*भारतीय मानक*
***Indian Standard***

**IS 17875 : 2022**

# सामान्य सेवाओं के लिए स्टेनलेस इस्पात सीमलेस पाइप और ट्यूब — विशिष्टि

# Stainless Steel Seamless Pipes and Tubes for General Services — Specification

ICS 77,140.75, 23.040.10



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# FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Steel Tubes, Pipes and Fittings Sectional Committee had been approved by the Metallurgical Engineering Division Council.

A large quantity of stainless steel seamless pipes and tubes are manufactured in India for various applications. Given the diverse applications of stainless steel seamless pipes and tubes, coupled with corrosion resistance and desired mechanical properties at low as well as high temperatures, the committee decided to formulate a standard on seamless stainless steel pipes and tubes for general applications. Because seamless pipes and tubes have no weld joints allowing it to withstand high levels of pressure and temperature for a given nominal thickness. Therefore, stainless steel seamless pipes and tubes are quite versatile. Apart from wide applications in oil and gas industry, it is used in various mechanical and engineering industries also.

There are many grades of stainless steel and corrosion and mechanical properties varies vastly from grade to grade and hence proper selection of the grade for a particular application is of utmost importance. Proper care should be taken while production, handling storage and fabrication of final product to retain the important properties of stainless steel pipes and tubes.

In the formulation of this standard, due weightage has been given to international co-ordination among the standards prevailing in different countries in addition to relating it to the practices in the field in this country. Assistance has been derived from the following:

| | |
|---|---|
| ASTM A 268 | Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service |
| ASTM A 269 | Seamless and Welded Austenitic Stainless Steel Tubing for General Service |
| ASTM A 312 | Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes |
| ASTM A 632 | Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service |
| ASTM A 789 | Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service |
| ASTM A 790 | Seamless and Welded Ferritic/Austenitic Stainless Steel Pipe |
| ISO 1127 | Stainless steel tubes — Dimensions, tolerances and conventional masses per unit length |
| ISO 9329-4 | Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 4: Austenitic stainless steels |
| EN 10297-2 | Seamless steel tubes for mechanical and general engineering purposes - Technical delivery conditions - Part 2: Stainless steel |

This standard contains clauses **8.1**, **9.2**, **11.1**, **18.1** and **19** which call for an agreement between the manufacturer and the purchaser.

The Composition of the Committee and the Panel responsible for the formulation of this standard is given at Annex C.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values ( *second revision* )’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Indian Standard*

# STAINLESS STEEL SEAMLESS PIPES AND TUBES FOR GENERAL SERVICES — SPECIFICATION

## 1 SCOPE

**1.1** This standard covers the requirements for seamless stainless steel pipes and tubes for general services.

**1.2** This standard does not specify requirements of seamless Stainless Steel pipes and tubes intended for distinct purposes, which are covered by separate Indian Standards.

## 2 REFERENCES

The following standards contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

| *IS No.* | *Title* |
|---|---|
| 228 (various parts) | Methods of chemical analysis of steels |
| 1387 : 1993 | General requirements for the supply of metallurgical materials (*second revision*) |
| 1500 (Part 1) : 2019/ ISO 6506-1 : 2014 | Metallic materials — Brinell hardness test: Part 1 Test method (*fifth revision*) |
| 1586 (Part 1) : 2018/ ISO 6508-1 : 2016 | Metallic materials — Rockwell hardness test: Part 1 Test method (*fifth revision*) |
| 1608 (Part 1) : 2018/ ISO 6892-1 : 2016 | Metallic materials — Tensile testing: Part 1 Method of test at room temperature (*fourth revision*) |
| 1956 (Part 8) : 1976 | Glossary of terms related to iron and steel Part 8 Steel tubes and pipes (*first revision*) |
| 2328 : 2018/ ISO 8492 : 2013 | Metallic materials — Tube — Flattening test (*third revision*) |
| 4748 : 2021/ ISO 643 : 2019 | Steel — Micrographic determination of the apparent grain size (*third revision*) |
| 8910 : 2010/ ISO 404 : 1992 | General technical delivery requirements for steel and steel products (*first revision*) |

## 3 TERMINOLOGY

Unless otherwise provided herein, the definitions as mentioned in IS 1956 (Part 8) shall apply.

**3.1 Pipe** — A long hollow cylinder of round cross section, ordered by specifying nominal bore and wall thickness.

**3.2 Tube** — A long hollow cylinder of round cross section ordered by specifying outside diameter (OD) and wall thickness.

## 4 TYPES AND GRADES

**4.1** Types of the seamless stainless steel pipes/tubes for general services are primarily classified on the basis of crystalline structure as austenitic, ferritic, martensitic, and duplex.

**4.2** Stainless steel pipes/tubes are designated by the symbol SML to indicate the process of manufacture as seamless.

## 5 SUPPLY OF MATERIAL

General requirements relating to the supply of the steel pipes/tubes shall conform to IS 8910.

## 6 ORDERING INFORMATION

Orders for pipes/tubes under this specification shall include the following to describe the desired material adequately:

a) Quantity (mass or number);
b) Grade;
c) Size (nominal bore and thickness or outside diameter and thickness);
d) Length; and
e) Optional requirements.

## 7 MANUFACTURE

**7.1** The pipes and tubes shall be manufactured by seamless process.

**7.2** The pipes and tubes may be furnished as either hot finish or cold finish.

## 8. CHEMICAL COMPOSITION

### 8.1 Ladle Analysis

The ladle analysis of stainless steels shall be as given in Table 1. The analysis of steel shall be carried out either by the method specified in IS 228 and its relevant parts or any other established instrumental/chemical method. In case of dispute the procedure given in IS 228 and its relevant parts, shall be the referee method. However, in case the method is not given in IS 228 and its relevant parts, the referee method shall be as agreed to between the purchaser and the manufacturer.

### 8.2 Product Analysis

Permissible variations in the case of product analysis from the limits specified in Table 1 shall be as given in Table 2.

## 9 HEAT TREATMENT

**9.1** All pipes/tubes shall be furnished in heat treated condition.

**9.2** Accordingly, ferritic and martensitic stainless steels shall be supplied in heat treated condition, where the pipes/tubes are reheated to a temperature of 650 °C (temperature for grade 410S2 is 700 to 760 °C) and cooled as appropriate to meet the requirements of this specification.

**9.3** Austenitic stainless steel pipes/tubes are to be supplied in solution annealed condition. The heat treatment procedure shall consist of reheating the material to the minimum temperature mentioned in Table 3, followed by quenching in water or rapidly cooled by other means as appropriate to meet the requirements of this specification.

**9.3.1** In addition, pipes/tubes of certain grades of austenitic stainless steels, such as 309H, 310H, 321, 321H, 347, 347H, 348 may be subjected to stabilizing heat treatment subsequent to the solution annealing at a temperature as agreed to between the purchaser and the manufacturer, which is generally lower than the solution annealing temperature.

**9.4** Duplex stainless steel pipes/tubes shall be supplied in the heat treatment condition as mentioned in Table 3.

**9.5** For austenitic and duplex stainless steel pipes/tubes, alternate to final heat treatment in a reheated condition as mentioned in **9.3** and **9.4** respectively, immediately following hot forming, while the temperature of tubes is not less than the specified minimum solution temperature, tubes may be individually quenched in water or rapidly cooled by other means

## 10 MECHANICAL PROPERTIES

### 10.1 Tensile Requirements

Pipes and tubes made of ferritic, austenitic, martensitic and duplex steel shall confirm to the tensile properties prescribed in Table 4. One tension test shall be carried out in accordance with IS 1608 (Part 1) on a specimen for lots of not more than 50 tubes. Tension tests shall be made on specimens from two tubes for lots of more than 50 tubes.

## 11 TRANSVERSE TENSION TEST

It is an optional test and shall be conducted if required by the purchaser. For pipes of OD 219 mm and above transverse test may be done for 10 percent of the lengths supplied for all austenitic grades other than 310 MoLN and 326. In such case the elongation shall be 25 percent minimum.

## 12 HARDNESS TEST

### 12.1 Pipes

Pipes of ferritic and duplex stainless steel shall conform to the requirements of Hardness values on one of the scales (Rockwell or Brinell) prescribed in Table 5. The hardness test shall be carried out by IS 1500 (Part 1) or IS 1586 (Part 1), as applicable.

**Table 1 Chemical Composition,** Percent

( *Clauses* 8.1 *and* 8.2 )

| Sl No. | Grade Designation Letter Symbol [*see* IS 1762 (Part 1)] | Numerical Symbol ISS | C *Max* | Si *Max* | Mn *Max* | Ni *Max* | Cr | Mo | S *Max* | P *Max* | N *Max* | Cu *Max* | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
| i) | ***Ferritic steels:*** | | | | | | | | | | | | |
| 1 | X 04Cr12Al | 405 | 0.08 | 1.00 | 1.00 | 0.60 | 11.5-14.5 | – | 0.030 | 0.040 | – | | Al 0.10-0.30 |
| 2 | X 02Cr12 | 409 M | 0.030 | 1.00 | 0.50-1.50 | 1.50 | 10.5-12.5 | – | 0.030 | 0.040 | – | | – |
| 3 | X02Cr12Ni1 | 410S2 | 0.04 | 1.00 | 1.00 | 0.60-1.10 | 10.5-12.5 | – | 0.030 | 0.045 | 0.100 | – | – |
| 4 | X10Cr15 | 429 | 0.12 | 1.00 | 1.00 | – | 14.0-16.0 | – | 0.030 | 0.040 | – | – | – |
| 5 | X 07Cr17 | 430 | 0.12 | 1.00 | 1.00 | 0.75 | 16.0-18.0 | – | 0.030 | 0.040 | – | | – |
| 6 | X02Cr17TiNb | 430Ti | 0.030 | 0.75 | 1.00 | – | 16.00-19.00 | – | 0.030 | 0.040 | – | – | Ti or Nb 0.10-1.00 |
| 7 | X 02Cr18Ti | 439 | 0.030 | 1.00 | 1.00 | 0.50 | 17.0-19.0 | – | 0.030 | 0.040 | 0.030 | – | Ti [0.2 + 4 (C + N)] *Min* —1.1 *Max*; Al 0.15 *Max* |
| 8 | X02Cr18TiNb | 439Ti2 | 0.030 | 1.00 | 1.00 | – | 17.5-18.5 | – | 0.015 | 0.040 | – | – | Ti (0.1-0.6) Nb [(0.3 + (3 x C)] *Min* |
| 9 | X10Cr20 | 442 | 0.200 | 1.00 | 1.00 | 0.60 | 18.0-23.0 | – | 0.040 | 0.040 | – | – | - |
| 10 | X02Cr18Mo2TiNb | 444 | 0.025 | 1.00 | 1.00 | 1 | 17.5-19.5 | 1.75-2.50 | 0.030 | 0.040 | 0.035 | – | (Ti + Nb) [0.20 + 4 (C + N)] *Min*, 0.80 *Max* |
| 11 | X10Cr25 | 446S1 | 0.200 | 1.00 | 1.50 | 0.75 | 23.0-27.0 | – | 0.030 | 0.040 | 0.250 | – | – |
| 12 | X03Cr26Mo1Ti | 446S2 | 0.06 | 0.75 | 0.75 | 0.50 | 25.0-27.0 | 0.75-1.50 | 0.020 | 0.040 | 0.040 | 0.20 | Ti 0.20-1.00; Ti 7 (C + N) *Min* |
| 13 | X01Cr26Mo1Nb | 446S3 | 0.010 | 0.40 | 0.40 | 0.50 | 25.0-27.5 | 0.75-1.50 | 0.020 | 0.020 | $0.015^{N}$ | 0.20 | Nb0.05-0.20, (Ni + Cu) 0.50 |
| ii) | ***Martensitic steels:*** | | | | | | | | | | | | |
| 1 | X 12Cr12 | 410 | 0.08-0.15 | 1.00 | 1.00 | 0.75 | 11.5-13.5 | – | 0.030 | 0.040 | – | – | – |
| | | | | | | | | | | | | | |
| iii) | ***Austenitic steels:*** | | | | | | | | | | | | |
| 1 | X 10Cr17Mn6Ni4N20 | 201 | 0.15 | 1.00 | 5.5-7.5 | 3.5·5.5 | 16.0-18.0 | – | 0.030 | 0.060 | 0.250 | – | – |
| 2 | X02Cr17Mn7Ni4N | 201LN | 0.030 | 0.75 | 6.40-7.50 | 4.0-5.0 | 16.0-17.5 | – | 0.015 | 0.045 | 0.10-0.25 | 1.00 | – |
| 3 | X02Cr16Mn8Ni2N | 204 | 0.030 | 1.00 | 7.00-9.00 | 1.50-3.00 | 15.0-17.0 | – | 0.030 | 0.040 | 0.15-0.30 | – | – |
| 4 | X04Cr19Ni9 | 304 | 0.07 | 0.75 | 2.00 | 8.0-10.5 | 17.5-19.5 | – | 0.030 | 0.045 | 0.100 | – | – |
| 5 | X 02Cr19Ni10 | 304 L | 0.030 | 0.75 | 2.00 | 8.0.12.0 | 17.5-19.5 | – | 0.030 | 0.045 | 0.100 | – | – |
| 6 | X 07Cr19Ni9 | 304H | 0.04-0.10 | 0.75 | 2.00 | 8.0-10.5 | 18.0-20.0 | – | 0.030 | 0.045 | – | – | – |

**Table 1** (*Continued*)

| Sl No. | Grade Designation Letter Symbol [*see* IS 1762 (Part 1)] | Numerical Symbol ISS | C *Max* | Si *Max* | Mn *Max* | Ni *Max* | Cr | Mo | S *Max* | P *Max* | N *Max* | Cu *Max* | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
| 7 | X 02Cr19Ni10N | 304LN | 0.030 | 0.75 | 2.00 | 8.0 – 12.0 | 18.00-20.00 | – | 0.030 | 0.045 | 0.10-0.16 | – | – |
| 8 | X 04Cr19Ni9N | 304N | 0.08 | 0.75 | 2.00 | 8.0-10.5 | 18.0-20.0 | – | 0.030 | 0.045 | 0.10-0.16 | – | – |
| 9 | X05Cr18Ni9Si1CeN | 304Ce | 0.04-0.06 | 1.00-2.00 | 0.80 | 9.0-10.0 | 18.0-19.0 | – | 0.030 | 0.045 | 0.12-0.18 | – | Ce 0.03-0.08 |
| 10 | X07Cr21Ni11Ce | 308Ce | 0.05-0.10 | 1.40-2.00 | 0.80 | 10.0-12.00 | 20.0-22.0 | – | 0.030 | 0.040 | 0.14-0.20 | – | Ce 0.03-0.08 |
| 11 | X 04Cr23Ni14 | 309 S | 0.08 | 0.75 | 2.00 | 12.0-15.0 | 22.0-24.0 | — | 0.030 | 0.045 | – | – | – |
| 12 | X05Cr23Ni13 | 309H | 0.04-0.10 | 0.75 | 2.00 | 12.0-15.0 | 22.0-24.0 | – | 0.030 | 0.045 | – | – | — |
| 13 | X05Cr23Ni13Nb | 309Nb | 0.08 | 0.75 | 2.00 | 12.0-16.0 | 22.0-24.0 | – | 0.030 | 0.045 | – | – | Nb 10 × C *Min*, 1.10 *Max* |
| 14 | X07Cr23Ni13Nb | 309HNb | 0.04-0.10 | 0.75 | 2.00 | 12.0-16.0 | 22.0-24.0 | – | 0.030 | 0.045 | – | – | Nb 10 × C *Min*, 1.10 *Max* |
| 15 | X 04Cr25Ni20 | 310 S | 0.08 | 1.50 | 2.00 | 19.0–22.0 | 24.0-26.0 | — | 0.030 | 0.045 | – | – | — |
| 16 | X07Cr25Ni20 | 310H | 0.04-0.10 | 0.75 | 2.00 | 19.0-22.0 | 24.0-26.0 | – | 0.030 | 0.045 | – | – | — |
| 17 | X05Cr25Ni20Nb | 310Nb | 0.08 | 1.50 | 2.00 | 19.0-22.0 | 24.0-26.0 | – | 0.030 | 0.045 | – | – | Nb 10 × C *Min*, 1.10 *Max* |
| 18 | X07Cr25Ni20Nb | 310HNb | 0.04-0.10 | 0.75 | 2.00 | 19.0-22.0 | 24.0-26.0 | – | 0.030 | 0.045 | – | – | Nb 10 × C *Min, 1.10 Max* |
| 19 | X01Cr25Ni21Mo2N | 310MoLN | 0.020 | 0.50 | 2.00 | 20.5-23.5 | 24.0-26.0 | 1.60-2.60 | 0.010 | 0.030 | 0.09-0.1 | – | — |
| 20 | X02Cr20Ni18Mo6CuN | 312 | 0.020 | 0.80 | 1.00 | 17.5-18.5 | 19.5-20.5 | 6.0-6.5 | 0.010 | 0.030 | 0.18-0.25 | 0.50-1.00 | — |
| 21 | X 04Cr17Ni12Mo2 | 316 | 0.08 | 0.75 | 2.00 | 10.0-14.0 | 16.0-18.0 | 2.0-3.0 | 0.030 | 0.045 | 0.100 | – | — |
| 22 | X 02Cr17Ni12Mo2 | 316 L | 0.030 | 0.75 | 2.00 | 10.0-14.0 | 16.0-18.0 | 2.0-3.0 | 0.030 | 0.045 | 0.100 | – | — |
| 23 | X 07Cr17Ni12Mo2 | 316 H | 0.04-0.10 | 0.75 | 2.00 | 10.0-14.0 | 16.0-18.0 | 2.0–3.0 | 0.030 | 0.045 | — | – | — |
| 24 | X 02Cr17Ni12Mo2N | 316 LN | 0.030 | 0.75 | 2.00 | 10.0-14.0 | 16.0-18.0 | 2.0–3.0 | 0.030 | 0.045 | 0.10-0.16 | – | — |
| 25 | X 04Cr17Ni12Mo2Ti | 316 Ti | 0.08 | 0.75 | 2.00 | 10.0·14.0 | 16.0-18.0 | 2.0-3.0 | 0.030 | 0.045 | 0.100 | – | Ti 5 × (C + N ) *Min — 0.70 Max* |
| 26 | X05Cr17Ni12Mo2N | 316N1 | 0.08 | 0.75 | 2.00 | 10.0-14.0 | 16.0-18.0 | 2.00-3.00 | 0.030 | 0.045 | 0.10-0.16 | – | — |
| 27 | X02Cr20Ni9Mo1N | 316N2 | 0.030 | 1.00 | 2.00 | 8.0-9.5 | 19.5-21.5 | 0.50-1.50 | 0.015 | 0.045 | 0.14-0.25 | 1 | — |
| 28 | X 04Cr19Ni13Mo3 | 317 | 0.08 | 0.75 | 2.00 | 11.0-15.0 | 18.0-20.0 | 3.0–4.0 | 0.030 | 0.045 | 0.100 | – | — |
| 29 | X 02Cr19Ni13Mo3 | 317L | 0.030 | 0.75 | 2.00 | 11.0-15.0 | 18.0-20.0 | 3.0–4.0 | 0.030 | 0.045 | 0.100 | – | — |
| 30 | X02Cr18Ni15Mo4Cu3N | 317LCu | 0.030 | 1.00 | 1.00 | 14.5-16.5 | 17.5-19.0 | 3.8-4.5 | 0.030 | 0.030 | 0.15-0.21 | 2.8-4.0 | - |
| 31 | X02Cr19Ni12Mo3N | 317LN | 0.030 | 0.75 | 2.00 | 11.0-15.0 | 18.0-20.0 | 3.0-4.0 | 0.030 | 0.045 | 0.10-0.22 | – | - |
| 32 | X02Cr19Ni14Mo4 | 317LM | 0.030 | 1.00 | 2.00 | 13.5-17.5 | 18.0-20.0 | 4.0-5.0 | 0.030 | 0.045 | 0.20 | 0.75 | |

**Table 1** (*Concluded*)

| Sl No. | Grade Designation Letter Symbol [*see* IS 1762 (Part 1)] | Numerical Symbol ISS | C *Max* | Si *Max* | Mn *Max* | Ni *Max* | Cr | Mo | S *Max* | P *Max* | N *Max* | Cu *Max* | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
| 33 | X02Cr18Ni14Mo4N | 317LMN | 0.030 | 1.00 | 2.00 | 13.5-17.5 | 17.0-20.0 | 4.0-5.0 | 0.030 | 0.045 | 0.100.20 | 0.75 | |
| 34 | X 04Cr18Ni10Ti | 321 | 0.08 | 0.75 | 2.00 | 9.0-12.0 | 17.0-19.0 | — | 0.030 | 0.045 | 0.100 | | Ti 5 × (C + N) *Min* — 0.70 *Max* |
| 35 | X07Cr18Ni10Ti | 321H | 0.04-0.10 | 0.75 | 2.00 | 9.0-12.0 | 17.0-19.0 | – | 0.030 | 0.045 | – | – | Ti 4 × (C + N) *Min*, 0.70 Max |
| 36 | X02Cr24Ni22Mo7N | 326 | 0.020 | 0.50 | 2.00-4.00 | 21.0-23.0 | 24.0-25.0 | 7.0-8.0 | 0.005 | 0.030 | 0.45-0.55 | 0.30-0.60 | - |
| 37 | X02Cr24Ni17Mo4Mn6N | 345 | 0.030 | 1.00 | 5.00-7.00 | 16.0-18.0 | 23.0-25.0 | 4.0-5.0 | 0.010 | 0.030 | 0.40-0.60 | – | Nb 0.10 |
| 38 | X 04Cr18Ni10Nb | 347 | 0.08 | 0.75 | 2.00 | 9.0-13.0 | 17.0-19.0 | — | 0.030 | 0.045 | — | | Nb 10 × C – 1.00 *Max* |
| 39 | X07Cr18Ni10Nb | 347H | 0.04-0.10 | 0.75 | 2.00 | 9.0-13.0 | 17.0-19.0 | – | 0.030 | 0.045 | – | – | Nb 8 × C *Min*, 1.00 Max |
| 40 | X01Cr18Ni10NbN | 347LN | 0.005-0.020 | 1.00 | 2.00 | 9.0-13.0 | 17.0-19.0 | – | 0.030 | 0.045 | 0.06-0.10 | – | Nb 0.20-0.50’ 15 × C Min |
| 41 | X05Cr18Ni10NbTa | 348 | 0.08 | 0.75 | 2.00 | 9.0-13.0 | 17.0-19.0 | – | 0.030 | 0.045 | – | – | (Nb + Ta)10 × C min, 1.00 Max, Ta 0.10, Co 0.20 |
| 42 | X07Cr18Ni10NbTa | 348H | 0.04-0.10 | 0.75 | 2.00 | 9.0-13.0 | 17.0-19.0 | – | 0.030 | 0.045 | – | – | (Nb + Ta) 8 × C *Mi*n, 1.00 Max, Ta 0.10, Co 0.20 |
| 43 | X02Cr21Ni25Cu | 904L | 0.020 | 1.00 | 2.00 | 23.0-28.0 | 19.0-23.0 | 4.00-5.00 | 0.035 | 0.045 | 0.100 | 1.00-2.00 | - |
| 44 | X01Cr20Ni25Mo6Cu | 904LN | 0.020 | 0.50 | 2.00 | 24.0-26.0 | 19.0-21.0 | 6.00-7.00 | 0.010 | 0.030 | 0.15-0.25 | 0.50-1.50 | - |
| iv) | ***Duplex:*** | | | | | | | | | | | | |
| 1 | X02Cr22Ni5Mo3N | 1803 | 0.030 | 1.00 | 2.00 | 4.5-6.5 | 21.0-23.0 | 2.5-3.5 | 0.020 | 0.030 | 0.08-0.20 | – | - |
| 2 | X02Cr21Mn5Ni2N | 2101 | 0.040 | 1.00 | 4.00-6.00 | 1.35-1.70 | 21.0-22.0 | 0.10-0.80 | 0.030 | 0.040 | 0.20-0.25 | 0.10-0.80 | - |
| 3 | X 02Cr22Ni6Mo3N | 2205 | 0.030 | 1.00 | 2.00 | 4.5-6.5 | 22.0-23.0 | 3.0-3.5 | 0.020 | 0.030 | 0.14-0.20 | – | - |
| 4 | X 02Cr23Ni4CuN | 2304 | 0.030 | 1.00 | 2.50 | 3.0-5.5 | 21.5-24.5 | 0.05-0.60 | 0.030 | 0.040 | 0.05-0.20 | 0.05-0.60 | - |
| 5 | X 02Cr25Ni7Mo4CuN | 2507 | 0.030 | 0.80 | 1.20 | 6.0-8.0 | 24.0-26.0 | 3.0-5.0 | 0.020 | 0.035 | 0.24-0.32 | 0.50 | - |
| 6 | X02Cr25Ni7Mo3CuWN | 2760 | 0.030 | 1.00 | 1.00 | 6.0-8.0 | 24.0-26.0 | 3.0-4.0 | 0.010 | 0.030 | 0.20-0.30 | 0.50-1.00 | W 0.50-1.00 |

**Table 2 Permissible Variation Between Specified Analysis and Product Analysis**

( *Clause* 8.2 )

| Sl No. | Element | Limits of Ladle Analysis as Shown in Table 1, Percent | | Permissible Deviation[1] Percent, *Max* |
|---|---|---|---|---|
| | | Over | Upto and Including | ± unless specified as + |
| (1) | (2) | (3) | (4) | (5) |
| i) | C | – | 0.03 | + 0.005 |
| | | 0.03 | 0.2 | 0.01 |
| | | 0.2 | 0.6 | 0.02 |
| | | 0.6 | 1.2 | 0.03 |
| ii) | Si | – | 1 | 0.05 |
| | | 1 | 2.5 | 0.1 |
| iii) | Mn | – | 1 | 0.03 |
| | | 1 | 3 | 0.04 |
| | | 3 | 6 | 0.05 |
| | | 6 | 10 | 0.06 |
| | | 10 | 14 | 0.1 |
| iv) | Al | – | 0.3 | 0.05 |
| v) | Cr | 10 | 15 | + 0.15 |
| | | 15 | 20 | 0.2 |
| | | 20 | 30 | 0.25 |
| vi) | Mo | – | 0.6 | + 0.03 |
| | | 0.6 | 1.75 | 0.05 |
| | | 1.75 | 3 | 0.1 |
| vii) | Ni | – | 1 | + 0.03 |
| | | 1 | 5 | 0.07 |
| | | 5 | 10 | 0.1 |
| | | 10 | 20 | 0.15 |
| | | 20 | 30 | 0.2 |
| viii) | N | – | 0.02 | 0.005 |
| | | 0.02 | 0.15 | 0.01 |
| | | 0.15 | 0.35 | 0.02 |
| ix) | Ti | – | 1 | + 0.05 |
| x) | Nb | – | 1.2 | + 0.05 |
| xi) | S | – | 0.04 | + 0.005 |
| | | 0.04 | 0.2 | 0.01 |
| | | 0.2 | 0.5 | 0.02 |
| xii) | P | – | 0.04 | + 0.005 |
| | | 0.04 | 0.1 | 0.01 |
| xiii) | Ta | – | 1.5 | + 0.05 |
| Xiv | Cu | – | 0.5 | + 0.03 |
| | | 0.5 | 1 | 0.05 |
| | | 1 | 3 | 0.1 |
| | | 3 | 4 | 0.15 |
| xv) | V | – | 0.5 | + 0.03 |
| | | 0.5 | 1.5 | 0.05 |
| xvi) | W | – | 1 | + 0.03 |
| | | 1 | 2 | 0.05 |

NOTE — Tolerance shall be mutually as agreed to between the purchaser and the supplier for other alloying elements.

1) The use of '+'means that in one cast the deviation may occur over the upper value or under the lower value of the specified range in the table but not both at the same time.

**Table 3 Recommended Heat Treatment**

( *Clause* 9.4 )

| Type | Grades | Heat treatment temp, °C |
|---|---|---|
| (1) | (2) | (3) |
| Duplex | 1803,2205, | 1020-1100 |
| | 2101 | 1020 *Min*. |
| | 2304, | 925-1050 |
| | 2507, | 1025-1125 |
| | 2760 | 1100-1150 |
| Austenitic | 201, 201LN, 204, 304, 304L, 304H, 304Ce, 304N, 304LN, 309S, 309H, 309Nb, 309HNb, 310S, 310H, 310Nb, 310HNb, 310MoLN 316, 316L, 316H, 316Ti, 316N1, 316LN, 316N2, 317, 317L, 317LN, 321,347, 347LN, 348 | 1040 *Min*. |
| | 317LCu | 1060-1180 |
| | 308Ce | 1050 *Min*. |
| | 321H, 347H | 1050-1150 |
| | 348H | 1050-1100 |
| | 904L, 904LN | 1100 *Min*. |
| | 312, 326 | 1150 *Min*. |
| | 345 | 1120-1170 |

**Table 4 Tensile Requirements**

( *Clause* 10.1 )

| Grade | Tensile Strength, Mpa, *Min* | Yield Strength, Mpa, *Min* | Percent Elongation, *Min* on a Gauge length of 50 mm |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| Ferritic and martensitic | | | |
| 405 | 415 | 205 | 20 |
| 409 | 380 | 170 | 20 |
| 409M | 450 | 280 | 18 |
| 410 | 415 | 205 | 20 |
| 410S2 | 485 | 350 | 18 |
| 415 | 795 | 620 | 15 |
| 429 | 415 | 240 | 20 |
| 430 | 415 | 240 | 20 |
| 430Ti | 415 | 240 | 20 |
| 439 | 415 | 205 | 20 |
| 439Ti2 | 430 | 250 | 18 |
| 442 | 485 | 275 | 20 |
| 444 | 415 | 275 | 20 |
| 446S1 | 485 | 275 | 18 |
| 446S2 | 470 | 310 | 20 |
| 446S3 | 450 | 275 | 20 |
| | | | |
| Duplex | | | |
| 1803 | 620 | 450 | 25 |
| 2101 t > 5mm | 650 | 450 | 30 |

**Table 4** (*Continued*)

| **Grade** | **Tensile Strength**, Mpa, *Min* | **Yield Strength**, Mpa, *Min* | **Percent Elongation**, *Min* on a Gauge length of 50 mm |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| 2101 t ≤ 5mm | 700 | 530 | 30 |
| 2205 | 655 | 450 | 25 |
| 2304 OD < = 25 mm | 690 | 450 | 25 |
| 2304 OD > 25 mm | 600 | 400 | 25 |
| 2507 | 800 | 550 | 15 |
| 2760 | 750 | 550 | 25 |
| | | | |
| Austenitic | | | |
| 204 | 635 | 330 | 35 |
| 304 | 515 | 205 | 35 |
| 304L | 485 | 170 | 35 |
| 304H | 515 | 205 | 35 |
| 304Ce | 600 | 290 | 35 |
| 304N | 550 | 240 | 35 |
| 304LN | 515 | 205 | 35 |
| 308Ce | 600 | 310 | 35 |
| 309S | 515 | 205 | 35 |
| 309H | 515 | 205 | 35 |
| 309Nb | 515 | 205 | 35 |
| 309HNb | 515 | 205 | 35 |
| 310S | 515 | 205 | 35 |
| 310H | 515 | 205 | 35 |
| 310Nb | 515 | 205 | 35 |
| 310HNb | 515 | 205 | 35 |
| 310MoLN, t ≤ 6.35 mm | 580 | 270 | 25 |
| 310MoLN, t > 6.35 mm | 540 | 255 | 25 |
| 312 t ≤ 5.00 mm | 675 | 310 | 35 |
| 312 t > 5.00 mm | 655 | 310 | 35 |
| 316 | 515 | 205 | 35 |
| 316L | 485 | 170 | 35 |
| 316H | 515 | 205 | 35 |
| 316Ti | 515 | 205 | 35 |
| 316N1 | 550 | 240 | 35 |
| 316LN | 515 | 205 | 35 |
| 317L | 515 | 205 | 35 |
| 317LM | 515 | 205 | 35 |
| 317LMN | 550 | 240 | 35 |
| 321 - t ≤ 9.5mm | 515 | 205 | 35 |
| 321 - t >9.5mm | 485 | 170 | 35 |
| 321H - t ≤ 4.8mm | 515 | 205 | 35 |
| 321H – t > 4.8mm | 480 | 170 | 35 |
| 326 | 750 | 430 | 25 |

**Table 4** (*Concluded*)

| **Grade** | **Tensile Strength**, Mpa, *Min* | **Yield Strength**, Mpa, *Min* | **Percent Elongation**, *Min* on a Gauge length of 50 mm |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| 345 | 795 | 415 | 35 |
| 347 | 515 | 205 | 35 |
| 347H | 515 | 205 | 35 |
| 347LN | 515 | 205 | 35 |
| 348 | 515 | 205 | 35 |
| 348H | 515 | 205 | 35 |
| 904L | 490 | 215 | 35 |
| 904LN | 650 | 295 | 35 |
| Small diameter pipes and tubes of austenitic grades of outside diameter from 3.2 mm to 12.7 mm and wall thickness from 0.4 mm to 1.65 mm | | | |
| 304 | 515 | 205 | 35 |
| 304L | 485 | 170 | 35 |
| 310 | 515 | 205 | 35 |
| 316 | 515 | 205 | 35 |
| 316L | 485 | 170 | 35 |
| 317 | 515 | 205 | 35 |
| 321 | 515 | 205 | 35 |
| 347 | 515 | 205 | 35 |
| 348 | 515 | 205 | 35 |

NOTES

**1** For pipes of ferritic and martensitic stainless steel smaller than 12.7 mm in outside diameter, the elongation values applicable for strip specimen shall apply. For longitudinal strip tests, a deduction of 1 percent shall be made from the above-mentioned minimum elongation for each 0.8 mm decrease in wall thickness below 8 mm.

**2** Tensile requirements do not apply to pipes of ferritic and martensitic stainless steel smaller than 3.2 mm in outside diameter or with walls thinner than 0.4 mm.

**Table 5 Hardness Requirement for Pipes**

( *Clause* 12.1 )

| Grade | Brinell Hardness, *Max* | Rockwell Hardness HRC *Max* |
|---|---|---|
| (1) | (2) | (3) |
| 410S2 | 360 | |
| 1803 | 290 | 30 |
| 2101 | 290 | 30 |
| 2507 | 300 | 32 |
| 2205 | 290 | 30 |
| 2304 | 290 | 30 |
| 2760 | 270 | – |

## 12.2 Tubes

**12.2.1** Tubes shall conform to the requirements of Hardness values on one of the scales (Rockwell or Brinell) prescribed in Table 6. The hardness test shall be carried out by IS 1500 (Part 1) or IS 1586 (Part 1), as applicable.

**12.2.2** Hardness test is not required for tubes smaller than 6.4 mm in outside diameter or having a wall thickness less than 0.51 mm. Such tubes shall be subjected to tensile test only.

**Table 6 Hardness Requirement for Tubes**

( *Clause* 12.2.1 )

| Grade | Brinell Hardness, *Max* | Rockwell Hardness HRB *Max* |
|---|---|---|
| (1) | (2) | (3) |
| 405 | 207 | 95 |
| 409 | 207 | 95 |
| 409M | 180 | 88 |
| 410 | 207 | 95 |
| 415 | 295 | 32 HRC |
| 429 | 190 | 90 |
| 430 | 190 | 90 |
| 430Ti | 190 | 90 |
| 439 | 190 | 90 |
| 439Ti2 | 180 | 88 |
| 443 | 207 | 95 |
| 444 | 217 | 95 |
| 446S1 | 207 | 95 |
| 446S2 | 241 | 100 |
| 446S3 | 241 | 100 |
| 1803 | 290 | 30 HRC |
| 2205 | 290 | 30 HRC |
| 2304 | 290 | 30 HRC |
| 2507 | 310 | 32 HRC |
| 2760 | 300 | 32 HRC |
| 201 | 220 | 96 |
| 201LN | 250 | 100 |
| 304 | 192 | 90 |
| 304L | 192 | 90 |
| 304LN | 192 | 90 |
| 312 | 220 | 96 |
| 316 | 192 | 90 |
| 316L | 192 | 90 |
| 316LN | 192 | 90 |
| 316N2 | 192 | 90 |
| 317 | 192 | 90 |
| 317LM | 192 | 90 |
| 317LMN | 192 | 90 |
| 317LCu | 192 | 90 |
| 321 | 192 | 90 |
| 326 | 250 | 100 |
| 345 | 265 | 100 |
| 347 | 192 | 90 |
| 348 | 192 | 90 |
| 904L | 192 | 90 |
| 904LN | 265 | 100 |

## 13 FLARING TEST (FOR TUBES ONLY)

**13.1** Flaring test shall be made on lengths cut from tubes, consisting of section of pipe about 100 mm in length. The tube shall show no crack after being flared with a tool having 60° included angle until the pipe at the mouth of the flare has been expanded to the extent given in Table 7 or clause **13.2**.

**Table 7 Extension of Diameter Required in a Flare Test**

( *Clause* 13.1 )

| Ratio of Inside Diameter to Outside Diameter | Minimum Extension of Inside Diameter in Percent for Austenitic Grades |
|---|---|
| 0.9 | 21 |
| 0.8 | 22 |
| 0.7 | 25 |
| 0.6 | 30 |
| 0.5 | 39 |
| 0.4 | 51 |
| 0.3 | 68 |

**13.2** For ferritic, martensitic and duplex grades tubes, the minimum expansion of tube at the mouth of the flare shall be 10 percent of inside diameter.

**13.3** Flaring test is not required to be carried out for tubes of Inside diameter below 2.38 mm.

## 14 FLATTENING TEST (FOR PIPES AND LARGE SIZE TUBES ONLY)

**14.1** Flattening test shall be carried out in accordance with IS 2328 for sizes upto 600 mm and a thickness no greater than 15 percent of the outside diameter. A section of pipe not less than 60 mm shall be flattened cold between parallel plates. The pipes shall be capable of not showing crack or flaw during flattening, till the distance between the parallel plates H is less than specified, which is calculated as follows:

$$H = (1 + e)t/(e + t/D)$$

where

$H$ = distance between flattening plates, in. [mm];

$t$ = specified wall thickness, in. [mm];

$D$ = specified outside diameter; and

$e$ = deformation per unit length (constant for a given grade of steel, 0.09 for austenitic and duplex steel, 0.08 for ferritic and martensitic).

**14.2** For the purpose of flattening test, tubes over 203 mm in outside diameter, or tubes with wall thickness 9.52 mm and over are termed as large size tubes.

## 15 GRAIN SIZE

**15.1** The grain size shall be determined as per IS 4748 for grades of austenitic steels mentioned in Table 8.

**Table 8 Grain size**

( *Clause* 15.1 )

| Grades | Grain size |
|---|---|
| 309H, 309HCb<br>310H, 310HCb | No 6 or Coarser |
| 304H, 316H, 321H<br>347H, 348H | No 7 or Coarser |

## 16 SAMPLING

**16.1** One pipe shall be tested for product analysis from pipes of each heat of steel.

**16.2** For determination of mechanical properties and grain size, one pipe from each lot shall be tested. The term lot applies to all pipes prior to cutting, of the same nominal diameter and wall thickness that are produced from the same heat of steel. When final heat treatment is in a batch-type furnace, a lot shall include only those tubes of the same size and the same heat which are heat treated in the same furnace charge. When the final heat treatment is in a continuous furnace or when the heat-treated condition is obtained directly by quenching after hot forming, a lot shall include all pipes of the same size and heat, heat treated in the same furnace at the same temperature, time at heat, and furnace speed, or all pipes of the same size and heat, hot formed and quenched in the same production run.

## 17 LEAK TIGHTNESS TEST

**17.1** All pipes/tubes shall be tested for leak tightness by hydrostatic test.

**17.2** Hydrostatic test shall be carried out for pipes and tubes as per respective clauses given below:

**17.2.1** If any pipe/tube shows leakage in hydrostatic test, it shall be rejected.

**17.2.2** The test pressure shall be held for a minimum of 5 s. The test pressure shall be held for a time sufficient to permit the entire length of the pipe/tube to be inspected.

**17.2.3** The hydrostatic test may not be capable of testing the end portion of the pipe / tube. The length of pipe/tube that cannot be tested shall be determined by the manufacturer and, if specified in the purchase order, reported to the purchaser.

### 17.3 For Pipes

**17.3.1** Hydraulic test shall be carried out against each length of pipe by subjecting pipe to a hydrostatic pressure that will produce in the pipe wall a stress not less 50 percent of the specified minimum yield strength for austenitic stainless steel pipes and 60 percent of the specified minimum yield strength for other stainless steel pipes. The test pressure or stress shall be determined using the following equation:

$$P = 2St/D \text{ or } S = PD/2t$$

where

$P$ = hydrostatic test pressure, in psi [MPa];

$S$ = pipe wall stress, in psi or [MPa];

$t$ = specified wall thickness, nominal wall thickness; and

$D$ = specified outside diameter, outside diameter.

The hydrostatic test pressure determined by the above equation shall be rounded to the nearest 0.5 MPa for pressure below 7 MPa, and to the nearest 1.0 MPa for pressure of 7 MPa and above. The hydrostatic test may be performed prior to cutting to final length, or prior to upsetting, swaging, expanding, bending or other forming operation or both.

**17.3.2** Regardless of pipe-wall stress-level determined by equation, the minimum hydrostatic test pressure required to satisfy these requirements need not exceed 17.0 MPa for outside diameters of 88.9 mm or less, or 19.0 MPa for outside diameters over 88.9 mm. This does not prohibit testing at higher pressures at the option of the manufacturer.

### 17.4 For Tubes

**17.4.1** Each tube made from ferritic, martensitic and austenitic steel shall be tested by the manufacturer at

hydrostatic pressure not less than the pressure derived from the following equation:

$$P = 220.6\ t/D$$

In case of tube made from duplex steel, the following equation to be used to derive minimum hydrostatic pressure

$$P = 441.2t/D$$

where

$P$ = hydrostatic test pressure, in psi [MPa];

$t$ = wall thickness, all thickness; and

$D$ = outside diameter.

**17.4.2** The hydrostatic test pressure determined by the above equation shall be rounded to the nearest 0.3 MPa for pressure below 7 MPa, and to the nearest 0.7 MPa for pressure of 7 MPa and above. The hydrostatic test may be performed prior to cutting to final length, or prior to upsetting, swaging, expanding, bending or other forming operation or both.

**17.4.3** Regardless of the determination made by the above equation, the minimum hydrostatic test pressure required to satisfy these requirements need not exceed 7 MPa. This does not prohibit testing at higher pressures at manufacturer's option or as provided in **17.4.4**.

**17.4.4** With concurrence of the manufacturer, a minimum hydrostatic test pressure in excess of the requirements prescribed may be stated on the order. The tube wall stress shall be determined by the following equation:

$$S = PD/2t$$

where

$S$ = pipe/tube wall stress, in MPa, and all other symbols as defined in **17.4.1**.

## 18 CORROSION TEST

If required by the purchaser, the material shall be tested for corrosion resistance as specified in IS 10461 (Part 1) or IS 10461 (Part 2) for austenitic steels and in accordance with any method as agreed to between manufacturer and purchaser for duplex and ferritic stainless steels.

## 19 OTHER TESTS

In addition to tests specified in **10** to **18**, as applicable, additional tests, such as eddy current test, air under water test and other tests can be carried out for requirements and corresponding method of test as agreed to between the manufacturer and the purchaser.

## 20 RETESTS

Should any one of the test pieces first selected fail to pass any of the tests specified, two further samples shall be selected for testing in respect of each failure from the same lot. Should the test pieces from both these additional samples pass, the lot represented by the test samples shall be deemed to comply with the requirement of that particular test. Should the test pieces from either of these additional samples fail, the lot represented by the test samples shall be deemed as not complying with the standard.

## 21 WORKMANSHIP, FINISH, AND APPEARANCE

**21.1** The pipes and tubes shall be clean and free from such defects as can be established by visual inspection. The pipes and tubes shall have a finish and surface condition, which permits surface imperfections or marks requiring dressing to be identified.

**21.2** The finished pipes &tubes shall be reasonably straight and shall be free from burr. For tubes over 50 mm in diameter, deviation from straightness over the entire length shall not exceed 0.2 percent of the length. Deviation from straightness over any length of 1 M shall not exceed 3 mm.

## 22 REPAIR BY WELDING OR GRINDING

**22.1** It shall be permissible to dress the base metal by grinding or machining surface marks and imperfections, such as scabs, seams, tears, laps, slivers or gouges, provided that the thickness of the pipe/tube after dressing does not fall below the nominal thickness by more than the tolerance specified.

**22.2** Repair welding of base metal defects in pipes of OD equal to or above 168.3 mm with a specified wall thickness of 4.8 mm or more, is permissible only with the approval of the purchaser and with the further understanding that the pipe shall be marked 'WR' and the composition of the deposited filler metal shall be suitable for the composition being welded. Defects shall be thoroughly chipped or ground out before welding and each repaired length shall be reheat-treated or stress relieved as required by the specification. Each length of repaired pipe/tubes shall be tested hydrostatically as required by the product specification.

**22.3** Repair of base metal of tubes by welding is not permitted.

## 23 DIMENSIONS AND TOLERANCES

### 23.1 For Pipes

**23.1.1** The preferred dimensions of pipes are given in Annex A. Also, pipes having other dimensions can also be furnished provided such pipes comply with all other requirements of this specification.

**23.1.2** Permissible variations on the outside diameter and wall thickness for pipes shall be as given in Table 9 and 10 respectively.

**Table 9 Permissible Variations on Outside Diameter for Pipes**

All dimensions in millimetres.

( *Clauses* 23.1.2 *and* 23.1.4 )

| Outside Diameter | Tolerance on Outer Diameter |
|---|---|
| 10.3 to 48.3, incl. | + 0.4/– 0.8 |
| Over 48.26 to 114.3, incl. | ± 0.8 |
| Over 114.3 to 168.3, incl. | + 1.6/– 0.8 |
| Over 168.3 to 457, incl. | + 2.4/– 0.8 |
| Over 457 to 660, incl. | + 3.2/– 0.8 |
| Over 660 to 864, incl. | + 4.0/– 0.8 |

**23.1.3** The tolerances on outside diameter include ovality. Except for thin walled pipes, defined as pipe having a wall thickness of 3 percent or less of the specified OD. Ovality for such pipes shall be within 1.5 percent of the specified OD. Tolerance OD of such pipes also shall be applicable only to the mean of the extreme OD reading in any one cross-section.

**Table 10 Permissible Variations on Thickness for Pipes**

( *Clauses* 23.1.3 *and* 23.1.4 )

| Outside Diameter<br>mm | Tolerance on Wall Thickness<br>Percent from Nominal |
|---|---|
| 10.3 to 73, incl. for all t/D ratios | + 20/– 12.5 |
| Over 73 to 457, incl., t/D up to 5% incl | + 22.5/– 12.5 |
| Over 73 to 457, incl., t/D > 5% | + 15/– 12.5 |
| Over 457 all t/D ratios | + 17.5/– 12.5 |

**23.1.4** Pipes with Stricter limits for the tolerances mentioned in Table 9 and 10 may also be supplied subject to agreement between the manufacturer and the purchaser.

**23.1.5** Details of NPS designation for purpose of guidance only are given in Annex B.

### 23.2 For Tubes

**23.2.1** The tolerance on OD, wall thickness and cut lengths for tubes is as given in Table 11.

## 24 MARKING

**24.1** Each tube shall be marked with the following details:

a) Name and trade-mark of the manufacturer;
b) Nominal bore and thickness for pipes or OD and thickness for tubes;
c) Grade;
d) Heat No.;
e) Lot Number; and
f) SML (process of manufacture).

### 24.2 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

## 25 PACKING

The methods of preparation for dispatch shall be subject to agreement between the purchaser and the manufacturer.

**Table 11 Tolerance on Sizes of Tubes**

( *Clause* 23.2.1 )

| Outside Diameter<br>mm | Tolerance on OD<br>mm | Tolerance on Wall Thickness[1]<br>percent | Tolerance on Cut Lengths[2]<br>mm | Thin Walled tubes[3] |
|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) |
| Up to 13, excl. | ± 0.13 | ± 15 | + 3/– 0 | |
| 13 to 38, excl. | ± 0.13 | ± 10 | + 3/– 0 | Less than 1.6 mm nominal |
| 38 to 89, excl. | ± 0.25 | ± 10 | + 5/– 0 | Less than 2.4 mm nominal |
| 89 to 140, excl. | ± 0.38 | ± 10 | + 5/– 0 | Less than 3.8 mm nominal |
| 140 to 203, excl. | ± 0.76 | ± 10 | + 5/– 0 | Less than 3.8 mm nominal |
| 203 to 305, excl. | ± 1.01 | ± 10 | + 5/– 0 | Less than 5.1 mm nominal |
| 305 to 356, excl. | ± 1.26 | ± 10 | + 5/– 0 | Less than 5.6 mm nominal |

[1] For tubes of wall thickness 19 mm or above, or ID 60 prcent or less of the OD, tolerance on wall thickness shall be ± 12.5 percent. For tubes less than 13 mm ID, the tolerance on wall thickness shall be ± 15 percent.

[2] These tolerances apply to cut lengths of ≤ 7 meter. For > 7 meter, tolerances shall be mutually agreed upon.

[3] Ovality for thin-walled tubes – the maximum and minimum diameter at a cross section shall not deviate more than twice of tolerance as above, however the mean diameter at that cross section must be within the tolerance.

# ANNEX A

## PREFERRED SIZES FOR PIPES

( *Clause* 23.1.1 )

| Nominal Bore | Outside Diameter mm | Nominal wall Thickness mm |
|---|---|---|
| (1) | (2) | (3) |
| 3 | 10.3 | 1.2 |
| | | 1.7 |
| | | 2.4 |
| 6 | 13.7 | 1.6 |
| | | 2.2 |
| | | 3 |
| 10 | 17.1 | 1.6 |
| | | 2.3 |
| | | 3.2 |
| 15 | 21.3 | 1.6 |
| | | 2.1 |
| | | 2.8 |
| | | 3.7 |
| 20 | 26.7 | 1.6 |
| | | 2.1 |
| | | 2.9 |
| | | 3.9 |
| 25 | 33.4 | 1.6 |
| | | 2.8 |
| | | 3.4 |
| | | 4.5 |
| 32 | 42.2 | 1.6 |
| | | 2.8 |
| | | 3.6 |
| | | 4.8 |
| 40 | 48.3 | 1.6 |
| | | 2.8 |
| | | 3.7 |
| | | 5.1 |
| 50 | 60.3 | 1.6 |
| | | 2.8 |
| | | 3.9 |
| | | 5.5 |

| Nominal Bore | Outside Diameter mm | Nominal wall Thickness mm |
|---|---|---|
| (1) | (2) | (3) |
| 65 | 73.0 | 2.1 |
| | | 3.1 |
| | | 5.2 |
| | | 7 |
| 75 | 88.9 | 2.1 |
| | | 3 |
| | | 5.5 |
| | | 7.6 |
| 90 | 101.6 | 2.1 |
| | | 3 |
| | | 5.7 |
| | | 8.1 |
| 100 | 114.3 | 2.1 |
| | | 3 |
| | | 6 |
| | | 8.6 |
| 125 | 141.3 | 2.8 |
| | | 3.4 |
| | | 6.5 |
| | | 9.5 |
| 150 | 168.3 | 2.8 |
| | | 3.4 |
| | | 7.1 |
| | | 11 |
| 200 | 219.1 | 2.8 |
| | | 3.8 |
| | | 8.2 |
| | | 12.7 |
| 250 | 273.0 | 3.4 |
| | | 4.2 |
| | | 9.3 |
| | | 12.7 |
| 300 | 323.8 | 4 |
| | | 4.6 |
| | | 9.5 |
| | | 12.7 |

| Nominal Bore | Outside Diameter mm | Nominal wall Thickness mm |
|---|---|---|
| (1) | (2) | (3) |
| 350 | 355.6 | 4 |
| | | 4.8 |
| | | 9.5 |
| 400 | 406.4 | 4.2 |
| | | 4.8 |
| | | 9.5 |
| 450 | 457.2 | 4.2 |
| | | 4.8 |
| | | 9.5 |
| 500 | 508.0 | 4.8 |
| | | 5.5 |
| | | 9.5 |
| 550 | 558.8 | 4.8 |
| | | 5.5 |
| | | 9.5 |
| 600 | 609.6 | 5.5 |
| | | 6.3 |
| | | 9.5 |
| 750 | 762.0 | 6.3 |
| | | 7.9 |
| 800 | 812.8 | (Thickness) : 6.35 ~ 30 mm Nominal diameter and wall thickness subject to the approval of manufacturer and purchaser |
| 850 | 864.0 | |
| 900 | 914.0 | |
| 950 | 965.0 | |
| 1000 | 1016.0 | |
| 1050 | 1067.0 | |
| 1100 | 1118.0 | |
| 1150 | 1168.0 | |
| 1200 | 1219.0 | |
| to | to | |
| 2000 | 2032.0 | |

# ANNEX B

## INFORMATION ON NPS DESIGNATION AGAINST NOMINAL BORE FOR PIPES FOR GUIDANCE ONLY

( *Clause* 23.1.5 )

| Nominal Bore | Outside Diameter mm | Nominal wall Thickness mm | Equivalent NPS Designation-Schedule |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| 3 | 10.3 | 1.2 | 1/8-10S |
| | | 1.7 | 1/8-40S |
| | | 2.4 | 1/8-80S |
| 6 | 13.7 | 1.6 | 1/4-10S |
| | | 2.2 | 1/4-40S |
| | | 3 | 1/4-80S |
| 10 | 17.1 | 1.6 | 3/8-10S |
| | | 2.3 | 3/8-40S |
| | | 3.2 | 3/8-80S |
| 15 | 21.3 | 1.6 | 1/2-5S |
| | | 2.1 | 1/2-10S |
| | | 2.8 | 1/2-40S |
| | | 3.7 | 1/2-80S |
| 20 | 26.7 | 1.6 | 3/4-5S |
| | | 2.1 | 3/4-10S |
| | | 2.9 | 3/4-40S |
| | | 3.9 | 3/4-80S |
| 25 | 33.4 | 1.6 | 1-5S |
| | | 2.8 | 1-10S |
| | | 3.4 | 1-40S |
| | | 4.5 | 1-80S |
| 32 | 42.2 | 1.6 | 1¼-5S |
| | | 2.8 | 1¼-10S |
| | | 3.6 | 1¼-40S |
| | | 4.8 | 1¼-80S |
| 40 | 48.3 | 1.6 | 1½-5S |
| | | 2.8 | 1½-10S |
| | | 3.7 | 1½-40S |
| | | 5.1 | 1½-80S |
| 50 | 60.3 | 1.6 | 2-5S |
| | | 2.8 | 2-10S |
| | | 3.9 | 2-40S |
| | | 5.5 | 2-80S |

| Nominal Bore | Outside Diameter mm | Nominal wall Thickness mm | Equivalent NPS Designation-Schedule |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| 65 | 73.0 | 2.1 | 2½-5S |
| | | 3.1 | 2½-10S |
| | | 5.2 | 2½-40S |
| | | 7 | 2½-80S |
| 75 | 88.9 | 2.1 | 3-5S |
| | | 3 | 3-10S |
| | | 5.5 | 3-40S |
| | | 7.6 | 13-80S |
| 90 | 101.6 | 2.1 | 3½-5S |
| | | 3 | 3½-10S |
| | | 5.7 | 3½-40S |
| | | 8.1 | 3½-80S |
| 100 | 114.3 | 2.1 | 4-5S |
| | | 3 | 4-10S |
| | | 6 | 4-40S |
| | | 8.6 | 4-80S |
| 125 | 141.3 | 2.8 | 5-5S |
| | | 3.4 | 5-10S |
| | | 6.5 | 5-40S |
| | | 9.5 | 5-80S |
| 150 | 168.3 | 2.8 | 6-5S |
| | | 3.4 | 6-10S |
| | | 7.1 | 6-40S |
| | | 11 | 6-80S |
| 200 | 219.1 | 2.8 | 8-5S |
| | | 3.8 | 8-10S |
| | | 8.2 | 8-40S |
| | | 12.7 | 8-80S |
| 250 | 273.0 | 3.4 | 10-5S |
| | | 4.2 | 10-10S |
| | | 9.3 | 10-40S |
| | | 12.7 | 10-80S |
| 300 | 323.8 | 4 | 12-5S |
| | | 4.6 | 12-10S |
| | | 9.5 | 12-40S |
| | | 12.7 | 12-80S |
| 350 | 355.6 | 4 | 14-5S |
| | | 4.8 | 14-10S |
| | | 9.5 | 14-40S |

| **Nominal Bore** | **Outside Diameter** mm | **Nominal wall Thickness** mm | **Equivalent NPS Designation-Schedule** |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| 400 | 406.4 | 4.2 | 16-5S |
| | | 4.8 | 16-10S |
| | | 9.5 | 16-40S |
| 450 | 457.2 | 4.2 | 18-5S |
| | | 4.8 | 18-10S |
| | | 9.5 | 18-40S |
| 500 | 508.0 | 4.8 | 20-5S |
| | | 5.5 | 20-10S |
| | | 9.5 | 20-40S |
| 550 | 558.8 | 4.8 | 22-5S |
| | | 5.5 | 22-10S |
| | | 9.5 | 22-40S |
| 600 | 609.6 | 5.5 | 24-5S |
| | | 6.3 | 24-10S |
| | | 9.5 | 24-40S |
| 750 | 762.0 | 6.3 | 30-5S |
| | | 7.9 | 30-10S |
| 800 | 812.8 | (Thickness): 6.35 ~ 30 mm Nominal diameter and wall thickness subject to the approval of manufacturer and purchaser | 32 |
| 850 | 864.0 | | 34 |
| 900 | 914.0 | | 36 |
| 950 | 965.0 | | 38 |
| 1000 | 1016.0 | | 40 |
| 1050 | 1067.0 | | 42 |
| 1100 | 1118.0 | | 44 |
| 1150 | 1168.0 | | 46 |
| 1200 | 1219.0 | | 48 |
| to | to | | to |
| 2000 | 2032.0 | | 80 |

# ANNEX C

( *Foreword* )

## COMMITTEE COMPOSITION

Steel Tubes, Pipes and Fittings Sectional Committee, MTD 19

| *Organization* | *Representative(s)* |
|---|---|
| Steel Authority of India Limited (SAIL)-ISP, Burnpur | Shri Arunava Dasgupta (***Chairperson***) |
| Bharat Heavy Electrical Limited, New Delhi | Shri K. Athimoolam<br>Shri M. Kannan (*Alternate*) |
| Delhi Jal Board, New Delhi | Shri Praveen Bhargava |
| Department for Promotion of Industry and Internal Trade, New Delhi | Shri S. K. Jain |
| Directorate General Quality Assurance, New Delhi | Shri Bikas Mondal<br>Shri S. K. Roy (*Alternate*) |
| Engineers India Limited, New Delhi | Shri Rameshwar Prasad<br>Shri Sanjeev Gupta (*Alternate*) |
| Federation of Industries of India, Maharashtra | Shri H. L. Bhardwaj |
| GAIL (India) Limited, New Delhi | Shri Anurag Srivastav<br>Shri M. I. Haque a (*Alternate*) |
| Goodluck Steel Tubes Limited, New Delhi | Shri M. C. Garg<br>Shri U. D. Sharma (*Alternate*) |
| Gujarat Gas Company Limited, Ahmedabad | Shri Dharmesh Sailor<br>Shri Pramath Shailesh (*Alternate*) |
| Gujarat State Petronet Limited, Gandhi Nagar | Shri N. Bose Babu<br>Shri Nilesh Tanna (*Alternate*) |
| Howrah Pipe Fittings Manufacturers Welfare Association, Kolkata | Shri Mahananda Dhara<br>Shri P. Ghosh (*Alternate*) |
| Indian Oil Corporation Limited-Refineries and Pipelines Division, New Delhi | Shri Parichay Das |
| Indian Stainless Steel Development Association, Gurugram | Shri Rohit Kumar |
| Indus Tubes Limited, Pitampura, New Delhi | Shri I. P. Jain<br>Shri D. K. Kapoor (*Alternate*) |
| Jindal Pipes Limited, Hapur | Shri D. B. Singh<br>Shri K. D. Sharma (*Alternate*) |
| Lalita Infra projects Private Limited, Kolkata | Dr Buddhadeb Duari<br>Shri Subhojit Bhattacharya (*Alternate*) |
| Ministry of Commerce and Industry, Department for Promotion of Industry and Internal Trade, New Delhi | Shri T. S. G. Narayannen |
| RITES Limited, Gurugram | Shri Ramendra Kumar<br>Shri Ajay Sharma (*Alternate*) |

| *Organization* | *Representative(s)* |
|---|---|
| Shri Bajrang Power and Ispat Limited, Raipur | Shri Banwari Lal Chopra<br>Shri Praveen Kumar (*Alternate*) |
| Society of Indian Automobile Manufacturers (SIAM), Delhi | Shri P. K. Banerjee<br>Shri Amit Kumar (*Alternate*) |
| Surya Roshni Limited, Delhi | Shri N. K. Singla<br>Shri Nitin Jain (*Alternate*) |
| Tata Steel Limited, Kolkata | Shri Braj B. Prasad<br>Shri Udyan Tyagi (*Alternate*) |
| In Personal Capacity | Shri C. B. Lunawat |
| BIS Directorate General | Shri N. Suryanarayana, Scientist 'E' and Head (MTD)<br>[Representing Director General (*Ex-officio*)] |

*Member Secretary*

Shri Arun Pucchakayala
Scientist 'D' (MTD), BIS

Panel for formulation of Standard on Stainless steel pipes and Tubes MTD 19/P 7

| *Organization* | *Representative(s)* |
|---|---|
| Indian Stainless Steel Development Association Gurugram | Shri N. K. Vijayvargia |
| Ratanamani metals and tubes, Gujarat | Shri P. H. Bhatt |
| Welspun Steel Ltd (WSL), Gujarat | Shri Prakash Tatia |
| RDSO, Lucknow | Shri Ahmad Nadeem |
| Stainless Steel Pipes and Tubes Manufacturers Association Western Region | Shri Ashish Sanghvi |
| Heavy metals and tubes, Ahmedabad | Shri Hitesh Jain |
| IDMA, V V Nagar | Shri Devendra Gupta |

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## Amendments Issued Since Publication

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