बी एच ई एल BHEL	**CORPORATE PURCHASE SPECIFICATION**	**AA 101 08**
		Rev. No. 10
		PREFACE SHEET

STRUCTURAL STEEL – STANDARD QUALITY (PLATES, SECTIONS, STRIPS, FLATS & BARS)

FOR INTERNAL USE ONLY
REMOVE THIS PREFACE BEFORE ISSUE TO SUPPLIERS

Equivalent/Comparable Standards:

1. **IS 2062 Latest Revision**
2. **DIN EN 10025 Grade : S275JR**
3. **ASTM A131 M-Latest Revision**
4. **JIS G 3106-Latest Revision**

Suggested Probable Suppliers & Grades:

1. M/s TISCO : TISTEN 42
2. M/s SAIL : i) MA 300 HY
   ii) Lloyds, Gr. A
   iii) IS 2062 Gr. A

User Plants Specs/References:

1. BHOPAL : PS 10108
2. JHANSI : PS 10108
3. HEEP, HARDWAR : 0500.001
4. HYDERABAD : HY 021 02 99
5. TRICHY : BM-C 20

Revisions : Cl: **30.4.0 of MOM of MRC_S & GPS**			**APPROVED :** INTERPLANT MATERIAL RATIONALISATION COMMITTEE-MRC (S&GPS)		
Rev. No. 10	**Amd.No.**	**Reaffirmed**	**Prepared**	**Issued**	**Dt. of 1st Issue**
Dt. Nov 2007	**Dt :**	**Year :**	**HYDERABAD**	**Corp. R&D**	**JULY, 1976**

STRUCTURAL STEEL – STANDARD QUALITY (PLATES, SECTIONS, STRIPS, FLATS & BARS)

(ORDERING DESCRIPTION)

1.0 GENERAL:

This specification governs the quality requirements of structural steel plates, strips, flats, bars and sections such as angles, beams, channels and tees etc. of latest version of IS:2062 Grade E250 (Fe410W) Quality A.

2.0 APPLICATION:

For general engineering purpose.

3.0 CONDITION OF DELIVERY:

Plates, Bars & Sections : Hot rolled in straight lengths without twists & bends.

4.0 COMPLIANCE WITH NATIONAL STANDARDS:

4.1 Material shall comply with the latest requirements of IS:2062 Gr. E250 (Fe410W) Quality A.

4.2 Material offered to DIN EN 10025-1994 Gr. S 275JR is also acceptable. The tolerance on dimensions for plates shall comply with DIN EN 10029.

5.0 DIMENSIONS AND TOLERANCES:

5.1 Dimensions:

5.1.1 Sizes: Material shall be supplied to the dimensions specified on BHEL order.

5.1.2 Length: Unless otherwise specified, hot rolled bars and sections shall be supplied in 3 to 6 metres length.

5.2 Tolerances:

5.2.1 The tolerances on hot rolled material shall comply with IS:1852. However, no plate shall be under the specified thickness at any point.

5.2.2 Straight for hot rolled bars: Unless otherwise specified, the permissible deviation in straightness shall not exceed 5 mm in any 1000 mm length.

6.0 HARDNESS (BRINELL):

When tested in accordance with IS:1500, the material shall show a brinell hardness in the range of 120-156 HB.

Note: Hardness test shall be conducted only when tensile test cannot be performed.

7.0 TEST CERTIFICATES:

Unless otherwise specified, three copies of test certificates shall be supplied.

In addition, the supplier shall ensure to enclose one copy of the test certificate along with their dispatch documents to facilitate quick clearance of the material.

The test certificate shall bear the following information.

AA10108 Rev.10 / IS:2062 Grade: E250 (Fe410W) Qaulity A / DIN EN 10025 Gr. S275JR, BHEL order no., Melt no. Size, Results of chemical analysis and Mechanical tests, Supplier's name, Identification no. TC no., Signature of competent authority etc.

8.0 PACKING AND MARKING:

Plates shall be transported suitably to avoid damage during transit.

For plates below 10 mm thick, each pile (preferably of 16 plates) and each plate 10 mm thick & over shall be marked with Melt no. AA10108, BHEL order no., Supplier's name, Identification no., Size & weight on any one corner and encircled with paint preferably of white colour.

9.0 REFERRED STANDARDS (LATEST PUBLICATIONS INCLUDING AMENDMENTS):

1. IS:2
2. IS:1500
3. IS:1599
4. IS:1608
5. IS:1852
6. IS:2062
7. DIN EN 10025
8. DIN EN 10029

FERRITIC STAINLESS STEEL SHEETS, PLATES AND STRIPS (ASTM A240 TYPE 409)

(ORDERING DESCRIPTION)

1.0 GENERAL:

This specification covers the additional requirements of ferritic stainless steel sheets, plates and strips to be supplied as per ASTM A240 Type 409 (Latest version).

2.0 APPLICATION :

For applications in Gas Turbine hot gas path like exhaust plenum assemblies and exhaust ducting.

3.0 CONDITION OF DELIVERY :

No.1 Finish or No. 2D Finish for Sheets and No.1 Finish for plates. Sheets and Plates shall be supplied with sheared edges and strips with rotary sheared edges and in cut lengths. Any other condition for edges shall be mutually agreed upon.

4.0 COMPLIANCE WITH NATIONAL / INTERNATIONAL STANDARDS:

This specification is based on the following international standard ASTM A240 - TP409 - Cr & Cr-Ni stainless steel plate, sheet and strip for pressure vessels and for general applications.

Note: 1) The suppliers may quote their equivalent grades which shall be capable of meeting the requirements of ASTM A240 TP409 (Latest version) also.

2) In case, the suppliers quote their own equivalent grade, the complete details of the properties (Like chemical & mechanical) of their grade with further processing methods like welding, bending, heat treatment characteristics shall also be specified. The variations from ASTM A240 TP409 with their effects shall also be specified in their technical offer.

5.0 DIMENSIONS AND TOLERANCES:

5.1 Sizes: Material shall be supplied to the dimensions specified on the order.

5.2 Tolerances: The tolerances on material shall be as per ASTM A 480.

6.0 FREEDOM FROM DEFECTS:

The material shall be of uniform quality consistent with the good manufacturing and inspection practice. The steel shall have no defects of a nature or a degree that will be detrimental to the stamping, forming, machining or fabrication of finished parts.

7.0 INSPECTION AT SUPPLIER'S WORKS:

BHEL representative shall have free access at all times while the work on the contract is being performed, to all parts of the manufacturer's works. The manufacturer shall offer BHEL's representative all reasonable facilities without charge to satisfy the later that the material is being furnished in accordance with this specification. The manufacturer shall prepare and provide necessary test specimens for testing to be carried out at his premises. If facilities do not exist at his works, the manufacturer shall make necessary arrangements for carrying out the prescribed tests elsewhere. The manufacturer shall notify BHEL in advance about the readiness of the material for inspection and testing.

BHEL reserves the right to test the material at BHEL's works and the final acceptance of the material shall be based on these test results.

8.0 TEST CERTIFICATES:

Three copies of test certificates shall be supplied unless otherwise stated on the order.

In addition, the supplier shall ensure to enclose one copy of test certificates alongwith their despatch documents to facilitate quick clearance of the material.

The test certificate shall bear the following information:

BHEL References:

HY 10783 Rev.No.03 / ASTM A240 TP409.
Order NO.

Supplier's references

Supplier's Name
Identification No.
Melt No.
Process of manufacture
Details of heat treatment.

Results of Tests:

Results of dimensional inspection.
Results of chemical analysis and mechanical tests.

9.0 PACKING AND MARKING:

Sheets shall be supplied in bundles or in packages each weighing upto a maximum of 3,000 kgs.

Sheets shall be securely packed in water-proof paper or hessian cloth and securely tied round with hoop iron and with wooden battens underneath to prevent the sheets from damage during transit.

For plates below 25mm thick, each pile (preferably of 16 plates) shall be marked with the supplier's identification mark, the melt number, ASTM A240 TP409 on the top plate.

Each plate of 25 mm thickness and above shall be stamped / painted with the supplier's identification mark the melt number and ASTM A240 TP409.

Plates shall be suitably packed to prevent damage during transit.

In addition, each bundle / package and each plate of 25 mm thickness and over shall bear the following information:

HY10783 (ASTM A240 TP409) : Ferritic Stainless Steel Sheets / Plates / Strips-Annealed.

BHEL Order No.

Consignment / Identification No.

Size and Weight.

Supplier's Name.

10.0 REJECTION AND REPLACEMENT:

If the material does not comply with the requirements of this specification during receipt inspection at BHEL or any defect found during the course of further processing, such material shall be rejected notwithstanding any previous certification of satisfactory testing and/or inspection.

The suppliers shall undertake to replace the rejected material at his own cost and the rejected material shall be taken back by the supplier after fulfilling the commercial terms and conditions.

STAINLESS STEEL SHEETS AND STRIPS

Grade X10Cr13 KG (for strips) and TP 410 or 410S (for sheets)

1.0 GENERAL:

This specification governs the requirements of cold rolled/hot rolled stainless steel sheets in annealed condition and cold rolled strips in heat treated and stress relieved condition.

2.0 APPLICATION:

a) Sheets**:** For manufacture of shims in ST and GT.

b) Strips**:** For manufacture of steam turbine components such as strainers.

3.0 CONDITION OF DELIVERY:

a) Strips: The strips shall be heat-treated, cold rolled and finally stresses relieved. The material shall be supplied in bright and smooth finished condition. The edges shall be trimmed and smoothened. The strips shall be coiled on reels weighing approximately 5 kgs each, with a minimum coil diameter of 300 mm. Open coils are not acceptable.

b) Sheets: The sheets shall be supplied in cold/hot rolled and annealed condition (Finish No. 1 or 2 B / 2D)

4.0 COMPLIANCE WITH STANDARDS:

This specification in general complies with specification for chromium and Cr-Ni stainless steel plates, sheets and strips for pressure vessel and general applications.

a) Sheets: Based on ASTM A240, TP 410 or 410 S; Specification for chromium and chromium nickel stainless steel plates, sheets and strips for pressure vessel and general purpose applications.

b) Strips**:** Based on DIN 17440-1985, Gr. X10Cr13 KG; Stainless steels, quality specification.

5.0 DIMENSIONS AND TOLERANCES:

5.1 Dimensions: As specified in the order.

5.2 Tolerances:

5.2.1 **Sheets:** The Tolerances on thickness, and width of sheets shall be as per ASTM A 480.

5.2.2 **Strips:** The tolerance on thickness and width of strips shall conform to DIN: 1544, the relevant values are reproduced below:

Thickness, mm		Tolerance on thickness mm
From	Upto and including	
0.10	0.15	± 0.010
0.15	0.25	± 0.020
0.25	0.40	± 0.020
0.40	0.60	± 0.030
0.60	1.00	± 0.030
1.00	1.50	± 0.040
1.50	2.50	± 0.050
2.50	4.00	± 0.060
4.00	6.00	± 0.080

Thickness, mm		Positive tolerance on width, mm			
Over & including	Upto	<125	≥125 <250	≥250 <400	≥400 ≤650
0.30	6.00	3.0	3.5	4.0	4.5

6.0 MANUFACTURE:

The steel shall be manufactured by basic electric furnace and shall be fully killed.

7.0 FREEDOM FROM DEFECTS:

The material shall be free from cracks, laps and rough non-metallic inclusions. Surface shall be clean and smooth.

8.0 HEAT TREATMENT:

The sheets and strips shall be suitably heat treated to achieve the specified mechanical properties. The actual heat treatment cycle followed shall be reported.

9.0 CHEMICAL COMPOSITION:

Sheets (TP 410 or TP 410S)

Grade	Element (%)	C	Mn	P	S	Si	Cr	Ni
410	Min.	0.08	--	--	--	--	11.50	--
	Max.	0.15	1.00	0.04	0.03	1.00	13.50	0.75
410 S	Min.	-	-	-	-	-	11.50	-
	Max.	0.08	1.00	0.04	0.03	1.00	13.50	0.60

Strips (X10Cr13 KG)

Element (%)	C	Mn	P	S	Si	Cr	Ni
Min.	0.08	--	--	--	--	12.00	--
Max.	0.15	1.00	0.045	0.030	1.00	14.00	--

10.0 TEST SAMPLES:

10.1 For Chemical Analysis: One test sample shall be taken from each melt for chemical analysis.

10.2 For Mechanical Tests: One tensile test shall be done per melt and heat-treatment batch of the material or part there of.

11.0 MECHANICAL PROPERTIES:

The material shall comply with the following mechanical properties when tested in accordance with IS:1608 or any reputed National Standard.

Sheets (TP 410 or TP 410S)

Type of material	Yield Stress or 0.2% P.S. N/mm^2 min.	Tensile strength N/mm^2 min.	% Elongation, Min	Hardness BHN, max
410	205	450	20	217
410S	205	415	22	183

Strips:

Thickness (mm)	Yield Stress or 0.2% P.S N/mm^2, min.	Tensile strength N/mm^2, min.	% Elongation L = 5d, min	
			L	T
≤ 3 mm	420	600 - 800	-	-
> 3 mm			16	12

12.0 INSPECTION AT SUPPLIER'S WORKS:

The representative of BHEL shall have free access to the suppliers works at all times during the execution of the order, to satisfy himself that the material is produced as per the quality requirements of this specification. All reasonable facilities shall be extended to him, free of charge. He may also witness the sampling, testing and marking called for in this specification.

13.0 TEST CERTIFICATE:

Five copies of the certificate shall be furnished with the following details.

a) BHEL Order No.
b) BHEL Specification No: HY 10780 / Rev.02
c) Manufacturer's Name:
d) Melt No. & Heat treatment batch No.
e) Heat treatment condition and details.
f) Size and dimensional check.
g) Results of chemical analysis and mechanical tests.

14.0 PACKING AND MARKING:

14.1 Marking: Each coil shall be provided with metal label bearing the following punch details.

a) Material Specification No. HY 10780
b) Melt No. & Heat treatment Batch No.
c) Size & weight.
d) Manufacturer's Trade Mark.

15.0 REJECTION:

In the event of any material proving defective during the course of further processing or testing, such materials shall be rejected and the supplier shall make immediate arrangements to replace the same free of cost.

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STAINLESS STEEL PLATE AUSTENITIC FOR PRESSURE VESSEL

ORDERING DESCRIPTION FOR ASME-SA 240 Gr.304

1.0 APPLICATION:

For use in fusion welded unfired pressure vessels and condensers.

2.0 PROCESS :

As per ASME SA 240

3.0 MANUFACTURE :

As per ASME SA 240

4.0 HEAT TREATMENT :

As per ASME SA 240.

5.0 CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES :

As per ASME SA 240 Gr.304.

6.0 SPECIAL REQUIREMENTS :

Test for resistance to intergranular corrosion to ASTM-A 262-Practice E.

7.0 INSPECTION AND TEST REPORTS REQUIRED :

As per ASME SA 240.

8.0 MARKRING AND PACKING

As per ASME SA 240.

9.0 SIZE AND QUANTITY :

As per purchase order.

10.0 ASME & DESIGNATION

ASME SA 240 Gr.304.

Revisions:			**ISSUED : STANDARDS ENGINEERING DEPARTMENT**		
Rev.No.	**Amd.No.**	**Reaffirmed**	**Prepared:**	**Approved:** SR.DGM (P,T& I SERVICES)	**Dt. of 1st issue**
Dt.	**Dt.**	**Year:**	MATLS.ENGG		DEC. 98

ALLOY STEEL PRESSURE VESSEL PLATES FOR ELEVATED TEMPETRATURE SERVICE

(ORDERING DESCRIPTION FOR ASME: SA 387 Gr : 12 CLASS 2 WITH S1, S3, S5 AND S8)

1.0 GENERAL:

The material and other requirements shall comply with the latest version of ASME : SA 387,Gr :12 class 2, with the following additional requirements.

2.0 APPLICATION:

For fabrication of pressure vessels and heat exchangers as per ASME Boiler and Pressure Vessel code or Indian Boiler Regulations (IBR) requiring S1,S3, S5 and S8 supplementary requirements as per SA 387.

3.0 CONDITION OF DELIVERY:

The plates shall be supplied in Normalised and Tempered condition.

4.0 DIMENSIONS:

4.1 The thickness of the plate shall be as specified in the Purchase Order.

4.2 Unless otherwise specified in the Purchase Order, plates shall be supplied to size 2500 mm (w) x 5000 mm (1).

5.0 CHEMICAL COMPOSITION:

Chemical Composition shall be as per SA 387, Gr: 12.

6.0 VACUUM TREATMENT:

Plates shall be vacuum degassed as per supplementary requirement S1 of ASME SA 387.

7.0 SIMULATED POST WELD HEAT TREATMENT (SUPPLEMENTARY REQUIREMENT S3) OF MECHANICAL TEST COUPONS:

The test coupons representing the plate shall be thermally treated after the final Heat treatment. The simulated post weld heat treatment cycles shall be selected as per ASME SEC.VIII Div. I (UCS-56).

8.0 LOW TEMPERATURE IMPACT TEST:

Charpy V-Notch impact test (at 0°C or lower) shall be conducted as per supplementary requirement S5 of SA387. The impact energy shall be 28 J minimum (average of 3 values). One value can be lower than 28 J but not less than 21 J. All the three values shall be reported in the test Certificate.

9.0 ULTRASONIC TEST:

Plates of all thickness shall be ultrasonically examined in accordance with ASTM A435, as per supplementary requirements S8 of ASME SA 387.

10.0 REPAIRS:

10.1 Repair of defects by welding is not permitted.

10.2 When other does repairs mechanical means the minimum plate thickness shall be met with and the surface shall be smoothly dressed up to avoid sharp edges.

11.0 INSPECTION:

11.1 If the material is purchased from WELL-KNOWN STEEL MAKER as approved by IBR (Indian Boiler Regulations) then inspection by any other third party inspection agency is not necessary unless it is specifically mentioned on the order.

11.2 In case of procurement from other suppliers all plates shall be inspected at supplier's works by an Inspection authority recognised by IBR and the test certificates shall be attested to that effect.

12.0 INSPECTION AT SUPPLIER'S WORKS:

12.1 BHEL representative / BHEL appointed Inspection Agency shall have free entry and access to all areas where the manufacture of the bars is carried out. All reasonable facilities shall be extended to him including labour wherever necessary.

12.2 BHEL representative / BHEL appointed Inspection Agency shall be given sufficient advance intimation to witness the various processes, tests etc. Punching and identification of test coupons and execution of various tests shall be done in presence of BHEL representative / BHEL appointed Inspection Agency.

13.0 TEST CERTIFICATE:

Three copies of the test certificates shall be furnished in English as per IBR form IV.

14.0 PRESERVATION :

Plates 10 mm and below shall be coated with suitable rust preventive.

15.0 MARKING:

The following details shall be hard punched on each plate, near the edge and encircled with the white paint.

BHEL Specification No. HY 10699 Rev.01
ASME: SA 387,Gr. 12 Cl.2
Melt No:
Supplier's Name:
Inspection authority's mark:
Material Code No:

16.0 REJECTION & REPLACEMENT:

In the event of the material proving defective in the course of further processing at BHEL, the same shall be rejected notwithstanding any previous acceptance. The supplier shall replace the material forging at his own cost and the rejected material shall be returned after all the commercial conditions are satisfied.

ALLOY STEEL BOILER QUALITY PLATES GR: 16 Mo 3

(ORDERING DESCRIPTION FOR DIN EN 10028, GR: 16 Mo 3)

1.0 GENERAL:

The plates shall comply with the latest version of DIN EN 10028, Gr: 16 Mo 3, and with the additional requirements stipulated below.

2.0 APPLICATION:

For use in Steam turbine components like Steam strainers, Governing valves etc at operating temperatures around 500° C.

3.0 DIMENSIONS:

3.1 The thickness of the plates shall be as specified in the purchase order.

3.2 Unless otherwise specified in the purchase order, plates shall be supplied to 1000x2000 mm width and Length.

4.0 CHEMICAL ANALYSIS:

Chemical composition analysis shall be carried out as per DIN EN 10028, Gr.16 Mo 3.

5.0 MECHANICAL TESTS:

Mechanical testing shall be carried out as per DIN EN 10028 Gr.16 Mo3.

6.0 HIGH TEMPARATURE PROPERTIES:

The supplier shall guarantee the high temperature properties as per DIN EN 10028, Gr.16 Mo 3 and the established high temperature test results shall be furnished, if asked for in the purchase order.

7.0 TEST CERTIFICATE:

Five copies of the certificate in English, covering the following details shall be furnished.

a) BHEL Order No.
b) BHEL Specification No. HY 10676 Rev.01
c) DIN EN 10028, Gr. 16 Mo 3
d) Size
e) Supplier's Name
f) Melt No.
g) Steel making process
h) Particulars of Heat treatment/Batch No.
i) Melt analysis
j) Results of mechanical tests
k) Guarantee for High temperature properties (if applicable, as per Purchase order).

8.0 PRESERVATION:

The plates shall be coated with a rust preventive compound suitable for outdoor storage for a period of 6 months. It shall be easily removable.

9.0 MARKING:

Each plate shall be legibly marked with the following details at a scale free zone and encircled by white paint.

a) Suppliers Name/Mark
b) BHEL Specification No: HY 10676 Rev. 01
c) DIN EN 10028 : Gr. 16 Mo 3
d) Melt No.:

HIGH STRENGTH LOW-ALLOY STEELS OF STRUCTURAL QUALITY

(ORDERING DESCRIPTION)

1.0 GENERAL:

The material shall conform to the latest version of IS 8500 Gr. Fe 490 or EN 10025 Grade S355 JR and comply with the following additional requirements.

2.0 APPLICATION:

These sections, particularly wide flange beams are used in fabricating the mast and sub-structure of Oil Rigs.

3.0 CONDITION OF DELIVERY:

Fully killed and hot rolled.

4.0 DIMENSIONS AND TOLERANCES:

4.1 **Sizes:** Beams shall be supplied to the dimensions specified on the order. Unless otherwise specified they shall be supplied in lengths of 40 ft.

4.2 **Tolerances:** Tolerances and general requirements shall be as per IS 8500 or EN 10025.

5.0 TEST CERTIFICATE:

5.1 Five copies of the certificate giving the following details shall be furnished.

a) BHEL Order No.
b) HY10591 / Rev.02
c) Name of supplier
d) Consignment or identification no.
e) Results of mechanical tests
f) Results of chemical tests

5.2 The test certificate shall be signed by the Chief of quality / Chief Metallurgist of the supplier and BHEL representative.

6.0 MARKING:

The following shall be legibly stamped / marked on each section.

1. HY10591 Rev.02
2. BHEL Order No.
3. Consignment or identification no.
4. Cast no.
5. Size & length (Eg. W8 x 5 1/4 x 18, 40 ft)
6. Weight
7. Supplier's name

7.0 REJECTION & REPLACEMENT:

In the event of the material proving defective in the course of further processing at BHEL, the same shall be rejected notwithstanding any previous acceptance.

The supplier shall replace the material at his own cost and the rejected material shall be returned after all the commercial conditions are satisfied.

HIGH STRENGTH LOW ALLOY STRUCTURAL STEEL PLATES

1.0 GENERAL:

This specification governs the requirements of high strength low-alloy structural steel plates.

2.0 APPLICATION :

For fabrication of components which require high strength and resistance to atmospheric corrosion.

3.0 CONDITION OF DELIVERY :

The plates shall be supplied in hot/cold rolled condition.

4.0 COMPLIANCE WITH STANDARDS:

The plates and sheets shall comply with the latest version of ASTM A242 Type 1, (for Cor-Ten-A Steel) and ASTMA 588, Gr.A (for Cor-Ten-B Steel)

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5.0 DIMENSION AND TOLERANCES:

5.1 Sizes: shall be as specified in the purchase order.

5.2 Tolerances: shall be as per ASTM A6.

6.0 MANUFACTURE:

Steel shall be manufactured by open-hearth, basic oxygen or electric furnace process.

7.0 FREEDOM FROM DEFECTS:

Material shall be free from laps, seams, segregation or any other injurious defects.

8.0 TEST SAMPLES:

8.1 Chemical Analysis: Each melt shall be analysed for chemical composition.

Revisions:			Issued :		
General Revision			STANDARDS ENGINEERING DEPARTMENT		
Rev.No	**Rev.Date**	**Revised:**	**Prepared:**	**Approved:**	**Date:**
01	**Mar 1992**	**Matls Engg.**	Stds Malts Engg	Specialist (testing)	02.07.1987

8.2 **Mechanical Properties:** Mechanical properties shall be analysed per melt per size.

9.0 CHEMICAL COMPOSITION:

The melt analysis of material shall be as follows:

Grade & Size	Melt analysis	C	Mn	Si	Ni	Cr	Cu	V	P	S
Cor-Ten A (Upto 12) mm	min. %	-	0.20	0.25	-	0.30	0.25	-	0.07	-
	max. %	0.12	0.50	0.75	0.65	1.25	0.55	-	0.15	0.05
Cor-Ten B (above12) mm	min. %	0.10	0.80	0.15	-	0.40	0.25	0.02	-	-
	max. %	0.19	1.25	0.30	-	0.65	0.40	0.10	0.04	0.05

NOTE: Permissible variations in product analysis shall be as per ASTM:A6.

10.0 MECHANICAL PROPERTIES:

The material shall have the following mechanical properties:

Grade	Tensile Strength N/mm^2 Min.	Yield strength N/mm^2 Min.	Elongation % (l=5d) Min.
Cor-Ten A (Upto 12 mm)	480	345	21
Cor-Ten B (Above 12 mm)	480	345	21

NOTE: The minimum yield point and tensile strength requirements for hot rolled sheet material will be reduced by 35 N/mm^2 , when material specified in annealed or normalised condition, or when specified to be furnished in coils.

11.0 BEND TEST:

The bend test specimens shall stand being bent cold through 180° without cracking on the outside of the bend portion. The bend radii shall be as given below

Size Range	Upto 19 mm	19-25 mm	25-40 mm	40-50 mm	50-100 mm
Bend Radius (times thick-ness)	1t	1 1/2t	2t	2 1/2t	3t

12.0 INSPECTION AT SUPPLIER'S WORKS:

BHEL representative/BHEL appointed Inspection Agency shall have free entry and access to all areas where the manufacture of the bars is carried out. All reasonable facilities shall be extended to him including labour wherever necessary.

BHEL representative/BHEL appointed Inspection Agency shall be given sufficient advance intimation to witness the various processes, tests, etc. Punching and identification of test coupons and execution of various tests shall be done in presence of BHEL representative/BHEL appointed Inspection Agency.

13.0 RETESTS:

If any of the test specimens fails to meet the requirements specified then two more test specimens may be taken. If either of the retest samples fail to meet the requirements the lot represented by the test samples shall be rejected.

14.0 TEST CERTIFICATES:

Five copies of the test certificates with the following details shall be furnished.

a) BHEL Order No
b) BHEL Specification No: HY 10579/Rev. 01
c) ASTM Designation
d) Melt No.
e) Consignment/Identification No.
f) Size
g) Results of product analysis.
h) Results of mechanical tests

15.0 MARKING:

The following shall be legibly stamped / marked on each plate/sheet and encircled by paint.

a) Melt No.
b) Supplier's identification mark
c) BHEL Order No.
d) HY 10579/Rev. 01
e) ASTM Designation
f) Consignment/Identification No.
g) Size & Weight
h) Supplier's Name

16.0 REJECTION AND REPLACEMENT:

In the event of the material proving defective in the course of further processing at BHEL, the same shall be rejected notwithstanding any previous acceptance.

The supplier shall replace the material forging at his own cost and the rejected material shall be returned after all the commercial conditions are satisfied.

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HIGH STRENGTH LOW ALLOY STRUCTURAL STEEL PLATES

(1) Cl.9.0 : Chemical Composition:-

Read the melt analysis of Cor-Ten B (above 12 mm) as follows in place of existing melt analysis of Cor Ten-B (above 12 mm)

Grade & Size	Melt Analysis	C	Mn	Si	Ni	Cr	Cu	V	P	S
Cor-Ten (above 12 mm)	Min.	-	0.80	0.30	-	0.40	0.25	0.02	-	-
	Max.	0.19	1.25	0.65	0.40	0.65	0.40	0.10	0.04	0.05

REF: Brought in line with latest ASTM A 588 Gr.A	Amd.No. 01	APPROVED DGM (P, T&I SERVICES)	ISSUED STDS. ENGG	DATE 28 . 6 . 98	CUM.Sr.No A 0247

		AMENDMENT-NOTIFICATION	HY 10576 REV.No.01
			PAGE 1 OF 1

HIGH YIELD STRENGTH, QUENCHED AND TEMPERED STEEL PLATES

1) Clause 8.0 CHEMICAL COMPOSITION :

Sulfur content of '0.040' shall be replaced by '0.035' in chemical composition table.

2) Clause 11.0 TEST CERTIFICTE :

The last sentence given under (g) shall be replaced by

"g) Results of hardness test on each plate".

REF:	AMD.NO.	APPROVED	ISSUED	DATE	CUM. Sl.No.
Chemical composition corrected in line with ASTM A514 – 2000 a.	01	MANAGER, STDS. ENGG.	STDS. ENGG.	10.09.2001	A 0349

HIGH YIELD STRENGTH, QUENCHED AND TEMPERED STEEL PLATES

1.0 GENERAL:

This specification governs the quality requirements of high yield strength, quenched and tempered steel plates to ASTM A514 Gr. B.

2.0 APPLICATION:

For pulverising mills' components which require high abrasion resistance.

3.0 CONDITION OF DELIVERY:

Hot rolled, quenched and tempered condition. Plates shall be supplied with hardness 320 BHN min.

4.0 COMPLIANCE WITH STANDARDS:

This specification complies with ASTM A 514 Gr. B (the latest) and with the following additional requirements.

5.0 DIMENSIONS AND TOLERANCES:

5.1 Dimensions: shall be as specified in the order. Unless otherwise specified, plates shall be supplied in the standard dimension of 1500 mm x 5600 mm.

5.2 Tolerances: shall be as per ASTM A6 (the latest).

6.0 MANUFACTURE:

The steel shall be manufactured in open-hearth or basic electric furnace or by basic oxygen process. The steel shall be fully killed.

7.0 FREEDOM FROM DEFECTS:

The plates shall be free from cracks, scabs, laminations and other harmful defects.

8.0 CHEMICAL COMPOSITION:

Melt analysis of the steel shall conform to the following.

Element		C	Mn	Si	P	S	Cr	Mo	V	Ti	B
Heat Ana-lysis	Min.%	0.12	0.70	0.20	-	-	0.40	0.15	0.03	0.01	0.0005
	Max.%	0.21	1.00	0.35	0.035	0.040	0.65	0.25	0.08	0.03	0.005

Note: 1. Product analysis of the steel shall be as per ASTM A6.

2. The suppliers may quote their equivalent grades in order to achieve the minimum hardness specified.

3. In case, the suppliers quote their own grades of steel, their quotations shall invariably furnish the bending details and full welding details i.e. electrode composition (AWS no.) preheating temperature, PW HT etc.

9.0 HEAT TREATMENT:

Suitable heat treatment cycle shall be selected to achieve the mechanical properties specified.

10.0 MECHANICAL PROPERTIES:

The plates shall conform to the minimum hardness of 320 BHN only. Each plate shall be tested for hardness.

11.0 TEST CERTIFICATES:

Five copies of the test certificate with the following details shall be furnished.

a) BHEL Order No.

b) HY10576 Rev.01

c) Name of the Mill

d) Size & Weight

e) Heat No.

f) Heat treatment details (Charts)

g) Results of chemical analysis

h) Results of mechanical properties tests (hardness and tensile test).

12.0 MARKING:

Each plate shall be punched with the following details and encircled with paint.

a) BHEL Order No.

b) HY10576 Rev. 01

c) Size & Weight

d) Heat/Melt No.

e) Supplier's name

f) Supplier's trade mark

13.0 REJECTION AND REPLACEMENT:

In the event of any plate proving defective during the course of further processing or testing, such material shall be rejected and the supplier shall make immediate arrangements to replace the same at free of cost.

HIGH STRENGTH LOW ALLOY STRUCTURAL STEEL PLATES

1.0 GENERAL:

This Specification governs the requirements of High Strength Low-Alloy Structural Steel Plates.

2.0 APPLICATION :

For fabrication of Oil Rig Components which require good resistance to atmosphere corrosion.

3.0 CONDITION OF DELIVERY:

Hot / Cold rolled, Normalized condition.

4.0 COMPLIANCE WITH NATIONAL STANDARDS:

The plates shall comply with the latest version of ASTM A588, Gr.A.

5.0 DIMENSIONS AND TOLERANCES :

5.1 Dimensions: Shall be as specified in the purchase order. Unless otherwise specified, plates shall be supplied in the standard dimension of 6' x 13' (1830mm x 3962mm).

5.2 Tolerances: Shall be as per ASTM:A6.

6.0 MANUFACTURE:

The steel shall be manufactured by one of the following process: Open hearth, basic oxygen or electric furnace. The steel shall be made to fine grain practice.

7.0 HEAT TREATMENT:

The material shall be supplied in the normalized condition.

8.0 CHEMICAL COMPOSITION:

The Melt analysis of material shall be as follows:

Element		C	Mn	Si	Ni	Cr	Cu	V	P	S
	Min	--	0.80	0.30	-	0.40	0.25	0.02	-	-
	Max	0.19	1.25	0.65	0.40	0.65	0.40	0.10	0.040	0.050
Permissible Variation in Product analysis		+ 0.04	+ 0.10 - 0.08	± 0.05	+ 0.03	± 0.04	± 0.03	± 0.01	+ 0.010	+ 0.010

9.0 MECHANICAL PROPERTIES:

The mechanical properties of the different groups of the sections shall be follows:

Thickness of the plate mm	Tensile Strength N/mm^2 Min.	Yield Strength, N/mm^2 Min	% Elongation Min.
			L=50 mm (L=4d)
Below 100	485	345	21
>100≤125	460	315	21
>125≤200.0	435	290	21

NOTE:

1) For plates wider than 610mm test specimen is taken in the transverse direction as per ASTM 6 Clause 11.2.

.2) For plates wider than 610mm, the elongation requirement is reduced by two percentage points.

10.0 INSPECTION AT SUPPLIER'S WORKS:

BHEL representative/BHEL appointed Inspection Agency shall have free entry and access to all areas where the manufacture of the bars is carried out. All reasonable facilities shall be extended to him including labour wherever necessary.

BHEL representative/BHEL appointed Inspection Agency shall be given sufficient advance intimation to witness the various processes, tests, etc. Punching and identification of test coupons and execution of various tests shall be done in presence of BHEL representative/BHEL appointed Inspection Agency.

11.0 TEST CERTIFICATE:

Five copies of the certificates giving the following details shall be furnished.

a) BHEL Order No.
b) BHEL Specification No. HY 105 75 / Rev.01
c) ASTM A588, Gr:A
d) Melt No.
e) Consignment/Identification No.
f) Size
g) Results of Chemical analysis.
h) Results of Mechanical tests.

12.0 MARKING:

Each plate shall be punched with the following details and encircled by paint.

a) Melt No.
b) Supplier's identification mark

In addition to the above, the following details shall also be marked legibly on each plate.

c) BHEL Order No.
d) HY 10575/Rev. 01
e) ASTM A588, Gr.A
f) Size & Weight
g) Supplier's Name

13.0 REJECTION AND REPLACEMENT:

In the event of the material proving defective in the course of further processing at BHEL, the same shall be rejected notwithstanding any previous acceptance.

The supplier shall replace the material forging at his own cost and the rejected material shall be returned after all the commercial conditions are satisfied.

HIGH YIELD STRENGTH QUENCHED AND TEMPERED ALLOY STEEL PLATE, SUITABLE FOR WELDING

(ORDERING DESCRIPTION OF ASTM A 514 OR EN 10137 Gr. S690 QL (1))

1.0 **GENERAL:**

This specification governs the quality aspects of alloy steel plates in quenched and tempered condition with the following additional requirements. The supplier has the option of supplying material as per latest version of ASTM A514 or EN 10137 Gr. S690 QL (1) meeting the requirements of this specification.

2.0 **APPLICATION:**

For Gas Turbine components, like support legs etc.

3.0 **CONDITION OF DELIVERY**:

The plates shall be supplied in hot rolled quenched and tempered condition.

4.0 **COMPLIANCE WITH NATIONAL / INTERNATIONAL STANDARDS:**

This specification is based on ASTM A514 or equivalent German standard DIN EN 10137 Gr. S690 QL (1).

Note: (1) The supplier may quote their equivalent grade which shall be capable of meeting the requirements of this specification also.

(2) In case, the suppliers quote their own equivalent grade, the complete details of the properties (like chemical & mechanical) of their grade with further processing methods like welding, bending and heat treatment characteristics shall also be specified alongwith their technical offer. BHEL reserves the right to accept or reject the offer based on technical suitability for intended applications of the material.

5.0 **DIMENSIONS AND TOLERANCES**:

5.1 Dimensions shall be as per purchase order.

5.2 Tolerances shall be as per ASTM A6 or any other equivalent reputed International standard.

6.0 **ULTRASONIC TESTING:**

All plates shall be subjected to 100% ultrasonic testing as per ASTM A435.

7.0 **INSPECTION AT SUPPLIER'S WORKS:**

BHEL's representative shall have all reasonable facilities afforded to him to satisfy himself that the material is being furnished in accordance with this specification. Test shall be witnessed at supplier's works by BHEL or consultant's representative and in such cases the supplier shall notify those concerned when the material is available for inspection and testing.

8.0 **TEST CERTIFICATION:**

Five copies of the test certificate with the following details shall be furnished.

a) BHEL Order No.
b) HY 10567 Rev.02
c) Name of the Mill
d) Size and Weight
e) Heat No.
f) Results of Chemical analysis
g) Results of Mechanical properties tests.
h) Results of ultrasonic tests.
i) Details of heat treatment cycles followed.

9.0 **MARKING AND PACKING:**

Shall be as per ASTM A514 or EN 10137.

CARBON STEEL PRESSURE VESSEL PLATES FOR LOW AND MODERATE TEMPERATURE SERVICE

(ORDERING DESCRIPTION FOR ASME : SA 516, Gr : 70)

1.0 GENERAL:

The material and other requirements shall comply with the latest version of ASME : SA 516, Gr: 70 as per ASME: Sec.II Part A – 2001 with additional requirements.

2.0 APPLICATION :

For fabrication of pressure vessels and heat exchangers as per ASME Boiler and Pressure Vessel code or Indian Boiler Regulations (IBR) requiring S1, S5, S12 and S14 supplementary requirements as per SA 516.

3.0 DIMENSIONS :

3.1 The thickness of the plate shall be as specified in the Purchase Order.

3.2 Unless otherwise specified in the Purchase Order, plates shall be supplied to the following widths and lengths.

Thickness (mm)	Width x Length (mm)
6 to 8	2500 x 6000
10 to 50	2500 x 7500
56 and above	3000 x 6000

4.0 CHEMICAL COMPOSITION :

Chemical Composition shall be as per SA516, Gr: 70 but carbon content shall not exceed 0.25% max.

5.0 HEAT TREATMENT:

The plates shall be supplied in normalised condition irrespective of thickness.

6.0 MECHANICAL TESTS:

Tensile test shall be as per ASME : SA 516.

7.0 VACUUM TREATMENT:

Plates shall be vacuum degassed as per supplementary requirement S1 of ASME SA516.

8.0 LOW TEMP. IMPACT TEST:

Charpy V-Notch impact test at low temperature shall be conducted as per supplementary requirement S5 of SA516.

9.0 ULTRASONIC TEST:

Plates of all thickness shall be ultrasonically examined as per supplementary requirements S12 of ASME SA516 (acceptance standard level-C of SA578). Test to be carried out after the Heat treatment.

10.0 BEND TEST:

Plates of all thickness shall be bend tested as per supplementary requirements S14 of SA 20.

11.0 REPAIRS:

11.1 Repair of defects by welding is not permitted.

11.2 When repairs are done by other mechanical means the minimum plate thickness shall be met with and the surface shall be smoothly dressed up to avoid sharp edges.

12.0 INSPECTION:

12.1 Material shall be inspected by M/s.IBR approved inspection agency. BHEL may also specify any other additional inspection agency at the time of placement of enquiry or purchase order.

12.2 INSPECTION AT SUPPLIER'S WORKS:

12.2.1 BHEL representative/BHEL appointed Inspection Agency shall have free entry and access to all areas where the manufacture of the bars is carried out. All reasonable facilities shall be extended to him including labour wherever necessary.

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12.2.2 BHEL representative/BHEL appointed Inspection Agency shall be given sufficient advance intimation to witness the various processes, tests, etc. Punching and identification of test coupons and execution of various tests shall be done in presence of BHEL representative/BHEL appointed Inspection Agency

13.0 TEST CERTIFICATE:

The test certificate shall be furnished in IBR Format Form IV.

14.0 PRESSERVATION:

Plates 10 mm and below shall be coated with suitable rust preventive.

15.0 MARKING:

The following details shall be hard punched on each plate near the edge and encircled with the white paint.

BHEL Specification No : HY 104 99 / Rev.01
ASME : SA 516, Gr : 70
BHEL Order No :
Melt NO :
Supplier's Name :
Inspection authority's mark :
Material Code No. as given in the Purchase Order.

16.0 REJECTION & REPLACEMENT:

In the event of the material proving defective in the course of further processing at BHEL, the same shall be rejected notwithstanding any previous acceptance.

The supplier shall replace the material forging at his own cost and the rejected material shall be returned after all the commercial conditions are satisfied.

17.0 REFERENCE STANDARDS:

ASME: SA516 Gr.70 as per ASME: Sec.II Part A – 2001.

CARBON STEEL PRESURE VESSEL PLATES FOR LOW AND MODERATE TEMPERATURE SERVICE (ORDERING DESCRIPTION FOR ASME: SA516 GR 70)

1.0 GENERAL :

The material and other requirements shall comply with the latest versions of ASME: SA516, Gr: 70, with the following additional requirements.

2.0 APPLICATION :

For fabrication of pressure vessels and heat exchangers as per ASME Boiler and Pressure Vessel code with S8 supplementary requirement as per SA 516.

3.0 DIMENSIONS :

Size of the plates shall be as per enquiry/purchase order.

4.0 CHEMICAL COMPOSITION :

Chemical composition shall be as per SA 516 Gr: 70 but carbon content shall not exceed 0.25% max.

5.0 MECHANICAL TESTS:

Tension tests shall be as per ASME: SA 516.

6.0 ULTRASONIC TESTS:

All the plates shall be ultrasonically examined as per supplementary requirement S8 of ASME SA 516.

7.0 REPAIRS

7.1 Repair of defects by welding is not permitted.

7.2 When repairs are done by other mechanical means, the minimum plate thickness shall be met with and the surface shall be smoothly dressed up to avoid sharp edges.

8.0 INSPECTION AT SUPPLIER'S WORKS:

8.1 BHEL representative / BHEL appointed Inspection Agency shall have free entry and access to all areas where the manufacture of the plates is carried out. All reasonable facilities shall be extended to him including labour wherever necessary.

8.2 BHEL representative / BHEL appointed Inspection Agency shall be given sufficient advance intimation to witness the various processes, tests, etc. Punching and identification of test coupons and execution of various tests shall be done in presence of BHEL representative / BHEL appointed Inspection Agency.

9.0 TEST CERTIFICATE:

Three copies of the test certificate shall be furnished in English, giving the details of the following:

a) HY 10498 Rev.01
b) ASME SA 516 Gr.70, latest Edition & Addenda.
c) Chemical, mechanical & NDT test results.
d) Melt No. / Plate Nos. etc.

10.0 MARKING

The following details shall be hard punched / stencil marked on each plate, near the edge and encircled with the white paint.

BHEL Specification No. HY 10498 Rev. 01
ASME Grade SA 516 Gr:70
BHEL Order No.
Melt No
Supplier's Name
Inspection Authority Mark
Material Code No. as given in the Purchase Order.

11.0 REJECTION & REPLACEMENT

In the event of the material proving defective in the course of further processing at BHEL, the same shall be rejected notwithstanding any previous acceptance.

The supplier shall replace the material at his own cost and the rejected material shall be returned after all the commercial conditions are satisfied.

CARBON STEEL PRESSURE VESSEL PLATES FOR LOW AND MODERATE TEMPETRATURE SERVICE

(ORDERING DESCRIPTION FOR ASME: SA 516, Gr : 70 WITH S1, S5 AND S8)

1.0 GENERAL:

The material and other requirements shall comply with the latest version of ASME : SA 516, Gr : 70, with the following additional requirements.

2.0 APPLICATION:

For fabrication of pressure vessels and heat exchangers as per ASME Boiler and Pressure Vessel code or Indian Boiler Regulations (IBR) requiring S1, S5 (Transverse direction) and S8 supplementary requirements as per SA 516.

3.0 CONDITION OF DELIVERY:

All the plates shall be free from mill scales and suitably protected with rust preventative coatings at the time of supplies.

4.0 DIMENSIONS:

4.1 The thickness of the plate shall be as specified in the Purchase Order.

4.2 Unless otherwise specified in the Purchase Order, plates shall be supplied to the following widths and lengths.

Thickness (mm)	Width x Length (mm)
6 to 8	2500 x 6000
10 to 50	3000 x 7500
56 and above	3000 x 6000

5.0 CHEMICAL COMPOSITION:

Chemical Composition shall be as per SA 516, Gr: 70 but carbon content shall not exceed 0.25% max.

6.0 MECHANICAL TESTS:

Tensile test shall be as per ASME: SA 516.

7.0 VACUUM TREATMENT:

Plates shall be vacuum degassed as per supplementary requirement S1 of ASME SA 516.

8.0 LOW TEMP. IMPACT TEST:

Charpy V-Notch impact test at low temperature shall be conducted as per supplementary requirement S5 of SA 516. The acceptance criteria shall be as per SA 20. The orientation of the test specimen shall be transverse to the rolling direction of the plate.

9.0 ULTRASONIC TEST:

Plates shall be ultrasonically examined as per supplementary requirements S8 of ASME SA516.

10.0 REPAIRS:

10.1 Repair of defects by welding is not permitted.

10.2 When repairs are done by other mechanical means the minimum plate thickness shall be met with and the surface shall be smoothly dressed up to avoid sharp edges.

11.0 INSPECTION:

11.1 If the material is purchased from WELL KNOWN STEEL MAKERs as approved by IBR (Indian Boiler Regulations) third party inspection is not necessary.

11.2 In case of procurement from other suppliers all plates shall be inspected at supplier's works by an Inspection authority recognised by IBR and the test certificates shall be attested to that effect.

11.3.0 **INSPECTION AT SUPPLIER'S WORKS:**

11.3.1 BHEL representative / BHEL appointed Inspection Agency shall have free entry and access to all areas where the manufacture of the bars is carried out. All reasonable facilities shall be extended to him including labour wherever necessary.

11.3.2 BHEL representative / BHEL appointed Inspection Agency shall be given sufficient advance intimation to witness the various processes, tests etc. Punching and identification of test coupons and execution of various tests shall be done in presence of BHEL representative / BHEL appointed Inspection Agency.

12.0 TEST CERTIFICATE:

Three copies of the test certificates shall be furnished as per IBR format FORM IV.

13.0 RUST PREVENTION:

All the plates shall be protected with rust preventative coatings suitable for providing resistance from atmospheric corrosion during outside storage for atleast six months.

14.0 **MARKING:**

The following details shall be hard punched on each plate, near the edge and encircled with the white paint.

HY10497 / Rev.00 OR ASME: SA 516, Gr : 70 (S1, S5,S8)
BHEL Order No :
Melt No :
Supplier's Name :
Inspection authority's mark :

15.0 **REJECTION & REPLACEMENT:**

In the event of the material proving defective in the course of further processing at BHEL, the same shall be rejected notwithstanding any previous acceptance.The supplier shall replace the material forging at his own cost and the rejected material shall be returned after all the commercial conditions are satisfied.

CARBON STEEL PRESSURE VESSEL PLATES FOR LOW AND MODERATE TEMPERATURE SERVICE

(ORDERING DESCRIPTION FOR ASME: SA 516, Gr : 70 WITH S1, S5 AND S8)

1.0 GENERAL:

The material and other requirements shall comply with the latest version of ASME : SA 516, Gr : 70, with the following additional requirements.

2.0 APPLICATION:

For fabrication of pressure vessels and heat exchangers as per ASME Boiler and Pressure Vessel code or Indian Boiler Regulations (IBR) requiring S1, S5 and S8 supplementary requirements as per SA 516.

3.0 CONDITION OF DELIVERY:

All the plates shall be free from mill scales and suitably protected with rust preventative coatings at the time of supplies.

4.0 DIMENSIONS:

4.1 The thickness of the plate shall be as specified in the Purchase Order.

4.2 Unless otherwise specified in the Purchase Order, plates shall be supplied to the following widths and lengths.

Thickness (mm)	Width x Length (mm)
6 to 8	2500 x 6000
10 to 36	2500 x 6000

5.0 CHEMICAL COMPOSITION:

Chemical Composition shall be as per SA 516, Gr: 70 but carbon content shall not exceed 0.25% max.

6.0 MECHANICAL TESTS:

Tensile test shall be as per ASME: SA 516.

7.0 VACUUM TREATMENT:

Plates shall be vacuum degassed as per supplementary requirement S1 of ASME SA 516.

8.0 LOW TEMPERATURE IMPACT TEST:

Charpy V-Notch impact test at low temperature shall be conducted as per supplementary requirement S5 of SA 516. The acceptance criteria shall be as per SA 20.

9.0 **ULTRASONIC TEST:**

Plates shall be ultrasonically examined as per supplementary requirements S8 of ASME SA516.

10.0 REPAIRS:

10.1 Repair of defects by welding is not permitted.

10.2 When repairs are done by other mechanical means the minimum plate thickness shall be met with and the surface shall be smoothly dressed up to avoid sharp edges.

11.0 INSPECTION:

11.1 If the material is purchased from WELL-KNOWN STEEL MAKER as approved by IBR (Indian Boiler Regulations) then inspection by any other third party inspection agency is not necessary unless it is specifically mentioned on the order.

11.2 In case of procurement from other suppliers all plates shall be inspected at supplier's works by an Inspection authority recognised by IBR and the test certificates shall be attested to that effect.

11.3.0 **INSPECTION AT SUPPLIER'S WORKS:**

11.3.1 BHEL representative / BHEL appointed Inspection Agency shall have free entry and access to all areas where the manufacture of the bars is carried out. All reasonable facilities shall be extended to him including labour wherever necessary.

11.3.2 BHEL representative / BHEL appointed Inspection Agency shall be given sufficient advance intimation to witness the various processes, tests etc. Punching and identification of test coupons and execution of various tests shall be done in presence of BHEL representative / BHEL appointed Inspection Agency.

12.0 **TEST CERTIFICATE**:

Three copies of the test certificates shall be furnished as per IBR format FORM IV.

13.0 RUST PREVENTION:

All the plates shall be protected with rust preventative coatings suitable for providing resistance from atmospheric corrosion during outside storage for atleast six months.

14.0 **MARKING:**

The following details shall be hard punched on each plate, near the edge and encircled with the white paint.

HY 10470 Rev.06 **OR** ASME: SA 516, Gr: 70 (S1, S5, S8)
BHEL Order No:
Melt No:
Supplier's Name:
Inspection authority's mark:

15.0 **REJECTION & REPLACEMENT:**

In the event of the material proving defective in the course of further processing at BHEL, the same shall be rejected notwithstanding any previous acceptance. The supplier shall replace the material forging at his own cost and the rejected material shall be returned after all the commercial conditions are satisfied.

STRUCTURAL STEEL SECTIONS (ORDERING DESCRIPTION FOR ASTM A36)

1.0 GENERAL:

This specification governs the requirements of Structural Steel Sections according to ASTM A36.

2.0 APPLICATION :

These sections, particularly wide flange beams are used in fabricating the mast and substructure of Oil Rigs.

3.0 COMPLIANCE WITH DELIVERY:

The Sections shall comply with the latest version of ASTM A36 and with the following additional requirements.

4.0 CONDITION OF DELIVERY :

Hot rolled.

5.0 DIMENSIONS AND TOLERANCES:

5.1 Sizes:

Sections shall be supplied to the dimensions specified on the order. Unless otherwise stated, they shall be supplied in lengths of 40 feet.

5.2 Tolerances:

Tolerances and general requirements shall be as per ASTM: A6.

.

6.0 CHEMICAL ANALYSIS:

The analysis of the material shall be as follows:

Element	C	Cu
Min.	-	0.20
Max.	0.26	-
Permissible variation in product analysis	+0.04	-0.02

7.0 TEST CERTIFICATE:

Five copies of the test certificate with the following details shall be furnished.

a) BHEL Order NO.

b) HY 101 98 / Rev 01

c) ASTM A36

d) Name of supplier

e) Results of chemical tests

f) Results of mechanical tests

8.0 MARKING:

The following shall be legibly stamped/marked on each section.

1. HY 101 98 (ASTM A36) / Rev 01
2. BHEL Order No.
3. Size & Length
4. Supplier's Name

9.0 REJECTION & REPLACEMENT

In the event of the material proving defective in the course of further processing at BHEL, the same shall be rejected notwithstanding any previous acceptance.

The supplier shall replace the material forging at his own cost and the rejected material shall be returned after all the commercial conditions are satisfied.

	CORPORATE PURCHASING SPECIFICATION	AA 107 40
		Rev. No. 07
		PREFACE SHEET

AUSTENITIC STAINLESS STEEL SHEETS, PLATES AND STRIPS – SOLUTION ANNEALED (ASTM A 240, TYPE 321)

FOR INTERNAL USE ONLY
REMOVE THIS PREFACE SHEET BEFORE ISSUE TO SUPPLIERS

Comparable Standards:

1. AMERICAN	:	ASTM A 240 Type 321, Solution annealed.
2. INDIAN	:	IS : 6911 - 1992 Gr :X04Cr18Ni10Ti, Solution annealed
3. EUROPEAN	:	EN 10088-2, Gr:X6CrNiTi 18-10

Suggested/Probable Suppliers And Grades:

Refer Plant Vendors list

User Plant References:

1.	HEEP - HARDWAR	:	HW 021 02 99
2.	BHOPAL	:	PS10506 Sheets & Plates
3.	HYDERABAD	:	AISI 321 CSN 417246.1

Revisions : Cl 27.3b of MOM of MRC-S&GPS			APPROVED : Interplant Material Rationalization Committee-MRC (S&GPS)		
Rev. No. 07	**Amd.No.**	**Reaffirmed**	**Prepared**	**Issued**	**Dt. of 1st Issue**
Dt.:15.06.2005	**Dt :**	**Year :**	**HARDWAR**	**Corp. R&D**	**JUNE, 1978**

AUSTENITIC STAINLESS STEEL SHEETS , PLATES AND STRIPS - SOLUTION ANNEALED (ASTM A 240, TYPE 321)

ORDERING DESCRIPTION

1.0 GENERAL :

The sheets, plates and strips shall conform to the latest version of ASTM A 240, Type 321 and comply with the following additional requirements.

2.0 APPLICATION :

For general engineering purposes, where corrosion resistance is essential.

3.0 CONDITION OF DELIVERY:

Hot/Cold rolled, solution annealed and descaled (Finish number 1 or 2 B/2D).

4.0 DIMENSIONS AND TOLERANCES

Material shall be supplied to the dimensions specified in BHEL order.

5.0 CHEMICAL COMPOSITION :

As per ASTM A 240, Type 321.

6.0 TEST CERTIFICATES :

Three copies of test certificates shall be supplied along with the following information:

BHEL References :

AA 107 40 -Rev. No.07 / ASTM A 240, Type:321
BHEL order No,

Supplier's References :
Name
Identification No.
Melt No.
Process of manufacture
Details of heat treatment.

Result of Tests:
Dimensional inspection.
Results of chemical analysis, mechanical tests

7.0 PACKING AND MARKING :

Sheets shall be supplied in bundles or in packages each weighing upto a maximum of 3000kg. Plates shall be suitably packed to prevent damage during transit.

For plates below 25 mm thick, each pile (preferably of 16 plates) shall be marked with suppliers identification mark, 'AA 107 40 / ASTM A 240, Type:321, melt No., BHEL order No., on the top plate.

Each plate of 25mm thickness and above shall be stamped/painted with the suppliers identification mark, 'AA 107 40 / ASTM A 240, Type:321, melt No., BHEL order No., on the top plate.

FOR INFORMATION ONLY

CHEMICAL COMPOSITION

C	Si	Mn	Ni	Cr	S	P	Ti	N
≤ 0.08	≤ 0.75	≤ 2.0	9.0-12.0	17.0-19.0	≤ 0.030	≤ 0.045	5(C+N) - 0.70, max	0.10

MECHANICAL PROPERTIES

Hardness, max		0.2% PS, min	UTS, min	% El, min	Bend Test
BHN	HRB	N/mm^2	N/mm^2		Dia.
217	95	205	515	40	-

	CORPORATE PURCHASING SPECIFICATION	AA 107 39
		Rev. No. 07
		PREFACE SHEET

AUSTENITIC STAINLESS STEEL SHEETS, PLATES AND STRIPS - SOLUTION ANNEALED (ASTM A 240, TYPE 304)

FOR INTERNAL USE ONLY
REMOVE THIS PREFACE SHEET BEFORE ISSUE TO SUPPLIERS

Comparable Standards:

1. AMERICAN	:	ASTM A 240 Type 304, Solution annealed.
2. INDIAN	:	IS : 6911 - 1992 Gr : X 04Cr 19 Ni 9 Solution annealed
3. EUROPEAN	:	EN 10088-2, Gr:X5CrNi18-10

Suggested/Probable Suppliers And Grades:

Refer Plant Vendors list

User Plant References:

1.	HEEP - HARDWAR	:	HW 021 02 99
2.	BHOPAL	:	PS10587, PS10512-Sheets & Plates
3.	HYDERABAD	:	AISI 304; ASTM A 240,Gr:TP304; ASEA 2 2333-02
4.	TRICHY	:	AISI 304

Revisions :	APPROVED : Interplant Material Rationalization Committee-MRC (S&GPS)
Cl 27.6.25 of MOM of MRC-S&GPS	

Rev. No. 07	Amd.No.	Reaffirmed	Prepared	Issued	Dt. of 1st Issue
Dt.:15.06.2005	Dt :	Year :	HARDWAR	Corp. R&D	JUNE, 1978

AUSTENITIC STAINLESS STEEL SHEETS , PLATES AND STRIPS - SOLUTION ANNEALED (ASTM A 240, TYPE 304)

ORDERING DESCRIPTION

1.0 GENERAL :

The sheets, plates and strips shall conform to the latest version of ASTM A 240, Type 304 and comply with the following additional requirements.

2.0 APPLICATION :

For general engineering purposes, where corrosion resistance is essential.

3.0 CONDITION OF DELIVERY:

Hot/Cold rolled, solution annealed and descaled (Finish number 1 or 2 B/2D).

4.0 DIMENSIONS AND TOLERANCES

Material shall be supplied to the dimensions specified in BHEL order.

5.0 CHEMICAL COMPOSITION :

As per ASTM A 240, Type 304.

6.0 TEST CERTIFICATES :

Three copies of test certificates shall be supplied along with the following information:

BHEL References :

AA 107 39 -Rev. No.07 / ASTM A 240, Type:304
BHEL order No,

Supplier's References :
Name
Identification No.
Melt No.
Process of manufacture
Details of heat treatment.

Result of Tests:
Dimensional inspection.
Results of chemical analysis, mechanical tests

7.0 PACKING AND MARKING :

Sheets shall be supplied in bundles or in packages each weighing upto a maximum of 3000kg. Plates shall be suitably packed to prevent damage during transit.

For plates below 25 mm thick, each pile (preferably of 16 plates) shall be marked with suppliers identification mark, 'AA 107 39 / ASTM A 240, Type:304, melt No., BHEL order No., on the top plate.

Each plate of 25mm thickness and above shall be stamped/painted with the suppliers identification mark, 'AA 107 39 / ASTM A 240, Type:304 , melt No., BHEL order No., on the top plate.

FOR INFORMATION ONLY

CHEMICAL COMPOSITION

C	Si	Mn	Ni	Cr	S	P	N
≤ 0.08	≤ 0.75	≤ 2.0	8.0-10.5	18.0 -20.0	≤ 0.030	≤ 0.045	0.10

MECHANICAL PROPERTIES

Hardness Max		0.2% PS min	UTS min	% El min	Bend Test
BHN	HRB	N/mm^2	N/mm^2		Dia.
201	92	205	515	40	-

	CORPORATE PURCHASING SPECIFICATION	AA 107 38
		Rev. No. 06
		PREFACE SHEET

STAINLESS STEEL SHEETS AND PLATES - ANNEALED
ASTM A 240, TYPE 410

FOR INTERNAL USE ONLY
REMOVE THIS PREFACE SHEET BEFORE ISSUE TO SUPPLIERS

Comparable Standards:

1. AMERICAN	:	ASTM A 240 Type: 410, Annealed.
2. INDIAN	:	IS : 6911 - 1992 Gr : X 12Cr 12, Annealed (A2)
3. EUROPEAN	:	EN 10088-2, Gr:X12Cr13.

Suggested/Probable Suppliers And Grades:

Refer Plant Vendors list

User Plant References:

1. HEEP - HARDWAR	:	HW 021 02 99

Revisions : Cl 27.3 of MOM of MRC-S&GPS			APPROVED : Interplant Material Rationalization Committee-MRC (S&GPS)		
Rev. No. 06	Amd.No.	Reaffirmed	Prepared	Issued	Dt. of 1st Issue
Dt.:15.06.2005	Dt :	Year :	HARDWAR	Corp. R&D	JUNE, 1978

STAINLESS STEEL SHEETS AND PLATES - ANNEALED ASTM A 240, TYPE 410

ORDERING DESCRIPTION

1.0 GENERAL :

The sheets and plates shall conform to the latest version of ASTM A 240, Type: 410 and comply with the following additional requirements.

2.0 APPLICATION :

For general engineering purposes, where corrosion resistance is essential.

3.0 CONDITION OF DELIVERY:

Hot, annealed and descaled (Finish No.1).

Cold rolled, annealed (2B / 2 D).

4.0 DIMENSIONS AND TOLERANCES:

Material shall be supplied to the dimensions specified in BHEL order.

5.0 CHEMICAL COMPOSITION:

As per ASTM A 240, Type 410.

6.0 TEST CERTIFICATES :

Three copies of test certificates shall be supplied along with the following information:

BHEL References :

AA 107 38 -Rev. No.06 / ASTM A 240, Type:410
BHEL order No,

Supplier's References :
Name
Identification No.
Melt No.
Process of manufacture
Details of heat treatment.

Result of Tests:
Dimensional inspection.
Results of chemical analysis, mechanical tests

7.0 PACKING AND MARKING :

Sheets shall be supplied in bundles or in packages each weighing upto a maximum of 3000kg. Plates shall be suitably packed to prevent damage during transit.

For plates below 25 mm thick, each pile (preferably of 16 plates) shall be marked with suppliers identification mark, 'AA 107 38 / ASTM A 240, Type:410, melt No., BHEL order No., on the top plate.

Each plate of 25mm thickness and above shall be stamped/painted with the suppliers identification mark, 'AA 107 38 / ASTM A 240, Type:410 , melt No., BHEL order No., on the top plate.

FOR INFORMATION ONLY

CHEMICAL COMPOSITION

C	Si	Mn	Ni	Cr	S	P	Al
0.08-0.15	≤ 1.0	≤ 1.0	≤ 0.75	11.5-13.5	≤ 0.030	≤ 0.040	-

MECHANICAL PROPERTIES

Hardness, max		0.2% PS min	UTS, min	% El min	Bend Test
BHN	HRB	N/mm^2	N/mm^2		Dia.
217	96	205	450	20	180^0

	CORPORATE PURCHASING SPECIFICATION	**AA 107 37**
		Rev. No. 05
		PREFACE SHEET

FERRITIC STAINLESS STEEL SHEETS AND PLATES - ANNEALED ASTM A 240, TYPE 405

FOR INTERNAL USE ONLY
REMOVE THIS PREFACE SHEET BEFORE ISSUE TO SUPPLIERS

Comparable Standards:

1. AMERICAN	:	ASTM A 240 Type: 405, Annealed.
2. INDIAN	:	IS : 6911 - 1992 Gr : X 04Cr 12 , Annealed

Suggested/Probable Suppliers And Grades:

Refer Plant Vendors list

User Plant References:

1.	HEEP - HARDWAR	:	HW 021 02 99
2.	BHOPAL	;	PS 10641
3.	HYDERABAD	:	--

Revisions :			**APPROVED : Interplant Material Rationalization Committee-MRC (S&GPS)**		
Cl 27.6.23 of MOM of MRC-S&GPS					
Rev. No. 05	**Amd.No.**	**Reaffirmed**	**Prepared**	**Issued**	**Dt. of 1st Issue**
Dt.:15.06.2005	**Dt :**	**Year :**	**HARDWAR**	**Corp. R&D**	**JUNE, 1978**

FERRITIC STAINLESS STEEL SHEETS AND PLATES-ANNEALED (ASTM A 240, TYPE 405)

ORDERING DESCRIPTION

1.0 GENERAL :

The sheets and plates shall conform to the latest version of ASTM A 240, Type 405 and comply with the following additional requirements.

2.0 APPLICATION :

For general engineering purposes, where corrosion resistance is essential.

3.0 CONDITION OF DELIVERY:

Hot/Cold rolled, annealed and descaled (Finish number 1 or 2 B/2D).

4.0 DIMENSIONS:

Material shall be supplied to the dimensions specified in BHEL order.

5.0 CHEMICAL COMPOSITION :

As per ASTM A 240, Type 405.

6.0 TEST CERTIFICATES :

Three copies of test certificates shall be supplied along with the following information:

BHEL References :

AA 107 37 -Rev. No.05 (ASTM A 240, Type:405)
BHEL order No,

Supplier's References :
Name
Identification No.
Melt No.
Process of manufacture
Details of heat treatment.

Result of Tests:
Dimensional inspection.
Results of chemical analysis, mechanical tests

7.0 PACKING AND MARKING :

Sheets shall be supplied in bundles or in packages each weighing upto a maximum of 3000kg. Plates shall be suitably packed to prevent damage during transit.

For plates below 25 mm thick, each pile (preferably of 16 plates) shall be marked with suppliers identification mark, 'AA 107 37 / ASTM A 240, Type: 405', melt No., BHEL order No., on the top plate.

Each plate of 25mm thickness and above shall be stamped/painted with the suppliers identification mark, the melt number and AA 10737 (ASTM A 240, Type: 405).

FOR INFORMATION ONLY

CHEMICAL COMPOSITION

C	Si	Mn	Ni	Cr	S	P	Al
≤ 0.08	≤ 1.0	≤ 1.0	0.60, max	11.5-14.5	≤ 0.030	≤ 0.040	0.10-0.30

MECHANICAL PROPERTIES

Hardness Max		0.2% PS min	UTS min	% El min	Bend Test
BHN	HRB	N/mm²	N/mm²		Dia.
179	88	170	415	20	2 X Th of test Pc.

	CORPORATE PURCHASING SPECIFICATION	**AA 106 47**
		Rev. No. 05
		PREFACE SHEET

CHROMIUM – MOLYBDENUM ALLOY STEEL PLATES, Gr.: 12, CLASS 2, FOR PRESSURE VESSELS

FOR INTERNAL USE ONLY
REMOVE THIS PREFACE BEFORE ISSUE TO SUPPLIERS

Comparable Standards:

Suggested/Probable Suppliers and Grades:

User Plants /References

1. HEEP, HARDWAR :
2. BHOPAL :
3. HYDERABAD : HY10698, 10699

Revisions: Cl: 33.1.0 .C.1 of MRC-FCF+HTM			**APPROVED : INTERPLANT MATERIAL RATIONALISATION COMMITTEE-MRC (FCF+HTM)**		
Rev. No. 05	**Amd.No.**	**Reaffirmed**	**Prepared**	**Issued**	**Dt. of 1st Issue**
Dt: 29.01.2008	**Dt :**	**Year :**	**TRICHY**	**Corp. R&D**	**MARCH, 1979**

CHROMIUM – MOLYBDENUM ALLOY STEEL PLATES, Gr.: 12, CLASS 2, FOR PRESSURE VESSELS

ORDERING DESCRIPTION FOR ASME SA 387, Gr.: 12, CLASS 2

1.0 GENERAL

The plates shall conform to the latest version for ASME SA 387, Gr.: 12 Cl. 2 and comply with the following additional requirements.

2.0 APPLICATION

For high temperature service at stress levels and temperatures allowed by ASME Boiler and Pressure Vessel Code, Section I and Indian Boiler Regulations for steam and water application.

3.0 MANUFACTURE:

Steel shall be killed and vacuum degassed. (S 1).

4.0 HEAT TREATMENT:

As per ASME SA 387.

5.0 TEST SAMPLES:

As per ASME SA 387.

6.0 MECHANICAL PROPERTIES:

Bend test as per S 14 of ASME SA 20 shall be conducted.

7.0 ULTRASONIC TEST:

Ultrasonic examination and acceptance standards shall be as per ASME SA 578, level B.

8.0 INSPECTION:

All the plates must be inspected at works by an Inspecting Authority and the test certificates must be countersigned by an Inspecting Authority recognised by Indian Boiler Regulations like Lloyds register of Shipping.

9.0 EDGE PROCESSING:

Edge processing shall be accomplished by procedures which will not result in edge cracking.

10.0 MARKING:

10.1 Hard stamping of melt number, specification and grade, plate number and the inspection authority's stamp on the plates along rolling direction and bordered by white paint.

10.2 Painting of purchase order number, melt number specification number, size, net weight and BHEL on the plates and protected by transparent varnish coating.

10.3 Rust preventive coating for plates less than 20 mm thickness.

11.0 REPAIRS

Fusion welding is prohibited.

When done by mechanical means, the specified thickness is to be met with and the surfaces to be smoothly dressed up from any sharp edges.

12.0 CERTIFICATION

12.1 As per IBR form IV.

12.2 In addition to the above, the following details shall be furnished with the test certificates:

a) Heat treatment status of the plate.
b) Heat treatment temperature, soaking time and cooling medium for mill test samples.

13.0 REJECTION AND REPLACEMENT

In the event of any material proving defective during the course of preparation, machining, testing or erection such material shall be rejected notwithstanding any previous certification of satisfactory testing and /or inspection.

	CORPORATE PURCHASING SPECIFICATION	AA 101 79
		Rev. No. 02
		PREFACE SHEET

EXPANDED METAL STEEL SHEET

FOR INTERNAL USE ONLY
REMOVE THIS PREFACE SHEET BEFORE ISSUE TO SUPPLIERS

Comparable Standards:

1. INDIAN : IS: 412 – 1975

Suggested/Probable Suppliers And Grades:

Refer plant vendors list

User Plant References:

1. BHOPAL : PS 101 79
2. HEEP, HARDWAR : 0500.026

Revisions : Cl: 26.6.15 of MOM of MRC-S&GPS			APPROVED : INTERPLANT MATERIAL RATIONALISATION COMMITTEE-MRC (S&GPS)		
Rev. No. 02	Amd.No.	Reaffirmed	Prepared BHOPAL	Issued Corp. R&D	Dt. of 1st Issue FEBRUARY, 1977
Dt:15.01.2004	Dt :	Year :			

EXPANDED METAL STEEL SHEET

1.0 GENERAL:

This specification governs the quality requirements of Expanded metal steel sheets .

2.0 APPLICATION:

For general engineering purposes.

3.0 CONDITION OF DELIVERY:

The material shall be supplied with suitable protective coating to prevent corrosion.

4.0 COMPLIANCE WITH NATIONAL STANDARDS:

The material shall comply with the requirements of the following National standards and also meet the requirements of this specification:

IS: 412-1975: Expanded metal steel sheets for general purposes.

5.0 DIMENSIONS AND TOLERANCES:

Sizes:

The material shall be supplied to the dimensions specified in BHEL order.

BHEL order shall clearly state the shortway mesh, longway mesh, thickness and width of sheet required..

5.2 Tolerances:

5.2.1 Dimensions:

When expanded metal sheets are required to be supplied to the specified dimensions, the limits of thickness as follows:

On nominal specified dimension : ± 10 mm

On minimum specified dimensions: - 0 mm
+ 10 mm

5.2.2 Mass:

The tolerance on nominal mass of expanded metal sheets shall be ± 10 percent.

5.2.3 Mass:

Size of mesh:

The tolerance on sizes of mesh shall be as follows:

On swm		**Tolerance**
Upto and incld.	20 mm	± 1 mm
Over	20 mm	± 2 mm

On lwm

Upto and incld.	60 mm	± 2 mm
Over	60 mm	± 4 mm

6.0 MANUFACTURE :

Blank steel sheets and plates used in the manufacture of expanded metal steel sheets shall be made from steel manufactured by the open hearth, electric, basic oxygen or a combination of these processes. If any other process is employed, prior approval of BHEL shall be obtained.

7.0 FREEDOM FROM DEFECTS :

The finished expanded metal sheets shall be free from flaws, joints, blows, broken strands, laminations and other surface defects.

8.0 CHEMICAL COMPOSITION:

The sulphur and phosphorus content shall be limited to 0.050 percent , maximum each with a permissible variation of + 0.005 percent for each element.

9.0 SELECTION OF TEST SAMPLES:

For every lot of 100 expanded metal sheets or less, two sheets shall be selected for bend test.

One bend test piece shall be cut from each of the two sheets.

The test piece shall preferably be cut from the edge of the sheet to avoid wastage.

10.0 BEND TEST:

The material when tested in accordance with IS:1599 shall withstand without fracture, being doubled over either by pressure or by blows from a hammer, until the two sides of the strands are paralleled and the internal radius of the bend is not greater than 1.5 times the thickness of the test piece. Sheets with shortway mesh less than 40 mm thickness are not subjected to this test.

11.0 PROTECTIVE COATING:

The material shall be given a suitable protective coating to prevent corrosion.

12.0 TEST CERTIFICATES:

Unless otherwise specified, three copies of test certificates shall be supplied.

In addition, the supplier shall ensure to enclose one copy of the test certificate along with their despatch documents to facilitate quick clearance of the material.

The test certificate shall bear the following information:

AA 101 79, Rev 02: Expanded metal steel sheets
BHEL Order No,
Supplier's name,
Identification No
Dimensional inspection
Results of bend and chemical composition

13.0 PACKING AND MARKING:

The material shall be supplied in rolls suitably packed to prevent from corrosion and damage during transit.
A metal label shall be securely attached to each bundle and shall bear the following information :

AA 101 79: Expanded metal steel sheets
BHEL Order No,
Supplier's Name
Consignment & Identification No,
Size & Weight.

14.0 REFERRED STANDARDS (Latest Publications Including Amendments) :

1. IS : 412 2. IS : 1599

	REAFFIRMATION - NOTIFICATION	AA 101 31 Rev. No. 04
		PAGE 1 OF 1

AA 101 31 : COLD-REDUCED MILD STEEL SHIMS

This specification is reaffirmed in 1999.

Please see Instruction on the reverse

Ref :	Approved	Issued	Date	Cum.Sl.No.
Cl 23-7-12 of MOM of MRC-S&GPS	MRC S&GPS	CORP. R&D	15.11.99	R 2685

COLD-REDUCED MILD STEEL SHIMS

FOR INTERNAL USE ONLY
REMOVE THIS PREFACE BEFORE ISSUE TO SUPPLIERS

Equivalent/Comparable Standards :

Acceptable Suppliers and Grades :

User Plants & Replaced Plant Specifications/References :

1.	BHOPAL	: PS 101 31
2.	HEEP, HARDWAR	: --
3.	HYDERABAD	: HY 021 02 99 (Commercial grade)
4.	TIRUCHY	: BM-C 10

Revision: CL. 18.2.13 OF MOM OF MRC - S&GPS			Approved: INTERPLANT MATERIAL RATIONALISATION COMMITTEE - MRC (S&GPS)		
Rev.No. 04	AMD.No.	Reaffirmed	Prepared	Issued	Dt. of 1st Issue
Dt. Jan'95	Dt.	Year:	BHOPAL	CORP. R&D	Aug'76

COLD-REDUCED MILD STEEL SHIMS

1.0 GENERAL:

This specification governs the quality requirements of Cold Mild Steel Shims of thickness 0.05 to 0.49 mm, supplied in the form of sheets in coils.

2.0 APPLICATION:

For shims and other general engineering purposes.

3.0 CONDITION OF DELIVERY:

Cold-Reduced sheets in coils.

4.0 COMPLIANCE WITH NATIONAL STANDARDS:

There is no Indian standard covering this thickness of material. However, assistance has been derived from IS:2385.

5.0 DIMENSIONS AND TOLERANCES:

5.1 Sizes:
Material shall be supplied to the dimensions specified on the order.

5.2 Tolerances:
The thickness of shim/sheet shall comply with the following:

5.2.1 Thickness:

Average thickness of consignment:
The mean of the thickness of each lot of 5 sheets selected from a package shall not deviate from the ordered nominal thickness by more than ± 2.5 percent.

Average thickness of individual sheet:
The average thickness of any of the 5 sample sheets selected from a package shall not deviate by more than ± 8.5 percent from the ordered nominal thickness.

Variation within a sheet:
The thickness of an individual specimen shall not deviate by more than ± 4 percent from the average thickness of the sheet.

5.2.2 Length and Width:
+ 5 mm
- 0 mm

5.2.3 Shape:

Flatness:
Sheet shall be commercially flat when placed vertical and horizontal positions.
Sheets hanging from vertical position shall not show bowing of more than 5 mm.

Edge waviness:
Sheet lying on a flat surface shall not show edge waviness of more than 3 mm.

Squareness:
The maximum out of squareness shall not normally exceed 0.15 percent of the length. However,5 percent of the sheet may exceed this limit to a maximum of 0.25%.

Camber:
Maximum camber on any edge shall be such that the deviation from the straight line does not exceed 0.15 percent on any side.

6.0 MANUFACTURE :

The method of manufacture of the material shall be at the discretion of manufacturer.

7.0 TREATMENT:

The hot-rolled strip shall be pickled, cold-reduced with or without intermediate annealing and cleaned, annealed and finally temper-rolled, if necessary, to obtain the desired condition of the material and surface.

8.0 FREEDOM FROM DEFECTS:

The material shall be free from cracks, pitting, blisters, laminations and other surface defects.

9.0 CHEMICAL COMPOSITION :

The melt analysis of steel and permissible variation in the composition of the material from the melt analysis shall be as follows:

Element	Percent, Max.	Permissible variation, Percent, Max.
Carbon	0.12	0.02
Manganese	0.60	0.03
Sulphur	0.050	0.005
Phosphorus	0.050	0.005

10.0 TEST SAMPLES:

Hardness Test:
One sample shall be selected from each package.

11.0 HARDNESS (VICKERS):

When tested in accordance with IS: 1501, the test pieces shall have a Vicker's hardness in the range of 80-120 HV.

12.0 INSPECTION AT SUPPLIERS' WORKS :

Whenever specified, tests and inspection are to be conducted in the presence of BHEL's representative.

BHEL's representative shall have free access at all times while the work on the contract is being performed, to all parts of the manufacturer's works. The manufacturer shall offer BHEL's representative all reasonable facilities without charge to satisfy the latter that the material is being furnished in accordance with this specification. The manufacturer shall prepare and provide necessary test specimens for testing to be carried out at his premises. If facilities do not exit at his works, the manufacturer shall make necessary arrangements for carrying out the prescribed tests elsewhere. The manufacturer shall notify BHEL's representative in advance about the readiness of the material for inspection and testing.

BHEL reserves the right to test the material at BHEL's works and the final acceptance of the material shall be based on these test results.

13.0 TEST CERTIFICATES :

Three copies of test certificates shall be supplied unless otherwise stated on the order.
In addition, the supplier shall ensure to enclose one copy of the test certificate along with their despatch documents to facilitate quick clearance of the material.
The test certificate shall bear the following information :

BHEL References :
AA 10131 : Rev.No.04
BHEL Order No.

Supplier's References :
Name
Identification No.
Melt No.
Process of manufacture.

Results of tests :
Dimensional inspection.
Results of chemical analysis and mechanical tests.

14.0 PACKING AND MARKING :

14.1 Packing:

The material shall be supplied in coils of continuous strip. The nominal weight of each coil shall be 1800-2000kg. The nominal internal diameter of coil shall be 500 mm.
Sheet shall be protected to prevent damage and rusting during transit.
Sheet shall be packed in line with IS: 2385.

14.2 Marking:

A matal label shall be securely attached to each bundle and shall be marked with the following:

AA 101 31 : Cold - Reduced M.S Shims
BHEl Order No.
Consignment / Identification No.
Weight, Size and Thickness
Supplier's Name and Grade
Melt No.
Packet/ Bundle No.

15.0 REJECTION AND REPLACEMENT :

If the material does not comply with the requirements of this specification during receipt inspection at BHEL or any defect is found during the course of further processing,such material shall be rejected notwithstanding any previous certification of satisfactory testing and/or inspection.

The manufacturer shall undertake to replace the rejected material of his own cost and the rejected material shall be taken back by the supplier after fulfilling the commercial terms and conditions.

16.0 REFERRED STANDARDS :

The following is the list of the latest standards, as published by the respective issuing bodies, referred to in this specification.

1. IS:228 2. IS:1501 3. IS:2385

	CORPORATE PURCHASING SPECIFICATION	**AA 101 22**
		Rev. No. 14
		PREFACE SHEET

STRUCTURAL STEEL-HIGH TENSILE PLATES, FLATS & BARS

FOR INTERNAL USE ONLY
REMOVE THIS PREFACE SHEET BEFORE ISSUE TO SUPPLIERS

Comparable Standards:

1. GERMAN : DIN EN 10025-2:2004
   Gr: S355 J2 G3
   Mat. No. 1.0577
2. INDIAN : IS: 2062-2006 Grade E350 (Fe 490)

Suggested/Probable Suppliers And Grades:

Refer Plant Vendors List

User Plant References:

1.	BHOPAL	:	PS 10541
2.	JHANSI	:	PS 10541
3.	HEEP, HARDWAR	:	0500.009, HW10181
4.	HYDERABAD	:	HY 021 02 99, HY10591
5.	TRICHY	:	TDC 0:301

Revisions : **CL.32.7 of MOM of MRC-S&GPS**			**APPROVED :** **INTERPLANT MATERIAL RATIONALISATION COMMITTEE-MRC (S&GPS)**		
Rev. No. 14	**Amd.No.**	**Reaffirmed:**	**Prepared**	**Issued**	**Dt. of 1 st Issue**
Dt:01.07.2008	**Dt :**	**Year :**	**HYDERABAD**	**Corp. R&D**	**JULY, 1976**

STRUCTURAL STEEL - HIGH TENSILE PLATES, FLATS & BARS

1.0 GENERAL:

This specification governs the quality requirements of High Tensile Structural Steel Plates where guaranteed weldability is required.

2.0 APPLICATION :

Steel intended for use in structures where enhanced mechanical properties are required and where saving in weight can be effected due to their greater strength.

3.0 CONDITION OF DELIVERY :

Plates shall be supplied in the normalized condition or in an equivalent condition obtained by normalizing rolling.

4.0 COMPLIANCE WITH NATIONAL STANDARDS:

Material shall comply with the requirements of DIN EN 10025-2:2004, Gr: S355J2G3 (Material Number 1.0577) or the equivalent grade of latest version.

The supply of the material as per IS:2062-2006 Grade E350 (Fe 490) (latest version) meeting the requirement of clause 3.0, 5.0, and 12.0 of this specification is also acceptable.

5.0 DIMENSIONS AND TOLERANCES :

5.1 Dimensions :

5.1.1 Sizes

Material shall be supplied to the dimensions specified on BHEL Order.

5.1.2 Length :

Unless otherwise specified, hot rolled bars and sections shall be supplied in 3 to 6 metres length.

5.2 Tolerances:

The tolerances on dimensions for plates shall comply with DIN EN 10029.

6.0 MANUFACTURE:

Material shall be manufactured from fully killed (FF) steel having a Carbon Equivalent (melt analysis) of:

0.45 max. for plates upto & incl. 30 mm thick

0.47 max. for plates above 40 mm thick upto & incl. 150 mm thick.

0.49 max for plates > 150mm & $\leq$ 250 mm thick.

7.0 FREEDOM FROM DEFECTS :

All finished steel shall be well and cleanly rolled to the dimensions, sections and weights specified. The finished material shall be free from cracks, surface flaws, laminations; rough, jagged and imperfect edges and internal & surface defects.

8.0 CHEMICAL COMPOSITION:

The melt analysis of steel and the permissible variation in the composition of the material from the melt analysis shall be as follows:

Element	Percent, max.	Permissible variation, percent, maximum
Carbon		
Upto&Incl 40mm thick	0.20	0.03
Above 40mm thick	0.22	0.02
Silicon	0.55	0.05
Manganese	1.60	0.10
Sulphur	0.025	0.010
Phosphorus	0.025	0.010
Copper	0.55	0.050

Note :

1. Total Aluminum: 0.020%, minimum.
2. Micro-alloying elements like niobium, boron, titanium and vanadium may be added by the manufacturer to achieve the mechanical properties specified.
3. Carbon Equivalent (CE) based on melt analysis shall be calculated as per following formula :

$$CE = C + \frac{Mn}{6} + \frac{Cr+Mo+V}{5} + \frac{Ni+Cu}{15}$$

9.0 TEST SAMPLES:

Test samples shall be selected and prepared in accordance with DIN EN 10025. One tensile test piece per 40 tonnes or part thereof shall be selected from finished steel from each melt for each class of products.

10.0 MECHANICAL PROPERTIES (On longitudinal test samples) :

i) Tensile :

The test pieces shall show the following properties, when tested in accordance with IS: 1608 / DIN EN 10025.

Nominal thickness, mm	Tensile strength N/mm^2, min.	Yield strength N/mm^2, min.	Elongation on 5.65 √So gauge length, percent, min.
From 5 to 16	470-630	355	22
Over 16 to 40	470-630	345	22
--- 40 to 63	470-630	335	21
--- 63 to 80	470-630	325	20
---- 80 to 100	470-630	315	20
---- 100 to 150	450-600	295	18
---- 150 to 200	450-600	285	17
---- 200 to 250	450-600	275	17
---- 250 to 400	450-600	265	17

ii) Impact :

The impact test shall be carried out in accordance with DIN EN 10045-1/IS-1757 at (-20^0C). The impact values achieved shall be as follows.

Nominal thickness (mm)	Impact strength (KCV) (2mm 'V' notch)
< 16	Note (1)
16 ≥ to ≤ 150	27 Joules
150 > to ≤ 250	27 Joules

Note :

(1) Impact test is not required for plates below 16 mm.

The average value of the three test results shall meet the specified requirement. One individual value may be the below minimum average value specified, provided that it is not less than 2/3 rd of the same.

11.0 PROTECTIVE COATING :

Plates upto 10 mm thick shall be applied with a suitable rust preventive coating for overseas shipping only.

12.0 ULTRASONIC EXAMINATION:

Plates above 40mm shall be ultrasonically examined in accordance with BHEL standard AA 085 01 20 (or ASTM A435 / EN10160) and shall comply with the acceptance norms specified therein.

13.0 OPTIONAL:

PRESERVATION:

If specified in order, all plates shall be applied with a suitable rust preventive to avoid pitting.

14.0 TEST CERTIFICATES:

Unless otherwise specified, three copies of test certificates shall be supplied.

In addition, the supplier shall ensure to enclose one copy of the test certificate along with their despatch documents to facilitate quick clearance of the material.

The test certificate shall bear the following information:

(i) AA 101 22-Rev. No.13, DIN EN 10025 Gr. S355J2G3, Matl. No. 1.0577.

(ii) BHEL order No, Melt No, Size & Quantity, Batch No with heat treatment details, Results of Chemical analysis, Mechanical tests & NDT, Supplier's name, Identification No, TC No, Signature of Competent authority, etc.

15.0 PACKING AND MARKING:

Plates shall be transported suitably to avoid damage during transit.

For plates below 10 mm thick, each pile (preferably of 16 mm plates) and each plate 10 mm thick and over shall be marked with Melt No., AA 101 22, BHEL Order No, Supplier's Name, Identification No, Size & weight, on any one corner and encircled with paint preferably of white colour.

15.0 REFERRED STANDARDS (Latest Publications including amendments):

1. IS : 1608	2. IS: 2062	3. DIN EN 10025
4. DIN EN 10029	5. DIN EN 10045-1	6. AA 085 01 20
7. ASTM A435	8. EN10160	

बी एच ई एल BHEL	**CORPORATE PURCHASE SPECIFICATION**	**AA 101 19** **Rev. No. 12** **PREFACE SHEET**

STRUCTURAL STEEL - WELDABLE QUALITY (PLATES, SECTIONS, STRIPS, FLATS AND BARS)

FOR INTERNAL USE ONLY
REMOVE THIS PREFACE BEFORE ISSUE TO SUPPLIERS

Equivalent/Comparable Standards:

1. **IS 2062 Grade : B**
2. **DIN EN 10025 Grade : S275J2G3**

Acceptable Suppliers & Commercial Grades:

User Plants & Replaced Plant Specs/References:

1. BHOPAL
2. HEEP, HARDWAR

Revisions : Cl: 30.4.0 of MOM of MRC_S & GPS			**APPROVED :** INTERPLANT MATERIAL RATIONALISATION COMMITTEE-MRC (S&GPS)		
Rev. No. 12	**Amd.No.**	**Reaffirmedd**	**Prepared**	**Issued**	**Dt. of 1st Issue**
Dt. Nov 2007	**Dt :**	**Year :**	**HYDERABAD**	**Corp. R&D**	**JUNE, 1976**

बी एच ई एल BHEL	**CORPORATE PURCHASE SPECIFICATION**	**AA 10119**
		Rev. No. 12
		PAGE 1 OF 2

STRUCTURAL STEEL - WELDABLE QUALITY (PLATES, SECTIONS, STRIPS, FLATS, AND BARS)

(ORDERING DESCRIPTION)

1.0 GENERAL:

The material shall conform to the latest version of IS 2062, GradeE250 (Fe410W) Quality B or DIN EN 10025, Gr.: S275J2G3 and comply with following additional requirements.

2.0 APPLICATION:

For general engineering purposes, suitable for welding.

3.0 CONDITION OF DELIVERY:

3.1 Bars & Sections: Hot rolled in straight lengths without twists and bends.

3.2 Plates: Plates upto 12 mm thickness shall be supplied in as rolled condition. Plates above 12mm thickness shall be supplied in hot rolled, normalized or an equivalent condition obtained by normalizing rolling or controlled rolling.

All the plates shall be free from mill scales and suitably protected with rust preventative coatings at the time of supplies.

4.0 DIMENSIONS AND TOLERANCES:

4.1 Sizes: Material shall be supplied to the dimensions specified in BHEL Order.

4.2 Tolerances: The tolerances on hot rolled material shall comply with IS:1852 or any other equivalent National standard.

4.3 Straightness for hot rolled bars: Unless otherwise specified, the permissible deviation in straightness shall not exceed 5 mm in any 1000 mm length.

5.0 TEST SAMPLES:

5.1 Tensile Test Pieces: One tensile test sample shall be made from finished steel of each melt per size for each class of product viz. plates, sections, strips, flats and bars size of the product.

5.2 Bend Test Pieces:

Bend test piece shall be made from finished steel of each melt per size of the product.

6.0 ULTRASONIC EXAMINATION:

Plates shall be ultrasonically examined in accordance with BHEL standard AA 085 01 20 (or ASTM-A 435) as detailed below and shall comply with the acceptance standards specified therein.

6.1 For plates above 40mm thick: Shall be ultrasonically examined, unless otherwise specified in order.

7.0 TEST CERTIFICATES:

Unless otherwise specified, three copies of test certificates shall be supplied. In addition, the supplier shall ensure to enclose one copy of the test certificate along with their dispatch documents to facilitate quick clearance of the material.

The test certificate shall bear the following information:

AA 101 19-Rev. No.12 S : 2062-Gr. E250 (Fe410W) Quality B or DIN EN 100 25 Gr. S275J2G3, BHEL order No., Melt No, Size & Quantity, Batch No with heat treatment details, Results of Chemical analysis, Mechanical tests & NDT, Supplier's name, Identification No, TC No, Signature of Competent authority, etc.

8.0 RUST PREVENTION:

All the plates shall be protected with rust preventative coatings suitable for providing resistance from atmospheric corrosion during outside storage for at least six months.

9.0 PACKING AND MARKING :

Plates shall be transported suitably to avoid damage during transit. Each plate shall be marked with Melt No. Material grade and specification, BHEL Order No., Supplier's Name Identification No, Size & weight, on any one corner and encircled with paint preferably of white color.

10.0 REJECTION AND REPLACEMENT:

If the material does not comply with the requirements of this specification during receipt inspection at BHEL or if any defect is found during further processing of material, BHEL reserves the right to reject the whole consignment and the supplier shall replace the material free of cost. The rejected material shall be taken back by the supplier after fulfilling the commercial terms and conditions.

	CORPORATE PURCHASING SPECIFICATION	AA 101 14
		Rev. No. 07
		PREFACE SHEET

COLD ROLLED CARBON STEEL SHEET-ORDINARY

FOR INTERNAL USE ONLY
REMOVE THIS PREFACE SHEET BEFORE ISSUE TO SUPPLIERS

Comparable Standards:

1.	INDIAN	:	IS: 513-1994 Gr: O-Ordinary Quality : Killed/Semi Killed Temper : No 4-Annealed & skin passed Surface finish : Matt Surface type : Best

Suggested/Probable Suppliers And Grades:

1.	M/s SAIL	:	IS : 513, Gr.: O

User Plant References:

1. BHOPAL	:	--
2. HEEP, HARDWAR	:	--
3. HYDERABAD	:	HY 021 02 99
4. TIRUCHY	:	BM-C 07

Revisions : **Cl: 27.6.7 of MOM of MRC-S&GPS**			**APPROVED :** **INTERPLANT MATERIAL RATIONALISATION COMMITTEE-MRC (S&GPS)**		
Rev. No. 07	**Amd.No.**	**Reaffirmed**	**Prepared**	**Issued**	**Dt. of 1st Issue**
Dt: 15.06.2005	**Dt :**	**Year :**	**BHOPAL**	**Corp. R&D**	**JULY, 1976**

COLD ROLLED CARBON STEEL SHEET – ORDINARY

1.0 GENERAL:

This specification governs the quality requirements of Cold Rolled Carbon Steel Sheet of ordinary quality, Annealed and skin passed condition. Sheets having thickness of 0.40 to 2.50 mm (both inclusive) are covered in this specification.

2.0 APPLICATION:

Suitable for general purpose.

3.0 CONDITION OF DELIVERY:

Cold rolled descaled and oiled sheets/coils shall be supplied in fully annealed and skin passed condition. The size, weight and packing of the coils/sheets shall be as agreed to between the manufacturer and BHEL for indigenous material. For imported material, it shall comply with clause 14.0.

Sheets shall be supplied in straight lengths or in coils as specified in BHEL order.

Sheets shall be flat and the edges cleanly sheared and truly squared to the specified dimensions.

Oils used for rust prevention shall be free from pungent smell. The following oils are suggested :

a) SERVO RP 125 of M/s. IOC.

b) RUSTOP 387/388 of M/s. HPC

c) Bharat TCPF of M/s. Bharat Petroleum

d) Any other TRP conforming to IS : 1154

4.0 COMPLIANCE WITH NATIONAL STANDARDS:

The material shall comply with the requirements of the following national standards and also meet the requirements of this specification.
IS: 513-1994, Gr: O-ordinary
Temper: No 4, Annealed & Skin passed;
Quality: killed/semi killed
Surface type - Best;
Surface finish : Matt.

5.0 DIMENSIONS AND TOLERANCES:

5.1 Sizes:

Cold rolled carbon steel sheets shall be supplied to the dimensions specified in BHEL order.

5.2 Tolerances:

The tolerances on sheets shall comply with IS : 513 as detailed below:

5.2.1 Thickness:

Shall comply with table 6 of IS:513.

5.2.2 Width:

Width	Tolerance
Upto and incld. 1250 mm	+ 7 mm - 0 mm
Above 1250 mm	+ 10 mm - 0 mm

5.2.3 Length:

Width	Tolerance
Up to and incld. 2000 mm	+ 15 mm - 0 mm
Over 2000 mm	+ 0.75 percent of length - 0 percent

5.2.4 Edge Camber:

The edge camber (ie. Lateral departure of the edge of the material from a straight line forming a chord) of sheets in cut lengths/coils shall not exceed 0.4 percent X length.

5.2.5 Out of Square Tolerances (for cut lengths) :

1 % (percent) of the width.

(Out of squareness is the deviation of an edge from a straight line drawn at a right angle to the other edge of the sheet, touching one corner and extending to the opposite edge).

6.0 MANUFACTURE :

Steel shall be manufactured by open-hearth, electric, basic oxygen or a combination of these processes.

Material shall be manufactured from semi – killed or killed steel.

Rimmed steel is not acceptable.

7.0 FINISH:

Material shall have a medium or dull finish. Pores, roll marks or scratches which do not impair uniform appearance of the finished product are permissible. The sheets shall be free from waviness and the surface shall be ideal for spray painting.

8.0 HEAT TREATMENT :

Sheets shall be fully annealed and skin passed.

9.0 FREEDOM FROM DEFECTS :

The material shall be free from harmful defects such as scale, rust, blisters, laminations, pitting, cracked edges, etc.

10.0 CHEMICAL COMPOSITION :

The melt analysis of steel and the permissible variation in the composition of the material from the melt analysis shall be as follows:

Element	Melt analysis, percent, max	Permissible variation, percent, max.
Carbon	0.15	0.02
Manganese	0.60	0.03
Sulphur	0.055	0.005
Phosphorus	0.055	0.005

11.0 TEST SAMPLES:

One bend test and hardness test shall be carried out from each melt and heat treatment batch of each size.

Test pieces shall be cut so that the axis of the bend is parallel to the direction of rolling, viz., transverse direction.

12.0 MECHANICAL PROPERTIES :

12.1 Bend Test :

The test piece shall be capable of being bent cold through 1 t (t = thickness) without showing sign of cracks or fracture on the outer convex surface.

Bend test shall be carried out in accordance with IS : 1599.

12.2 Hardness (Vickers) :

When tested as per IS : 1501, the test pieces shall show a Vickers hardness of 120 HV, max..

12.3 Tensile Strength (for information only):

275 N/mm^2 for design purpose.

13.0 TEST CERTIFICATES:

Unless otherwise specified, three copies of test certificates shall be supplied.

In addition, the supplier shall ensure to enclose one copy of the test certificate along with their dispatch documents to facilitate quick clearance of the material.

The test certificate shall bear the following information:
AA 101 14, Rev 07: Cold rolled carbon steel sheet-ordinary
BHEL Order No,
Melt No,
Process of manufacture
Supplier's name,
Identification No
Details of oiling and heat treatment
Dimensional inspection
Results of Chemical analysis and Mechanical tests

Note: Material procured, supplied and certified as AA 101 14, Rev 07/IS:513, Gr.: O-ordinary from M/S SAIL and comply with the requirements of this specification is acceptable.

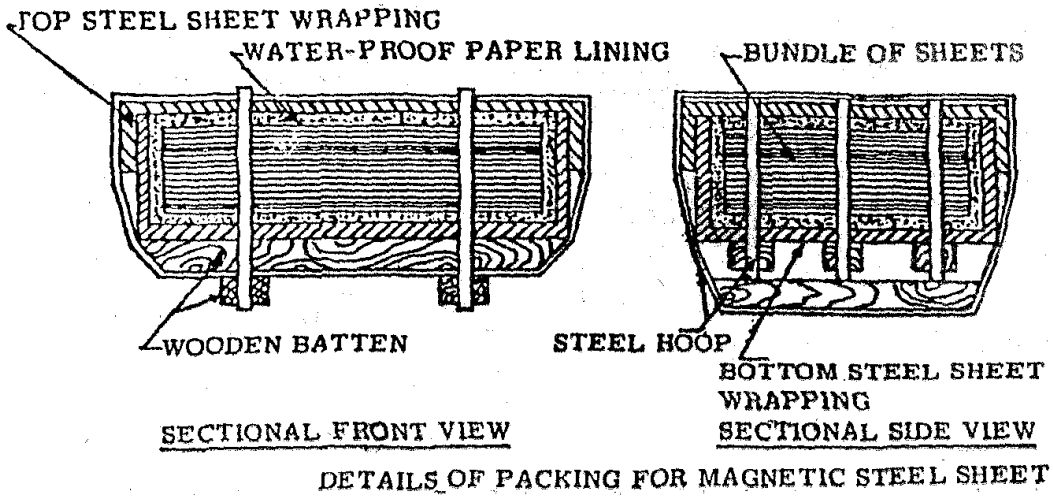
14.0 PACKING AND MARKING:

14.1 Packing:

Sheets and Coils shall be suitably packed in bundles to prevent corrosion and damage during transit.

Recommended packing for imported material shall be as shown below. However, other methods of packing is also acceptable if prior agreement of BHEL is obtained in writing by the manufacturer.

14.1.1 Sheets :



DETAILS OF PACKING FOR MAGNETIC STEEL SHEET

Note:

a) Water proof paper lining shall be preferably Volatile Corrosion Inhibitor (V.C.I.) Coated Paper with an additional polythene (100 micron) enveloped.

b) Approximate weight of each bundle shall be 2 to 3 tonnes. Bundle weighing 2 metric tonnes is however preferred.

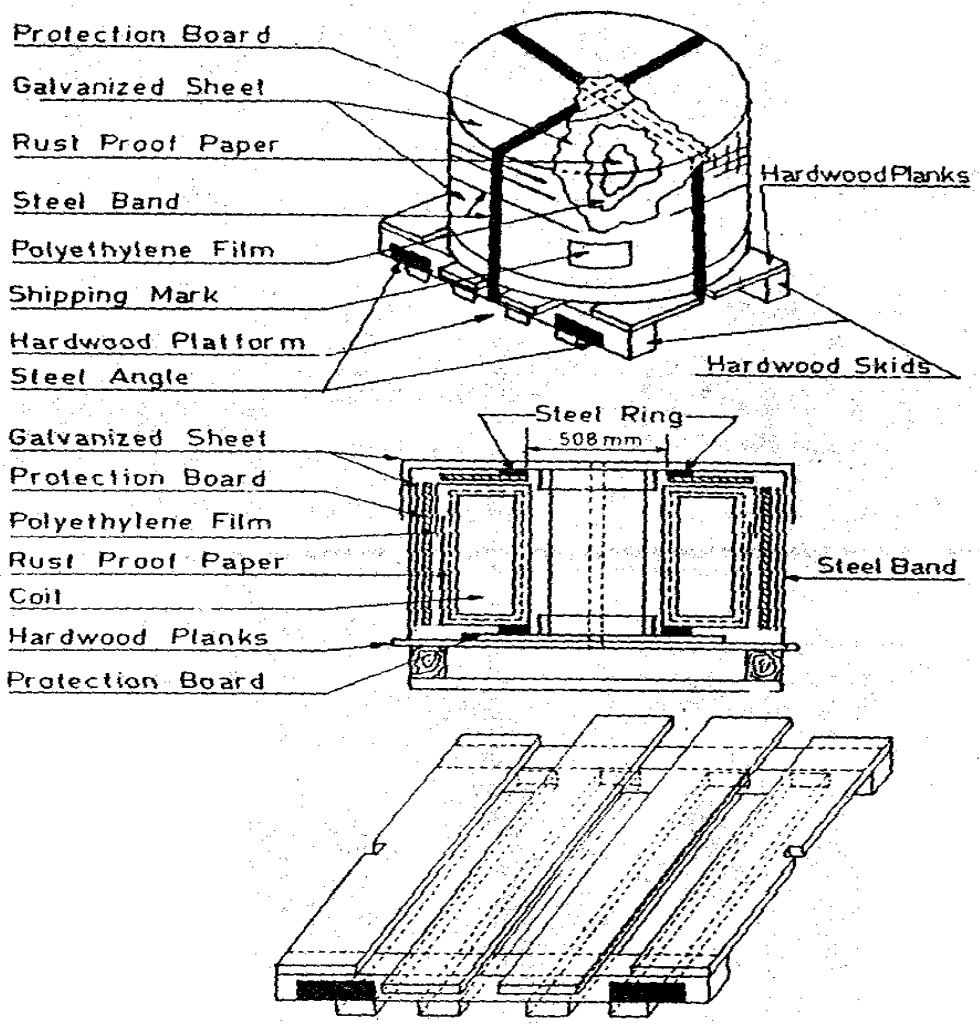
14.1.2 Coils:

The material shall be supplied in coils of continuous strip. The nominal weight of each coil shall be 1800 - 2000 kg.

The nominal internal diameter of coil shall be 500 mm.

Sheet shall be protected to prevent damage and rusting during transit.

Sheet shall be vertically packed according to the instructions and drawings given below:



a) An annular protection board shall be placed at either end of the coil.

b) The coil should then be wrapped with waterproof anti-rust proof paper by lapping axially all around the circumference.

c) The coil shall then be covered by polythylene sheet or anti-rust waterproof paper and the ends sealed properly.

d) A galvanized sheet shall be wrapped on the outside of the coil and the top and bottom of the coils. Care shall be taken to ensure that the ends of the top and bottom of the coils extend sufficiently over the inside diameter of the coil.

e) A galvanized sheet shall be wrapped on the inside of the coil. Care shall be taken that it overlaps sufficiently over the ends of the sheet mentioned in (d) above.

f) Steel ring made from thick angle sheets shall be placed on the rim of the inner diameter at both ends of the coil. The rings shall be held at either ends at four points by steel bands.

g) The coil should then be mounted on wooden skids held together by steel bands. Wooden skids must have cutouts to house the steel bands for tight fit and to avoid slippage.

h) The packing shall ensure that there is no seepage of moisture and the coils reach BHEL in completely rust free condition. It shall be strong enough to withstand handling.

i) Coils shall be sufficiently tight-wound to prevent collapse to an extent that would preclude their being mounted on a mandrel appropriate to the ordered internal diameter.

j) Each package should indicate the , Sling Position, for lifting without damage. It is preferable to fix a suitable size of, 'Sheet Steel Angle', at the position where the Sling Rope is to be fitted to avoid slippage/damage/breakage of the wooden skid at four places.

14.2 MARKING:

A metal label shall be securely attached to each bundle and shall bear the following information :

AA 101 14 : Cold rolled carbon steel sheet-ordinary

BHEL Order No,

Supplier's Name & Identification No,

Melt No, Size & Thickness of sheet,

Bundle No., Weight.

15.0 REFERRED STANDARDS (Latest Publications Including Amendments) :

1. IS : 513 2. IS : 1154 3. IS : 1501 4. IS : 1599

	CORPORATE PURCHASING SPECIFICATION	AA 101 13
		Rev. No. 05
		PREFACE SHEET

HOT ROLLED CARBON STEEL SHEET (330 N/mm^2 TENSILE)

FOR INTERNAL USE ONLY
REMOVE THIS PREFACE SHEET BEFORE ISSUE TO SUPPLIERS

Comparable Standards:

1. INDIAN : IS: 5986-2002, Gr: Fe 330

Suggested/Probable Suppliers And Grades:

1. M/s SAIL : IS : 5986, Gr.: Fe 330
2. Refer plant vendors list

User Plant References:

1. HEEP, HARDWAR : 0500.004, Gr.: St.34
2. HYDERABAD : HY 021 22 99
3. BHOPAL : PS 10113
4. TRICHY : BM –C10

Revisions : Cl: 27.6.6 of MOM of MRC-S&GPS			APPROVED : INTERPLANT MATERIALRATIONALISATION COMMITTEE-MRC-(S&GPS)		
Rev. No. 05	**Amd.No.**	**Reaffirmed**	**Prepared**	**Issued**	**Dt. of 1st Issue**
Dt: 15.06.2005	**Dt :**	**Year :**	**BHOPAL**	**Corp. R&D**	**JULY, 1976**

HOT ROLLED CARBON STEEL SHEET (330 N/mm^2 TENSILE)

1.0 GENERAL:

This specification governs the quality requirements of Hot Rolled Carbon Steel Sheet of thickness of 2.5 mm to 4.0 mm (both inclusive).

2.0 APPLICATION:

Suitable for cold forming/drawing/ fabrication by welding..

3.0 CONDITION OF DELIVERY:

Sheets shall be supplied in hot rolled, descaled and oiled condition. Imported sheets shall be supplied in straight lengths. The edges shall be flattened and sheared. Mill edges are not acceptable. Sheets shall be free from waviness and shall have a uniformly dull (matt) finish.

Oil used for rust prevention should be free from pungent smell. The following oils are suggested:

a) SERVO RP 125 of M/s. IOC.

b) RUSTOP 387/388 of M/s. HPC

c) Bharat TCPF of M/s. Bharat Petroleum

d) Any other TRP conforming to IS : 1154

4.0 COMPLIANCE WITH NATIONAL STANDARDS:

The material shall comply with the requirements of the following National standards and also meet the requirements of this specification.

IS: 5986-2002, Gr.: Fe 330 : Hot Rolled Steel Plates, Sheets, Strips and Flats for flanging and forming operation.

5.0 DIMENSIONS AND TOLERANCES:

5.1 Sizes:

Hot rolled carbon steel sheets shall be supplied to the dimensions in BHEL order.

5.2 Tolerances:

The tolerances on sheets shall comply with the following:

5.2.1 Thickness (IS:1852):

Thickness, mm	Tolerance, mm
2.50	± 0.20
3.15	± 0.22
4.0	± 0.25

5.2.2 Width (IS:1852):

Width, mm	Tolerance, mm
Upto & incld. 1250 mm	+ 6 mm - 0 mm
Over 1250 mm & upto and incld.1550 mm	+ 0.5 percent - 0.0 percent
Over 1550 mm	+ 0.6 percent - 0.0 percent

5.2.3 Length (Continuous mill) IS:1852:

Length, mm	Tolerance, mm
Upto & incld. 2500 mm	+ 25 mm - 00 mm
Over 2500 mm	+ 1 percent subject to a maximum of 70 mm - 0 percent

5.2.4 Flatness (for cut lengths):

Thickness, mm	Width, mm	Flatness tolerance, mm
From 2.5 to 4.0	Upto & incld. 1200	15
	Over 1200 & upto incld. 1500	20
	Over 1500	25

5.2.5 Edge camber IS:5986:

The edge camber (i.e. lateral departure of the edge of the material from a straight line forming a chord) of sheets in cut lengths and coil shall not exceed the following values:

5.2.5.1 For Cut Lengths:

Length in meters		Tolerance, mm
Over	**Upto & incld.**	
--	1.25	5
1.25	1.80	6
1.80	2.50	8
2.50	3.15	10
3.15	3.55	12
3.55	4.00	16
4.00	5.00	19

5.2.5.2 For Coils:

25 mm in any 5000 mm length.

6.0 MANUFACTURE :

Process of manufacture is left to the discretion of the manufacturer except Bessemer process.

Material shall be manufactured from semi killed or killed steel.

7.0 FREEDOM FROM DEFECTS:

The sheets shall be free from harmful defects, twists, buckle, rust, scale and waviness and shall be reasonably smooth, flat and square.

8.0 CHEMICAL COMPOSITION :

The melt analysis of steel and the permissible variation in the composition of the material from the melt analysis shall be as follows:

Element	Melt analysis, percent, max.	Permissible variation, percent, max.
Carbon	0.15	0.03
Manganese	0.80	0.05
Sulphur	0.040	0.005
Phosphorus	0.040	0.005

9.0 TEST SAMPLES:

9.1 Tensile Test:

One sample shall be taken per thickness per consignment from each melt.

As far as possible test pieces shall be cut transverse to the direction of rolling and shall be of full thickness of the sheet rolled.

9.2 Bend Test:

One sample shall be taken per thickness per consignment from each melt.

Bend test pieces shall be cut so that the axis of the bend is parallel to the direction of rolling viz. transverse.

Note: When more than one thickness is rolled from the same melt, one additional test piece for each thickness shall be taken.

10.0 MECHANICAL PROPERTIES :

10.1 Bend:

When tested in accordance with IS : 1608, the test pieces shall be capable of being bent cold through 180^0 close. The outer convex surface of the test piece shall be free from cracks.

10.2 Tensile:

When tested as per IS : 1608, the test pieces shall show the following properties:

Tensile strength : 330 – 440 N/mm^2

Yield strength : 205 N/mm^2, min.

Elongation:

For sheets upto & Incl. 3 mm, thick : 18 %, minimum on 80 mm gauge length
For sheets above 3 mm, thick : 28 %, minimum in 5.65 √So gauge length

11.0 HARDNESS (VICKERS):

When tested in accordance with IS:1501, the material shall show a Vickers hardness in the range of 100 – 140 HV.

Note: Hardness test shall be conducted only when tensile test cannot be performed.

12.0 TEST CERTIFICATES:

Unless otherwise specified, three copies of test certificates shall be supplied.

In addition, the supplier shall ensure to enclose one copy of the test certificate along with their dispatch documents to facilitate quick clearance of the material.

The test certificate shall bear the following information:

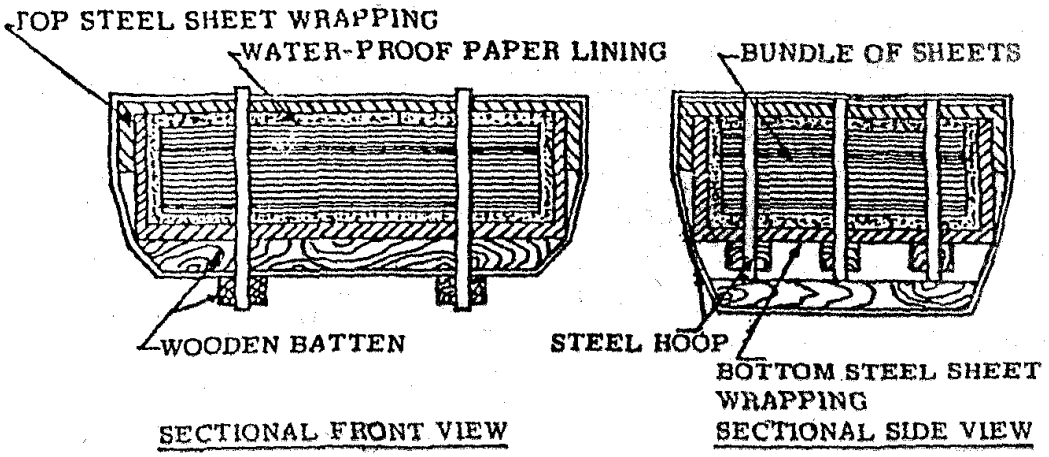
AA 101 13, Rev 05: Hot rolled carbon steel sheet (330 N/mm^2 Tensile)
BHEL Order No,
Supplier's name,
Identification No
Melt No,
Process of manufacture
Details of pickling, descaling and oiling
Results of dimensional inspection
Results of Chemical analysis and Mechanical tests,

Note: Material procured, supplied and certified as AA 101 13, rev 05/IS:5986, Gr.:Fe 330 and comply with the requirements of this specification is acceptable.

13.0 PACKING AND MARKING:

Steel sheets shall be supplied in bundles and shall be suitably packed in bundles to prevent corrosion and damage during transit.

The recommended packing for imported material shall be as shown below.



DETAILS OF PACKING FOR MAGNETIC STEEL SHEET

Note:

a) Water proof paper lining shall be preferably Volatile Corrosion Inhibitor (V.C.I.) Coated Paper with an additional polythene (100 micron) enveloped.

b) Approximate weight of each bundle shall be 2 to 3 tonnes. Bundle weighing 2 metric tonnes is however preferred.

A metal label shall be securely attached to each bundle and shall bear the following information :

AA 101 13: Hot rolled carbon steel sheet
BHEL Order No,
Supplier's Name & Identification No,
Size & Thickness of sheets
Weight

14.0 REFERRED STANDARDS (Latest Publications Including Amendments) :

1. IS : 1154
2. IS:1501
3. IS : 1608
4. IS:1852
5. IS : 5986

	CORPORATE PURCHASING SPECIFICATION	**AA 101 11**
		Rev. No. 05
		PREFACE SHEET

HOT ROLLED CARBON STEEL SHEET (410 N/mm^2 TENSILE)

FOR INTERNAL USE ONLY
REMOVE THIS PREFACE SHEET BEFORE ISSUE TO SUPPLIERS

Comparable Standards:

1. INDIAN : IS: 5986-2002, Gr: Fe 410

Suggested/Probable Suppliers And Grades:

1. M/s SAIL : IS : 5986, Gr.: Fe 410
2. Refer plant vendors list

User Plant References:

1. HEEP, HARDWAR : 0500.004, Gr.: St.42
2. HYDERABAD : IS:1079, Gr.: St 42-1079

Revisions : Cl: 27.6.4 of MOM of MRC-S&GPS			**APPROVED :** INTERPLANT MATERIALRATIONALISATION COMMITTEE-MRC-(S&GPS)		
Rev. No. 05	**Amd.No.**	**Reaffirmed**	**Prepared**	**Issued**	**Dt. of 1st Issue**
Dt: 15.06.2005	**Dt :**	**Year :**	**BHOPAL**	**Corp. R&D**	**APRIL, 1978**

HOT ROLLED CARBON STEEL SHEET (410 N/mm^2 TENSILE)

1.0 GENERAL:

This specification governs the quality requirements of Hot Rolled Carbon Steel Sheet of thickness of 2.5 mm to 4.0 mm (both inclusive).

2.0 APPLICATION:

Suitable for cold forming/drawing/ fabrication by welding..

3.0 CONDITION OF DELIVERY:

Sheets shall be supplied in hot rolled, descaled and oiled condition. Imported sheets shall be supplied in straight lengths. The edges shall be flattened and sheared. Mill edges are not acceptable. Sheets shall be free from waviness and shall have a uniformly dull (matt) finish.

Oil used for rust prevention should be free from pungent smell. The following oils are suggested:

a) SERVO RP 125 of M/s. IOC.

b) RUSTOP 387/388 of M/s. HPC

c) Bharat TCPF of M/s. Bharat Petroleum

d) Any other TRP conforming to IS : 1154

4.0 COMPLIANCE WITH NATIONAL STANDARDS:

The material shall comply with the requirements of the following National standards and also meet the requirements of this specification.

IS: 5986-2002, Gr.: Fe 410 : Hot Rolled Steel Plates, Sheets, Strips and Flats for flanging and forming operation.

5.0 DIMENSIONS AND TOLERANCES:

5.1 Sizes:

Hot rolled carbon steel sheets shall be supplied to the dimensions in BHEL order.

5.2 Tolerances:

The tolerances on sheets shall comply with the following:

5.2.1 Thickness (IS:1852):

Thickness, mm	Tolerance, mm
2.50	± 0.20
3.15	± 0.22
4.0	± 0.25

5.2.2 Width, Length, Flatness, Edge chamber and Out of square tolerance for cut lengths:

As per IS:5986.

6.0 MANUFACTURE :

Process of manufacture is left to the discretion of the manufacturer except Bessemer process.

Material shall be manufactured from semi killed or killed steel.

7.0 FREEDOM FROM DEFECTS:

The sheets shall be free from harmful defects, twists, buckle, rust, scale and waviness and shall be reasonably smooth, flat and square.

8.0 CHEMICAL COMPOSITION :

The melt analysis of steel and the permissible variation in the composition of the material from the melt analysis shall be as follows:

Element	Melt analysis, percent, max.	Permissible variation, percent, max.
Carbon	0.20	0.03
Manganese	1.20	0.05
Sulphur	0.040	0.005
Phosphorus	0.040	0.005

Carbon equivalent (C.E.): 0.42, max.

9.0 TEST SAMPLES:

9.1 Tensile Test:

One sample shall be taken per thickness per consignment from each melt.

As far as possible test pieces shall be cut transverse to the direction of rolling and shall be of full thickness of the sheet rolled.

9.2 Bend Test:

One sample shall be taken per thickness per consignment from each melt.

Bend test pieces shall be cut so that the axis of the bend is parallel to the direction of rolling viz. transverse.

Note: When more than one thickness is rolled from the same melt, one additional test piece for each thickness shall be taken.

10.0 MECHANICAL PROPERTIES :

10.1 Bend:

When tested in accordance with IS : 1599, the test pieces shall be capable of being bent cold through 180^0 close. The outer convex surface of the test piece shall be free from cracks.

10.2 Tensile:

When tested as per IS : 1608, the test pieces shall show the following properties:

Tensile strength	: 410 – 520 N/mm^2
Yield strength	: 255 N/mm^2, min.
Elongation:	
For sheets upto & Incl. 3 mm, thick	: 15 %, minimum on 80 mm gauge length
For sheets above 3 mm, thick	: 24 %, minimum in 5.65 √So gauge length

11.0 TEST CERTIFICATES:

Unless otherwise specified, three copies of test certificates shall be supplied.

In addition, the supplier shall ensure to enclose one copy of the test certificate along with their dispatch documents to facilitate quick clearance of the material.

The test certificate shall bear the following information:

AA 101 11, Rev 05: Hot rolled carbon steel sheet (410 N/mm^2 Tensile)

BHEL Order No,

Supplier's name,

Identification No

Melt No,

Process of manufacture

Details of pickling, descaling and oiling

Results of dimensional inspection

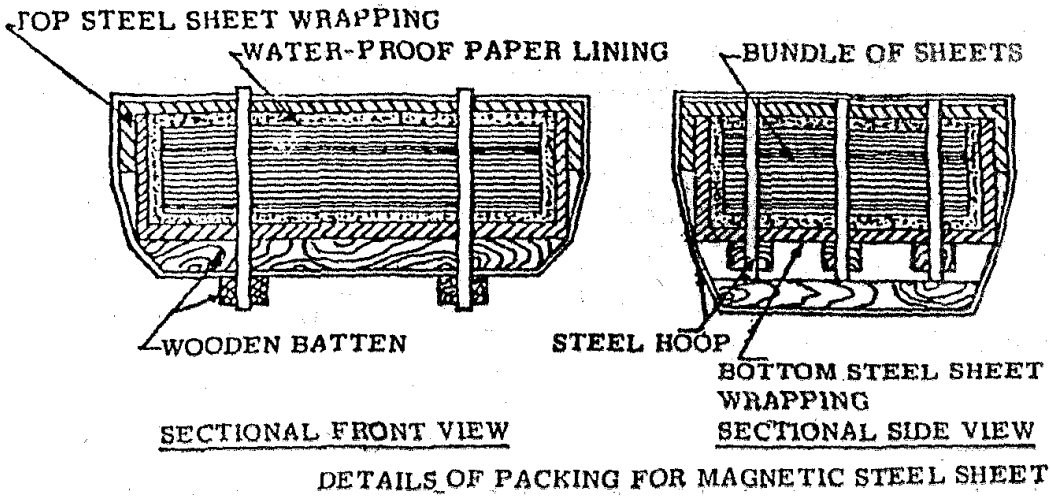
Results of Chemical analysis and Mechanical tests,

Note: Material procured, supplied and certified as AA 101 11, rev 05/IS:5986, Gr.:Fe 410 and comply with the requirements of this specification is acceptable.

12.0 PACKING AND MARKING:

Steel sheets shall be supplied in bundles and shall be suitably packed in bundles to prevent corrosion and damage during transit.

The recommended packing for imported material shall be as shown below.



DETAILS OF PACKING FOR MAGNETIC STEEL SHEET

Note:

a) Water proof paper lining shall be preferably Volatile Corrosion Inhibitor (V.C.I.) Coated Paper with an additional polythene (100 micron) enveloped.

b) Approximate weight of each bundle shall be 2 to 3 tonnes. Bundle weighing 2 metric tonnes is however preferred.

A metal label shall be securely attached to each bundle and shall bear the following information :

AA 101 11: Hot rolled carbon steel sheet
BHEL Order No,
Supplier's Name & Identification No,
Size & Thickness of sheets
Weight

13.0 REFERRED STANDARDS (Latest Publications Including Amendments) :

1. IS : 1154 2. IS:1599 3. IS : 1608 4. IS:1852 5. IS : 5986

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AUSTENITIC STAINLESS STEEL PLATE, SHEET & STRIP

GRADE AISI 304L

CLAUSE 12.0 INTERGRANULAR CORROSION :

The first line shall be read as " This test shall be conducted in accordance with practice E of ASTM A 262 " in place of the existing first line.

REF:	AMD.NO.	APPROVED	ISSUED	DATE	CUM. Sl.No.
	01	DY.MNGR. STDS. ENGG.	STDS. ENGG.	12.05.2000	A 0323

AUSTENITIC STAINLESS STEEL PLATE, SHEET & STRIP
GRADE: AISI 304 L

1.0 GENERAL:

This specification governs the requirements for Austenitic stainless steel plates, sheets & strips of grade AISI 304 L.

2.0 APPLICATION:

This material is used in Gas Turbines, Heat Exchangers.

3.0 CONDITION OF DELIVERY:

Hot Rolled and solution annealed and pickled condition.

4.0 COMPLIANCE WITH NATIONAL STANDARDS:

This material complies, in general, with American Standard ASTM A240 Gr. 304L.

5.0 DIMENSIONS AND TOLERANCES:

5.1 Sizes: Material shall be supplied to the dimensions specified on the order.

5.2 Tolerances: The tolerances on material shall comply with the following:

5.2.1 Sheets & Plates:

5.2.1.1 Flatness*:

Width, mm	Length, mm	Maximum deviation from flatness, mm
Upto & excld. 1000	Upto & incld. 2000	15
	Over 2000	20
1000 and above	Upto & incld. 2000	20
	Over 2000	20

* Maximum deviation from a horizontal flat surface.

5.2.1.2 Thickness:

Thickness, mm		Tolerance on thickness for width, mm			
From	Below	Below 1000	From 1000 to below 1250	From 1250 to below 1600	From 1600 to below 2000
1.0	1.5	± 0.15	± 0.15	± 0.20	--
1.5	2.0	± 0.20	± 0.20	± 0.25	--
2.0	2.5	± 0.20	± 0.25	± 0.30	--
2.5	3.0	± 0.25	± 0.30	± 0.30	--
3.0	4.0	± 0.30	± 0.30	± 0.35	--
4.0	5.0	± 0.40	± 0.40	± 0.45	--
5.0	6.0	± 0.50	± 0.50	± 0.55	± 0.70
6.0	8.0	± 0.60	± 0.60	± 0.60	± 0.75
8.0	10.0	± 0.65	± 0.65	± 0.65	± 0.80
10.0	16.0	± 0.70	± 0.70	± 0.70	± 0.85
16.0	25.0	± 0.80	± 0.80	± 0.80	± 0.95
25.0	40.0	± 0.90	± 0.90	± 0.90	± 1.10
40.0	50.0	± 1.00	± 1.00	± 1.00	± 1.20

5.2.1.3 Width and Length:

Thickness, mm	Tolerance, mm	
	On width	On length
Less than 10	+ 5 - 0	+ 10 - 0
From 10 and upto & incld. 25	+ 10 - 0	+ 15 - 0
Above 25 and upto & incld. 40	+ 15 - 0	+ 25 - 0
Above 40 and upto & incld. 50	+ 20 - 0	+ 30 - 0

5.2.2 Strips:

5.2.2.1 Thickness:

Thickness, mm		Tolerance on thickness for width, mm			
From	Below	Below 250	From 250 to below 500	From 500 to below 1000	From 1000 to below 1250
1.00	1.50	± 0.12	± 0.12	± 0.15	± 0.15
1.50	2.00	± 0.15	± 0.18	± 0.20	± 0.20
2.00	2.50	± 0.16	± 0.18	± 0.20	± 0.25
2.50	3.00	± 0.18	± 0.20	± 0.25	± 0.30
3.00	4.00	± 0.20	± 0.25	± 0.30	± 0.30
4.00	5.00	± 0.25	± 0.30	± 0.40	± 0.40

5.2.2.2 Width (Strip of thickness upto & incld. 5 mm):

Width, mm		Tolerance, mm	
From	Below	Plus	Minus
-	250	5	0
250	500	5	0
500	1000	10	0
1000	1250	10	0

5.2.2.3 Camber:

Width, mm		Maximum value of Camber for any 2000 mm length, mm
From	Below	
-	250	10
250	500	8
500	1000	5
1000	1250	5

6.0 MANUFACTURE:

The steel shall be made by basic electric process.

7.0 HEAT TREATMENT:

The recommended heat treatment is as follows:

Solution annealing: Heating to 1040°C minimum for sufficient time followed by water quenching or rapid cooling by other means.

8.0 FREEDOM FROM DEFECTS:

The material shall be of uniform quality consistent with the good manufacturing and inspection practice. The steel shall have no defects of a nature or a degree that will be detrimental to the stamping, forming, machining or fabrication of finished parts.

9.0 CHEMICAL COMPOSITION:

The Melt analysis of material shall be as follows:

Element	C	Si	Mn	Ni	Cr	P	S	N
% Min.	-	-	-	8.00	18.00	-	-	-
% Max.	0.030	1.00	2.00	12.00	20.00	0.045	.0.030	0.10
Permissible variation in Product Analysis	+0.005	+0.05	+0.04	+0.15 -0.10	±0.20	+0.005	+0.005	+0.01

10.0 TEST SAMPLES:

10.1 Chemical Analysis: One sample shall be taken per melt.

10.2 Mechanical Testing: One sample shall be taken per melt per heat treatment batch per thickness.

10.3 Intergranular Corrosion Test: One sample per melt per heat treatment batch per thickness.

11.0 MECHANICAL PROPERTIES:

The mechanical properties of the material shall be as follows:

Tensile Strength N/mm² (min.)	0.2% Yield Stress N/mm² (min.)	% Elongation L= 50 mm min.	Hardness BHN
482	172	45	183

Note: Tensile test shall be conducted as per IS:1608 or any reputed international standard.

12.0 INTERGRANULAR CORROSION:

This test shall be conducted in accordance with practice of ASTM A262. It shall be on sensitized specimens. This test is applicable to all thicknesses.

13.0 INSPECTION AT SUPPLIER'S WORKS:

The representative of BHEL shall have free access to the supplier's works at all times during the execution of the order, to satisfy himself that the material is produced as per the quality requirements of this specification. All reasonable facilities shall be extended to him free or charge. He may also witness the sampling, testing and marking called for in this specification.

14.0 TEST CERTIFICATES:

Five copies of the test certificate giving the folllowing details shall be furnished.

a. BHEL Order No.
b. BHEL Specification No. HY 10786
c. ASTM A 240, TP 304L
d. Melt/Heat No.
e. Size
f. Heat treatment details and batch No.
g. Results of Heat & Product analysis
h. Results of Hardness test.
i. Results of Mechanical test.
j. Results of Intergranular corrosion test.

15.0 PACKING AND MARKING:

15.1 The material shall be suitably packed to prevent corrosion and damage during transit.

15.2 Sheets and strips shall be bundled together and each bundle shall have details of Purchase Order No., Specification, Size, Melt No., Weight and Manufacturer's Name etc.

15.3 Plates shall be individually identified by hard punching of the details like Melt No., Size, Specification and Manufacturer's Name/Emblem.

16.0 REJECTION AND REPLACEMENT:

In the event of any material proving defective in the course of processing or testing, such material shall be rejected and the supplier shall make immediate arrangements to replace the same free of cost.