

MSC
Madhukar Steel Centre

Manufacturer, Stockists & Suppliers of :

Stainless Steel, Carbon Steel, Alloy Steel, Tubes, Pipes, Sheets, Plates, Rods, Strips, Pipe Fittings, Ferrous & Non - Ferrous Metals, Other Industrial Raw Materials etc.



We are committed to continuously upgrade our knowledge and skills to improve the efficiency of our organisation and strive for outstanding quality of our products.

We assure quality of our products by satisfying the customer's requirement and by perfecting our systems and procedures through involvement of our employees.

We promise to deliver : Quality service at the most reasonable price, at the right time, at the right place and with right documents.

BUTT-WELD FITTINGS

BUTT-WELD FITTINGS :

Stainless Steel: ASTM A403 WP 304/ 304L/ 304H /316/ 316U 317L/ 321/ 310S/ 347/ 347H/ 904L etc.

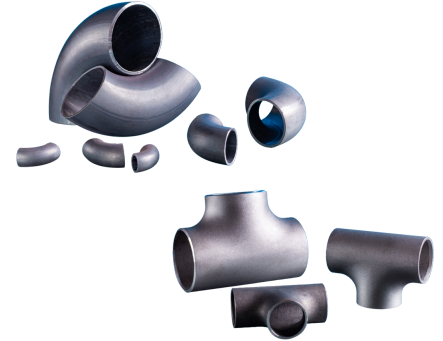
Carbon Steel: ASTM A234 WPB/ A420 WPL3/ A420 WPL6/ WPHY 42/46/52/56/60/65/70.

Alloy Steel: ASTM A234 WPI/ WP5/ WP9/ WP11/ WP22/MP91 etc.

Types: Elbow Tee, Reducer, Return Bends, Stub-Ends, Cap, Collar, Cross, Insert etc.

Size: 1 1/4" NB TO 32" NB. (Seamless & Welded)

Wall Thickness: Sch. 5S To Sch. XXS.



FLANGES

FLANGES:

Stainless Steel: ASTM A182 F304/ 304L/ 304H/ 316/ 316L/ 317/ 317L/ 321/ 310S/ 347/ 347H/ 904L/ etc.

Carbon Steel : ASTM A105/ A694/ F42/46/52/56/60/65/70/A350 LF3/A350 LF2, etc.

Alloy Steel : ASTM A182 F1/F5/F9/F11/F22/F91 etc.

Types: Weldneck, Slipon, Blind, Socket Weld, Lap Joint, Spectacles, Ring Joint, Oriface, Long Weldneck, Deck Flange, etc.

Size: 1 1/2" NB TO 24" NB.

Class: 150#, 300#, 400#, 600#, 900#, 1500# & 2500#.



SOCKET - WELD FITTING

SOCKET - WELD FITTINGS:

Stainless Steel: ASTM A182 F304/ 304L/ 304H/ 316/ 316L/ 317/ 317L/ 321/ 310S/ 347/ 347H/ 904L etc.

Carbon Steel : ASTM A105/ A694 F42/46/52/56/60/65/70/A350 LF3/A350 LF2.

Alloy Steel: ASTM A182 F1/F5/F9/F11/F22/F91 etc.

Types: Elbow, Tee, Union, Cross, Coupling Bushing, Plug, Swage Nipple, Welding Boss, Hexagon Nipple, Barrel Nipple, Welding Nipple, Parallel Nipple, Street Elbow, Hexagon Nut, Hose Nipple, Bend, Adapter, Insert, Weldolet, Elbowlet, Socketlet, Thredolet, Nipolet, Letrolet, etc.

Size: 1/4" NB TO 4" NB. (Socket weld & Threaded)

Class: 3000#, 6000#, 9000#.

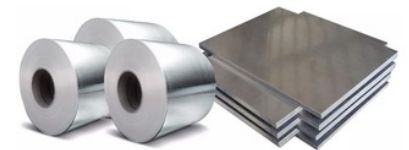


PLATES & COILS

PLATES & COILS :

Material Grade: Stainless Steel, Nickel Alloys, Carbon Steel, Corrosion Resistant, Wear Resistant, Alloy Steel,

Types: Sheet, Plates, Strips, Coils etc.



FASTENERS:

Stainless Steel: AISI 302, 304, 304L, 316, 316L, 310S, 317L, 321, 347, 410, 420, 904L etc.

Alloy Steel: 4.6, 5.6, 6.6, 8.8, 10.9 & 12.9 / 'R', 'S', 'T' Conditions.

Carbon Steel: Bare Condition, Galvanized, Phosphetised, Cadmium Plated, Hot Deep Galvanized, Blackened, Nickel Chrome Plated, etc.

Types: Bolts, Nuts, Washers, Anchor Fasteners, Stud Bolts, Eye Bolt, Stud, Threaded Rod, Cotter Pin, Socket Screw, Fine Fasteners & Spares, Foundation Fasteners, etc.



STAINLESS STEEL SCHEDULE PIPE & DIMENSION

| DESIGNATION OF DIAMETER | | | NOMINAL WALL THICKNESS | | | | | | | | | | | | | | | |
|-------------------------|-------|--------------|------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | | | SCH.5S | | SCH.5 | | SCH.10S | | SCH.10 | | SCH.20 | | SCH.30 | | SCH.40S | | SCH.40 | |
| DN | NPS | DIA METER MM | WALL THK (MM) | WEIGHT KG/MTR | WALL THK (MM) | WEIGHT KG/MTR | WALL THK (MM) | WEIGHT KG/MTR | WALL THK (MM) | WEIGHT KG/MTR | WALL THK (MM) | WEIGHT KG/MTR | WALL THK (MM) | WEIGHT KG/MTR | WALL THK (MM) | WEIGHT KG/MTR | WALL THK (MM) | WEIGHT KG/MTR |
| 6 | 1/8 | 10.3 | | | | | 1.24 | 0.28 | | | | | | | 1.73 | 0.37 | | |
| 8 | 1/4 | 13.7 | | | | | 1.65 | 0.49 | | | | | | | 2.24 | 0.63 | | |
| 10 | 3/8 | 17.1 | | | | | 1.65 | 0.63 | | | | | | | 2.31 | 0.84 | | |
| 15 | 1/2 | 21.3 | 1.65 | 0.80 | | | 2.11 | 1.00 | | | | | | | 2.77 | 1.27 | | |
| 20 | 3/4 | 26.7 | 1.65 | 1.02 | | | 2.11 | 1.28 | | | | | | | 2.87 | 1.69 | | |
| 25 | 1 | 33.4 | 1.65 | 1.29 | | | 2.77 | 2.09 | | | | | | | 3.38 | 2.50 | | |
| 32 | 1-1/4 | 42.2 | 1.65 | 1.65 | | | 2.77 | 2.69 | | | | | | | 3.56 | 3.39 | | |
| 40 | 1-1/2 | 48.3 | 1.65 | 1.90 | | | 2.77 | 3.11 | | | | | | | 3.68 | 4.05 | | |
| 50 | 2 | 60.3 | 1.65 | 2.39 | | | 2.77 | 3.93 | | | | | | | 3.91 | 5.44 | | |
| 65 | 2-1/2 | 73.0 | 2.11 | 3.69 | | | 3.05 | 5.26 | | | | | | | 5.16 | 8.63 | | |
| 80 | 3 | 88.9 | 2.11 | 4.52 | | | 3.05 | 6.46 | | | | | | | 5.49 | 11.29 | | |
| 90 | 3-1/2 | 101.6 | 2.11 | 5.18 | | | 3.05 | 7.41 | | | | | | | 5.74 | 13.57 | | |
| 100 | 4 | 114.3 | 2.11 | 5.84 | | | 3.05 | 8.37 | | | | | | | 6.02 | 16.08 | | |
| 125 | 5 | 141.3 | 2.77 | 9.46 | | | 3.40 | 11.56 | | | | | | | 6.55 | 21.77 | | |
| 150 | 6 | 168.3 | 2.77 | 11.31 | | | 3.40 | 13.83 | | | | | | | 7.11 | 28.26 | | |
| 200 | 8 | 219.1 | 2.77 | 14.78 | | | 3.76 | 19.97 | | | 6.35 | 33.31 | 7.04 | 36.31 | 8.18 | 42.55 | | |
| 250 | 10 | 273.1 | 3.40 | 22.61 | | | 4.19 | 27.79 | | | 6.35 | 41.75 | 7.80 | 51.01 | 9.27 | 60.31 | | |
| 300 | 12 | 323.9 | 3.96 | 31.25 | | | 4.57 | 35.99 | | | 6.35 | 49.71 | 8.38 | 65.18 | 9.53 | 73.88 | 10.31 | 79.70 |
| 350 | 14 | 355.6 | 3.96 | 34.34 | | | 4.78 | 41.36 | 6.35 | 54.69 | 7.92 | 67.90 | 9.53 | 81.23 | 9.53 | 81.33 | 11.13 | 94.55 |
| 400 | 16 | 406.4 | 4.19 | 41.56 | | | 4.78 | 47.34 | 6.35 | 62.64 | 7.92 | 77.83 | 9.53 | 93.27 | 9.53 | 93.27 | 12.70 | 123.30 |
| 450 | 18 | 457.0 | 4.19 | 46.79 | | | 4.78 | 53.31 | 6.35 | 70.60 | 7.92 | 87.75 | 11.13 | 122.43 | 9.53 | 105.10 | 14.27 | 155.87 |
| 500 | 20 | 508.0 | 4.78 | 59.32 | | | 5.54 | 68.65 | 6.35 | 78.55 | 9.53 | 117.15 | 12.70 | 155.13 | 9.53 | 117.15 | 15.09 | 183.42 |
| 550 | 22 | 559.0 | 4.78 | 65.33 | | | 5.54 | 75.62 | 6.35 | 86.54 | 9.53 | 131.07 | 12.70 | 171.09 | | | | |
| 600 | 24 | 610.0 | 5.54 | 82.58 | | | 6.35 | 94.53 | 6.35 | 94.53 | 9.53 | 141.12 | 14.27 | 209.05 | 9.53 | 141.12 | 17.48 | 255.24 |
| 750 | 30 | 762.0 | 6.35 | 118.34 | | | 7.92 | 147.29 | 7.92 | 147.28 | 12.70 | 234.67 | 15.88 | 292.18 | | | | |

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WALL THICKNESS & WEIGHT / METER

| NOMINAL WALL THICKNESS | | | | | | | | | | | | | | | |
|------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| SCH 60 | | SCH 80 S | | SCH.80 | | SCH.100 | | SCH.120 | | SCH.140 | | SCH.160 | | SCH.XXS | |
| WALL THK (MM) | WEIGHT KG/MTR | WALL THK (MM) | WEIGHT KG/MTR | WALL THK (MM) | WEIGHT KG/MTR | WALL THK (MM) | WEIGHT KG/MTR | WALL THK (MM) | WEIGHT KG/MTR | WALL THK (MM) | WEIGHT KG/MTR | WALL THK (MM) | WEIGHT KG/MTR | WALL THK (MM) | WEIGHT KG/MTR |
| | | 2.41 | 0.47 | | | | | | | | | | | | |
| | | 3.02 | 0.80 | | | | | | | | | | | | |
| | | 3.20 | 1.10 | | | | | | | | | | | | |
| | | 3.73 | 1.62 | | | | | | | | | | | | |
| | | 3.91 | 2.20 | | | | | | | | | 4.78 | 1.95 | 7.47 | 2.55 |
| | | 4.55 | 3.24 | | | | | | | | | 5.56 | 2.90 | 7.82 | 3.64 |
| | | 4.85 | 4.47 | | | | | | | | | 6.35 | 4.24 | 9.09 | 5.45 |
| | | 5.08 | 5.41 | | | | | | | | | 6.35 | 5.61 | 9.70 | 7.77 |
| | | 5.54 | 7.48 | | | | | | | | | 7.14 | 7.25 | 10.15 | 9.56 |
| | | 7.01 | 11.41 | | | | | | | | | 8.74 | 11.11 | 11.07 | 13.44 |
| | | 7.62 | 15.27 | | | | | | | | | 9.53 | 14.90 | 14.02 | 20.39 |
| | | 8.08 | 18.64 | | | | | | | | | 11.13 | 21.35 | 15.24 | 27.68 |
| | | 8.56 | 22.32 | | | | | 11.13 | 28.75 | | | 13.49 | 33.54 | 17.12 | 41.03 |
| | | 9.53 | 30.97 | | | | | 12.70 | 40.90 | | | 15.88 | 49.11 | 19.05 | 57.43 |
| | | 10.97 | 42.56 | | | | | 14.27 | 55.03 | | | 18.26 | 67.56 | 21.95 | 79.22 |
| 10.31 | 53.08 | 12.70 | 64.64 | | | 15.09 | 75.92 | 18.26 | 90.44 | 20.62 | 100.92 | 23.01 | 111.27 | 22.23 | 107.88 |
| 12.70 | 81.52 | 12.70 | 81.56 | 15.09 | 95.97 | 18.26 | 114.70 | 21.44 | 133.00 | 25.40 | 155.09 | 28.58 | 172.21 | 25.40 | 155.09 |
| 14.27 | 108.92 | 12.70 | 97.47 | 17.48 | 132.04 | 21.44 | 159.86 | 25.40 | 186.91 | 28.58 | 208.00 | 33.32 | 238.68 | 25.40 | 186.91 |
| 15.09 | 126.71 | 12.70 | 107.40 | 19.05 | 158.10 | 23.83 | 194.96 | 27.79 | 224.65 | 31.75 | 253.56 | 35.71 | 281.70 | | |
| 16.66 | 106.12 | 12.70 | 123.31 | 21.44 | 203.53 | 26.19 | 245.56 | 30.96 | 286.64 | 36.53 | 333.19 | 40.49 | 365.35 | | |
| 19.05 | 205.83 | 12.70 | 139.20 | 23.83 | 254.67 | 29.36 | 309.76 | 34.93 | 363.64 | 39.67 | 408.45 | 45.24 | 459.59 | | |
| 20.62 | 247.83 | 12.70 | 155.13 | 26.19 | 311.17 | 32.54 | 381.53 | 38.10 | 441.49 | 44.45 | 508.11 | 50.01 | 564.81 | | |
| 22.23 | 294.25 | | | 28.57 | 373.83 | 34.93 | 451.42 | 41.28 | 527.02 | 47.63 | 600.63 | 53.98 | 672.26 | | |
| 24.59 | 355.02 | 12.70 | 187.07 | 30.96 | 441.78 | 38.89 | 547.33 | 46.02 | 639.58 | 52.37 | 719.63 | 59.54 | 807.63 | | |
| | | 12.70 | 238.28 | | | | | | | | | | | | |

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CHEMICAL REQUIREMENTS OF STAINLESS STEEL PIPES AS PER ASTM A312

| Grade | UNS Designation ^a | Composition, % ^b | | | | | | | | | |
|---------|------------------------------|-----------------------------|-----------|------------|--------|---------|-----------|------------------------|------------|-----------------------|------------------|
| | | Carbon | Manganese | Phosphorus | Sulfur | Silicon | Chromium | Nickel | Molybdenum | Nitrogen ^c | Other Elements |
| TP304 | S30400 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 | 18.0-20.0 | 8.0-11.0 | ... | ... | ... |
| TP304L | S30403 | 0.035 ^d | 2.00 | 0.045 | 0.030 | 1.00 | 18.0-20.0 | 8.0-13.0 | ... | ... | ... |
| TP304H | S30409 | 0.04-0.10 | 2.00 | 0.045 | 0.030 | 1.00 | 18.0-20.0 | 8.0-11.0 | ... | ... | ... |
| TP304LN | S30453 | 0.035 | 2.00 | 0.045 | 0.030 | 1.00 | 18.0-20.0 | 8.0-12.0 | ... | 0.10-0.16 | ... |
| TP309S | S30908 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 | 22.0-24.0 | 12.0-15.0 | 0.75 | ... | ... |
| TP309H | S30909 | 0.04-0.10 | 2.00 | 0.045 | 0.030 | 1.00 | 22.0-24.0 | 12.0-15.0 | ... | ... | ... |
| TP310S | S31008 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 | 24.0-26.0 | 19.0-22.0 | 0.75 | ... | ... |
| TP310H | S31009 | 0.04-0.10 | 2.00 | 0.045 | 0.030 | 1.00 | 24.0-26.0 | 19.0-22.0 | ... | ... | ... |
| TP316 | S31600 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 | 16.0-18.0 | 11.0-14.0 ^e | 2.00-3.00 | ... | ... |
| TP316L | S31603 | 0.035 ^d | 2.00 | 0.045 | 0.030 | 1.00 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | ... | ... |
| TP316H | S31609 | 0.04-0.10 | 2.00 | 0.045 | 0.030 | 1.00 | 16.0-18.0 | 11.0-14.0 ^e | 2.00-3.00 | ... | ... |
| TP316LN | S31653 | 0.035 | 2.00 | 0.045 | 0.030 | 1.00 | 16.0-18.0 | 11.0-14.0 ^e | 2.00-3.00 | 0.10-0.16 | ... |
| TP317 | S31700 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 | 18.0-20.0 | 11.0-14.0 | 3.0-4.0 | ... | ... |
| TP317L | S31703 | 0.035 | 2.00 | 0.045 | 0.030 | 1.00 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | ... | ... |
| TP321 | S32100 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 | 17.0-19.0 | 9.0-12.0 | ... | 0.10 | Ti (5 X C)-0.70 |
| TP321H | S32109 | 0.04-0.10 | 2.00 | 0.045 | 0.030 | 1.00 | 17.0-19.0 | 9.0-12.0 | ... | ... | Ti (4 X C)-0.60 |
| TP347 | S34700 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 | 17.0-19.0 | 9.0-13.0 | ... | ... | Cb (10 X C)-1.00 |
| TP347H | S34709 | 0.04-0.10 | 2.00 | 0.045 | 0.030 | 1.00 | 17.0-19.0 | 9.0-13.0 | ... | ... | Cb (8 x C)-1.00 |

- Maximum, unless otherwise indicated.
- New designation established in accordance with Practice E527 and SAE J 1086.
- The method of analysis for nitrogen shall be a matter of agreement between the purchaser and manufacturer.
- For small diameter or thin walls or both, where many drawing passes are required, a carbon maximum of 0.040% is necessary in grades TP304L and TP316L. Small Outside diameter tubes are defined as those less than 0.500 in. (12.7mm) in outside diameter and light wall tubes as those less than 0.049 in. (1.20mm) in average wall thickness [0.44 in. (1.10mm) in minimum wall thickness].
- For welded TP316, TP316LN, and TP316H pipe, the nickel range shall be 10.0-14.0%

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TENSILE REQUIREMENTS AS PER ASTM A312

LENGTHS

Pipe lengths shall be in accordance with the following regular practice :

1. Unless otherwise agreed upon, all size from NPS ½ to and including NPS 8 are available in a length up to 24 ft with the permissible range of 15 to 24 ft. Short lengths are acceptable and the number and minimum length shall be agreed upon between the manufacturer and the purchaser.

HEAT TREATMENT

All pipe shall be furnished in the heat - treated condition in accordance with the requirements as mentioned below. Alternatively, for seamless pipe, immediately following hot forming while the temperature of the pipes in not less than the specified minimum solution treatment temperature pipes may be individually quenched in water or rapidly cooled by other means.

ANNEALING REQUIREMENTS AS PER ASTM A312

| Grade or UNS Designation ^a | Heat treating Temperature ^a | Cooling/Testing Requirements |
|---|--|------------------------------|
| All grades not individually listed below: | 1900°F [1040°C] | c |
| TP321H, TP347H, | | |
| Cold finished | 2000°F [1100°C] | d |
| Hot finished | 1925°F [1050°C] | d |
| TP304H, TP316H | | |
| Cold Finished | 1900°F [1040°C] | d |
| Hot Finished | 1900°F [1040°C] | d |
| TP309H, TP310H | 1900°F [1040°C] | d |

New designation established in accordance with Practice E 527 and SAE J1086. Minimum unless otherwise stated. Quenched in water or rapidly cooled by other means, at a rate sufficient to prevent re-precipitation of carbides, as demonstrable by the capability of passing Practices A 262, Practice E. The manufacturer is not required to run the test unless it is specified on the purchase order (see Supplementary Requirement 57). Note that Practices A 262 requires the test to be performed on sensitized specimens in the low-carbon and stabilized types and on specimens representative of the as-shipped condition for other types. In the case of low-carbon types containing 3% or more molybdenum, the applicability of the sensitizing treatment prior to testing shall be a matter for negotiation between the seller and the purchaser Quenched in water or rapidly cooled by other means

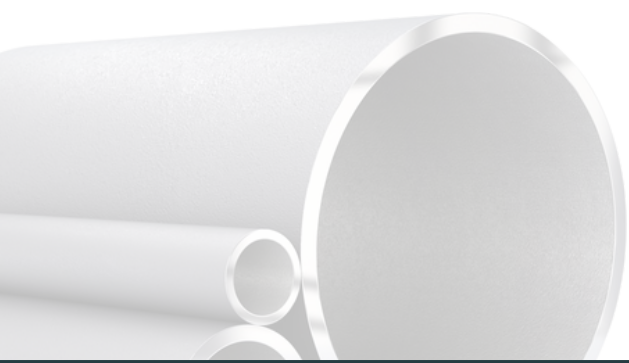
| Grade | UNS Designation | Tensile Strength, min ksi [MPa] | Yield Strength, min ksi [MPa] |
|------------|-----------------|---------------------------------|-------------------------------|
| TP304 | S30400 | 75 [515] | 30 [205] |
| TP304L | S30403 | 70 [485] | 25 [170] |
| TP304H | S30409 | 75 [515] | 30 [205] |
| TP304LN | S30453 | 75 [515] | 30 [205] |
| TP309S | S30908 | 75 [515] | 30 [205] |
| TP309H | S30909 | 75 [515] | 30 [205] |
| TP310S | S31008 | 75 [515] | 30 [205] |
| TP310H | S31009 | 75 [515] | 30 [205] |
| TP316 | S31600 | 75 [515] | 30 [205] |
| TP316L | S31603 | 70 [485] | 25 [170] |
| TP316H | S31609 | 75 [515] | 30 [205] |
| TP316LN | S31653 | 75 [515] | 30 [205] |
| TP317 | S31700 | 75 [515] | 30 [205] |
| TP317L | S31703 | 75 [515] | 30 [205] |
| TP321 | S32100: | | |
| Welded | | 75 [515] | 30 [205] |
| Seamless: | | | |
| ≤ ¾ in. | | 75 [515] | 30 [205] |
| > ¾ in. | | 70 [485] | 25 [170] |
| TP321H | S32109: | | |
| Welded | | 75 [515] | 30 [205] |
| Seamless: | | | |
| ≤ ¾ in. | | 75 [515] | 30 [205] |
| > ¾ in. | | 70 [480] | 25 [170] |
| TP347 | S34700 | 75 [515] | 30 [205] |
| TP347H | S34709 | 75 [515] | 30 [205] |
| All Grades | | 35 | 25 |

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TOLERANCE : ASTM SPECIFICATION FOR TUBING & PIPING

| Specification | Allowable Outside Diameter Variation in mm | | | Allowable Wall Thickness Variation | | Exact Length Testing Tolerance in mm | | |
|---|--|------------|-------|---|--------|--------------------------------------|-------|---|
| | Nominal Diameter | Over | Under | %Over | %Under | Over | Under | |
| ASTM-A213 Seamless Boiler Superheater and Heat Exchanger Tubes | Under 25.4 | .101 | .101 | +20% | -0 | 3.175 | 0 | Tension Test Flattening Test Flare Test Hardness Test 100% Hydrostatic test Refer to ASTM A-450 |
| | 25.4-38.1 incl | .152 | .152 | +22% | -0 | 3.175 | 0 | |
| | 38.1-50.8 excl | .203 | .203 | +22% | -0 | 3.176 | 0 | |
| | 50.8-63.5 excl | .254 | .254 | +22% | -0 | 4.46 | 0 | |
| | 63.5-76.2 excl | .304 | .304 | +22% | -0 | 4.76 | 0 | |
| 76.2-101.6 incl | .381 | .381 | +22% | -0 | 4.76 | 0 | | |
| ASTM-A249 Welded Boiler Superheater, Heat Exchanger And Condenser Tubes | Under 25.4 | .101 | .101 | +10% | -10% | 3.175 | 0 | Tension Test Flattening Test Flare Test Reverse Bend Test Hardness Test 100% Hydrostatic Test *Reverse flattening Test Refer to ASTM A-450 *Wherever applicable |
| | 25.4 - 38.1 incl | .152 | .152 | +10% | -10% | 3.175 | 0 | |
| | 38.1-50.8 Excl | .203 | .203 | +10% | -10% | 3.175 | 0 | |
| | 50.0-63.5 excl | .254 | .254 | +10% | -10% | 4.76 | 0 | |
| | 63.5-76.2 excl | .384 | .304 | +10% | -10% | 4.76 | 0 | |
| 76.2-101.6 incl | .381 | .381 | +10% | -10% | 4.76 | 0 | | |
| | | | | Minimum Wall tubes + 18% 0 available On request | | | | |
| ASTM-A269 Seamless & Welded Tubing for General Service | Upto 12.7 | .13 | .13 | +15% | -15% | 3.2 | 0 | Flare Test Flange Test (Welded Only) Hardness Test Reverse Flattening Test (Welded only) 100% Hydrostatic Test Refer to ASTM-A269 |
| | 12.7- 48.3 excl | .13 | .13 | +10% | -10% | 3.2 | 0 | |
| | 48.3 - 101.6 excl | .25 | .25 | +10% | -10% | 4.8 | 0 | |
| | 101.6 - 139.7 excl | .38 | .38 | +10% | -10% | 4.8 | 0 | |
| | 139.7-203.2 excl | .76 | .76 | +10% | -10% | 4.8 | 0 | |
| ASTM-A270 Seamless & Welded Sanitary Tubing | 38.1 and under | .05 | .20 | +12.5% | -12.5% | 3.2 | 0 | Reverse flattening Test 100% Hydrostatic Test External polish on all tubes Refer to ASTM A-270 |
| | 38.1 - 63.5 | .05 | .28 | +12.5% | -12.5% | 3.2 | 0 | |
| | 63.5 - 76.2 | .08 | .30 | +12.5% | -12.5% | 3.2 | 0 | |
| | 76.2 - 101.6 | .08 | .38 | +12.5% | -12.5% | 3.2 | 0 | |
| | 101.6 - 139.7 excl | .38 | .38 | +12.5% | -12.5% | 4.8 | 0 | |
| | 139.7 - 203.2 excl | .76 | .76 | +12.5% | -12.5% | 4.8 | 0 | |
| ASTM-A312 Seamless & Welded pipes | 10.3 - 48.3, incl | .40 | .40 | Minimum Wall Thickness 12.5% under nominal wall thickness Specified | | 6.4 | 0 | Tension Test Flattening Test 100% Hydrostatic Test Refer to ASTM A-530 (Normally Random Lengths ordered) |
| | 48.3 - 114.3, incl | .79 | .79 | | | 6.4 | 0 | |
| | 114.3 - 219.1, incl | 1.59 | .79 | | | 6.4 | 0 | |
| | 219.1 - 457.2, incl | 2.38 | .79 | | | | | |
| | 457.2 - 660.4, incl | 3.18 | .79 | | | | | |
| ASTM A-358 Welded pipe | 219.1 - 750 | + / - 0.5% | | Thickness at any point shall not be more than 0.3mm under the nominal thickness. | | 6.0 | | Refer to ASTM A-530 |

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1, ASTM/ASME : STEEL TUBES FOR HEAT TRANSFER

(1) Chemical Requirement and Tensile Requirement

| Specification Code | Grade Designation | Manufacturing Method | Chemical Requirements | | | | | | | | | | | Heat Treatment (3) | | | Tensile Requirements | | |
|--------------------|-------------------|----------------------|-----------------------|-----------|---------|---------|-----------|-----------|------------|-----------|-----------|--------------|-----------------------|------------------------|---------------|--------------------------|------------------------|----------------------|--|
| | | | C% | Mn% | P% max. | S% max. | S% | N% | Cr% | Mo% | V% | other% | Hot Finished Seamless | Cold Finished Seamless | As welded ERW | Tensile Strength Mpa min | Yield strength Mpa min | Elongation min % (L) | |
| A 53 | A | S,E | ≤ 0.25 | ≤ 0.95 | 0.050 | 0.045 | - | ≤ 0.40 | ≤ 0.4 | ≤ 0.15 | ≤ 0.08 | Cu ≤ 0.4 | - | - | - | 330 | 205 | (4) | |
| SA 53 | B | S,E | ≤ 0.30 | ≤ 1.20 | 0.050 | 0.045 | - | ≤ 0.40 | ≤ 0.40 | ≤ 0.15 | ≤ 0.8 | Cu ≤ 0.4 | - | - | SA | 415 | 240 | (4) | |
| A106 | A | S | ≤ 0.25 | 0.27-0.93 | 0.035 | 0.035 | ≥ 0.10 | ≤ 0.40 | ≤ 0.40 | ≤ 0.15 | ≤ 0.08 | Cu ≤ 0.4 | - | A | - | 330 | 205 | 35 | |
| SA 106 | B | S | ≤ 0.30 | 0.29-1.06 | 0.035 | 0.035 | ≥ 0.10 | ≤ 0.40 | ≤ 0.40 | ≤ 0.15 | ≤ 0.08 | Cu ≤ 0.4 | - | A | - | 415 | 240 | 30 | |
| | C | S | ≤ 0.35 | 0.29-1.06 | 0.035 | 0.035 | ≥ 0.10 | ≤ 0.40 | ≤ 0.40 | ≤ 0.15 | ≤ 0.08 | Cu ≤ 0.4 | - | A | - | 485 | 275 | 30 | |
| A 135 | A | E | ≤ 0.25 | ≤ 0.95 | 0.035 | 0.035 | - | - | - | - | - | - | - | - | - | 331 | 207 | 35 | |
| SA 135 | B | E | ≤ 0.30 | ≤ 1.20 | 0.035 | 0.035 | - | - | - | - | - | - | - | - | SA | 414 | 241 | 30 | |
| A 333 | 1 | S | ≤ 0.30 | 0.40-1.06 | 0.025 | 0.025 | - | - | - | - | - | - | N, NQ | N, NQ | N, NQ | 380 | 205 | 35 | |
| SA 333 | 3 | S | ≤ 0.19 | 0.31-0.64 | 0.025 | 0.025 | 0.18-0.37 | 3.18-3.82 | - | - | - | - | N | N | N | 450 | 240 | 30 | |
| | 4 | S | ≤ 0.12 | 0.50-1.05 | 0.025 | 0.025 | 0.08-0.37 | 0.47-0.98 | 0.44-0.01 | - | - | - | N | N | N | 415 | 240 | 30 | |
| | 6 | S | ≤ 0.30 | 0.29-1.06 | 0.025 | 0.025 | ≥ 0.10 | - | - | - | - | - | N, NQ | N, NQ | N, NQ | 415 | 240 | 30 | |
| | 7 | S | ≤ 0.19 | ≤ 0.90 | 0.025 | 0.025 | 0.13-0.32 | 2.03-2.57 | - | - | - | - | N | N | N | 450 | 240 | 30 | |
| | 8 | S8 | ≤ 0.13 | ≤ 0.90 | 0.025 | 0.025 | 0.13-0.32 | 8.40-9.60 | - | - | - | - | QT, DNT | QT, DNT | QT, DNT | 690 | 515 | 22 | |
| | 9 | S | ≤ 0.20 | 0.40-0.80 | 0.025 | 0.025 | - | 1.60-2.24 | - | - | - | Cu 0.75-1.25 | N | N | N | 435 | 315 | 28 | |
| | 10 | S | ≤ 0.20 | 1.15-1.50 | 0.035 | 0.015 | 0.10-0.35 | ≤ 0.25 | ≤ 0.15 | ≤ 0.05 | ≤ 0.12 | - | NQ | NQ | NQ | 550 | 450 | 22 | |
| | 11 | S | ≤ 0.10 | ≤ 0.60 | 0.025 | 0.025 | ≤ 0.35 | 35.0-37.0 | ≤ 0.50 | ≤ 0.50 | - | Co ≤ 0.50 | AN | AN | AN | 450 | 240 | 18 | |
| A 335 | P1 | S | 0.10-0.20 | 0.30-0.60 | 0.025 | 0.025 | 0.10-0.50 | - | - | 0.44-0.65 | - | - | A | A | A | 380 | 205 | 30 | |
| SA 335 | P2 | S | 0.10-0.20 | 0.30-0.67 | 0.025 | 0.025 | 0.10-0.30 | - | 0.50-0.81 | 0.44-0.65 | - | - | A | A | A | 380 | 205 | 30 | |
| | P5 | S | ≤ 0.15 | 0.30-0.60 | 0.025 | 0.025 | ≤ 0.50 | - | 4.00-6.00 | 0.45-0.65 | - | - | FA, IA, NT | FA, IA, NT | FA, IA, NT | 415 | 205 | 30 | |
| | P5b | S | ≤ 0.15 | 0.30-0.60 | 0.025 | 0.025 | 1.00-2.00 | - | 4.00-6.00 | 0.45-0.65 | - | - | FA, IA, NT | FA, IA, NT | FA, IA, NT | 415 | 205 | 30 | |
| | P5c | S | ≤ 0.12 | 0.30-0.60 | 0.025 | 0.025 | ≤ 0.50 | - | 4.00-6.00 | 0.45-0.65 | - | - | A | A | A | 415 | 205 | 30 | |
| | P9 | S | ≤ 0.15 | 0.30-0.60 | 0.025 | 0.025 | 0.25-1.00 | - | 8.00-10.00 | 0.90-1.10 | - | - | FA, IA, NT | FA, IA, NT | FA, IA, NT | 415 | 205 | 30 | |
| | P11 | S | 0.05-0.15 | 0.30-0.60 | 0.025 | 0.025 | 0.50-1.00 | - | 1.00-1.50 | 0.44-0.65 | - | - | FA, IA, NT | FA, IA, NT | FA, IA, NT | 415 | 205 | 30 | |
| | P12 | S | 0.05-0.15 | 0.30-0.61 | 0.025 | 0.025 | ≤ 0.50 | - | 0.80-1.25 | 0.44-0.65 | - | - | A | A | A | 415 | 220 | 30 | |
| | P15 | S | 0.05-0.15 | 0.30-0.60 | 0.025 | 0.025 | 1.15-1.65 | - | - | 0.44-0.65 | - | - | FA, IA, NT | FA, IA, NT | FA, IA, NT | 415 | 205 | 30 | |
| | P21 | S | 0.05-0.05 | 0.30-0.60 | 0.025 | 0.025 | ≤ 0.50 | - | 2.65-3.35 | 0.80-1.06 | - | - | FA, IA, NT | FA, IA, NT | FA, IA, NT | 415 | 205 | 30 | |
| | P22 | S | 0.05-0.15 | 0.30-0.60 | 0.025 | 0.025 | ≤ 0.50 | - | 1.90-2.60 | 0.87-1.13 | - | - | FA, IA, NT | FA, IA, NT | FA, IA, NT | 415 | 205 | 30 | |
| | P23 | S | 0.04-0.10 | 0.10-0.60 | 0.030 | 0.010 | ≤ 0.50 | - | 1.90-2.60 | 0.05-0.30 | 0.20-0.30 | (2) | NT | NT | NT | 510 | 400 | 20 | |
| | P91 | S | 0.08-0.12 | 0.30-0.60 | 0.020 | 0.010 | 0.20-0.50 | ≤ 0.40 | 8.00-9.50 | 0.85-1.05 | 0.18-0.25 | (2) | NT | NT | NT | 585 | 415 | 20 | |
| | P92 | S | 0.07-0.13 | 0.30-0.60 | 0.020 | 0.010 | ≤ 0.50 | ≤ 0.40 | 8.50-9.50 | 0.30-0.60 | 0.15-0.25 | (2) | NT | NT | NT | 620 | 440 | 20 | |

Note :

(1) Manufacturing Method

E : Electric resistance welded process

S : Seamless process hot finished and cold finished

S-C : Seamless process and cold finished

(2) Other elements

%

T2, T12 : S 0.045 max (permissible to order)

(3) Other elements

%

T5C : $4 \times C \leq Ti \leq 0.70$

T23 : W 1.45-1.75 Cb 0.02~0.08 B 0.0005~0.006

$N \leq 0.030$ Al ≤ 0.030

T91 : Cb 0.06~0.10 N ≤ 0.030 ~0.070 Al ≤ 0.040

T92 : W 1.50~2.00 Cb 0.04~0.09 B 0.001~0.006

$N \leq 0.030$ ~0.070 Al ≤ 0.040

(4) Heat Treatment

The tubes shall be subjected to the heat treatment by one of specified method, the heat treatment other than those specified in the table shall be agreed up on by the purchaser and the manufacturer

A: Annealing

FA: Full annealing

IA: Isothermal annealing

NT: Normalizing and

Tempering

SA : Subcritical annealing

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(2) TEST AND EXAMINATION

| Specification Code | Grade Designation | Manufacturing Method (1) | Flattening Test (2) | Flaring Test (3) | Flange Test (4) | Crush Test (5) | Mechanical Test (6) | | Reverse Flattening Test (7) | Hydrostatic Test (8) | Non Destructive Test (9) | Outside Diameter (OD) (10) | Dimensional Tolerance | | | Supplementary Quality Requirements (15) | |
|--------------------------------|--|--|--|---|---|---|---|---|--|--|---|---|---|---|-----------------|---|-------------------|
| | | | | | | | HB | HR | | | | | Wall Thickness (WT) (11) | WT Variation (12),(13) | length (L) (14) | | |
| A 178 SA 178 | A C D | E E E | 0 0 0 | - - - | 0 0 0 | 0 0 0 | - - - | - - - | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | UST (E 273 or E213) | |
| A 179, SA 179 A 192, SA 192 | - S | S-C S | 0 0 | 0 0 | 0 0 | 0 0 | - - | B 72 B 77 | - 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | | Surface Condition |
| A 209 SA 209 | T1 T1a T1b | S S S | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | - - - | 146 153 137 | B 80 B 81 B 77 | - 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | | |
| A 210 SA 210 | A1 C | S S | 0 0 | 0 0 | 0 0 | 0 0 | - - | 143 179 | B 79 B 89 | - 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | Intergranular Corrosion Test ect | |
| A 213 SA 213 | T2 T5 T5b T5c T9 T11 T12 T17 T21 T22 T23 T91 T92 | S S S S S S S S S S S S S S | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 0 0 0 | - - - - - - - - - - - - - - - | 163 163 179 163 179 163 163 163 163 163 220 250 250 | B 85 B 85 B 89 B 85 B 89 B 85 B 85 B 85 B 85 B 97 C 25 C 25 | - 0 0 0 0 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 0 0 0 | | | |

Note :

(1) Manufacturing Method

E : Electric resistance welded process

S : Seamless process hot finished and cold finished

S-C : Seamless process and cold finished

(2) Flattening test

H =

H : distance between flattening plates (mm)

t : specified wall thickness of the tubes (mm)

D : specified outside diameter of the tubes (mm)

e : constant individually defined for each grade of the pipe

0.09 : low carbon steel ($C \leq 0.18\%$)

0.07 : medium carbon steel ($C \leq 0.19\%$)

0.08 : ferritic alloy steel

(3) Flaring test (Seamless Steel Tubes)

| Ratio of ID to OD | Minimum Expansion of ID % | |
|-------------------|---------------------------|-----------------------------|
| | C-Steel and C-Mo Steels | Other Ferritic Alloy Steels |
| 0.9 | 21 | 15 |
| 0.8 | 22 | 17 |
| 0.7 | 25 | 19 |
| 0.6 | 30 | 23 |
| 0.5 | 39 | 28 |
| 0.4 | 51 | 38 |
| 0.3 | 68 | 50 |

ID : Inside diameter of the tube (mm)

OD : Outside diameter of the tube (mm)

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(4) Flange test

| OD of Tubes mm | Width of Flange |
|---------------------|-----------------|
| ≤ 63.5 | 15% of OD |
| $63.5 < \leq 95.2$ | 12.5% of OD |
| $95.2 < \leq 203.2$ | 10% of OD |

(5) Crush test

| WT of Tubes mm | Height of Crushed Section mm |
|----------------|--|
| ≤ 3.43 | 19 or Until Outside folds are in contact |
| > 3.43 | 32 |

(6) Hardness test

| WT of tube mm | Hardness Test |
|------------------|---|
| ≤ 1.7 | - |
| $1.7 \leq < 5.1$ | Rockwell Hardness (HR) |
| $5.1 \leq$ | Brinell Hardness (HB) or Rockwell Hardness (HR) |

HR B or C : Rockwell hardness tester scale

(7) Reverse flattening test

This test shall be applied for welded steel tubes,

Please refer ASTM A 450

(8) Hydrostatic test and (9) Non destructive test

Each tube shall be subjected to the non destructive electric test or the hydrostatic test at the option of the manufacturer, unless otherwise specified in the purchase order.

(10) Tolerance in Outside Diameter mm

| OD of Tubes | Tolerance |
|----------------------|-----------|
| ≤ 101.6 | +0.4,-0.8 |
| $101.6 < \leq 190.5$ | +0.4,-1.2 |
| $190.5 < < 228.6$ | +0.4,-1.6 |

mm

| OD of Tubes | Tolerance |
|------------------------|----------------|
| < 25.4 | ± 0.1 |
| $25.4 \leq \leq 38.1$ | ± 0.15 |
| $38.1 < < 50.8$ | ± 0.20 |
| $50.8 \leq < 63.5$ | ± 0.25 |
| $63.5 \leq < 76.2$ | ± 0.30 |
| $76.2 \leq \leq 101.6$ | ± 0.38 |
| $101.6 < \leq 190.5$ | + 0.38, - 0.64 |
| $190.5 < \leq 228.6$ | + 0.38, - 1.14 |

(11) Tolerance in wall thickness

This test shall be applied for welded steel tubes,

Please refer ASTM A 450

| W.T. of Tubes | S. H. OD \leq | S. H. OD $>$ | S. C. OD \leq | S. C. OD $>$ | E |
|------------------|----------------------|--------------|-----------------|--------------|-------------|
| ≤ 2.4 | 101.6 +40% -0% | 101.6 | 38.1 | 38.1 | - |
| $2.4 < \leq 3.8$ | +35% -0% | +35% -0% | +20% -0% | +22% -0% | +18% -0% |
| $3.8 < \leq 4.6$ | +33% -0% | +33% -0% | -0% | -0% | -0% |
| $4.6 <$ | +28% -0% | +28% -0% | -0% | -0% | -0% |

mm

(2) TEST AND EXAMINATION

| Specification Code | Grade Designation | Manufacturing Method (1) | Flattening Test (2) | Flaring Test (3) | Flange Test (4) | Crush Test (5) | Mechanical Test (6) | | Reverse Flattening Test (7) | Hydrostatic Test (8) | Non Destructive Test (9) | Outside Diameter (OD) (10) | Dimensional Tolerance | | | Supplementary Quality Requirements (15) | |
|--------------------|-------------------|--------------------------|---------------------|------------------|-----------------|----------------|------------------------|------|-----------------------------|----------------------|--------------------------|----------------------------|--------------------------|------------------------|-----------------|---|----------------------------------|
| | | | | | | | Hardness Test max. (6) | | | | | | Wall Thickness (WT) (11) | Wt Variation (12),(13) | length (L) (14) | | |
| | | | | | | | HB | HR | | | | | | | | | |
| A 178 | A | E | 0 | - | 0 | 0 | - | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | UST (E 273 or E213) |
| SA 178 | C | E | 0 | - | 0 | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | D | E | 0 | - | 0 | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| A 179, SA 179 | - | S-C | 0 | 0 | 0 | - | - | B 72 | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| A 192, SA 192 | - | S | 0 | 0 | - | - | 137 | B 77 | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| A 209 | T1 | S | 0 | 0 | - | - | 146 | B 80 | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Surface Condition |
| SA 209 | T1a | S | 0 | 0 | - | - | 153 | B 81 | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | T1b | S | 0 | 0 | - | - | 137 | B 77 | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| A 210 | A1 | S | 0 | 0 | - | - | 143 | B 79 | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| SA 210 | C | S | 0 | 0 | - | - | 179 | B 89 | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| A 213 | T2 | S | 0 | 0 | - | - | 163 | B 85 | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Intergranular Corrosion Test ect |
| SA 213 | T5 | S | 0 | 0 | - | - | 163 | B 85 | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | T5b | S | 0 | 0 | - | - | 179 | B 89 | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | T5c | S | 0 | 0 | - | - | 163 | B 85 | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | T9 | S | 0 | 0 | - | - | 179 | B 89 | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | T11 | S | 0 | 0 | - | - | 163 | B 85 | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | T12 | S | 0 | 0 | - | - | 163 | B 85 | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | T17 | S | 0 | 0 | - | - | 163 | B 85 | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | T21 | S | 0 | 0 | - | - | 163 | B 85 | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | T22 | S | 0 | 0 | - | - | 163 | B 85 | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | T23 | S | 0 | 0 | - | - | 220 | B 97 | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | T91 | S | 0 | 0 | - | - | 250 | C 25 | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | T92 | S | 0 | 0 | - | - | 250 | C 25 | - | 0 | 0 | 0 | 0 | 0 | 0 | | |

(12) Tolerance of variation in wall thickness

mm

| OD of Tubes | WT of Tubes | S Tubes | E Tubes |
|-------------|-------------|---------|---------|
| < 50.8 | - | - | - |
| ≥ 50.8 | < 5.6 | - | - |
| | ≥ 5.6 | ± 10 % | ± 5 % |

(12) Tolerance in Height of Flash on Electric Resistance Welded Tubes

mm

| OD of Tubes | WT of Tubes | Tolerance |
|-------------|-------------|-----------|
| ≥ 50.8 | ≤ 3.4 | + 0.15 |
| | > 3.4 | + 0.25 |
| < 50.8 | | + 0.25 |

(12) Tolerance in Length

mm

| OD of Tubes | S - H Tubes | S - C Tubes | E Tubes |
|-------------|-------------|-------------|----------|
| < 50.8 | + 5, - 0 | + 3, - 0 | + 3, - 0 |
| ≥ 50.8 | + 5, - 0 | + 3, - 0 | + 3, - 0 |

These permissible variation in length applied to tubes before bending.

They apply to cut lengths up to and including 7,300mm (24ft), and for lengths greater than 7,300mm, the above over-tolerance shall be increased by 3mm (1/8 in) for each 3000mm (10ft) or fraction thereof over 7300mm (24ft) or 13mm (1/2in), whichever is less.

(15) Supplementary Requirements

The supplementary requirements shall apply only when specified by the purchase order

2. ASTM/ASME : STEEL PIPES FOR PIPING

(1) Chemical Requirement and Tensile Requirement

| Specification Code | Grade Designation | Manufacturing Method | Chemical Requirements | | | | | | | | | | Heat Treatment (3) | | | Tensile Requirements | | | |
|--------------------|-------------------|----------------------|-----------------------|-----------|-----------|-----------|-----------|-----------|------------|-----------|-----------|----------|-----------------------|------------------------|---------------|--------------------------|------------------------|----------------------|----|
| | | | C% | Mn% | P% max. | S% max. | Si% | N% | Cr% | Mo% | V% | other% | Hot Finished Seamless | Cold Finished Seamless | As welded ERW | Tensile Strength Mpa min | Yield strength Mpa min | Elongation min % (L) | |
| A 53 | A | S,E | ≤ 0.25 | ≤ 0.95 | 0.050 | 0.045 | - | ≤ 0.40 | ≤ 0.4 | ≤ 0.15 | ≤ 0.08 | Cu ≤ 0.4 | - | - | - | 330 | 205 | (4) | |
| SA 53 | B | S,E | ≤ 0.30 | ≤ 1.20 | 0.050 | 0.045 | - | ≤ 0.40 | ≤ 0.40 | ≤ 0.15 | ≤ 0.8 | Cu ≤ 0.4 | - | - | SA | 415 | 240 | (4) | |
| A106 | A | S | ≤ 0.25 | 0.27-0.93 | 0.035 | 0.035 | ≥ 0.10 | ≤ 0.40 | ≤ 0.40 | ≤ 0.15 | ≤ 0.08 | Cu ≤ 0.4 | - | A | - | 330 | 205 | 35 | |
| SA 106 | B | S | ≤ 0.30 | 0.29-1.06 | 0.035 | 0.035 | ≥ 0.10 | ≤ 0.40 | ≤ 0.40 | ≤ 0.15 | ≤ 0.08 | Cu ≤ 0.4 | - | A | - | 415 | 240 | 30 | |
| | C | S | ≤ 0.35 | 0.29-1.06 | 0.035 | 0.035 | ≥ 0.10 | ≤ 0.40 | ≤ 0.40 | ≤ 0.15 | ≤ 0.08 | Cu ≤ 0.4 | - | A | - | 485 | 275 | 30 | |
| A 135 | A | E | ≤ 0.25 | ≤ 0.95 | 0.035 | 0.035 | - | - | - | - | - | - | - | - | - | 331 | 207 | 35 | |
| SA 135 | B | E | ≤ 0.30 | ≤ 1.20 | 0.035 | 0.035 | - | - | - | - | - | - | - | - | SA | 414 | 241 | 30 | |
| A 333 | 1 | S | ≤ 0.30 | 0.40-1.06 | 0.025 | 0.025 | - | - | - | - | - | - | N, NQ | N, NQ | N, NQ | 380 | 205 | 35 | |
| SA 333 | 3 | S | ≤ 0.19 | 0.31-0.64 | 0.025 | 0.025 | 0.18-0.37 | 3.18-3.82 | - | - | - | - | N | N | N | 450 | 240 | 30 | |
| | 4 | S | ≤ 0.12 | 0.50-1.05 | 0.025 | 0.025 | 0.08-0.37 | 0.47-0.98 | 0.44-0.01 | - | - | - | N | N | - | 415 | 240 | 30 | |
| | 6 | S | ≤ 0.30 | 0.29-1.06 | 0.025 | 0.025 | ≥ 0.10 | - | - | - | - | - | N, NQ | N, NQ | N, NQ | 415 | 240 | 30 | |
| | 7 | S | ≤ 0.19 | ≤ 0.90 | 0.025 | 0.025 | 0.13-0.32 | 2.03-2.57 | - | - | - | - | N | N | N | 450 | 240 | 30 | |
| | 8 | S8 | ≤ 0.13 | ≤ 0.90 | 0.025 | 0.025 | 0.13-0.32 | 8.40-9.60 | - | - | - | - | QT, DNT | QT, DNT | QT, DNT | 690 | 515 | 22 | |
| | 9 | S | ≤ 0.20 | 0.40-0.60 | 0.025 | 0.025 | - | 1.60-2.24 | - | - | - | - | N | N | N | 435 | 315 | 28 | |
| | 10 | S | ≤ 0.20 | 1.15-1.50 | 0.035 | 0.015 | 0.10-0.35 | ≤ 0.25 | ≤ 0.15 | ≤ 0.05 | ≤ 0.12 | - | NQ | NQ | NQ | 550 | 450 | 22 | |
| | 11 | S | ≤ 0.10 | ≤ 0.60 | 0.025 | 0.025 | ≤ 0.35 | 35.0-37.0 | ≤ 0.50 | ≤ 0.50 | - | - | Co ≤ 0.50 | AN | AN | AN | 450 | 240 | 18 |
| | A 335 SA 335 | P1 | S | 0.10-0.20 | 0.30-0.80 | 0.025 | 0.025 | 0.10-0.50 | - | - | 0.44-0.65 | - | - | A | A | - | 380 | 205 | 30 |
| | | P2 | S | 0.10-0.20 | 0.30-0.67 | 0.025 | 0.025 | 0.10-0.30 | - | 0.50-0.81 | 0.44-0.65 | - | - | A | A | - | 380 | 205 | 30 |
| P5 | | S | ≤ 0.15 | 0.30-0.60 | 0.025 | 0.025 | ≤ 0.50 | - | 4.00-6.00 | 0.45-0.65 | - | - | FA, IA, NT | FA, IA, NT | - | 415 | 205 | 30 | |
| P5b | | S | ≤ 0.15 | 0.30-0.60 | 0.025 | 0.025 | 1.00-2.00 | - | 4.00-6.00 | 0.45-0.65 | - | - | FA, IA, NT | FA, IA, NT | - | 415 | 205 | 30 | |
| P5c | | S | ≤ 0.12 | 0.30-0.60 | 0.025 | 0.025 | ≤ 0.50 | - | 4.00-6.00 | 0.45-0.65 | - | - | A | A | - | 415 | 205 | 30 | |
| P9 | | S | ≤ 0.15 | 0.30-0.60 | 0.025 | 0.025 | 0.25-1.00 | - | 8.00-10.00 | 0.90-1.10 | - | - | FA, IA, NT | FA, IA, NT | - | 415 | 205 | 30 | |
| P11 | | S | 0.05-0.15 | 0.30-0.60 | 0.025 | 0.025 | 0.50-1.00 | - | 1.00-1.50 | 0.44-0.65 | - | - | FA, IA, NT | FA, IA, NT | - | 415 | 205 | 30 | |
| P12 | | S | 0.05-0.15 | 0.30-0.61 | 0.025 | 0.025 | ≤ 0.50 | - | 0.80-1.25 | 0.44-0.65 | - | - | A | A | - | 415 | 220 | 30 | |
| P15 | | S | 0.05-0.15 | 0.30-0.60 | 0.025 | 0.025 | 1.15-1.85 | - | - | 0.44-0.65 | - | - | FA, IA, NT | FA, IA, NT | - | 415 | 205 | 30 | |
| P21 | | S | 0.05-0.05 | 0.30-0.60 | 0.025 | 0.025 | ≤ 0.50 | - | 2.65-3.35 | 0.80-1.06 | - | - | FA, IA, NT | FA, IA, NT | - | 415 | 205 | 30 | |
| P22 | | S | 0.05-0.15 | 0.30-0.60 | 0.025 | 0.025 | ≤ 0.50 | - | 1.90-2.60 | 0.87-1.13 | - | - | FA, IA, NT | FA, IA, NT | - | 415 | 205 | 30 | |
| P23 | | S | 0.04-0.10 | 0.10-0.60 | 0.030 | 0.010 | ≤ 0.50 | - | 1.90-2.60 | 0.05-0.30 | 0.20-0.30 | (2) | NT | NT | - | 510 | 400 | 20 | |
| P91 | S | 0.08-0.12 | 0.30-0.60 | 0.020 | 0.010 | 0.20-0.50 | ≤ 0.40 | 8.00-9.50 | 0.85-1.05 | 0.18-0.25 | (2) | NT | NT | - | 585 | 415 | 20 | | |
| P92 | S | 0.07-0.13 | 0.30-0.60 | 0.020 | 0.010 | ≤ 0.50 | ≤ 0.40 | 8.50-9.50 | 0.30-0.60 | 0.15-0.25 | (2) | NT | NT | - | 620 | 440 | 20 | | |

Note :

(1) Manufacturing Method

E : Electric resistance welded process

S : Seamless process hot finished and cold finished

S-C : Seamless process and cold finished

(2) Other elements

%

P23 W 1.45~1.75 Cb 0.02~0.08 B 0.0005~0.006

N ≤ 0.030 Al ≤ 0.030

P91 Cb 0.06~0.10 N 0.030~0.070 Al ≤ 0.04

P92 W 1.50~2.00 Cb 0.04~0.09 B 0.001~0.006

N 0.03~0.07 Al ≤ 0.04

(3) Heat Treatment

The tubes shall be subjected to the heat treatment e = 1940 (A)0.2

by one of specified method, the heat treatment

other than those specified in the table shall be

agreed up on by the purchaser and the

manufacturer.

A: Annealing

FA: Full annealing

IA: Isothermal annealing

NT: Normalizing and Tempering

N : Normalizing

QT : Quenching and Tempering

DNT : Double normalizing and Tempering

SA : Seam annealing of the welded portion

(4) Minimum Elongation : %

(U)0.9

A= cross-sectional area of the tensile specimen. (mm)²

U= Specified tensile strength, MPa

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(2) TEST AND EXAMINATION

| Specification Requirements Code | Grade Designation | Manufacturing Method | Mechanical Test | | | | Hardness Test max. | Impact Test (5) | Hydrostatic Test (6) | Nondestructive Test (7) | Dimensional Tolerance | | | Weight (11) | Supplementary (12) |
|---------------------------------|-------------------|----------------------|---------------------|-----------------------|----------------------|-------------------------|--------------------|-----------------|----------------------|-------------------------|-----------------------|---|---|-------------------|--------------------|
| | | | Flattening Test (2) | Bending Test (3), (4) | Outside Diameter (8) | Wall Thickness (WT) (9) | | | | | Length (L) (10) | | | | |
| A 53 | A | S, E | O (e : 0.09) | O (Pipe) | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| SA 53 | B | S, E | O (e : 0.07) | O (Pipe) | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | - | |
| A 106 | A | S | O (e : 0.08) | O (Pipe) | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| SA 106 | B | S | O (e : 0.07) | O (Pipe) | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | - | |
| | C | S | O (e : 0.07) | O (Pipe) | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| A 135 | A | E | O (H=2/3D) | - | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | - | |
| SA 135 | B | E | O (H=2/3D) | - | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| A 333 | 1 | S | O | - | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| SA 333 | 3 | S | O | - | - | - | O (+ W) - 45°C | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | 4 | S | O | - | - | - | O (+ W) - 100°C | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | 6 | S | O | - | - | - | O (+ W) - 100°C | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | 7 | S | O | - | - | - | O (+ W) - 45°C | 0 | 0 | 0 | 0 | 0 | 0 | S1 Subsize Impact | |
| Specimens | 8 | S | O | - | - | - | O (+ W) - 75°C | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | 9 | S | O | - | - | - | - 195°C | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | 10 | S | O | - | - | - | O (+ W) - 75°C | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | 11 | S | O | - | - | - | O (+ W) - 60°C | 0 | 0 | 0 | 0 | 0 | 0 | | |
| A 335 | P1 | S | O | O | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| SA 335 | P2 | S | O | O | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | P5 | S | O | O | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | P5b | S | O | O | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | P5c | S | O | O | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | P9 | S | O | O | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | P11 | S | O | O | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | P12 | S | O | O | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | P15 | S | O | O | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | P21 | S | O | O | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | P22 | S | O | O | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | P23 | S | O | O | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | P91 | S | O | O | 250 | C 25 | - | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | P92 | S | O | O | 250 | C 25 | - | 0 | 0 | 0 | 0 | 0 | 0 | | |

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(2) TEST AND EXAMINATION

Note :

(1) Manufacturing Method

E : Electric resistance welded process

S : Seamless process hot finished and cold finished

S-C : Seamless process and cold finished

(2) Flattening test

$$H = \frac{1+e}{e \div t/d}$$

H : distance between flattening plates (mm)

t : specified wall thickness of the tubes (mm)

D : specified outside diameter of the tubes (mm)

e : constant individually defined for each grade of the pipe

0.09 : low carbon steel ($C \leq 0.18\%$)

0.07 : medium carbon steel ($C \leq 0.19\%$)

0.08 : ferritic alloy steel

(3) Bending Test (A53, SA53, A106, SA 106)

For pipe NPS2 and under shall be capable for being bend cold through 90 degree around a cylindrical mandrel, the diameter of which is 12 times the outside diameter of the pipe, without developing cracks.

(4) Bending Test (A335, SA335)

For pipe whose diameter exceed NPS 25, whose diameter to wall thickness ratio is 7.0 or less shall be subjected to the bend test instead of the flattening test, the bend test specimens shall be bend at room temperature through 180 degree without cracking on the outside of the bend portion. The inside diameter of the bend shall be 1 inch.

(5) Impact Test

a absorbed energy for charpy impact test

| Size of specimen mm | Minimum Average Value One set of 3 Specimens | Minimum Value of One specimen |
|------------------------|---|----------------------------------|
| 10 x 10 | 18 | 14 |
| 10 x 7.50 | 14 | 11 |
| 10 x 6.67 | 12 | 9 |
| 10 x 5.0 | 9 | 7 |
| 10 x 3.33 | 7 | 4 |
| 10 x 2.5 | 5 | 4 |

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| Specification Code | OD NPS mm ⁽⁸⁾ | WT % ⁽⁹⁾ | L mm ⁽¹⁰⁾ | Weight % ⁽¹¹⁾ |
|--------------------|--|--|---|---|
| A 53 SA 53 | $\leq 1-1/2 \pm 0.40$ $\geq 2 \pm 1\% \text{ OD}$ | - 12.5 | < ES SRL (4.88-6.71m) $\geq \text{ES RL (3.66-6.71m)}$ | ± 10 |
| A 106 SA 106 | $\leq 1-1/2 \pm 0.40$ $1-1/2 < \leq 4 \pm 0.79$ $4 < \leq 8 + 1.59$ $- 0.79$ $8 < \leq 18 + 2.38$ $- 0.79$ $18 < \leq 26 + 3.18$ $- 0.79$ | - 12.5 | SRL DRL | + 10 - 3.5 |
| A 135 SA 135 | $\pm 1.0\%$ | - 12.5 | by agreed | + 10 - 3.5 |
| A 333 SA 333 | $1/8 \leq \leq 1-1/2 + 0.4$ $- 0.8$ $1-1/2 < \leq 4 + 0.8$ $- 0.8$ $4 < \leq 18 + 1.6$ $- 0.8$ $8 < \leq 18 + 2.4$ $- 0.8$ $18 < + 3.2 + 3.2$ $- 0.8$ | D(NPS) U/D $1/8 \leq \leq 2-1/2 + 20$ $- 12.5$ $3 \leq \leq 18 \leq 5\% + 22.5$ $- 12.5$ $3 \leq \leq 18 > 5\% + 15$ $- 12.5$ $20 \leq \text{Welded pipes} + 17.5$ $- 12.5$ $20 \leq \text{Seamless pipes} \leq 5\% + 22.5$ $- 12.5$ $20 \leq \text{Seamless pipes} > 5\% + 15$ $- 12.5$ | by agreed | $\leq \text{NPS 12}$ $+ 10$ $- 3.5$ $> \text{NPS 12}$ $+ 10$ $- 5$ |

- ES pipe of weights lighter than extra strong
- SRL Single random length
- A335 and SA335 (ferritic alloy steel pipe) shall apply the specification of steel tubes for heat transfer

(12) Supplementary Requirements

One or more of the Supplementary requirements shall apply only when specified in the purchase order



b, On welded pipe, additional impact tests of the same number shall be, made to test the weld

(6) Hydrostatic test and (7) Non destructive test

Each tube shall be subjected to the non destructive electric test or the hydrostatic test at the option of the manufacturer, unless otherwise specified in the purchase order.

DIMENSIONS, WEIGHTS, AND TEST PRESSURES FOR CARBON STEEL SEAMLESS PIPE

| NPS Designator | DN Designator | Outside Diameter, in. [mm] | Nominal Wall Thickness, in. [mm] | Nominal Weight [Mass] per Unit Length, Plain End, lb/ft [kg/m] | Weight Class | Schedule No. | Test Pressure, ^A psi [kPa] | |
|----------------|---------------|----------------------------|----------------------------------|--|---------------|--------------|---------------------------------------|---------------|
| | | | | | | | Grade A | Grade B |
| ¼ | 6 | 0.405 [10.3] | 0.068 [1.73] | 0.24 [0.37] | STD | 40 | 700 [4800] | 700 [4800] |
| | | | 0.095 [2.41] | 0.31 [0.47] | XS | 80 | 850 [5900] | 850 [5900] |
| ¼ | 8 | 0.540 [13.7] | 0.088 [2.24] | 0.43 [0.63] | STD | 40 | 700 [4800] | 700 [4800] |
| | | | 0.119 [3.02] | 0.54 [0.80] | XS | 80 | 850 [5900] | 850 [5900] |
| ¾ | 10 | 0.675 [17.1] | 0.091 [2.31] | 0.57 [0.84] | STD | 40 | 700 [4800] | 700 [4800] |
| | | | 0.126 [3.20] | 0.74 [1.10] | XS | 80 | 850 [5900] | 850 [5900] |
| ½ | 15 | 0.840 [21.3] | 0.109 [2.77] | 0.85 [1.27] | STD | 40 | 700 [4800] | 700 [4800] |
| | | | 0.147 [3.73] | 1.09 [1.62] | XS | 80 | 850 [5900] | 850 [5900] |
| | | | 0.188 [4.78] | 1.31 [1.95] | - | 160 | 900 [6200] | 900 [6200] |
| | | | 0.294 [7.47] | 1.72 [2.55] | XXS | - | 1000 [6900] | 1000 [6900] |
| ¾ | 20 | 1.050 [26.7] | 0.113 [2.87] | 1.13 [1.69] | STD | 40 | 700 [4800] | 700 [4800] |
| | | | 0.154 [3.91] | 1.48 [2.20] | XS | 80 | 850 [5900] | 850 [5900] |
| | | | 0.219 [5.56] | 1.95 [2.90] | - | 160 | 950 [6500] | 950 [6500] |
| | | | 0.308 [7.82] | 2.44 [3.64] | XXS | - | 1000 [6900] | 1000 [6900] |
| 1 | 25 | 1.315 [33.4] | 0.133 [3.38] | 1.68 [2.50] | STD | 40 | 700 [4800] | 700 [4800] |
| | | | 0.179 [4.55] | 2.17 [3.24] | XS | 80 | 850 [5900] | 850 [5900] |
| | | | 0.250 [6.35] | 2.85 [4.24] | - | 160 | 950 [6500] | 950 [6500] |
| | | | 0.358 [9.09] | 3.66 [5.45] | XXS | - | 1000 [6900] | 1000 [6900] |
| 1¼ | 32 | 1.660 [42.2] | 0.140 [3.56] | 2.27 [3.39] | STD | 40 | 1200 [8300] | 1300 [9000] |
| | | | 0.191 [4.85] | 3.00 [4.47] | XS | 80 | 1800 [12 400] | 1900 [13 100] |
| | | | 0.250 [6.35] | 3.77 [5.61] | - | 160 | 1900 [13 100] | 2000 [13 800] |
| | | | 0.382 [9.70] | 5.22 [7.77] | XXS | - | 2200 [15 200] | 2300 [15 900] |
| 1½ | 40 | 1.900 [48.3] | 0.145 [3.68] | 2.72 [4.05] | STD | 40 | 1200 [8300] | 1300 [9000] |
| | | | 0.200 [5.08] | 3.63 [5.41] | XS | 80 | 1800 [12 400] | 1900 [13 100] |
| | | | 0.281 [7.14] | 4.86 [7.25] | - | 160 | 1950 [13 400] | 2050 [14 100] |
| | | | 0.400 [10.16] | 6.41 [9.56] | XXS | - | 2200 [15 200] | 2300 [15 900] |
| 2 | 50 | 2.375 [60.3] | 0.154 [3.91] | 3.66 [5.44] | STD | 40 | 2300 [15 900] | 2500 [17 200] |
| | | | 0.218 [5.54] | 5.03 [7.48] | XS | 80 | 2500 [17 200] | 2500 [17 200] |
| | | | 0.344 [8.74] | 7.47 [11.11] | - | 160 | 2500 [17 200] | 2500 [17 200] |
| | | | 0.436 [11.07] | 9.04 [13.44] | XXS | - | 2500 [17 200] | 2500 [17 200] |
| 2½ | 65 | 2.875 [73.0] | 0.203 [5.16] | 5.80 [8.63] | STD | 40 | 2500 [17 200] | 2500 [17 200] |
| | | | 0.276 [7.01] | 7.67 [11.41] | XS | 80 | 2500 [17 200] | 2500 [17 200] |
| | | | 0.375 [9.52] | 10.02 [14.90] | - | 160 | 2500 [17 200] | 2500 [17 200] |
| | | | 0.552 [14.02] | 13.71 [20.39] | XXS | - | 2500 [17 200] | 2500 [17 200] |
| 3 | 80 | 3.500 [88.9] | 0.125 [3.18] | 4.51 [6.72] | - | - | 1290 [8900] | 1500 [10000] |
| | | | 0.156 [3.96] | 5.58 [8.29] | - | - | 1600 [11 000] | 1870 [12 900] |
| | | | 0.188 [4.78] | 6.66 [9.92] | - | - | 1930 [13 300] | 2260 [15 800] |
| | | | 0.216 [5.49] | 7.58 [11.29] | STD | 40 | 2220 [15 300] | 2500 [17 200] |
| | | | 0.250 [6.35] | 8.69 [12.93] | - | - | 2500 [17 200] | 2500 [17 200] |
| | | | 0.281 [7.14] | 9.67 [14.40] | - | - | 2500 [17 200] | 2500 [17 200] |
| | | | 0.300 [7.62] | 10.26 [15.27] | XS | 80 | 2500 [17 200] | 2500 [17 200] |
| | | | 0.438 [11.13] | 14.34 [21.35] | - | 160 | 2500 [17 200] | 2500 [17 200] |
| | | | 0.600 [15.24] | 18.60 [27.68] | XXS | - | 2500 [17 200] | 2500 [17 200] |
| | | | ¾ | 90 | 4.000 [101.6] | 0.125 [3.18] | 5.18 [7.72] | - |
| 0.156 [3.96] | 6.41 [9.53] | - | | | | - | 1400 [6700] | 1640 [11 300] |
| 0.188 [4.78] | 7.66 [11.41] | - | | | | - | 1690 [11 700] | 1970 [13 600] |
| 0.226 [5.74] | 9.12 [13.57] | STD | | | | 40 | 2030 [14 000] | 2370 [16 300] |
| 0.250 [6.35] | 10.02 [14.92] | - | | | | - | 2250 [15 500] | 2500 [17 200] |
| 0.281 [7.14] | 11.17 [16.63] | - | | | | - | 2500 [17 200] | 2500 [17 200] |
| 0.318 [8.08] | 12.52 [18.63] | XS | | | | 80 | 2800 [19 300] | 2800 [19 300] |
| 4 | 100 | 4.500 [114.3] | | | | 0.125 [3.18] | 5.85 [8.71] | - |
| | | | 0.156 [3.96] | 7.24 [10.78] | - | - | 1250 [8600] | 1460 [10 100] |
| | | | 0.188 [4.78] | 8.87 [12.91] | - | - | 1500 [10 300] | 1750 [12 100] |
| | | | 0.219 [5.56] | 10.02 [14.91] | - | - | 1750 [12 100] | 2040 [14 100] |
| | | | 0.237 [6.02] | 10.80 [16.07] | STD | 40 | 1900 [13 100] | 2210 [15 200] |
| | | | 0.250 [6.35] | 11.36 [16.90] | - | - | 2000 [13 800] | 2330 [16 100] |
| | | | 0.281 [7.14] | 12.67 [18.87] | - | - | 2250 [15 100] | 2620 [18 100] |
| | | | 0.312 [7.92] | 13.97 [20.78] | - | - | 2500 [17 200] | 2800 [19 300] |

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DIMENSIONS, WEIGHTS, AND TEST PRESSURES FOR CARBON STEEL SEAMLESS PIPE

| NPS Designator | DN Designator | Outside Diameter, in. [mm] | Nominal Wall Thickness, in. [mm] | Nominal Weight [Mass] per Unit Length, Plain End, lb/ft [kg/m] | Weight Class | Schedule No. | Test Pressure, ⁴ psi [kPa] | |
|----------------|-----------------|----------------------------|----------------------------------|--|---------------|--------------|---------------------------------------|---------------|
| | | | | | | | Grade A | Grade B |
| 5 | 125 | 5.563 [141.3] | 0.337 [8.56] | 15.00 [22.32] | XS | 80 | 2700 [18 600] | 2800 [19 300] |
| | | | 0.438 [11.13] | 19.02 [28.32] | - | 120 | 2800 [19 300] | 2800 [19 300] |
| | | | 0.531 [13.49] | 22.53 [33.54] | - | 160 | 2800 [19 300] | 2800 [19 300] |
| | | | 0.674 [17.12] | 27.57 [41.03] | XXS | - | 2800 [19 300] | 2800 [19 300] |
| | | | 0.156 [3.96] | 9.02 [13.41] | - | - | 1010 [7000] | 1180 [8100] |
| | | | 0.188 [4.78] | 10.80 [16.09] | - | - | 1220 [8400] | 1420 [9800] |
| | | | 0.219 [5.56] | 12.51 [18.61] | - | - | 1420 [9800] | 1650 [11 400] |
| | | | 0.258 [6.55] | 14.63 [21.77] | STD | 40 | 1670 [11 500] | 1950 [13 400] |
| | | | 0.281 [7.14] | 15.87 [23.62] | - | - | 1820 [12 500] | 2120 [14 600] |
| | | | 0.312 [7.92] | 17.51 [26.05] | - | - | 2020 [13 900] | 2360 [16 300] |
| 0.344 [8.74] | 19.19 [28.57] | - | - | 2230 [15 400] | 2600 [17 900] | | | |
| 0.375 [9.52] | 20.80 [30.94] | XS | 80 | 2430 [16 800] | 2800 [19 300] | | | |
| 0.500 [12.70] | 27.06 [40.26] | - | 120 | 2800 [19 300] | 2800 [19 300] | | | |
| 0.625 [15.88] | 32.99 [49.11] | - | 160 | 2800 [19 300] | 2800 [19 300] | | | |
| 0.750 [19.05] | 38.59 [57.43] | XXS | - | 2800 [19 300] | 2800 [19 300] | | | |
| 6 | 150 | 6.625 [168.3] | 0.188 [4.78] | 12.94 [19.27] | - | - | 1020 [7000] | 1190 [8200] |
| | | | 0.203 [5.56] | 15.00 [22.31] | - | - | 1190 [8200] | 1390 [9600] |
| | | | 0.250 [6.35] | 17.04 [25.36] | - | - | 1360 [9400] | 1580 [10 900] |
| | | | 0.280 [7.11] | 18.99 [28.26] | STD | 40 | 1520 [10 500] | 1780 [12 300] |
| | | | 0.312 [7.92] | 21.06 [31.32] | - | - | 1700 [11 700] | 1980 [13 700] |
| | | | 0.344 [8.74] | 23.10 [34.39] | - | - | 1870 [12 900] | 2180 [15 000] |
| | | | 0.375 [9.52] | 25.05 [37.28] | - | - | 2040 [14 100] | 2380 [16 400] |
| | | | 0.432 [10.97] | 28.60 [42.56] | XS | 80 | 2350 [16 200] | 2740 [18 900] |
| | | | 0.562 [14.27] | 36.43 [54.20] | - | 120 | 2800 [19 300] | 2800 [19 300] |
| | | | 0.719 [18.26] | 45.39 [67.56] | - | 160 | 2800 [19 300] | 2800 [19 300] |
| 0.864 [21.95] | 53.21 [79.22] | XXS | - | 2800 [19 300] | 2800 [19 300] | | | |
| 8 | 200 | 8.625 [219.1] | 0.188 [4.78] | 16.96 [25.26] | - | - | 780 [5400] | 920 [6300] |
| | | | 0.203 [5.16] | 18.28 [27.22] | - | - | 850 [5900] | 1000 [6900] |
| | | | 0.219 [5.56] | 19.68 [29.28] | - | - | 910 [6300] | 1070 [7400] |
| | | | 0.250 [6.35] | 22.38 [33.31] | - | 20 | 1040 [7200] | 1220 [8400] |
| | | | 0.277 [7.04] | 24.72 [36.31] | - | 30 | 1160 [7800] | 1350 [9300] |
| | | | 0.312 [7.92] | 27.73 [41.24] | - | - | 1300 [9000] | 1520 [10 500] |
| | | | 0.322 [8.18] | 28.58 [42.55] | STD | 40 | 1340 [9200] | 1570 [10 800] |
| | | | 0.344 [8.74] | 30.45 [45.34] | - | - | 1440 [9900] | 1680 [11 600] |
| | | | 0.375 [9.52] | 33.07 [49.20] | - | - | 1570 [10 800] | 1830 [12 600] |
| | | | 0.406 [10.31] | 35.67 [53.08] | - | 60 | 1700 [11 700] | 2000 [13 800] |
| | | | 0.438 [11.13] | 38.33 [57.06] | - | - | 1830 [12 600] | 2130 [14 700] |
| | | | 0.500 [12.70] | 43.43 [64.64] | XS | 80 | 2090 [14 400] | 2430 [16 800] |
| | | | 0.594 [15.09] | 51.00 [75.92] | - | 100 | 2500 [17 200] | 2800 [19 300] |
| | | | 0.719 [18.26] | 60.77 [90.44] | - | 120 | 2800 [19 300] | 2800 [19 300] |
| | | | 0.812 [20.62] | 67.82 [100.92] | - | 140 | 2800 [19 300] | 2800 [19 300] |
| | | | 0.875 [22.22] | 72.49 [107.88] | XXS | - | 2800 [19 300] | 2800 [19 300] |
| 0.906 [23.01] | 74.76 [111.27] | - | 160 | 2800 [19 300] | 2800 [19 300] | | | |
| 10 | 250 | 10.750 [273.0] | 0.188 [4.78] | 21.23 [31.62] | - | - | 630 [4300] | 730 [5000] |
| | | | 0.203 [5.16] | 22.89 [34.08] | - | - | 680 [4700] | 800 [5500] |
| | | | 0.219 [5.56] | 24.65 [36.67] | - | - | 730 [5000] | 860 [5900] |
| | | | 0.250 [6.35] | 28.06 [41.75] | - | 20 | 840 [5800] | 980 [6800] |
| | | | 0.279 [7.09] | 31.23 [46.49] | - | - | 930 [6400] | 1090 [7500] |
| | | | 0.307 [7.80] | 34.27 [51.01] | - | 30 | 1030 [7100] | 1200 [8300] |
| | | | 0.344 [8.74] | 38.27 [56.96] | - | - | 1150 [7900] | 1340 [9200] |
| | | | 0.365 [9.27] | 40.52 [60.29] | STD | 40 | 1220 [8400] | 1430 [9900] |
| | | | 0.438 [11.13] | 48.28 [71.87] | - | - | 1470 [10 100] | 1710 [11 800] |
| | | | 0.500 [12.70] | 54.79 [81.52] | XS | 60 | 1670 [11 500] | 1950 [13 400] |
| | | | 0.594 [15.09] | 64.49 [95.97] | - | 80 | 1990 [13 700] | 2320 [16 000] |
| | | | 0.719 [18.26] | 77.10 [114.70] | - | 100 | 2410 [16 600] | 2800 [19 300] |
| | | | 0.844 [21.44] | 89.38 [133.00] | - | 120 | 2800 [19 300] | 2800 [19 300] |
| 1.000 [25.40] | 104.23 [155.09] | XXS | 140 | 2800 [19 300] | 2800 [19 300] | | | |
| 1.125 [28.57] | 115.75 [172.21] | - | 160 | 2800 [19 300] | 2800 [19 300] | | | |
| 12 | 300 | 12.750 [323.8] | 0.203 [5.16] | 27.23 [40.55] | - | - | 570 [3900] | 670 [4600] |
| | | | 0.219 [5.56] | 29.34 [43.63] | - | - | 620 [4300] | 720 [5000] |
| | | | 0.250 [6.35] | 33.41 [49.71] | - | 20 | 710 [4900] | 820 [5700] |
| | | | 0.281 [7.14] | 37.46 [55.75] | - | - | 790 [5400] | 930 [6400] |
| | | | 0.312 [7.92] | 41.48 [61.69] | - | - | 880 [6100] | 1030 [7100] |
| | | | 0.330 [8.38] | 43.81 [65.18] | - | 30 | 930 [6400] | 1090 [7500] |
| | | | 0.344 [8.74] | 45.62 [67.90] | - | - | 970 [6700] | 1130 [7800] |
| | | | 0.375 [9.52] | 49.61 [73.78] | STD | - | 1060 [7300] | 1240 [8500] |

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DIMENSIONS, WEIGHTS, AND TEST PRESSURES FOR CARBON STEEL SEAMLESS PIPE

| NPS Designator | DN Designator | Outside Diameter, in. [mm] | Nominal Wall Thickness, in. [mm] | Nominal Weight [Mass] per Unit Length, Plain End, lb/ft [kg/m] | Weight Class | Schedule No. | Test Pressure, ^A psi [kPa] | | | | |
|----------------|-----------------|----------------------------|----------------------------------|--|----------------|--------------|---------------------------------------|---------------|---|------------|------------|
| | | | | | | | Grade A | Grade B | | | |
| | | | 0.406 [10.31] | 53.57 [79.70] | - | 40 | 1150 [7900] | 1340 [9200] | | | |
| | | | 0.438 [11.13] | 57.65 [85.82] | - | - | 1240 [8500] | 1440 [9900] | | | |
| | | | 0.500 [12.70] | 65.48 [97.43] | XS | - | 1410 [9700] | 1650 [11 400] | | | |
| | | | 0.562 [14.27] | 73.22 [108.92] | - | 60 | 1590 [11 000] | 1850 [12 800] | | | |
| | | | 0.688 [17.48] | 88.71 [132.04] | - | 80 | 1940 [13 400] | 2270 [15 700] | | | |
| | | | 0.844 [21.44] | 107.42 [159.86] | - | 100 | 2390 [16 500] | 2780 [19 200] | | | |
| | | | 1.000 [25.40] | 125.61 [186.91] | XXS | 120 | 2800 [19 300] | 2800 [19 300] | | | |
| | | | 1.125 [28.57] | 139.81 [208.00] | - | 140 | 2800 [19 300] | 2800 [19 300] | | | |
| | | | 1.312 [33.32] | 160.42 [238.68] | - | 160 | 2800 [19 300] | 2800 [19 300] | | | |
| | | | 14 | 350 | 14.000 [355.6] | 0.210 [5.33] | 30.96 [45.04] | - | - | 540 [3700] | 630 [4300] |
| | | | | | | 0.219 [5.56] | 32.26 [47.99] | - | - | 560 [3900] | 660 [4500] |
| 0.250 [6.35] | 36.75 [54.69] | - | | | | 10 | 640 [4400] | 750 [5200] | | | |
| 0.281 [7.14] | 41.21 [61.35] | - | | | | - | 720 [5000] | 840 [5800] | | | |
| 0.312 [7.92] | 45.65 [67.90] | - | | | | 20 | 800 [5500] | 940 [6500] | | | |
| 0.344 [8.74] | 50.22 [74.76] | - | | | | - | 880 [6100] | 1030 [7100] | | | |
| 0.375 [9.52] | 54.62 [81.25] | STD | | | | 30 | 960 [6600] | 1120 [7700] | | | |
| 0.438 [11.13] | 63.50 [94.55] | - | | | | 40 | 1130 [7800] | 1310 [9000] | | | |
| 0.469 [11.91] | 67.84 [100.94] | - | | | | - | 1210 [8300] | 1410 [9700] | | | |
| 0.500 [12.70] | 72.16 [107.39] | XS | | | | - | 1290 [8900] | 1500 [10 300] | | | |
| 0.594 [15.09] | 85.13 [126.71] | - | | | | 60 | 1530 [10 500] | 1790 [12 300] | | | |
| 0.750 [19.05] | 106.23 [158.10] | - | | | | 80 | 1930 [13 300] | 2250 [15 500] | | | |
| 0.938 [23.83] | 130.98 [194.96] | - | | | | 100 | 2410 [16 600] | 2800 [19 300] | | | |
| 1.094 [27.79] | 150.93 [224.65] | - | | | | 120 | 2800 [19 300] | 2800 [19 300] | | | |
| 1.250 [31.75] | 170.37 [253.56] | - | | | | 140 | 2800 [19 300] | 2800 [19 300] | | | |
| 1.406 [35.71] | 189.29 [281.70] | - | | | | 160 | 2800 [19 300] | 2800 [19 300] | | | |
| 2.000 [50.80] | 256.56 [381.83] | - | | | | - | 2800 [19 300] | 2800 [19 300] | | | |
| 2.125 [53.97] | 269.76 [401.44] | - | | | | - | 2800 [19 300] | 2800 [19 300] | | | |
| 2.200 [55.88] | 277.51 [413.01] | - | | | | - | 2800 [19 300] | 2800 [19 300] | | | |
| 2.500 [63.50] | 307.34 [457.40] | - | - | 2800 [19 300] | 2800 [19 300] | | | | | | |
| 16 | 400 | 16.000 [406.4] | 0.219 [5.56] | 36.95 [54.96] | - | - | 490 [3400] | 570 [3900] | | | |
| | | | 0.250 [6.35] | 42.09 [62.64] | - | 10 | 560 [3900] | 660 [4500] | | | |
| | | | 0.281 [7.14] | 47.22 [70.30] | - | - | 630 [4300] | 740 [5100] | | | |
| | | | 0.312 [7.92] | 52.32 [77.83] | - | 20 | 700 [4800] | 820 [5700] | | | |
| | | | 0.344 [8.74] | 57.57 [85.71] | - | - | 770 [5300] | 900 [6200] | | | |
| | | | 0.375 [9.52] | 62.64 [93.17] | STD | 30 | 840 [5800] | 980 [6800] | | | |
| | | | 0.438 [11.13] | 72.86 [108.49] | - | - | 990 [6800] | 1150 [7900] | | | |
| | | | 0.469 [11.91] | 77.87 [115.86] | - | - | 1060 [7300] | 1230 [8500] | | | |
| | | | 0.500 [12.70] | 82.85 [123.30] | XS | 40 | 1120 [7700] | 1310 [9000] | | | |
| | | | 0.656 [16.66] | 107.60 [160.12] | - | 60 | 1480 [10 200] | 1720 [11 900] | | | |
| | | | 0.844 [21.44] | 136.74 [203.53] | - | 80 | 1900 [13 100] | 2220 [15 300] | | | |
| | | | 1.031 [26.19] | 164.98 [245.56] | - | 100 | 2320 [16 000] | 2710 [18 700] | | | |
| | | | 1.219 [30.96] | 192.61 [286.64] | - | 120 | 2740 [18 900] | 2800 [19 300] | | | |
| | | | 1.438 [36.53] | 223.85 [333.19] | - | 140 | 2800 [19 300] | 2800 [19 300] | | | |
| | | | 1.594 [40.49] | 245.48 [365.35] | - | 160 | 2800 [19 300] | 2800 [19 300] | | | |
| 18 | 450 | 18.000 [457] | 0.250 [6.35] | 47.44 [70.60] | - | 10 | 500 [3400] | 580 [4000] | | | |
| | | | 0.281 [7.14] | 53.23 [79.24] | - | - | 560 [3900] | 660 [4500] | | | |
| | | | 0.312 [7.92] | 58.99 [87.75] | - | 20 | 620 [4300] | 730 [5000] | | | |
| | | | 0.344 [8.74] | 64.93 [96.66] | - | - | 690 [4800] | 800 [5500] | | | |
| | | | 0.375 [9.52] | 70.65 [105.10] | STD | - | 750 [5200] | 880 [6100] | | | |
| | | | 0.406 [10.31] | 76.36 [113.62] | - | - | 810 [5600] | 950 [6500] | | | |
| | | | 0.438 [11.13] | 82.23 [122.43] | - | 30 | 880 [6100] | 1020 [7000] | | | |
| | | | 0.469 [11.91] | 87.89 [130.78] | - | - | 940 [6500] | 1090 [7500] | | | |
| | | | 0.500 [12.70] | 93.54 [139.20] | XS | - | 1000 [6900] | 1170 [8100] | | | |
| | | | 0.562 [14.27] | 104.76 [155.87] | - | 40 | 1120 [7700] | 1310 [9000] | | | |
| | | | 0.750 [19.05] | 138.30 [205.83] | - | 60 | 1500 [10 300] | 1750 [12 100] | | | |
| | | | 0.938 [23.83] | 171.08 [254.67] | - | 80 | 1880 [13 000] | 2190 [15 100] | | | |
| | | | 1.156 [29.36] | 208.15 [309.76] | - | 100 | 2310 [15 900] | 2700 [18 600] | | | |
| | | | 1.375 [34.92] | 244.37 [363.64] | - | 120 | 2750 [19 000] | 2800 [19 300] | | | |
| 1.562 [39.67] | 274.48 [408.45] | - | 140 | 2800 [19 300] | 2800 [19 300] | | | | | | |
| 1.781 [45.24] | 308.79 [459.59] | - | 160 | 2800 [19 300] | 2800 [19 300] | | | | | | |
| 20 | 500 | 20.000 [508] | 0.250 [6.35] | 52.78 [78.55] | - | 10 | 450 [3100] | 520 [3600] | | | |
| | | | 0.281 [7.14] | 59.23 [88.19] | - | - | 510 [3500] | 590 [4100] | | | |
| | | | 0.312 [7.92] | 65.66 [97.67] | - | - | 560 [3900] | 660 [4500] | | | |
| | | | 0.344 [8.74] | 72.28 [107.60] | - | - | 620 [4300] | 720 [5000] | | | |
| | | | 0.375 [9.52] | 78.67 [117.02] | STD | 20 | 680 [4700] | 790 [5400] | | | |
| | | | 0.406 [10.31] | 84.04 [126.53] | - | - | 730 [5000] | 850 [5900] | | | |
| | | | 0.438 [11.13] | 91.59 [136.37] | - | - | 790 [5400] | 920 [6300] | | | |

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DIMENSIONS, WEIGHTS, AND TEST PRESSURES FOR CARBON STEEL SEAMLESS PIPE

| NPS Designator | DN Designator | Outside Diameter, in. [mm] | Nominal Wall Thickness, in. [mm] | Nominal Weight [Mass] per Unit Length, Plain End, lb/ft [kg/m] | Weight Class | Schedule No. | Test Pressure, ^A psi [kPa] | |
|----------------|-----------------|----------------------------|----------------------------------|--|---------------|--------------|---------------------------------------|---------------|
| | | | | | | | Grade A | Grade B |
| | | | 0.469 [11.91] | 97.92 [145.70] | - | - | 850 [5900] | 950 [6500] |
| | | | 0.500 [12.70] | 104.23 [155.12] | XS | 30 | 900 [6200] | 1050 [7200] |
| | | | 0.594 [15.09] | 123.23 [183.42] | - | 40 | 1170 [8100] | 1250 [8600] |
| | | | 0.812 [20.62] | 166.56 [247.83] | - | 60 | 1460 [10 100] | 1710 [11 800] |
| | | | 1.031 [26.19] | 209.06 [311.17] | - | 80 | 1860 [12 800] | 2170 [15 000] |
| | | | 1.281 [32.54] | 256.34 [381.53] | - | 100 | 2310 [15 900] | 2690 [18 500] |
| | | | 1.500 [38.10] | 296.65 [441.49] | - | 120 | 2700 [18 600] | 2800 [19 300] |
| | | | 1.750 [44.45] | 341.41 [508.11] | - | 140 | 2800 [19 300] | 2800 [19 300] |
| | | | 1.969 [50.01] | 379.53 [564.81] | - | 160 | 2800 [19 300] | 2800 [19 300] |
| 24 | 600 | 24.000 [610] | 0.250 [6.35] | 63.47 [94.46] | - | 10 | 380 [2600] | 440 [3000] |
| | | | 0.281 [7.14] | 71.25 [106.08] | - | - | 420 [2900] | 490 [3400] |
| | | | 0.312 [7.92] | 79.01 [117.51] | - | - | 470 [3200] | 550 [3800] |
| | | | 0.344 [8.74] | 86.99 [129.50] | - | - | 520 [3600] | 600 [4100] |
| | | | 0.375 [9.52] | 94.71 [140.88] | STD | 20 | 560 [3900] | 660 [4500] |
| | | | 0.406 [10.31] | 102.40 [152.37] | - | - | 610 [4200] | 710 [4900] |
| | | | 0.438 [11.13] | 110.32 [164.26] | - | - | 660 [4500] | 770 [5300] |
| | | | 0.469 [11.91] | 117.98 [175.54] | - | - | 700 [4800] | 820 [5700] |
| | | | 0.500 [12.70] | 125.61 [186.94] | XS | - | 750 [5200] | 880 [6100] |
| | | | 0.562 [14.27] | 140.81 [209.50] | - | 30 | 840 [5800] | 980 [6800] |
| | | | 0.688 [17.48] | 171.45 [255.24] | - | 40 | 1030 [7100] | 1200 [8300] |
| | | | 0.938 [23.83] | 231.25 [344.23] | - | - | 1410 [9700] | 1640 [11 300] |
| | | | 0.969 [24.61] | 238.57 [355.02] | - | 60 | 1450 [10 000] | 1700 [11 700] |
| | | | 1.219 [30.96] | 296.86 [441.78] | - | 80 | 1830 [12 600] | 2130 [14 700] |
| 1.531 [38.89] | 367.74 [547.33] | - | 100 | 2300 [15 900] | 2680 [18 500] | | | |
| 1.812 [46.02] | 429.79 [639.58] | - | 120 | 2720 [18 800] | 2800 [19 300] | | | |
| 2.062 [52.37] | 483.57 [719.63] | - | 140 | 2800 [19 300] | 2800 [19 300] | | | |
| 2.344 [59.54] | 542.64 [807.63] | - | 160 | 2800 [19 300] | 2800 [19 300] | | | |
| 26 | 650 | 26.000 [660] | 0.250 [6.35] | 68.82 [102.42] | - | - | 350 [2400] | 400 [2800] |
| | | | 0.281 [7.14] | 77.26 [115.02] | - | - | 390 [2700] | 450 [3100] |
| | | | 0.312 [7.92] | 85.68 [127.43] | - | 10 | 430 [3000] | 500 [3400] |
| | | | 0.344 [8.74] | 94.35 [140.45] | - | - | 480 [3300] | 560 [3900] |
| | | | 0.375 [9.52] | 102.72 [152.80] | STD | - | 520 [3600] | 610 [4200] |
| | | | 0.406 [10.31] | 111.08 [165.28] | - | - | 560 [3900] | 660 [4500] |
| | | | 0.438 [11.13] | 119.69 [178.20] | - | - | 610 [4200] | 710 [4900] |
| | | | 0.469 [11.91] | 128.00 [190.46] | - | - | 650 [4500] | 760 [5200] |
| | | | 0.500 [12.70] | 136.30 [202.85] | XS | 20 | 690 [4800] | 810 [5600] |
| | | | 0.562 [14.27] | 152.83 [227.37] | - | - | 780 [5400] | 910 [6300] |

The Minimum test pressure for outside diameters and wall thicknesses not listed shall be computed by the formula given below. The Computed test pressure shall be used in all cases with the following exceptions:

- (1) When the wall thickness is greater than the heaviest wall thickness shown for a given diameter, the test pressure for the heaviest wall listed shall be the required test pressure.
- (2) For Grades A and B in sizes under NPS 2 (DN 50) when the wall thickness is lighter than the lightest shown for a given diameter, use the test pressure given for the lightest wall thickness of the table for the diameter involved.
- (3) For all sizes of Grade A and B Pipe smaller than NPS 2 [DN 50], the test pressure has been arbitrarily assigned. Test pressures for intermediate outside diameters need not exceed those for the next larger listed size.

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TABLE OF MINIMUM WALL THICKNESS ON INSPECTION FOR NOMINAL PIPE WALL THICKNESS

| Nominal Wall Thickness (t _n), in. [mm] | Minimum Wall Thickness on Inspection (t _i), in. [mm] | Nominal Wall Thickness (t _n), in. [mm] | Minimum Wall Thickness on Inspection (t _i), in. [mm] | Nominal Wall Thickness (t _n), in. [mm] | Minimum Wall Thickness on Inspection (t _i), in. [mm] |
|--|--|--|--|--|--|
| 0.068 [1.73] | 0.060 [1.52] | 0.294 [7.47] | 0.257 [6.53] | 0.750 [19.05] | 0.656 [16.66] |
| 0.088 [2.24] | 0.077 [1.96] | 0.300 [7.62] | 0.262 [6.65] | 0.812 [20.62] | 0.710 [18.03] |
| 0.091 [2.31] | 0.080 [2.03] | 0.307 [7.80] | 0.269 [6.83] | 0.844 [21.44] | 0.739 [18.77] |
| 0.095 [2.41] | 0.083 [2.11] | 0.308 [7.82] | 0.270 [6.86] | 0.864 [21.94] | 0.756 [19.20] |
| 0.109 [2.77] | 0.095 [2.41] | 0.312 [7.92] | 0.273 [6.93] | 0.875 [22.22] | 0.766 [19.46] |
| 0.113 [2.87] | 0.099 [2.51] | 0.318 [8.08] | 0.278 [7.06] | 0.906 [23.01] | 0.793 [20.14] |
| 0.119 [3.02] | 0.104 [2.64] | 0.322 [8.18] | 0.282 [7.16] | 0.938 [23.82] | 0.821 [20.85] |
| 0.125 [3.18] | 0.109 [2.77] | 0.330 [8.38] | 0.289 [7.34] | 0.968 [24.59] | 0.847 [21.51] |
| 0.126 [3.20] | 0.110 [2.79] | 0.337 [8.56] | 0.295 [7.49] | 1.000 [25.40] | 0.875 [22.22] |
| 0.133 [3.38] | 0.116 [2.95] | 0.343 [8.71] | 0.300 [7.62] | 1.031 [26.19] | 0.902 [22.91] |
| 0.140 [3.56] | 0.122 [3.10] | 0.344 [8.74] | 0.301 [7.65] | 1.062 [26.97] | 0.929 [23.60] |
| 0.145 [3.68] | 0.127 [3.23] | 0.358 [9.09] | 0.313 [7.95] | 1.094 [27.79] | 0.957 [24.31] |
| 0.147 [3.73] | 0.129 [3.28] | 0.365 [9.27] | 0.319 [8.10] | 1.125 [28.58] | 0.984 [24.99] |
| 0.154 [3.91] | 0.135 [3.43] | 0.375 [9.52] | 0.328 [8.33] | 1.156 [29.36] | 1.012 [25.70] |
| 0.156 [3.96] | 0.136 [3.45] | 0.382 [9.70] | 0.334 [8.48] | 1.219 [30.96] | 1.067 [27.08] |
| 0.179 [4.55] | 0.157 [3.99] | 0.400 [10.16] | 0.350 [8.89] | 1.250 [31.75] | 1.094 [27.79] |
| 0.187 [4.75] | 0.164 [4.17] | 0.406 [10.31] | 0.355 [9.02] | 1.281 [32.54] | 1.121 [28.47] |
| 0.188 [4.78] | 0.164 [4.17] | 0.432 [10.97] | 0.378 [9.60] | 1.312 [33.32] | 1.148 [29.16] |
| 0.191 [4.85] | 0.167 [4.24] | 0.436 [11.07] | 0.382 [9.70] | 1.343 [34.11] | 1.175 [29.85] |
| 0.200 [5.08] | 0.175 [4.44] | 0.437 [11.10] | 0.382 [9.70] | 1.375 [34.92] | 1.203 [30.56] |
| 0.203 [5.16] | 0.178 [4.52] | 0.438 [11.13] | 0.383 [9.73] | 1.406 [35.71] | 1.230 [31.24] |
| 0.216 [5.49] | 0.189 [4.80] | 0.500 [12.70] | 0.438 [11.13] | 1.438 [36.53] | 1.258 [31.95] |
| 0.218 [5.54] | 0.191 [4.85] | 0.531 [13.49] | 0.465 [11.81] | 1.500 [38.10] | 1.312 [33.32] |
| 0.219 [5.56] | 0.192 [4.88] | 0.552 [14.02] | 0.483 [12.27] | 1.531 [38.89] | 1.340 [34.04] |
| 0.226 [5.74] | 0.198 [5.03] | 0.562 [14.27] | 0.492 [12.50] | 1.562 [39.67] | 1.367 [34.72] |
| 0.237 [6.02] | 0.207 [5.26] | 0.594 [15.09] | 0.520 [13.21] | 1.594 [40.49] | 1.395 [35.43] |
| 0.250 [6.35] | 0.219 [5.56] | 0.600 [15.24] | 0.525 [13.34] | 1.750 [44.45] | 1.531 [38.89] |
| 0.258 [6.55] | 0.226 [5.74] | 0.625 [15.88] | 0.547 [13.89] | 1.781 [45.24] | 1.558 [39.57] |
| 0.276 [7.01] | 0.242 [6.15] | 0.656 [16.66] | 0.574 [14.58] | 1.812 [46.02] | 1.586 [40.28] |
| 0.277 [7.04] | 0.242 [6.15] | 0.674 [17.12] | 0.590 [14.99] | 1.968 [49.99] | 1.722 [43.74] |
| 0.279 [7.09] | 0.244 [6.20] | 0.688 [17.48] | 0.602 [15.29] | 2.062 [52.37] | 1.804 [45.82] |
| 0.280 [7.11] | 0.245 [6.22] | 0.719 [18.26] | 0.629 [15.98] | 2.344 [59.54] | 2.051 [52.10] |
| 0.281 [7.14] | 0.246 [6.25] | | | | |

NOTE 1-The following equation, upon which this table is based, shall be applied to calculate minimum wall thickness from nominal wall thickness:

$$t_n \times 0.875 = t_m$$

t_n = nominal wall thickness, in. [mm], and

t_m = minimum wall thickness, in. [mm].

The wall thickness is expressed to three decimal places the fourth decimal place being carried forward or dropped in accordance with practice E 29.

NOTE 2 - This table is a master table covering wall thicknesses available in the purchase of different classifications of pipe, but it is not meant to imply that all of the walls listed therein are obtainable under specification

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IS : 1239 (PART 1) - MILD STEEL TUBES

This standard covers the requirements for butt welded and seamless screwed and socketed and Plain end mild steel tubes intended for ordinary uses in steam, water, gas and air lines. Only 'medium' and 'heavy' tubes are recommended for carrying steam.

Chemical Composition :

The ladle analysis of the steel for tubes and sockets used for water and gas purposes shall not show sulphur and phosphorus in amounts exceeding 0.060% percent each.

The ladle analysis of the steel for tubes and sockets used for steam services shall not show sulphur and phosphorus in amounts exceeding 0.050% percent each.

The maximum permissible variation of sulphur and phosphorus shall be 0.005 percent each.

Marking:

Each tube shall carry legibly the manufacturer's name or trademark.

The different classes of tubes shall be distinguished by colour brands which shall be applied as follows before the tubes leave the manufacturer's works :

'Light' Tubes Yellow

'Medium' Tubes Blue

'Heavy' Tubes Red

All long random lengths shall each have two 750mm colour bands, one near each end; all other lengths shall each have one 75 mm band.

Lengths :- Tubes shall be supplied in random lengths from 4 to 7m.

DIMENSIONS AND NOMINAL WEIGHTS OF BLACK STEEL TUBES

| Nominal Bore mm | OUTSIDE DIAMETER | | THICKNESS | | | | | | WEIGHT OF BLACK TUBES | | | | | | DIMENSIONS OF SOCKETS | | | |
|-----------------|------------------|--------|----------------|--------|-------|-----|--------|-----|-----------------------|-----|------------------|-----------------------------|------------------|-----------------------------|-----------------------|-----------------------------|-------------------------|---------------|
| | LIGHT | | MEDIUM & HEAVY | | LIGHT | | MEDIUM | | HEAVY | | LIGHT | | MEDIUM | | HEAVY | | Outside Diameter Max mm | Length Min mm |
| | Max mm | Min mm | Max mm | Min mm | mm | swg | mm | swg | mm | swg | Plain End kg / m | Screwed and Socketed kg / m | Plain End kg / m | Screwed and Socketed kg / m | Plain End kg / m | Screwed and Socketed kg / m | | |
| 6 | 10.1 | 9.7 | 10.6 | 9.8 | 1.80 | 15 | 2.0 | 14 | 2.65 | 12 | 0.361 | 0.364 | 0.407 | 0.410 | 0.493 | 0.496 | 15.0 | 19 |
| 8 | 13.6 | 13.2 | 14.0 | 13.2 | 1.80 | 15 | 2.35 | 13 | 2.90 | 11 | 0.517 | 0.521 | 0.650 | 0.654 | 0.769 | 0.773 | 18.5 | 27 |
| 10 | 17.1 | 16.7 | 17.5 | 16.7 | 1.80 | 15 | 2.35 | 13 | 2.90 | 11 | 0.674 | 0.680 | 0.852 | 0.858 | 1.020 | 1.030 | 22.0 | 28 |
| 15 | 21.4 | 21.0 | 21.8 | 21.0 | 2.00 | 14 | 2.65 | 12 | 3.25 | 10 | 0.952 | 0.961 | 1.220 | 1.230 | 1.450 | 1.460 | 27.0 | 37 |
| 20 | 26.9 | 26.4 | 27.3 | 26.5 | 2.35 | 13 | 2.65 | 12 | 3.25 | 10 | 1.410 | 1.420 | 1.580 | 1.590 | 1.900 | 1.910 | 32.5 | 39 |
| 25 | 33.8 | 33.2 | 34.2 | 33.3 | 2.65 | 12 | 3.25 | 10 | 4.05 | 8 | 2.010 | 2.030 | 2.440 | 2.460 | 2.970 | 2.990 | 39.5 | 46 |
| 32 | 42.5 | 41.9 | 42.9 | 42.0 | 2.65 | 12 | 3.25 | 10 | 4.05 | 8 | 2.580 | 2.610 | 3.140 | 3.170 | 3.840 | 3.870 | 49.0 | 51 |
| 40 | 48.4 | 47.8 | 48.8 | 47.9 | 2.90 | 11 | 3.25 | 10 | 4.05 | 8 | 3.250 | 3.290 | 3.610 | 3.650 | 4.430 | 4.470 | 56.0 | 51 |
| 50 | 60.2 | 59.6 | 60.8 | 59.7 | 2.90 | 11 | 3.65 | 9 | 4.50 | 7 | 4.110 | 4.180 | 5.100 | 5.170 | 6.170 | 6.240 | 68.0 | 60 |
| 65 | 76.0 | 75.2 | 76.6 | 75.3 | 3.25 | 10 | 3.65 | 9 | 4.50 | 7 | 5.800 | 5.920 | 6.510 | 6.630 | 7.900 | 8.020 | 84.0 | 69 |
| 80 | 88.7 | 87.9 | 89.5 | 88.0 | 3.25 | 10 | 4.05 | 8 | 4.85 | 6 | 6.810 | 6.980 | 8.470 | 8.640 | 10.10 | 10.30 | 98.0 | 75 |
| 100 | 113.9 | 113.0 | 115.0 | 113.1 | 3.65 | 9 | 4.5 | 7 | 5.40 | 5 | 9.890 | 10.20 | 12.10 | 12.40 | 14.40 | 14.70 | 124.0 | 87 |
| 125 | - | - | 140.8 | 138.5 | - | - | 4.85 | 6 | 5.40 | 5 | - | - | 16.20 | 16.70 | 17.80 | 18.30 | 151.0 | 96 |
| 150 | - | - | 166.5 | 163.9 | - | - | 4.85 | 6 | 5.40 | 5 | - | - | 19.20 | 19.80 | 21.20 | 21.80 | 178.0 | 96 |

Tolerances on Thickness and Weight :

The following manufacturing tolerances shall be permitted on the tubes and sockets,

(a) Thickness:

(1) Butt welded Light Tubes

+ Not Limited

- 8 percent

(2) Medium and Heavy Tubes

- 10 percent

(3) Seamless tubes

- 12.5 percent

(b) Weight :

(1) Single Tube (light series)

+ 10 percent

- 8 percent

(2) Single tube (medium and heavy series)

+ 10 percent

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S : 3589 STEEL TUBES FOR WATER, GAS AND SEWAGE OF NOMINAL SIZE 150 TO 2000 MM.

IS: 3589 pipes applies to electric fusion (arc) welded, electric resistance welded and induction welded carbon steel pipes for water, gas and sewage of nominal size from 150 to 2000 mm and having joints with plain or bevelled ends for butt welding or sleeve welded joints (swelled and plain end.)

CHEMICAL COMPOSITION

Ladle Analysis -The steel shall show on ladle analysis the composition given below appropriate to the steel grade specified.

| Steel Grade | Chemical Composition (Ladle Analysis) | | |
|-------------|--|----------|----------|
| | C Max | P Max | S Max |
| Fe 330 | 0.17 | 0.055 | 0.055 |
| Fe 410 | 0.25 | 0.055 | 0.055 |
| Fe 450 | 0.30 | 0.055 | 0.055 |

MECHANICAL PROPERTIES : The Tensile properties of strip cut longitudinally shall show following properties.

| Steel Grade | Tensile strength MPa (min) | % Elongation (5.65√so mm.) |
|-------------|-------------------------------|-------------------------------|
| Fe 330 | 330 | 20 |
| Fe 410 | 410 | 18 |
| Fe 450 | 450 | 12 |

In the case of non-availability of ladle analysis, the finished product may also be checked to verify the chemical composition, if so agreed to by the producer,

In the case of pipes manufactured from steel plates, these shall conform to either IS : 2062

RANDOM LENGTHS : Steel tubes shall be supplied in single random lengths from 4 to 7 meters or double random lengths of 7 to 14 meters.

MINIMUM SPECIFIED THICKNESS OF PIPES

| Nominal Size mm | Minimum Specified Thickness of Pipe mm |
|--------------------|--|
| 150 to 400 | 4 |
| Above 400 to 550 | 5 |
| Above 550 to 900 | 6 |
| Above 900 to 1200 | 7 |
| Above 1200 to 1600 | 8 |
| Above 1600 to 2000 | 10 |

TOLERANCES

Outside Diameter

a) PIPE BODY - The tolerance on the pipe body shall be as shown below :

| Nominal size | Tolerance |
|--------------|----------------|
| Up to 500 mm | ± 0.75 percent |
| Over 500 mm | + 1.00 percent |

Note: Measurements may be made by any suitable instrument, such as outside calipers, diameter tapes, micrometers, etc.

b) **THICKNESS** -The tolerance on specified wall thickness shall be as follows :

| | |
|----------|--------------------------------|
| ERW pipe | ± 10 percent |
| EFW pipe | + 20 percent - 12.5 percent |

The hydraulic test pressure shall be the pressure calculated from the following formula, except that the maximum test the pressure shall not exceed 5 MPa. (NDT Test may be carried out in place of hydraulic pressure test) ($P=2St/D$)

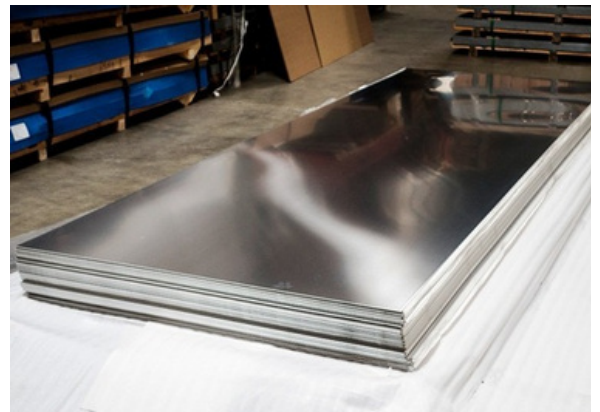
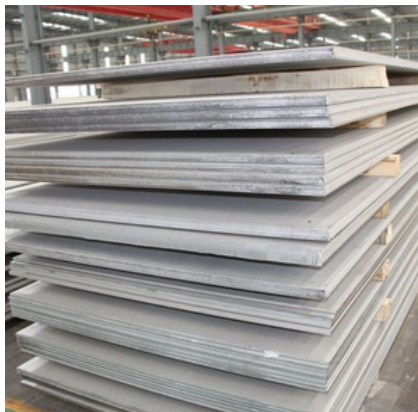
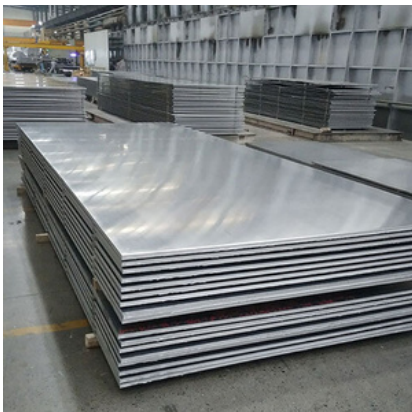
P- test pressure in MPa, S- stress in MPa which shall taken as 40 percent of specified minimum tensile strength

t- specified thickness in mm, D- specified outside diameter in mm.

CHEMICAL COMPOSITION REQUIREMENTS, % 'FOR STAINLESS PLATES

| UNS Designation | Type ^c | Carbon ^d | Manganese | Phosphorus | Sulfur | Silicon | Chromium | Nickel | Molybdenum | Nitrogen | Copper | Other Elements ^e |
|---|-------------------|---------------------|-----------|------------|--------|---------|-------------|-------------|------------|-----------|---------|-----------------------------|
| AUSTENITIC (CHROMIUM-MANGANESE-NICKEL) | | | | | | | | | | | | |
| N08904 | 904L ^d | 0.020 | 2.00 | 0.045 | 0.035 | 1.00 | 19.00-23.00 | 23.00-28.00 | 4.0-5.0 | 0.10 | 1.0-2.0 | ... |
| S20200 | 202 | 0.15 | 7.50-10.0 | 0.060 | 0.030 | 1.00 | 17.00-19.00 | 4.00-6.00 | ... | 0.25 | ... | ... |
| S30400 | 304 | 0.07 | 2.00 | 0.045 | 0.030 | 0.75 | 17.50-19.50 | 8.00-10.50 | ... | 0.10 | ... | ... |
| S30403 | 304L | 0.030 | 2.00 | 0.045 | 0.030 | 0.75 | 17.50-19.50 | 8.00-12.00 | ... | 0.10 | ... | ... |
| S30409 | 304H | 0.045-0.10 | 2.00 | 0.045 | 0.030 | 0.75 | 18.00-20.00 | 8.00-10.50 | ... | ... | ... | ... |
| S30453 | 304LN | 0.030 | 2.00 | 0.045 | 0.030 | 0.75 | 18.00-20.00 | 8.00-12.00 | ... | 0.10-0.16 | ... | ... |
| S30908 | 309S | 0.08 | 2.00 | 0.045 | 0.030 | 0.75 | 22.00-24.00 | 12.00-15.00 | ... | ... | ... | ... |
| S31008 | 310S | 0.08 | 2.00 | 0.045 | 0.030 | 1.50 | 24.00-26.00 | 19.00-22.00 | ... | ... | ... | ... |
| S31600 | 316 | 0.08 | 2.00 | 0.045 | 0.030 | 0.75 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | 0.10 | ... | ... |
| S31603 | 316L | 0.030 | 2.00 | 0.045 | 0.030 | 0.75 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | 0.10 | ... | ... |
| S31609 | 316H ^d | 0.04-0.10 | 2.00 | 0.045 | 0.030 | 0.75 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | ... | ... | ... |
| S31635 | 316Ti | 0.08 | 2.00 | 0.045 | 0.030 | 0.75 | 16.00-18.00 | 10.00-14.00 | 2.0-3.0 | 0.10 | ... | Ti 5 x (C+N) min, 0.70 max |
| S31653 | 316LN | 0.030 | 2.00 | 0.045 | 0.030 | 0.75 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | 0.10-0.16 | ... | ... |
| S31700 | 317 ^d | 0.08 | 2.00 | 0.045 | 0.030 | 0.75 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | 0.10 | ... | ... |
| S31703 | 317L | 0.030 | 2.00 | 0.045 | 0.030 | 0.75 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | 0.10 | ... | ... |
| S31753 | 317LN | 0.030 | 2.00 | 0.045 | 0.030 | 0.75 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | 0.10-0.22 | ... | ... |
| S32100 | 321 | 0.08 | 2.00 | 0.045 | 0.030 | 0.75 | 17.00-19.00 | 9.00-12.00 | ... | 0.10 | ... | Ti 5 x (C+N) min, 0.70 max |
| S32109 | 321H | 0.04-0.10 | 2.00 | 0.045 | 0.030 | 0.75 | 17.00-19.00 | 9.00-12.00 | ... | ... | ... | Ti 4 x (C+N) min, 0.70 max |
| S34700 | 347 | 0.08 | 2.00 | 0.045 | 0.030 | 0.75 | 17.00-19.00 | 9.00-13.00 | ... | ... | ... | Cb 10 x C min, 1.00 max |
| S34709 | 347H | 0.04-0.10 | 2.00 | 0.045 | 0.030 | 0.75 | 17.00-19.00 | 9.00-13.00 | ... | ... | ... | Cb 8 x C min, 1.00 max |
| FERRITIC OR MARTENSITIC (CHROMIUM) | | | | | | | | | | | | |
| S40500 | 405 | 0.08 | 1.00 | 0.040 | 0.030 | 1.00 | 11.50-14.50 | 0.60 | ... | ... | ... | Al 0.10-0.30 |
| S41000 | 410 | 0.15 | 1.00 | 0.040 | 0.030 | 1.00 | 11.50-13.50 | 0.75 | ... | ... | ... | ... |
| S41008 | 410S | 0.08 | 1.00 | 0.040 | 0.030 | 1.00 | 11.50-13.50 | 0.60 | ... | ... | ... | ... |
| S42900 | 429 ^d | 0.12 | 1.00 | 0.040 | 0.030 | 1.00 | 14.00-16.00 | ... | ... | ... | ... | ... |
| S43000 | 430 | 0.12 | 1.00 | 0.040 | 0.030 | 1.00 | 16.00-18.00 | 0.75 | ... | ... | ... | ... |
| S43035 | 439 | 0.07 | 1.00 | 0.040 | 0.030 | 1.00 | 17.00-19.00 | 0.050 | ... | 0.04 | ... | Ti 0.20 + 4 (C+N) min; 1.10 |

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**MECHANICAL TEST REQUIREMENTS FOR
STAINLESS STEEL PLATES**

| UNS Designation | Type ^a | Tensile Strength, min | | Yield strength ^b min | | Elongation in 2 in. or 50 mm, min, % | Hardness, max ^c | | Cold Bend ^d |
|---|--------------------|-----------------------|-----|---------------------------------|-----|--------------------------------------|----------------------------|------------|------------------------|
| | | ksi | MPa | ksi | MPa | | Brinell | Rockwell B | |
| Austenitic (Chromium-Nickel) (Chromium-Manganese-Nickel) | | | | | | | | | |
| N08904 | 904L ^e | 71 | 490 | 31 | 220 | 35.0 | ... | 90 | not required |
| S20200 | 202 | 90 | 620 | 38 | 260 | 40.0 | 241 | ... | ... |
| S30400 | 304 | 75 | 515 | 30 | 205 | 40.0 | 201 | 92 | not required |
| S30403 | 304L | 70 | 485 | 25 | 170 | 40.0 | 201 | 92 | not required |
| S30409 | 304H | 75 | 515 | 30 | 205 | 40.0 | 201 | 92 | not required |
| S30453 | 304LN | 75 | 515 | 30 | 205 | 40.0 | 201 | 92 | not required |
| S30908 | 309S | 75 | 515 | 30 | 205 | 40.0 | 217 | 95 | not required |
| S31008 | 310S | 75 | 515 | 30 | 205 | 40.0 | 217 | 95 | not required |
| S31600 | 316 | 75 | 515 | 30 | 205 | 40.0 | 217 | 95 | not required |
| S31603 | 316L | 70 | 485 | 25 | 170 | 40.0 | 217 | 95 | not required |
| S31653 | 316LN | 75 | 515 | 30 | 205 | 40.0 | 217 | 95 | not required |
| S31609 | 316H | 75 | 515 | 30 | 205 | 40.0 | 217 | 95 | not required |
| S31635 | 316Ti ^f | 75 | 515 | 30 | 205 | 40.0 | 217 | 95 | not required |
| S31700 | 317 | 75 | 515 | 30 | 205 | 35.0 | 217 | 95 | not required |
| S31703 | 317L | 75 | 515 | 30 | 205 | 40.0 | 217 | 95 | not required |
| S31753 | 317N | 80 | 550 | 35 | 240 | 40.0 | 217 | 95 | not required |
| S32100 | 321 | 75 | 515 | 30 | 205 | 40.0 | 217 | 95 | not required |
| S32109 | 321H | 75 | 515 | 30 | 205 | 40.0 | 217 | 95 | not required |
| S34700 | 347 | 75 | 515 | 30 | 205 | 40.0 | 201 | 92 | not required |
| S34709 | 347H | 75 | 515 | 30 | 205 | 40.0 | 201 | 92 | not required |
| S40500 | 405 | 60 | 415 | 25 | 170 | 20.0 | 179 | 88 | 180 |
| S41000 | 410 | 65 | 450 | 30 | 205 | 20.0 | 217 | 96 | 180 |
| S41008 | 410S | 60 | 415 | 30 | 205 | 22.0 ^g | 183 | 89 | 180 |
| S42900 | 429 ^f | 65 | 450 | 30 | 205 | 22.0 ^g | 183 | 89 | 180 |
| S43000 | 430 | 65 | 450 | 30 | 205 | 22.0 ^g | 183 | 89 | 180 |
| S43035 | 439 | 60 | 415 | 30 | 205 | 22.0 | 183 | 89 | 180 |

- Unless otherwise indicated, a grade designation originally assigned by the American Iron Steel Institute (AISI).
- Yield strength shall be determined by the offset method at 0.2% in accordance with Test methods and Definitions A 370. Unless otherwise specified (see Specification A 480/A 480M, paragraph 4.1.11 in Ordering Information), an alternative method of determining yield strength, may be based on total extension under load of 0.5 %.
- Either brinell or Rockwell B Hardness is permissible.
- Common name, not a trademark, widely used, not associated with any one producer.
- Material 0.050 in (1.27 mm) and under in thickness shall have a minimum elongation of 20.0 %.

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CARBON STEEL PLATES - IS 8500

| CHEMICAL COMPOSITION | | | | | | |
|----------------------|----------------|------------|-----------|-----------|------------|-------------|
| Grade IS 8500 | Ladle Analysis | | | | | |
| | C% Max | Mn% Max | S% Max | P% Max | Si% Max | C.E% Max |
| Fe 440 | 0.20 | 1.30 | 0.040 | 0.040 | 0.45 | 0.40 |
| Fe 490 | 0.20 | 1.50 | 0.040 | 0.040 | 0.45 | 0.42 |
| Fe 540 | 0.20 | 1.60 | 0.040 | 0.040 | 0.45 | 0.44 |
| Fe 570 | 0.22 | 1.60 | 0.040 | 0.040 | 0.45 | 0.46 |
| Fe 590 | 0.22 | 1.80 | 0.040 | 0.040 | 0.45 | 0.48 |

| MECHANICAL PROPERTIES | | | | | | | | | |
|-----------------------|-------------------------------|----------------------|-----------------|---------------|--------------------------------------|--------------------------|---------------|---|------|
| Grade IS 8500 | Tensile Strength (Min) MPa | Yield Strength (Min) | | | Elongation Percent (Min) 5.65.√So | Bend (Internal diameter) | | Charpy V -notch Impact toughness, Joules, Min | |
| | | <16 mm MPa | 16-40 mm MPa | >40 mm MPa | | 25 mm Min | >25 mm Min | RT | 20°C |
| Fe 440 | 440 | 300 | 290 | 280 | 22 | 2t | 3t | 50 | 30 |
| Fe 490 | 490 | 350 | 330 | 320 | - | 2t | 3t | 50 | 25 |
| Fe 540 | 540 | 410 | 390 | 380 | - | 2t | 3t | 50 | 25 |
| Fe 570 | 570 | 450 | 430 | 420 | - | 2t | 3t | 45 | 20 |
| Fe 590 | 590 | 450 | 430 | 420 | - | 2t | 3t | 45 | 20 |

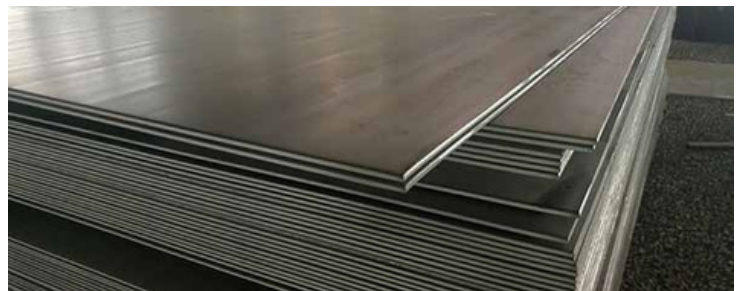
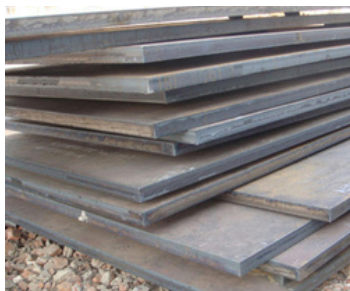
SAILMA HIGH STRENGTH MICRO ALLOY STRUCTURAL STEEL (KILLED)

| CHEMICAL COMPOSITION | | | | |
|----------------------|-----------|------------|-----------|-----------|
| Grade | C% Max | Mn% Max | S% Max | P% Max |
| SAILMA 350 | 0.25 | 1.50 | 0.055 | 0.055 |
| SAILMA 350HI | 0.20 | 1.50 | 0.055 | 0.055 |
| SAILMA 410 | 0.25 | 1.50 | 0.055 | 0.055 |
| SAILMA 410HI | 0.25 | 1.50 | 0.055 | 0.055 |
| SAILMA 450 | 0.25 | 1.50 | 0.055 | 0.055 |
| SAILMA 450HI | 0.20 | 1.50 | 0.040 | 0.040 |

| MECHANICAL PROPERTIES | | | | | | |
|-----------------------|-----------|-----------------|-----------------------|--|------|-----------|
| Grade | UTS (MPa) | YS (MPa) Min | El. % Min 5.65.√So | Charpy V - notch Impact toughness, Joules, Min | | Bend Test |
| | | | | RT | 20°C | |
| SAILMA350 | 490-610 | 350 | 20 | - | - | 3T |
| SAILMA350HI | 490-610 | 350 | 21 | 35 | 25 | 3T |
| SAILMA410 | 510-660 | 410 | 19 | - | - | 3T |
| SAILMA410HI | 540-660 | 410 | 20 | 30 | 20 | 3T |
| SAILMA450 | 570-720 | 450 | 18 | - | - | 3T |
| SAILMA450HI | 570-720 | 450 | 19 | * | * | 3T |

For SAILMA 450HI Impact is for > 10mm for < 12mm Impact to be given only if specified

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CARBON STEEL: CHEMICAL COMPOSITION OF STANDARD GRADES

| Grades | % Chemical Composition | | | | | | | | | Deoxidation |
|--------------------|------------------------|-------------|-------------|--------------|--------------|-------------|---------------|-------------|-------------|----------------------|
| | C | Mn | Si | S | P | Al | Cu | Nb+V+Ti | Ce | |
| IS 1079 Gr O | 0.15 max | 0.60 max | - | 0.055 max | 0.055 max | - | - | - | - | Semi Killed / Killed |
| IS 1079 Gr D | 0.12 max | 0.50 max | - | 0.040 max | 0.040 max | - | - | - | - | Semi Killed / Killed |
| IS 1079 Gr DD | 0.10 max | 0.40 max | - | 0.035 max | 0.035 max | 0.02 min | - | - | - | Al Killed |
| IS 1079 Gr EDD | 0.08 max | 0.40 max | - | 0.030 max | 0.030 max | 0.02 min | - | - | - | Al Killed |
| IS 2062 E 250 A | 0.23 max | 1.50 max | 0.40 max | 0.045 max | 0.045 max | - | - | 0.25 | 0.25 | Semi Killed / Killed |
| IS 2062 E 250 B | 0.22 max | 1.50 max | 0.40 max | 0.045 max | 0.045 max | - | - | 0.25 max | 0.41 max | Killed |
| IS 2062 E250 C | 0.20 max | 1.50 max | 0.04 max | 0.040 max | 0.040 max | - | 0.20- 0.35 | 0.25 max | - | Killed |
| IS 2062 E 250 Cu C | 0.20 max | 1.60 max | 0.45 max | 0.045 max | 0.045 max | - | - | 0.25 max | 0.44 max | Killed |
| IS 2062 E410 | 0.20 max | 1.60 max | 0.45 max | 0.045 max | 0.045 max | - | - | 0.25 max | 0.44 max | Killed |
| IS 2060 E450 D | 0.22 max | 1.60 max | 0.45 max | 0.045 max | 0.045 max | - | - | 0.25 max | 0.45 max | Killed |
| IS 2062 E450 E | 0.22 max | 1.80 max | 0.45 max | 0.045 max | 0.045 max | - | - | 0.25 max | 0.48 max | Killed |
| IS 5986 Fe 410 | 0.20 max | 1.20 max | - | 0.040 max | 0.040 max | - | - | - | 0.42 max | Killed |
| IS 10748 Gr 1 | 0.10 max | 0.50 max | - | 0.040 max | 0.040 max | - | - | - | - | Killed |

CARBON STEEL : MECHANICAL PROPERTIES OF STANDARD GRADES

| Grades | YS N/mm ² | UTS N/mm ² | % El (Min) GL= 5.65√S ₀ | Bend Test (t) | Hard R _e | Charpy V-Notch Impact Energy (min) |
|-----------------|-------------------------|--------------------------|---------------------------------------|------------------|------------------------|---------------------------------------|
| IS 1079 Gr O | - | - | - | 2 t | - | - |
| IS 1079 Gr D | - | 240 - 400 | 25 | 1 t | - | - |
| IS 1079 Gr DD | - | 260 - 390 | 28 | Close | - | - |
| IS 1079 Gr EDD | - | 260 - 380 | 32 | Close | - | - |
| IS 2062 E250 A | 250 min | 410 min | 23 | 3 t | - | - |
| IS 2062 E250 B | 250 min | 410 min | 23 | 2 t | - | 27 J at Room temp See Note |
| IS 2062 E250 C | 250 min | 410 min | 23 | 2 t | - | 27 J at Roomtemp See Note |
| IS 2062E250Cu C | 250 min | 410 min | 23 | 2 t | - | 27 J at Roomtemp See Note |
| IS 2062 E410 | 410 min | 540 min | 23 | 2 t | - | 50 J at Roomtemp See Note |
| IS 2062 E450 D | 450 min | 570 min | 20 | 2 t | - | 45 J at Room temp See Note. |
| IS 2062 E450 E | 450 min | 590 min | 20 | 2 t | - | 45 J at Room temp See Note |
| IS 5986 Fe410 | 255 min | 410-520 | 24 for t>3/0 mm* | 2 t | - | - |

't'= Nominal thickness of test piece, *:Elongation l5min N in 80mm GL fort <3.0mm

Note : For grade IS 2062 E2508, E250C, E410, E450E Impact Test shall be certified for product thickness of 12mm or more. The testing temperature will be room temperature unless otherwise specified in the order.

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EQUIVALENT SPECIFICATIONS OF IS STANDARDS

| TITLE (1) | Indian Standard No. and Grade (2) | | Near Equivalent Non IS Specifications (3) |
|---|-----------------------------------|--|--|
| Steel Plates for Pressure vessels for Intermediate and high temperature service including boilers | IS 2002 | Grade 1 Grade 2 Grade 3 | A/SA 515 Grade 60 A/SA 515 Grade 65 A/SA 515 Grade 70 |
| Steel Plates for Pressure vessels used at moderate and low temperature | IS 2041 | Grade R220 Grade R220 Grade R260 Grade R260 Grade R355 Grade H235 Grade H235 Grade H265 Grade H295 Grade H355 | A/SA 515 Grade 55 A/SA 515 Grade 60 A/SA 515 Grade 65 A/SA 515 Grade 70 A/SA 537 Class 1 DIN 17155 Gr. HI EN 10028-P2-P235GH EN 10028-P2-P235GH EN 10028-P2-P295GH EN 10028-P2-P355GH |
| Hot Rolled medium and high tensile structural steel (excluding bars and rods of diameter or thickness less than 6mm and structural below 50mm x 50mm x 6mm) | IS 2062 | E250 A E250 A E300 A E350 A E350 A or E 410 E250 BR E250 BR E300 BR E250 BR, B0, C E275 BR, B0, C E350 BR, B0, C E250 A E350 C E300 A E300 C E350 A E350 C E410 A E410 C E450 A E450 BR E550 A E550 BR E550 A | A / SA 36 A / SA 283 Grade D A / SA 572 Grade 42 A / SA 572 Grade 50 A / SA 572 Grade 55 A / SA 573 Grade 58 A / SA 573 Grade 65 A / SA 573 Grade 70 EN 10025 S235 JR,J0,J2 EN 10025 S275 JR,J0,J2 EN 10025 S355 JR,J0,J2 DIN 17100 Rst 37.2, St 44.2 DIN 17100 St 52.3 SALIMA 300 SALIMA 300 HI SALIMA 350 SALIMA 350 HI SALIMA 410 SALIMA 410 HI SALIMA 450 SALIMA 450 HI SALIMA 550 SALIMA 550 HI SAIL HITEN |

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EQUVALENT GRADES IN VARTOVS SPECTFTTCATION

Alloy Steel

| Equivalent Grades | | | | |
|-------------------|-----------|--------------|--------|------------|
| BS | DIN | IS | EN | SAE/AISI |
| 530A40 | 37Cr4 | 40Cr1 | EN18 | 5140 |
| 817M40 | 34CrNiMo6 | 40NiCr4Mo3 | EN24 | 4340 |
| 709M40 | - | 40Cr4Mo3 | EN19C | 4140, 4142 |
| 709M40 | - | 40Cr4Mo3 | EN19 | 4140, 4142 |
| 530A40 | 37Cr4 | 40Cr1 | EN18D | 5140 |
| 530A40 | 37Cr4 | 40Cr1 | EN18C | 5140 |
| 530A40 | 37Cr4 | 40Cr1 | EN18A | 5140 |
| - | 28Mn6 | 27C15 | - | 1527 |
| - | 20MnCr5 | 20MnCr1 | - | - |
| 150MB | - | 20Mn2 | EN14A | 1524 |
| - | 16MnCr5 | 17Mn1Cr95 | - | 5120 |
| 530A40 | 37Cr4 | 40Cr1 | EN18B | 5140 |
| 805M20 | - | 20NiCrMo2 | EN362 | 8620 |
| 805M20 | - | 20Ni2CrMo2 | - | 8622 |
| 815M17 | - | 15NiCr1Mo12 | EN353 | - |
| 820M17 | - | 15NiVCr1Mo15 | EN354 | 4320 |
| - | 17Cr3 | - | - | - |
| 41Cr4 | 41Cr4 | 40Cr4 | EN 18D | 5140 |
| 34Cr4 | 34Cr4 | - | EN 18 | 5130 |

Carbon Steels

| Equivalent Grades | | | | |
|-------------------|-------|---------------|--------|----------------|
| BS | DIN | IS | EN | SAE/AISI |
| 150M36 | 36Mn5 | 37Mn2, 37C15 | EN15B, | 1536 |
| - | CK15 | C14 | EN32B | 1015,1016,1018 |
| - | CK38 | - | - | 1038 |
| - | - | C50 | EN43C | 1050 |
| - | CK45 | 45C8 | 1045 | - |
| 070M55 | CK55 | C55 | EN9 | 1055 |
| - | C35 | 35C8, C35Mn75 | - | 1035 |
| - | CK75 | 80C6 | EN42 | 1074 |
| - | C67 | 65C6 | EN42B | 1065 |
| 080M50 | C55 | 60C6 | EN43 | 1055 |
| 080A47 | CK45 | - | EN43B | 1045 |

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ASTM A 283 LOW AND INTERMEDIATE TENSILE STRENGTH CARBON STEEL PLATES.

| Designation | Chemical Composition | | | | Mechanical Properties | | | |
|-------------|----------------------|---------|--------|--------|------------------------|----------------------|-----------------|---------|
| | C% max | Mn% max | P% max | S% max | Tensile Strength (Mpa) | Yield Strength (MPa) | Elongation %min | |
| | | | | | | | GL=8 in | GL=2 in |
| Grade A | 0.14 | 0.90 | 0.035 | 0.040 | 310-415 | 165 | 27 | 30 |
| Grade B | 0.17 | 0.90 | 0.035 | 0.040 | 345-450 | 185 | 25 | 28 |
| Grade C | 0.24 | 0.90 | 0.035 | 0.040 | 380-515 | 205 | 22 | 25 |
| Grade D | 0.27 | 0.90 | 0.035 | 0.040 | 415-550 | 230 | 20 | 23 |

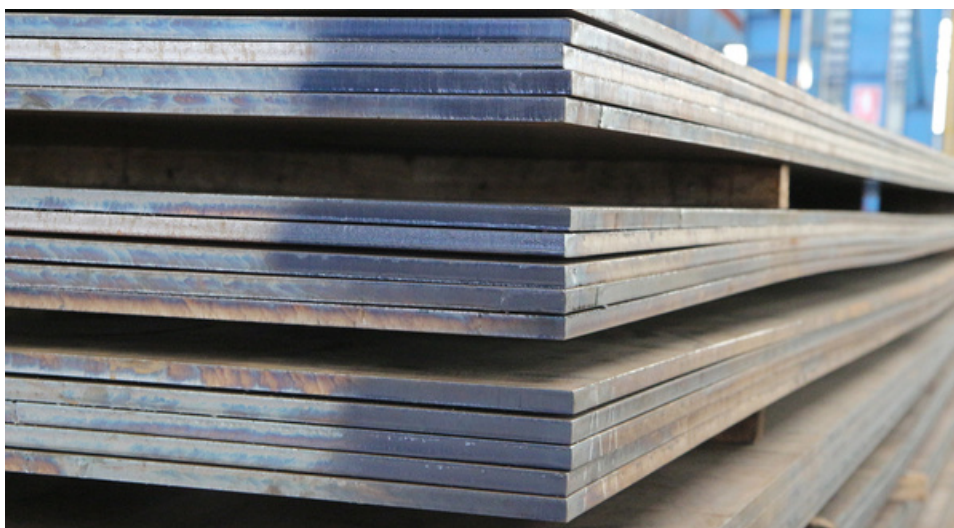
Note :

- 1) For Silicon: Thickness 40mm and under 0.40max & for Thickness over 40mm 0.15-0.40
- 2) Min% when copper is specified 0.20

ASTM A 285 PRESSURE VESSEL PLATES, CARBON STEEL LOW AND INTERMEDIATE TENSILE STRENGTH

| Designation | Chemical Composition | | | | Mechanical Properties | | | |
|-------------|----------------------|---------|--------|--------|------------------------|----------------------|-----------------|---------|
| | C% max | Mn% max | P% max | S% max | Tensile Strength (Mpa) | Yield Strength (MPa) | Elongation %min | |
| | | | | | | | GL=8 in | GL=2 in |
| Grade A | 0.17 | 0.90 | 0.035 | 0.035 | 310-415 | 165 | 27 | 30 |
| Grade B | 0.22 | 0.90 | 0.035 | 0.040 | 345-485 | 185 | 25 | 28 |
| Grade C | 0.28 | 0.90 | 0.035 | 0.040 | 380-515 | 205 | 22 | 23 |

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ASTM 515 PRESSURE VESSEL PLATES, CARBON STEEL FOR INTERMEDIATE AND HIGHER TEMPERATURE SERVICES

CHEMICAL COMPOSITION

| Elements | Composition % | | |
|---|-------------------------|-------------------------|-------------------------|
| | Grade 60 (Grade 415) | Grade 65 (Grade 450) | Grade 70 (Grade 485) |
| Carbon, Max (A) : | | | |
| 1 in. [25 mm] and under | 0.24 | 0.28 | 0.31 |
| Over 1 in. to 2 in. [25 to 50 mm], incl. | 0.27 | 0.31 | 0.33 |
| Over 2 in. to 4 in. [50 to 100 mm], incl. | 0.29 | 0.33 | 0.35 |
| Over 4 to 8 in. [100 to 200 mm], incl. | 0.31 | 0.33 | 0.35 |
| Over 8 in. [200 mm] | 0.31 | 0.33 | 0.35 |
| Manganese max : | | | |
| Heat analysis | 0.90 | 0.90 | 1.20 |
| Product analysis | 0.98 | 0.98 | 1.30 |
| Phosphorus, Max (A) | 0.035 | 0.035 | 0.035 |
| Sulfur, max (A) | 0.035 | 0.035 | 0.035 |
| Silicon : | | | |
| Heat analysis | 0.15-0.40 | 0.15-0.40 | 0.15-0.40 |
| Product analysis | 0.13-0.45 | 0.13-0.45 | 0.13-0.45 |

Note :

(A) Applies to both heat and product analysis

TENSILE REQUIREMENTS

| Elements | Composition % | | |
|---|-------------------------|-------------------------|-------------------------|
| | Grade 60 (Grade 415) | Grade 65 (Grade 450) | Grade 70 (Grade 485) |
| Tensile Strength, ksi [Mpa] | 60-80 [415-550] | 65-85 [450-585] | 70-90 [485-620] |
| Yield Strength, min. ksi [Mpa] | 32 [220] | 35 [240] | 38 [260] |
| Elongation in 8 in. [200 mm], min % (A) | 21 | 19 | 17 |
| Elongation in 2 in. [50 mm], min. % (A) | 25 | 23 | 21 |

Note :

(A) See Specification A20/420M for elongation adjustment,

ASTM 516 PRESSURE VESSEL PLATES, CARBON STEEL FOR INTERMEDIATE AND LOWER TEMPERATURE SERVICES

CHEMICAL COMPOSITION

| Elements | Composition % | | | |
|---|-------------------------|-------------------------|-------------------------|-------------------------|
| | Grade 55 (Grade 380) | Grade 60 (Grade 415) | Grade 65 (Grade 450) | Grade 70 (Grade 485) |
| Carbon, Max ¹ | | | | |
| ½ in. [12.5 mm] and under | 0.18 | 0.21 | 0.24 | 0.27 |
| Over ½ in. to 2 in. [12.5 to 50mm], incl. | 0.20 | 0.23 | 0.26 | 0.28 |
| Over 2 in. to 4 in. [50 to 100mm], incl. | 0.22 | 0.25 | 0.28 | 0.30 |
| Over 4 to 8 in. [100 to 200 mm], incl. | 0.24 | 0.27 | 0.29 | 0.31 |
| Over 8 in. [200 mm] | 0.26 | 0.27 | 0.29 | 0.31 |
| Manganese : | | | | |
| ½ in. [12.5 mm] and under | 0.60-0.90 | 0.60-0.90 | 0.85-1.20 | 0.85-1.20 |
| Heat analysis ² | 0.55-0.98 | 0.55-0.98 | 0.79-1.30 | 0.79-1.30 |
| Product analysis ² | | | | |
| Over ½ in. [12.5] : | | | | |
| Heat analysis ² | 0.60-1.20 | 0.85-1.20 | 0.85-1.20 | 0.85-1.20 |
| Product analysis ² | 0.55-1.30 | 0.79-1.30 | 0.79-1.30 | 0.79-1.30 |
| Phosphorus, Max ¹ | 0.035 | 0.035 | 0.035 | 0.035 |
| Sulfur, max ¹ | 0.035 | 0.035 | 0.035 | 0.035 |
| Silicon : | | | | |
| Heat analysis ² | 0.15-0.40 | 0.15-0.40 | 0.15-0.40 | 0.15-0.40 |
| Product analysis ² | 0.13-0.45 | 0.13-0.45 | 0.13-0.45 | 0.13-0.45 |

Applies to both heat and product analysis Grade 60 plates % in [12,5mm] and under in thickness may have 0,85-1 20% manganese on heat analysis, and 0,79-1 .30% manganese on product analysis

TENSILE REQUIREMENTS

| Elements | Composition % | | | |
|--------------------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| | Grade 55 (Grade 380) | Grade 60 (Grade 415) | Grade 65 (Grade 450) | Grade 70 (Grade 485) |
| Tensile Strength, ksi [Mpa] | 55-75 [380-515] | 60-80 [415-550] | 65-85 [450-585] | 70-90 [485-620] |
| Yield Strength, min., ksi [Mpa] | 30 [205] | 30 [220] | 35 [240] | 38 [260] |
| Elongation in 8 in. [200 mm], min. % | 23 [†] | 21 [†] | 19 [†] | 17 [†] |
| Elongation in 2 in. [50 mm], min. % | 27 [†] | 25 [†] | 23 [†] | 21 [†] |

See Specification A201 A 20M

- Determined by either the 0,2% offset method or the 0.5% extension under-load method.

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ALLOY STEEL PLATES

| ASTM A387 PRESSURE VESSEL PLATES, ALLOY STEEL, CHROMIUM - MOLYBDENUM | | | | | | | | | | | | |
|--|----------------------|-----------|-----------|--------|--------|------------|-----------|-----------|-------------------------------|--|---------------------------|-----------------------|
| Specification | CHEMICAL COMPOSITION | | | | | | | | MECHANICAL PROPERTIES | | | |
| | C% max | Si% | Mn% | P% max | S% max | Cr% | Mo% | V% | Tensile Strength Ksi (MPa) | Yield Strength (0.2% offset) Ksi (MPa) min | Elongation % min | |
| | | | | | | | | | | | GL = 8 in *2 or 200 mm | GL = 2 in. or 50 m |
| Grade 5 Class-2 | 0.15 | 0.50 max | 0.30-0.60 | 0.035 | 0.030 | 4.00-6.00 | 0.45-0.65 | | 75-100 (515-690) | 45 (310) | - | 18 |
| Grade 9 Class-2 | 0.15 | 1.00 max | 0.30-0.60 | 0.030 | 0.030 | 8.00-10.00 | 0.90-1.10 | 0.04 max | 75-100 (515-690) | 45 (310) | - | 18 |
| Grade 11 Class-2 | 0.05-0.17 | 0.50-0.80 | 0.40-0.65 | 0.035 | 0.035 | 1.00-1.50 | 0.45-0.65 | | 75-100 (515-690) | 43 (310) | 18 | 22 |
| Grade 12 Class-2 | 0.05-0.17 | 0.15-0.40 | 0.40-0.65 | 0.035 | 0.035 | 0.80-1.15 | 0.45-0.60 | | 65-85 (450-585) | 40 (275) | 19 | 22 |
| Grade 22 Class-2 | 0.05-0.15 | 0.50 max | 0.30-0.60 | 0.035 | 0.035 | 2.00-2.50 | 0.90-1.10 | | 75-100 (515-690) | 45 (310) | - | 18 |
| Grade 91* Class-2 | 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 | 85-110 (585-760) | 60 415 | - | 18 |

Additional Properties for Grade 91) Ni- 0.40max, Cb-0.06-0.10, N - 0.030-0.070, Al- 0.02, Ti&Z : 0.01 max

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ALLOY STEEL PLATES

CHEMICAL COMPOSITION

| Grade | C | Si | Mn | P | S | Cr | Mo | Ni | Nb | Ti | V | Al | N | Cu |
|----------|-----------|------|-----------|-------|-------|-----------|-----------|----|----|----|---|----|-------|------|
| 13CrMo45 | 0.08/0.18 | 0.35 | 0.40/1.00 | 0.025 | 0.010 | 0.70/1.15 | 0.40/0.60 | - | - | - | - | - | 0.012 | 0.30 |

MECHANICAL PROPERTIES

| Grade | Thickness | Yield Strength | Tensile Strength | Elongation (A) | Impact energy KV at test temperature | | |
|----------|-----------|----------------|------------------|----------------|--------------------------------------|-----|-------|
| | | | | | -20°C | 0°C | +20°C |
| | mm | Mpa | Mpa | % | J | J | J |
| 13CrMo45 | <16 | 300 | 450/600 | 19 | - | - | 31 |
| | >16<60 | 290 | 450/600 | 19 | - | - | 31 |
| | >60<100 | 270 | 440/590 | | | | 27 |
| | >100<150 | 255 | 430/580 | | | | 27 |
| | >150<250 | 245 | 420/570 | | | | 27 |

CHEMICAL COMPOSITION

| Grade | C | Si | Mn | P | S | Cr | Mo | Ni | Nb | Ti | V | Al | N | Cu |
|-------|-----------|------|-----------|-------|-------|-------|-----------|------|----|----|---|----|-------|------|
| 16Mo3 | 0.12/0.20 | 0.35 | 0.40/0.90 | 0.025 | 0.010 | 0.030 | 0.25/0.35 | 0.30 | - | - | - | - | 0.012 | 0.30 |

MECHANICAL PROPERTIES

| Grade | Thickness | Temperature (°C) | | | | | | | | | |
|-------|-----------|------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| | | 50° MPa | 100° MPa | 150° MPa | 200° MPa | 250° MPa | 300° MPa | 350° MPa | 400° MPa | 450° MPa | 500° MPa |
| | (mm) | | | | | | | | | | |
| 16Mo3 | <16 | 273 | 264 | 250 | 233 | 213 | 194 | 175 | 159 | 147 | 141 |
| | >16<40 | 268 | 259 | 245 | 228 | 209 | 190 | 172 | 156 | 145 | 139 |
| | >40<60 | 258 | 250 | 236 | 220 | 202 | 183 | 165 | 150 | 139 | 134 |
| | >60<100 | 238 | 230 | 218 | 203 | 186 | 169 | 153 | 139 | 129 | 123 |
| | >100<150 | 218 | 211 | 200 | 186 | 171 | 155 | 140 | 127 | 118 | 113 |
| | >150<250 | 208 | 202 | 191 | 178 | 163 | 148 | 134 | 121 | 113 | 108 |

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EN 10025 : 1993 - HOT ROLLED PRODUCTS OF NON-ALLOY STRUCTURAL STEELS

(Properties minima unless stated)

| Grade | | S185 ¹⁾ | S235 ^{15*} | S235JR ²⁾ | S235JRG1 ³⁾ | S235JRG2 | S235JO | S235J2G3 | S235J2G4 | S275 ^{11*} | S275JR | S275JO | |
|---|-------------|-----------------------|-----------------------|----------------------|--------------------------|------------|---------|----------|----------|-----------------------|---------|---------|--------------------|
| ISO : Standard 630 | | Fe310-0 ⁴⁾ | Fe360A ¹⁰⁾ | Fe360B ²⁾ | Fe360B(FU) ⁹⁾ | Fe360B(FN) | Fe 360C | Fe 360D1 | Fe 360D2 | Fe430A ¹⁸⁾ | Fe 430B | Fe 430C | |
| BS4360 Equivalent Grade - | | - | 40A | - | - | 40B | 40C | 40D | - | 43A | 43B | BC | |
| Type of Deoxidation ¹⁾ | | opt. | opt. | opt. | FU | FN | FN | FF | FF | FN | FN | FN | |
| | | Thickness (mm) | | | | | | | | | | | |
| Chemical Composition | C | ≤ 16 | - | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.21 | 0.21 | 0.18 |
| | | ≥ 16 ≤ 40 | - | 0.20 | 0.20 | 0.20 | 0.17 | 0.17 | 0.17 | 0.17 | 0.21 | 0.21 | 0.18 |
| | | ≥ 40 ⁶⁾ | - | - | - | - | 0.20 | 0.17 | 0.17 | 0.17 | 0.22 | 0.22 | 0.18 ⁸⁾ |
| | % maximum | Si | - | - | - | - | - | - | - | - | - | - | - |
| | | Mn | - | 1.40 | 1.40 | 1.40 | 1.40 | 1.40 | 1.40 | 1.40 | 1.50 | 1.50 | 1.50 |
| | | P | - | 0.045 | 0.045 | 0.045 | 0.045 | 0.040 | 0.035 | 0.035 | 0.045 | 0.045 | 0.040 |
| S | | - | 0.045 | 0.045 | 0.045 | 0.045 | 0.040 | 0.035 | 0.035 | 0.045 | 0.045 | 0.040 | |
| N ²³⁾ | | - | 0.009 | 0.009 | 0.007 | 0.009 | 0.009 | - | - | 0.009 | 0.009 | 0.009 | |
| Yield Stress ⁸⁾ R _{0.2} N/mm ² | ≤ 16 | 185 | 235 | 235 | 235 | 235 | 235 | 235 | 235 | 275 | 275 | 275 | |
| | ≥ 16 ≤ 40 | 175 | 225 | 225 | 225 | 225 | 225 | 225 | 225 | 265 | 265 | 265 | |
| | ≥ 40 ≤ 63 | - | - | - | - | 215 | 215 | 215 | 215 | 255 | 255 | 255 | |
| | ≥ 63 ≤ 80 | - | - | - | - | 215 | 215 | 215 | 215 | 245 | 245 | 245 | |
| | ≥ 80 ≤ 100 | - | - | - | - | 215 | 215 | 215 | 215 | 235 | 235 | 235 | |
| | ≥ 100 ≤ 150 | - | - | - | - | 195 | 195 | 195 | 195 | 225 | 225 | 225 | |
| | ≥ 150 ≤ 200 | - | - | - | - | 185 | 185 | 185 | 185 | 215 | 215 | 215 | |
| ≥ 200 ≤ 250 | - | - | - | - | 175 | 175 | 175 | 175 | 205 | 205 | 205 | | |
| Tensile Strength ⁸⁾ R _m N/mm ² | < 3 | 310/540 | 360/510 | 360/510 | 360/510 | 360/510 | 360/510 | 360/510 | 360/510 | 430/580 | 430/580 | 430/580 | |
| | ≥ 3 ≤ 100 | 290/510 | 340/470 | 340/470 | 340/470 | 340/470 | 340/470 | 340/470 | 340/470 | 410/560 | 410/560 | 410/560 | |
| | ≥ 100 ≤ 150 | - | - | - | - | 340/470 | 340/470 | 340/470 | 340/470 | 400/540 | 400/540 | 400/540 | |
| | > 150 ≤ 250 | - | - | - | - | 320/470 | 320/470 | 320/470 | 320/470 | 380/540 | 380/540 | 380/540 | |
| Elongation ⁸⁾³⁾⁴⁾ %(Values in Parentheses are Transverse Values) | ≤ 1 | 10 (8) | 17 (15) | 17 (15) | 17 (15) | 17 (15) | 17 (15) | 17 (15) | 17 (15) | 14 (12) | 14 (12) | 14 (12) | |
| | > 1 ≤ 1.5 | 11 (9) | 18 (16) | 18 (16) | 18 (16) | 18 (16) | 18 (16) | 18 (16) | 18 (16) | 15 (13) | 15 (13) | 15 (13) | |
| | > 1.5 ≤ 2 | 12 (10) | 19 (17) | 19 (17) | 19 (17) | 19 (17) | 19 (17) | 19 (17) | 19 (17) | 16 (14) | 16 (14) | 16 (14) | |
| | > 2 ≤ 2.5 | 13 (11) | 20 (18) | 20 (18) | 20 (18) | 20 (18) | 20 (18) | 20 (18) | 20 (18) | 17 (15) | 17 (15) | 17 (15) | |
| | > 2.5 ≤ 3 | 14 (12) | 21 (19) | 21 (19) | 21 (19) | 21 (19) | 21 (19) | 21 (19) | 21 (19) | 18 (16) | 18 (16) | 18 (16) | |
| | ≥ 3 ≤ 40 | 18 (16) | 26 (24) | 26 (24) | 26 (24) | 26 (24) | 26 (24) | 26 (24) | 26 (24) | 22 (20) | 22 (20) | 22 (20) | |
| | > 40 ≤ 63 | - | 25 (23) | 25 (23) | 25 (23) | 25 (23) | 25 (23) | 25 (23) | 25 (23) | 21 (19) | 21 (19) | 21 (19) | |
| | > 63 ≤ 100 | - | 24 (22) | 24 (22) | 24 (22) | 24 (22) | 24 (22) | 24 (22) | 24 (22) | 20 (18) | 20 (18) | 20 (18) | |
| | > 100 ≤ 150 | - | 22 (22) | 22 (22) | 22 (22) | 22 (22) | 22 (22) | 22 (22) | 22 (22) | 18 (18) | 18 (18) | 18 (18) | |
| > 150 ≤ 250 | - | 21 (21) | 21 (21) | 21 (21) | 21 (21) | 21 (21) | 21 (21) | 21 (21) | 17 (17) | 17 (17) | 17 (17) | | |
| Impact KV J | Temp °C | +20 | > 10 ≤ 150 | - | - | 27 | 27 | 27 | - | - | - | 27 | |
| | | 0 | > 10 ≤ 150 | - | - | - | - | - | 27 | - | - | 27 | |
| | | -20 | > 10 ≤ 150 | - | - | - | - | - | - | 27 | - | - | |
| | | +20 | > 10 ≤ 150 | - | - | - | - | 23 | - | - | - | 23 | |
| | | 0 | > 10 ≤ 150 | - | - | - | - | - | 23 | - | - | - | |
| | | -20 | > 10 ≤ 150 | - | - | - | - | - | - | 23 | 23 | - | - |

Note : 1), 2), 3), 4), 5), 6), 7) references Shall be made to BS EN10155 Handbook

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EN 10025 : 1993 - HOT ROLLED PRODUCTS OF NON-ALLOY STRUCTURAL STEELS

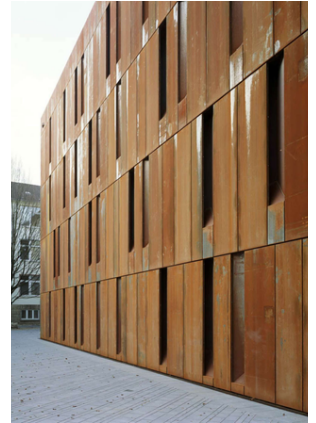
| Grade | S275J2G3 | S275JG4 | S355 ¹⁵⁾ | S355JR | S355JO ²⁾ | S355J2G3 ¹⁾ | S355J2G4 ²⁾ | S355K2G3 ²⁾ | S355K2G4 ²⁾ | E295 ¹⁶⁾ | E335 ¹⁶⁾ | E360 ¹⁶⁾ | | |
|---|--------------------------------------|--------------------|---------------------|--------------------|----------------------|------------------------|------------------------|------------------------|------------------------|---------------------|---------------------|---------------------|---------|-------|
| ISO : Standard 630 | Fe430D1 | Fe430D2 | Fe510A | Fe510B | Fe510C | Fe510D1 | Fe510D2 | Fe510DD1 | Fe510DD2 | Fe490-2 | Fe590-2 | Fe690-2 | | |
| BS4360 Equivalent Grade | 43D | 43D | 50A | 50B | 50C | 50D | 50D | 50DD | 50DD | - | - | - | | |
| Type of Deoxidation ¹⁾ | FF | FF | FN | FN | FN | FF | FF | FN | FN | FN | FN | FN | | |
| Thickness (mm) | | | | | | | | | | | | | | |
| Chemical Composition | C | ≤ 16 | 0.18 | 0.18 | 0.24 | 0.24 | 0.20 | 0.20 | 0.20 | 0.20 | - | - | - | |
| | | ≥ 16 ≤ 40 | 0.18 | 0.18 | 0.24 | 0.24 | 0.20 ⁸⁾ | 0.20 ⁸⁾ | 0.20 ⁸⁾ | 0.20 ⁸⁾ | 0.20 | - | - | - |
| | | ≥ 40 ⁹⁾ | 0.18 ⁸⁾ | 0.18 ⁸⁾ | 0.24 | 0.24 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | - | - | - |
| | Si | - | - | 0.55 | 0.55 | 0.55 | 0.55 | 0.55 | 0.55 | 0.55 | - | - | - | |
| | Mn | 1.50 | 1.50 | 1.60 | 1.60 | 1.60 | 1.60 | 1.60 | 1.60 | 1.60 | - | - | - | |
| | % maximum | P | 0.035 | 0.035 | 0.045 | 0.045 | 0.040 | 0.035 | 0.035 | 0.035 | 0.035 | 0.045 | 0.045 | 0.045 |
| | S | 0.035 | 0.035 | 0.045 | 0.045 | 0.040 | 0.035 | 0.035 | 0.035 | 0.035 | 0.045 | 0.045 | 0.045 | |
| | N ¹³⁾ | - | - | 0.009 | 0.009 | 0.009 | - | - | - | 0.009 | 0.009 | 0.009 | | |
| Yield Stress ¹⁰⁾ | R _{eH} N/mm ² | ≤ 16 | 275 | 275 | 355 | 355 | 355 | 355 | 355 | 355 | 295 | 335 | 365 | |
| | | ≥ 16 ≤ 40 | 265 | 265 | 345 | 345 | 345 | 345 | 345 | 345 | 285 | 325 | 355 | |
| | | ≥ 40 ≤ 63 | 255 | 255 | 335 | 335 | 335 | 335 | 335 | 335 | 275 | 315 | 345 | |
| | | ≥ 63 ≤ 80 | 245 | 245 | 325 | 325 | 325 | 325 | 325 | 325 | 265 | 305 | 335 | |
| | | ≥ 80 ≤ 100 | 235 | 235 | 315 | 315 | 315 | 315 | 315 | 315 | 255 | 295 | 325 | |
| | | ≥ 100 ≤ 150 | 225 | 225 | 295 | 295 | 295 | 295 | 295 | 295 | 245 | 275 | 305 | |
| | | ≥ 150 ≤ 200 | 215 | 215 | 285 | 285 | 285 | 285 | 285 | 285 | 235 | 265 | 295 | |
| ≥ 200 ≤ 250 | 205 | 205 | 275 | 275 | 275 | 275 | 275 | 275 | 225 | 255 | 285 | | | |
| Tensile Strength ¹¹⁾ | R _m N/mm ² | < 3 | 430/580 | 430/580 | 510/680 | 510/680 | 510/680 | 510/680 | 510/680 | 510/680 | 490/660 | 590/770 | 690/90 | |
| | | ≥ 3 ≤ 100 | 410/560 | 410/560 | 490/630 | 490/630 | 490/630 | 490/630 | 490/630 | 490/630 | 470/610 | 570/710 | 670/830 | |
| | | > 100 ≤ 150 | 400/540 | 400/540 | 470/630 | 470/630 | 470/630 | 470/630 | 470/630 | 470/630 | 450/610 | 550/710 | 650/830 | |
| | | > 150 ≤ 250 | 380/540 | 380/540 | 450/630 | 450/630 | 450/630 | 450/630 | 450/630 | 450/630 | 440/610 | 540/710 | 640/830 | |
| Elongation ^{9) 13) 14)} % (Values in Parentheses are Transverse Values) | ≤ 1 | 14 (12) | 14 (12) | 14 (12) | 14 (12) | 14 (12) | 14 (12) | 14 (12) | 14 (12) | 14 (12) | 12 (10) | 8 (6) | 4 (3) | |
| | > 1 ≤ 1.5 | 15 (13) | 15 (13) | 15 (13) | 15 (13) | 15 (13) | 15 (13) | 15 (13) | 15 (13) | 15 (13) | 13 (11) | 9 (7) | 5 (4) | |
| | > 1.5 ≤ 2 | 16 (14) | 16 (14) | 16 (14) | 16 (14) | 16 (14) | 16 (14) | 16 (14) | 16 (14) | 16 (14) | 14 (12) | 10 (8) | 6 (5) | |
| | > 2 ≤ 2.5 | 17 (15) | 17 (15) | 17 (15) | 17 (15) | 17 (15) | 17 (15) | 17 (15) | 17 (15) | 17 (15) | 15 (13) | 11 (9) | 7 (6) | |
| | > 2.5 ≤ 3 | 18 (16) | 18 (16) | 18 (16) | 18 (16) | 18 (16) | 18 (16) | 18 (16) | 18 (16) | 18 (16) | 16 (14) | 12 (10) | 8 (7) | |
| | ≥ 3 ≤ 40 | 22 (20) | 22 (20) | 22 (20) | 22 (20) | 22 (20) | 22 (20) | 22 (20) | 22 (20) | 22 (20) | 20 (18) | 16 (14) | 11 (10) | |
| | > 40 ≤ 63 | 21 (19) | 21 (19) | 21 (19) | 21 (19) | 21 (19) | 21 (19) | 21 (19) | 21 (19) | 21 (19) | 19 (17) | 15 (13) | 10 (9) | |
| | > 63 ≤ 100 | 20 (18) | 20 (18) | 20 (18) | 20 (18) | 20 (18) | 20 (18) | 20 (18) | 20 (18) | 20 (18) | 18 (16) | 14 (12) | 9 (8) | |
| | > 100 ≤ 150 | 18 (18) | 20 (18) | 20 (18) | 20 (18) | 20 (18) | 20 (18) | 20 (18) | 20 (18) | 20 (18) | 16 (15) | 12 (11) | 8 (7) | |
| > 150 ≤ 250 | 17 (17) | 17 (17) | 17 (17) | 17 (17) | 17 (17) | 17 (17) | 17 (17) | 17 (17) | 17 (17) | 15 (14) | 11 (10) | 7 (6) | | |
| | +20 | > 10 ≤ 150 | - | - | - | 27 | - | - | - | - | - | - | - | |
| | 0 | > 10 ≤ 150 | - | - | - | - | 27 | - | - | - | - | - | - | |
| | -20 | > 10 ≤ 150 | 27 | 27 | - | - | - | 27 | 27 | 40 | 40 | - | - | |
| | +20 | > 150 ≤ 250 | - | - | - | 23 | - | - | - | - | - | - | - | |
| | 0 | > 150 ≤ 250 | - | - | - | - | 23 | - | - | - | - | - | - | |
| | -20 | > 150 ≤ 250 | 23 | 23 | - | - | - | 23 | 23 | 33 | 33 | - | - | |

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COR-TEN WEATHERING STEEL

PRODUCT DESCRIPTION

Cor-ten Steel oxidizes naturally over time, giving it an orange-brown color and a rough and granular texture. It has a very high tensile strength, and in spite of its rusted appearance it is actually more resistant to damaging corrosion than standard forms of carbon steel. Cor-ten is a combination of alloys that through the chemical interaction of weather and steel, prevents rust from penetrating the surface and creating rust holes. The steel actually forms a shield over the steel. Cor-ten is highly resistant to exposure-related corrosion once the initial oxidation process reaches saturation levels. Weathering steel has become extremely popular in architectural applications for both residential and commercial projects. It is used for both siding and roofing materials in corrugated, standing seam and plate cladding systems. Special care should be taken in detailing projects to allow for proper isolation of the material from incompatible substrates and to allow for proper runoff to avoid possible staining from early releases of iron oxide.

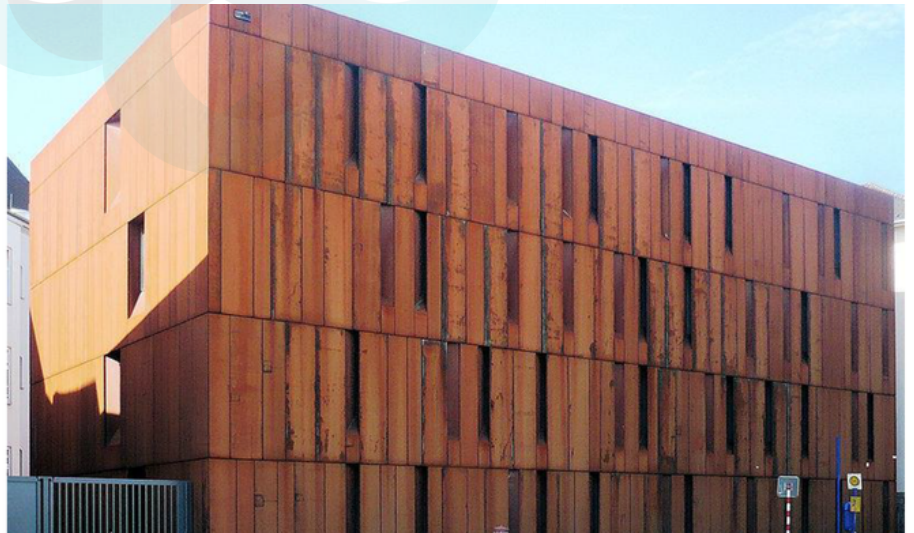


FEATURES & BENEFITS

- Weather resistant
- Maintenance-free.
- Beautiful, aged patina that develops over time.

APPLICATIONS

- Roofing
- Facades
- Fences & gates
- Sculpture
- Rural buildings
- Gazebos
- Interior ceilings & accents



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CHEMICAL PROPERTIES OF WEATHERING STEEL IN VARIOUS SPECIFICATIONS

| GRADE | C | Mn | Si | S | P | Al | Cr | Ni | Cu | V |
|----------------------|-------------|-------------|-------------|--------------|--------------|-------------|-----------|-------------|-----------|---------------|
| IRSM-41 | 0.10 max | 0.25-0.45 | 0.28-0.72 | 0.030 max | 0.075-0.14 | 0.08 max | 0.35-0.60 | 0.20-0.47 | 0.30-0.60 | -- |
| SAILCOR | 0.10 max | 0.25-0.45 | 0.28-0.72 | 0.030 max | 0.075-0.14 | 0.08 max | 0.35-0.60 | 0.20-0.47 | 0.30-0.60 | -- |
| CORTEN-A | 0.12 max | 0.20-0.50 | 0.25-0.75 | 0.030 max | 0.070-0.15 | -- | 0.50-1.25 | 0.65 max | 0.25-0.55 | -- |
| CORTEN-B | 0.16 max | 0.80-1.25 | 0.30-0.50 | 0.030 max | 0.030 max | -- | 0.40-0.65 | 0.40 max | 0.25-0.40 | 0.02-0.10 |
| S355J2W | 0.16 max | 0.50-1.50 | 0.50 max | 0.030 max | 0.030 max | 0.02 max | 0.40-0.80 | 0.65 max | 0.25-0.55 | 0.02-0.12 |
| S355J0WP | 0.12 Max | 1.00 Max | 0.75 max | 0.035 max | 0.06-0.15 | -- | 0.30-1.25 | -- | 0.25-0.55 | -- |
| ASTM A242 TYPE-1 | 0.12 max | 1.00 Max | 0.75 max | 0.030 max | 0.06-0.15 | -- | 0.30-1.25 | -- | 0.25-0.55 | -- |
| ASTM A588 GRADE-A | 0.19 max | 0.80-1.25 | 0.30-0.65 | 0.040 max | 0.050 max | -- | 0.40-0.65 | 0.40 max | 0.25-0.40 | -- |
| ASTM A588 GRADE-B | 0.20 max | 0.75-1.35 | 0.15-0.50 | 0.050 max | 0.040 max | -- | 0.40-0.70 | 0.50 max | 0.20-0.40 | 0.01-0.10 |
| ASTM A588 GRADE-C | 0.15 max | 0.80-1-35 | 0.15-0.30 | 0.050 max | 0.040 max | -- | 0.30-0.50 | 0.25-0.50 | 0.20-0.50 | 0.001- 0.1 |

N : 0.010% max is applicable for ASTM A588 GRADE-A & GRADE -C

0.009% max is applicable for S355J0WP

MECHANICAL PROPERTIES OF WEATHERING STEEL IN VARIOUS SPECIFICATIONS

| GRADE | Yield (Mpa) | UTS (Mpa) | Minimum Elongation% |
|-------------------|---|---|--------------------------------|
| IRSM-41 | 340 min. | 480min | 22 |
| SAILCOR | 340 min. | 480min | 22 |
| CORTEN-A | 355 min. | 470-630 | 20 |
| CORTEN-B | Up to 16mm-355min Above 16mm-345min | 470-630 | 20 |
| S355J2W | 355 min. | 510-680 | 22 |
| S355J0WP | Up to 16mm-355min Above 16mm-345min | Up to 3mm-510-680 Above 3mm-470-630 | |
| ASTM A242 TYPE-1 | Up to 16mm-355min Above 16mm-345min | Up to 3mm-510-680 Above 3mm-470-630 | 20 |
| ASTM A588 GRADE-A | Up to 100mm-340min 100mm to 200mm-290min | Up to 100mm-480min 100mm to 200mm-460min | 20 |
| ASTM A588 GRADE-B | 345 min. | 485min. | Up to 50mm-18 Above 50mm-21 |
| ASTM A588 GRADE-C | 290-345 | 435-485 | 20 |

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EN 10155 - 1993 STRUCTURAL STEEL WITH IMPROVED ATMOSPHERE CORROSION RESISTANCE

| Grade ¹⁾ | S235J0W | S235J2W | S355J0WP | S355J2WP | S355J0W | S355J2G1W | S355J2G2W | S355K2G1W | S355K2G2W |
|--|----------------------|------------------|------------------|--|------------------|------------------|------------------|------------------|------------------|
| Corresponding En 10025 Grade ²⁾ S235-J0 | S235-J0 | S235J2G3 | - | - | S355J0 | S355J2G3 | S355J2G4 | S355K2G3 | S355K2G4 |
| BS4360 Equivalent Grade | - | - | WR50A | - | WR50B | WR50C | WR50C | - | - |
| Chemical Composition | C | 0.13 | 0.13 | 0.12 | 0.12 | 0.16 | 0.16 | 0.16 | 0.16 |
| | Si | 0.40 | 0.40 | 0.75 | 0.75 | 0.50 | 0.50 | 0.50 | 0.50 |
| | Mn | 0.20-0.60 | 0.20-0.60 | 1.00 | 1.00 | 0.50-1.50 | 0.50-1.50 | 0.50-1.50 | 0.50-1.50 |
| | P | 0.040 | 0.040 | 0.06-0.15 | 0.06-0.15 | 0.040 | 0.035 | 0.035 | 0.035 |
| | S | 0.040 | 0.035 | 0.04 | 0.035 | 0.040 | 0.035 | 0.035 | 0.035 |
| % maximum | Cr | 0.40-0.80 | 0.40-0.80 | 0.30-1.25 | 0.30-1.25 | 0.40-0.80 | 0.40-0.80 | 0.40-0.80 | 0.40-0.80 |
| | Mo | - | - | - | - | 0.30 | 0.30 | 0.30 | 0.30 |
| | Ni | 0.65 | 0.65 | 0.65 | 0.65 | 0.65 | 0.65 | 0.65 | 0.65 |
| | Others ¹⁾ | Cu 0.25 -0.55 | Cu 0.25 -0.55 | Cu 0.25 -0.55 N 0.009 Zr 0.15 | Cu 0.25 -0.55 | Cu 0.25 -0.55 | Cu 0.25 -0.55 | Cu 0.25 -0.55 | Cu 0.25 -0.55 |
| | N 0.009 | N 0.009 | | Zr 0.15 | Zr 0.15 | Zr 0.15 | Zr 0.15 | | |

Thickness (mm)

| Yield Stress ^{3,4)} R _y N/mm ² | ≤ 16 | 235 | 235 | 355 ⁵⁾ | 355 ⁵⁾ | 355 | 355 | 355 | 355 | 355 |
|---|------------|-----|-----|-------------------|-------------------|-----|-----|-----|-----|-----|
| | ≥ 16 ≤ 40 | 225 | 225 | 345 ⁵⁾ | 345 ⁵⁾ | 345 | 345 | 345 | 345 | 345 |
| | ≥ 40 ≤ 63 | 215 | 215 | - | - | 335 | 335 | 335 | 335 | 335 |
| | ≥ 63 ≤ 80 | 215 | 215 | - | - | 325 | 325 | 325 | 325 | 325 |
| | ≥ 80 ≤ 100 | 215 | 215 | - | - | 315 | 315 | 315 | 315 | 315 |

| Tensile Strength ⁶⁾ R _m N/mm ² | < 3 | 360/510 | 360/510 | 510/680 | 510/680 | 510/680 | 510/680 | 510/680 | 510/680 | 430/580 |
|---|-----------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| | ≥ 3 ≤ 100 | 340/470 | 340/470 | 490/630 | 490/630 | 490/630 | 490/630 | 490/630 | 490/630 | 490/630 |

| Elongation ⁷⁾ % | > 1.5 ≤ 2 | 19 (17) | 19 (17) | 16 (14) | 16 (14) | 16 (14) | 16 (14) | 16 (14) | 16 (14) | 16 (14) |
|-------------------------------|------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| | > 2 ≤ 2.5 | 20 (18) | 20 (18) | 17 (15) | 17 (15) | 17 (15) | 17 (15) | 17 (15) | 17 (15) | 17 (15) |
| | > 2.5 ≤ 3 | 21 (19) | 21 (19) | 18 (16) | 18 (16) | 18 (16) | 18 (16) | 18 (16) | 18 (16) | 18 (16) |
| | ≥ 3 ≤ 40 | 26 (24) | 26 (24) | 22 (20) | 22 (20) | 22 (20) | 22 (20) | 22 (20) | 22 (20) | 22 (20) |
| | > 40 ≤ 63 | 25 (23) | 25 (23) | - | - | 21 (19) | 21 (19) | 21 (19) | 21 (19) | 21 (19) |
| | > 63 ≤ 100 | 24 (22) | 24 (22) | - | - | 20 (18) | 20 (18) | 20 (18) | 20 (18) | 20 (18) |

Temp degree C

| Impact ⁸⁾ KV J | 0 | 27 | - | 27 | - | 27 | - | - | - | - |
|---------------------------------|-----|----|----|----|----|----|----|---|----|----|
| | -20 | - | 27 | - | 27 | - | 27 | - | 27 | 40 |

Notes : 1), 2), 3), 4), 5), 6), 7) references shall be made to BS EN 10155 Handbook

Symbols Used in EN 10025

| | | |
|----|---|--|
| S | = | Structural steel |
| E | = | Engineering Steel |
| JR | = | Longitudinal Charpy V-notch impacts 27J@ room temperature |
| J0 | = | 27J @ 00C |
| J2 | = | 27J @ -200C |
| K2 | = | 40J @ -200C |
| G1 | = | Rimming Steel (FU) |
| G2 | = | Rimming Steel not permitted (FN) |
| G3 | = | Supply Condition "N", i.e. normalized or normalized rolled |
| G4 | = | Supply Condition at the manufacturer's discretion. |

| Grade | BS 4360 Equivalent Grade | Chemical Composition % maximum (minimum) | | | | | | | | Mechanical properties are the same as grades S235JRG2, S275JR and S355JR but without specified impact properties |
|-------|--------------------------|--|-----|-----|-------|------|-------------|------------|---|--|
| | | C | Si | Mn | P | S | Nb | V | | |
| S 235 | 40A | 0.22 | 0.5 | 1.6 | 0.005 | 0.05 | - | - | - | |
| S 275 | 43 A | 0.25 | 0.5 | 1.6 | 0.005 | 0.05 | - | - | - | |
| S 355 | 50 A | 0.23 | 0.5 | 1.6 | 0.005 | 0.05 | 0.1 (0.003) | 0.1(0.003) | - | |

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ABRASION RESISTANT STEEL

Abrasion resistant steel is used om areas where there is likely to be a high degree of abrasion or wear of the steel plate, typical applications are in truck beds, attachments to diggers and earth movers and in processing applications in the mining industry

| |
|---|
| Grades of AR Plates Brand Names & It's Manufacturer |
|---|

| Brand Name | Its Manufacture | Country |
|------------|-------------------|----------|
| Sumihard | Sumitomo Metal | Japan |
| Hardox | SSAB | Swedan |
| Raex | Rukki | Finland |
| Everhard | JFE Steel | Japan |
| Welhard | NSC Steel | Japan |
| FORA | Indu Steel | Belgium |
| XAR | Thyssenkrup Metal | Germany |
| Abrazo | Corus | Europe |
| Nicrodur | Acroni | Europe |
| Brinar | Satzgitter | Germany |
| Dillidur | Dillinger | Germany |
| Hartplast | Huta | European |
| Quard | Duferco | Belgium |

The key quality for wear resistant steels is their hardness. We sell wear plate according to its hardness measured on the Brinell Hardness Test-usually in 400HB grades. 400 HB steel is over 3 times harder than mild steel (120HB), but only a third as hard as stainless steel (150HB). Example uses are for construction machinery, skips, bulldozers and excavators, buckets and conveyors. Steel with a high HB rating (Brinell Hardness) are intended for applications where wear or abrasion resistance is important. The benefit of using an abrasion resistant steel is that the plant, machinery or constructions working life can be extended considerably. This can significantly improve the reliability, durability and safety of structures and equipment. It also helps to reduce the maintenance costs associated with wear and breakdown of plant. The steel is quenched which provides wear resistance; in order to improve hardness it may also be tempered. Lower Hb's generally provide good cold bending properties and good weldability. Weldability is not generally reduced as the hardness increases. It is not registered at international standard association such as ASTM JIN, DIN so each manufacture has their own Brand like

H A R D O X S U M I H A R D R A E X J F E X A R B I S

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ROUND BAR - METRIC

| Size mm | Weight in kg. | | Size mm | Weight in kg. | | Size mm | Weight in kg. | |
|------------|---------------|--------------|------------|---------------|--------------|------------|---------------|--------------|
| | Wt. per ft. | Wt. per. Mtr | | Wt. per ft. | Wt. per. Mtr | | Wt. per ft. | Wt. per. Mtr |
| .5 | .0004 | .0015 | 21 | .829 | 2.72 | 72 | 9.74 | 31.96 |
| 1.0 | .0018 | .0062 | 22 | .908 | 2.98 | 75 | 10.57 | 34.68 |
| 1.5 | .0042 | .014 | 23 | .994 | 3.26 | 80 | 12.03 | 39.46 |
| 2.0 | .0076 | .025 | 24 | 1.08 | 3.55 | 90 | 15.22 | 49.94 |
| 2.5 | .012 | .039 | 25 | 1.17 | 3.85 | 100 | 18.79 | 61.65 |
| 3.0 | .017 | .055 | 26 | 1.27 | 4.17 | 110 | 22.74 | 74.60 |
| 3.5 | .023 | .076 | 27 | 1.37 | 4.50 | 120 | 27.07 | 88.80 |
| 4.0 | .030 | .099 | 28 | 1.47 | 4.83 | 130 | 31.70 | 104.00 |
| 4.5 | .038 | .125 | 30 | 1.69 | 5.55 | 140 | 36.88 | 121.00 |
| 5.0 | .047 | .154 | 32 | 1.92 | 6.31 | 150 | 42.37 | 139.00 |
| 5.5 | .057 | .187 | 33 | 2.05 | 6.71 | 160 | 48.16 | 158.00 |
| 6.0 | .068 | .222 | 35 | 2.30 | 7.55 | 170 | 54.26 | 178.00 |
| 6.5 | .079 | .260 | 36 | 2.44 | 7.99 | 180 | 60.96 | 200.00 |
| 7.0 | .092 | .302 | 38 | 2.71 | 8.90 | 190 | 67.97 | 223.00 |
| 7.5 | .106 | .347 | 39 | 2.86 | 9.38 | 200 | 75.30 | 247.00 |
| 8.0 | .120 | .395 | 40 | 3.01 | 9.86 | 220 | 90.80 | 298.00 |
| 8.5 | .136 | .445 | 42 | 3.32 | 10.88 | 240 | 108.00 | 355.00 |
| 9.0 | .152 | .499 | 45 | 3.80 | 12.48 | 250 | 117.00 | 385.00 |
| 9.5 | .169 | .556 | 48 | 4.33 | 14.21 | 260 | 127.00 | 417.00 |
| 10 | .188 | .617 | 50 | 4.70 | 15.41 | 280 | 147.00 | 483.00 |
| 11 | .227 | .746 | 52 | 5.08 | 16.67 | 300 | 169.00 | 555.00 |
| 12 | .271 | .888 | 55 | 5.69 | 18.65 | 320 | 192.00 | 631.00 |
| 13 | .317 | 1.04 | 56 | 5.89 | 19.33 | 340 | 217.00 | 713.00 |
| 14 | .369 | 1.21 | 58 | 6.32 | 20.74 | 350 | 230.00 | 755.00 |
| 15 | .424 | 1.39 | 60 | 6.77 | 22.20 | 360 | 244.00 | 799.00 |
| 16 | .482 | 1.58 | 62 | 7.22 | 23.70 | 380 | 271.00 | 890.00 |
| 17 | .543 | 1.78 | 64 | 7.70 | 25.25 | 400 | 301.00 | 986.00 |
| 18 | .610 | 2.00 | 65 | 7.94 | 26.05 | 500 | 469.00 | 1540.00 |
| 19 | .680 | 2.23 | 68 | 8.69 | 28.51 | | | |
| 20 | .753 | 2.47 | 70 | 9.21 | 30.21 | | | |

STAINLESS, ALLOY STEELS ROUND BAR

WEIGHT OF ROUND BAR

Dr A (MM) X Dr A (MM) X 0.001939 KG.(PER FEET)

Dr A (MM) Dr A (MM) X 0.006165 KG (PER MTR)

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HEXAGONAL BAR - METRIC

| Size mm | Weight in kg. | |
|------------|---------------|-------------|
| | Wt. per ft. | Wt. per Mtr |
| 5 | .0518 | .170 |
| 5.5 | .0628 | .206 |
| 7 | .102 | .333 |
| 8 | .133 | .435 |
| 10 | .207 | .680 |
| 11 | .251 | .823 |
| 12 | .298 | .979 |
| 13 | .351 | 1.15 |
| 14 | .405 | 1.33 |
| 15 | .466 | 1.53 |

| Size mm | Weight in kg. | |
|------------|---------------|-------------|
| | Wt. per ft. | Wt. per Mtr |
| 16 | .530 | 1.74 |
| 17 | .597 | 1.96 |
| 18 | .671 | 2.20 |
| 19 | .747 | 2.45 |
| 20 | .829 | 2.72 |
| 22 | 1.00 | 3.29 |
| 24 | 1.20 | 3.92 |
| 25 | 1.30 | 4.25 |
| 27 | 1.51 | 4.96 |
| 30 | 1.87 | 6.12 |

| Size mm | Weight in kg. | |
|------------|---------------|-------------|
| | Wt. per ft. | Wt. per Mtr |
| 32 | 2.12 | 6.56 |
| 35 | 2.54 | 8.33 |
| 36 | 2.69 | 8.81 |
| 38 | 2.99 | 9.82 |
| 40 | 3.32 | 10.89 |
| 41 | 3.48 | 11.41 |
| 46 | 4.39 | 14.40 |
| 48 | 4.79 | 15.71 |
| 50 | 5.18 | 17.00 |

SQUARE BAR - METRIC

| Size mm | Weight in kg. | |
|------------|---------------|-------------|
| | Wt. per ft. | Wt. per Mtr |
| 5 | .0597 | .196 |
| 5.5 | .0722 | .237 |
| 6 | .0862 | .283 |
| 7 | .117 | .385 |
| 8 | .153 | .502 |
| 9 | .194 | .636 |
| 10 | .239 | .785 |
| 11 | .290 | .950 |
| 12 | .344 | 1.13 |
| 13 | .405 | 1.33 |
| 14 | .469 | 1.54 |
| 15 | .540 | 1.77 |

| Size mm | Weight in kg. | |
|------------|---------------|-------------|
| | Wt. per ft. | Wt. per Mtr |
| 16 | .613 | 2.01 |
| 17 | .692 | 2.27 |
| 18 | .774 | 2.54 |
| 19 | .863 | 2.83 |
| 20 | .957 | 3.14 |
| 21 | 1.06 | 3.46 |
| 22 | 1.16 | 3.80 |
| 23 | 1.27 | 4.15 |
| 24 | 1.38 | 4.52 |
| 25 | 1.50 | 4.91 |
| 26 | 1.62 | 5.31 |
| 27 | 1.74 | 5.72 |

| Size mm | Weight in kg. | |
|------------|---------------|-------------|
| | Wt. per ft. | Wt. per Mtr |
| 28 | 1.88 | 6.15 |
| 30 | 2.15 | 7.06 |
| 32 | 2.45 | 8.04 |
| 35 | 2.93 | 9.62 |
| 36 | 3.11 | 10.2 |
| 38 | 3.44 | 11.3 |
| 40 | 3.84 | 12.6 |
| 42 | 4.21 | 13.8 |
| 45 | 4.85 | 15.9 |
| 46 | 5.06 | 16.6 |
| 48 | 5.52 | 18.1 |
| 50 | 5.97 | 19.6 |

STAINLESS, ALLOY STEELS, HEXAGON AND SQUARE BAR
WEIGHT OF S. S. HEXAGONAL ROD.
DIA (MM) X DIA (MM) X 0.002072 KG. (PER FEET)

STANDARD WIRE GAUGE

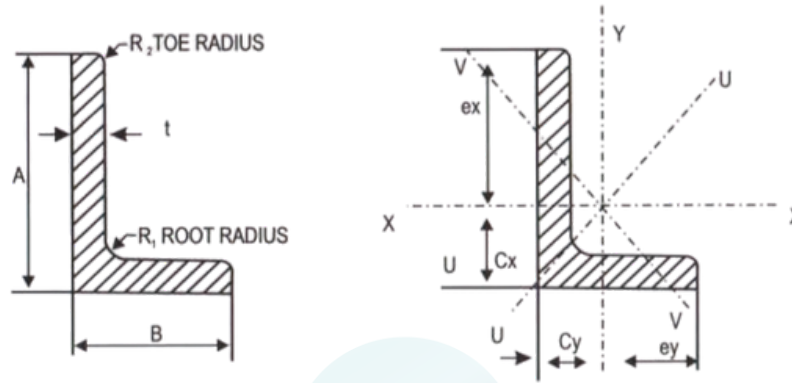
| SWG No. | Dia inch | Dia MM | SWG No. | Dia inch | Dia MM | SWG No. | Dia inch | Dia MM |
|---------|----------|---------|---------|----------|--------|---------|----------|--------|
| 7/0 | .500 | 12.7000 | 13 | .092 | 2.2368 | 32 | .0108 | 0.2743 |
| 6/0 | .464 | 11.7856 | 14 | .080 | 2.0320 | 33 | .0100 | 0.2540 |
| 5/0 | .432 | 10.9728 | 15 | .072 | 1.8288 | 34 | .0092 | 0.2337 |
| 4/0 | .400 | 10.1600 | 16 | .064 | 1.6256 | 35 | .0084 | 0.2134 |
| 3/0 | .372 | 9.4488 | 17 | .056 | 1.4224 | 36 | .0076 | 0.1930 |
| 2/0 | .348 | 8.8392 | 18 | .048 | 1.2192 | 37 | .0068 | 0.1727 |
| 1/0 | .324 | 8.2296 | 19 | .040 | 1.0160 | 38 | .0060 | 0.1524 |
| 1 | .300 | 7.6200 | 20 | .036 | 0.9144 | 39 | .0052 | 0.1321 |
| 2 | .276 | 7.0104 | 21 | .032 | 0.8128 | 40 | .0048 | 0.1219 |
| 3 | .252 | 6.4008 | 22 | .028 | 0.7112 | 41 | .0044 | 0.1118 |
| 4 | .232 | 5.8928 | 23 | .024 | 0.6096 | 42 | .0040 | 0.1016 |
| 5 | .212 | 5.3848 | 24 | .022 | 0.5588 | 43 | .0036 | 0.0914 |
| 6 | .192 | 4.8768 | 25 | .020 | 0.5080 | 44 | .0032 | 0.0813 |
| 7 | .176 | 4.4704 | 26 | .018 | 0.4572 | 45 | .0028 | 0.0711 |
| 8 | .160 | 4.0604 | 27 | .0164 | 0.4166 | 46 | .0024 | 0.0610 |
| 9 | .144 | 3.6576 | 28 | .0148 | 0.3759 | 47 | .0020 | 0.0508 |
| 10 | .128 | 3.2512 | 29 | .0136 | 0.3459 | 48 | .0016 | 0.0406 |
| 11 | .116 | 2.9464 | 30 | .0214 | 0.3150 | 49 | .0012 | 0.0305 |
| 12 | .104 | 2.6416 | 31 | .0116 | 0.2946 | 50 | .0010 | 0.0254 |

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EQUAL LEG ANGLES

Table 5.1 Nominal Dimensions, Mass and Sectional Properties of India Standard Equal Leg Angles



| Designation | Mass M | Sectional area, a | Dimensions | | | | | | Sectional Properties | | | | | | | | | | | |
|--------------------------------|-----------|----------------------|------------|-----|----------------|-----------------------------|----------------|----------------|----------------------|----------------|----------------------|----------------------|----------------|----------------|----------------------|----------------------|----------------|----------------|--|--|
| | | | AxB | t | R ₁ | R ₂ | C _x | C _y | I _x | I _y | I _x (Max) | I _x (Min) | r _x | r _y | r _x (Max) | r _x (Max) | Z _x | Z _y | | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) | (19) | | |
| 20 20 x 3 x 4 | 0.9 | 1.12 | 20 x 20 | 3.0 | 4.0 | | 0.59 | 0.59 | 0.4 | 0.4 | 0.6 | 0.2 | 0.58 | 0.58 | 0.73 | 0.37 | 0.3 | 0.3 | | |
| | 1.1 | 1.45 | | 3.0 | 4.0 | | 0.63 | 0.63 | 0.5 | 0.5 | 0.8 | 0.2 | 0.58 | 0.58 | 0.72 | 0.37 | 0.4 | 0.4 | | |
| 25 25 x 3 x 4 x 5 | 1.1 | 1.41 | 25 x 25 | 3.0 | 4.5 | Should be reasonably square | 0.71 | 0.71 | 0.8 | 0.8 | 1.2 | 0.3 | 0.73 | 0.73 | 0.93 | 0.47 | 0.4 | 0.4 | | |
| | 1.4 | 1.84 | | 4.0 | 4.0 | | 0.75 | 0.75 | 1.0 | 1.0 | 1.6 | 0.4 | 0.73 | 0.73 | 0.91 | 0.47 | 0.6 | 0.6 | | |
| | 1.8 | 0.25 | | 5.0 | 5.0 | | 0.79 | 0.79 | 1.2 | 1.2 | 1.8 | 0.5 | 0.72 | 0.72 | 0.91 | 0.47 | 0.7 | 0.7 | | |
| 30 30 x 3 x 4 x 5 | 1.4 | 1.73 | 30 x 30 | 4.0 | 5.0 | Should be reasonably square | 0.83 | 0.83 | 1.4 | 1.4 | 2.2 | 0.6 | 0.89 | 0.89 | 1.13 | 0.57 | 0.6 | 0.6 | | |
| | 1.8 | 2.26 | | 4.0 | 4.0 | | 0.87 | 0.87 | 1.8 | 1.8 | 2.8 | 0.7 | 0.89 | 0.89 | 1.12 | 0.57 | 0.8 | 0.8 | | |
| | 2.2 | 2.77 | | 5.0 | 5.0 | | 0.92 | 0.92 | 2.1 | 2.1 | 3.4 | 0.9 | 0.88 | 0.88 | 1.11 | 0.57 | 1.0 | 1.0 | | |
| 35 35 x 3 x 4 x 5 x 6 | 1.6 | 2.03 | 35 x 35 | 3.0 | 5.0 | Should be reasonably square | 0.95 | 0.95 | 2.3 | 2.3 | 3.6 | 0.9 | 1.05 | 1.05 | 1.33 | 0.67 | 0.9 | 0.9 | | |
| | 2.1 | 2.66 | | 4.0 | 4.0 | | 1.00 | 1.00 | 2.9 | 2.9 | 4.7 | 1.2 | 1.05 | 1.05 | 1.32 | 0.67 | 1.2 | 1.2 | | |
| | 2.6 | 3.27 | | 5.0 | 5.0 | | 1.04 | 1.04 | 3.5 | 3.5 | 5.6 | 1.5 | 1.04 | 1.04 | 1.31 | 0.67 | 1.4 | 1.4 | | |
| | 3.0 | 3.86 | | 6.0 | 6.0 | | 1.08 | 1.08 | 4.1 | 4.1 | 6.5 | 1.7 | 1.03 | 1.03 | 1.29 | 0.67 | 1.7 | 1.7 | | |
| 40 40 x 3 x 4 x 5 x 6 | 1.8 | 2.34 | 40 x 40 | 3.0 | 5.5 | Should be reasonably square | 1.08 | 1.08 | 3.4 | 3.4 | 5.5 | 1.4 | 1.21 | 1.21 | 1.54 | 0.77 | 1.2 | 1.2 | | |
| | 2.4 | 3.07 | | 4.0 | 4.0 | | 1.12 | 1.12 | 4.5 | 4.5 | 7.1 | 1.8 | 1.21 | 1.21 | 1.53 | 0.77 | 1.6 | 1.6 | | |
| | 3.0 | 3.78 | | 5.0 | 5.0 | | 1.16 | 1.16 | 5.4 | 5.4 | 8.6 | 2.2 | 1.20 | 1.20 | 1.51 | 0.77 | 1.9 | 1.9 | | |
| | 3.5 | 4.47 | | 6.0 | 6.0 | | 1.20 | 1.20 | 6.3 | 6.3 | 10.0 | 2.6 | 1.19 | 1.19 | 1.50 | 0.77 | 2.3 | 2.3 | | |
| 45 45 x 3 x 4 x 5 x 6 | 2.1 | 2.64 | 45 x 45 | 3.0 | 5.5 | Should be reasonably square | 1.20 | 1.20 | 5.0 | 5.0 | 8.0 | 2.0 | 1.38 | 1.38 | 1.74 | 0.87 | 1.5 | 1.5 | | |
| | 2.7 | 3.47 | | 4.0 | 4.0 | | 1.25 | 1.25 | 6.5 | 6.5 | 10.4 | 2.6 | 1.37 | 1.37 | 1.73 | 0.87 | 2.0 | 2.0 | | |
| | 3.4 | 4.28 | | 5.0 | 5.0 | | 1.29 | 1.29 | 7.9 | 7.9 | 12.6 | 3.2 | 1.36 | 1.36 | 1.72 | 0.87 | 2.5 | 2.5 | | |
| | 4.0 | 5.07 | | 6.0 | 6.0 | | 1.33 | 1.33 | 9.2 | 9.2 | 14.6 | 3.8 | 1.35 | 1.35 | 1.70 | 0.87 | 2.9 | 2.9 | | |

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Table 5.1

| Designation | Mass M Kg/m | Sectional Area, a cm ² | Dimensions | | | | Sectional Properties | | | | | | | | | | | | | |
|-------------|----------------|--------------------------------------|------------|------|----------------|-----------------------------|----------------------|----------------|-----------------|-----------------|----------------------|----------------------|----------------|----------------|----------------------|----------------------|-----------------|-----------------|--|--|
| | | | AxB | t | R ₁ | R ₂ | C _x | C _y | I _x | I _y | I _x (Min) | I _y (Min) | r _x | r _y | r _x (Max) | r _y (Max) | Z _x | Z _y | | |
| | | | mm x mm | mm | mm | mm | cm | cm | cm ⁴ | cm ⁴ | cm ⁴ | cm ⁴ | cm | cm | cm | cm | cm ³ | cm ³ | | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) | (19) | | |
| 50 50 x 3 | 2.3 | 2.95 | 50 x 50 | 3.0 | 6.0 | Should be reasonably square | 1.32 | 1.32 | 6.9 | 6.9 | 11.1 | 2.8 | 1.53 | 1.53 | 1.94 | 0.97 | 1.9 | 1.9 | | |
| x 4 | 3.0 | 3.88 | | 4.0 | | | 1.37 | 1.37 | 9.1 | 9.1 | 14.5 | 3.6 | 1.53 | 1.53 | 1.93 | 0.97 | 2.5 | 2.5 | | |
| x 5 | 3.8 | 4.79 | | 5.0 | | | 1.41 | 1.41 | 11.0 | 11.0 | 17.6 | 4.5 | 1.52 | 1.52 | 1.92 | 0.97 | 3.1 | 3.1 | | |
| x 6 | 4.5 | 5.68 | | 6.0 | | | 1.45 | 1.45 | 12.9 | 12.9 | 20.6 | 5.3 | 1.51 | 1.51 | 1.90 | 0.96 | 3.6 | 3.6 | | |
| 55 55 x 4 | 3.3 | 4.26 | 55 x 55 | 4.0 | 6.5 | | 1.49 | 1.49 | 12.30 | 12.30 | 19.59 | 4.73 | 1.68 | 1.68 | 2.12 | 1.06 | 3.00 | 3.00 | | |
| x 5 | 4.1 | 5.27 | | 5.0 | | | 1.53 | 1.53 | 14.7 | 14.7 | 23.5 | 5.9 | 1.67 | 1.67 | 2.11 | 1.06 | 3.7 | 3.7 | | |
| x 6 | 4.9 | 6.26 | | 6.0 | | | 1.57 | 1.57 | 17.3 | 17.3 | 27.5 | 7.0 | 1.66 | 1.66 | 2.10 | 1.06 | 4.4 | 4.4 | | |
| x 8 | 6.4 | 8.18 | | 8.0 | | | 1.65 | 1.65 | 22.0 | 22.0 | 34.9 | 9.1 | 1.64 | 1.64 | 2.07 | 1.06 | 5.7 | 5.7 | | |
| 60 60 x 4 | 3.7 | 4.71 | 60 x 60 | 4.0 | 6.5 | | 1.60 | 1.60 | 15.8 | 15.8 | 25.0 | 6.58 | 1.83 | 1.83 | 2.30 | 1.18 | 3.58 | 3.58 | | |
| x 5 | 4.5 | 5.75 | | 5.0 | | | 1.65 | 1.65 | 19.2 | 19.2 | 30.6 | 7.7 | 1.82 | 1.82 | 2.31 | 1.16 | 4.4 | 4.4 | | |
| x 6 | 5.4 | 6.84 | | 6.0 | | | 1.69 | 1.69 | 22.6 | 22.6 | 36.0 | 9.1 | 1.82 | 1.82 | 2.29 | 1.15 | 5.2 | 5.2 | | |
| x 8 | 7.0 | 8.96 | | 8.0 | | | 1.77 | 1.77 | 29.0 | 29.0 | 46.0 | 11.9 | 1.80 | 1.80 | 2.27 | 1.15 | 6.8 | 6.8 | | |
| 65 65 x 4 | 4.0 | 5.04 | 65 x 65 | 4.0 | 6.5 | 1.74 | 1.74 | 21.7 | 21.7 | 34.5 | 8.0 | 2.00 | 2.00 | 2.52 | 1.26 | 4.5 | 4.5 | | | |
| x 5 | 4.9 | 6.25 | | 5.0 | | 1.77 | 1.77 | 24.7 | 24.7 | 39.4 | 9.9 | 1.99 | 1.99 | 2.51 | 1.26 | 5.2 | 5.2 | | | |
| x 6 | 5.8 | 7.44 | | 6.0 | | 1.81 | 1.81 | 29.1 | 29.1 | 46.5 | 11.7 | 1.98 | 1.98 | 2.50 | 1.26 | 6.2 | 6.2 | | | |
| x 8 | 7.7 | 9.76 | | 8.0 | | 1.89 | 1.89 | 37.4 | 37.4 | 59.5 | 15.3 | 1.96 | 1.96 | 2.47 | 1.25 | 8.1 | 8.1 | | | |
| 70 70 x 5 | 5.3 | 6.77 | 70 x 70 | 5.0 | 7.0 | 1.89 | 1.89 | 31.1 | 31.1 | 49.8 | 12.5 | 2.15 | 2.15 | 2.71 | 1.36 | 6.1 | 6.1 | | | |
| x 6 | 6.3 | 8.06 | | 6.0 | | 1.94 | 1.94 | 36.8 | 36.8 | 58.8 | 14.8 | 2.14 | 2.14 | 2.70 | 1.36 | 7.3 | 7.3 | | | |
| x 8 | 8.3 | 10.6 | | 8.0 | | 2.02 | 2.02 | 47.4 | 47.4 | 75.5 | 17.5 | 2.12 | 2.12 | 2.67 | 1.35 | 9.5 | 9.5 | | | |
| x 10 | 10.2 | 13.0 | | 10.0 | | 2.10 | 2.10 | 57.2 | 57.2 | 90.7 | 23.7 | 2.10 | 2.10 | 2.64 | 1.35 | 11.7 | 11.7 | | | |
| 75 75 x 5 | 5.7 | 7.27 | 75 x 75 | 5.0 | 7.0 | 2.02 | 2.02 | 38.7 | 38.7 | 61.9 | 15.5 | 2.31 | 2.31 | 2.92 | 1.46 | 7.1 | 7.1 | | | |
| x 6 | 6.8 | 8.66 | | 6.0 | | 2.06 | 2.06 | 45.7 | 45.7 | 73.1 | 18.4 | 2.30 | 2.30 | 2.91 | 1.46 | 8.4 | 8.4 | | | |
| x 8 | 8.9 | 11.4 | | 8.0 | | 2.14 | 2.14 | 59.0 | 59.0 | 94.1 | 24.0 | 2.28 | 2.28 | 2.88 | 1.45 | 11.0 | 11.0 | | | |
| x 10 | 11.0 | 14.0 | | 10.0 | | 2.22 | 2.22 | 71.4 | 71.4 | 113 | 29.4 | 2.26 | 2.26 | 2.84 | 1.45 | 13.5 | 13.5 | | | |
| 80 80 x 6 | 7.3 | 9.29 | 80 x 80 | 6.0 | 8.0 | 2.18 | 2.18 | 56.0 | 56.0 | 89.6 | 22.5 | 2.46 | 2.46 | 3.11 | 1.56 | 9.6 | 9.6 | | | |
| x 8 | 9.6 | 12.2 | | 8.0 | | 2.27 | 2.27 | 72.5 | 72.5 | 116 | 29.4 | 2.44 | 2.44 | 3.08 | 1.55 | 12.6 | 12.6 | | | |
| x 10 | 11.8 | 15.0 | | 10.0 | | 2.34 | 2.34 | 87.7 | 87.7 | 139 | 36.0 | 2.41 | 2.41 | 3.04 | 1.55 | 15.5 | 15.5 | | | |
| x 12 | 14.0 | 17.8 | | 12.0 | | 2.42 | 2.42 | 102 | 102 | 161 | 42.4 | 2.39 | 2.39 | 3.01 | 1.54 | 18.3 | 18.3 | | | |
| 90 90 x 6 | 8.2 | 10.5 | 90 x 90 | 6.0 | 8.5 | 2.42 | 2.42 | 80.1 | 80.1 | 128 | 32.0 | 2.77 | 2.77 | 3.50 | 1.75 | 12.2 | 12.2 | | | |
| x 8 | 10.8 | 13.8 | | 8.0 | | 2.51 | 2.51 | 104 | 104 | 166 | 42.0 | 2.75 | 2.75 | 3.47 | 1.75 | 16.0 | 16.0 | | | |
| x 10 | 13.4 | 17.0 | | 10.0 | | 2.59 | 2.59 | 127 | 127 | 202 | 51.6 | 2.73 | 2.73 | 3.44 | 1.74 | 19.8 | 19.8 | | | |
| x 12 | 15.8 | 20.2 | | 12.0 | | 2.66 | 2.66 | 148 | 148 | 235 | 60.9 | 2.71 | 2.71 | 3.41 | 1.74 | 23.3 | 23.3 | | | |
| 100 100 x 6 | 9.2 | 11.7 | 100 x 100 | 6.0 | 8.5 | 2.67 | 2.67 | 111 | 111 | 178 | 44.5 | 3.09 | 3.09 | 3.91 | 1.95 | 15.2 | 15.2 | | | |
| x 8 | 12.1 | 15.4 | | 8.0 | | 2.76 | 2.76 | 145 | 145 | 232 | 58.4 | 3.07 | 3.07 | 3.88 | 1.95 | 20.0 | 20.0 | | | |
| x 10 | 14.9 | 19.0 | | 10.0 | | 2.84 | 2.84 | 177 | 177 | 282 | 71.8 | 3.05 | 3.05 | 3.85 | 1.94 | 24.7 | 24.7 | | | |
| x 12 | 17.7 | 22.6 | | 12.0 | | 2.92 | 2.92 | 207 | 207 | 329 | 84.7 | 3.03 | 3.03 | 3.82 | 1.94 | 29.2 | 29.2 | | | |

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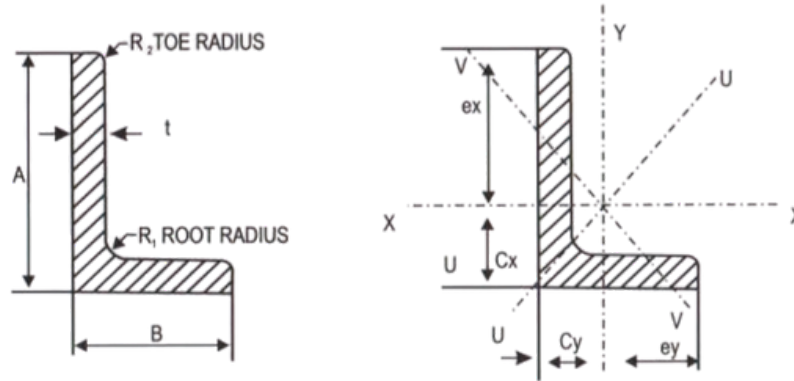
Table 5.1

| Designation | Mass M | Sectional Area, a | Dimensions | | | | | | | Sectional Properties | | | | | | | | |
|--------------|-----------|----------------------|------------|------|----------------|----------------|----------------|----------------|-----------------|----------------------|-------------------------|-------------------------|----------------|----------------|-------------------------|-------------------------|-----------------|-----------------|
| | | | AxB | t | R ₁ | R ₂ | C _x | C _y | I _x | I _y | I _x (Min) | I _y (Min) | r _x | r _y | r _x (Max) | r _y (Max) | Z _x | Z _y |
| | Kg/m | Cm ² | mm x mm | mm | mm | mm | cm | cm | cm ⁴ | cm ⁴ | cm ⁴ | cm ⁴ | cm | cm | cm | cm | cm ³ | cm ³ |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) | (19) |
| 110 110 x 8 | 13.4 | 17.1 | 110 x 110 | 8.0 | 10.0 | 4.8 | 3.00 | 3.00 | 197 | 197 | 313 | 81.0 | 3.40 | 3.40 | 4.28 | 2.18 | 24.6 | 24.6 |
| x 10 | 16.6 | 21.1 | | 10.0 | | | 3.09 | 3.09 | 240 | 240 | 381 | 98.9 | 3.37 | 3.37 | 4.25 | 2.16 | 30.4 | 30.4 |
| x 12 | 19.7 | 25.1 | | 12.0 | | | 3.17 | 3.17 | 281 | 281 | 446 | 116 | 3.35 | 3.35 | 4.22 | 2.15 | 35.9 | 35.9 |
| x 16 | 32.8 | 32.8 | | 16.0 | | | 3.32 | 3.32 | 357 | 357 | 560 | 150 | 3.30 | 3.30 | 4.15 | 2.14 | 46.5 | 46.5 |
| 130 130 x 8 | 15.9 | 20.3 | 130 x 130 | 8.0 | 10.0 | 4.8 | 3.50 | 3.50 | 331 | 331 | 526 | 136 | 4.04 | 4.04 | 5.10 | 2.59 | 34.9 | 34.9 |
| x 10 | 19.7 | 25.1 | | 10.0 | | | 3.59 | 3.59 | 405 | 405 | 640 | 166 | 4.02 | 4.02 | 5.07 | 2.57 | 43.1 | 43.1 |
| x 12 | 23.5 | 29.9 | | 12.0 | | | 3.67 | 3.67 | 476 | 476 | 757 | 196 | 3.99 | 3.99 | 5.03 | 2.56 | 51.0 | 51.0 |
| x 16 | 30.7 | 39.2 | | 16.0 | | | 3.82 | 3.82 | 609 | 609 | 966 | 250 | 3.94 | 3.94 | 4.97 | 2.54 | 66.3 | 66.3 |
| 150 150 x 10 | 22.9 | 29.2 | 150 x 150 | 10.0 | 12.0 | 4.8 | 4.08 | 4.08 | 634 | 634 | 1 010 | 260 | 4.66 | 4.66 | 5.87 | 2.98 | 58.0 | 58.0 |
| x 12 | 27.3 | 34.8 | | 12.0 | | | 4.16 | 4.16 | 746 | 746 | 1 190 | 306 | 4.63 | 4.63 | 5.84 | 2.97 | 68.8 | 68.8 |
| x 16 | 35.8 | 45.6 | | 16.0 | | | 4.31 | 4.31 | 959 | 959 | 1 520 | 395 | 4.58 | 4.58 | 5.77 | 2.94 | 89.7 | 89.7 |
| x 20 | 44.1 | 56.2 | | 20.0 | | | 4.46 | 4.46 | 1 160 | 1 160 | 1 830 | 481 | 4.53 | 4.53 | 5.71 | 2.93 | 110 | 110 |
| 200 200 x 12 | 36.9 | 46.9 | 200 x 200 | 12.0 | 15.0 | 4.8 | 5.39 | 5.39 | 1 830 | 1 830 | 2 910 | 747 | 6.24 | 6.24 | 7.87 | 3.99 | 125 | 125 |
| x 16 | 48.5 | 61.8 | | 16.0 | | | 5.56 | 5.56 | 2 370 | 2 370 | 3 760 | 968 | 6.19 | 6.19 | 7.80 | 3.96 | 164 | 164 |
| x 20 | 60.0 | 76.4 | | 20.0 | | | 5.71 | 5.71 | 2 880 | 2 880 | 4 570 | 1 180 | 6.14 | 6.14 | 7.73 | 3.93 | 201 | 201 |
| x 25 | 73.9 | 94.1 | | 25.0 | | | 5.90 | 5.90 | 3 470 | 3 470 | 5 500 | 1 440 | 6.07 | 6.07 | 7.61 | 3.91 | 246 | 246 |

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UNEQUAL LEG ANGLES

Table 6.1 Nominal Dimensions, Mass and Sectional Properties of India Standard UnEqual Leg Angles



| Designation | Mass M | Sectional area, a | Dimensions | | | | | | | Sectional Properties | | | | | | | | | | | |
|---------------------------|-----------|----------------------|------------|------|----------------|----------------|----------------|----------------|-------|----------------------|----------------|----------------------|----------------------|----------------|----------------|----------------------|----------------------|----------------|----------------|--|--|
| | | | AxB | t | R ₁ | R ₂ | C _x | C _y | Tan a | I _x | I _y | I _x (Max) | I _x (Min) | r _x | r _y | r _x (Max) | r _x (Min) | Z _x | Z _y | | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) | (19) | (20) | | |
| 30 20x3 x4 x5 x6 | 1.1 | 1.41 | 30x20 | 3.0 | 4.5 | | 0.98 | 0.49 | 0.43 | 1.2 | 0.4 | 1.4 | 0.2 | 0.92 | 0.54 | 0.99 | 0.41 | 0.6 | 0.3 | | |
| | 1.4 | 1.84 | | 1.02 | | | 0.53 | 0.42 | 1.5 | 0.5 | 1.8 | 0.3 | 0.92 | 0.54 | 0.98 | 0.41 | 8.0 | 0.4 | | | |
| | 1.8 | 2.25 | | 1.06 | | | 0.57 | 0.41 | 1.9 | 0.6 | 2.1 | 0.4 | 0.91 | 0.53 | 0.97 | 0.41 | 1.0 | 0.4 | | | |
| 40 25x3 x4 x5 x6 | 1.5 | 1.88 | 40x25 | 3.0 | 5.0 | | 1.30 | 0.57 | 0.38 | 3.0 | 0.9 | 3.3 | 0.5 | 1.25 | 0.68 | 1.33 | 0.52 | 1.1 | 0.5 | | |
| | 1.9 | 2.46 | | 1.35 | | | 0.62 | 0.38 | 3.8 | 1.1 | 4.3 | 0.7 | 1.25 | 0.68 | 1.32 | 0.52 | 1.4 | 0.6 | | | |
| | 2.4 | 3.02 | | 1.39 | | | 0.66 | 0.37 | 4.6 | 1.4 | 5.1 | 0.8 | 1.24 | 0.67 | 1.31 | 0.52 | 1.8 | 0.7 | | | |
| | 2.8 | 3.56 | | 1.43 | | | 0.69 | 0.37 | 5.4 | 1.6 | 5.9 | 1.0 | 1.23 | 0.66 | 1.29 | 0.52 | 2.1 | 0.9 | | | |
| 45 30x3 x4 x5 x6 | 1.7 | 2.18 | 45x30 | 3.0 | 5.0 | | 1.42 | 0.69 | 0.44 | 4.4 | 1.5 | 5.0 | 0.9 | 1.42 | 0.84 | 1.52 | 0.63 | 1.4 | 0.7 | | |
| | 2.2 | 2.86 | | 1.47 | | | 0.73 | 0.43 | 5.7 | 2.0 | 6.5 | 1.1 | 1.41 | 0.84 | 1.51 | 0.63 | 1.9 | 0.9 | | | |
| | 2.8 | 3.52 | | 1.51 | | | 0.77 | 0.43 | 6.9 | 2.4 | 7.9 | 1.4 | 1.40 | 0.83 | 1.50 | 0.63 | 2.3 | 1.1 | | | |
| | 3.3 | 4.16 | | 1.55 | | | 0.81 | 0.42 | 8.0 | 2.8 | 9.2 | 1.7 | 1.39 | 0.82 | 1.49 | 0.63 | 2.7 | 1.3 | | | |
| 50 30x3 x4 x5 x6 | 1.8 | 2.34 | 50x30 | 3.0 | 5.5 | | 1.63 | 0.66 | 0.36 | 5.9 | 1.6 | 6.5 | 1.0 | 1.59 | 0.83 | 1.67 | 0.65 | 1.7 | 0.7 | | |
| | 2.4 | 3.07 | | 1.68 | | | 0.70 | 0.36 | 7.7 | 2.1 | 8.5 | 1.2 | 1.58 | 0.82 | 1.66 | 0.63 | 2.3 | 0.9 | | | |
| | 3.0 | 3.78 | | 1.72 | | | 0.74 | 0.35 | 9.3 | 2.5 | 10.3 | 1.5 | 1.57 | 0.81 | 1.65 | 0.63 | 2.8 | 1.1 | | | |
| | 3.5 | 4.47 | | 1.76 | | | 0.78 | 0.35 | 10.9 | 2.9 | 11.9 | 1.8 | 1.56 | 0.80 | 1.64 | 0.63 | 3.4 | 1.3 | | | |
| 60 40x5 x6 x8 | 3.7 | 4.76 | 60x40 | 5.0 | 6.0 | | 1.95 | 0.96 | 0.44 | 16.9 | 6.0 | 19.5 | 3.4 | 1.89 | 1.12 | 2.02 | 0.85 | 4.2 | 2.0 | | |
| | 4.4 | 5.65 | | 1.99 | | | 1.00 | 0.43 | 19.9 | 7.0 | 22.3 | 4.0 | 1.88 | 1.11 | 2.01 | 0.85 | 5.0 | 2.3 | | | |
| | 5.8 | 7.37 | | 2.07 | | | 1.08 | 0.42 | 25.4 | 8.8 | 29.0 | 5.2 | 1.86 | 1.10 | 1.98 | 0.84 | 6.5 | 3.0 | | | |

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Table 6.1

| Designation | Mass M kg/m | Sectional Area, a cm ² | Dimensions | | | | | | | Sectional Properties | | | | | | | | | |
|-----------------------------------|-------------------|---|----------------|---------|----------------------|----------------------|----------------------|----------------------|----------|-----------------------------------|-----------------------------------|--|--|----------------------|----------------------|-------------------------------|-------------------------------|-----------------------------------|-----------------------------------|
| | | | AxB mm x mm | t mm | R ₁ mm | R ₂ mm | C _s cm | C _y cm | Tan α | I _x cm ⁴ | I _y cm ⁴ | I _x (Max) cm ⁴ | I _y (Min) cm ⁴ | r _x cm | r _y cm | r _x (Max) cm | r _y (Min) cm | Z _x cm ³ | Z _y cm ³ |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) | (19) | (20) |
| 65 45 x 5 x 6 x 8 | 4.1 | 5.26 | 65x45 | 5.0 | 6.0 | ↑ | 2.07 | 1.08 | 0.47 | 22.1 | 8.6 | 25.9 | 4.8 | 2.05 | 1.28 | 2.22 | 0.96 | 5.0 | 2.5 |
| | 4.9 | 6.25 | | 6.0 | | | 2.11 | 1.12 | 0.47 | 26.0 | 10.1 | 30.4 | 5.7 | 2.04 | 1.27 | 2.21 | 0.95 | 5.9 | 3.0 |
| | 6.4 | 8.17 | | 8.0 | | | 2.19 | 1.20 | 0.46 | 33.2 | 12.8 | 38.7 | 7.4 | 2.02 | 1.25 | 2.18 | 0.95 | 7.7 | 3.9 |
| 70 45 x 5 x 6 x 8 x 10 | 4.3 | 5.52 | 70x45 | 5.0 | 6.5 | ↑ | 2.27 | 1.04 | 0.41 | 27.2 | 8.8 | 30.9 | 5.1 | 2.22 | 2.26 | 2.36 | 0.96 | 5.7 | 2.5 |
| | 5.2 | 6.56 | | 6.0 | | | 2.32 | 1.09 | 0.41 | 32.0 | 10.3 | 36.3 | 6.0 | 2.21 | 1.25 | 2.35 | 0.96 | 6.8 | 3.0 |
| | 6.7 | 8.58 | | 8.0 | | | 2.40 | 1.16 | 0.40 | 41.0 | 13.0 | 46.3 | 7.8 | 2.19 | 1.24 | 2.32 | 0.95 | 8.9 | 3.9 |
| | 8.3 | 10.5 | | 10.0 | | | 2.48 | 1.24 | 0.39 | 49.3 | 15.6 | 55.4 | 9.5 | 2.16 | 1.22 | 2.29 | 0.95 | 10.9 | 4.8 |
| 75 50 x 5 x 6 x 8 x 10 | 4.7 | 6.02 | 75x50 | 5.0 | 6.5 | ↑ | 2.39 | 1.16 | 0.44 | 34.1 | 12.2 | 39.4 | 6.9 | 2.38 | 1.42 | 2.56 | 1.07 | 6.7 | 3.2 |
| | 5.6 | 7.16 | | 6.0 | | | 2.44 | 1.20 | 0.44 | 40.3 | 14.3 | 46.4 | 8.2 | 2.37 | 1.41 | 2.56 | 1.07 | 8.0 | 3.8 |
| | 7.4 | 9.38 | | 8.0 | | | 2.52 | 1.28 | 0.42 | 51.8 | 18.3 | 59.4 | 10.6 | 2.85 | 1.40 | 2.52 | 1.06 | 10.4 | 4.9 |
| | 9.0 | 11.5 | | 10.0 | | | 2.60 | 1.36 | 0.42 | 62.2 | 21.8 | 71.2 | 12.9 | 2.33 | 1.38 | 2.49 | 1.06 | 12.7 | 6.0 |
| 80 50 x 5 x 6 x 8 x 10 | 4.9 | 6.27 | 80x50 | 5.0 | 7.0 | ↑ | 2.60 | 1.12 | 0.39 | 40.6 | 12.3 | 45.7 | 7.2 | 2.55 | 1.40 | 2.70 | 1.07 | 7.5 | 3.2 |
| | 5.9 | 7.46 | | 6.0 | | | 2.64 | 1.16 | 0.39 | 48.0 | 14.4 | 53.9 | 8.5 | 2.54 | 1.39 | 2.69 | 1.07 | 9.0 | 3.8 |
| | 7.7 | 9.78 | | 8.0 | | | 2.73 | 1.24 | 0.38 | 61.9 | 18.5 | 69.3 | 11.0 | 2.52 | 1.37 | 2.66 | 1.06 | 11.7 | 4.9 |
| | 9.4 | 12.0 | | 10.0 | | | 2.81 | 1.32 | 0.38 | 74.7 | 22.1 | 83.3 | 13.5 | 2.49 | 1.36 | 2.63 | 1.06 | 14.4 | 6.0 |
| 90 60 x 6 x 8 x 10 x 12 | 6.8 | 8.65 | 90x60 | 6.0 | 7.5 | ↑ | 2.87 | 1.39 | 0.44 | 70.6 | 25.2 | 81.5 | 14.3 | 2.86 | 1.71 | 3.07 | 1.28 | 11.5 | 5.5 |
| | 8.9 | 11.4 | | 8.0 | | | 2.96 | 1.48 | 0.44 | 91.5 | 32.4 | 105 | 18.6 | 2.84 | 1.69 | 3.04 | 1.28 | 15.1 | 7.2 |
| | 11.0 | 14.0 | | 10.0 | | | 3.04 | 1.55 | 0.43 | 111 | 39.1 | 127 | 22.8 | 2.81 | 1.67 | 3.01 | 1.27 | 18.6 | 8.8 |
| | 13.0 | 16.6 | | 12.0 | | | 3.12 | 1.63 | 0.42 | 129 | 45.2 | 148 | 26.8 | 2.79 | 1.65 | 2.98 | 1.27 | 22.0 | 10.3 |
| 100 65 x 6 x 8 x 10 | 7.5 | 9.55 | 100x65 | 6.0 | 8.0 | ↑ | 3.19 | 1.47 | 0.42 | 96.7 | 32.4 | 111 | 18.6 | 3.18 | 1.84 | 3.40 | 1.39 | 14.2 | 6.4 |
| | 9.9 | 12.6 | | 8.0 | | | 3.28 | 1.55 | 0.42 | 126 | 41.9 | 144 | 24.2 | 3.16 | 1.83 | 3.38 | 1.39 | 18.7 | 8.5 |
| | 12.2 | 15.5 | | 10.0 | | | 3.37 | 1.63 | 0.41 | 153 | 50.7 | 174 | 29.7 | 3.14 | 1.81 | 3.35 | 1.38 | 23.1 | 10.4 |
| 100 75 x 6 x 8 x 10 x 12 | 8.0 | 10.1 | 100x75 | 6.0 | 8.5 | ↑ | 3.01 | 1.78 | 0.55 | 101 | 48.7 | 124 | 25.6 | 3.15 | 2.19 | 3.50 | 1.59 | 14.4 | 8.5 |
| | 10.5 | 13.4 | | 8.0 | | | 3.10 | 1.87 | 0.55 | 132 | 63.3 | 161 | 33.6 | 3.14 | 2.18 | 3.48 | 1.59 | 19.1 | 11.2 |
| | 13.0 | 16.5 | | 10.0 | | | 3.19 | 1.95 | 0.55 | 160 | 76.9 | 196 | 41.2 | 3.12 | 2.16 | 3.45 | 1.58 | 23.6 | 13.0 |
| | 15.4 | 19.6 | | 12.0 | | | 3.27 | 2.03 | 0.54 | 188 | 89.5 | 228 | 48.6 | 3.10 | 2.14 | 3.42 | 1.58 | 27.9 | 16.3 |
| 125 75 x 6 x 8 x 10 | 9.2 | 11.7 | 125x75 | 6.0 | 9.0 | ↑ | 4.05 | 1.59 | 0.37 | 188 | 51.6 | 209 | 30.5 | 4.01 | 2.10 | 4.23 | 1.62 | 22.2 | 8.7 |
| | 12.1 | 15.4 | | 8.0 | | | 4.15 | 1.68 | 0.36 | 246 | 67.2 | 273 | 40.0 | 4.00 | 2.09 | 4.21 | 1.61 | 29.4 | 11.5 |
| | 14.9 | 19.0 | | 10.0 | | | 4.25 | 1.76 | 0.36 | 300 | 81.6 | 333 | 49.1 | 3.97 | 2.07 | 4.18 | 1.61 | 36.5 | 14.2 |

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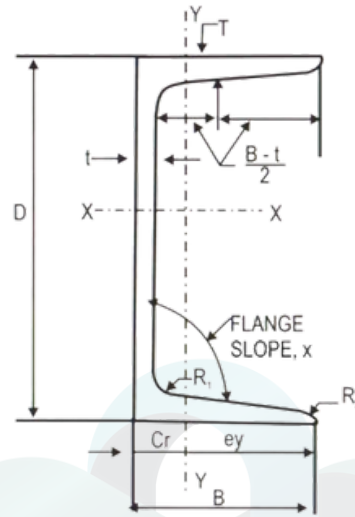
Table 6.1

| Designation (1) | Mass M kg/m (2) | Sectional Area, a cm ² (3) | Dimensions | | | | | | | Sectional Properties | | | | | | | | | |
|--------------------------------------|------------------------------|--|--------------|------------------------------|----------------|----------------|------------------------------|------------------------------|------------------------------|----------------------------------|------------------------------|----------------------------------|----------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|
| | | | AxB | t | R ₁ | R ₂ | C _x | C _y | Tan α | I _x | I _y | I _u | I _v | r _x | r _y | r _u | r _v | Z _x | Z _y |
| | | | mmxmm (4) | mm (5) | mm (6) | mm (7) | cm (8) | cm (9) | | cm ⁴ (11) | cm ⁴ (12) | cm ⁴ (13) (Max) | cm ⁴ (14) (Min) | cm (15) | cm (16) | cm (17) (Max) | cm (18) (Min) | cm ³ (19) | cm ³ (20) |
| 125 95 x 6 x 8 x 10 x 12 | 10.1 13.4 16.5 19.7 | 12.9 17.0 21.1 25.0 | 125x95 | 6.0 8.0 10.0 12.0 | 9.0 | 4.8 | 3.72 3.80 3.89 3.97 | 2.24 2.32 2.40 2.48 | 0.57 0.57 0.56 0.56 | 205 268 328 385 | 103 135 164 192 | 254 331 404 474 | 55.1 71.7 87.6 103 | 3.99 3.97 3.95 3.92 | 2.83 2.81 2.79 2.77 | 4.43 4.41 4.38 4.35 | 2.07 2.05 2.04 2.03 | 23.4 30.9 38.1 45.1 | 14.3 23.1 23.1 27.3 |
| 150 75 x 8 x 10 x 12 | 13.7 17.0 20.2 | 17.5 21.6 25.7 | 150x75 | 8.0 10.0 12.0 | 10.0 | 4.8 | 5.24 5.33 5.42 | 1.54 1.62 1.70 | 0.26 0.28 0.26 | 410 502 590 | 71.1 86.3 100 | 436 533 625 | 45.7 55.7 66.4 | 4.88 4.82 4.79 | 2.02 2.00 1.98 | 4.99 4.96 4.93 | 1.62 1.61 1.60 | 42.0 51.9 61.6 | 11.9 14.7 17.3 |
| 150 115 x 8 x 10 x 12 x 16 | 16.3 20.1 24.0 31.4 | 20.7 25.7 30.5 40.0 | 150x115 | 8.0 10.0 12.0 16.0 | 11.0 | 4.8 | 4.48 4.57 4.65 4.81 | 2.76 2.84 2.92 3.07 | 0.58 0.58 0.57 0.57 | 474 582 685 878 | 244 299 351 447 | 590 723 849 1 090 | 129 158 186 239 | 4.78 4.76 4.74 4.69 | 3.45 3.41 3.39 3.34 | 5.33 5.31 5.28 5.21 | 2.50 2.48 2.47 2.44 | 45.1 55.8 66.2 86.2 | 28.0 34.5 40.8 53.0 |
| 200 100 x 10 x 12 x 16 | 22.9 27.3 35.8 | 29.2 34.8 45.7 | 200x100 | 10.0 12.0 16.0 | 12.0 | 4.8 | 6.98 7.07 7.23 | 2.03 2.11 2.27 | 0.27 0.26 0.26 | 1 230 1 450 1 870 | 215 251 320 | 1 300 1 540 1 980 | 138 162 208 | 6.48 6.46 6.40 | 2.71 2.69 2.66 | 6.68 6.65 6.59 | 2.17 2.16 2.13 | 94.3 112 147 | 26.9 31.9 41.3 |
| 200 150 x 10 x 12 x 16 x 20 | 26.9 32.1 42.2 52.0 | 34.3 40.9 53.7 66.3 | 200x150 | 10.0 12.0 16.0 20.0 | 13.5 | 4.8 | 6.02 6.11 6.27 6.42 | 3.55 3.63 3.79 3.94 | 0.56 0.55 0.55 0.55 | 1 410 1 670 2 150 2 620 | 689 812 1 040 1 260 | 1 730 2 040 2 640 3 180 | 368 434 561 683 | 6.41 6.39 6.33 6.28 | 4.48 4.46 4.41 4.36 | 7.10 7.07 7.01 6.94 | 3.28 3.26 3.23 3.21 | 101 120 157 193 | 60.2 71.4 93.2 114 |

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CHANNEL SECTIONS

Table 4.1 Nominal Dimensions, Mass and Sectional Properties of sloping Flange Channels



| Designation | Mass M | Sectional Area, a | Dimensions | | | | | | | | Sectional Properties | | | | | |
|------------------------|-------------|------------------------|------------|-----------|-----------|-----------|---------------------------|----------------|----------------|----------------|-------------------------|-------------------------|----------------|----------------|-------------------------|-------------------------|
| | | | D | B | t | T | Flange Slope, α | R ₁ | R ₂ | C _r | I _x | I _y | r _x | r _y | Z _x | Z _y |
| (1) | Kg/m (2) | Cm ² (3) | mm (4) | mm (5) | mm (6) | mm (7) | deg (8) | mm (9) | mm (10) | mm (11) | cm ⁴ (12) | cm ⁴ (13) | cm (14) | cm (15) | cm ³ (16) | cm ³ (17) |
| Medium Weight Channels | | | | | | | | | | | | | | | | |
| MC75 | 7.14 | 9.1 | 75 | 40 | 4.8 | 7.5 | 96 | 8 | 2.4 | 1.32 | 78.5 | 12.9 | 2.94 | 1.19 | 20.9 | 4.81 |
| MC100 | 9.56 | 12.2 | 100 | 50 | 5 | 7.7 | 96 | 9 | 2.4 | 1.54 | 192 | 26.7 | 3.97 | 1.48 | 33.5 | 7.71 |
| MC125 | 13.1 | 16.7 | 125 | 65 | 5.3 | 8.2 | 96 | 9.5 | 2.4 | 1.95 | 425 | 61.1 | 5.05 | 1.91 | 68.1 | 13.4 |
| MC125* | 13.7 | 17.5 | 125 | 66 | 6 | 8.1 | 96 | 9.5 | 2.4 | 1.92 | 435 | 64.4 | 4.98 | 1.92 | 69.6 | 13.8 |
| MC150 | 16.8 | 21.3 | 150 | 75 | 5.7 | 9 | 96 | 10 | 2.4 | 2.2 | 788 | 103 | 6.08 | 2.2 | 105 | 19.5 |
| MC150* | 17.7 | 22.6 | 150 | 76 | 6.5 | 9 | 96 | 10 | 2.4 | 2.17 | 813 | 110 | 6 | 2.2 | 108 | 20.2 |
| MC175 | 19.6 | 24.9 | 175 | 75 | 6 | 10.2 | 96 | 10.5 | 3.2 | 2.19 | 1240 | 112 | 7.04 | 2.21 | 141 | 23 |
| MC175* | 22.7 | 27.6 | 175 | 76 | 7.5 | 10.2 | 96 | 10.5 | 3.2 | 2.14 | 1310 | 136 | 6.89 | 2.22 | 150 | 24.5 |

The heavier sections in each side intended for use in wagon industry are to be obtained from same set of rolls as the corresponding lightest section in that size group, by raising the rolls.

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Table 4.1

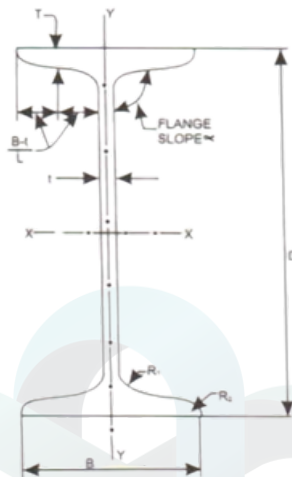
| Designation | Mass M | Sectional Area, a | Dimensions | | | | | | | Sectional Properties | | | | | | |
|-------------|-----------|----------------------|------------|-----|------|------|--------------------|----------------|----------------|----------------------|----------------|----------------|----------------|----------------|----------------|----------------|
| | | | D | B | t | T | Flange Slope, α | R ₁ | R ₂ | C _y | I _x | I _y | r _x | r _y | Z _x | Z _y |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) |
| MC 200 | 22.3 | 28.5 | 200 | 75 | 6.2 | 11.4 | 96 | 11.0 | 3.2 | 2.20 | 1 830 | 141 | 8.02 | 2.22 | 181 | 26.4 |
| MC 200* | 24.3 | 31.0 | 200 | 76 | 7.5 | 11.4 | 96 | 11.0 | 3.2 | 2.12 | 1 910 | 151 | 7.85 | 2.21 | 191 | 27.5 |
| MC 225 | 26.1 | 33.3 | 225 | 80 | 6.5 | 12.4 | 96 | 12.0 | 3.2 | 2.31 | 2 710 | 188 | 9.02 | 2.37 | 241 | 33.0 |
| MC 225* | 30.7 | 39.0 | 225 | 82 | 9.0 | 12.4 | 96 | 12.0 | 3.2 | 2.22 | 2 960 | 219 | 8.71 | 2.37 | 263 | 36.0 |
| MC 250 | 30.6 | 39.0 | 250 | 80 | 7.2 | 14.1 | 96 | 12.0 | 3.2 | 2.30 | 3 880 | 211 | 9.92 | 2.37 | 307 | 38.5 |
| MC 250* | 34.2 | 43.5 | 250 | 82 | 9.0 | 14.1 | 96 | 12.0 | 3.2 | 2.23 | 4 080 | 244 | 9.68 | 2.37 | 326 | 40.9 |
| MC 250* | 38.1 | 48.5 | 250 | 83 | 11.0 | 14.1 | 96 | 12.0 | 3.2 | 2.19 | 4 340 | 268 | 9.46 | 2.35 | 347 | 43.2 |
| MC 300 | 36.3 | 46.3 | 300 | 90 | 7.8 | 13.6 | 96 | 13.0 | 3.2 | 2.35 | 6 420 | 313 | 11.8 | 2.60 | 428 | 47.1 |
| MC 300* | 41.5 | 52.8 | 300 | 92 | 10.0 | 13.6 | 96 | 13.0 | 3.2 | 2.26 | 6 900 | 345 | 11.4 | 2.56 | 460 | 49.8 |
| MC 300* | 46.2 | 58.8 | 300 | 93 | 12.0 | 13.6 | 96 | 13.0 | 3.2 | 2.22 | 7 350 | 375 | 11.2 | 2.52 | 490 | 52.2 |
| MC 350 | 42.7 | 54.4 | 350 | 100 | 8.3 | 13.5 | 96 | 14.0 | 4.8 | 2.44 | 10 000 | 434 | 13.6 | 2.82 | 576 | 57.3 |
| MC 400 | 50.1 | 63.8 | 400 | 100 | 8.8 | 15.3 | 96 | 15.0 | 4.8 | 2.42 | 15 200 | 508 | 15.4 | 2.82 | 760 | 67.0 |

The heavier sections in each side intended for use in wagon industry are to be obtained from same set of rolls as the corresponding lightest section in that size group, by raising the rolls.

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BEAM SECTIONS

NOMINAL DIMENSIONS, MASS AND SECTIONAL PROPERTIES OF INDIAN STANDARD MEDIUM FLANGE BEAMS



| Designation | Mass M | Sectional Area, a | Dimensions | | | | | | | | Sectional Properties | | | | | |
|-------------|----------|---------------------|------------|--------|--------|--------|-------------------|----------------|----------------|----------------------|----------------------|----------------|----------------|----------------------|----------------------|--|
| | | | D | B | t | T | Flange Slope, Max | R ₁ | R ₂ | I _x | I _y | r _x | r _y | Z _x | Z _y | |
| (1) | kg/m (2) | cm ² (3) | mm (4) | mm (5) | mm (6) | mm (7) | α, deg (8) | mm (9) | mm (10) | cm ⁴ (11) | cm ⁴ (12) | cm (13) | cm (14) | cm ³ (15) | cm ³ (16) | |
| MB 100 | 8.9 | 11.4 | 100 | 50 | 4.7 | 7.0 | 98.0 | 9.0 | 4.5 | 183 | 12.9 | 4.00 | 1.05 | 36.6 | 5.16 | |
| MB 125 | 13.3 | 17.0 | 125 | 70 | 5.0 | 8.0 | 98.0 | 9.0 | 4.5 | 445 | 38.5 | 5.16 | 1.51 | 71.2 | 11.0 | |
| MB 150 | 15.0 | 19.1 | 150 | 75 | 5.0 | 8.0 | 98.0 | 9.0 | 4.5 | 718 | 46.8 | 6.13 | 1.57 | 95.7 | 12.5 | |
| MB 175 | 19.6 | 25.0 | 175 | 85 | 5.8 | 9.0 | 98.0 | 10.0 | 5.0 | 1260 | 76.7 | 7.13 | 1.76 | 144 | 18.0 | |
| MB 200 | 24.2 | 30.8 | 200 | 100 | 5.7 | 10.0 | 98.0 | 11.0 | 5.5 | 2120 | 137 | 8.29 | 2.11 | 212 | 27.4 | |
| MB 225 | 31.1 | 39.7 | 225 | 110 | 6.5 | 11.8 | 98.0 | 12.0 | 6.0 | 3440 | 218 | 9.31 | 2.34 | 306 | 39.7 | |
| MB 250 | 37.3 | 47.5 | 250 | 125 | 6.9 | 12.5 | 98.0 | 13.0 | 6.5 | 5130 | 335 | 10.4 | 2.65 | 410 | 53.5 | |
| MB 300 | 46.0 | 58.6 | 300 | 140 | 7.7 | 13.1 | 98.0 | 14.0 | 7.0 | 8990 | 486 | 12.4 | 2.86 | 599 | 69.5 | |
| MB 350 | 52.4 | 66.7 | 350 | 140 | 8.1 | 14.2 | 98.0 | 14.0 | 7.0 | 13600 | 538 | 14.3 | 2.84 | 779 | 76.8 | |
| MB 400 | 61.5 | 78.4 | 400 | 140 | 8.9 | 16.0 | 98.0 | 14.0 | 7.0 | 20500 | 622 | 16.2 | 2.82 | 1020 | 88.9 | |
| MB 450 | 72.4 | 92.2 | 450 | 150 | 9.4 | 17.4 | 98.0 | 15.0 | 7.5 | 30400 | 834 | 18.2 | 3.01 | 1350 | 111 | |
| MB 500 | 86.9 | 111 | 500 | 180 | 10.2 | 17.2 | 98.0 | 17.0 | 8.5 | 45200 | 1370 | 20.2 | 3.52 | 1810 | 152 | |
| MB 550 | 104 | 132 | 550 | 190 | 11.2 | 19.3 | 98.0 | 18.0 | 9.0 | 64900 | 1830 | 22.2 | 3.73 | 2360 | 193 | |
| MB 600 | 123 | 156 | 600 | 250 | 12.0 | 20.3 | 98.0 | 20.0 | 10.0 | 91800 | 2650 | 24.2 | 4.12 | 3060 | 252 | |

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FLAT BARS



| MILD STEEL FLAT BAR | |
|---------------------|--------|
| Section Size | Weight |
| Mm | kg/m |
| 3mm x 12mm | 0.283 |
| 3mm x 13mm | 0.306 |
| 3mm x 16mm | 0.377 |
| 3mm x 18mm | 0.424 |
| 3mm x 19mm | 0.447 |
| 3mm x 25mm | 0.589 |
| 3mm x 30mm | 0.710 |
| 3mm x 32mm | 0.754 |
| 3mm x 38mm | 0.895 |
| 3mm x 44mm | 1.040 |
| 3mm x 50mm | 1.180 |
| 3mm x 65mm | 1.530 |
| 3mm x 75mm | 1.766 |
| 3mm x 100mm | 2.355 |
| 4mm x 12mm | 0.377 |
| 4mm x 15mm | 0.471 |
| 4mm x 18mm | 0.565 |
| 4mm x 25mm | 0.785 |
| 4.5mm x 12mm | 0.424 |
| 4.5mm x 13mm | 0.459 |
| 4.5mm x 15mm | 0.530 |
| 4.5mm x 16mm | 0.565 |
| 4.5mm x 18mm | 0.636 |
| 4.5mm x 19mm | 0.670 |
| 4.5mm x 25mm | 0.880 |
| 4.5mm x 30mm | 1.060 |
| 4.5mm x 32mm | 1.130 |
| 4.5mm x 38mm | 1.340 |
| 4.5mm x 44mm | 1.550 |
| 4.5mm x 50mm | 1.770 |
| 4.5mm x 65mm | 2.300 |
| 4.5mm x 75mm | 2.600 |
| 4.5mm x 100mm | 3.550 |
| 5mm x 25mm | 0.981 |
| 5mm x 32mm | 1.256 |
| 5mm x 38mm | 1.492 |
| 5mm x 50mm | 1.963 |
| 6mm x 12mm | 0.570 |
| 6mm x 15mm | 0.707 |
| 6mm x 16mm | 0.754 |
| 6mm x 18mm | 0.848 |
| 6mm x 19mm | 0.895 |
| 6mm x 25mm | 1.180 |
| 6mm x 30mm | 1.410 |
| 6mm x 32mm | 1.510 |
| 6mm x 38mm | 1.790 |
| 6mm x 44 mm | 2.070 |

| MILD STEEL FLAT BAR | |
|---------------------|--------|
| Section Size | Weight |
| Mm | kg/m |
| 6mm x 50mm | 2.360 |
| 6mm x 65mm | 3.060 |
| 6mm x 75mm | 3.530 |
| 6mm x 90mm | 4.240 |
| 6mm x 100mm | 4.710 |
| 6mm x 125mm | 5.890 |
| 6mm x 150mm | 7.050 |
| 6mm x 200mm | 9.420 |
| 6mm x 250mm | 11.780 |
| 6mm x 300mm | 14.130 |
| 8mm x 25mm | 1.570 |
| 8mm x 30mm | 1.880 |
| 8mm x 32mm | 2.010 |
| 8mm x 38mm | 2.390 |
| 8mm x 44mm | 2.760 |
| 8mm x 50mm | 3.140 |
| 8mm x 65mm | 4.080 |
| 8mm x 75mm | 4.710 |
| 8mm x 90mm | 5.650 |
| 8mm x 100mm | 6.280 |
| 8mm x 125mm | 7.850 |
| 8mm x 150mm | 9.420 |
| 9mm x 18mm | 1.272 |
| 9mm x 19mm | 1.340 |
| 9mm x 25mm | 1.770 |
| 9mm x 30mm | 2.120 |
| 9mm x 32mm | 2.260 |
| 9mm x 35mm | 2.470 |
| 9mm x 38mm | 2.680 |
| 9mm x 44mm | 3.110 |
| 9mm x 50mm | 3.530 |
| 9mm x 65mm | 4.590 |
| 9mm x 75mm | 5.300 |
| 9mm x 90mm | 6.360 |
| 9mm x 100mm | 7.060 |
| 9mm x 125mm | 8.830 |
| 9mm x 150mm | 10.600 |
| 9mm x 200mm | 14.100 |
| 9mm x 250mm | 17.700 |
| 9mm x 300mm | 21.200 |
| 12mm x 25mm | 2.360 |
| 12mm x 30mm | 2.826 |
| 12mm x 32mm | 3.010 |
| 12mm x 35mm | 3.310 |
| 12mm x 38mm | 3.580 |
| 12mm x 44mm | 4.140 |
| 12mm x 50mm | 4.710 |

| MILD STEEL FLAT BAR | |
|---------------------|--------|
| Section Size | Weight |
| Mm | kg/m |
| 12mm x 65mm | 6.120 |
| 12mm x 75mm | 7.060 |
| 12mm x 90mm | 8.480 |
| 12mm x 100mm | 9.420 |
| 12mm x 125mm | 11.800 |
| 12mm x 150mm | 14.100 |
| 12mm x 200mm | 18.800 |
| 12mm x 250mm | 23.600 |
| 12mm x 300mm | 28.300 |
| 16mm x 25mm | 3.140 |
| 16mm x 32mm | 4.020 |
| 16mm x 38mm | 4.770 |
| 16mm x 44mm | 5.530 |
| 16mm x 50mm | 6.280 |
| 16mm x 65mm | 8.160 |
| 16mm x 75mm | 9.420 |
| 16mm x 90mm | 11.300 |
| 16mm x 100mm | 12.600 |
| 16mm x 125mm | 15.700 |
| 16mm x 150mm | 18.800 |
| 16mm x 200mm | 25.100 |
| 16mm x 250mm | 31.400 |
| 16mm x 300mm | 37.700 |
| 19mm x 32mm | 4.770 |
| 19mm x 38mm | 5.670 |
| 19mm x 44mm | 6.560 |
| 19mm x 50mm | 7.460 |
| 19mm x 65mm | 9.690 |
| 19mm x 75mm | 11.200 |
| 19mm x 90mm | 13.400 |
| 19mm x 100mm | 14.900 |
| 19mm x 125mm | 18.600 |
| 19mm x 150mm | 22.400 |
| 19mm x 200mm | 29.800 |
| 19mm x 250mm | 37.300 |
| 19mm x 300mm | 44.900 |
| 25mm x 50mm | 9.810 |
| 25mm x 65mm | 12.800 |
| 25mm x 75mm | 14.700 |
| 25mm x 90mm | 17.700 |
| 25mm x 100mm | 19.600 |
| 25mm x 125mm | 24.500 |
| 25mm x 150mm | 29.400 |
| 25mm x 200mm | 39.200 |
| 25mm x 250mm | 49.100 |
| 25mm x 300mm | 58.900 |

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FORMULA OF CALCULATING WEIGHT

- WEIGHT OF STAINLESS STEEL / CARBON STEEL PIPES & TUBES
OD (MM) - W.T. (MM) X W.T (MM) X 0.02466 = KG/MTR
- WEIGHT OF STAINLESS STEEL SHEETS
Length (mtr) x Width (mtr) x Thk. (mm) x 8 =KG/SHEET
- WEIGHT OF CARBON STEEL SHEETS
Length (mtr) x Width (mtr) x Thk. (mm) x 7.85 = KG/SHEET
- WEIGHT OF STAINLESS STEEL CIRCLE & BI-ANKS
O.D. (mm) X O.D (mm) X Thk. (mm) 160/1000 = KG/PCS.
- WEIGHT OF STAINLESS STEEL ROUNDS
Dia (mm) x Dia (mm) x 0.00623 = KG/MTR
- WEIGHT OF STAINLESS STEEL HEXAGONAL RODS
Dia. (mm) X Dia. (mm) x 0.00787 = KG/MTR
- WEIGHT OF STAINLESS STEEL SQUARE RODS
Dia. (mm) x Dia. (mm) x 0.00787 = KG/MTR
- WEIGHT OF COPPER PIPES
O.D. (mm) - W.T. (mm) X W.I (mm) X 0.0285 = KG/MTR
- WEIGHT OF ALUMINIUM PIPE
O.D. (mm) - Thick (mm) x Thick (mm) x 0.0082 = KG/MTR
- WEIGHT OF ALUMINIUM SHEET
Length (Mtr.) x Width (Mtr.) x Thick (mm) x 2.66 = KG/SHEET
- WEIGHT OF LEAD PIPE
O.D. (mm) - Wt. (mm) x Wt. (mm) x 0.0345 = KG/MTR
- WEIGHT OF LEAD SHEETS
Length (mtr.) - Thk. (mm) X 3.14 = Sheet Width (mm)
- SHEET WIDTH REQD FOR ROLLED & WELDED PIPES
O.D (mm) - Thk (mm) x 3.14 = sheet width (mm)
- WEIGHT FOR SQUARE / RECTANGLE PIPES
Length from 4 Angle (OD)/3.14-Thk. (mm) x Thk. (mm) x 0.00756
=KG / PER FEET

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THE FOLLOWING EXTRA SERVICES ARE AVAILABLE ON REQUEST

Extra Services

Standard Packing

In bundles with protective foil wrapping in wooden crates / cases. For smaller tubes on shelf fittings in carton boxes

Cutting to lengths

Cutting from 3.00 mm O.D. up to 406 mm. high volume tube cutting.

Cleaning

For normal degrease standard and also for the much higher standard of " Oxygen clean" treatment, where air, gas, powder or other substances of high purity require non-contaminated surface finish. Reannealing from 6.00 mm up to 323 mm. Special cleaning will be applied by customers request!



Polishing

We polish over a range of sizes from 6.00 mm O.D. up to 406 mm O.D. although sizes bigger than 168 mm are hand polished, not mechanical. Polishing standards are grit 1g0, 240,320,400 and mirror

On the inside we polish from 6.00 mm up to 168 mm. Other facilities are honing and electro polishing, which we can supply till 0.2 m smoothness.

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Extra testing

All chemical and mechanical testing. Hardness according to: Rockwell, Brinell, Vickers and NACE MR 01-75. X-ray, Magnetic Permeability and ultrasonic testing. Witnessing by independent authorities as Lloyds Register of shipping, Det Norske Veritas, TUV, Bureau Veritas, ABS, Germanischer Lloyd and EIL or any other certifying authority.



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