                    |                  |                  |
|                                                        | 50        | <b>CKP 1508</b>  | 229                   | 44.4                  |                  |                  |
| 1500 Lbs<br>BB-O.S.&Y.<br>• 138 bar at<br>- 30 + 38° C | 15        | <b>CKS 1503</b>  | 92                    | 12                    |                  |                  |
|                                                        | 20        | <b>CKS 1504</b>  | 114                   | 17. 5                 |                  |                  |
|                                                        | 25        | <b>CKS 1505</b>  | 127                   | 22                    |                  |                  |
|                                                        | 40        | <b>CKS 1507</b>  | 172                   | 32                    |                  |                  |
|                                                        | 50        | <b>CKS 1508</b>  | 229                   | 44.4                  |                  |                  |
| 1500 Lbs<br>BB-O.S.&Y.<br>• 138 bar at<br>- 30 + 38° C | 15        | <b>CKS 1503</b>  | 92                    | 12                    |                  |                  |
|                                                        | 20        | <b>CKS 1504</b>  | 114                   | 17. 5                 |                  |                  |
|                                                        | 25        | <b>CKS 1505</b>  | 127                   | 22                    |                  |                  |
|                                                        | 40        | <b>CKS 1507</b>  | 172                   | 32                    |                  |                  |
|                                                        | 50        | <b>CKS 1508</b>  | 229                   | 44.4                  |                  |                  |

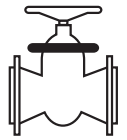
St = Stellite

| Ref. | Part. Name         |
|------|--------------------|
| 32   | REGULATING NEEDLE  |
| 21   | RING IN TWO HALVES |
| 20   | DISC NUT           |
| 19   | YOKE RETAINING NUT |
| 18   | BODY               |
| 17   | DISC               |
| 16   | SEAT               |
| 15   | STEM               |
| 13   | BONNET             |
| 10   | PACKING            |
| 9    | EYEBOLTS UNIT      |
| 8    | PACKING GLAND      |
| 7    | EYEBOLTS           |
| 6    | GRAND FLANGE       |
| 5    | NUT                |
| 4    | YOKE NUT           |
| 3    | NAME PLATE         |
| 2    | BOLT               |
| 1    | HANDWHEEL          |

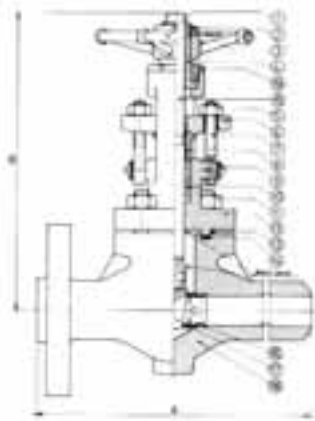
Note: For reference to items number add to the base drawing number a stroke then item no.  
i.e BSC 1503/18 means body for Gate Valve screwed or socket weld ends. Size 15 mm.  
• RATING FOR CARBON STEEL TO ANSI B 16.34 EDITION 1977  
BRITISH STANDARD 5352



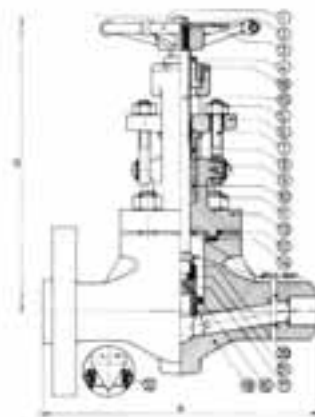
# FLANGED OR B.W. ENDS VALVES



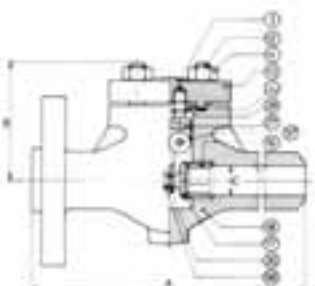
FORGED GATE, GLOBE AND CHECK VALVES  
BOLTED BONNET, O.S. & Y.  
CARBON, ALLOY, STAINLESS STEEL AND SPECIAL MATERIALS  
FLANGES INTEGRALLY FORGED WITH BODY CLASS 150 – 300 – 600 LBS



**Gate Valves**  
**type SCF 600**  
or SCF 300  
or SCF 150



**Globe & Needle Valves**  
**type DF 0600**  
or DF 0300  
or DF 0150  
\* Button head up to  
ND 25 size



**Swing Check Valves**  
**type CKBF 0600**  
or CKBF 300

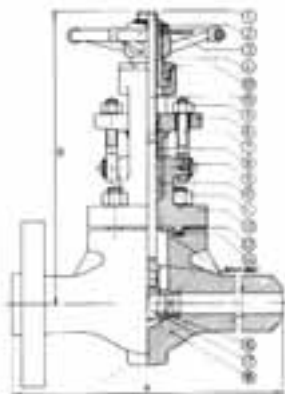
| CLASS                                        | ND<br>mm.          | OUR TYPE           | END TO END<br>'A' mm. | PORT DIAM.<br>'C' mm. | BODY<br>MATERIAL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      | TRIM<br>MATERIAL |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|----------------------------------------------|--------------------|--------------------|-----------------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------------------|------|-------------------|------------|--------------------|------------|----------|------------|--------------------|--------------|------|-------------|------|-------------|------|--------------|------|---------------|--------|--------------|--------|---------------|------------|--------------|-----|--------------|---------|-------------|---------------|-------------|---------------|-------|----------|---------|--------------|----------|-----|-------------|----------|------------|------------|-------------|------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---|--------|---|-----------|---|-----------|---|--------------|---|-----------|---|--------------|---|-----------|---|--------------|---|-------|---|---------|---|----------|---|-------------|---|------------|---|---------------|---|-------------|---|-------------|---|--------|---|------------|---|-----------|---|-------------|---|---------|
| 150 Lbs<br><br>• 19.5 bar at<br>-30 + 38° C  | 15                 | SCF 153            | 108                   | 11                    | <table><tr><td>A</td><td>A105</td></tr><tr><td>B</td><td>A182 GR F1</td></tr><tr><td>C</td><td>A182 GR F5</td></tr><tr><td>D</td><td>A182 Gr F9</td></tr><tr><td>E</td><td>A182 Gr. F11</td></tr><tr><td>F</td><td>A182 Gr F12</td></tr><tr><td>G</td><td>A182 Gr F22</td></tr><tr><td>H</td><td>A182 Gr F304</td></tr><tr><td>I</td><td>A182 Gr F304L</td></tr><tr><td>L</td><td>A182 Gr F316</td></tr><tr><td>M</td><td>A182 Gr F316L</td></tr><tr><td>N</td><td>A182 Gr F321</td></tr><tr><td>O</td><td>A182 Gr F347</td></tr><tr><td>P</td><td>A350 Gr LF2</td></tr><tr><td>Q</td><td>A350 Gr LF3</td></tr><tr><td>R</td><td>Monel</td></tr><tr><td>S</td><td>Inconel</td></tr><tr><td>T</td><td>Titanium</td></tr><tr><td>U</td><td>Incoloy 825</td></tr><tr><td>Y</td><td>UNS N08904</td></tr><tr><td>K</td><td>Duplex 2205</td></tr><tr><td>J</td><td>254 SMO</td></tr></table>                     |      | A                | A105 | B                 | A182 GR F1 | C                  | A182 GR F5 | D        | A182 Gr F9 | E                  | A182 Gr. F11 | F    | A182 Gr F12 | G    | A182 Gr F22 | H    | A182 Gr F304 | I    | A182 Gr F304L | L      | A182 Gr F316 | M      | A182 Gr F316L | N          | A182 Gr F321 | O   | A182 Gr F347 | P       | A350 Gr LF2 | Q             | A350 Gr LF3 | R             | Monel | S        | Inconel | T            | Titanium | U   | Incoloy 825 | Y        | UNS N08904 | K          | Duplex 2205 | J    | 254 SMO | <table><tr><td>A</td><td>13% CR</td></tr><tr><td>B</td><td>13% Cr St</td></tr><tr><td>H</td><td>A182-F304</td></tr><tr><td>D</td><td>A182-F304 St</td></tr><tr><td>L</td><td>A182-F316</td></tr><tr><td>F</td><td>A182-F316 St</td></tr><tr><td>N</td><td>A182-F321</td></tr><tr><td>P</td><td>A182-F321 St</td></tr><tr><td>R</td><td>Monel</td></tr><tr><td>S</td><td>Inconel</td></tr><tr><td>T</td><td>Titanium</td></tr><tr><td>U</td><td>Incoloy 825</td></tr><tr><td>Y</td><td>UNS N08904</td></tr><tr><td>J</td><td>UNS N08904 St</td></tr><tr><td>X</td><td>Hastelloy C</td></tr><tr><td>M</td><td>A 182-F316L</td></tr><tr><td>C</td><td>Bronze</td></tr><tr><td>Q</td><td>Monel PTFE</td></tr><tr><td>E</td><td>Soft Seal</td></tr><tr><td>K</td><td>Duplex 2205</td></tr><tr><td>V</td><td>254 SMO</td></tr></table> |  | A | 13% CR | B | 13% Cr St | H | A182-F304 | D | A182-F304 St | L | A182-F316 | F | A182-F316 St | N | A182-F321 | P | A182-F321 St | R | Monel | S | Inconel | T | Titanium | U | Incoloy 825 | Y | UNS N08904 | J | UNS N08904 St | X | Hastelloy C | M | A 182-F316L | C | Bronze | Q | Monel PTFE | E | Soft Seal | K | Duplex 2205 | V | 254 SMO |
|                                              | A                  | A105               |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | B                  | A182 GR F1         |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | C                  | A182 GR F5         |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | D                  | A182 Gr F9         |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| E                                            | A182 Gr. F11       |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| F                                            | A182 Gr F12        |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| G                                            | A182 Gr F22        |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| H                                            | A182 Gr F304       |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| I                                            | A182 Gr F304L      |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| L                                            | A182 Gr F316       |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| M                                            | A182 Gr F316L      |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| N                                            | A182 Gr F321       |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| O                                            | A182 Gr F347       |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| P                                            | A350 Gr LF2        |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| Q                                            | A350 Gr LF3        |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| R                                            | Monel              |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| S                                            | Inconel            |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| T                                            | Titanium           |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| U                                            | Incoloy 825        |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| Y                                            | UNS N08904         |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| K                                            | Duplex 2205        |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| J                                            | 254 SMO            |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| A                                            | 13% CR             |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| B                                            | 13% Cr St          |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| H                                            | A182-F304          |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| D                                            | A182-F304 St       |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| L                                            | A182-F316          |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| F                                            | A182-F316 St       |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| N                                            | A182-F321          |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| P                                            | A182-F321 St       |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| R                                            | Monel              |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| S                                            | Inconel            |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| T                                            | Titanium           |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| U                                            | Incoloy 825        |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| Y                                            | UNS N08904         |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| J                                            | UNS N08904 St      |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| X                                            | Hastelloy C        |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| M                                            | A 182-F316L        |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| C                                            | Bronze             |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| Q                                            | Monel PTFE         |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| E                                            | Soft Seal          |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| K                                            | Duplex 2205        |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| V                                            | 254 SMO            |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 20                                           | SCF 154            | 118                | 12.7                  |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 25                                           | SCF 155            | 127                | 19                    |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 40                                           | SCF 157            | 165                | 30                    |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 50                                           | SCF 158            | 178                | 38                    |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 300 Lbs<br><br>• 51 bar at<br>-30 + 38° C    | 15                 | SCF 303            | 140                   | 12.7                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 25                 | SCF 305            | 165                   | 24                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 40                 | SCF 307            | 190.5                 | 38                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 50                 | SCF 308            | 216                   | 50                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 600 Lbs<br><br>• 102 bar at<br>-30 + 38° C   | 15                 | SCF 603            | 165                   | 12.7                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 20                 | SCF 604            | 190.5                 | 19                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 25                 | SCF 605            | 216                   | 24                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 40                 | SCF 607            | 241                   | 38                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 50                 | SCF 608            | 292                   | 50                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 150 Lbs<br><br>• 19.5 bar at<br>- 30 + 38° C | 15                 | DF 0153            | 108                   | 7                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 20                 | DF 0154            | 117.5                 | 12                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 25                 | DF 0155            | 127                   | 17.7                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 40                 | DF 0157            | 165                   | 29                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 50                 | DF 0158            | 203                   | 32                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 300 Lbs<br><br>• 51 bar at<br>-30 + 38° C    | 15                 | DF 0303            | 152.4                 | 12                    | <table><tr><th>Ref.</th><th>Part. Name</th></tr><tr><td>32</td><td>REGULATING NEEDLE</td></tr><tr><td>21</td><td>RING IN TWO HALVES</td></tr><tr><td>20</td><td>DISC NUT</td></tr><tr><td>19</td><td>YOKE RETAINING NUT</td></tr><tr><td>18</td><td>BODY</td></tr><tr><td>17</td><td>DISC</td></tr><tr><td>16</td><td>SEAT</td></tr><tr><td>15</td><td>STEM</td></tr><tr><td>14</td><td>GASKET</td></tr><tr><td>13</td><td>BONNET</td></tr><tr><td>12</td><td>STUD BOLTS</td></tr><tr><td>11</td><td>NUT</td></tr><tr><td>10</td><td>PACKING</td></tr><tr><td>9</td><td>EYEBOLTS UNIT</td></tr><tr><td>8</td><td>PACKING GLAND</td></tr><tr><td>7</td><td>EYEBOLTS</td></tr><tr><td>6</td><td>GRAND FLANGE</td></tr><tr><td>5</td><td>NUT</td></tr><tr><td>4</td><td>YOKE NUT</td></tr><tr><td>3</td><td>NAME PLATE</td></tr><tr><td>2</td><td>BOLT</td></tr><tr><td>1</td><td>HANDWHEEL</td></tr></table> | Ref. | Part. Name       | 32   | REGULATING NEEDLE | 21         | RING IN TWO HALVES | 20         | DISC NUT | 19         | YOKE RETAINING NUT | 18           | BODY | 17          | DISC | 16          | SEAT | 15           | STEM | 14            | GASKET | 13           | BONNET | 12            | STUD BOLTS | 11           | NUT | 10           | PACKING | 9           | EYEBOLTS UNIT | 8           | PACKING GLAND | 7     | EYEBOLTS | 6       | GRAND FLANGE | 5        | NUT | 4           | YOKE NUT | 3          | NAME PLATE | 2           | BOLT | 1       | HANDWHEEL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | Ref.               | Part. Name         |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 32                 | REGULATING NEEDLE  |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 21                 | RING IN TWO HALVES |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 20                 | DISC NUT           |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 19                                           | YOKE RETAINING NUT |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 18                                           | BODY               |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 17                                           | DISC               |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 16                                           | SEAT               |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 15                                           | STEM               |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 14                                           | GASKET             |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 13                                           | BONNET             |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 12                                           | STUD BOLTS         |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 11                                           | NUT                |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 10                                           | PACKING            |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 9                                            | EYEBOLTS UNIT      |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 8                                            | PACKING GLAND      |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 7                                            | EYEBOLTS           |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 6                                            | GRAND FLANGE       |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 5                                            | NUT                |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 4                                            | YOKE NUT           |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 3                                            | NAME PLATE         |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 2                                            | BOLT               |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 1                                            | HANDWHEEL          |                    |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 20                                           | DF 0304            | 177.8              | 17.5                  |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 25                                           | DF 0305            | 203.2              | 22                    |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 40                                           | DF 0307            | 228.6              | 29                    |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 50                                           | DF 0308            | 266.7              | 40                    |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 600 Lbs<br><br>• 102 bar at<br>-30 + 38° C   | 15                 | DF 0603            | 165                   | 12                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 20                 | DF 0604            | 190.5                 | 17.5                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 25                 | DF 0605            | 216                   | 22                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 40                 | DF 0607            | 241                   | 29                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 50                 | DF 0608            | 292                   | 40                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 300 Lbs<br><br>• 51 bar at<br>- 30 + 38° C   | 15                 | CKBF 303           | 165                   | 12                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 20                 | CKBF 304           | 190.5                 | 17.5                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 25                 | CKBF 305           | 216                   | 22                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 40                 | CKBF 307           | 241                   | 32                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 50                 | CKBF 308           | 266.7                 | 44.4                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 600 Lbs<br><br>• 102 bar at<br>- 30 + 38° C  | 15                 | CKBF 603           | 165.1                 | 12                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 20                 | CKBF 604           | 190.5                 | 17.5                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 25                 | CKBF 605           | 216                   | 22                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 40                 | CKBF 607           | 241                   | 32                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 50                 | CKBF 608           | 292                   | 44.4                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                  |      |                   |            |                    |            |          |            |                    |              |      |             |      |             |      |              |      |               |        |              |        |               |            |              |     |              |         |             |               |             |               |       |          |         |              |          |     |             |          |            |            |             |      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |

Note: For reference to items number add to the base drawing number a stroke then item no.  
i.e SCF 153/18 means body for Gate Valves flanged ANSI 150. Size 15 mm.  
• RATING FOR CARBON STEEL TO ANSI B 16.34 EDITION 1977  
STANDARD API 602 & BS 5352

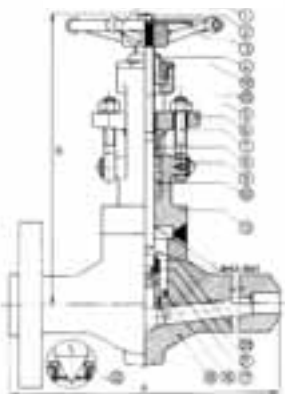


# FLANGED OR BUTT WELD ENDS - O.S. & Y. – CLASS 1500 LBS

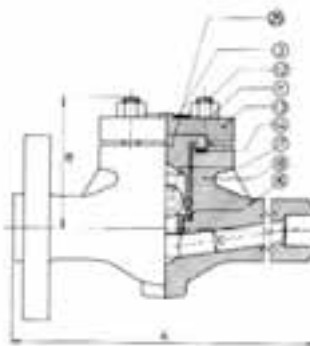
FORGED STEEL GATE, GLOBE, CHECK VALVES  
CARBON, ALLOY, STAINLESS STEEL AND SPECIAL MATERIALS  
FLANGES INTEGRALLY FORGED WITH BODY  
BOLTED BONNET OR FULL PENETRATION WELDED BONNET



**Gate Valves**  
**type SCF 1500**  
or WSCF 1500



**Globe Valves**  
**type WDF 01500**  
or DF 01500  
\* Button head up to  
ND 20 size



**Ball Check Valves**  
**type CKSF 1500**  
or Piston Check Valves  
type CKPF 1500  
or Swing Check Valves  
type CKBF 1500

| CLASS                                        | ND<br>mm.                                    | OUR TYPE   | END TO END<br>'A' mm. | PORT DIAM.<br>'C' mm. | BODY<br>MATERIAL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  | TRIM<br>MATERIAL |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|----------------------------------------------|----------------------------------------------|------------|-----------------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------------------|------|------|------------|----|-------------------|----|--------------------|----|--------------|----|--------------------|----|-------------|----|--------------|----|---------------|----|--------------|----|---------------|----|--------------|---|---------------|---|---------------|---|-------------|---|--------------|---|---------|---|----------|---|-------------|---|------------|---|-------------|---|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---|--------|---|-----------|---|-----------|---|--------------|---|-----------|---|--------------|---|-----------|---|--------------|---|-------|---|---------|---|----------|---|-------------|---|------------|---|---------------|---|-------------|---|-------------|---|--------|---|------------|---|-----------|---|-------------|---|---------|
| 1500 Lbs<br><br>• 255 bar at<br>-30 + 38° C  | 15                                           | SCF 1503   | 216                   | 12.7                  | <table><tr><td>A</td><td>A105</td></tr><tr><td>B</td><td>A182 GR F1</td></tr><tr><td>C</td><td>A182 GR F5</td></tr><tr><td>D</td><td>A182 Gr F9</td></tr><tr><td>E</td><td>A182 Gr. F11</td></tr><tr><td>F</td><td>A182 Gr F12</td></tr><tr><td>G</td><td>A182 Gr F22</td></tr><tr><td>H</td><td>A182 Gr F304</td></tr><tr><td>I</td><td>A182 Gr F304L</td></tr><tr><td>L</td><td>A182 Gr F316</td></tr><tr><td>M</td><td>A182 Gr F316L</td></tr><tr><td>N</td><td>A182 Gr F321</td></tr><tr><td>O</td><td>A182 Gr F347</td></tr><tr><td>P</td><td>A350 Gr LF2</td></tr><tr><td>Q</td><td>A350 Gr LF3</td></tr><tr><td>R</td><td>Monel</td></tr><tr><td>S</td><td>Inconel</td></tr><tr><td>T</td><td>Titanium</td></tr><tr><td>U</td><td>Incoloy 825</td></tr><tr><td>Y</td><td>UNS N08904</td></tr><tr><td>K</td><td>Duplex 2205</td></tr><tr><td>J</td><td>254 SMO</td></tr></table> |  | A                | A105 | B    | A182 GR F1 | C  | A182 GR F5        | D  | A182 Gr F9         | E  | A182 Gr. F11 | F  | A182 Gr F12        | G  | A182 Gr F22 | H  | A182 Gr F304 | I  | A182 Gr F304L | L  | A182 Gr F316 | M  | A182 Gr F316L | N  | A182 Gr F321 | O | A182 Gr F347  | P | A350 Gr LF2   | Q | A350 Gr LF3 | R | Monel        | S | Inconel | T | Titanium | U | Incoloy 825 | Y | UNS N08904 | K | Duplex 2205 | J | 254 SMO | <table><tr><td>A</td><td>13% CR</td></tr><tr><td>B</td><td>13% Cr St</td></tr><tr><td>H</td><td>A182-F304</td></tr><tr><td>D</td><td>A182-F304 St</td></tr><tr><td>L</td><td>A182-F316</td></tr><tr><td>F</td><td>A182-F316 St</td></tr><tr><td>N</td><td>A182-F321</td></tr><tr><td>P</td><td>A182-F321 St</td></tr><tr><td>R</td><td>Monel</td></tr><tr><td>S</td><td>Inconel</td></tr><tr><td>T</td><td>Titanium</td></tr><tr><td>U</td><td>Incoloy 825</td></tr><tr><td>Y</td><td>UNS N08904</td></tr><tr><td>J</td><td>UNS N08904 St</td></tr><tr><td>X</td><td>Hastelloy C</td></tr><tr><td>M</td><td>A 182-F316L</td></tr><tr><td>C</td><td>Bronze</td></tr><tr><td>Q</td><td>Monel PTFE</td></tr><tr><td>E</td><td>Soft Seal</td></tr><tr><td>K</td><td>Duplex 2205</td></tr><tr><td>V</td><td>254 SMO</td></tr></table> |  | A | 13% CR | B | 13% Cr St | H | A182-F304 | D | A182-F304 St | L | A182-F316 | F | A182-F316 St | N | A182-F321 | P | A182-F321 St | R | Monel | S | Inconel | T | Titanium | U | Incoloy 825 | Y | UNS N08904 | J | UNS N08904 St | X | Hastelloy C | M | A 182-F316L | C | Bronze | Q | Monel PTFE | E | Soft Seal | K | Duplex 2205 | V | 254 SMO |
|                                              | A                                            | A105       |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | B                                            | A182 GR F1 |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | C                                            | A182 GR F5 |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | D                                            | A182 Gr F9 |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| E                                            | A182 Gr. F11                                 |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| F                                            | A182 Gr F12                                  |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| G                                            | A182 Gr F22                                  |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| H                                            | A182 Gr F304                                 |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| I                                            | A182 Gr F304L                                |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| L                                            | A182 Gr F316                                 |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| M                                            | A182 Gr F316L                                |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| N                                            | A182 Gr F321                                 |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| O                                            | A182 Gr F347                                 |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| P                                            | A350 Gr LF2                                  |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| Q                                            | A350 Gr LF3                                  |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| R                                            | Monel                                        |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| S                                            | Inconel                                      |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| T                                            | Titanium                                     |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| U                                            | Incoloy 825                                  |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| Y                                            | UNS N08904                                   |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| K                                            | Duplex 2205                                  |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| J                                            | 254 SMO                                      |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| A                                            | 13% CR                                       |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| B                                            | 13% Cr St                                    |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| H                                            | A182-F304                                    |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| D                                            | A182-F304 St                                 |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| L                                            | A182-F316                                    |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| F                                            | A182-F316 St                                 |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| N                                            | A182-F321                                    |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| P                                            | A182-F321 St                                 |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| R                                            | Monel                                        |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| S                                            | Inconel                                      |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| T                                            | Titanium                                     |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| U                                            | Incoloy 825                                  |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| Y                                            | UNS N08904                                   |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| J                                            | UNS N08904 St                                |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| X                                            | Hastelloy C                                  |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| M                                            | A 182-F316L                                  |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| C                                            | Bronze                                       |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| Q                                            | Monel PTFE                                   |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| E                                            | Soft Seal                                    |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| K                                            | Duplex 2205                                  |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| V                                            | 254 SMO                                      |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 20                                           | SCF 1504                                     | 228.6      | 19                    |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 25                                           | SCF 1505                                     | 254        | 24                    |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 40                                           | SCF 1507                                     | 305        | 38                    |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 1500 Lbs<br><br>• 255 bar at<br>- 30 + 38° C | 15                                           | WSCF 1503  | 216                   | 12.7                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 20                                           | WSCF 1504  | 228.6                 | 19                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 25                                           | WSCF 1505  | 254                   | 24                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 40                                           | WSCF 1507  | 305                   | 38                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 1500 Lbs<br><br>• 255 bar at<br>- 30 + 38° C | 15         | DF 01503              | 216                   | 12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 20                                           |                                              | DF 01504   | 228.6                 | 17.5                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 25                                           |                                              | DF 01505   | 254                   | 22                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 40                                           |                                              | DF 01507   | 305                   | 29                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 1500 Lbs<br><br>• 255 bar at<br>-30 + 38° C  |                                              | 15         | WDF 01503             | 216                   | 12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 20                                           | WDF 01504  | 228.6                 | 17.5                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 25                                           | WDF 01505  | 254                   | 22                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 40                                           | WDF 01507  | 305                   | 29                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 1500 Lbs<br><br>• 255 bar at<br>-30 + 38°C   | 15         | CKPF 1503             | 216                   | 12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 20                                           |                                              | CKPF 1504  | 229                   | 17.5                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 25                                           |                                              | CKPF 1505  | 254                   | 22                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 40                                           |                                              | CKPF 1507  | 305                   | 29                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 1500 Lbs<br><br>• 255 bar at<br>- 30 + 38° C |                                              | 15         | CKSF 1503             | 216                   | 12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 20                                           | CKSF 1504  | 229                   | 17.5                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 25                                           | CKSF 1505  | 254                   | 22                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 40                                           | CKSF 1507  | 305                   | 29                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              | 1500 Lbs<br><br>• 255 bar at<br>- 30 + 38° C | 15         | CKBF 1503             | 216                   | 12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 20                                           |                                              | CKBF 1504  | 228.6                 | 17.5                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 25                                           |                                              | CKBF 1505  | 254                   | 22                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 40                                           |                                              | CKBF 1507  | 305                   | 32                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
|                                              |                                              |            |                       |                       | <table><tr><th>Ref.</th><th>Part. Name</th></tr><tr><td>32</td><td>REGULATING NEEDLE</td></tr><tr><td>21</td><td>RING IN TWO HALVES</td></tr><tr><td>20</td><td>DISC NUT</td></tr><tr><td>19</td><td>YOKE RETAINING NUT</td></tr><tr><td>18</td><td>BODY</td></tr><tr><td>17</td><td>DISC</td></tr><tr><td>16</td><td>SEAT</td></tr><tr><td>15</td><td>STEM</td></tr><tr><td>13</td><td>BONNET</td></tr><tr><td>10</td><td>PACKING</td></tr><tr><td>9</td><td>EYEBOLTS UNIT</td></tr><tr><td>8</td><td>PACKING GLAND</td></tr><tr><td>7</td><td>EYEBOLTS</td></tr><tr><td>6</td><td>GRAND FLANGE</td></tr><tr><td>5</td><td>NUT</td></tr><tr><td>4</td><td>YOKE NUT</td></tr><tr><td>2</td><td>BOLT</td></tr><tr><td>1</td><td>HANDWHEEL</td></tr></table>                                                                                                                             |  |                  |      | Ref. | Part. Name | 32 | REGULATING NEEDLE | 21 | RING IN TWO HALVES | 20 | DISC NUT     | 19 | YOKE RETAINING NUT | 18 | BODY        | 17 | DISC         | 16 | SEAT          | 15 | STEM         | 13 | BONNET        | 10 | PACKING      | 9 | EYEBOLTS UNIT | 8 | PACKING GLAND | 7 | EYEBOLTS    | 6 | GRAND FLANGE | 5 | NUT     | 4 | YOKE NUT | 2 | BOLT        | 1 | HANDWHEEL  |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| Ref.                                         | Part. Name                                   |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 32                                           | REGULATING NEEDLE                            |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 21                                           | RING IN TWO HALVES                           |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 20                                           | DISC NUT                                     |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 19                                           | YOKE RETAINING NUT                           |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 18                                           | BODY                                         |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 17                                           | DISC                                         |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 16                                           | SEAT                                         |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 15                                           | STEM                                         |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 13                                           | BONNET                                       |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 10                                           | PACKING                                      |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 9                                            | EYEBOLTS UNIT                                |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 8                                            | PACKING GLAND                                |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 7                                            | EYEBOLTS                                     |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 6                                            | GRAND FLANGE                                 |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 5                                            | NUT                                          |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 4                                            | YOKE NUT                                     |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 2                                            | BOLT                                         |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |
| 1                                            | HANDWHEEL                                    |            |                       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                  |      |      |            |    |                   |    |                    |    |              |    |                    |    |             |    |              |    |               |    |              |    |               |    |              |   |               |   |               |   |             |   |              |   |         |   |          |   |             |   |            |   |             |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |   |        |   |           |   |           |   |              |   |           |   |              |   |           |   |              |   |       |   |         |   |          |   |             |   |            |   |               |   |             |   |             |   |        |   |            |   |           |   |             |   |         |

St = Stellite

| Ref. | Part. Name         |
|------|--------------------|
| 32   | REGULATING NEEDLE  |
| 21   | RING IN TWO HALVES |
| 20   | DISC NUT           |
| 19   | YOKE RETAINING NUT |
| 18   | BODY               |
| 17   | DISC               |
| 16   | SEAT               |
| 15   | STEM               |
| 13   | BONNET             |
| 10   | PACKING            |
| 9    | EYEBOLTS UNIT      |
| 8    | PACKING GLAND      |
| 7    | EYEBOLTS           |
| 6    | GRAND FLANGE       |
| 5    | NUT                |
| 4    | YOKE NUT           |
| 2    | BOLT               |
| 1    | HANDWHEEL          |

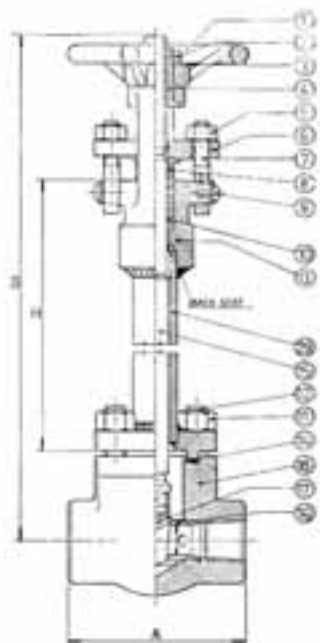
Note: For reference to item numbers add to the base drawing number a stroke then item no.  
i.e SCF 1503/18 means body for Gate Valve flanged RF. Size 15 mm.  
• RATING FOR CARBON STEEL TO ANSI B 16.34 EDITION 1977  
BRITISH STANDARD BS 5352



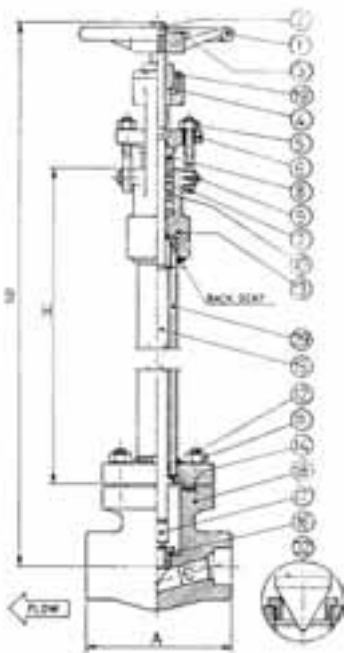
# FOR CRYOGENIC SERVICE – EXTENDED BOLTED BONNET O.S. & Y. CLASS 800 AND 1500 LBS



FORGED GATE AND GLOBE VALVES  
IN STAINLESS STEEL  
SCREWED OR SOCKED WELD ENDS



**Cryogenic Gate Valves**  
**type BSC 800 BT**  
or Globe Valves  
type BBD 0800 BT



**Cryogenic Globe Valves**  
**type BBD 01500 BT**  
or Gate Valves  
type BSC 1500 BT  
\* Button head up to  
ND 25 size

| CLASS                                                  | ND<br>mm. | OUR TYPE            | END TO END<br>'A' mm. | PORT DIAM.<br>'C' mm. | BODY<br>MATERIAL | TRIM<br>MATERIAL |
|--------------------------------------------------------|-----------|---------------------|-----------------------|-----------------------|------------------|------------------|
| 800 Lbs<br><br>99 bar at<br>cold non shock<br>- 196° C | 15        | <b>BSC 803 BT</b>   | 89                    | 12.7                  | H A182 GR. F304  | H A182-F304      |
|                                                        | 20        | <b>BSC 804 BT</b>   | 105                   | 19                    | I A182 GR F304L  | D A182-F304 St   |
|                                                        | 25        | <b>BSC 805 BT</b>   | 127                   | 24                    | L A182 GR F316   | L A182-F316      |
|                                                        | 40        | <b>BSC 807 BT</b>   | 172                   | 38                    | M A182 Gr F316L  | F A182-F316 St   |
|                                                        | 50        | <b>BSC 808 BT</b>   | 184                   | 50                    | N A182 Gr F321   | N A182-F321      |
| 800 Lbs<br><br>99 bar at<br>cold non shock<br>- 196° C | 15        | <b>BBD 0803 BT</b>  | 89                    | 12                    | O A182 Gr F347   | P A182-F321 St   |
|                                                        | 20        | <b>BBD 0804 BT</b>  | 105                   | 17.5                  | R Monel          | R Monel          |
|                                                        | 25        | <b>BBD 0805 BT</b>  | 127                   | 22                    | S Inconel        | S Inconel        |
|                                                        | 40        | <b>BBD 0807 BT</b>  | 172                   | 29                    | T Titanium       | T Titanium       |
|                                                        | 50        | <b>BBD 0808 BT</b>  | 184                   | 40                    | U Incoloy 825    | U Incoloy 825    |
| 1500 Lbs<br><br>248 bar at<br>- 196° C                 | 15        | <b>BSC 1503 BT</b>  | 92                    | 12.7                  | K Duplex 2205    | X Hastelloy C    |
|                                                        | 20        | <b>BSC 1504 BT</b>  | 114                   | 19                    |                  | M A182-F316L     |
|                                                        | 25        | <b>BSC 1505 BT</b>  | 127                   | 24                    |                  | C Bronze         |
|                                                        | 40        | <b>BSC 1507 BT</b>  | 172                   | 38                    |                  | Q Monel PTFE     |
|                                                        | 50        | <b>BSC 1508 BT</b>  | 228.6                 | 50                    |                  | E Soft Seal      |
| 1500 Lbs<br><br>248 bar at<br>- 196° C                 | 15        | <b>BBD 01503 BT</b> | 92                    | 12                    |                  |                  |
|                                                        | 20        | <b>BBD 01504 BT</b> | 114                   | 17.5                  |                  |                  |
|                                                        | 25        | <b>BBD 01505 BT</b> | 127                   | 22                    |                  |                  |
|                                                        | 40        | <b>BBD 01507 BT</b> | 172                   | 29                    |                  |                  |
|                                                        | 50        | <b>BBD 01508 BT</b> | 228.6                 | 40                    |                  |                  |

St = Stellite

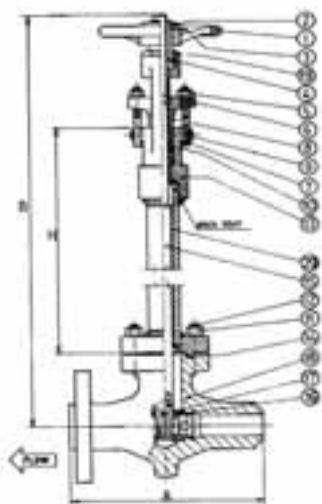
| Ref. | Part. Name         |
|------|--------------------|
| 32   | REGULATING NEEDLE  |
| 29   | EXTENSION PIPE     |
| 19   | YOKE RETAINING NUT |
| 18   | BODY               |
| 17   | DISC               |
| 16   | SEAT               |
| 15   | STEM               |
| 14   | GASKET             |
| 13   | BONNET             |
| 12   | STUD BOLTS         |
| 11   | NUT                |
| 10   | PACKING            |
| 9    | EYEBOLTS UNIT      |
| 8    | PACKING GLAND      |
| 7    | EYEBOLTS           |
| 6    | GRAND FLANGE       |
| 5    | NUT                |
| 4    | YOKE NUT           |
| 3    | NAME PLATE         |
| 2    | BOLT               |
| 1    | HANDWHEEL          |

Note: For reference to items number add to the base drawing number a stroke then item no.  
i.e BSC 803 BT/18 means body for Gate Valve 800 Lbs. Size 15 mm.  
British standard 5352

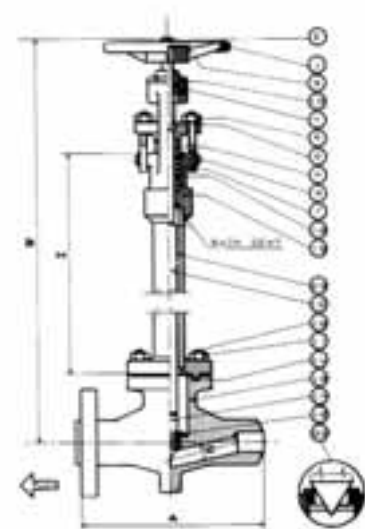


# FOR CRYOGENIC SERVICE – EXTENDED BONNET FLANGED OR BUTT WELD ENDS – O.S. & Y. CLASS 300 AND 600 LBS

FORGED GATE AND GLOBE VALVES  
IN STAINLESS STEEL  
FLANGES INTEGRALLY FORGED WITH BODY



**Cryogenic Gate Valves**  
type SCF 300 BT  
or SCF 600 BT



**Cryogenic Globe Valves**  
type DF 0300 BT  
or DF 0600 BT  
\* Button head up to  
ND 25 size

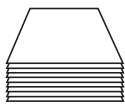
| CLASS                                  | ND<br>mm. | OUR TYPE   | END TO END<br>'A' mm. | PORT DIAM.<br>'C' mm. | BODY<br>MATERIAL | TRIM<br>MATERIAL |
|----------------------------------------|-----------|------------|-----------------------|-----------------------|------------------|------------------|
| 300 Lbs<br><br>49.6 bar at<br>- 196° C | 15        | SCF 303 BT | 140                   | 12.7                  | H A182 GR. F304  | H A182-F304      |
|                                        | 20        | SCF 304 BT | 152.4                 | 19                    | I A182 GR F304L  | D A182-F304 St   |
|                                        | 25        | SCF 305 BT | 165                   | 24                    | L A182 GR F316   | L A182-F316      |
|                                        | 40        | SCF 307 BT | 191                   | 38                    | M A182 Gr F316L  | F A182-F316 St   |
|                                        | 50        | SCF 308 BT | 216                   | 50                    | N A182 Gr F321   | N A182-F321      |
| 600 Lbs<br><br>99 bar at<br>- 196° C   | 15        | SCF 603 BT | 165                   | 12.7                  | O A182 Gr F347   | P A182-F321 St   |
|                                        | 20        | SCF 604 BT | 190.5                 | 19                    | R Monel          | R Monel          |
|                                        | 25        | SCF 605 BT | 216                   | 24                    | S Inconel        | S Inconel        |
|                                        | 40        | SCF 607 BT | 241                   | 38                    | T Titanium       | T Titanium       |
|                                        | 50        | SCF 608 BT | 292                   | 50                    | U Incoloy 825    | U Incoloy 825    |
| 300 Lbs<br><br>49 bar at<br>- 196° C   | 15        | DF 0303 BT | 152                   | 12                    | K Duplex 2205    | X Hastelloy C    |
|                                        | 20        | DF 0304 BT | 178                   | 17.5                  |                  | M A182-F316L     |
|                                        | 25        | DF 0305 BT | 203                   | 22                    |                  | C Bronze         |
|                                        | 40        | DF 0307 BT | 229                   | 29                    |                  | Q Monel PTFE     |
|                                        | 50        | DF 0308 BT | 267                   | 40                    |                  | E Soft Seal      |
| 600 Lbs<br><br>99 bar at<br>- 196° C   | 15        | DF 0603 BT | 165                   | 12                    |                  |                  |
|                                        | 20        | DF 0604 BT | 190.5                 | 17.5                  |                  |                  |
|                                        | 25        | DF 0605 BT | 216                   | 22                    |                  |                  |
|                                        | 40        | DF 0607 BT | 241                   | 29                    |                  |                  |
|                                        | 50        | DF 0608 BT | 292                   | 40                    |                  |                  |

St = Stellite

| Ref. | Part. Name         |
|------|--------------------|
| 32   | REGULATING NEEDLE  |
| 29   | EXTENSION PIPE     |
| 19   | YOKE RETAINING NUT |
| 18   | BODY               |
| 17   | DISC               |
| 16   | SEAT               |
| 15   | STEM               |
| 14   | GASKET             |
| 13   | BONNET             |
| 12   | STUD BOLTS         |
| 11   | NUT                |
| 10   | PACKING            |
| 9    | EYEBOLTS UNIT      |
| 8    | PACKING GLAND      |
| 7    | EYEBOLTS           |
| 6    | GRAND FLANGE       |
| 5    | NUT                |
| 4    | YOKE NUT           |
| 3    | NAME PLATE         |
| 2    | BOLT               |
| 1    | HANDWHEEL          |

Note: For reference to items number add to the base drawing number a stroke then item no.  
i.e SCF 603 BT/18 means body for Gate Valve 600 Lbs. Size 15 mm.  
British standard 5352





# Extract of Ferritic, Martensitic and Austenitic Steel for Plates and Bars

## EXTRACT OF COMPARISON OF STANDARDS

## CHEMICAL ANALYSIS

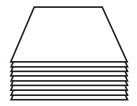
### DIN EN 10 088-2

Vergleich mit verschiedenen  
Normen

| USA<br>AISI | JAPAN<br>JIS    | GUS<br>GOST | Werk-<br>Stoff-<br>Nr. | Kurzname          | Delivery<br>con-<br>dition* | C<br>%<br>max. | SI<br>%<br>max. | MN<br>%<br>max. |
|-------------|-----------------|-------------|------------------------|-------------------|-----------------------------|----------------|-----------------|-----------------|
|             |                 |             | 1.4003                 | X2CrNi12          | K                           | 0.03           | 1.00            | 1.50            |
|             |                 |             | 1.4512                 | X2CrTi12          | W                           |                |                 |                 |
|             |                 |             |                        |                   | K                           | 0.03           | 1.00            | 1.00            |
| 409         | SUS 409         |             | 1.4000                 | X6Cr13            | W                           |                |                 |                 |
|             |                 |             |                        |                   | K                           | 0.08           | 1.00            | 1.00            |
| 410S        | SUS410S         | 08Ch13      | 1.4002                 | X6CrAl13          | W                           |                |                 |                 |
|             |                 |             |                        |                   | K                           | 0.08           | 1.00            | 1.00            |
| 405         | SUS405          | 1.4006      | X12Cr13                |                   | W                           |                |                 |                 |
|             |                 |             |                        |                   | K                           | 0.08-0.15      | 1.00            | 1.50            |
| 410         | SUS410          | 12Ch13      | 1.4021                 | X20Cr13           | W                           |                |                 |                 |
|             |                 |             |                        |                   | K                           | 0.16-0.25      | 1.00            | 1.50            |
| (420)       | SUS420J1        | 20Ch13      | 1.4031                 | X39Cr13           | W                           |                |                 |                 |
|             |                 |             |                        |                   | K                           | 0.36-0.42      | 1.00            | 1.00            |
| (420)       |                 | 40Ch13      | 1.4016                 | X6Cr17            | W                           |                |                 |                 |
|             |                 |             |                        |                   | K                           | 0.08           | 1.00            | 1.00            |
| 430         | SUS430          | 12Ch17      | 1.4520                 | X2CrTi17          | W                           |                |                 |                 |
|             |                 |             |                        |                   | K                           | 0.025          | 0.50            | 0.50            |
|             |                 | 1.4510      | X3CrTi17               |                   | W                           |                |                 |                 |
|             |                 |             |                        |                   | K                           | 0.05           | 1.00            | 1.00            |
| 304         | SUS304          | 08Ch18N10   | 1.4301                 | X5CrNi18-10       | W                           |                |                 |                 |
|             |                 |             |                        |                   | K                           | 0.07           | 1.00            | 2.00            |
| 304L        | SUS304L         | 03Ch18N11   | 1.4306                 | X2CrNi19-11       | W                           |                |                 |                 |
|             |                 |             |                        |                   | K                           | 0.03           | 1.00            | 2.00            |
| 321         | SUS321          | 08Ch18N10T  | 1.4541                 | X6CrNiTi18-10     | W                           |                |                 |                 |
|             |                 |             |                        |                   | K                           | 0.08           | 1.00            | 2.00            |
| 347         | SUS347          | 08Ch18N12B  | 1.4550                 | X6CrNiNb18-10     | W                           |                |                 |                 |
|             |                 |             |                        |                   | K                           | 0.08           | 1.00            | 2.00            |
| 316         | SUS316          | 03Ch17M13M2 | 1.4401                 | X5CrNiMo17-12-2   | W                           |                |                 |                 |
|             |                 |             |                        |                   | K                           | 0.07           | 1.00            | 2.00            |
| 316L        | SUS316L         | 03Ch17N13M2 | 1.4404                 | X2CrNiMo17-12-2   | W                           |                |                 |                 |
|             |                 |             |                        |                   | K                           | 0.03           | 1.00            | 2.00            |
| 316Ti       | SUS316Ti<br>M2T | 10 Ch17N13  | 1.4571                 | X6CrNiMoTi17-12-2 | W                           |                |                 |                 |
|             |                 |             |                        |                   | K                           | 0.08           | 1.00            | 2.00            |

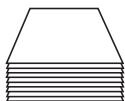
\*K = cold rolled; W = hot rolled

# Extract of Ferritic, Martensitic and Austenitic Steel for Plates and Bars



| Cr %        | Mo %      | Ni %        | Others %<br>Rp 0.2 | 0.2%-<br>YS<br>Rm<br>N/mm <sub>2</sub> min. | TS<br>N/mm <sub>2</sub> |
|-------------|-----------|-------------|--------------------|---------------------------------------------|-------------------------|
| 10.50-12.50 |           | 0.30-1.00   | N:0.030            | 320                                         | 450-650                 |
| 10.50-12.50 |           |             | 6x(C+N)Ti0.65      | 320                                         | 450-650                 |
|             |           |             |                    | 220                                         | 380-560                 |
| 12.00-14.00 |           |             |                    | 220                                         | 380-560                 |
|             |           |             |                    | 250                                         | 400-600                 |
| 12.00-14.00 |           |             | Al:0.10-0.30       | 230                                         | 400-600                 |
|             |           |             |                    | 250                                         | 400-600                 |
|             |           |             |                    | 230                                         | 400-600                 |
| 11.50-13.50 |           | 0.75        |                    |                                             | max. 600                |
| 12.00-14.00 |           |             |                    |                                             | max. 600                |
|             |           |             |                    |                                             | max. 700                |
| 12.50-14.50 |           |             |                    |                                             | max. 700                |
|             |           |             |                    |                                             | max. 760                |
| 16.00-18.00 |           |             |                    | 280                                         | 450-600                 |
|             |           |             |                    | 260                                         | 450-600                 |
| 16.00-18.00 |           |             | Ti:0.30-0.60       | 200                                         | 380-530                 |
|             |           |             | N:0.015            | 200                                         | 380-530                 |
| 16.00-18.00 |           |             | 4x(C+N)+0.15Ti0.80 | 240                                         | 420-600                 |
|             |           |             |                    | 240                                         | 420-600                 |
| 17.00-19.50 |           | 8.00-10.50  | N:0.11             | 230                                         | 540-750                 |
|             |           |             |                    | 210                                         | 520-720                 |
| 18.00-20.00 |           | 10.00-12.00 | N:0.11             | 220                                         | 520-670                 |
|             |           |             |                    | 200                                         | 520-670                 |
| 17.00-19.00 |           | 9.00-12.00  | 5xC<Ti<0.70        | 220                                         | 520-720                 |
|             |           |             |                    | 200                                         | 520-720                 |
| 17.00-19.00 |           | 9.00-12.00  | 10xC<Nb<1.00       | 220                                         | 520-720                 |
|             |           |             |                    | 200                                         | 520-720                 |
| 16.50-18.50 | 2.00-2.50 | 10.00-13.00 |                    | 240                                         | 530-680                 |
|             |           |             |                    | 220                                         | 530-680                 |
| 16.50-18.50 | 2.00-2.50 | 10.00-13.00 | N:0.11             | 240                                         | 530-680                 |
|             |           |             |                    | 220                                         | 530-680                 |
| 16.50-18.50 | 2.00-2.50 | 10.50-13.50 | 5xC<Ti<0.70        | 240                                         | 540-690                 |
|             |           |             |                    | 220                                         | 540-690                 |





# Extract of Ferritic, Martensitic and Austenitic Steel for Plates and Bars

## DIN EN 10 088-2

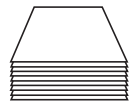
| USA<br>AISI | JAPAN<br>JIS | GUS<br>GOST | Werk-<br>Stoff-Nr. | Kurzname          | Delivery<br>Condition | C<br>% max. |
|-------------|--------------|-------------|--------------------|-------------------|-----------------------|-------------|
| 316L        | SUS316L      | 03Ch17N14M2 | 1.4435             | X2CrNiMo18-14-3   | K<br>W                | 0.02        |
| S31726      | SUS317       |             | 1.4439             | X2CrNiMoN17-13-5  | K<br>W                | 0.03        |
| N08904      |              |             | 1.4539             | X1NiCrMoCu25-20-5 | K<br>W                | 0.03        |
|             |              |             |                    |                   |                       |             |
|             |              |             |                    |                   |                       |             |

| USA<br>AISI                    | JAPAN<br>JIS | GUS<br>GOST           | Werk-<br>Stoff-Nr. | Kurzname       | C<br>% max. | Si<br>% max. |
|--------------------------------|--------------|-----------------------|--------------------|----------------|-------------|--------------|
| <b>FERRITIC STEEL GRADES</b>   |              |                       |                    |                |             |              |
|                                |              | 15Ch6SJ <sub>u</sub>  | 1.4713             | X10CrAl7       | 0,12        | 0.5-1.0      |
|                                |              | 10Ch13SJ <sub>u</sub> | 1.4724             | X10CrAl13      | 0,12        | 0.7-1.4      |
| 442                            |              |                       | 1.4742             | X10CrAl18      | 0,12        | 0.7-1.4      |
| 446                            |              |                       | 1.4762             | X10CrAl24      | 0,12        | 0.7-1.4      |
| <b>AUSTENITIC STEEL GRADES</b> |              |                       |                    |                |             |              |
| 321H                           |              | 12Ch18N10T            | 1.4878             | X12CrNiTi18-9  | 0,12        | 1.0          |
| 309                            |              | 20Ch20N14S2           | 1.4828             | X15CrNiSi20-12 | 0,20        | 1.5-2.5      |
| 310S                           |              |                       | 1.4845             | X12CrNi25-21   | 0,15        | 0.75         |
| 310                            |              | 20Ch25N20S2           | 1.4841             | X15CrNiSi25-20 | 0,20        | 1.5-2.5      |

\*K = cold rolled; W = hot rolled



# Extract of Ferritic, Martensitic and Austenitic Steel for Plates and Bars

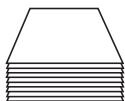


| Al<br>% | Cr<br>%   | Ni<br>%   | Sonstige<br>% | 0.2%-<br>YS<br>Rp0.2<br>N/mm <sub>min.</sub> | TS<br>Rm<br>N/mm <sub>min.</sub> |
|---------|-----------|-----------|---------------|----------------------------------------------|----------------------------------|
| 0.5-1.0 | 6.0-8.0   |           |               | 220                                          | 420-620                          |
| 0.7-1.2 | 12.0-14.0 |           |               | 250                                          | 450-650                          |
| 0.7-1.2 | 17.0-19.0 |           |               | 270                                          | 500-700                          |
| 1.2-1.7 | 23.0-26.0 |           |               | 280                                          | 520-720                          |
|         | 17.0-19.0 | 9.0-11.5  | 4xCrTi0.8     | 210                                          | 500-750                          |
|         | 19.0-21.0 | 11.0-13.0 |               | 230                                          | 500-750                          |
|         | 24.0-26.0 | 19.0-22.0 |               | 210                                          | 500-750                          |
|         | 24.0-26.0 | 19.0-22.0 |               | 230                                          | 550-800                          |

| Si<br>% | Mn<br>% | Cr<br>%     | Mo<br>%   | Ni<br>%     | Sonstige<br>% | 0.2%-<br>YS<br>Rp0.2<br>N/mm <sub>min.</sub> | TS<br>Rm<br>N/mm <sub>min.</sub> |
|---------|---------|-------------|-----------|-------------|---------------|----------------------------------------------|----------------------------------|
| max.    | max.    |             |           |             |               |                                              |                                  |
| 0.50    | 2.00    | 17.00-18.50 | 2.00-2.50 | 11.50-13.50 | Ti:0.40-0.60  | 190                                          | 490-690                          |
|         |         |             |           |             |               | 190                                          | 490-690                          |
| 1.00    | 2.00    | 17.00-19.00 | 2.50-3.00 | 12.50-15.00 | N:0.11        | 240                                          | 550-700                          |
|         |         |             |           |             |               | 220                                          | 550-700                          |
| 1.00    | 2.00    | 16.50-18.50 | 4.00-5.00 | 12.50-14.50 | N:0.12-0.22   | 290                                          | 580-780                          |
|         |         |             |           |             |               | 270                                          | 580-780                          |







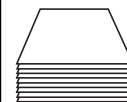
# Nickel Alloy and Titanium Plates

## Extract of Nickel Alloy Plates

| Norm       | Grade      | Chemical Composition |         |         |        |        |            |            |            |                     |
|------------|------------|----------------------|---------|---------|--------|--------|------------|------------|------------|---------------------|
|            |            | C max.               | Si max. | Mn max. | P max. | S max. | Cr min-max | Ni min-max | Mo min-max | Ti                  |
| ASTM B 162 | Alloy 200  | 0,15                 | 0,35    | 0,35    | -      | 0,01   | -          | 99,0 min   | -          | -                   |
| UNS-Grade  | N02200     | 0,15                 | 0,35    | 0,35    | -      | 0,01   | -          | 99,0 min   | -          | -                   |
| ASTM B 127 | Alloy 400  | 0,300                | 0,50    | 2,00    | -      | 0,024  | -          | 63,0 min   | -          | -                   |
| UNS-Grade  | N04400     | 0,300                | 0,50    | 2,00    | -      | 0,024  | -          | 63,0 min   | -          | -                   |
| ASTM B 168 | Alloy 600  | 0,150                | 0,50    | 1,00    | -      | 0,015  | 14,0-17,0  | 72,0 min   | -          | -                   |
| UNS-Grade  | N06600     | 0,150                | 0,50    | 1,00    | -      | 0,015  | 14,0-17,0  | 72,0 min   | -          | -                   |
| ASTM B 409 | Alloy 800  | 0,100                | 1,00    | 1,50    | 0,030  | 0,015  | 19,0-23,0  | 30,0-35,0  | -          | 0,15-0,60           |
| UNS-Grade  | N08800     | 0,100                | 1,00    | 1,50    | 0,030  | 0,015  | 19,0-23,0  | 30,0-35,0  | -          | 0,15-0,60           |
| ASTM B 424 | Alloy 825  | 0,050                | 0,50    | 1,00    | -      | 0,030  | 19,5-23,5  | 38,0-46,0  | 2,5-3,5    | 0,60-1,20           |
| UNS-Grade  | N08825     | 0,050                | 0,50    | 1,00    | -      | 0,030  | 19,5-23,5  | 38,0-46,0  | 2,5-3,5    | 0,6-1,2 $\geq$ 20xC |
| ASTM B 463 | Alloy 8020 | 0,070                | 1,00    | 2,00    | 0,045  | 0,035  | 19,0-21,0  | 32,0-38,0  | 2,0-3,0    |                     |
| UNS Grade  | N08020     | 0,070                | 1,00    | 2,00    | 0,045  | 0,035  | 19,0-21,0  | 32,0-38,0  | 2,0-3,0    |                     |

## Titanium Plates

| ASTM Grade          | Chemical Composition |         |         |          |         |          |         |           |         |         |
|---------------------|----------------------|---------|---------|----------|---------|----------|---------|-----------|---------|---------|
|                     | N % max              | C % max | H % max | Fe % max | O % max | Al % max | V % max | Pa        | Mo      | Ni      |
| ASTM B 265 Grade 1  | 0,03                 | 0,08    | 0,015   | 0,20     | 0,18    | -        | -       | -         | -       | -       |
| ASTM B 265 Grade 2  | 0,03                 | 0,08    | 0,015   | 0,30     | 0,25    | -        | -       | -         | -       | -       |
| ASTM B 265 Grade 3  | 0,05                 | 0,08    | 0,015   | 0,30     | 0,35    | -        | -       | -         | -       | -       |
| ASTM B 265 Grade 7  | 0,03                 | 0,08    | 0,015   | 0,30     | 0,25    | -        | -       | 0,12-0,25 | -       | -       |
| ASTM B 265 Grade 9  | 0,02                 | 0,08    | 0,015   | 0,25     | 0,15    | 2,5-3,5  | 2,0-3,0 | -         | -       | -       |
| ASTM B 265 Grade 11 | 0,03                 | 0,08    | 0,015   | 0,20     | 0,18    | -        | -       | 12,0-0,25 | -       | -       |
| ASTM B 265 Grade 12 | 0,03                 | 0,08    | 0,015   | 0,30     | 0,25    | -        | -       | -         | 0,2-0,4 | 0,6-0,9 |

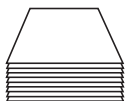


## PLATE

| Others<br>min.                       | Mechanical properties and heat treatment |                |            |      |                |
|--------------------------------------|------------------------------------------|----------------|------------|------|----------------|
|                                      | Rp 0,2 N/sq.mm                           | Rp 1,0 N/sq.mm | Rm N/sq.mm | A5 % | Heat treatment |
| Cu 0,25 max.                         | min. 100                                 | -              | min. 380   | 40   | annealed       |
| CU 0,25 max                          | min. 100                                 | -              | min. 380   | 40   | annealed       |
| Cu 28,0-34,0;Fe 2,5 max.             | min. 195                                 | -              | min. 485   | 35   | annealed       |
| Cu 28,0-34,0;Fe 2,5 max.             | min. 195                                 | -              | min. 485   | 35   | annealed       |
| Cu 0,5 max;Fe 6,0-10,0               | min. 240                                 | -              | min. 550   | 30   | annealed       |
| Cu 0,5 max;Fe 6,0-10,0               | min. 240                                 | -              | min. 550   | 30   | annealed       |
| Cu 0,75 max;Al 0,15-0,6;Fe 39,5 min  | min. 205                                 | -              | min. 520   | 30   | annealed       |
| Cu 0,75 max;Al 0,15-0,6;Fe 39,5 min. | min. 205                                 | -              | min. 520   | 30   | annealed       |
| Cu 1,5-3,0;Al 0,2 max;Fe 22,0 min.   | min. 241                                 | -              | min. 586   | 30   | annealed       |
| Cu 1,5-3,0;Al 0,2 max;Fe Rest        | min. 241                                 | -              | min. 586   | 30   | annealed       |
| Cu 3-4;Nb+Ta 8xC max. 1,0;Fe Rest    | min. 241                                 | -              | min. 551   | 30   | annealed       |
| Cu 3-4;Nb+Ta 8xC max.1,0;Fe Rest     | min. 241                                 | -              | min. 551   | 30   | annealed       |

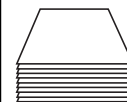
Remark: Mechanical properties are for hot rolled annealed execution.

|                    |                     |          | Mechanical properties and heat treatment |                        |            |               |
|--------------------|---------------------|----------|------------------------------------------|------------------------|------------|---------------|
| Residuals/<br>Each | Residuals/<br>Total | Titanium | Rp 0,2 N/sq.mm                           | Rp 1,0 N/sq.mm<br>min. | Rm N/sq.mm | A 5 %<br>min. |
| 0,1                | 0,4                 | Rem.     | 170 min.                                 | -                      | 240 min.   | 24            |
| 0,1                | 0,4                 | Rem.     | 275 min.                                 | -                      | 345 min.   | 20            |
| 0,1                | 0,4                 | Rem.     | 345 min.                                 | -                      | 450 min.   | 18            |
| 0,1                | 0,4                 | Rem.     | 275 min.                                 | -                      | 345 min.   | 20            |
| 0,1                | 0,4                 | Rem.     | 620 min.                                 | -                      | 483 min.   | 10            |
| 0,1                | 0,4                 | Rem.     | 170 min.                                 | -                      | 240 min.   | 24            |
| 0,1                | 0,4                 | Rem.     | 345 min.                                 | -                      | 483 min.   | 18            |



# Comparison of Standards - Copper Alloys

| WERKSTOFF<br>DIN<br>EN               | WERKSTOFF<br>NR. | ISO            | ASTM     | BS     | AFNOR             | JIS    |
|--------------------------------------|------------------|----------------|----------|--------|-------------------|--------|
| <b>BLEIFREIES MESSING</b>            |                  |                |          |        |                   |        |
| Cu Zn 5                              | 2.0220           | Cu Zn 5        | C 21000  | CZ 125 | Cu Zn 5           | C 2100 |
| CW 500 L                             |                  |                |          |        |                   |        |
| Cu Zn 10                             | 2.0230           | Cu Zn 10       | C 22000  | CZ 101 | Cu Zn 10          | C 2200 |
| CW 501 L                             |                  |                |          |        |                   |        |
| Cu Zn 15                             | 2.0240           | Cu Zn 15       | C 23000  | CZ 102 | Cu Zn 15          | C 2300 |
| CW 502 L                             |                  |                |          |        |                   |        |
| Cu Zn 20                             | 2.0250           | Cu Zn 20       | C 24000  | CZ 103 | Cu Zn 20          | C 2400 |
| CW 503 L                             |                  |                |          |        |                   |        |
| Cu Zn 28                             | 2.0261           |                |          |        |                   |        |
| CW 504 L                             |                  |                |          |        |                   |        |
| Cu Zn 30                             | 2.0265           | Cu Zn 30       | C 26000  | CZ 105 | Cu Zn 30          | C 2600 |
| CW 505 L                             |                  |                |          |        |                   |        |
| Cu Zn 33                             | 2.0280           |                | C 26800  |        | Cu Zn 33          | C 2680 |
| CW 506 L                             |                  |                |          |        |                   |        |
| Cu Zn 36                             | 2.0335           |                | C 27000  | CZ 107 | Cu Zn 36          |        |
| CW 507 L                             |                  |                |          |        |                   |        |
| Cu Zn 37                             | 2.0321           | Cu Zn 37       | C 27400  | CZ 108 |                   | C 2720 |
| CW 508 L                             |                  |                |          |        |                   |        |
| Cu Zn 40                             | 2.0360           | Cu Zn 40       | C 28000  | CZ 109 | Cu Zn 40          | C 2801 |
| CW 509 L                             |                  |                |          |        |                   |        |
| <b>BLEIHALTIGES MESSING</b>          |                  |                |          |        |                   |        |
| Cu Zn 39 Pb 0,5                      | 2.0372           |                | C 36500  | CZ 123 |                   | C 3710 |
| CW 610 N                             |                  |                |          |        |                   |        |
| Cu Zn 39 Pb 2                        | 2.0380           |                | C 37700  | CZ 120 | Cu Zn 39 Pb 2     | C 3713 |
| CW 612 N                             |                  |                |          |        |                   |        |
| <b>SONDERMESSING</b>                 |                  |                |          |        |                   |        |
| Cu Zn 20 Al 2                        | 2.0406           | CuZn20 Al 2    | C 68700  | CZ 110 | Cu Zn 22 Al 2     | C 6870 |
| CW 702 R                             |                  |                |          |        |                   |        |
| Cu Zn 38 Sn 1                        | 2.0530           | CuZn38 Sn 1    | C 46400  | CZ 112 | Cu Zn 38 Sn 1     | C 4640 |
| CW 717 R                             |                  |                |          |        |                   |        |
|                                      |                  |                | C 46210  | CZ 112 |                   | C 4621 |
| Cu Zn 38 Sn Al                       | 2.0525           |                | C 47000  |        |                   |        |
| CW 775 R                             |                  |                |          |        |                   |        |
| <b>KUPFER-NICKEL-KNETLEGIERUNGEN</b> |                  |                |          |        |                   |        |
| Cu Ni 10 Fe 1 Mn                     | 2.0872           | CuNi10Fe1Mn    | C 70600  | CN 102 | Cu Ni 10 Fe       | C 7060 |
| CW 352 H                             |                  |                |          |        |                   |        |
| Cu Ni 30 Mn 1 Fe                     | 2.0882           | CuNi30Mn1Fe    | C 71500  | CN 107 | Cu Ni 30 Mn 1 Fe  | C 7150 |
| CW 354 H                             |                  |                |          |        |                   |        |
| <b>ALUMINIUMBRONZE</b>               |                  |                |          |        |                   |        |
| Cu Al 5 As                           | 2.0918           | Cu Al 5        | C 60800  | CA 101 | Cu Al 6           |        |
| CW 301 G                             |                  |                |          |        |                   |        |
| Cu Al 8 Fe 3                         | 2.0932           | Cu Al 8 Fe 3   | C 61400  | CA 106 | Cu Al 7 Fe 2      | C 6140 |
| CW 303 G                             |                  |                |          |        |                   |        |
| Cu Al 9 Ni 3 Fe 2                    | 2.0971           | Cu Al 9 Ni3Fe2 | C 62300  | CA 103 | Cu Al 9 Ni 3 Fe 2 | C 6161 |
| CW 304 G                             |                  |                |          |        |                   |        |
| Cu Al 10 Fe 3 Mn 2                   | 2.0936           | Cu Al 10 Fe 3  | C 62500  | CA 105 |                   | C 6280 |
| CW 306 G                             |                  |                |          |        |                   |        |
| Cu Al 10 Ni 5 Fe 4                   | 2.0966           | CuAl10Ni5Fe4   | C 63000  | CA 104 | Cu Al 9 Ni 5 Fe 3 | C 6301 |
| CW 307 G                             |                  |                |          |        |                   |        |
| <b>ZINNBRONZE</b>                    |                  |                |          |        |                   |        |
| Cu Sn 4                              | 2.1016           | Cu Sn 4        | C 51800  |        | Cu Sn 4 P         | C 5111 |
| CW 450 K                             |                  |                |          |        |                   |        |
| Cu Sn 5                              |                  | Cu Sn 5        | C 51000  | PB 102 | Cu Sn 5 Zn 4      | C 5102 |
| CW 451 K                             |                  |                |          |        |                   |        |
| Cu Sn 6                              | 2.1020           | Cu Sn 6        | C 51900  | PB 103 | Cu Sn 6 P         | C 5191 |
| CW 452 K                             |                  |                |          |        |                   |        |
| Cu Sn 8                              | 2.1030           | Cu Sn 8        | C 521000 | PB 104 | Cu Sn 9 P         | C 5212 |
| CW 453 K                             |                  |                |          |        |                   |        |



## COPPER ALLOY NO. C28000 (Muntz Metal, 60 %)

| Composition-percent | Nominal | Minimum   | Maximum | Nearest Applicable ASTM Specifications |   |
|---------------------|---------|-----------|---------|----------------------------------------|---|
| Copper              | 60      | 59.0      | 63.0    | Plate Products                         | - |
| Lead                | -       | -         | .30     |                                        |   |
| Iron                | -       | -         | .07     |                                        |   |
| Zinc                | 40      | Remainder |         |                                        |   |

| Physical Properties                  | English Units                           | C. G. S. Units                   |
|--------------------------------------|-----------------------------------------|----------------------------------|
| Melting Point (Liquidus)             | 1660 F                                  | 905 C                            |
| Melting Point (Solidus)              | 1650 F                                  | 900 C                            |
| Density                              | .303 lb/cu in @ 68 F                    | 8.39 gm/cu cm @ 20 C             |
| Specific Gravity                     | 8.39                                    | 8.39                             |
| Coefficient of Thermal Expansion     | .0000116 per °F from 68 F to 572 F<br>C | .0000208 per °C from 20 C to 300 |
| Thermal Conductivity                 | 71 Btu/sq ft/ft/hr/°F @ 68 F            | .29 cal/sq cm/cm/sec/°C @ 20 C   |
| Electrical Resistivity (Annealed)    | 370 Ohms (circ mil/ft) @ 68 F           | 6.16 Microhm-cm @ 20 C           |
| Electrical Conductivity * (Annealed) | 28% IACS @ 68 F                         | .162 Megmho-cm @ 20 C            |
| Thermal Capacity (Specific Heat)     | .09 Btu/lb °F @ 68 F                    | .09 cal/gm/°C @ 20 C             |
| Modulus of Elasticity (Tension)      | 15.000 ksi                              | 10.500 Kg/sq mm                  |
| Modulus of Rigidity                  | 5.600 ksi                               | 3.900 Kg/sq mm                   |

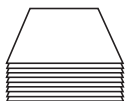
\*Volume Basis

## COPPER ALLOY NO. C36500 (Leaded Muntz Metal, Uninhibited)

| Composition-percent | Nominal | Minimum   | Maximum | Nearest Applicable ASTM Specifications |      |
|---------------------|---------|-----------|---------|----------------------------------------|------|
| Copper              | 59.5    | 58.0      | 61.0    | Plate Products                         | B171 |
| Lead                | .5      | .25       | .7      |                                        |      |
| Iron                | -       | -         | .15     |                                        |      |
| Tin                 | -       | -         | .25     |                                        |      |
| Zinc                | 40      | Remainder |         |                                        |      |

| Physical Properties                  | English Units                           | C. G. S. Units                   |
|--------------------------------------|-----------------------------------------|----------------------------------|
| Melting Point (Liquidus)             | 1650 F                                  | 900 C                            |
| Melting Point (Solidus)              | 1630 F                                  | 885 C                            |
| Density                              | .304 lb/cu in @ 68 F                    | 8.41 gm/cu cm @ 20 C             |
| Specific Gravity                     | 8.41                                    | 8.41                             |
| Coefficient of Thermal Expansion     | .0000116 per °F from 68 F to 572 F<br>C | .0000208 per °C from 20 C to 300 |
| Thermal Conductivity                 | 71 Btu/sq ft/ft/hr/°F @ 68 F            | .29 cal/sq cm/cm/sec/°C @ 20 C   |
| Electrical Resistivity (Annealed)    | 370 Ohms (circ mil/ft) @ 68 F           | 6.16 Microhm-cm @ 20 C           |
| Electrical Conductivity * (Annealed) | 28% IACS @ 68 F                         | .162 Megmho-cm @ 20 C            |
| Thermal Capacity (Specific Heat)     | .09 Btu/lb °F @ 68 F                    | .09 cal/gm/°C @ 20 C             |
| Modulus of Elasticity (Tension)      | 15.000 ksi                              | 10.500 Kg/sq mm                  |
| Modulus of Rigidity                  | 5.600 ksi                               | 3.900 Kg/sq mm                   |



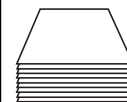
## Tube Sheets - Copper Alloy

### COPPER ALLOY NO. C44300 (Admiralty, Arsenical)

| Composition-percent                  | Nominal | Minimum                            | Maximum | Nearest Applicable ASTM Specifications |      |
|--------------------------------------|---------|------------------------------------|---------|----------------------------------------|------|
| Copper                               | 71      | 70.0                               | 73.0    | Plate Products                         | B171 |
| Lead                                 |         |                                    | .07     |                                        |      |
| Iron                                 |         |                                    | .06     |                                        |      |
| Tin                                  | 1       | .8                                 | 1.2     |                                        |      |
| Arsenic                              |         | .02                                | .06     |                                        |      |
| Zinc                                 | 28      | Remainder                          |         |                                        |      |
| Physical Properties                  |         | English Units                      |         | C. G. S. Units                         |      |
| Melting Point (Liquidus)             |         | 1720 F                             |         | 935 C                                  |      |
| Melting Point (Solidus)              |         | 1650 F                             |         | 900 C                                  |      |
| Density                              |         | .308 lb/cu in @ 68 F               |         | 8.53 gm/cu cm @ 20 C                   |      |
| Specific Gravity                     |         | 8.53                               |         | 8.53                                   |      |
| Coefficient of Thermal Expansion     |         | .0000112 per °F from 68 F to 572 F |         | .0000202 per °C from 20 C to 300 C     |      |
| Thermal Conductivity                 |         | 64 Btu/sq ft/ft/hr/°F @ 68 F       |         | .26 cal/sq cm/cm/sec/°C @ 20 C         |      |
| Electrical Resistivity (Annealed)    |         | 41.5 Ohms (circ mil/ft) @ 68 F     |         | 6.90 Microhm-cm @ 20 C                 |      |
| Electrical Conductivity * (Annealed) |         | 25% IACS @ 68 F                    |         | .145 Megmho-cm @ 20 C                  |      |
| Thermal Capacity (Specific Heat)     |         | .09 Btu/lb °F @ 68 F               |         | .09 cal/gm/°C @ 20 C                   |      |
| Modulus of Elasticity (Tension)      |         | 16.000 ksi                         |         | 11.200 Kg/sq mm                        |      |
| Modulus of Rigidity                  |         | 6.000 ksi                          |         | 4.200 Kg/sq mm                         |      |

### COPPER ALLOY NO. C46400 (Naval Brass, Uninhibited) COPPER ALLOY NO. C46500 (Naval Brass, Arsenical)

| Composition-percent                  | Nominal | Minimum                            | Maximum | Nearest Applicable ASTM Specifications |      |
|--------------------------------------|---------|------------------------------------|---------|----------------------------------------|------|
| C46400                               |         |                                    |         | Plate Products                         | B171 |
| Copper                               | 60      | 59.0                               | 62.0    |                                        |      |
| Lead                                 |         |                                    | .20     |                                        |      |
| Iron                                 |         |                                    | .10     |                                        |      |
| Tin                                  | .8      | .50                                | 1.0     |                                        |      |
| Zinc                                 | 39.2    | Remainder                          |         |                                        |      |
| C46500-Same as C46400 with:          |         |                                    |         |                                        |      |
| Arsenic                              |         | .02                                | .06     |                                        |      |
| Physical Properties                  |         | English Units                      |         | C. G. S. Units                         |      |
| Melting Point (Liquidus)             |         | 1650 F                             |         | 900 C                                  |      |
| Melting Point (Solidus)              |         | 1630 F                             |         | 885 C                                  |      |
| Density                              |         | .304 lb/cu in @ 68 F               |         | 8.41 gm/cu cm @ 20 C                   |      |
| Specific Gravity                     |         | 8.41                               |         | 8.41                                   |      |
| Coefficient of Thermal Expansion     |         | .0000118 per °F from 68 F to 572 F |         | .0000212 per °C from 20 C to 300 C     |      |
| Thermal Conductivity                 |         | 67 Btu/sq ft/ft/hr/°F @ 68 F       |         | .28 cal/sq cm/cm/sec/°C @ 20 C         |      |
| Electrical Resistivity (Annealed)    |         | 39.9 Ohms (circ mil/ft) @ 68 F     |         | 6.63 Microhm-cm @ 20 C                 |      |
| Electrical Conductivity * (Annealed) |         | 26% IACS @ 68 F                    |         | .151 Megmho-cm @ 20 C                  |      |
| Thermal Capacity (Specific Heat)     |         | .09 Btu/lb °F @ 68 F               |         | .09 cal/gm/°C @ 20 C                   |      |
| Modulus of Elasticity (Tension)      |         | 15.000 ksi                         |         | 10.500 Kg/sq mm                        |      |
| Modulus of Rigidity                  |         | 5.600 ksi                          |         | 3.900 Kg/sq mm                         |      |



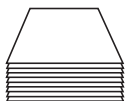
## COPPER ALLOY NO. C61400 (Aluminium Bronze, 7%)

| Composition-percent                  |                                    | Nominal | Minimum   | Nearest Applicable Maximum ASTM Specifications |            |
|--------------------------------------|------------------------------------|---------|-----------|------------------------------------------------|------------|
| Copper (incl. Silver)                | 91                                 |         | Remainder | Plate Products                                 | B169, B171 |
| Lead                                 |                                    |         | .01       |                                                |            |
| Iron                                 | 2                                  | 1.5     | 3.5       |                                                |            |
| Zinc                                 |                                    |         | .20       |                                                |            |
| Aluminium                            | 7                                  | 6.0     | 8.0       |                                                |            |
| Manganese                            |                                    |         | 1.0       |                                                |            |
| Phosphorus                           |                                    |         | .015      |                                                |            |
| Physical Properties                  | English Units                      |         |           | C. G. S. Units                                 |            |
| Melting Point (Liquidus)             | 1915 F                             |         |           | 1045 C                                         |            |
| Melting Point (Solidus)              | 1905 F                             |         |           | 1040 C                                         |            |
| Density                              | .285 lb/cu in @ 68 F               |         |           | 7.89 gm/cu cm @ 20 C                           |            |
| Specific Gravity                     | 7.89                               |         |           | 7.89                                           |            |
| Coefficient of Thermal Expansion     | .0000090 per °F from 68 F to 572 F |         |           | .0000162 per °C from 20 C to 300 C             |            |
| Thermal Conductivity                 | 39 Btu/sq ft/ft/hr/°F @ 68 F       |         |           | .16 cal/sq cm/cm/sec/°C @ 20 C                 |            |
| Electrical Resistivity (Annealed)    | 74.1 Ohms (circ mil/ft) @ 68 F     |         |           | 12.3 Microhm-cm @ 20 C                         |            |
| Electrical Conductivity * (Annealed) | 14% IACS @ 68 F                    |         |           | .081 Megmho-cm @ 20 C                          |            |
| Thermal Capacity (Specific Heat)     | .09 Btu/lb °F @ 68 F               |         |           | .09 cal/gm/°C @ 20 C                           |            |
| Modulus of Elasticity (Tension)      | 17000 ksi                          |         |           | 12.000 Kg/sq mm                                |            |
| Modulus of Rigidity                  | 6.400 ksi                          |         |           | 4.500 Kg/sq mm                                 |            |

\*Volume Basis

## COPPER ALLOY NO. C63000 (Nickel Aluminium Bronze, 10%)

| Composition-percent                  |                                    | Nominal | Minimum | Nearest Applicable Maximum ASTM Specifications |      |
|--------------------------------------|------------------------------------|---------|---------|------------------------------------------------|------|
| Copper (incl. Silver)                | 82                                 |         |         | Plate Products                                 | B171 |
| Iron                                 | 3                                  | 2.0     | 4.0     |                                                |      |
| Tin                                  |                                    |         | .20     |                                                |      |
| Zinc                                 |                                    |         | .30     |                                                |      |
| Aluminium                            | 10                                 | 9.0     | 11.0    |                                                |      |
| Manganese                            |                                    |         | 1.5     |                                                |      |
| Silicon                              |                                    |         | .25     |                                                |      |
| Nickel (incl. Cobalt)                | 5                                  | 4.0     | 5.5     |                                                |      |
| Physical Properties                  | English Units                      |         |         | C. G. S. Units                                 |      |
| Melting Point (Liquidus)             | 1930 F                             |         |         | 1054 C                                         |      |
| Melting Point (Solidus)              | 1895 F                             |         |         | 1035 C                                         |      |
| Density                              | .274 lb/cu in @ 68 F               |         |         | 7.58 gm/cu cm @ 20 C                           |      |
| Specific Gravity                     | 7.58                               |         |         | 7.58                                           |      |
| Coefficient of Thermal Expansion     | .0000090 per °F from 68 F to 572 F |         |         | .0000162 per °C from 20 C to 300 C             |      |
| Thermal Conductivity                 | 22.6 Btu/sq ft/ft/hr/°F @ 68 F     |         |         | .09 cal/sq cm/cm/sec/°C @ 20 C                 |      |
| Electrical Resistivity (Annealed)    | 116 Ohms (circ mil/ft) @ 68 F      |         |         | 19.2 Microhm-cm @ 20 C                         |      |
| Electrical Conductivity * (Annealed) | 7% IACS @ 68 F                     |         |         | .041 Megmho-cm @ 20 C                          |      |
| Thermal Capacity (Specific Heat)     | .09 Btu/lb °F @ 68 F               |         |         | .09 cal/gm/°C @ 20 C                           |      |
| Modulus of Elasticity (Tension)      | 17500 ksi                          |         |         | 12.250 Kg/sq mm                                |      |
| Modulus of Rigidity                  | 6.400 ksi                          |         |         | 4.500 Kg/sq mm                                 |      |



## Tube Sheets - Copper Alloy

### COPPER ALLOY NO. C70600 (Copper Nickel, 10%)

| Composition-percent   | Nominal | Minimum | Maximum   | Nearest Applicable ASTM Specifications |            |
|-----------------------|---------|---------|-----------|----------------------------------------|------------|
| Copper (incl. Silver) | 88.6    |         | Remainder | Plate Products                         | B122, B171 |
| Lead                  |         |         | .05*      |                                        |            |
| Iron                  | 1.4     | 1.0     | 1.8       |                                        |            |
| Zinc                  |         |         | 1.0*      |                                        |            |
| Nickel                | 10      | 9.0     | 11.0      |                                        |            |
| Manganese             |         |         | 1.0       |                                        |            |

\* When the product is for subsequent welding applications and so specified by the purchaser, Zn shall be .50% max., Pb .025% max., P .02% max., Sulfur .02% max. and Carbon .05% max.

| Physical Properties                  | English Units                      | C. G. S. Units                     |
|--------------------------------------|------------------------------------|------------------------------------|
| Melting Point (Liquidus)             | 2100 F                             | 1150 C                             |
| Melting Point (Solidus)              | 2010 F                             | 1100 C                             |
| Density                              | .323 lb/cu in @ 68 F               | 8.94 gm/cu cm @ 20 C               |
| Specific Gravity                     | 8.94                               | 8.94                               |
| Coefficient of Thermal Expansion     | .0000095 per °F from 68 F to 572 F | .0000171 per °C from 20 C to 300 C |
| Thermal Conductivity                 | 26 Btu/sq ft/ft/hr/ °F @ 68 F      | .11 cal/sq cm/cm/sec/ °C @ 20 C    |
| Electrical Resistivity (Annealed)    | 115 Ohms (circ mil/ft) @ 68 F      | 19.1 Microhm-cm @ 20 C             |
| Electrical Conductivity * (Annealed) | 9.0% IACS @ 68 F                   | .0522 Megmho-cm @ 20 C             |
| Thermal Capacity (Specific Heat)     | .09 Btu/lb °F @ 68 F               | .09 cal/gm/ °C @ 20 C              |
| Modulus of Elasticity (Tension)      | 18.000 ksi                         | 12.700 Kg/sq mm                    |
| Modulus of Rigidity                  | 6.800 ksi                          | 4.800 Kg/sq mm                     |

### COPPER ALLOY NO. C71500 (Copper Nickel, 30%)

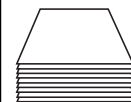
| Composition-percent | Nominal | Minimum | Maximum   | Nearest Applicable ASTM Specifications |            |
|---------------------|---------|---------|-----------|----------------------------------------|------------|
| Copper              | 69.5    |         | Remainder | Plate Products                         | B122, B171 |
| Lead                |         |         | .05*      |                                        |            |
| Iron                | .5      | .40     | 1.0       |                                        |            |
| Zinc                |         |         | 1.0*      |                                        |            |
| Nickel              | 30      | 29.0    | 33.0      |                                        |            |
| Manganese           |         |         | 1.0       |                                        |            |

When the product is for subsequent welding applications and so specified by the purchaser, Zn shall be .50% max., Pb .025% max., P .02% max., Sulfur .02% max. and Carbon .05% max.

| Physical Properties                  | English Units                      | C. G. S. Units                     |
|--------------------------------------|------------------------------------|------------------------------------|
| Melting Point (Liquidus)             | 2260 F                             | 1240 C                             |
| Melting Point (Solidus)              | 2140 F                             | 1170 C                             |
| Density                              | .323 lb/cu in @ 68 F               | 8.94 gm/cu cm @ 20 C               |
| Specific Gravity                     | 8.94                               | 8.94                               |
| Coefficient of Thermal Expansion     | .0000090 per °F from 68 F to 572 F | .0000162 per °C from 20 C to 300 C |
| Thermal Conductivity                 | 17 Btu/sq ft/ft/hr/ °F @ 68 F      | .07 cal/sq cm/cm/sec/ °C @ 20 C    |
| Electrical Resistivity (Annealed)    | 225 Ohms (circ mil/ft) @ 68 F      | 37.5 Microhm-cm @ 20 C             |
| Electrical Conductivity * (Annealed) | 4.6% IACS @ 68 F                   | .0267 Megmho-cm @ 20 C             |
| Thermal Capacity (Specific Heat)     | .09 Btu/lb °F @ 68 F               | .09 cal/gm/ °C @ 20 C              |
| Modulus of Elasticity (Tension)      | 22.000 ksi                         | 15.500 Kg/sq mm                    |
| Modulus of Rigidity                  | 8.300 ksi                          | 5.800 Kg/sq mm                     |



# Carbon Steel Plates for Boiler and Pressure Vessels



## Pressure Vessel Plates – Alloy Steel

| Chemical Composition (%) |           |           |            |            |           |            |           | Tension Test                                 |                            |                                    |    |
|--------------------------|-----------|-----------|------------|------------|-----------|------------|-----------|----------------------------------------------|----------------------------|------------------------------------|----|
| Chemical Composition     |           |           |            |            |           |            |           | Tensile Properties<br>Class 2 plates / A 387 |                            |                                    |    |
| Classific.               | C         | Mn        | P          | S          | Si        | Cr         | Mo        | Tensile strength<br>KSI                      | Yield strength<br>KSI min. | Elongation<br>min %<br>GL=8" GL=2" |    |
| A387 Gr. 12              | 0.05-0.17 | 0.05-0.17 | 0.035 max. | 0.040 max. | 0.15-0.40 | 0.80-1.15  | 0.45-0.60 | 65-85<br>(450-585)                           | 40<br>(275)                | 19                                 | 22 |
| A387 Gr. 11              | 0.05-0.17 | 0.40-0.65 | 0.035 max. | 0.040 max. | 0.50-0.80 | 1.00-1.50  | 0.45-0.65 | 75-100<br>(515-690)                          | 45<br>(310)                | 18                                 | 22 |
| A387 Gr. 22              | 0.05-0.15 | 0.40-0.65 | 0.035 max. | 0.035 max. | 0.50 max. | 2.00-2.50  | 0.90-1.10 | 75-100<br>(515-690)                          | 45<br>(310)                | --                                 | 1  |
| A387 Gr. 5               | 0.15 max. | 0.30-0.60 | 0.040 max. | 0.030 max. | 0.50 max. | 4.00-6.00  | 0.45-0.65 | 75-100<br>(515-690)                          | 45<br>(310)                | --                                 | 18 |
| A387 Gr. 9               | 0.15 max. | 0.30-0.60 | 0.030 max. | 0.030 max. | 1.00 max. | 8.00-10.00 | 0.90-1.10 | 75-100<br>(515-690)                          | 45<br>(310)                | --                                 | 18 |

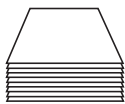
  

|            | C         | Mn        | P          | S          | Si        | Ni        |  |                    |             |    |    |
|------------|-----------|-----------|------------|------------|-----------|-----------|--|--------------------|-------------|----|----|
| A203 Gr. D | 0.17 max. | 0.70 max. | 0.035 max. | 0.040 max. | 0.15-0.40 | 3.25-3.75 |  | 65-85<br>(450-585) | 37<br>(255) | 19 | 23 |
| A203 Gr. E | 0.20 max. | 0.70 max. | 0.035 max. | 0.040 max. | 0.15-0.40 | 3.25-3.75 |  | 70-90<br>(485-620) | 40<br>(275) | 17 | 21 |

|            | C         | Mn        | P          | S          | Si        | Mo        |  |                    |             |    |    |
|------------|-----------|-----------|------------|------------|-----------|-----------|--|--------------------|-------------|----|----|
| A204 Gr. A | 0.18 max. | 0.90 max. | 0.035 max. | 0.040 max. | 0.15-0.40 | 0.45-0.60 |  | 65-85<br>(450-585) | 37<br>(255) | 19 | 23 |
| A204 Gr. B | 0.20 max. | 0.90 max. | 0.035 max. | 0.040 max. | 0.15-0.40 | 0.45-0.60 |  | 70-90<br>(485-620) | 40<br>(275) | 17 | 21 |
| A204 Gr. C | 0.23 max. | 0.90 max. | 0.035 max. | 0.040 max. | 0.15-0.40 | 0.45-0.60 |  | 75-95<br>(515-655) | 43<br>(295) | 16 | 20 |





# Carbon Steel Plates for Boiler and Pressure Vessels

## ASTM A 283-93 Low and Medium Strength Carbon Steel

| Chemical Composition (%) |                                  |                |          |           |           |            |           | Tension Test              |                           |                                         |    |
|--------------------------|----------------------------------|----------------|----------|-----------|-----------|------------|-----------|---------------------------|---------------------------|-----------------------------------------|----|
| Code                     | Maximum Available Thickness (mm) | Thickness (mm) | C        | Mn        | Si        | P          | S         | Min. Yield Point ksi(Mpa) | Tensile Strength ksi(Mpa) | Min. Elongation (%)<br>GL=200mm GL=50mm |    |
| A 283-A                  | 100                              | <1 1/2(40)     | 0.14 max | 0.90 max. | 0.40 max  | 0.035 max. | 0.04 max. | 24                        | 45-60                     | 27                                      | 30 |
|                          |                                  | 1 1/2(40)<t    |          |           | 0.15-0.40 |            |           | (165)                     | (310-415)                 |                                         |    |
| A 283-B                  | 100                              | <1 1/2(40)     | 0.17 max | 0.90 max. | 0.40 max  | 0.035 max. | 0.04 max. | 27                        | 50-65                     | 25                                      | 28 |
|                          |                                  | 1 1/2(40)<t    |          |           | 0.15-0.40 |            |           | (185)                     | (345-450)                 |                                         |    |
| A 283-C                  | 100                              | <1 1/2(40)     | 0.24 max | 0.90 max. | 0.40 max  | 0.035 max. | 0.04 max. | 33                        | 60-80                     | 20                                      | 23 |
|                          |                                  | 1 1/2(40)<t    |          |           | 0.15-0.40 |            |           | (230)                     | (415-550)                 |                                         |    |
| A 283-D                  | 100                              | <1 1/2(40)     | 0.27 max | 0.90 max. | 0.40 max  | 0.035 max. | 0.04 max. | 33                        | 60-80                     | 20                                      | 23 |
|                          |                                  | 1 1/2(40)<t    |          |           | 0.15-0.40 |            |           | (230)                     | (415-550)                 |                                         |    |

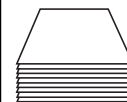
## ASTM A 285/A 285M-90 Carbon Steel for Pressure Vessels for Low and Intermediate Tensile Strength

| Chemical Composition (%) |           |           |            |            |                          | Tension Test                 |                                 |                                                   |    |
|--------------------------|-----------|-----------|------------|------------|--------------------------|------------------------------|---------------------------------|---------------------------------------------------|----|
| Classification           | C         | Mn        | P          | S          | Cu<br>(May be specified) | Tensile Strength<br>ksi(Mpa) | Minimum Yield Point<br>ksi(Mpa) | Elongation (Min.)(%)<br>GL=8 (200mm) GL=2 (50 mm) |    |
| A 285A                   | 0.17 max. | 0.90 max. | 0.035 max. | 0.035 max. | 0.20-0.35                | 45-65(310-450)               | 24(165)                         | 27                                                | 30 |
| A 285B                   | 0.22 max. | 0.90 max. | 0.035 max. | 0.035 max. | 0.20-0.35                | 50-70(345-485)               | 27(185)                         | 25                                                | 28 |
| A 285C                   | 0.28 max. | 0.90 max. | 0.035 max. | 0.035 max. | 0.20-0.35                | 55-75(380-515)               | 30(205)                         | 23                                                | 27 |

## ASTM A 516/A 516M-90 Carbon Steel for Moderate and Lower Temperature

| Chemical Composition (%) |           |           |               |                                    |              |           | Tension Test |                                                     |                              |                                    |                     |                |
|--------------------------|-----------|-----------|---------------|------------------------------------|--------------|-----------|--------------|-----------------------------------------------------|------------------------------|------------------------------------|---------------------|----------------|
| Classification           |           | 1/2"      | C             |                                    |              | Si        | Mn           |                                                     | Tensile Strength<br>ksi(Mpa) | Minimum<br>Yield Point<br>ksi(Mpa) | Elongation(Min.)(%) |                |
|                          |           |           | 1/2"~t£2"(50) | Thickness in. (mm)<br>2"~t£4"(100) | 4"~t£8"(200) |           | 8"(200)      | Thickness in (mm)<br>1/2"(13)and over 1/2"<br>under |                              |                                    | GL=8<br>(200mm)     | GL=2<br>(50mm) |
| A 515-55                 | 0.18 max. | 0.20 max. | 0.22 max.     | 0.24 max.                          | 0.26 max.    | 0.15-0.40 | 0.60-0.90    | 0.60-1.20                                           | 55-75<br>(380-515)           | 30(205)                            | 23                  | 27             |
| A 515-60                 | 0.21 max. | 0.23 max. | 0.25 max.     | 0.27 max.                          | 0.27 max.    | 0.15-0.41 | 0.60-0.90    | 0.85-1.20                                           | 60-80<br>(415-550)           | 32(220)                            | 21                  | 25             |
| A 515-65                 | 0.24 max. | 0.26 max. | 0.28 max.     | 0.29 max.                          | 0.29 max.    | 0.15-0.40 | 0.85-1.20    | 0.85-1.20                                           | 65-85<br>(450-585)           | 35(240)                            | 19                  | 23             |
| A 515-70                 | 0.27 max. | 0.28 max. | 0.30 max.     | 0.31 max.                          | 0.31 max.    | 0.15-0.40 | 0.85-1.20    | 0.85-1.20                                           | 70-90<br>(485-620)           | 38(260)                            | 17                  | 21             |

# Carbon and Alloy Steel Plates Comparision of Standards



## Carbon and alloy steel plates comparison of standards

| USA<br>ASTM   | Germany<br>DIN | Europe<br>EN |
|---------------|----------------|--------------|
| A 285 Gr. C.  | H II           | P 265 GH     |
| A 516 Gr. 70  | 19 MN 5        | P310 GH      |
| A 204 Gr. A/B | 15 Mo 3        | 16 Mo3       |
| A 387 Gr. 12  | 13 CrMo 44     | 13 CrMo 45   |
| A 387 Gr. 11  | 13 CrMo 44     | 13 CrMo 45   |
| A387 Gr. 22   | 10 CrMo 910    | ---          |
| A 387 Gr. 5   | 12 CrMo 195    | ---          |
| A 387 Gr.9    | X 11 CrMo 9-1  | ---          |
| A 203 Gr.D    | 10 Ni 14       | 12 Ni 14     |
| A 203 Gr. E   | 10 Ni 14       | 12 Ni 14     |





# Nickel Alloy and Titanium Bars

## Extract of Nickel Alloy Bars

| Norm       | Grade      | Chemical Composition |         |         |        |        |             |             |             |                |
|------------|------------|----------------------|---------|---------|--------|--------|-------------|-------------|-------------|----------------|
|            |            | C max.               | Si max. | Mn max. | P max. | S max. | Cr min-max. | Ni min-max. | Mo min-max. | Ti             |
| ASTM B 160 | Alloy 200  | 0,15                 | 0,35    | 0,35    | -      | 0,01   | -           | 99,0 min.   | -           | -              |
| UNS Grade  | N02200     | 0,15                 | 0,35    | 0,35    | -      | 0,014  | -           | 99,0 min.   | -           | -              |
| ASTM B 164 | Alloy 400  | 0,300                | 0,50    | 2,00    | -      | 0,024  | -           | 63,0 min.   | -           | -              |
| UNS-Grade  | N 04400    | 0,300                | 0,50    | 2,00    | -      | 0,024  | -           | 63,0 min.   | -           | -              |
| ASTM B 166 | Alloy 600  | 0,150                | 0,50    | 1,00    | -      | 0,015  | 14,0 – 17,0 | 72,0 min.   | -           | -              |
| UNS-Grade  | N 06600    | 0,150                | 0,50    | 1,00    | -      | 0,015  | 14,0 – 17,0 | 72,0 min.   | -           | -              |
| ASTM B 408 | Alloy 800  | 0,100                | 1,00    | 1,50    | 0,030  | 0,015  | 19,0 – 23,0 | 30,0 – 35,0 | -           | 0,15 – 0,60    |
| UNS-Grade  | N 08800    | 0,100                | 1,00    | 1,50    | 0,030  | 0,015  | 19,0 – 23,0 | 30,0 – 35,0 | -           | 0,15 – 0,60    |
| ASTM B 425 | Alloy 825  | 0,050                | 0,50    | 1,00    | -      | 0,030  | 19,5 – 23,5 | 38,0 – 46,0 | 2,5 – 3,5   | 0,60 – 1,20    |
| UNS-Grade  | N 08825    | 0,050                | 0,50    | 1,00    | -      | 0,030  | 19,5 – 23,5 | 38,0 – 46,0 | 2,5 – 3,5   | 0,6-1,2 ≥ 20xC |
| ASTM B 472 | Alloy 8020 | 0,070                | 1,00    | 2,00    | 0,045  | 0,035  | 19,0 – 21,0 | 32,0 – 38,0 | 2,0 – 3,0   |                |
| UNS-Grade  | N 08020    | 0,070                | 1,00    | 2,00    | 0,045  | 0,035  | 19,0 – 21,0 | 32,0 – 38,0 | 2,0 – 3,0   |                |

## Titanium Bars

| ASTM Grade          | Chemical Composition |            |            |             |            |             |            |             |           |           |
|---------------------|----------------------|------------|------------|-------------|------------|-------------|------------|-------------|-----------|-----------|
|                     | N<br>% max           | C<br>% max | H<br>% max | Fe<br>% max | O<br>% max | Al<br>% max | V<br>% max | Pa          | Mo        | Ni        |
| ASTM B 348 Grade 1  | 0,03                 | 0,08       | 0,015      | 0,20        | 0,18       | -           | -          | -           | -         | -         |
| ASTM B 348 Grade 2  | 0,03                 | 0,08       | 0,015      | 0,30        | 0,25       | -           | -          | -           | -         | -         |
| ASTM B 348 Grade 3  | 0,05                 | 0,08       | 0,015      | 0,30        | 0,35       | -           | -          | -           | -         | -         |
| ASTM B 348 Grade 7  | 0,03                 | 0,08       | 0,015      | 0,30        | 0,25       | -           | -          | 0,12 – 0,25 | -         | -         |
| ASTM B 348 Grade 9  | 0,02                 | 0,08       | 0,015      | 0,25        | 0,15       | 2,5 – 3,5   | 2,0 – 3,0  | -           | -         | -         |
| ASTM B 348 Grade 11 | 0,03                 | 0,08       | 0,015      | 0,20        | 0,18       | -           | -          | 0,12 – 0,25 | -         | -         |
| ASTM B 348 Grade 12 | 0,03                 | 0,08       | 0,015      | 0,30        | 0,25       | -           | -          | -           | 0,2 – 0,4 | 0,6 – 0,9 |



| Others                                 | Mechanical Properties and heat treatment |                |            |     |                |
|----------------------------------------|------------------------------------------|----------------|------------|-----|----------------|
|                                        | Rp 0.2/Nsqmm                             | Rp 1.0 N/sq.mm | Rm N/sq.mm | A5% | Heat treatment |
| Cu 0.25 max                            | min 105                                  | -              | min 415    | 35  | annealed       |
| Cu 0.25 max.                           | min 105                                  | -              | min 415    | 35  | annealed       |
| Cu 28.0-34.0; Fe 2.5 max.              | min 170                                  | -              | min 480    | 35  | annealed       |
| Cu 28.0-34.0; Fe 2.5 max.              | min 170                                  | -              | min 480    | 35  | annealed       |
| Cu 0.5 max.; Fe 6.0-10.0               | min 240                                  | -              | min 585    | 30  | annealed       |
| Cu 0.5 max.; Fe 6.0-10.0               | min 240                                  | -              | min 585    | 30  | annealed       |
| Cu 0.75 max.; Al 0.15-0.6; Fe 39.5 min | min 205                                  | -              | min 515    | 30  | annealed       |
| Cu 0.75 max.; Al 0.15-0.6; Fe 39.5 min | min 205                                  | -              | min 515    | 30  | annealed       |
| Cu 1.5-3.0; Al 0.2 max.; Fe 22.0 min.  | min 241                                  | -              | min 586    | 30  | annealed       |
| Cu 1.5-3.0; Al 0.2 max.; Fe Rest       | min 241                                  | -              | min 586    | 30  | annealed       |
| Cu 3-4; Nb + Ta 8xC max. 1.0; Fe Rest  | min 241                                  | -              | min 551    | 30  | annealed       |
| Cu 3-4; Nb + Ta 8xC max. 1.0; Fe Rest  | min 241                                  | -              | min 551    | 30  | annealed       |

Remark: Mechanical Properties are for hot worked annealed execution

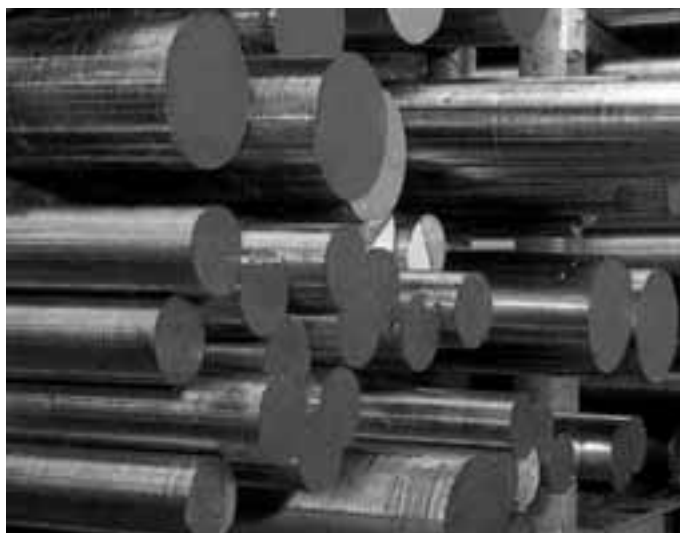
|                |                 |          | Mechanical Properties |                     |            |         |
|----------------|-----------------|----------|-----------------------|---------------------|------------|---------|
| Residuals Each | Residuals Total | Titanium | Rp 0.2 N/sq.mm        | Rp 1.0 N/sq.mm min. | Rm N/sq.mm | A5% min |
| 0.1            | 0.4             | Rem.     | 170 min               | -                   | 240 min    | 24      |
| 0.1            | 0.4             | Rem.     | 275 min               | -                   | 345 min    | 20      |
| 0.1            | 0.4             | Rem.     | 345 min               | -                   | 450 min    | 18      |
| 0.1            | 0.4             | Rem.     | 275 min               | -                   | 345 min    | 20      |
| 0.1            | 0.4             | Rem.     | 60 min                | -                   | 483 min    | 10      |
| 0.1            | 0.4             | Rem.     | 170 min               | -                   | 240 min    | 24      |
| 0.1            | 0.4             | Rem.     | 345 min               | -                   | 483 min    | 18      |



# Carbon and Alloy Steel Bar

## CARBON & ALLOY STEEL BAR

| Intermediate & High Temperature Grades |                                          |                |              |          |         |                | Low-Temp Grades |                |           |
|----------------------------------------|------------------------------------------|----------------|--------------|----------|---------|----------------|-----------------|----------------|-----------|
| Round Bar<br>ASTM Destination          | A-182                                    | A-182<br>A-739 |              | A-182    |         | A-105          | A-350           |                |           |
| Round Bar Grade                        | F-1                                      | F-12<br>B-11   | F-11<br>B-22 | F-22     | F-5     | N.A.           | LF-1            | LF-2           | LF-3      |
| Plate<br>ASTM Designation              | A-204<br>C-Mo                            | A-387<br>CR-Mo |              |          |         | A-515<br>A-516 | A-516           | A-516<br>A-537 | A-203     |
| Plate Grade                            | GRB&C                                    | GR12           | GR 11        | GR 22    | GR 5    | ALL GRADES     | ALL GRADES      | ALL GRADES     | GR D&F    |
| Elements                               | Max % Composition Unless Otherwise Noted |                |              |          |         |                |                 |                |           |
| Carbon                                 | .28                                      | .10-20         | .10-20       | .05-15   | .15     | .35            | .30             | .30            | .20       |
| Manganese                              | .60-90                                   | .30-80         | .30-80       | .30-60   | .30-60  | .60-1.05       | 1.35            | 1.35           | .90       |
| Phosphorus                             | .045                                     | .040           | .040         | .040     | .030    | .040           | .035            | .035           | .035      |
| Sulfur                                 | .045                                     | .040           | .040         | .040     | .030    | .050           | .040            | .040           | .040      |
| Silicon                                | .15-35                                   | .10-60         | .50-1.00     | .50      | .50     | .35            | .15-30          | .15-30         | .20-35    |
| Chromium                               | -                                        | .80-1.25       | 1.0-1.5      | 2.0-2.5  | 4.0-6.0 | .30            | .30             | .30            | .30       |
| Molybdenum                             | .44-65                                   | .44-65         | .44-65       | .87-1.13 | .44-65  | .12            | .12             | .12            | .12       |
| Nickel                                 | -                                        | -              | -            | -        | .50     | .40            | .40             | .40            | 3.25-3.75 |
| Columbium                              | -                                        | -              | -            | -        | -       | .02            | .02             | .02            | .02       |
| Vanadium                               | -                                        | -              | -            | -        | -       | .03            | .03             | .03            | .03       |
| Copper                                 | -                                        | -              | -            | -        | -       | .40            | .40             | .40            | .40       |
| Mechanical (Physical) Properties       |                                          |                |              |          |         |                |                 |                |           |
| Tensile ksi                            | 70                                       | 70             | 70           | 75       | 70      | 70             | 60-85           | 70-95          | 70-95     |
| Yield ksi                              | 40                                       | 40             | 40           | 45       | 40      | 36             | 30              | 36             | 37.5      |
| Elongation % min.                      | 20.0                                     | 20.0           | 20.0         | 20.0     | 20.0    | 30             | 28              | 30             | 30        |
| Reduction of area % min.               | 30.0                                     | 30.0           | 30.0         | 30.0     | 35.0    | 30             | 38              | 30             | 35        |
| Brinell Hardness                       | 143-192                                  | 143-207        | 143-207      | 156-207  | 143-217 | 187            | -               | -              | -         |



# Carbon and Alloy Steel Bars Comparison of Standards



## Carbon and alloy steel bars comparison of standards

| USA<br>ASTM | Germany<br>DIN | Europe<br>EN |
|-------------|----------------|--------------|
| A 105       | C. 22.8        | ---          |
| ---         | 15 Mo 3        | 16 Mo 3      |
| A 182 F 12  | 13 CrMo 44     | 13 CrMo 45   |
| A 182 F 11  | 10 CrMo 44     | 13 CrMo 45   |
| A 182 F 22  | 10 CrMo 910    | ---          |
| A 182 F 5   | 12 CrMo 195    | ---          |
| A 182 F 9   | X 11 CrMo 9-1  | ---          |
| A 350 LF 2  | ST 52-3        | S 355 J2 G3  |
| A 350 LF 3  | 10 Ni 14       | 12 Ni 14     |







# Brass Bars

## ALUMINIUM BRASS „ARSENICAL“ C-687

### ADMIRALTY BRASS BARS

#### Chemical Composition

(%max., unless shown as range or min.)

|           | Cu        | As      | Fe  | Pb  | Sn(1)  | Zn   |
|-----------|-----------|---------|-----|-----|--------|------|
| Min./Max. | 70.0-73.0 | .02-.06 | .06 | .07 | .8-1.2 | Rem. |
| Nominal   | 71.0      | .04     | -   | -   | 1.0    | 28.0 |

(1) For tubular products, the minimum Sn content may be .9%  
Note: Cu + Sum of Named Elements, 99.6% min.

#### Applicable Specifications

| Product               | Specification           |
|-----------------------|-------------------------|
| Plate, Clad           | ASTM B432               |
| Plate, Condenser Tube | ASME SB171<br>ASTM B171 |
| Tube                  | ASTM B135               |
| Tube Condenser        | ASME SB111<br>ASTM B111 |
| Tube, Finned          | ASME SB359<br>ASTM B359 |
| Tube, U-Bend          | ASME SB395<br>ASTM B395 |
| Tube, Welded          | ASME SB543<br>ASTM B543 |

### ALUMINIUM BRASS "ARSENICAL" C-687

#### Chemical Composition

(%max., unless shown as range or min.)

|           | Cu(1)     | Al      | As      | Fe  | Pb  | Zn   |
|-----------|-----------|---------|---------|-----|-----|------|
| Min./Max. | 76.0-79.0 | 1.8-2.5 | .02-.06 | .06 | .07 | Rem. |
| Nominal   | 77.5      | 2.0     | .04     | -   | -   | 20.5 |

(1) Cu value includes Ag.  
Note: Cu + Sum of Named Elements, 99.5% min.

#### Applicable Specifications

| Product         | Specification           |
|-----------------|-------------------------|
| Tube, Condenser | ASME SB111<br>ASTM B111 |
| Tube, Finned    | ASME SB359<br>ASTM B359 |
| Tube, U-Bend    | ASME SB395<br>ASTM B395 |
| Tube, Welded    | ASME SB543<br>ASTM B543 |

### NAVAL BRASS "LEAD FREE"

#### Chemical Composition

(%max., unless shown as range or min.)

|           | Cu        | Fe  | Pb  | Sn      | Zn   |
|-----------|-----------|-----|-----|---------|------|
| Min./Max. | 59.0-62.0 | .10 | .20 | .50-1.0 | Rem. |
| Nominal   | 60.0      | -   | -   | .7      | 39.2 |

Note: Cu + Sum of Named Elements, 99.6% min.

#### Applicable Specifications

| Product               | Specification                                                    |
|-----------------------|------------------------------------------------------------------|
| Bar                   | AMS 4611, 4612<br>ASTM B21<br>FEDERAL QQ-B-639<br>SAE J461, J463 |
| Bar, Forging          | ASTM B124                                                        |
| Bolts                 | ASTM F468                                                        |
| Forgings, Die         | ASTM B283                                                        |
| Nuts                  | ASTM F467                                                        |
| Plate                 | FEDERAL QQ-B-639                                                 |
| Plate, Clad           | ASTM B432                                                        |
| Plate, Condenser Tube | ASME SB171<br>ASTM B171                                          |
| Rod                   | AMS 4611, 4612<br>ASTM B21<br>SAE J461, J463                     |
| Rod, Forging          | ASTM B124                                                        |





## NICKEL ALUMINIUM BRONZE C-630 BARS

### Chemical Composition

(%max., unless shown as range or min.)

|           | Cu (1) | Al       | Fe      | Mn  | Ni(2)   | Si  | Sn  | Zn  |
|-----------|--------|----------|---------|-----|---------|-----|-----|-----|
| Min./Max. | Rem.   | 9.0-11.0 | 2.0-4.0 | 1.5 | 4.0-5.5 | .25 | .20 | .30 |
| Nominal   | 82.0   | 10.0     | 3.0     | -   | 5.0     | -   | -   | -   |

(1) Cu value includes Ag.

(2) Ni value includes Co.

Note: Cu + Sum of Named Elements, 99.5% min.

### Applicable Specifications

| Product               | Specification                                                             |
|-----------------------|---------------------------------------------------------------------------|
| Bar                   | AMS 4640<br>ASME SB150<br>ASTM B150<br>FEDERAL QQ-C-450<br>SAE J461, J463 |
| Bar, Forging          | ASTM B124                                                                 |
| Bolts                 | ASTM F468                                                                 |
| Forgings, Die         | AMS 4640<br>ASTM B283<br>MILITARY MIL-B-16166                             |
| Nuts                  | ASTM F467                                                                 |
| Plate                 | ASTM B171<br>FEDERAL QQ-C-450                                             |
| Plate, Condenser Tube | ASME SB171                                                                |
| Rod                   | ASTM B171<br>AMS 4640<br>ASME SB150<br>ASTM B150<br>SAE J461, J463        |
| Rod, Forging          | ASTM B124                                                                 |
| Screws                | ASTM F468                                                                 |
| Shapes                | AMS 4640<br>ASTM B150<br>SAE J461, J463                                   |
| Shapes, Forging       | ASTM B124                                                                 |
| Sheet                 | FEDERAL QQ-C-450                                                          |
| Strip                 | FEDERAL QQ-C-450                                                          |
| Tube                  | AMS 4640                                                                  |

## ALUMINIUM BRONZE C-614

### Chemical Composition

(%max., unless shown as range or min.)

|           | Cu(1) | Al      | Fe      | Pb  | Mn  | P    | Zn  |
|-----------|-------|---------|---------|-----|-----|------|-----|
| Min./Max. | Rem.  | 6.0-8.0 | 1.5-3.5 | .01 | 1.0 | .015 | .20 |
| Nominal   | 91.0  | 7.0     | 2.0     | -   | -   | -    | -   |

(1) Cu value includes Ag.

Note: Cu + Sum of Named Elements, 99.5% min.

### Applicable Specifications

| Product                   | Specification                                                 |
|---------------------------|---------------------------------------------------------------|
| Bar                       | ASME SB169<br>ASTM B169<br>FEDERAL QQ-C-450<br>SAE J461, J463 |
| Bolts                     | ASTM F468                                                     |
| Nuts                      | ASTM F467                                                     |
| Pipe                      | ASTM B315                                                     |
| Pipe, Welded              | ASTM B608                                                     |
| Plate                     | ASME SB169<br>ASTM B169, B171<br>FEDERAL QQ-C-450             |
| Plate, Bridge and Bearing | ASTM B100                                                     |
| Plate, Clad               | ASTM B432                                                     |
| Plate, Condenser Tube     | ASME SB171<br>ASTM B171                                       |
| Rod                       | ASME SB150<br>ASTM B150<br>SAE J461, J463                     |
| Screws                    | ASTM F468                                                     |
| Shapes                    | SAE J461, J463                                                |
| Sheet                     | ASME SB169<br>ASTM B169<br>FEDERAL QQ-C-450                   |
| Strip                     | SAE J461, J463<br>ASME SB169<br>ASTM B169<br>FEDERAL QQ-C-450 |
| Studs                     | SAE J461, J463<br>ASTM F468                                   |
| Tube                      | ASTM B315                                                     |
| Tube, Condensor           | ASTM B111                                                     |



# Copper - Nickel Bars

## COPPER NICKEL "90/10" C-706 BARS

### Chemical Composition

(%max., unless shown as range or min.)

|           | Cu (1) | Fe      | Pb  | Mn  | Ni(2)    | Zn  |
|-----------|--------|---------|-----|-----|----------|-----|
| Min./Max. | Rem.   | 1.0-1.8 | .05 | 1.0 | 9.0-11.0 | 1.0 |
| Nominal   | 88.6   | 1.4     | -   | -   | 10.0     | -   |

(1) Cu value includes Ag.

(2) Ni value includes Co.

Note: Cu + Sum of Named Elements, 99.5% min.

### Applicable Specifications

| Product               | Specification                                                           |
|-----------------------|-------------------------------------------------------------------------|
| Bar                   | ASTM B122, B151<br>MILITARY MIL-C-15726                                 |
| Pipe, Seamless        | ASME SB466<br>ASTM B466                                                 |
| Pipe, Welded          | ASME SB467<br>ASTM B467, B608                                           |
| Plate                 | ASTM B122<br>MILITARY MIL-C-15726                                       |
| Plate, Clad           | ASTM B432                                                               |
| Plate, Condenser Tube | ASME SB171<br>ASTM B171<br>SAE J461, J463                               |
| Rod                   | ASTM B151<br>MILITARY MIL-C-15726                                       |
| Rod, Welding          | AWS A5.15                                                               |
| Sheet                 | ASTM B122<br>MILITARY MIL-C-15726<br>SAE J461, J463                     |
| Strip                 | ASTM B122<br>MILITARY MIL-C-15726                                       |
| Tube, Condenser       | ASME SB111<br>ASTM B111, B552<br>MILITARY MIL-T-15005<br>SAE J461, J463 |
| Tube, Finned          | ASME SB359<br>ASTM B359<br>MILITARY MIL-T-22214                         |

## COPPER NICKEL "70/30" C-715

### Chemical Composition

(%max., unless shown as range or min.)

|           | Cu(1) | Fe      | Pb  | Mn  | Ni(2)     | Zn  |
|-----------|-------|---------|-----|-----|-----------|-----|
| Min./Max. | Rem.  | .40-1.0 | .05 | 1.0 | 29.0-33.0 | 1.0 |
| Nominal   | 69.5  | .50     | -   | -   | 30.0      | -   |

(1) Cu value includes Ag.

(2) Ni value includes Co.

Note: Cu + Sum of Named Elements, 99.5% min.

### Applicable Specifications

| Product               | Specification                                                           |
|-----------------------|-------------------------------------------------------------------------|
| Bar                   | ASTM B122, B151<br>MILITARY MIL-C-15726<br>SAE J461, J463               |
| Bolts                 | ASTM F468                                                               |
| Electrode, Welding    | AWS A5.6<br>MILITARY MIL-E-22200/4                                      |
| Nuts                  | ASTM F467                                                               |
| Pipe, Seamless        | ASME SB466<br>ASTM B466                                                 |
| Pipe, Welded          | ASTM B467, B608                                                         |
| Plate                 | ASTM B122<br>MILITARY MIL-C-15726<br>SAE J461, J463                     |
| Plate, Clad           | ASTM B432                                                               |
| Plate, Condenser Tube | ASME SB171<br>ASTM B171<br>SAE J461, J463                               |
| Rod                   | ASTM B151<br>MILITARY MIL-C-15726                                       |
| Screws                | ASTM F468                                                               |
| Sheet                 | ASTM B122<br>MILITARY MIL-C-15726<br>SAE J461, J463                     |
| Strip                 | ASTM B122<br>MILITARY MIL-C-15726<br>SAE J461, J463                     |
| Studs                 | ASTM F468                                                               |
| Tube, Condenser       | ASME SB111<br>ASTM B111, B552<br>MILITARY MIL-T-15005<br>SAE J461, J463 |
| Tube, Finned          | ASME SB359<br>ASTM B359<br>MILITARY MIL-T-22214                         |
| Tube, Seamless        | ASME SB466<br>ASTM B466<br>MILITARY MIL-T-16420                         |
| Tube, U-bend          | ASME SB395<br>ASTM B395                                                 |
| Tube, Welded          | ASME SB543<br>ASTM B543                                                 |
| Wire                  | MILITARY MIL-C-15726                                                    |

# Weight table - Round, Square and Hexagon Steel



## Weight table - Round, Square and Hexagon Steel

Based on Density 7,85 kg/dm<sup>3</sup>

| mm  | ○     | □     | ⬡     | mm | ○    | □    | ⬡    | mm  | ○    | □     | ⬡     | mm  | ○   | □   | ⬡   |
|-----|-------|-------|-------|----|------|------|------|-----|------|-------|-------|-----|-----|-----|-----|
| 3   | 0,056 | 0,070 | 0,061 | 23 | 3,26 | 4,15 | 3,60 | 50  | 15,4 | 19,6  | 17,0  | 130 | 104 | 133 | 115 |
| 3.5 | 0,076 | 0,100 | 0,083 | 24 | 3,55 | 4,52 | 3,91 | 53  | 17,3 | 22,1  | 19,1  | 135 | 112 | 143 | 124 |
| 4   | 0,099 | 0,126 | 0,109 | 25 | 3,85 | 4,91 | 4,25 | 55  | 18,7 | 23,8  | 20,6  | 140 | 121 | 154 | 133 |
| 4.5 | 0,125 | 0,159 | 0,138 | 26 | 4,17 | 5,31 | 4,60 | 58  | 20,7 | 26,4  | 22,9  | 145 | 130 | 165 | 143 |
| 5   | 0,154 | 0,196 | 0,170 | 27 | 4,50 | 5,72 | 4,96 | 60  | 22,2 | 28,3  | 24,5  | 150 | 139 | 177 | 153 |
| 5.5 | 0,187 | 0,237 | 0,206 | 28 | 4,83 | 6,15 | 5,33 | 63  | 24,5 | 31,2  | 27,0  | 160 | 158 | 201 | 174 |
| 6   | 0,222 | 0,283 | 0,245 | 29 | 5,19 | 6,61 | 5,72 | 65  | 26,0 | 33,2  | 28,7  | 170 | 178 | 227 | 197 |
| 7   | 0,302 | 0,385 | 0,333 | 30 | 5,55 | 7,07 | 6,12 | 68  | 28,5 | 36,3  | 31,4  | 180 | 200 | 254 | 220 |
| 8   | 0,395 | 0,502 | 0,435 | 31 | 5,92 | 7,54 | 6,54 | 70  | 30,2 | 38,5  | 33,3  | 190 | 223 | 283 | 245 |
| 9   | 0,499 | 0,636 | 0,551 | 32 | 6,31 | 8,04 | 6,96 | 73  | 32,9 | 41,8  | 36,3  | 200 | 247 | 314 | 272 |
| 10  | 0,617 | 0,785 | 0,680 | 33 | 6,71 | 8,55 | 7,41 | 75  | 34,7 | 44,2  | 38,3  | 210 | 272 | 346 | 300 |
| 11  | 0,746 | 0,950 | 0,823 | 34 | 7,13 | 9,07 | 7,86 | 78  | 37,5 | 47,8  | 41,4  | 220 | 298 | 380 | 329 |
| 12  | 0,888 | 1,13  | 0,980 | 35 | 7,55 | 9,62 | 8,33 | 80  | 39,5 | 50,2  | 43,5  | 230 | 326 | 415 | 360 |
| 13  | 1,04  | 1,33  | 1,15  | 36 | 7,99 | 10,2 | 8,81 | 83  | 42,5 | 54,4  | 46,9  | 240 | 355 | 452 | 392 |
| 14  | 1,21  | 1,54  | 1,33  | 37 | 8,44 | 10,7 | 9,31 | 85  | 44,5 | 56,7  | 49,1  | 250 | 385 | 491 | 425 |
| 15  | 1,39  | 1,77  | 1,53  | 38 | 8,90 | 11,3 | 9,82 | 90  | 49,9 | 63,6  | 55,1  | 260 | 417 | 531 | 460 |
| 16  | 1,58  | 2,01  | 1,74  | 39 | 9,38 | 11,9 | 10,3 | 95  | 55,6 | 70,8  | 61,4  | 270 | 450 | 572 | 496 |
| 17  | 1,78  | 2,27  | 1,96  | 40 | 9,87 | 12,6 | 10,9 | 100 | 61,7 | 78,5  | 68,0  | 280 | 483 | 615 | 533 |
| 18  | 2,00  | 2,54  | 2,20  | 41 | 10,4 | 13,2 | 11,4 | 105 | 68,0 | 86,6  | 75,0  | 290 | 519 | 660 | 572 |
| 19  | 2,23  | 2,83  | 2,45  | 42 | 10,9 | 13,9 | 12,0 | 110 | 74,6 | 95,0  | 82,2  | 300 | 555 | 707 | 612 |
| 20  | 2,47  | 3,14  | 2,72  | 45 | 12,5 | 15,9 | 13,8 | 115 | 81,5 | 104,0 | 89,9  |     |     |     |     |
| 21  | 2,72  | 3,46  | 3,00  | 46 | 13,0 | 16,6 | 14,4 | 120 | 88,8 | 113,0 | 97,9  |     |     |     |     |
| 22  | 2,98  | 3,80  | 3,29  | 48 | 14,2 | 18,1 | 15,7 | 125 | 96,3 | 123,0 | 106,0 |     |     |     |     |





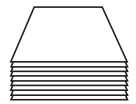
# Weight table - Flat Rolled Steel

## Weight table - Flat Rolled Steel

| width<br>in<br>mm | thickness in mm |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |       |
|-------------------|-----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|-------|-------|
|                   | 2               | 3    | 4    | 5    | 6    | 8    | 9    | 10   | 12   | 14   | 15   | 16   | 18   | 20   | 25   | 30   | 35   | 40   | 45    | 50    | 60    |
| 4                 | 0,06            | 0,09 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |       |
| 5                 | 0,08            | 0,12 | 0,16 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |       |
| 6                 | 0,09            | 0,14 | 0,19 | 0,24 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |       |
| 8                 | 0,13            | 0,19 | 0,25 | 0,32 | 0,38 |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |       |
| 10                | 0,16            | 0,24 | 0,31 | 0,39 | 0,47 | 0,63 | 0,71 |      |      |      |      |      |      |      |      |      |      |      |       |       |       |
| 12                | 0,19            | 0,28 | 0,38 | 0,47 | 0,57 | 0,75 | 0,85 | 0,94 |      |      |      |      |      |      |      |      |      |      |       |       |       |
| 14                | 0,22            | 0,33 | 0,44 | 0,55 | 0,66 | 0,88 | 0,99 | 1,10 | 1,32 |      |      |      |      |      |      |      |      |      |       |       |       |
| 15                | 0,24            | 0,35 | 0,47 | 0,59 | 0,71 | 0,94 | 1,06 | 1,18 | 1,41 | 1,65 |      |      |      |      |      |      |      |      |       |       |       |
| 16                | 0,25            | 0,38 | 0,50 | 0,63 | 0,75 | 1,01 | 1,13 | 1,26 | 1,51 | 1,76 | 1,88 |      |      |      |      |      |      |      |       |       |       |
| 18                | 0,28            | 0,42 | 0,57 | 0,71 | 0,85 | 1,13 | 1,27 | 1,41 | 1,70 | 1,98 | 2,12 | 2,26 |      |      |      |      |      |      |       |       |       |
| 20                | 0,31            | 0,47 | 0,63 | 0,79 | 0,94 | 1,26 | 1,41 | 1,57 | 1,88 | 2,20 | 2,36 | 2,51 | 2,83 |      |      |      |      |      |       |       |       |
| 22                | 0,34            | 0,52 | 0,69 | 0,86 | 1,04 | 1,38 | 1,55 | 1,73 | 2,07 | 2,42 | 2,59 | 2,76 | 3,11 | 3,45 |      |      |      |      |       |       |       |
| 24                | 0,38            | 0,57 | 0,75 | 0,94 | 1,13 | 1,51 | 1,70 | 1,88 | 2,26 | 2,64 | 2,83 | 3,01 | 3,39 | 3,77 |      |      |      |      |       |       |       |
| 25                | 0,39            | 0,59 | 0,79 | 0,98 | 1,18 | 1,57 | 1,77 | 1,96 | 2,36 | 2,75 | 2,94 | 3,14 | 3,53 | 3,93 |      |      |      |      |       |       |       |
| 26                | 0,41            | 0,61 | 0,82 | 1,02 | 1,23 | 1,63 | 1,84 | 2,04 | 2,45 | 2,86 | 3,06 | 3,27 | 3,67 | 4,08 |      |      |      |      |       |       |       |
| 28                | 0,44            | 0,66 | 0,88 | 1,10 | 1,32 | 1,76 | 1,98 | 2,20 | 2,64 | 3,08 | 3,30 | 3,52 | 3,96 | 4,40 | 5,50 |      |      |      |       |       |       |
| 30                | 0,47            | 0,71 | 0,94 | 1,18 | 1,41 | 1,88 | 2,12 | 2,36 | 2,83 | 3,30 | 3,53 | 3,77 | 4,24 | 4,71 | 5,89 |      |      |      |       |       |       |
| 32                | 0,50            | 0,75 | 1,00 | 1,26 | 1,51 | 2,01 | 2,26 | 2,51 | 3,01 | 3,52 | 3,77 | 4,02 | 4,52 | 5,02 | 6,28 | 7,54 |      |      |       |       |       |
| 35                | 0,55            | 0,82 | 1,10 | 1,37 | 1,65 | 2,20 | 2,47 | 2,75 | 3,30 | 3,85 | 4,12 | 4,40 | 4,95 | 5,50 | 6,87 | 8,24 |      |      |       |       |       |
| 40                | 0,63            | 0,94 | 1,26 | 1,57 | 1,88 | 2,51 | 2,83 | 3,14 | 3,77 | 4,40 | 4,71 | 5,02 | 5,65 | 6,28 | 7,85 | 9,42 | 11,0 |      |       |       |       |
| 45                | 0,71            | 1,06 | 1,41 | 1,77 | 2,12 | 2,83 | 3,18 | 3,53 | 4,24 | 4,95 | 5,30 | 5,65 | 6,36 | 7,07 | 8,83 | 10,6 | 12,4 | 14,2 |       |       |       |
| 50                | 0,78            | 1,18 | 1,57 | 1,96 | 2,36 | 3,14 | 3,53 | 3,93 | 4,71 | 5,50 | 5,89 | 6,28 | 7,07 | 7,85 | 9,81 | 11,8 | 13,7 | 15,7 | 17,6  |       |       |
| 55                | 0,86            | 1,30 | 1,73 | 2,16 | 2,59 | 3,45 | 3,89 | 4,32 | 5,18 | 6,05 | 6,48 | 6,91 | 7,77 | 8,64 | 10,8 | 13,0 | 15,1 | 17,3 | 19,4  | 21,6  |       |
| 60                | 0,94            | 1,41 | 1,88 | 2,36 | 2,83 | 3,77 | 4,24 | 4,71 | 5,65 | 6,59 | 7,07 | 7,54 | 8,48 | 9,42 | 11,8 | 14,1 | 16,5 | 18,8 | 21,2  | 23,6  |       |
| 65                | 1,02            | 1,53 | 2,04 | 2,55 | 3,06 | 4,08 | 4,59 | 5,10 | 6,12 | 7,14 | 7,65 | 8,16 | 9,18 | 10,2 | 12,8 | 15,3 | 17,9 | 20,4 | 22,9  | 25,5  |       |
| 70                | 1,10            | 1,65 | 2,20 | 2,75 | 3,30 | 4,40 | 4,95 | 5,50 | 6,59 | 7,76 | 8,24 | 8,79 | 9,89 | 11,0 | 13,7 | 16,5 | 19,2 | 22,0 | 24,7  | 27,5  |       |
| 75                | 1,18            | 1,77 | 2,36 | 2,94 | 3,53 | 4,71 | 5,30 | 5,89 | 7,07 | 8,24 | 8,83 | 9,42 | 10,6 | 11,8 | 14,7 | 17,7 | 20,6 | 23,6 | 26,5  | 29,4  |       |
| 80                | 1,26            | 1,88 | 2,51 | 3,14 | 3,77 | 5,02 | 5,65 | 6,28 | 7,54 | 8,79 | 9,42 | 10,0 | 11,3 | 12,6 | 15,7 | 18,8 | 22,0 | 25,1 | 28,3  | 31,4  | 37,7  |
| 85                | 1,33            | 2,00 | 2,67 | 3,34 | 4,00 | 5,34 | 6,01 | 6,67 | 8,01 | 9,34 | 10,0 | 10,7 | 12,0 | 13,3 | 16,7 | 20,0 | 23,4 | 26,7 | 30,0  | 33,4  | 40,0  |
| 90                | 1,41            | 2,12 | 2,83 | 3,53 | 4,24 | 5,65 | 6,36 | 7,07 | 8,48 | 9,89 | 10,6 | 11,3 | 12,7 | 14,1 | 17,7 | 21,2 | 24,7 | 28,3 | 31,8  | 35,3  | 42,4  |
| 95                | 1,49            | 2,24 | 2,98 | 3,73 | 4,47 | 5,97 | 6,71 | 7,46 | 8,95 | 10,4 | 11,2 | 11,9 | 13,4 | 14,9 | 18,6 | 22,4 | 26,1 | 29,8 | 33,6  | 37,4  | 44,8  |
| 100               | 1,57            | 2,36 | 3,14 | 3,93 | 4,71 | 6,28 | 7,07 | 7,85 | 9,42 | 11,0 | 11,8 | 12,6 | 14,1 | 15,7 | 19,6 | 23,6 | 27,5 | 31,4 | 35,3  | 39,3  | 46,8  |
| 110               | 1,73            | 2,59 | 3,45 | 4,32 | 5,18 | 6,91 | 7,77 | 8,64 | 10,4 | 12,1 | 13,0 | 13,8 | 15,5 | 17,3 | 21,6 | 25,9 | 30,2 | 34,5 | 38,8  | 43,2  | 51,8  |
| 120               | 1,88            | 2,83 | 3,77 | 4,71 | 5,65 | 7,54 | 8,48 | 9,42 | 11,3 | 13,2 | 14,1 | 15,1 | 17,0 | 18,8 | 23,6 | 28,3 | 33,0 | 37,7 | 42,4  | 47,1  | 56,5  |
| 130               | 2,04            | 3,06 | 4,08 | 5,10 | 6,12 | 8,16 | 9,18 | 10,2 | 12,3 | 14,3 | 15,3 | 16,3 | 18,4 | 20,4 | 25,5 | 30,6 | 35,7 | 40,8 | 45,9  | 51,0  | 61,3  |
| 140               | 2,20            | 3,30 | 4,40 | 5,50 | 6,59 | 8,79 | 9,89 | 11,0 | 13,2 | 15,4 | 16,5 | 17,6 | 19,8 | 22,0 | 27,5 | 33,0 | 38,5 | 44,0 | 49,5  | 55,0  | 66,0  |
| 150               | 2,36            | 3,53 | 4,71 | 5,89 | 7,07 | 9,42 | 10,6 | 11,8 | 14,1 | 16,5 | 17,7 | 18,8 | 21,2 | 23,6 | 29,4 | 35,3 | 41,2 | 47,1 | 53,0  | 58,9  | 70,7  |
| 160               | 2,51            | 3,77 | 5,02 | 6,28 | 7,51 | 10,1 | 11,3 | 12,6 | 15,1 | 17,6 | 18,8 | 20,1 | 22,6 | 25,1 | 31,4 | 37,7 | 44,0 | 50,2 | 56,5  | 62,8  | 75,4  |
| 180               | 2,83            | 4,24 | 5,65 | 7,07 | 8,48 | 11,3 | 12,7 | 14,1 | 17,0 | 19,8 | 21,2 | 22,6 | 25,4 | 28,3 | 35,3 | 42,4 | 49,5 | 56,5 | 63,6  | 70,7  | 84,8  |
| 200               | 3,14            | 4,71 | 6,28 | 7,85 | 9,42 | 12,6 | 14,1 | 15,7 | 18,8 | 22,0 | 23,6 | 25,1 | 28,3 | 31,4 | 39,3 | 47,1 | 55,0 | 62,8 | 70,6  | 78,5  | 94,2  |
| 250               | 3,93            | 5,89 | 7,85 | 9,81 | 11,8 | 15,7 | 17,7 | 19,6 | 23,6 | 27,5 | 29,4 | 31,4 | 35,3 | 39,3 | 49,1 | 58,9 | 68,7 | 78,5 | 88,3  | 98,1  | 118,0 |
| 300               | 4,71            | 7,07 | 9,42 | 11,8 | 14,1 | 18,8 | 21,2 | 23,6 | 28,3 | 33,0 | 35,3 | 37,7 | 42,3 | 47,1 | 58,9 | 70,7 | 82,4 | 94,2 | 106,0 | 118,0 | 141,0 |

# Steel Sheets and Plates

STANDARD SIZES, THICKNESS AND APPROXIMATE WEIGHT PER PIECE



## Steel Sheets and Plates

Standard Sizes, Thickness and approximate Weight per Piece

| Thickness<br>mm | 2000mm<br>x<br>1000mm | 2500mm<br>x<br>1250mm | 3000mm<br>x<br>1500mm | 4000mm<br>x<br>2000mm | 5000mm<br>x<br>2500mm | 6000mm<br>x<br>2000mm | 6000mm<br>x<br>2700mm | 8000mm<br>x<br>2000mm | 8000mm<br>x<br>2500mm | 10000mm<br>x<br>2500mm | 12000mm<br>x<br>3000mm |
|-----------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|------------------------|
| 0,4             | 6                     | 10                    |                       |                       |                       |                       |                       |                       |                       |                        |                        |
| 0,5             | 8                     | 13                    |                       |                       |                       |                       |                       |                       |                       |                        |                        |
| 0,6             | 10                    | 15                    |                       |                       |                       |                       |                       |                       |                       |                        |                        |
| 0,7             | 11                    | 18                    |                       |                       |                       |                       |                       |                       |                       |                        |                        |
| 0,8             | 13                    | 20                    |                       |                       |                       |                       |                       |                       |                       |                        |                        |
| 0,9             | 14                    | 23                    |                       |                       |                       |                       |                       |                       |                       |                        |                        |
| 1,0             | 16                    | 25                    |                       |                       |                       |                       |                       |                       |                       |                        |                        |
| 1,2             | 19                    | 30                    |                       |                       |                       |                       |                       |                       |                       |                        |                        |
| 1,6             | 26                    | 40                    | 58                    |                       |                       |                       |                       |                       |                       |                        |                        |
| 2,0             | 32                    | 50                    | 72                    | 128                   |                       |                       |                       |                       |                       |                        |                        |
| 3,0             | 48                    | 75                    | 108                   | 192                   | 300                   | 288                   |                       | 384                   | 480                   | 600                    |                        |
| 4,0             | 64                    | 100                   | 144                   | 256                   | 400                   | 384                   |                       | 512                   | 640                   | 800                    |                        |
| 5,0             | 80                    | 125                   | 180                   | 320                   | 500                   | 480                   |                       | 640                   | 800                   | 1000                   |                        |
| 6,0             | 96                    | 150                   | 216                   | 384                   | 600                   | 576                   |                       | 768                   | 960                   | 1200                   |                        |
| 7,0             | 112                   | 175                   | 252                   | 448                   | 700                   | 672                   |                       | 896                   | 1120                  | 1400                   | 2016                   |
| 8,0             | 128                   | 200                   | 288                   | 512                   | 800                   | 768                   |                       | 1025                  | 1280                  | 1600                   | 2304                   |
| 9,0             | 144                   | 225                   | 324                   | 576                   | 900                   | 864                   |                       | 1152                  | 1440                  | 1800                   | 2592                   |
| 10,0            | 160                   | 250                   | 360                   | 540                   | 1000                  | 960                   |                       | 1280                  | 1600                  | 2000                   | 2880                   |
| 12,0            | 192                   | 300                   | 432                   | 768                   | 1200                  | 1152                  | 1555                  | 1536                  | 1920                  | 2400                   | 3456                   |
| 12,5            | 200                   | 330                   | 450                   | 800                   | 1250                  | 1200                  | 1620                  | 1600                  | 2000                  | 2500                   | 3600                   |
| 15,0            | 240                   | 375                   | 540                   | 960                   | 1500                  | 1440                  | 1944                  | 1920                  | 2400                  | 3000                   | 4320                   |
| 20,0            | 320                   | 500                   | 720                   | 1280                  | 2000                  | 1920                  | 2592                  | 2560                  | 3200                  | 4000                   | 5760                   |
| 25,0            | 400                   | 625                   | 900                   | 1600                  | 2500                  | 2400                  | 3240                  | 3200                  | 4000                  | 5000                   |                        |
| 30,0            | 480                   | 750                   | 1080                  | 1920                  | 3000                  | 2880                  | 3888                  | 3840                  | 4800                  |                        |                        |
| 35,0            | 560                   | 875                   | 1260                  | 2240                  | 3500                  | 3660                  | 4536                  | 4480                  | 5600                  |                        |                        |
| 40,0            | 640                   | 1000                  | 1440                  | 2560                  | 4000                  | 3740                  | 5184                  | 5120                  |                       |                        |                        |
| 45,0            | 720                   | 1125                  | 1620                  | 2880                  | 4500                  | 4320                  |                       |                       |                       |                        |                        |
| 50,0            | 800                   | 1250                  | 1800                  | 3200                  | 5000                  | 4800                  |                       |                       |                       |                        |                        |
| 55,0            | 880                   | 1375                  | 1980                  | 3520                  |                       |                       |                       |                       |                       |                        |                        |
| 60,0            | 960                   | 1500                  | 2160                  |                       |                       |                       |                       |                       |                       |                        |                        |
| 65,0            | 1040                  | 1625                  | 2340                  | 4160                  |                       |                       |                       |                       |                       |                        |                        |
| 70,0            | 1120                  | 1750                  | 2520                  | 4480                  |                       |                       |                       |                       |                       |                        |                        |
| 75,0            | 1200                  | 1875                  | 2700                  | 4800                  |                       |                       |                       |                       |                       |                        |                        |
| 80,0            | 1280                  | 2000                  | 2880                  | 5120                  |                       |                       |                       |                       |                       |                        |                        |
| 85,0            | 1360                  | 2125                  | 3060                  |                       |                       |                       |                       |                       |                       |                        |                        |
| 95,0            | 1520                  | 2375                  | 3420                  |                       |                       |                       |                       |                       |                       |                        |                        |
| 100,0           | 1600                  | 2500                  | 3600                  |                       |                       |                       |                       |                       |                       |                        |                        |
| 120,0           | 1920                  | 6000                  | 4320                  |                       |                       |                       |                       |                       |                       |                        |                        |
| 140,0           | 2240                  | 3500                  | 5040                  |                       |                       |                       |                       |                       |                       |                        |                        |
| 160,0           | 2560                  | 4000                  |                       |                       |                       |                       |                       |                       |                       |                        |                        |
| 180,0           | 2880                  | 4500                  |                       |                       |                       |                       |                       |                       |                       |                        |                        |
| 200,0           | 3220                  | 5000                  |                       |                       |                       |                       |                       |                       |                       |                        |                        |
| 220,0           | 3540                  | 5500                  |                       |                       |                       |                       |                       |                       |                       |                        |                        |

Weight Formula Plates:

Thickness (MM) x Width (METERS) x LENGTH (METERS) x 8 = Kg/Piece



# Welding Ends

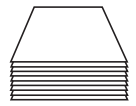
## Welding End Preparation

### Welding Ends

### Welding End Preparation

| Form              | Designation      | Sectional-view | Wall Thickness inch       | Measures                       |                    |                       |                                  |
|-------------------|------------------|----------------|---------------------------|--------------------------------|--------------------|-----------------------|----------------------------------|
|                   |                  |                |                           | Angle                          |                    | Distance inch)        | path inch                        |
| DIN 2559 F1       | I-seam           |                | $\leq 3$<br>$\leq 0.118$  | -<br>-                         | -<br>-             | 0 to 3<br>0 to 0.118  | -<br>-                           |
| DIN 2559 F2       | V-seam           |                | $\leq 16$<br>$\leq 0.630$ | $\approx 60^\circ$             | -                  | 0 to 4<br>0 to 0.157  | -<br>-                           |
| ASA<br>B 1 6,9    | -                |                | $\leq 19$<br>$\leq 0.750$ | $\approx 37 \frac{1}{2}^\circ$ | -                  | 0 to 4<br>0 to 0.157  | $\approx 1,6$<br>$\approx 0.063$ |
| API Std<br>SL/SLX | -                |                | $\leq 19$<br>$\leq 0.750$ | $30^\circ$                     | -                  | 0 to 4<br>0 to 0.157  | $\approx 1,6$<br>$\approx 0.063$ |
| DIN 2559 F3       | U-seam           |                | $\geq 12$<br>$\geq 0.472$ | -<br>-                         | $\approx 10^\circ$ | 0 bis 3<br>0 to 0.118 | 2<br>0,079                       |
| DIN 2559 F4       | U-seam on V-root |                | $\geq 12$<br>$\geq 0.472$ | $30^\circ$                     | $\approx 10^\circ$ | 0 bis 4<br>0 to 0.157 | $\approx 4$<br>$\approx 0.157$   |
| DIN 2559 F5       | U-seam on V-root |                | $\geq 16$<br>$\geq 0.630$ | $\approx 35^\circ$             | $\approx 6^\circ$  | 0 bis 2<br>0 to 0.079 | $\approx 6$<br>$\approx 0.236$   |
| ASA-<br>B 16,9    | -                |                | $\geq 19$<br>$\geq 0.750$ | $\approx 37 \frac{1}{2}^\circ$ | $\approx 10^\circ$ | 0 to 2<br>0 to 0.079  | $\approx 1.6$<br>$\approx 0.063$ |





## Conversion Tables - Linear/Square/Cubic measures and Weights

### Linear measures

|      |                       |                |             |            |
|------|-----------------------|----------------|-------------|------------|
| 1 mm | = 0.039370 in.        | 1 inch         | = 25,400 mm |            |
| 1 cm | = 0.393701 in.        | 1 inch         | = 2,540 cm  |            |
| 1 m  | = 3.280840 ft.        | 1 foot         | = 12 inches | = 0,3048 m |
| 1 kg | = 0.6214 English mile | 1 Yard         | = 3 feet    | = 914,4 mm |
|      |                       | 1 English mile | = 1.60930km |            |

### Square measures

|                   |                         |               |                            |                           |
|-------------------|-------------------------|---------------|----------------------------|---------------------------|
| 1 mm <sup>2</sup> | = 0.001550 square inch  | 1 square inch | = 645,160 mm <sup>2</sup>  |                           |
| 1 cm <sup>2</sup> | = 0.155000 square inch  | 1 square inch | = 6,541600 cm <sup>2</sup> |                           |
| 1 m <sup>2</sup>  | = 10.763911 square feet | 1 square foot | = 144 square inches        | = 0,092903 m <sup>2</sup> |

### Cubic measures

|                   |                        |              |                             |                             |
|-------------------|------------------------|--------------|-----------------------------|-----------------------------|
| 1 cm <sup>3</sup> | = 0.061024 cubic inch  | 1 cubic inch | = 16,387064 cm <sup>3</sup> |                             |
| 1 dm <sup>3</sup> | = 0.035315 cubic inch  | 1 cubic foot | = 1728 cubic inches         | = 28,316847 dm <sup>3</sup> |
| 1 m <sup>3</sup>  | = 35.314670 cubic feet | 1 cubic foot | = 0,028317 m <sup>3</sup>   |                             |

### Weights

|              |                        |              |             |                 |
|--------------|------------------------|--------------|-------------|-----------------|
| 1 g          | = 0.035274 ounce       | 1 ounce      | = 28,3495 g |                 |
| 1 kg         | = 2.204622 pounds (lb) | 1 pound (lb) | = 16 ounces | = 0,453592 kg   |
| 1 metric ton | = 0.984206 long ton    | 1 long ton   | = 2240 lb   | = 1016,04706 kg |
|              | = 1.10231 short ton    | 1 short ton  | = 2000 lb   | = 907,185 kg    |

### Weights per linear, square or cubic unit measure

|                      |                           |                   |                               |  |
|----------------------|---------------------------|-------------------|-------------------------------|--|
| 1 kg/cm              | = 5.599741 lb./in.        | 1 lb./in.         | = 0,178580 kg/cm              |  |
| 1 kg/m               | = 0.671969 lb./foot       | 1 lb./foot        | = 1,488164 kg/m               |  |
| 1 kp/mm <sup>2</sup> | = 1422.336968 lb./sq. in. | 1 lb./sq. in.     | = 0,000703 kg/mm <sup>2</sup> |  |
| 1 kp/cm <sup>2</sup> | = 14.223370 lb./sq. in.   | 1 lb./sq. in.     | = 0,070307 kg/cm <sup>2</sup> |  |
| 1 kp/m <sup>2</sup>  | = 0.204816 lb./sq. ft.    | 1 lb./sq. ft.     | = 4,882430 kg/m <sup>2</sup>  |  |
| 1 kp/cm              | = 36.127135 lb./cu. in.   | 1 oz./sq. ft.     | = 305,15 p/m <sup>2</sup>     |  |
| 1 kp/m <sup>3</sup>  | = 0.062428 lb./cu. ft.    | 1 long ton/sq.in. | = 1,575 kp/mm <sup>2</sup>    |  |
|                      |                           | 1 lb./cu. in.     | = 0,027680 kp/cm <sup>3</sup> |  |
|                      |                           | 1 lb./cu. ft.     | = 16,018464 kp/m <sup>3</sup> |  |

|                      |                             |                     |                               |  |
|----------------------|-----------------------------|---------------------|-------------------------------|--|
| 1 kp/mm <sup>2</sup> | = 9.80665 N/mm <sup>2</sup> | 1 N/mm <sup>2</sup> | = 0,101972 kp/mm <sup>2</sup> |  |
| 1 kmp                | = 9.80665 J                 | 1 J                 | = 0,101972 kpm                |  |
| 1 kpm                | = 7,233 ft.-lbs.            | 1 ft.-lb.           | = 0,138254 kpm                |  |
| 1 J                  | = 0,7376 ft.-lbs.           | 1 ft.-lb.           | = 1,355748 J                  |  |



# Freight Cost Calculation for Tubes- „measuring sizes“

## Freight Cost Calculation for Tubes-”measuring sizes”

| Outside Diameter<br>mm | inch (N.B.) | measuring incl.<br>mm wall | m/m3   | x measuring | measuring/m<br>with 100 DM/m3 |
|------------------------|-------------|----------------------------|--------|-------------|-------------------------------|
| 2.020                  |             | 85,5                       | 0,25   | 4,08        | 408,04                        |
| 1.920                  |             | 81,5                       | 0,27   | 3,69        | 369,64                        |
| 1.820                  |             | 77,0                       | 0,30   | 3,312       | 331,24                        |
| 1.720                  |             | 72,5                       | 0,34   | 2,96        | 295,84                        |
| 1.620                  | 64          | 68,5                       | 0,38   | 2,62        | 262,44                        |
| 1.520                  |             | 64,0                       | 0,43   | 2,31        | 231,04                        |
| 1.420                  |             | 60,0                       | 0,50   | 2,02        | 201,64                        |
| 1.321                  | 52          | 55,5                       | 0,57   | 1,75        | 174,50                        |
| 1.270                  | 50          | 53,5                       | 0,62   | 1,61        | 161,29                        |
| 1.219                  | 48          | 51,5                       | 0,67   | 1,49        | 148,60                        |
| 1.168                  | 46          | 49,4                       | 0,73   | 1,36        | 136,42                        |
| 1.120                  | 44          | 47,4                       | 0,80   | 1,25        | 125,44                        |
| 1.067                  | 42          | 45,1                       | 0,88   | 1,14        | 113,85                        |
| 1.016                  | 40          | 43,0                       | 0,97   | 1,03        | 103,22                        |
| 965                    | 38          | 40,8                       | 1,07   | 0,93        | 93,12                         |
| 914                    | 36          | 38,7                       | 1,20   | 0,84        | 83,54                         |
| 864                    | 34          | 36,5                       | 1,34   | 0,75        | 74,65                         |
| 813                    | 32          | 34,4                       | 1,51   | 0,66        | 66,10                         |
| 762                    | 30          | 32,2                       | 1,72   | 0,58        | 58,06                         |
| 711                    | 28          | 30,1                       | 1,98   | 0,51        | 50,55                         |
| 660                    | 26          | 27,9                       | 2,30   | 0,44        | 43,56                         |
| 610                    | 24          | 25,8                       | 2,69   | 0,37        | 37,21                         |
| 559                    | 22          | 23,6                       | 3,20   | 0,31        | 31,25                         |
| 521                    |             | 22,0                       | 3,68   | 0,27        | 27,14                         |
| 508                    | 20          | 21,5                       | 3,88   | 0,26        | 25,81                         |
| 470                    |             | 19,9                       | 4,53   | 0,22        | 22,09                         |
| 457,2                  | 18          | 19,3                       | 4,78   | 0,21        | 20,90                         |
| 419                    |             | 17,7                       | 5,70   | 0,176       | 17,56                         |
| 406,4                  | 16          | 17,2                       | 6,05   | 0,165       | 16,52                         |
| 368                    |             | 15,5                       | 7,38   | 0,135       | 13,54                         |
| 355,6                  | 14          | 15,0                       | 7,91   | 0,127       | 12,65                         |
| 323,9                  | 12          | 13,7                       | 9,53   | 0,105       | 10,49                         |
| 318                    |             | 13,4                       | 9,89   | 0,101       | 10,11                         |
| 298,5                  |             | 12,6                       | 11,22  | 0,089       | 8,91                          |
| 273                    | 10          | 11,5                       | 13,42  | 0,075       | 7,45                          |
| 267                    |             | 11,3                       | 14,03  | 0,071       | 7,13                          |
| 244,5                  |             | 10,3                       | 16,73  | 0,06        | 5,98                          |
| 219,1                  | 8           | 9,2                        | 20,83  | 0,048       | 4,80                          |
| 216                    |             | 9,1                        | 21,43  | 0,047       | 4,67                          |
| 193,7                  |             | 8,2                        | 26,65  | 0,038       | 3,75                          |
| 177,8                  |             | 7,5                        | 31,63  | 0,032       | 3,16                          |
| 168,3                  | 6           | 7,1                        | 35,30  | 0,028       | 2,83                          |
| 165,1                  |             | 6,9                        | 36,69  | 0,027       | 2,73                          |
| 159                    |             | 6,7                        | 39,56  | 0,025       | 2,53                          |
| 152,4                  |             | 6,4                        | 43,06  | 0,023       | 2,32                          |
| 141,3                  | 5           | 5,9                        | 50,09  | 0,02        | 2,00                          |
| 139,7                  |             | 5,9                        | 51,24  | 0,02        | 1,95                          |
| 133                    |             | 5,6                        | 56,53  | 0,018       | 1,77                          |
| 127                    |             | 5,3                        | 62,00  | 0,016       | 1,61                          |
| 121                    |             | 5,1                        | 68,30  | 0,015       | 1,46                          |
| 114,3                  | 4           | 4,8                        | 76,54  | 0,013       | 1,31                          |
| 108                    |             | 4,5                        | 85,73  | 0,012       | 1,17                          |
| 101,6                  | 3 1/2       | 4,3                        | 96,88  | 0,01        | 1,03                          |
| 88,9                   | 3           | 3,7                        | 126,53 | 0,008       | 0,79                          |
| 76,1                   |             | 3,2                        | 172,68 | 0,006       | 0,58                          |
| 73,0                   | 2 1/2       | 3,0                        | 187,65 | 0,53        | 0,53                          |
| 70,0                   |             | 2,9                        | 204,08 | 0,005       | 0,49                          |
| 63,5                   |             | 2,6                        | 248,00 | 0,004       | 0,40                          |
| 60,3                   | 2           | 2,5                        | 275,03 | 0,004       | 0,36                          |
| 57,0                   |             | 2,4                        | 307,79 | 0,003       | 0,33                          |
| 51,0                   |             | 2,1                        | 384,47 | 0,003       | 0,26                          |



In the table of European standards for metallic materials, specifications for seamless and welded steel pipes and pipes products, wire and wire products, forgings, sheets, strips and definition of steel products are presented.

|               |           |                                                                                                                                              |
|---------------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------|
| EN 1369       | 1996 - 09 | Founding; magnetic particle inspection                                                                                                       |
| EN 1370       | 1996 - 09 | Founding; surface roughness inspection by visual tactile comparators                                                                         |
| EN 1371-1     | 1994 - 02 | Founding; liquid penetrant inspection; part 1: sand, gravity die and low pressure die castings                                               |
| EN 1559-1     | 1994 - 08 | Founding - Technical conditions of delivery - Part 1: General                                                                                |
| EN 1559-2     | 1995 - 09 | Founding - Technical conditions of delivery - Part 2: Additional requirements for steel castings                                             |
| EN 1559-3     | 1994 - 08 | Founding - Technical conditions of delivery - Part 3: Additional requirements for iron castings                                              |
| EN 1559-5     | 1995 - 03 | Founding - Technical conditions of delivery - Part 5: Additional requirements for magnesium alloy castings                                   |
| EN 1560       | 1994 - 08 | Founding - Designation system for cast iron - Material symbols and material numbers                                                          |
| EN 1561       | 1994 - 08 | Founding - Grey cast irons EN 1562 1994 - 08 Founding - Malleable cast irons                                                                 |
| EN 1563       | 1994 - 08 | Founding - Spheroidal graphite cast irons                                                                                                    |
| EN 1564       | 1994 - 08 | Founding - Austempered ductile cast irons                                                                                                    |
| EN 12454      | 1996 - 12 | Founding - Visual examination of surface discontinuities - Steel and castings                                                                |
| EN 10001      | 1990 - 07 | Definition and classification of pig - irons                                                                                                 |
| EN 10016 - 1  | 1994 - 12 | Non - alloy steel rod for drawing and/or cold rolling<br>Part 1: General requirements                                                        |
| EN 10016 - 2  | 1994 - 12 | Non - alloy steel rod for drawing and/or cold rolling<br>Part 2: Specific requirements for general purposes rod                              |
| EN 10016 - 3  | 1994 - 12 | Non - alloy steel rod for drawing and/or cold rolling<br>Part 3: Specific requirements for rimmed and rimmed substitute low carbon steel rod |
| EN 10016 - 4  | 1994 - 12 | Non - alloy steel rod for drawing and/or cold rolling<br>Part 4: Specific requirements for rod for special applications                      |
| EN 10020      | 1995 - 12 | Definition and classification of grades of steel                                                                                             |
| EN 10020 / AC | 1996 - 08 | Determination and classification of grades of steel; amendment to EN 10020: 1988                                                             |
| EN 10021      | 1996 - 01 | General technical delivery requirements for steel and iron products                                                                          |
| EN 10024      | 1996 - 08 | Hot rolled taper flange I sections - Tolerances on shape and dimensions                                                                      |
| EN 10025      | 1996 - 08 | Hot rolled products of non - alloy structural steels; technical delivery conditions<br>( includes amendment A1: 1993)                        |
| EN 10027 - 1  | 1995 - 12 | Designation systems for steels; part 1: steel names, principal symbols                                                                       |
| EN 10027 - 2  | 1995 - 12 | Designation systems for steels; part 2: numerical system                                                                                     |
| ECISS/IC 10   | 1995 - 12 | Designation systems for steel: Additional symbols for steel names                                                                            |
| EN 10028 - 1  | 1996 - 08 | Flat products made of steels for pressure purposes<br>Part 1: general requirements                                                           |
| EN 10028 - 2  | 1996 - 08 | Flat products made of steels for pressure purposes<br>Part 2: non - alloy and alloy steels with specified elevated temperature properties    |
| EN 10028 - 3  | 1992 - 12 | Flat products made of steels for pressure purposes; part 3: weldable fine grain steels, normalized                                           |
| EN 10028 - 4  | 1994 - 09 | Flat products made of steels for pressure purposes<br>Part 4: Nickel alloy steels with specified low temperature properties                  |
| EN 10028 - 5  | 1993 - 10 | Flat products made of steels for pressure purposes<br>Part 5: weldable fine grain steels, thermomechanically rolled                          |
| EN 10028 - 6  | 1993 - 10 | Flat products made of steels for pressure purposes<br>Part 6: weldable fine grain steels, quenched and tempered                              |
| EN 10029      | 1996 - 08 | Hot rolled steel plates 3 mm thick or above; tolerances on dimensions, shape and mass                                                        |
| EN 10029/AC   | 1996 - 08 | Hot rolled steel plates 3 mm thick or above; tolerances on dimensions, shape and mass                                                        |
| EN 10034      | 1993 - 09 | Structural steel I and H sections; tolerances on shape and dimensions                                                                        |
| EN 10048      | 1995 - 06 | Hot rolled narrow steel strip - Tolerances on dimensions and shape                                                                           |
| EN 10051      | 1991 - 12 | Continuously hot - rolled uncoated plate, sheet and strip of non - alloy and alloy steels;<br>tolerances on dimensions and shape             |
| EN 10051/A1   | 1995 - 09 | Continuously hot - rolled uncoated plate, sheet and strip of non - alloy and alloy steels;<br>tolerances on dimensions and shape             |



# European Standards for Metallic Materials

|                  |                        |                                                                                                                                                                                                       |
|------------------|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EN 10052         | 1996 - 08              | Vocabulary of heat treatment terms for ferrous products                                                                                                                                               |
| EN 10055         | 1995 - 11              | Hot rolled steel equal flange tees with radiused root and toes<br>Dimensions and tolerances on shape and dimensions                                                                                   |
| EN 10056         | 1991 - 03              | Structural steel equal and unequal leg angles; tolerances on shape and dimensions                                                                                                                     |
| EN 10056 - 1     | 1994 - 11              | Structural steel equal and unequal leg angles - Part 1: Dimensions                                                                                                                                    |
| EN 10056 - 2     | 1993 - 09              | Structural steel equal and unequal leg angles; part 2: tolerances on shape and dimensions                                                                                                             |
| EN 10067         | 1992 - 08              | Hot rolled bulb flats; dimensions and tolerances on shape and dimensions                                                                                                                              |
| EN 10079         | 1995 - 12              | Definition of steel products                                                                                                                                                                          |
| ENV 10080        | 1995 - 04              | Steel for the reinforcement of concrete - Weldable ribbed reinforcing steel B 500<br>Technical delivery conditions for bars, coils and welded fabric                                                  |
| EN 10083 - 1     | 1996 - 08              | Quenched and tempered steels; part 1: technical delivery conditions for special steels                                                                                                                |
| EN 10083 - 1/A1  | 1995 - 03              | Quenched and tempered steels - Part 1: Technical delivery conditions for special steels                                                                                                               |
| EN 10083 - 2     | 1991 - 02              | Quenched and tempered steels - Part 2: Technical delivery conditions for unalloyed quality steels                                                                                                     |
| EN 10083 - 2/A1  | 1995 - 03              | Quenched and tempered steels - Part 2: Technical delivery conditions for unalloyed quality steels                                                                                                     |
| EN 10083 - 3     | 1995 - 09              | Quenched and tempered steels - Part 3: Technical delivery conditions for boron steels                                                                                                                 |
| EN 10084EN 10087 | 1995 - 02<br>1995 - 04 | Case hardening steels - Technical delivery conditionsFree - cutting steels -<br>Technical delivery conditions for semi - finished products, hot rolled bars and rods                                  |
| EN 10088 - 1     | 1995 - 04              | Stainless steels - Part 1: List of stainless steels                                                                                                                                                   |
| EN 10088 - 2     | 1995 - 04              | Stainless steels - Part 2: Technical delivery conditions for sheet/plate and strip for general purposes                                                                                               |
| EN 10088 - 3     | 1995 - 04              | Stainless steels - Part 3: Technical delivery conditions for semi finished products, bars, rods and sections for general purposes                                                                     |
| EN 10095         | 1996 - 02              | Heat - resisting steels and alloys                                                                                                                                                                    |
| EN 10106         | 1995 - 12              | Cold rolled non - oriented electrical steel sheet and strip delivered in fully processed state                                                                                                        |
| EN 10107         | 1995 - 12              | Grain - oriented electrical steel sheet and strip delivered in fully processed state                                                                                                                  |
| EN 10111         | 1993 - 06              | Continuously hot-rolled low carbon steel sheet and strip for cold bending; technical delivery conditions                                                                                              |
| EN 10113 - 1     | 1993 - 03              | Hot-rolled products in weldable fine grain structural steels<br>Part 1: general delivery conditions                                                                                                   |
| EN 10113 - 2     | 1993 - 03              | Hot-rolled products in weldable fine grain structural steels<br>Part 2: delivery conditions for normalized/normalized rolled steels                                                                   |
| EN 10113 - 3     | 1993 - 03              | Hot-rolled products in weldable fine grain structural steels<br>Part 3: delivery conditions for thermomechanical rolled steels                                                                        |
| EN 10120         | 1994 - 06              | Steel sheet and strip for welded gas cylinders                                                                                                                                                        |
| EN 10126         | 1995 - 12              | Cold rolled electrical non-alloyed steel sheet and strip delivered in semi-processed state                                                                                                            |
| EN 10130         | 1991 - 03              | Cold rolled low carbon steel flat products for cold forming; technical delivery conditions                                                                                                            |
| EN 10130/A1      | 1995 - 03              | Cold rolled low carbon steel flat products for cold forming; -Technical delivery conditions                                                                                                           |
| EN 10137 - 2     | 1995 - 09              | Plates and wide flats made of high yield strength structural steels in the quenched and tempered or precipitation hardened conditions - Part 2: Delivery conditions for quenched and tempered steels  |
| EN 10131         | 1991 - 11              | Cold rolled uncoated low carbon high yield strength steel flat products for cold forming; tolerances on dimensions and shape                                                                          |
| EN 10137 - 1     | 1995 - 09              | Plates and wide flats made of high yield strength structural steels in the quenched and tempered or precipitation hardened conditions - Part 1: General delivery conditions                           |
| EN 10137 - 2     | 1995 - 09              | Plates and wide flats made of high yield strength structural steels in the quenched and tempered or precipitation hardened conditions - Part 2: Delivery conditions for quenched and tempered steels  |
| EN 10137 - 3     | 1995 - 09              | Plates and wide flats made of high yield strength structural steels in the quenched and tempered or precipitation hardened conditions - Part 3: Delivery conditions for precipitation hardened steels |
| EN 10138 - 1     | 1991 - 11              | Prestressing steels; part 1: general requirements                                                                                                                                                     |
| EN 10138 - 2     | 1991 - 11              | Prestressing steels; part 2: stress relieved cold drawn wire                                                                                                                                          |
| EN 10138 - 3     | 1991 - 11              | Prestressing steels; part 3: strand                                                                                                                                                                   |
| EN 10138 - 4     | 1991 - 11              | Prestressing steels; part 4: hot rolled and processed bars                                                                                                                                            |
| EN 10138 - 5     | 1991 - 11              | Prestressing steels; part 5: quenched and tempered wire                                                                                                                                               |
| EN 10139         | 1992 - 10              | Cold rolled uncoated mild steel narrow strip for cold forming; technical delivery conditions                                                                                                          |



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| EN 10140     | 1992 - 10 | Cold rolled narrow steel strip; tolerances on dimensions and shape                                                                                     |
| EN 10142     | 1996 - 08 | Continuously hot-dip zinc coated low carbon steel sheet and strip for cold forming; technical delivery conditions                                      |
| EN 10143     | 1993 - 01 | Continuously hot-dip metal coated steel sheet and strip; tolerances on dimensions and shape                                                            |
| EN 10147     | 1991 - 11 | Continuously hot-dip zinc coated unalloyed structural steel sheet and strip; technical delivery conditions                                             |
| EN 10147/A1  | 1995 - 06 | Continuously hot-dip zinc coated structural steel strip and sheet - Technical delivery conditions; Amendment A1                                        |
| EN 10149 - 1 | 1995 - 09 | Hot rolled flat products made of high yield strength steels for cold forming<br>Part 1: General delivery conditions                                    |
| EN 10149 - 2 | 1995 - 09 | Hot rolled flat products made of high yield strength steels for cold forming<br>Part 2: Delivery conditions for thermomechanically rolled steels       |
| EN 10149 - 3 | 1995 - 09 | Hot rolled flat products made of high yield strength steels for cold forming<br>Part 3: Delivery conditions for normalized or normalized rolled steels |
| EN 10152     | 1993 - 10 | Electrolytically zinc coated cold rolled steel flat products; technical delivery conditions                                                            |
| EN 10154     | 1995 - 10 | Continuously hot-dip aluminium-silicon (AS) coated steel strip and sheet - Technical delivery conditions                                               |
| EN 10155     | 1993 - 06 | Structural steels with improved atmospheric corrosion resistance; technical delivery conditions                                                        |
| EN 10163 - 1 | 1991 - 08 | Delivery requirements for surface condition of hot rolled steel plates, wide flats and sections<br>Part 1: general requirements                        |
| EN 10163 - 2 | 1991 - 08 | Delivery requirements for surface condition of hot rolled steel plates, wide flats and sections<br>Part 2: plate and wide flats                        |
| EN 10163 - 3 | 1991 - 08 | Delivery requirements for surface condition of hot rolled steel plates, wide flats and sections<br>Part 3: sections                                    |
| EN 10163 - 4 | 1991 - 09 | Delivery requirements for surface quality of hot rolled steel products; part 4: round bars and wire rod                                                |
| EN 10164     | 1993 - 06 | Steel products with improved deformation properties perpendicular of the product; technical delivery conditions                                        |
| EN 10165     | 1995 - 12 | Cold rolled electrical alloyed steel sheet and strip delivered in semi - processed state                                                               |
| EN 10169 - 1 | 1995 - 08 | Continuously organic coated steel flat products<br>Part 1: General information (definitions, materials, tolerances, test methods )                     |
| EN 10169 - 2 | 1995 - 10 | Continuously organic coated (coil coated) steel flat products<br>Part 2: Products for building exterior applications                                   |
| EN 10173     | 1987 - 03 | Double cold reduced electrolytic chromium/chromium oxide coated steel;<br>coil for subsequent cutting into sheets                                      |
| EN 10202     | 1996 - 08 | Cold reduced electrolytic chromium/chromium oxide coated steel                                                                                         |
| EN 10203     | 1991 - 08 | Cold reduced electrolytic tinplate                                                                                                                     |
| EN 10204     | 1996 - 01 | Metallic products; types of inspection documents                                                                                                       |
| EN 10204/A1  | 1996 - 01 | Metallic products-Types of inspection documents; Amendment A1                                                                                          |
| EN 10205     | 1991 - 11 | Cold reduced blackplate in coil form for the production of tinplate or electrolytic chromium/chromium oxide coated steel                               |
| EN 10207     | 1991 - 11 | Steels for simple pressure vessels; technical delivery requirements for plates, strips and bars                                                        |
| EN 10208 - 1 | 1992 - 11 | Steel pipes for pipe lines for combustible fluids; technical delivery conditions<br>Part 1: pipes of requirement class A                               |
| EN 10208 - 2 | 1996 - 09 | Steel pipes for pipe lines for combustible fluids; technical delivery conditions;<br>Part 2: pipes of requirement class B                              |
| EN 10209     | 1996 - 10 | Cold rolled low carbon steel flat products for vitreous enamelling - Technical delivery conditions                                                     |
| EN 10210 - 1 | 1994 - 03 | Hot finished structural hollow sections of non - alloy and fine grain structural steels<br>Part 1: technical delivery requirements                     |
| EN 10210 - 2 | 1992 - 09 | Hot finished structural hollow sections of non - alloy and fine grain structural steels<br>Part 2: tolerances, dimension and sectional properties      |
| EN 10213 - 1 | 1995 - 12 | Technical delivery conditions for steel castings for pressure purposes - Part 1: General                                                               |
| EN 10213 - 2 | 1995 - 12 | Technical delivery conditions for steel castings for pressure purposes<br>Part 2: Steel grades for use at room temperature and elevated temperatures   |
| EN 10213 - 3 | 1995 - 12 | Technical delivery conditions for steel castings for pressure purposes<br>Part 3: Steel grades for use at low temperatures                             |



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| EN 10213 - 4 | 1995 - 12   | Technical delivery conditions for steel castings for pressure purposes<br>Part 4: Austenitic and austenitic - ferritic steel grades             |
| EN 10214     | 1995 - 02   | Continuously hot-dip zinc-aluminium (ZA) coated steel strip and sheet - Technical delivery conditions                                           |
| EN 10215     | 1995 - 02   | Continuously hot-dip aluminium-zinc (AZ) coated steel strip and sheet - Technical delivery conditions                                           |
| EN 10216-1   | 1995 - 11   | Seamless steel tubes for pressure purposes; technical delivery conditions<br>Part 1: non-alloy steel with specified room temperature properties |
| EN 10217 - 1 | 1991 - 02   | Welded steel tubes for pressure purposes; technical delivery conditions<br>Part 1: non -alloy steel with specified room temperature properties  |
| EN 10218 - 1 | 1994 -      | Steel wire and wire products; general                                                                                                           |
| EN 10218 - 2 | 031995 - 11 | Part 1: test methodsSteel wire and wire products; general; part 2: wire dimensions and tolerances                                               |
| EN 10219 - 1 | 1992 - 09   | Cold formed structural hollow sections of non-alloy and fine grain structural steels<br>Part 1: technical delivery requirements                 |
| EN 10219 - 2 | 1992 - 09   | Cold formed structural hollow sections of non-alloy and fine grain structural steels<br>Part 2: tolerances, dimensions and sectional properties |
| ENV 10220    | 1993 - 11   | Seamless and welded steel tubes; dimensions and masses per unit length                                                                          |
| EN 10221     | 1995 - 11   | Surface quality classes for hot-rolled bars and rods - Technical delivery conditions                                                            |
| EN 10222 - 1 | 1994 - 06   | Steel forgings for pressure purposes<br>Part 1: General requirements for open die forgings                                                      |
| EN 10222 - 3 | 1994 - 06   | Steel forgings for pressure purposes<br>Part 3: Ferritic and martensitic steels with elevated temperature properties                            |
| EN 10222 - 4 | 1994 - 06   | Steel forgings for pressure purposes<br>Part 4: Nickel steels with specified low temperature properties                                         |
| EN 10222 - 5 | 1994 - 06   | Steel forgings for pressure purposes<br>Part 5: Fine grain steels with high proof stress                                                        |
| EN 10222 - 6 | 1994 - 06   | Steel forgings for pressure purposes<br>Part 6: Austenitic, martensitic and austenitic-ferritic stainless steels                                |
| EN 10223 - 1 | 1993 - 02   | Steel wire and wire products for fences<br>Part 1: zinc and zinc-alloy coated steel barbed wire                                                 |
| EN 10223 - 2 | 1993 - 04   | Steel wire and wire products for fences<br>Part 2: hexagonal steel wire netting for agricultural, insulation, and fencing purposes              |
| EN 10223 - 3 | 1993 - 04   | Steel wire and wire products for fences<br>Part 3: hexagonal steel wire netting for engineering purposes                                        |
| EN 10223 - 4 | 1994 -10    | Steel wire and wire products for fences<br>Part 4: Steel wire welded mesh fencing                                                               |
| EN 10223 - 5 | 1994 -10    | Steel wire and wire products for fences<br>Part 5: Steel wire woven hinged joint and knotted joint stock fencing                                |
| EN 10223 - 6 | 1994 -10    | Steel wire and wire products for fences<br>Part 6: Steel wire chain link fencing                                                                |
| EN 10224     | 1995 - 05   | Steel tubes and fittings for the conveyance of aqueous liquids including water for human consumption                                            |
| EN 10225     | 1994 - 10   | Weldable structural steels for fixed offshore structures                                                                                        |
| EN 10226 - 1 | 1995 -11    | Pipe threads where pressure tight joints are made on the threads<br>Part 1: Designation, dimensions and tolerances                              |
| EN 10229     | 1995 - 08   | Evaluation of resistance of steel products to hydrogen induced cracking (HIC)                                                                   |
| EN 10230     | 1993 - 02   | Steel wire and wire products; common, special and loose feed stock steel wire machine nails                                                     |
| EN 10238     | 1995 - 12   | Automatically blast cleaned and primed steel products                                                                                           |
| EN 10240     | 1994 - 06   | Internal and/or external protective coatings for steel tubes - Specification for hot dip galvanized coatings                                    |
| EN 10241     | 1994 - 06   | Threaded steel fittings                                                                                                                         |
| EN 10242     | 1994 - 11   | Threaded pipe fitting in malleable cast iron                                                                                                    |
| EN 10243 - 1 | 1995 - 08   | Steel drop and press forgings - Tolerances on dimensions                                                                                        |
| EN 10243 - 2 | 1995 - 08   | Steel upset forgings made on horizontal forging machines -Tolerances on dimensions                                                              |
| EN 10244 - 1 | 1995 - 01   | Steel wire and wire products - Non-ferrous metallic coatings on steel wire<br>Part 1: General principles                                        |





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| EN 10244 - 2    | 1995 - 01 | Steel wire and wire products - Non-ferrous metallic coatings on steel wire<br>Part 2: Zinc or zinc alloy coatings on steel wire              |
| EN 10244 - 3    | 1995 - 01 | Steel wire and wire products - Non-ferrous metallic coatings on steel wire<br>Part 3: Aluminium coatings                                     |
| EN 10244 - 4    | 1995 - 01 | Steel wire and wire products - Non-ferrous metallic coatings on steel wire<br>Part 4: Tin coatings                                           |
| EN 10244 - 5    | 1995 - 01 | Steel wire and wire products - Non-ferrous metallic coatings on steel wire<br>Part 5: Nickel coatings                                        |
| EN 10244 - 6    | 1995 - 01 | Steel wire and wire products - Non-ferrous metallic coatings on steel wire<br>Part 6: Copper, bronze or brass coatings                       |
| EN 10245 - 1    | 1995 - 01 | Steel wire and wire products - Organic coatings on wire -Part 1: General rules                                                               |
| EN 10245 - 2    | 1995 - 01 | Steel wire and wire products - Organic coatings on wire -Part 2: PVC coated wire                                                             |
| EN 10245 - 3    | 1995 - 01 | Steel wire and wire products - Organic coatings on wire -Part 3: PE coated wire                                                              |
| EN 10248 - 1    | 1995 - 06 | Hot rolled sheet piling of non alloy steels - Part 1: Technical delivery conditions                                                          |
| EN 10248 - 2    | 1995 - 06 | Hot rolled sheet piling of non alloy steels - Part 2: Tolerances on shape and dimensions                                                     |
| EN 10249 - 1    | 1995 - 06 | Cold formed sheet piling of non alloy steels - Part 1: Technical delivery conditions                                                         |
| EN 10249 - 2    | 1995 - 06 | Cold formed sheet piling of non alloy steels - Part 2: Tolerances on shape and dimensions                                                    |
| EN 10253 - 1    | 1994 - 01 | Butt welding pipe fittings wrought carbon steel without specific inspection requirements                                                     |
| EN 10254        | 1995 - 08 | Steel closed die forgings - General technical delivery conditions                                                                            |
| EN 10255        | 1996 - 01 | Non-alloy steel tubes suitable for welding or threading                                                                                      |
| EN 10257 - 1    | 1994 - 11 | Zinc or zinc alloy coated low carbon steel wire for armouring cables - Part 1: Land cables                                                   |
| EN 10257 - 2    | 1994 - 11 | Zinc or zinc alloy coated low carbon steel wire for armouring cables - Part 2: Submarine cables                                              |
| EN 10267        | 1995 - 08 | Ferritic-pearlitic engineering steels for precipitation hardening from hot-working temperatures                                              |
| EN 10268        | 1995 - 10 | Cold-rolled flat products made of high field strength steels for cold forming - General delivery conditions                                  |
| EN 10271        | 1996 - 03 | Electrolytically zinc-nickel (ZN) coated cold rolled steel flat products - Technical delivery conditions                                     |
| EN 10283        | 1996 - 04 | Corrosion resistant steel casting                                                                                                            |
| EN 10284        | 1996 - 04 | Malleable cast iron fittings with compression ends for plastics piping system                                                                |
| EN 10285        | 1996 - 12 | Steel tubes and fittings for on and offshore pipelines<br>External three layer extruded polyethylene based coating                           |
| EN 10286        | 1996 - 12 | Steel tubes and fittings for on and offshore pipelines<br>External three layer extruded polypropylene based coatings                         |
| EN 10287        | 1996 - 12 | Steel tubes and fittings for on and offshore pipelines - External fused polyethylene based coatings                                          |
| EN 10288        | 1997 - 01 | Steel tubes and fittings for on and offshore pipelines<br>External two layer extruded polyethylene based coatings                            |
| EN 20049 - 01   | 1991 - 12 | Malleable cast iron threaded pipe fittings;<br>Part 1: fittings with parallel internal and taper external threads in accordance with ISO 7-1 |
| EN 29658        | 1991 - 12 | Steel; determination of aluminium content; flame atomic absorption spectrometric method (ISO 9658 :1990)                                     |
| EN ISO 945      | 1994 - 07 | Cast iron - Designation of microstructure of graphite (ISO 945 : 1975)                                                                       |
| EN ISO 1127     | 1995 - 10 | Stainless steel tubes - Dimensions, tolerances and conventional masses per unit length                                                       |
| EN ISO 3785     | 1995 - 01 | Steel - Designation of test piece axes (ISO 3785 : 1976)                                                                                     |
| EN ISO 8434 - 1 | 1995 - 05 | Metallic tube connections for fluid power and general use<br>Part 1: 24 ° Grad compression fittings (ISO 8434-1:1994)                        |
| EN ISO 10380    | 1995 - 05 | Corrugated flexible metallic hose and hose assemblies (ISO 10380 : 1994)                                                                     |







# European Standards for Metallic Materials

In the table of standards for mechanical testing of metallic materials

- methods for static and dynamic mechanical testing,
  - methods for non-destructive testing of metallic materials
  - and methods for chemical analysis of ferrous materials
- are presented.

## STANDARDS FOR MECHANICAL TESTING OF METALLIC MATERIALS

|                 |           |                                                                                                                                                                                                                                                   |
|-----------------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EN 10002 - 1    | 1996      | Metallic materials; tensile testing; part 1: method of test                                                                                                                                                                                       |
| EN 10002-1/AC/1 | 1996      | Metallic materials; tensile testing; part 1: method of test; amendment to EN 10002 - 1                                                                                                                                                            |
| EN 10002 - 2    | 1996 - 06 | Metallic materials; tensile testing<br>Part 2: verification of the force measuring system of the tensile testing machines                                                                                                                         |
| EN 10002 - 3    | 1996 - 06 | Metallic materials; Tensile testing<br>Part 3: Calibration of force proving instruments used for the verification of uniaxial testing machines                                                                                                    |
| EN 10002 - 4    | 1994 - 11 | Metallic materials; tensile test; part 4: verification of extensimeters used in uniaxial testing                                                                                                                                                  |
| EN 10002 - 5    | 1991 - 10 | Metallic materials; tensile testing; part 5: method of testing at elevated temperature                                                                                                                                                            |
| EN 10003 - 1    | 1996      | Metallic materials; Brinell hardness test - Part 1: Test method                                                                                                                                                                                   |
| EN 10003 - 2    | 1996 - 06 | Metallic materials; Brinell hardness test; -Part 2: Verification of Brinell hardness testing machines                                                                                                                                             |
| EN 10003 - 3    | 1996 - 06 | Metallic materials; Brinell hardness test<br>Part 3: Calibration of standardized blocks to be used for Brinell hardness testing machines                                                                                                          |
| EN 10004 - 1    | 1991 - 02 | Metallic materials; hardness test; part 1: Rockwell test (scales A, B, C, D, E, F, G, H, K )                                                                                                                                                      |
| EN 10004 - 2    | 1991 - 02 | Metallic materials; hardness test<br>Part 2: verification of Rockwell hardness testing machines (scales A, B, C, D, E, F, G, H, K )                                                                                                               |
| EN 10004 - 3    | 1991 - 02 | Metallic materials; hardness test<br>Part 3: calibration of standardized blocks to be used for Rockwell hardness testing machines (scales A, B, C, D, E, F, G, H, K )                                                                             |
| EN 10045 - 2    | 1996 - 06 | Metallic materials; Charpy impact test; part 2: verification of the testing machine ( pendulum impact )                                                                                                                                           |
| EN 10109 - 1    | 1996      | Metallic materials - Hardness test - Part 1: Rockwell test (scales A, B, C, D, E, F, G, H, K) and Rockwell superficial test (scales 15N, 30N, 45N, 15T, 30T and 45T)                                                                              |
| EN 10109 - 2    | 1996 - 06 | Metallic materials - Hardness test - Part 2: Verification of Rockwell hardness testing machines (scales A, B, C, D, E, F, G, H, K, N, T)                                                                                                          |
| EN 10109 - 3    | 1996 - 06 | Metallic materials - Hardness test - Part 3: Calibration of standardized blocks to be used for Rockwell hardness testing machines (scales A, B, C, D, E, F, G, H, K, N, T)                                                                        |
| EN 10232        | 1993 - 10 | Metallic materials; tube (in full section); bend test                                                                                                                                                                                             |
| EN 10233        | 1993 - 10 | Metallic materials; tube flattening test                                                                                                                                                                                                          |
| EN 10234        | 1993 - 10 | Metallic materials; tube drift expanding test                                                                                                                                                                                                     |
| EN 10235        | 1993 - 10 | Metallic materials; tube flanging test                                                                                                                                                                                                            |
| EN 10236        | 1993 - 10 | Metallic materials; tube; ring expanding test                                                                                                                                                                                                     |
| EN 10237        | 1993 - 10 | Metallic materials; tube; ring tensile test                                                                                                                                                                                                       |
| EN 10238        | 1995 - 12 | Automatically blast cleaned and primed steel products                                                                                                                                                                                             |
| EN 10251        | 1995 - 07 | Magnetic materials - Methods of determination of geometrical characteristics of electrical steel sheet and strip                                                                                                                                  |
| EN 10252        | 1995 - 02 | Magnetic materials - Methods of measurement of magnetic properties of magnetic steel sheet and strip at medium frequencies                                                                                                                        |
| CR 10261        | 1995 - 01 | ECISS Information Circular 11 - Iron and steel - Review of available methods of chemical analysis                                                                                                                                                 |
| ENV 22605 - 1   | 1991 - 10 | Steel products for pressure purposes; derivation and verification of elevated temperature properties; Part 1: yield or proof stress of carbon and low alloy steel products (ISO 2605-1: 1976)                                                     |
| ENV 22605 - 2   | 1991 - 10 | Steel products for pressure purposes; derivation and verification of elevated temperature properties; Part 2: proof stress of austenitic steel products (ISO 2605-2: 1976)                                                                        |
| ENV 22605 - 3   | 1991 - 10 | Steel products for pressure purposes; derivation and verification of elevated temperature properties; Part 3: alternative procedure for deriving the elevated temperature yield or proof stress properties when data are limit (ISO 2605-3: 1985) |
| EN ISO 945      | 1994 - 07 | Cast iron - Designation of microstructure of graphite (ISO 945 : 1975)                                                                                                                                                                            |
| EN ISO 10380    | 1995 - 05 | Corrugated flexible metallic hose and hose assemblies (ISO 10380 : 1994)                                                                                                                                                                          |
| EN 10228 - 1    | 1994 - 05 | Non-destructive testing of steel forgings - Part 1: Magnetic particule inspection                                                                                                                                                                 |
| EN 10228 - 2    | 1994 - 05 | Non-destructive testing of steel forgings - Part 2: Penetrant testing                                                                                                                                                                             |



## STANDARDS FOR NON-DESTRUCTIVE TESTING OF METALLIC MATERIALS

|               |           |                                                                                                                                                                                                                                                    |
|---------------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EN 10228 - 3  | 1994 - 12 | Non-destructive testing of steel forgings - Part 3: Ultrasonic testing of ferritic or martensitic steel forgings                                                                                                                                   |
| EN 10228 - 4  | 1996 - 12 | Non-destructive testing of steel forgings - Part 4: Ultrasonic testing of austenitic and austenitic-ferritic stainless forgings                                                                                                                    |
| EN 10246 - 1  | 1995 - 09 | Non-destructive testing of steel tubes - Part 1: Automatic electromagnetic testing of seamless and welded (except submerged arc welded) ferromagnetic steel tubes for verification of hydraulic leak-tightness                                     |
| EN 10246 - 2  | 1995 - 11 | Non-destructive testing of steel tubes - Part 2:                                                                                                                                                                                                   |
| EN 10246 - 3  | 1995 - 10 | Non-destructive testing of steel tubes - Part 3: Automatic eddy current testing of seamless and welded (except submerged arc welded) steel tubes for the detection of imperfections                                                                |
| EN 10246 - 5  | 1995 - 10 | Non-destructive testing of steel tubes - Part 5: Automatic full peripheral magnetic transducer/flux leakage testing of seamless and welded (except submerged arc welded) ferromagnetic steel tubes for the detection of longitudinal imperfections |
| EN 10246 - 6  | 1995 - 10 | Non-destructive testing of steel tubes - Part 6: Automatic full peripheral ultrasonic testing of seamless steel tubes for the detection of transverse imperfections                                                                                |
| EN 10246 - 7  | 1995 - 09 | Non-destructive testing of steel tubes - Part 7: Automatic full peripheral ultrasonic testing of seamless and welded (except submerged arc welded) steel tubes for the detection of longitudinal imperfections                                     |
| EN 10246 - 8  | 1995 - 10 | Non-destructive testing of steel tubes - Part 8: Automatic ultrasonic testing of the weld seam of electric resistance and induction welded steel tubes for the detection of longitudinal imperfections                                             |
| EN 10246 - 9  | 1995 - 10 | Non-destructive testing of steel tubes - Part 9: Automatic ultrasonic testing of the weld seam of submerged arc welded steel tubes for the detection of longitudinal and/or transverse imperfections                                               |
| EN 10246 - 10 | 1995 - 10 | Non-destructive testing of steel tubes - Part 10: Radiographic testing of the weld seam of submerged arc-weld steel tubes for the detection of imperfections                                                                                       |
| EN 10246 - 14 | 1995 - 10 | Non-destructive testing of steel tubes - Part 14: Automatic ultrasonic testing for the detection of laminar imperfections for seamless and welded (except submerged arc-welded) steel tubes                                                        |
| EN 10246 - 15 | 1995 - 10 | Non-destructive testing of steel tubes - Part 15: Automatic ultrasonic testing of strip/plate used in the manufacture of welded steel tubes for the detection of laminar imperfections                                                             |
| EN 10256      | 1995 - 06 | Non-destructive testing of steel tubes - Qualification and competence of levels 1 and 2 non destructive testing personnel                                                                                                                          |
| EN 29302      | 1991 - 02 | Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes; electromagnetic testing for verification of hydraulic leak-tightness                                                                                          |
| EN 29303      | 1991 - 02 | Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes; full peripheral ultrasonic testing for the detection of longitudinal imperfections                                                                            |

## STANDARDS FOR CHEMICAL ANALYSIS OF FERROUS MATERIALS

|             |           |                                                                                                                                                      |
|-------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| EN 10036    | 1996 - 08 | Chemical analysis of ferrous materials; determination of total carbon in steels and irons; gravimetric method after combustion in a stream of oxygen |
| EN 10071    | 1996 - 08 | Chemical analysis of ferrous materials; determination of manganese in steels and irons; electrometric titration method                               |
| EN 10136    | 1989 - 01 | Chemical analysis of ferrous materials; determination of nickel in steels and irons; flame atomic absorption spectrometric method                    |
| EN 10177    | 1989 - 01 | Chemical analysis of ferrous materials; determination of calcium in steels; flame atomic absorption spectrometric method                             |
| EN 10178    | 1989 - 01 | Chemical analysis of ferrous materials; determination of niobium in steels; spectrophotometric method                                                |
| EN 10179    | 1989 - 01 | Chemical analysis of ferrous materials; determination of nitrogen (trace amounts) in steels; spectrophotometric method                               |
| EN 10181    | 1989 - 01 | Chemical analysis of ferrous materials; determination of lead in steels; flame atomic absorption spectrometric method                                |
| EN 10184    | 1989 - 05 | Chemical analysis of ferrous materials; determination of phosphorus in steels and irons; spectrophotometric method                                   |
| EN 10184/AC | 1991 - 09 | Chemical analysis of ferrous materials; determination of phosphorus in steels and irons; spectrophotometric method; amendment                        |
| EN 10188    | 1989 - 05 | Chemical analysis of ferrous materials; determination of chromium in steels and irons; flame atomic absorption spectrometric method                  |



## European Standards for Metallic Materials II

|                 |           |                                                                                                                                                                                              |
|-----------------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EN 10200        | 1991 - 12 | Chemical analysis of ferrous materials; determination of boron in steel; spectrophotometric method                                                                                           |
| EN 10201        | 1988 - 01 | Chemical analysis of ferrous materials; determination of silicon in steels and iron; flame atomic absorption spectrometric method                                                            |
| EN 10211        | 1995 - 10 | Chemical analysis of ferrous materials - Determination of titanium in steel and iron - Flame atomic absorption spectrometric method                                                          |
| EN 10212        | 1995 - 03 | Chemical analysis of ferrous materials - Determination of arsenic in steel and iron - Spectrometric method                                                                                   |
| EN 10265        | 1995 - 12 | Magnetic materials - Specification for steel sheet and strip with specified mechanical properties and magnetic permeability                                                                  |
| EN 10276 - 1    | 1995 - 09 | Chemical analysis of ferrous materials - Determination of oxygen in steel and iron - Part 1: Sampling and preparation of steel samples for oxygen determination                              |
| EN 24159        | 1989 - 05 | Ferromanganese and ferrosilicomanganese; determination of manganese content; potentiometric method (ISO 4159, 1 st edition 1978.12.15)                                                       |
| EN 24159/AC 1   | 1989 - 06 | Ferromanganese and ferrosilicomanganese; determination of manganese content; potentiometric method; amendment 1 to EN 24159 : 1989 (ISO 4159 : 1978)                                         |
| EN 24829 - 1    | 1990 - 03 | Steel and cast iron; determination of total silicon content; reduced molybdosilicate spectrophotometric method part 1: silicon content between 0,05 and 1%                                   |
| EN 24829 - 1/AC | 1991 - 09 | Steel and cast iron; determination of total silicon content; reduced molybdosilicate spectrophotometric method part 1: silicon content between 0,05 and 1%; amendment (ISO 4829-1 : 1986)    |
| EN 24829 - 2    | 1990 - 03 | Steel and cast iron; determination of total silicon content; reduced molybdosilicate spectrophotometric method part 2: silicon content between 0,01 and 0,05%                                |
| EN 24829 - 2/AC | 1991 - 09 | Steel and cast iron; determination of total silicon content; reduced molybdosilicate spectrophotometric method part 2: silicon content between 0,01 and 0,05%; amendment (ISO 4829-2 : 1986) |
| EN 24934        | 1989 - 05 | Steel and cast iron; determination of sulfur content; gravimetric method (ISO 4934, 1 st edition 1980.10.01)                                                                                 |
| EN 24935        | 1991 - 12 | Steel and cast iron; determination of sulfur content; infrared absorption method after combustion in an induction furnace (ISO 4935 : 1989)                                                  |
| EN 24935/AC     | 1992 - 06 | Steel and iron; determination of sulfur content; infrared absorption method after combustion in an induction furnace; amends (ISO 4935 : 1989)                                               |
| EN 24937        | 1990 - 03 | Steel and iron; determination of chromium content; potentiometric or visual method                                                                                                           |
| EN 24937/AC     | 1991 - 09 | Steel and iron; determination of chromium content; potentiometric or visual method; amendment (ISO 4937 : 1986)                                                                              |
| EN 24938        | 1990 - 03 | Steel and iron; determination of nickel content; gravimetric or titrimetric method                                                                                                           |
| EN 24938/AC     | 1991 - 09 | Steel and iron; determination of nickel content; gravimetric or titrimetric method; amendment (ISO 4938 : 1986)                                                                              |
| EN 24943        | 1990 - 03 | Chemical analysis of ferrous metal; determination of copper content; flame atomic absorption spectrometric method                                                                            |
| EN 24943/AC     | 1991 - 09 | Chemical analysis of ferrous metal; determination of copper content; flame atomic absorption spectrometric method; amendment (ISO 4943 : 1985)                                               |
| EN 24946        | 1990 - 03 | Determination of copper content in steel and cast iron                                                                                                                                       |
| EN 24946/AC     | 1991 - 09 | Steel and cast iron; determination of copper content; 2,2' diquinolyl spectrophotometric method; amendment (ISO 4946 : 1984)                                                                 |
| EN 24947        | 1991 - 03 | Steel and cast iron; determination of vanadium content; potentiometric titration method (ISO 4947 : 1986)                                                                                    |
| EN ISO 10280    | 1995 - 09 | Steel and iron - Determination of titanium content - Diantipyrylmethane spectrophotometric method (ISO 10280 : 1991)                                                                         |
| EN ISO 10700    | 1995 - 09 | Steel and iron - Determination of manganese content - Flame atomic absorption spectrometric method (ISO 10700 : 1994)                                                                        |
| EN 10211        | 1995 - 03 | Chemical analysis of ferrous materials - Determination of titanium in steel and iron - Flame atomic absorption spectrometric method                                                          |
| EN ISO 10806    | 1995 - 05 | Pipework - Non-alloyed and stainless steel fittings for corrugated flexible metallic hoses (ISO 10806 : 1994)                                                                                |
| EN ISO 10807    | 1995 - 05 | Pipework - Corrugated flexible metallic hose assemblies for the protection of electrical cables in explosive atmospheres (ISO 10807 : 1994) Warning: withdrawn document                      |

# Group of ASTM Standards for Steel Pipes, Tubes and Fittings



This group of ASTM standard specifications covers various types of steel pipes, tubes and fittings for high-temperature service, ordinary use and special applications such as fire protection use. Specifications for steel tubes list standard requirements for boiler and superheater tubes, general service tubes, steel tubes in refinery service, heat exchanger and condenser tubes, mechanical and structural tubing.

This article contains ASTM standards for various types of steel pipes which specify requirements for high-temperature service, ordinary use and special applications such as fire protection use.

Specifications for steel tubes list standard requirements for:

- Boiler and superheater tubes
- General service tubes
- Still tubes in refinery service
- Heat exchanger and condenser tubes
- Mechanical tubing and
- Structural tubing.

New standards, which cover the general requirements for alloy and stainless steel pipes, and editorial form and style for writing product specifications are also included.

## STEEL PIPES

|              |                  |                                                                                                                                                                 |
|--------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A53          | A53/A53M-99b     | Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless                                                                           |
| A74          | A74-98           | Specification for Cast Iron Soil Pipe and Fittings                                                                                                              |
| A106         | A106-99e1        | Specification for Seamless Carbon Steel Pipe for High-Temperature Service                                                                                       |
| A126         | A126-95e1        | Specification for Grey Iron Castings for Valves, Flanges, and Pipe Fittings                                                                                     |
| A134         | A134-96          | Specification for Pipe, Steel, Electric-Fusion (Arc)-Welded (Sizes NPS 16 and Over)                                                                             |
| A135         | A135-97c         | Specification for Electric-Resistance-Welded Steel Pipe                                                                                                         |
| A139         | A139-96e1        | Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)                                                                                      |
| A182         | A182/A182M-99    | Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service                                 |
| A252         | A252-98          | Specification for Welded and Seamless Steel Pipe Piles                                                                                                          |
| A312         | A312/A312M-00    | Specification for Seamless and Welded Austenitic Stainless Steel Pipes                                                                                          |
| A333         | A333/A333M-99    | Specification for Seamless and Welded Steel Pipe for Low-Temperature Service                                                                                    |
| A335         | A335/A335M-99    | Specification for Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service                                                                               |
| A338         | A338-84 (1998)   | Specification for Malleable Iron Flanges, Pipe Fittings, and Valve Parts for Railroad, Marine, and Other Heavy Duty Service at Temperatures Up to 650°F (345°C) |
| A358 Service | A358/A358M-98    | Specification for Electric-Fusion-Welded Austenitic Chromium-Nickel Alloy Steel Pipe for High-Temperature                                                       |
| A369         | A369/A369M-92    | Specification for Carbon and Ferritic Alloy Steel Forged and Bored Pipe for High-Temperature Service                                                            |
| A376         | A376/A376M-98    | Specification for Seamless Austenitic Steel Pipe for High-Temperature Central-Station Service                                                                   |
| A377         | A377-99          | Index of Specifications for Ductile-Iron Pressure Pipe                                                                                                          |
| A409         | A409/A409M-95ae1 | Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service                                                         |
| A426         | A426-92 (1997)   | Specification for Centrifugally Cast Ferritic Alloy Steel Pipe for High-Temperature Service                                                                     |
| A451         | A451-93 (1997)   | Specification for Centrifugally Cast Austenitic Steel Pipe for High-Temperature Service                                                                         |
| A523         | A523-96          | Specification for Plain End Seamless and Electric-Resistance-Welded Steel Pipe for High-Pressure Pipe-Type Cable Circuits                                       |
| A524         | A524-96          | Specification for Seamless Carbon Steel Pipe for Atmospheric and Lower Temperatures                                                                             |
| A530         | A530/A530M-99    | Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe                                                                              |
| A648         | A648-95e1        | Specification for Steel Wire, Hard Drawn for Prestressing Concrete Pipe                                                                                         |
| A674         | A674-95          | Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids                                                                           |
| A691         | A691-98          | Specification for Carbon and Alloy Steel Pipe, Electric-Fusion-Welded for High-Pressure Service at High Temperatures                                            |



# Group of ASTM Standards for Steel Pipes, Tubes and Fittings

|              |                      |                                                                                                                                                                |
|--------------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A694         | A694/A694M-00        | Specification for Carbon and Alloy Steel Forgings for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission Service                         |
| A716         | A716-99              | Specification for Ductile Iron Culvert Pipe                                                                                                                    |
| A733         | A733-99              | Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples                                                                 |
| A742         | A742/A742M-98        | Specification for Steel Sheet, Metallic Coated and Polymer Precoated for Corrugated Steel Pipe                                                                 |
| A746         | A746-99              | Specification for Ductile Iron Gravity Sewer Pipe                                                                                                              |
| A760         | A760/A760M-99        | Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains                                                                                 |
| A761         | A761/A761M-98        | Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches                                               |
| A762         | A762/A762M-98        | Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains                                                                               |
| A790         | A790/A790M-99        | Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Pipe                                                                                 |
| A796         | A796/A796M-99        | Practice for Structural Design of Corrugated Steel Pipe, Pipe-Arches, and Arches for Storm and Sanitary Sewers and Other Buried Applications                   |
| A798         | A798/A798M-97a       | Practice for Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications                                                                   |
| A807         | A807/A807M-97        | Practice for Installing Corrugated Steel Structural Plate Pipe for Sewers and Other Applications                                                               |
| A810         | A810-94              | Specification for Zinc-Coated (Galvanized) Steel Pipe Winding Mesh                                                                                             |
| A813         | A813/A813M-95e2      | Specification for Single- or Double-Welded Austenitic Stainless Steel Pipe                                                                                     |
| A814         | A814/A814M-96 (1998) | Specification for Cold-Worked Welded Austenitic Stainless Steel Pipe                                                                                           |
| A849<br>Pipe | A849-99              | Specification for Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage                                                          |
| A861         | A861-94e1            | Specification for High-Silicon Iron Pipe and Fittings                                                                                                          |
| A862         | A862/A862M-98        | Practice for Application of Asphalt Coatings to Corrugated Steel Sewer and Drainage Pipe                                                                       |
| A865         | A865-97              | Specification for Threaded Couplings, Steel, Black or Zinc-Coated (Galvanized) Welded or Seamless, for Use in Steel Pipe Joints                                |
| A872         | A872-91 (1997)       | Specification for Centrifugally Cast Ferritic/Austenitic Stainless Steel Pipe for Corrosive Environments                                                       |
| A885         | A885/A885M-96        | Specification for Steel Sheet, Zinc and Aramid Fiber Composite Coated for Corrugated Steel Sewer, Culvert, and Underdrain Pipe                                 |
| A888         | A888-98e1            | Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications                                   |
| A926         | A926-97              | Test Method for Comparing the Abrasion Resistance of Coating Materials for Corrugated Metal Pipe                                                               |
| A928         | A928/A928M-98        | Specification for Ferritic/Austenitic (Duplex) Stainless Steel Pipe Electric Fusion Welded with Addition of Filler Metal                                       |
| A929         | A929/A929M-97        | Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe                                                                |
| A930         | A930-99              | Practice for Life-Cycle Cost Analysis of Corrugated Metal Pipe Used for Culverts, Storm Sewers, and Other Buried Conduits                                      |
| A943         | A943/A943M-95e1      | Specification for Spray-Formed Seamless Austenitic Stainless Steel Pipes                                                                                       |
| A949         | A949/A949M-95e1      | Specification for Spray-Formed Seamless Ferritic/Austenitic Stainless Steel Pipe                                                                               |
| A954         | A954-96              | Specification for Austenitic Chromium-Nickel-Silicon Alloy Steel Seamless and Welded Pipe                                                                      |
| A972         | A972/A972M-99        | Specification for Fusion Bonded Epoxy-Coated Pipe Piles                                                                                                        |
| A978         | A978/A978M-97        | Specification for Composite Ribbed Steel Pipe, Precoated and Polyethylene Lined for Gravity Flow Sanitary Sewers, Storm Sewers, and Other Special Applications |
| A984         | A984/A984M-00        | Specification for Steel Line Pipe, Black, Plain-End, Electric-Resistance-Welded                                                                                |
| A998         | A998/A998M-98        | Practice for Structural Design of Reinforcements for Fittings in Factory-Made Corrugated Steel Pipe for Sewers and Other Applications                          |
| A999         | A999/A999M-98        | Specification for General Requirements for Alloy and Stainless Steel Pipe                                                                                      |
| A1005        | A1005/A1005M-00      | Specification for Steel Line Pipe, Black, Plain End, Longitudinal and Helical Seam, Double Submerged-Arc Welded                                                |
| A1006        | A1006/A1006M-00      | Specification for Steel Line Pipe, Black, Plain End, Laser Beam Welded                                                                                         |





## STEEL TUBES - Boiler, Superheater, and Miscellaneous Tubes

|      |                          |                                                                                                                                             |
|------|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| A178 | A178/A178M-95            | Specification for Electric-Resistance-Welded Carbon Steel and Carbon-Manganese Steel Boiler and Superheater Tubes                           |
| A179 | A179/A179M-90a (1996) e1 | Specification for Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes                                                   |
| A192 | A192/A192M-91 (1996) e1  | Specification for Seamless Carbon Steel Boiler Tubes for High-Pressure Service                                                              |
| A209 | A209/A209M-98            | Specification for Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes                                                       |
| A210 | A210/A210M-96            | Specification for Seamless Medium-Carbon Steel Boiler and Superheater Tubes                                                                 |
| A213 | A213/A213M-99a           | Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes                                |
| A249 | A249/A249M-98e1          | Specification for Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes                                          |
| A250 | A250/A250M-95            | Specification for Electric-Resistance-Welded Ferritic Alloy-Steel Boiler and Superheater Tubes                                              |
| A254 | A254-97                  | Specification for Copper-Brazed Steel Tubing                                                                                                |
| A268 | A268/A268M-96            | Specification for Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service                                   |
| A269 | A269-98                  | Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service                                                 |
| A270 | A270-98ae1               | Specification for Seamless and Welded Austenitic Stainless Steel Sanitary Tubing                                                            |
| A334 | A334/A334M-99            | Specification for Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service                                              |
| A423 | A423/A423M-95            | Specification for Seamless and Electric-Welded Low-Alloy Steel Tubes                                                                        |
| A450 | A450/A450M-96a           | Specification for General Requirements for Carbon, Ferritic Alloy, and Austenitic Alloy Steel Tubes                                         |
| A608 | A608-91a (1998)          | Specification for Centrifugally Cast Iron-Chromium-Nickel High-Alloy Tubing for Pressure Application at High Temperatures                   |
| A618 | A618-99                  | Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing                                                  |
| A632 | A632-98                  | Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service                                |
| A688 | A688/A688M-98            | Specification for Welded Austenitic Stainless Steel Feedwater Heater Tubes                                                                  |
| A771 | A771/A771M-95            | Specification for Seamless Austenitic and Martensitic Stainless Steel Tubing for Liquid Metal-Cooled Reactor Core Components                |
| A778 | A778-98                  | Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products                                                            |
| A789 | A789/A789M-00            | Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service                                        |
| A803 | A803/A803M-98            | Specification for Welded Ferritic Stainless Steel Feedwater Heater Tubes                                                                    |
| A822 | A822-90 (1995) e1        | Specification for Seamless Cold-Drawn Carbon Steel Tubing for Hydraulic System Service                                                      |
| A826 | A826/A826M-95            | Specification for Seamless Austenitic and Martensitic Stainless Steel Duct Tubes for Liquid Metal-Cooled Reactor Core Components            |
| A847 | A847-99a                 | Specification for Cold-Formed Welded and Seamless High Strength, Low Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance |
| A908 | A908-91 (1998)           | Specification for Stainless Steel Needle Tubing                                                                                             |
| A953 | A953-96                  | Specification for Austenitic Chromium-Nickel-Silicon Alloy Steel Seamless and Welded Tubing                                                 |

## Mechanical Tubes

|      |                          |                                                                                                                            |
|------|--------------------------|----------------------------------------------------------------------------------------------------------------------------|
| A179 | A179/A179M-90a (1996) e1 | Specification for Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes                                  |
| A213 | A213/A213M-99a           | Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes               |
| A214 | A214/A214M-96            | Specification for Electric-Resistance-Welded Carbon Steel Heat-Exchanger and Condenser Tubes                               |
| A249 | A249/A249M-98e1          | Specification for Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes                         |
| A498 | A498-98                  | Specification for Seamless and Welded Carbon, Ferritic, and Austenitic Alloy Steel Heat-Exchanger Tubes with Integral Fins |
| A851 | A851-96                  | Specification for High-Frequency Induction Welded, Unannealed, Austenitic Steel Condenser Tubes                            |



# Group of ASTM Standards for Steel Pipes, Tubes and Fittings

## Heat-Exchanger and Condenser Tubes

|      |           |                                                                                       |
|------|-----------|---------------------------------------------------------------------------------------|
| A511 | A511-96   | Specification for Seamless Stainless Steel Mechanical Tubing                          |
| A512 | A512-96   | Specification for Cold-Drawn Buttweld Carbon Steel Mechanical Tubing                  |
| A513 | A513-98   | Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing |
| A519 | A519-96   | Specification for Seamless Carbon and Alloy Steel Mechanical Tubing                   |
| A554 | A554-98e1 | Specification for Welded Stainless Steel Mechanical Tubing                            |

## Structural Tubes

|      |          |                                                                                                                                             |
|------|----------|---------------------------------------------------------------------------------------------------------------------------------------------|
| A500 | A500-99  | Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes                                       |
| A501 | A501-99  | Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing                                                             |
| A847 | A847-99a | Specification for Cold-Formed Welded and Seamless High Strength, Low Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance |
| A618 | A618-99  | Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing                                                  |

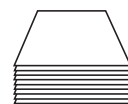
## Welding Fittings

|      |                |                                                                                                                                        |
|------|----------------|----------------------------------------------------------------------------------------------------------------------------------------|
| A234 | A234/A234M-99  | Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service                    |
| A403 | A403/A403M-99a | Specification for Wrought Austenitic Stainless Steel Piping Fittings                                                                   |
| A420 | A420/A420M-99  | Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service                                  |
| A758 | A758/A758M-98  | Specification for Wrought-Carbon Steel Butt-Welding Piping Fittings with Improved Notch Toughness                                      |
| A774 | A774/A774M-98  | Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures |





# Group of ASTM Standards for Steel Plate, Sheet, Strip and Wire



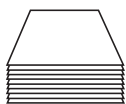
This group of ASTM standards covers steel plates, sheets and strips used in various applications, properties of assorted types of stainless and heat resisting steel wires, drawn galvanized wires for mechanical springs, alloy steel coarse round wires and industrial sizing screens.

This group of ASTM standards covers the requirements to be met by:

1. Steel plate, sheet, and strip used in various applications
2. The properties of assorted types of steel wire, e.g., stainless and heat resisting steel wire, drawn galvanized wire for mechanical springs, and alloy steel coarse round wire
3. Industrial sizing screens.

## STEEL PLATE, SHEET AND STRIP

|      |                 |                                                                                                                                                |
|------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| A109 | A109/A109M-98a  | Specification for Steel, Strip, Carbon (0.25 Maximum Percent), Cold-Rolled                                                                     |
| A167 | A167-99         | Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip                                                   |
| A176 | A176-99         | Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip                                                          |
| A240 | A240/A240M-00   | Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels                     |
| A262 | A262-98         | Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels                                                  |
| A263 | A263-94a (1999) | Specification for Corrosion-Resisting Chromium Steel-Clad Plate, Sheet, and Strip                                                              |
| A264 | A264-94a (1999) | Specification for Stainless Chromium-Nickel Steel-Clad Plate, Sheet, and Strip                                                                 |
| A265 | A265-94a (1999) | Specification for Nickel and Nickel-Base Alloy-Clad Steel Plate                                                                                |
| A345 | A345-98         | Specification for Flat-Rolled Electrical Steels for Magnetic Applications                                                                      |
| A366 | A366/A366M-97e1 | Specification for Commercial Steel (CS) Sheet, Carbon (0.15 Maximum Percent) Cold-Rolled                                                       |
| A370 | A370-97a        | Test Methods and Definitions for Mechanical Testing of Steel Products                                                                          |
| A380 | A380-99e1       | Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems                                             |
| A414 | A414/A414M-00   | Specification for Steel, Sheet, Carbon, for Pressure Vessels                                                                                   |
| A417 | A417-93 (1998)  | Specification for Steel Wire, Cold-Drawn, for Zig-Zag, Square-Formed, and Sinuous-Type Upholstery Spring Units                                 |
| A424 | A424-00         | Specification for Steel, Sheet, for Porcelain Enameling                                                                                        |
| A480 | A480/A480M-99b  | Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip                              |
| A505 | A505-00         | Specification for Steel, Sheet and Strip, Alloy, Hot-Rolled and Cold-Rolled, General Requirements for                                          |
| A506 | A506-93 (1998)  | Specification for Steel, Sheet and Strip, Alloy, Hot-Rolled and Cold-Rolled, Regular Quality and Structural Quality                            |
| A507 | A507-93 (1998)  | Specification for Steel, Sheet and Strip, Alloy, Hot-Rolled and Cold-Rolled, Drawing Quality                                                   |
| A568 | A568/A568M-00   | Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for                     |
| A569 | A569/A569M-98   | Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial Quality                                         |
| A570 | A570/A570M-98   | Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality                                                               |
| A604 | A604-93 (1998)  | Test Method for Macroetch Testing of Consumable Electrode Remelted Steel Bars and Billets                                                      |
| A606 | A606-98         | Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance |
| A607 | A607-98         | Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled and Cold-Rolled                 |
| A611 | A611-97         | Specification for Structural Steel (SS), Sheet, Carbon, Cold-Rolled                                                                            |
| A620 | A620/A620M-97   | Specification for Drawing Steel (DS), Sheet, Carbon, Cold-Rolled                                                                               |
| A622 | A622/A622M-97   | Specification for Drawing Steel (DS), Sheet and Strip, Carbon, Hot-Rolled                                                                      |
| A635 | A635/A635M-98   | Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot-Rolled                                                            |
| A659 | A659/A659M-97   | Specification for Commercial Steel (CS), Sheet and Strip, Carbon (0.16 Maximum to 0.25 Maximum Percent), Hot-Rolled                            |
| A666 | A666-00         | Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar                                         |



## Group of ASTM Standards for Steel Plate, Sheet, Strip and Wire

|      |                      |                                                                                                                                                                  |
|------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A682 | A682/A682M-98a       | Specification for Steel, Strip, High-Carbon, Cold-Rolled, General Requirements For                                                                               |
| A684 | A684/A684M-86 (1998) | Specification for Steel, Strip, High-Carbon, Cold-Rolled                                                                                                         |
| A693 | A693-93 (1999)       | Specification for Precipitation-Hardening Stainless and Heat-Resisting Steel Plate, Sheet, and Strip                                                             |
| A700 | A700-99              | Practices for Packaging, Marking, and Loading Methods for Steel Products for Domestic Shipment                                                                   |
| A702 | A702-89 (1994) e1    | Specification for Steel Fence Posts and Assemblies, Hot Wrought                                                                                                  |
| A715 | A715-98              | Specification for Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled, and Steel Sheet, Cold-Rolled, High-Strength, Low-Alloy, with Improved Formability |
| A749 | A749/A749M-97        | Specification for Steel, Strip, Carbon and High-Strength, Low-Alloy, Hot-Rolled, General Requirements for                                                        |
| A751 | A751-96              | Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products                                                                                 |
| A763 | A763-93 (1999) e1    | Practices for Detecting Susceptibility to Intergranular Attack in Ferritic Stainless Steels                                                                      |
| A793 | A793-96              | Specification for Rolled Floor Plate, Stainless Steel                                                                                                            |
| A794 | A794-97              | Specification for Commercial Steel (CS), Sheet, Carbon (0.16% Maximum to 0.25% Maximum), Cold-Rolled                                                             |
| A829 | A829/A829M-95        | Specification for Alloy Structural Steel Plates                                                                                                                  |

### STEEL WIRE

|       |                 |                                                                                                              |
|-------|-----------------|--------------------------------------------------------------------------------------------------------------|
| A227  | A227/A227M-99   | Specification for Steel Wire, Cold-Drawn for Mechanical Springs                                              |
| A228  | A228/A228M-93   | Specification for Steel Wire, Music Spring Quality                                                           |
| A229  | A229/A229M-99   | Specification for Steel Wire, Oil-Tempered for Mechanical Springs                                            |
| A230  | A230/A230M-99   | Specification for Steel Wire, Oil-Tempered Carbon Valve Spring Quality                                       |
| A231  | A231/A231M-96   | Specification for Chromium-Vanadium Alloy Steel Spring Wire                                                  |
| A232  | A232/A232M-99   | Specification for Chromium-Vanadium Alloy Steel Valve Spring Quality Wire                                    |
| A313  | A313/A313M-98   | Specification for Stainless Steel Spring Wire                                                                |
| A368  | A368-95a        | Specification for Stainless Steel Wire Strand                                                                |
| A401  | A401/A401M-98   | Specification for Steel Wire, Chromium-Silicon Alloy                                                         |
| A407  | A407-93 (1998)  | Specification for Steel Wire, Cold-Drawn, for Coiled-Type Springs                                            |
| A478  | A478-97         | Specification for Chromium-Nickel Stainless Steel Weaving and Knitting Wire                                  |
| A492  | A492-95         | Specification for Stainless Steel Rope Wire                                                                  |
| A493  | A493-95         | Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging                       |
| A510M | A510M-00        | Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel [Metric]            |
| A510  | A510-00         | Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel                     |
| A555  | A555/A555M-97   | Specification for General Requirements for Stainless Steel Wire and Wire Rods                                |
| A580  | A580/A580M-98   | Specification for Stainless Steel Wire                                                                       |
| A581  | A581/A581M-95b  | Specification for Free-Machining Stainless Steel Wire and Wire Rods                                          |
| A679  | A679/A679M-00   | Specification for Steel Wire, High Tensile Strength, Cold Drawn                                              |
| A713  | A713-93 (1998)  | Specification for Steel Wire, High-Carbon Spring, for Heat-Treated Components                                |
| A752M | A752M-93 (1998) | Specification for General Requirements for Wire Rods and Coarse Round Wire, Alloy Steel [Metric]             |
| A752  | A752-93 (1998)  | Specification for General Requirements for Wire Rods and Coarse Round Wire, Alloy Steel                      |
| A764  | A764-95         | Specification for Metallic Coated Carbon Steel Wire, Coated at Size and Drawn to Size for Mechanical Springs |
| A805  | A805-93 (1998)  | Specification for Steel, Flat Wire, Carbon, Cold-Rolled                                                      |

# Group of ASTM Standards for Steel Castings and Forgings



This group of ASTM specifications covers standard properties of steel and iron castings and forgings for valves, flanges, fittings, and other pressure containing parts for high-temperature and low-temperature service.

Additionally, in the table below standards for evaluating the microstructure of graphite in iron castings and methods for mechanical testing of cast irons are presented.

## STEEL CASTINGS

|               |                                   |                                                                                                                                                            |
|---------------|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A27           | A27/A27M-95                       | Specification for Steel Castings, Carbon, for General Application                                                                                          |
| A47           | A47/A47M-99                       | Specification for Ferritic Malleable Iron Castings                                                                                                         |
| A48M          | A48M-94e1                         | Specification for Gray Iron Castings [Metric]                                                                                                              |
| A48           | A48-94ae1                         | Specification for Gray Iron Castings                                                                                                                       |
| A74           | A74-98                            | Specification for Cast Iron Soil Pipe and Fittings                                                                                                         |
| A126          | A126-95e1                         | Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings                                                                                |
| A128          | A128/A128M-93 (1998)              | Specification for Steel Castings, Austenitic Manganese                                                                                                     |
| A148          | A148/A148M-93b (1998)             | Specification for Steel Castings, High Strength, for Structural Purposes                                                                                   |
| A159          | A159-83 (1993)                    | Specification for Automotive Gray Iron Castings                                                                                                            |
| A216          | A216/A216M-93 (1998)              | Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High- Temperature Service                                                       |
| A217          | A217/A217M-99                     | Specification for Steel Castings, Martensitic Stainless and Alloy, for Pressure- Containing Parts, Suitable for High-Temperature Service                   |
| A247          | A247-67 (1998)                    | Test Method for Evaluating the Microstructure of Graphite in Iron Castings                                                                                 |
| A278M         | A278M-93e1                        | Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 350°C                                                            |
| A278          | A278-93                           | Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650°F                                                            |
| A297          | A297/A297M-97 (1998)              | Specification for Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat Resistant, for General Application                                          |
| A319<br>A327M | A319-71 (1995)<br>A327M-91 (1997) | Specification for Gray Iron Castings for Elevated Temperatures for Non-Pressure Containing Parts<br>Test Methods for Impact Testing of Cast Irons (Metric) |
| A327          | A327-91 (1997)                    | Test Methods for Impact Testing of Cast Irons                                                                                                              |
| A351          | A351/A351M-94a (1999)             | Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts                                                        |
| A352          | A352/A352M-93 (1998)              | Specification for Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service                            |
| A356          | A356/A356M-98e1                   | Specification for Steel Castings, Carbon, Low Alloy, and Stainless Steel, Heavy-Walled for Steam Turbines                                                  |
| A367          | A367-60 (1999)                    | Test Methods of Chill Testing of Cast Iron                                                                                                                 |
| A389          | A389/A389M-93 (1998)              | Specification for Steel Castings, Alloy, Specially Heat-Treated, for Pressure-Containing Parts, Suitable for High-Temperature Service                      |
| A395          | A395/A395M-99                     | Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures                                                       |
| A426          | A426-92 (1997)                    | Specification for Centrifugally Cast Ferritic Alloy Steel Pipe for High-Temperature Service                                                                |
| A436          | A436-84 (1997) e1                 | Specification for Austenitic Gray Iron Castings                                                                                                            |
| A438          | A438-80 (1997)                    | Test Method for Transverse Testing of Gray Cast Iron                                                                                                       |
| A439          | A439-83 (1999)                    | Specification for Austenitic Ductile Iron Castings                                                                                                         |
| A447          | A447/A447M-93 (1998)              | Specification for Steel Castings, Chromium-Nickel-Iron Alloy (25-12 Class), for High-Temperature Service                                                   |
| A451          | A451-93 (1997)                    | Specification for Centrifugally Cast Austenitic Steel Pipe for High-Temperature Service                                                                    |
| A476M         | A476M-84 (1993)                   | Specification for Ductile Iron Castings for Paper Mill Dryer Rolls [Metric]                                                                                |
| A476          | A476-90 (1997)                    | Specification for Ductile Iron Castings for Paper Mill Dryer Rolls                                                                                         |
| A487          | A487/A487M-93 (1998)              | Specification for Steel Castings Suitable for Pressure Service                                                                                             |
| A488          | A488/A488M-99                     | Practice for Steel Castings, Welding, Qualifications of Procedures and Personnel                                                                           |
| A494          | A494/A494M-00                     | Specification for Castings, Nickel and Nickel Alloy                                                                                                        |
| A518          | A518/A518M-99                     | Specification for Corrosion-Resistant High-Silicon Iron Castings                                                                                           |
| A532          | A532/A532M-93a (1999) e1          | Specification for Abrasion-Resistant Cast Irons A                                                                                                          |



# Group of ASTM Standards for Steel Castings and Forgings

|       |                         |                                                                                                                                                         |
|-------|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| 536   | A536-84 (1999) e1       | Specification for Ductile Iron Castings                                                                                                                 |
| A560  | A560/A560M-93 (1998)    | Specification for Castings, Chromium-Nickel Alloy                                                                                                       |
| A571M | A571M-84 (1997)         | Specification for Austenitic Ductile Iron Castings for Pressure-Containing Parts Suitable for Low-Temperature Service [Metric]                          |
| A571  | A571-84 (1997)          | Specification for Austenitic Ductile Iron Castings for Pressure-Containing Parts Suitable for Low-Temperature Service                                   |
| A583  | A583-93 (1999)          | Specification for Cast Steel Wheels for Railway Service                                                                                                 |
| A597  | A597-87 (1999)          | Specification for Cast Tool Steel                                                                                                                       |
| A602  | A602-94 (1998)          | Specification for Automotive Malleable Iron Castings                                                                                                    |
| A608  | A608-91a (1998)         | Specification for Centrifugally Cast Iron-Chromium-Nickel High-Alloy Tubing for Pressure Application at High Temperatures                               |
| A609  | A609/A609M-91 (1997)    | Practice for Castings, Carbon, Low-Alloy, and Martensitic Stainless Steel, Ultrasonic Examination Thereof                                               |
| A644  | A644-98                 | Terminology Relating to Iron Castings                                                                                                                   |
| A667  | A667/A667M-87 (1998)    | Specification for Centrifugally Cast Dual Metal (Gray and White Cast Iron) Cylinders                                                                    |
| A703  | A703/A703M-99           | Specification for Steel Castings, General Requirements, for Pressure-Containing Parts                                                                   |
| A732  | A732/A732M-98           | Specification for Castings, Investment, Carbon and Low Alloy Steel for General Application, and Cobalt Alloy for High Strength at Elevated Temperatures |
| A743  | A743/A743M-98ae1        | Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application                                           |
| A744  | A744/A744M-98a          | Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service                                                               |
| A747  | A747/A747M-99           | Specification for Steel Castings, Stainless, Precipitation Hardening                                                                                    |
| A748  | A748/A748M-87 (1998)    | Specification for Statically Cast Chilled White Iron-Gray Iron Dual Metal Rolls for Pressure Vessel Use                                                 |
| A757  | A757/A757M-00           | Specification for Steel Castings, Ferritic and Martensitic, for Pressure-Containing and Other Applications, for Low-Temperature Service                 |
| A781  | A781/A781M-99a          | Specification for Castings, Steel and Alloy, Common Requirements, for General Industrial Use                                                            |
| A799  | A799/A799M-92 (1997)    | Practice for Steel Castings, Stainless, Instrument Calibration, for Estimating Ferrite Content                                                          |
| A800  | A800/A800M-91 (1997) e1 | Practice for Steel Casting, Austenitic Alloy, Estimating Ferrite Content Thereof                                                                        |
| A802  | A802/A802M-95 (1996)    | Practice for Steel Castings, Surface Acceptance Standards, Visual Examination                                                                           |
| A823  | A823-99                 | Specification for Statically Cast Permanent Mold Gray Iron Castings                                                                                     |
| A834  | A834-95                 | Specification for Common Requirements for Iron Castings for General Industrial Use                                                                      |
| A842  | A842-85 (1997)          | Specification for Compacted Graphite Iron Castings                                                                                                      |
| A872  | A872-91 (1997)          | Specification for Centrifugally Cast Ferritic/Austenitic Stainless Steel Pipe for Corrosive Environments                                                |
| A874  | A874/A874M-98           | Specification for Ferritic Ductile Iron Castings Suitable for Low-Temperature Service                                                                   |
| A888  | A888-98e1               | Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications                            |
| A890  | A890/A890M-99           | Specification for Castings, Iron-Chromium-Nickel-Molybdenum Corrosion-Resistant, Duplex (Austenitic/Ferritic) for General Application                   |
| A897M | A897M-90 (1997)         | Specification for Austempered Ductile Iron Castings [Metric]                                                                                            |
| A897  | A897-90 (1997)          | Specification for Austempered Ductile Iron Castings                                                                                                     |
| A903  | A903/A903M-99           | Specification for Steel Castings, Surface Acceptance Standards, Magnetic Particle and Liquid Penetrant Inspection                                       |
| A915  | A915/A915M-93 (1998)    | Specification for Steel Castings, Carbon, and Alloy, Chemical Requirements Similar to Standard Wrought Grades                                           |
| A942  | A942-95                 | Specification for Centrifugally Cast White Iron/Gray Iron Dual Metal Abrasion- Resistant Roll Shells                                                    |
| A957  | A957-96                 | Specification for Investment Castings, Steel and Alloy, Common Requirements, for General Industrial Use                                                 |
| A958  | A958-96e1               | Specification for Steel Castings, Carbon, and Alloy, with Tensile Requirements, Chemical Requirements Similar to Standard Wrought Grades                |
| A985  | A985-98a                | Specification for Steel Investment Casting General Requirements, for Pressure-Containing Parts                                                          |



# Group of ASTM Standards for Steel Castings and Forgings



|       |          |                                                                                        |
|-------|----------|----------------------------------------------------------------------------------------|
| A993  | A993-98  | Test Method for Dynamic Tear Testing of Cast Irons to Establish Transition Temperature |
| A1002 | A1002-99 | Specification for Castings, Nickel-Aluminum Ordered Alloy                              |

## FORGINGS

|      |                      |                                                                                                                                 |
|------|----------------------|---------------------------------------------------------------------------------------------------------------------------------|
| A105 | A105/A105M-98        | Specification for Carbon Steel Forgings for Piping Applications                                                                 |
| A181 | A181/A181M-95b       | Specification for Carbon Steel Forgings, for General-Purpose Piping                                                             |
| A182 | A182/A182M-99        | Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service |
| A266 | A266/A266M-99        | Specification for Carbon Steel Forgings for Pressure Vessel Components                                                          |
| A275 | A275/A275M-98        | Test Method for Magnetic Particle Examination of Steel Forgings                                                                 |
| A288 | A288-91 (1998)       | Specification for Carbon and Alloy Steel Forgings for Magnetic Retaining Rings for Turbine Generators                           |
| A289 | A289/A289M-97        | Specification for Alloy Steel Forgings for Nonmagnetic Retaining Rings for Generators                                           |
| A290 | A290-95 (1999)       | Specification for Carbon and Alloy Steel Forgings for Rings for Reduction Gears                                                 |
| A291 | A291-95 (1999)       | Specification for Steel Forgings, Carbon and Alloy, for Pinions, Gears and Shafts for Reduction Gears                           |
| A314 | A314-97              | Specification for Stainless Steel Billets and Bars for Forging                                                                  |
| A336 | A336/A336M-99        | Specification for Alloy Steel Forgings for Pressure and High-Temperature Parts                                                  |
| A350 | A350/A350M-99        | Specification for Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components                  |
| A369 | A369/A369M-92        | Specification for Carbon and Ferritic Alloy Steel Forged and Bored Pipe for High-Temperature Service                            |
| A372 | A372/A372M-99        | Specification for Carbon and Alloy Steel Forgings for Thin-Walled Pressure Vessels                                              |
| A388 | A388/A388M-95        | Practice for Ultrasonic Examination of Heavy Steel Forgings                                                                     |
| A418 | A418-99              | Test Method for Ultrasonic Examination of Turbine and Generator Steel Rotor Forgings                                            |
| A456 | A456/A456M-99        | Specification for Magnetic Particle Examination of Large Crankshaft Forgings                                                    |
| A469 | A469-94a (1999)      | Specification for Vacuum-Treated Steel Forgings for Generator Rotors                                                            |
| A471 | A471-94 (1999)       | Specification for Vacuum-Treated Alloy Steel Forgings for Turbine Rotor Disks and Wheels                                        |
| A472 | A472-98              | Test Method for Heat Stability of Steam Turbine Shafts and Rotor Forgings                                                       |
| A473 | A473-99              | Specification for Stainless Steel Forgings                                                                                      |
| A484 | A484/A484M-98        | Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings                                          |
| A493 | A493-95              | Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging                                          |
| A503 | A503/A503M-99        | Specification for Ultrasonic Examination of Large Forged Crankshafts                                                            |
| A508 | A508/A508M-95 (1999) | Specification for Quenched and Tempered Vacuum-Treated Carbon and Alloy Steel Forgings for Pressure Vessels                     |
| A522 | A522/A522M-95b       | Specification for Forged or Rolled 8 and 9% Nickel Alloy Steel Flanges, Fittings, Valves, and Parts for Low-Temperature Service |
| A541 | A541/A541M-95 (1999) | Specification for Quenched and Tempered Carbon and Alloy Steel Forgings for Pressure Vessel Components                          |
| A565 | A565-97              | Specification for Martensitic Stainless Steel Bars, Forgings, and Forging Stock for High-Temperature Service                    |
| A579 | A579-99              | Specification for Superstrength Alloy Steel Forgings                                                                            |
| A592 | A592/A592M-89 (1999) | Specification for High-Strength Quenched and Tempered Low-Alloy Steel Forged Fittings and Parts for Pressure Vessels            |
| A638 | A638/A638M-00        | Specification for Precipitation Hardening Iron Base Superalloy Bars, Forgings, and Forging Stock for High-Temperature Service   |
| A646 | A646-95 (1999)       | Specification for Premium Quality Alloy Steel Blooms and Billets for Aircraft and Aerospace Forgings                            |
| A649 | A649/A649M-99        | Specification for Forged Steel Rolls Used for Corrugating Paper Machinery                                                       |
| A668 | A668/A668M-96e1      | Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use                                                  |



# Group of ASTM Standards for Steel Castings and Forgings

|              |                      |                                                                                                                                          |
|--------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| A694         | A694/A694M-00        | Specification for Carbon and Alloy Steel Forgings for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission Service   |
| A705         | A705/A705M-95        | Specification for Age-Hardening Stainless Steel Forgings                                                                                 |
| A707         | A707/A707M-00        | Specification for Forged Carbon and Alloy Steel Flanges for Low-Temperature Service                                                      |
| A711         | A711-92 (1996) e1    | Specification for Steel Forging Stock                                                                                                    |
| A723         | A723/A723M-94 (1999) | Specification for Alloy Steel Forgings for High-Strength Pressure Component Application                                                  |
| A727         | A727/A727M-97        | Specification for Carbon Steel Forgings for Piping Components with Inherent Notch Toughness                                              |
| A730         | A730-93 (1999)       | Specification for Forgings, Carbon and Alloy Steel, for Railway Use                                                                      |
| A745         | A745/A745M-94 (1999) | Practice for Ultrasonic Examination of Austenitic Steel Forgings                                                                         |
| A765         | A765/A765M-98a       | Specification for Carbon Steel and Low-Alloy Steel Pressure-Vessel-Component Forgings with Mandatory Toughness Requirements              |
| A768         | A768-95              | Specification for Vacuum-Treated 12% Chromium Alloy Steel Forgings for Turbine Rotors and Shafts                                         |
| A788         | A788-98a             | Specification for Steel Forgings, General Requirements                                                                                   |
| A831         | A831/A831M-95        | Specification for Austenitic and Martensitic Stainless Steel Bars, Billets, and Forgings for Liquid Metal Cooled Reactor Core Components |
| A836 Service | A836/A836M-95b       | Specification for Titanium-Stabilized Carbon Steel Forgings for Glass-Lined Piping and Pressure Vessel                                   |
| A837         | A837-91 (1996) e1    | Specification for Steel Forgings, Alloy, for Carburizing Applications                                                                    |
| A859         | A859/A859M-95 (1999) | Specification for Age-Hardening Alloy Steel Forgings for Pressure Vessel Components                                                      |
| A891         | A891-98              | Specification for Precipitation Hardening Iron Base Superalloy Forgings for Turbine Rotor Disks and Wheels                               |
| A909         | A909-94 (1999)       | Specification for Steel Forgings, Microalloy, for General Industrial Use                                                                 |
| A921         | A921/A921M-93 (1999) | Specification for Steel Bars, Microalloy, Hot-Wrought, Special Quality, for Subsequent Hot Forging                                       |
| A952         | A952/A952M-98        | Specification for Forged Grade 80 and Grade 100 Steel Lifting Components and Welded Attachment Links                                     |
| A961         | A961-99              | Specification for Common Requirements for Steel Flanges, Forged Fittings, Valves, and Parts for Piping Applications                      |
| A965         | A965/A965M-99        | Specification for Steel Forgings, Austenitic, for Pressure and High Temperature Parts                                                    |
| A966         | A966/A966M-96        | Test Method for Magnetic Particle Examination of Steel Forgings Using Alternating Current                                                |



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| <input type="checkbox"/> <b>TPS-Techniseal®* - OCTG - Premium coupling<br/>connections for tubing and casing</b>         | <input type="checkbox"/> <b>Titanium Tubes Seamless and Welded</b>                                               |
| <input type="checkbox"/> <b>TPS-Multiseal®* - Two step premium integral tubing<br/>connections</b>                       | <input type="checkbox"/> <b>Supply Range</b>                                                                     |
| <input type="checkbox"/> <b>TPS-Multiseal®* - Flush Joint - Two step premium<br/>flush joint connections</b>             | <input type="checkbox"/> <b>Heat exchanger- and condenser tubes ex stock</b>                                     |
| <input type="checkbox"/> <b>API Drill Pipe</b>                                                                           | <input type="checkbox"/> <b>Non-Ferrous heat exchanger &amp; condenser tubes</b>                                 |
| <input type="checkbox"/> <b>OCTG - High quality tubular products and<br/>accessories</b>                                 | <input type="checkbox"/> <b>Extended surface tubes - Fin tubes</b>                                               |
|                                                                                                                          | <input type="checkbox"/> <b>Tube &amp; Pipe Sizes - Databook 4th edition</b>                                     |
|                                                                                                                          | <input type="checkbox"/> <b>Datasheet TP405/TP410/TP410S</b>                                                     |
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Country .....

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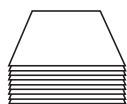
e-mail .....

City .....

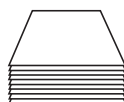
Department/Function .....

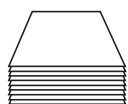
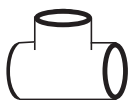
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Notes





Notes

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