IP SS

SPECIFICATION FOR PRECISION STEEL TUBES

BASED ON DIN 2391 (PARTS I AND II)

IPSS : 1-02-033-85

0. Foreword

0.1 Interplant standardization activity in steel industry is being pursued under the aegis of the Indian Standards Institution (ISI) and the Steel Authority of India Limited (SAIL). This Interplant Standard, prepared by the Standards Committee on Basic Standards and Hydraulic, Pneumatic and Lubricating Equipment, IPSS 1 : 2, with the active participation of the representatives of all the steel plants was adopted by the Approval Committee on Consumable Stores and General Equipment, IPSS 1, on 1 November 1985.

0.2 Interplant Standards for steel industry primarily aim at achieving rationalization and unification of parts and sub-assemblies used in steel plant equipment and accessories, and provide guidance in indenting stores or equipment for existing or new installations by individual steel plants. For exercising effective control on inventories, it is advisable to select a fewer number of sizes (or types) from among those mentioned in this standard for the purpose of company standards of individual steel plants. It is not desirable to make deviations in technical requirements.

---

1. Scope — This Interplant Standard applies to the seamless precision steel tubes which require high accuracy to dimensions and good surface conditions.

1.1 These tubes are used for compression type fittings, covered by IPSS : 1-02-005-85 to IPSS : 1-02-008-85.

2. Dimensions — The dimensions of the steel tubes covered by this standard are given in Table 1.

3. Material — The steel tubes covered by this standard shall be of the grades and properties as given in Table 2.

4. Mechanical Properties — The chemical composition and mechanical properties of the different grades of the steel tubes shall be as given in Table 2. These are suitable for welding, because of their chemical composition and the metallurgical treatment.

5. Selection of Thickness — The designer may work out the dimensions of the safe thickness of tube, with the help of the following 3 formulas:

a) BARLOW FORMULA $P = \frac{2ST}{D}$

b) BCARDMAN FORMULA $P = \frac{2ST}{D - 0{\cdot}8T}$

c) LAME FORMULA $P = S\left(\frac{D^2 - d^2}{D^2 + d^2}\right)$

where

D = outside diameter of tube in mm,
d = inside diameter of tube in mm,
P = hydrostatic working pressure in kg/cm^2,
S = allowable fibre stress of material in kg/cm^2, and
T = wall thickness of tubing in mm.

Note — Factor of safety may be taken as either 3 or 4.

Amendments Issued (*to be filled up by the user department*):

No.	Date of Issue	No.	Date of Issue
1		3	
2		4	

UDC 621·643·2 [669·14·018·473-462·3]

6. Conditions of Delivery — The tubes covered by this standard are to be supplied in one of the conditions listed below:

Condition	*Symbol*	*Explanation*
Cold-finished (cold finished as drawn)	CFH	No heat treatment after the last cold-forming process. The tubes therefore have only low deformability.
Cold-finished soft (lightly cold worked)	CFS	After the last heat treatment there is a light finishing pass (cold drawing). With proper subsequent processing, the tube can be cold formed (for example, bent expanded, etc, within certain limit).
Annealed	A	After the final cold forming process the tubes are annealed in a controlled atmosphere or under vacuum.
Normalized	N	The tubes are annealed also in the upper transformation point in a controlled atmophere or under vacuum.

7. Designation — A seamless steel tube of 38 mm outside diameter, 3 mm thickness, of grade 35, in annealed condition is to be designated as:

STEEL TUBE 38×3, st 35-A, IPSS : 1-02-033-85

8. Surface Quality of Tubes — Depending upon the method of manufacture, the tubes shall have a correspondingly smooth external and internal surface, that is, minor surface defects, for example, pits, pores and longitudinal scores are permissible but the defects like scabs, laps and laminations are not.

9. Lengths — The tubes shall be delivered in lengths between 2 to 7 m, unless at the time of ordering some special agreement has been reached between the buyer and the purchaser regarding the length. The tolerances on the length shall be as below:

Up to 500 mm length	$+2\ -0$ mm	Over 5 000 to 7 000 mm length	$+10\ -0$ mm
Over 500 to 2 000 mm length	$+3\ -0$ mm	Over 7 000 mm length	By mutual agreement
Over 2 000 to 5 000 mm length	$+5\ -0$ mm		

10. Informations Reguired for Ordering — At the time of indenting the seamless precision steel tubes, covered by this standard, the following informations is required:

a) Quantity,

b) Designation, and

c) Length in which to be delivered.

11. Tests

11.1 *Bending Test* — The finished tubing shall withstand bending on a centre line radius equal to three times the tubing outside the diameter without undue reduction of area of flattening where proper bending fixtures are used.

11.2 *Flattening Test* — A section, approximately 75 mm in length, cut from the finished tubing shall not crack or show any flaw when flattened between parallel plates to a distance equal to three times the wall thickness of the section under test; superficial ruptures resulting from minor surface imperfection shall not be considered cause for rejection.

11.3 *Proof Pressure Test* — Unless otherwise specified tubing supplied under this standard shall be tested hydrostatically with no evidence of failure. Test pressures shall be determined by the BARLOW's formula given in **5 (a)** of this standard.

Note—No tube shall be tested beyond a hydrostatic pressure of 355 MPA unless otherwise specified in the order.

11.4 Tensile tests shall be carried out on tubes as laid down in **6** of IS : 9158-1979 'Specification for cold drawn high pressure fluid power cylinder tubes'. The strength values for different grades of materials are given in Table 2.

TABLE 1 DIMENSIONS OF THE STEEL TUBES

(Clause 2)

All dimensions in millimetres.

Wall Thickness	Nominal Dimension Permissible Deviation	0·5	0·6	1	1·2	1·5	1·8	2	2·2	2·5	2·8	3	3·5	4	4·5	5	5·5	6	7	8	9	10
		± 10% of the nominal dimensions. The deviation of centres (eccentricity) is contained in the permissible wall thickness																				
Outside Nominal Dimension	Diameter Permissible Deviation	Inside diameter d_1 Nominal dimension and permissible deviation																				
4		3±0·30	2·4±0·30	2±0·30	1·6±0·30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5		4±0·30	3·4±0·30	3±0·30	2·6±0·30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6		5±0·25	4·4±0·25	4±0·25	3·6±0·30	3±0·30	2·4±0·40	2±0·40	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7	±0·1	6±0·20	5·4±0·20	5±0·25	4·6±0·30	4±0·30	3·4±0·40	3±0·40	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8		7±0·20	6·4±0·20	6±0·20	5·6±0·30	5±0·30	4·4±0·35	4±0·35	3·6±0·40	3±0·40	—	—	—	—	—	—	—	—	—	—	—	—
9		8±0·15	7·4±0·15	7±0·20	6·6±0·25	6±0·25	5·4±0·35	5±0·35	4·6±0·40	4±0·40	3·4±0·45	—	—	—	—	—	—	—	—	—	—	—
10		9±0·15	8·4±0·15	8±0·20	7·6±0·25	7±0·25	6·4±0·30	6±0·30	5·6±0·35	5±0·35	4·4±0·40	4±0·45	—	—	—	—	—	—	—	—	—	—
12		11±0·15	10·4±0·15	10±0·15	9·6±0·20	9±0·20	8·4±0·25	8±0·25	7·6±0·30	7±0·30	6·4±0·40	6±0·40	5±0·45	4±0·45	—	—	—	—	—	—	—	—
14		13±0·08	12·4±0·08	12±0·08	11·6±0·15	11±0·15	10·4±0·20	10±0·20	9·6±0·25	9±0·25	8·4±0·30	8±0·30	7±0·35	6±0·40	5±0·45	—	—	—	—	—	—	—
15		14±0·08	13·4±0·08	13±0·08	12·6±0·08	12±0·15	11·4±0·20	11±0·20	10·6±0·25	10±0·25	9·4±0·30	9±0·30	8±0·35	7±0·35	6±0·40	5±0·45	—	—	—	—	—	—
16		15±0·08	14·4±0·08	14±0·08	13·6±0·08	13±0·08	12·4±0·15	12±0·15	11·6±0·20	11±0·20	10·4±0·30	10±0·30	9±0·35	8±0·35	7±0·40	6±0·40	5±0·45	4±0·45	—	—	—	—
18	±0·08	17±0·08	16·4±0·08	16±0·08	15·6±0·08	15±0·08	14·4±0·08	14±0·08	13·6±0·20	13±0·20	12·4±0·20	12±0·20	11±0·35	10±0·35	9±0·35	8±0·35	7±0·40	6±0·40	—	—	—	—
20		19±0·08	18·4±0·08	18±0·08	17·6±0·08	17±0·08	16·4±0·08	16±0·08	15·6±0·15	15±0·15	14·4±0·15	14±0·20	13±0·30	12±0·35	11±0·35	10±0·35	9±0·35	8±0·35	6±0·35	—	—	—
22		21±0·08	20·4±0·08	20±0·08	19·6±0·08	19±0·08	18·4±0·08	18±0·08	17·6±0·08	17±0·15	16·4±0·15	16±0·15	15±0·20	14±0·30	13±0·35	12±0·35	11±0·35	10±0·35	8±0·35	—	—	—
25		24±0·08	23·4±0·08	23±0·08	22·6±0·08	22±0·08	21·4±0·08	21±0·08	20·6±0·08	20±0·08	19·4±0·15	19±0·15	18±0·15	17±0·20	16±0·20	15±0·30	14±0·30	13±0·30	11±0·35	9±0·35	—	—
26		25±0·08	24·4±0·08	24±0·08	23·6±0·08	23±0·08	22·4±0·08	22±0·08	21·6±0·08	21±0·08	20·4±0·15	20±0·15	19±0·15	18±0·15	17±0·20	16±0·30	15±0·30	14±0·30	12±0·35	10±0·35	—	—
28		27±0·08	26·4±0·08	26±0·08	25·6±0·08	25±0·08	24·4±0·08	24±0·08	23·6±0·08	23±0·08	22·4±0·08	22±0·15	21±0·15	20±0·15	19±0·15	18±0·20	17±0·30	16±0·30	14±0·30	12±0·35	—	—
30		29±0·08	28·4±0·08	28±0·08	27·6±0·08	27±0·08	26·4±0·08	26±0·08	25·6±0·08	25±0·08	24·4±0·08	24±0·15	23±0·15	22±0·15	21±0·15	20±0·15	19±0·30	18±0·30	16±0·30	14±0·30	12±0·35	10±0·30
32		31±0·15	30·4±0·15	30±0·15	29·6±0·15	28·4±0·15	28·4±0·15	28±0·15	27·6±0·15	27±0·15	26·4±0·15	26±0·15	25±0·15	24±0·15	23±0·15	22±0·15	21±0·30	20±0·30	18±0·30	16±0·30	14±0·30	12±0·30
35	±0·15	34±0·15	33·4±0·15	33±0·15	32·6±0·15	32±0·15	31·4±0·15	31±0·15	30·6±0·15	30±0·15	29·4±0·15	29±0·15	28±0·15	27±0·15	26±0·15	25±0·15	24±0·20	23±0·20	21±0·20	19±0·25	17±0·30	15±0·30
38		37±0·15	36·4±0·15	36±0·15	35·6±0·15	35±0·15	34·4±0·15	34±0·15	33·6±0·15	33±0·15	32·4±0·15	32±0·15	31±0·15	30±0·15	29±0·15	28±0·15	27±0·15	26±0·15	24±0·20	22±0·20	20±0·25	18±0·30
40		39±0·15	38·4±0·15	38±0·15	37·6±0·15	37±0·15	36·4±0·15	36±0·15	35·6±0·15	35±0·15	34·4±0·15	34±0·15	33±0·15	32±0·15	31±0·15	30±0·15	29±0·15	28±0·15	26±0·20	24±0·25	[illegible]	[illegible]
42				40±0·20	39·6±0·20	39±0·20	38·4±0·20	38±0·20	37·6±0·20	37±0·20	36·4±0·20	36±0·20	35±0·20	34±0·20	33±0·20	32±0·20	31±0·20	31±0·20	30±0·20	28±0·20	26±0·20	—

Note 1 — The full drawn black stepped lines indicate the ratios of $\frac{\text{Wall thickness}}{\text{Outside diameter}}$ for $\frac{1}{20}$, $\frac{1}{40}$ and $\frac{1}{60}$

Note 2 — Permissible variations in dimensions as a result of distortion during annealing, with annealed and normalized tubes, the diameter variations are greater, the permissible values being as follows:

$\frac{\text{Wall thickness}}{\text{Outside diameter}}$ = $\frac{1}{20}$ and more : Same values as given in the table.

= Below $\frac{1}{20}$ to $\frac{1}{40}$: 1.5 times the values given in table.

= Below $\frac{1}{40}$ to $\frac{1}{60}$: twice the values given in the table.

= Below $\frac{1}{60}$: 2·5 times the values given in the table

Note 3 — The permissible variations in the dimensions of the tube outside diameter include ovality

TABLE 2 CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES

(*Clauses* 3 *and* 4)

Grades	Chemical Composition in %					Normalised Condition			Annealed		Cold Finished/ Hard		Cold Finished Soft	
	C *Max*	Si *Max*	Mn	P *Max*	S *Max*	Tensile Strength N/mm²,	Upper Yield Point N/mm², *Min*	Elongation at Rupture, % *Min*	Tensile Strength N/mm², *Min*	Elongation at Rupture, % *Min*	Tensile Strength N/mm², *Min*	Elongation at Rupture, % *Min*	Tensile Strength N/mm², *Min*	Elongation at Rupture % *Min*
St 30 Si	0·10	0·30	0·55 *Max*	0·04	0·04	290–420	215	30	280	30	400	8	330	12
St 30 Al*	0·10	0·05	0·55 *Max*	0·04	0·04	290–420	215	30	280	30	400	8	330	12
St 35	0·17	0·35	0·40 *Min*	0·05	0·05	340–470	235	25	315	25	440	6	370	10
St 45	0·21	0·35	0·40 *Min*	0·05	0·05	440–570	255	21	390	21	540	5	470	8
St 52	0·22	0·55	1·60 *Max*	0·05	0·05	490–630	355	22	490	22	590	4	540	7

*This steel is deoxidized using aluminium.

12. Marking — The tube shall be marked by labels fixed firmly to the bundle or to the crate with the following information:

a) Manufacturer's symbol,

b) Designation according to this IPSS, and

c) The stamp of the tester if the tubes are being supplied with an acceptance testing certificate.

13. Surface Protections — Unless otherwise agreed, the tubes are delivered with the temporary corrosion protection normally furnished by the manufacturer on outside and inside surface of the tube.

14. Packing — The tubes are normally delivered in bundles secured bysteel tape, unless otherwise stated by the buyer. End caps shall be provided on both ends of the tubes.