For Comments Only

Draft *Standard*

HIGH STRENGTH FLAT ROLLED STEEL PLATE (UP TO 6 mm), SHEET AND STRIP FOR THE MANUFACTURE OF WELDED GAS CYLINDER

ICS 77.140.30

FOREWORD
(Formal clauses will be added later)

While formulating the draft standard, assistance has been derived from ISO 4978:1983 Flat rolled steel products for welded gas cylinders.

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 2:1960 `Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1 SCOPE

This draft standard covers the requirements for deep drawing quality hot rolled steel plate (Up to 6 mm), sheet and strip for the manufacture welded gas cylinders.

2 REFERENCES

The following standards contain provisions, which through reference in this text constitute provision 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 these standards are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
228 (in various parts)	Methods for chemical analysis of steels
1608:2005	Metallic materials –Tensile testing at ambient temperature (*third revision*)
1730:1989	Steel plates,sheets,strips and flats for structural and general engineering purposes (*second revision*)
1956(Part 4):1975	Glossary of terms relating to iron and steel. Part 4 Steel sheet and strip *(first revision)*
3803 (Part 1):1989	Steel –Conversion of elongation values : Part 1 Carbon and low alloy steels (*second revision*)
8910:1978	General technical delivery requirements for steel and steel products
13566:1992	Recommended practice of pickling by H_2SO_4 levelling and oiling of LPG sheets
IS/ ISO 16160:2005	Continuously hot-rolled steel sheet products – Dimensional and shape tolerances

3 TERMINOLOGY

For the purpose of this standard, the following definitions in addition to those given in IS 1956 (Part 4) shall apply.

3.1 Coil - A rolled flat strip product which is wound into regularly superimposed laps so as to form a coil with almost flat side. It shall have at least 50 laps**.**

3.2 Micro-Alloying Elements - Elements, such as niobium, vanadium and titanium, added singly or in combination to obtain higher strength levels combined with better formability, weldability and toughness as compared with non-alloyed steel produced to equivalent strength levels.

4 SUPPLY OF MATERIAL

4.1 General requirements relating to the supply of material shall conform to IS 8910.

4.2 Hot rolled steel plates and sheets covered by this standard shall be supplied in straight lengths and strips in coils.

5 MANUFACTURE

5.1 The processes used in making the steel and in manufacturing hot rolled steel plate, sheet and strip are left to the discretion of the manufacturer.

5.1.1 However, incase sheets and strips are manufactured through Thin slab casting route, the manufacturing process shall be suitably qualified on the basis of adequate data to ensure freedom from center line segregation, material inconsistency, internal cracks and poor surface quality.

5.2 The steel shall be of fully aluminum killed and non-ageing quality. However, other elements which, by binding the nitrogen, have a similar effect may also be used instead of, or in addition to, aluminium (see also table 1).

6 CHEMICAL COMPOSITION

6.1 Ladle Analysis

Ladle analysis of the material, when carried out either by the method specified in the relevant parts of IS 228 or any other established instrumental/chemical method, shall be as given in Table 1. In case of dispute, the procedure given in the relevant part of IS 228 shall be the referee method. However, where 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.

6.1.1 Alternatively the method specified in relevant ISO/IEC standard may be used.

6.2 Product Analysis

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

Table 1 Chemical Composition
(*Clauses* 6.1 *and* 6.2)

Grade	Constituent, Percent					
	Carbon	Manganese	Silicon	Sulphur	Phosphorus	Aluminium
	Max	*Min*	*Max*	*Max*	*Max*	*Min*
(1)	(2)	(3)	(4)	(5)	(6)	(7)
HS 235	0.16	0.30	0.25	0.025	0.025	0.015
HS 265	0.18	0.40	0.30	0.025	0.025	0.015
HS 295	0.19	0.50	0.35	0.025	0.025	0.015
HS 345	0.20	0.70	0.45	0.025	0.025	0.015

NOTES

1 Elements not listed in this table may not be added intentionally to the steel. All suitable arrangements are to be made to prevent such elements being added from scrap or other materials used during manufacture, which impair the mechanical properties and usability.

2 Steel may be supplied with the addition of micro-alloying elements like niobium, titanium, vanadium and boron. The micro-alloying elements shall not exceed 0.10 percent when added individually or in combination.

3 The nitrogen content of the steel shall not be more than 0.009 percent. This has to be ensured by the manufacturer by occasional check analysis.

Table 2 Permissible Variations for Product Analysis
(*Clause* 6.2)

Sl No.	**Constituent**	**Permissible Variations Over the Maximum and Under the Minimum Specified Limit, Percent**
		Max
(1)	(2)	(3)
i)	Carbon	0.02
ii)	Manganese	0.03
iii)	Silicon	0.03
iv)	Sulphur	0.005
v)	Phosphorus	0.005

NOTE – Aluminium content shall not be less than 0.015 percent.

7 TENSILE TEST

7.1 Number of Tensile Tests

Number of samples to be tested from a cast/heat, rolled or processed, shall be as follows:

a) For cast/heat size up to 100 tonne – 2 samples

b) For cast size between 100-200 tonne – 3 samples

c) For cast size over 200 tonne – 4 samples

The test pieces taken for tensile test shall be from the direction transverse to the direction of rolling. In case of coils, one sample shall be tested from each coil.

7.1.1 When plate**,** sheets and strips of more than one thickness are rolled from the same cast, one additional tensile test shall be made for each thickness.

7.2 Tensile Test

The tensile test shall be carried out in accordance with IS 1608, generally using a proportional gauge length $L_o = 5.65 \sqrt{S_o}$, where S_o is the cross-sectional area of the test piece. Test pieces with a non-proportional gauge length may be used; in this case the elongation values shall be converted in accordance with IS 3803 (Part 1). The tensile strength, yield stress and percentage elongation shall be as given in Table 3.

7.2.1 Should a test piece break outside the middle half of its gauge length and the percentage elongation obtained is less than that specified, the test may be discarded at the option of the manufacturer and another test made from the sample selected representing the same cast and batch.

Table 3 Mechanical Properties
(*Clause* 7.2)

Grade	**Tensile Strength** MPa min	**Yield Stress** MPa min	**Percent Elongation at gauge Length** $5.65 \sqrt{S_o}$ min	**Reference heat Treatment Austenitizing temperature**
HS 235	360-460	235	25	920-960
HS 265	410-510	265	22	890-930
HS 295	450-560	295	20	890-930
HS 345	490-610	345	18	880-920

Time at austenitizing temperature: approximately 2 min per millimeter of plate thickness..

NOTE- The above properties are specified for cold formed and normalized cylinder. However tensile properties of hot rolled plate / sheet / strip are to be mutually agreed upon by producer and cylinder manufacturer.

8 RETEST

If a test does not give the specified results, two additional tests shall be carried out at random on the same lot. Both retests shall conform to the requirements of this standard, otherwise, the lot shall be rejected.

9 FREEDOM FROM DEFECTS

The finished material shall be free from harmful defects such as seams, pipe, lamination, cracks, slivers, rolled-in-scale, blisters and pitted surface which will impair the drawability.

NOTE – When the material is supplied in the form of coils, the degree or amount of surface defects are expected to be more than in cut length sheets since the inspection of coils does not afford the same opportunity to reject the portion containing defects as with cut length. However, an excessive amount of defects may be a cause for rejection. It may be noted that hot rolled material may have some tertiary scale on the surface of the product and the presence of such scale should not be considered as surface defect.

10 DIMENSIONS AND TOLERANCES

10.1 Unless otherwise specified, the dimensions of steel plate, sheet and strip shall conform to the dimensions as given in IS 1730.

10.2 Unless otherwise specified, the dimensional and shape tolerances of steel plate, sheet and strip shall conform to the requirements as given in IS/ISO 16160:2005.

11 CONDITION OF DELIVERY

11.1 The delivery condition shall be agreed at the time of enquiry and order. The material may be supplied in 'hot rolled and normalized' or 'hot rolled under controlled conditions'

NOTE – The terms 'hot rolled normalized' or 'hot rolled under controlled conditions' refer to the conditions leading to a structure and to properties typical of those for material in the normalized condition.

The products can however, also be delivered in other conditions such as

- hot rolled
- hot rolled and pickled
- cold rolled
- cold rolled and annealed

11.2 Subject to prior agreement between the manufacturer and the purchaser, the material may be pickled and leveled with a suitable protective treatment in accordance with IS 13566.

12. WELDABILITY

The steels are weldable by the usually fusion welding processes.

13 MARKING

13.1 Steel plates and sheets shall be supplied in bundles and strips in coils. The mass of the bundle or coil shall be a s agreed to between the purchaser and the manufacturer. Each plate and sheet in each bundle shall be legibly marked with the cast/coil number. The top sheet in each bundle shall also be marked with the name of the manufacturer or trade-mark. Each bundle shall further carry a metal tag bearing the cast/coil number and the manufacturer's name or trade-mark or such information may be given on the top of the steel envelope containing the sheets during packing. In case of coils, each coil shall be legibly marked with the cast/coil number, grade and manufacturer's name or trademark.

13.2 BIS Certification Marking

The material may also be marked with Standard Mark.

13.2.1 The use of the Standard Mark is governed by the provisions of *Bureau of Indian Standards* Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

FORMAT FOR SENDING COMMENTS ON BIS DOCUMENTS

NAME OF THE COMMENTATOR / ORGANIZATION :

Doc. Number and Title :

Sl.No.	Clause / Subclause / Para No. commented	Comments / Suggestions
(1)	(2)	(3)