

	PLANT PURCHASING SPECIFICATION HYDERABAD	HY 19593
		Rev. No. 03
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STAINLESS STEEL CASTINGS (Gr. X4CrNi13-4)		
1.0	<u>GENERAL:</u>	
This specification governs the quality requirements of 12 Chromium-4 Nickel Stainless Steel Castings.		
2.0	<u>APPLICATION:</u>	
These castings are required for pumps components like Impellers, diffusers etc.		
3.0	<u>CONDITION OF DELIVERY:</u>	
These castings shall be supplied in hardened & tempered, rough machined and finally stress relieved condition, unless otherwise specified in the drawing or purchase order.		
4.0	<u>COMPLIANCE WITH NATIONAL STANDARD:</u>	
The castings shall comply with EN10213 Gr. X4CrNi13-4 (in general) and all the additional requirements of this specification.		
5.0	<u>MANUFACTURE:</u>	
5.1	The steel shall be made by electric arc or induction furnace process. Any other process of steel making shall be referred to BHEL for approval.	
5.2	The steel castings shall be made from fully killed steel.	
5.3	Depending on the surface finish requirements as per the ordering drawing, components like impellers and diffusers, etc. shall be made by investment casting process. Other castings can be manufactured by sand casting process.	
5.4	The castings shall not be peened, plugged or impregnated to stop leaks etc.	
5.5	Manufacturing Process Plan (MPP): Unless waive off for submission of MPP is provided by BHEL (in writing), the manufacturer shall submit a MPP for review & approval for each drawing. The MPP shall include stage wise details of the process controls during manufacturing with the details of the facilities used for steel melting and refining and heat treatment, inspection sequence and testing plan for destructive and non- destructive testing (including NDT scan plans for UT, MPI etc.) as per the specification and ordering drawing. This approved MPP can be used till there are no changes in the manufacturing process and the facilities used for the manufacture of the castings.	
Revision: Modified Cl. 4.0 to 12.0 and renumbered; added Cl. 5.5, 15.0 & 16.0 and QAP.		Issued : STANDARDS ENGINEERING & IPR COORDINATION DEPARTMENT
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Dt. NOV. 2014	Dt.	Year:
Prepared: ENGINEER, MATLS. ENGG.		Approved: Sr.DGM/TS
		Date of 1st issue: DEC. 1983

6.0 **HEAT TREATMENT:**

The castings shall be heat treated as per EN10213 to achieve the mechanical properties as per Cl.10.0 of this specification. Actual heat treatment cycles followed shall be reported in test certificate.

7.0 **Quality of Castings :**

7.1 **For Sand Casting:**

Dimensions & Tolerances: The enclosed drawings are finish machined ones (unless otherwise specified). The castings shall be supplied in rough machined condition with an allowance of 4 to 6mm on the surfaces where machining symbols have been shown on the drawing. Small grooves, steps etc., up to 50 mm (width or size), need not be rough machined.

Finish: The castings shall be cleaned and fettled thoroughly ensuring complete removal of sand, slag, fins and scales from both internal and external surfaces.

Freedom from defects: Foundry defects like blow holes, shrinkage cavities porosity, non-metallic inclusions etc. appearing on the surfaces to be machined shall be opened out and smoothly ground provided the depth of any of these defects, when so ground, doesn't exceed 2/3 of the machining allowances. All as cast surfaces shall be free from harmful foundry defects like slag inclusions, sand spots, cold shuts, shrinkage, scabs etc.

7.2 **For Investment casting:**

Dimensions & tolerances: The dimensions and tolerances shall be as specified in the ordering drawing/ product standard.

Finish: The surface of the casting shall be free of adhering ceramic, scale, and hot tears. The surface finish of the casting shall be as per the ordering drawing.

Freedom from defects: Cracks are not permitted on any surface of the casting.

7.3 In case where pressure tightness is called for (though the test may be required to be conducted at BHEL) the requisite quality must be ensured to guarantee the same.

8.0 **CHEMICAL COMPOSITION:**

The chemical analysis of the steel supplied shall confirm to the following chemical composition:

Elements (% wt)		C	Si	Mn	Cr	Ni	Mo	S	P
X4CrNi13-4*	Min.	-	-	-	12.0	3.50	-	-	-
	Max.	0.06	1.00	1.00	13.5	5.00	0.70	0.025	0.035

*V- 0.08 max; Cu- 0.30 max



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9.0 TEST SAMPLES:

Unless otherwise specified in the drawing, the mechanical properties shall be determined on one separately cast test coupon for each heat and heat treatment batch (if the casting weight is less than or equal to 500 kg) or on one integral test coupon (castings having weight more than 500 kg) for each casting.

The size of the test coupon shall be selected as appropriate to the thickness of the actual castings and the extent of testing and to carryout repeat tests if required. After casting, the test coupons shall receive a stamp indicating the heat number. It is mandatory to keep the separately cast test coupon along with the castings from same heat during each subsequent heat treatments of the casting. The integral test piece shall not be removed prior to complete heat treatment and shall be suitably stamped & identified by BHEL representative before detaching it from the casting.

10.0 MECHANICAL PROPERTIES:

The mechanical properties tested on test coupons shall be as follows:

Tensile Strength N/mm ² min.	0.2% Proof Stress, N/mm ² min.	Elongation % L = 5.65 √So min.	Charpy Impact Strength (ISO-V) J min.	Hardness (BHN) (on casting)
760-960	550	15	27	235-285

10.1 The tensile test shall be conducted as per IS: 1608 or any reputed National or International Standard.

10.2 The impact test specimen shall be 10mm x 10mm 55mm with a 2mm ISO V-notch. The test shall be conducted as per IS: 1757 or any other reputed National or International Standard.

The minimum impact strength specified above is the average of three samples at the same location. Only one value can be lower than the minimum specified average value, but in no case lower than 2/3rd of the same. All the three values shall be reported.

10.3 The Brinell hardness shall be tested on each casting after heat treatment. A minimum of 3 hardness values shall be taken at different locations as far as possible from each other (preferably of opposite faces of the casting) on each casting. The variation in the minimum and the maximum hardness values obtained on the casting shall not be more than 25BHN.

10.4 The hardness values shall also be tested on the repair welded areas and the hardness variation of weldment to the parent material shall not be more than 35 BHN.

11.0 HYDRAULIC TEST:

The hydraulic test shall be carried out at BHEL if mentioned in the drawing. In case the supplier needs to carry out the test the same will be indicated in the drawing/order. The test pressure shall be maintained for a minimum of 30 minutes (unless otherwise mentioned) without leakage.

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12.0 NON-DESTRUCTIVE TESTS :

The following non-destructive tests shall be performed in the final delivery condition of the casting:

12.1 Visual Inspection:

a. **For Sand casting:** The visual inspection on all the un-machined surfaces shall be as per MSS SP-55.

b. **For investment castings:** The visual examination shall be carried out as per the requirements of ordering drawing.

12.2 Magnetic Particle Inspection:

Unless otherwise specified in the drawing, all the areas of the castings (or as per the approved MPP) shall be tested by magnetic particle test as per AA 0850133 and the acceptance norms (if not specified in the drawing) shall be as per AA 0850134, level-2.

12.3 Ultrasonic Test (For Sand Casting):

Unless otherwise specified in the drawing, ultrasonic examination shall be conducted on 100% volume of the castings (or as per the approved MPP) as per AA 085 01 04 and acceptance norms (if not specified in the drawing) shall be level 2 as per the AA0850104.

13.0 ADDITIONAL TESTS:

13.1 Ultrasonic Test (For investment casting): If specified in the drawing / product Standard, Ultrasonic Examination shall be conducted on the casting as per the drawing requirement.

13.2 Radiographic Test: If specified in the drawing / product Standard, Radiographic Examination shall be conducted on the casting as per the drawing requirement.

13.3 Liquid Penetrant Examination: If specified in the drawing / product Standard, LPI shall be conducted on the casting as per the drawing requirement.

14.0 REPAIR WELDING:

Before weld repair, all the defects in the castings shall be reported to BHEL by sending defectograms & repair welding procedure for the written approval by BHEL.

15.0 FIRST PIECE QUALIFICATION TESTS:

Whenever the supplies are made for the first time to BHEL for each and every ordering drawing, additional requirements for the supplies will be applicable. Depending on the past experience and references available to BHEL, supplier will be asked to carry out additional tests which will be duly incorporated in the manufacturing process plan (MPP)/ Quality plan, before placement of order for the first time supplies.

Note: In case of first time supplies of pump impeller and diffuser casting, RT on cut piece castings will be applicable as a mandatory requirement, for the first lot. This requirement will be incorporated in the MPP.

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16.0 QUALITY PLAN:

16.1 The supplier shall follow the quality plan Ref. BHEL/QP/HY 19593 Rev.03 as per annexure A, unless the conditions stipulated in Cl. 16.2 & 16.3 are applicable.

16.2 In case customer/project related additional requirements are applicable in the enquiry/tender, vendor may be asked to submit a separate QP including such requirements.

16.3 In case of new vendors or first time supplies according to drawings mentioned in BHEL enquiry, QP shall be submitted for approval by BHEL. The attached QAP will not be applicable.

17.0 INSPECTION AT SUPPLIER'S WORKS:

17.1 BHEL representative shall have free entry and access to all areas where the manufacture of castings ordered is carried out. All reasonable facilities shall be provided to him including labour where necessary.

17.2 BHEL representative shall be given sufficient advance intimation to witness the various processes, tests etc. Punching and identification shall be done in the presence of BHEL representative.

18.0 TEST CERTIFICATE:

18.1 The supplier shall furnish five copies of certificates (in English) to BHEL. Each copy shall contain the following details.

1)

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2)

BHEL Order No.

3)

Item description and Drawing No. of the Casting.

4)

Supplier's Name

5)

Melt No. & Heat treatment Cycle

6)

Casting Serial No. per melt.

7)

Details of manufacturing process like sand or investment casting

8)

Heat treatment charts/ details

9)

Defectogram & Welding repair procedure (in case of weld repair)

10)

Results of all tests as per this specification (including FPQ requirement as per order)

11)

Dimensional inspection report

12)

Copy of BHEL approved MPP (if applicable)

18.2 The certificate shall be attested by the chief of Inspection / Chief Metallurgist of the supplier and attested by BHEL Representative.

19.0 MARKING & PACKING:

19.1 The following details shall be hard punched clearly on the castings:

1.

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2.

Melt No.

3.

Drawing No.

4.

BHEL Inspector's stamp

5.

Supplier's mark

19.2 The castings shall be suitably packed and protected from damage and corrosion during transit.

20.0 REJECTION AND REPLACEMENT:

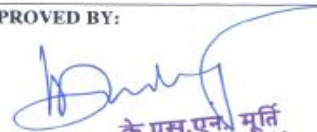
The final decision regarding acceptance or rejection rests with BHEL if the casting is not found as per this specification at any time during further operations on the castings. The supplier shall replace the rejected casting at his own cost and the rejected casting shall be returned after all commercial terms and conditions are satisfied.

ANNEXURE I

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		BHEL HYDERABAD-32		STANDARD QUALITY PLAN FOR VENDOR ITEMS				QP No. : BHEL / HY19593 REV.03					
				ITEM : STAINLESS STEEL CASTINGS(Gr.X4CrNi13-4)				Rev. No. : 00					
								DATE : 08-11-2014					
								PAGE : 1 OF 4					
SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS	
									D	S	M	C	

1.0 INSPECTION STAGES IN MANUFACTURING PROCESS													
1.1	Pattern / Die Inspection	Visual, Dimensional inspection	Major	Visual Measrt.	100%	Mfr Internal Records	Mfr Internal Records	Pattern Inspection Report				P	V
1.2	Moulding	Visual, Dimensional inspection of Moulds & Cores	Major	Visual	100%	Mfr Internal Records	Mfr Internal Records	Moulding Records	✓			P	V
1.3	Melting & Pouring	Chemical composition.	Major	Chemical	Every Melt	HY19593 Rev03 & BHEL Drg.	HY19593 Rev03 & BHEL Drg.	Test Certificate	✓			P	V
1.4	Heat Treatment	Time & Temperature	Major	Time & Temp.	100%	HY 19593 Rev.03	HY 19593 Rev.03	HT Chart, TC	✓			P	V
1.5	Keel Block/ Test Piece Identification	Physical	Major	Physical	Each Casting as per HY19593 & BHEL drg.	HY19593 Rev03 & BHEL Drg.	HY19593 Rev03 & BHEL Drg.	Identification Report	✓			P	W

Drg No. : As per BHEL PO.			BHEL Spec. No : HY 19593 Rev.03			PREPARED BY:			APPROVED BY:		
Legend: *D- Documents marked (✓) to be included by Supplier in Documentation Package. S - Sub Vendor M - Vendor / Manufacturer C - Customer (BHEL) / Inspection Agency			P - Perform W - Witness V - Verify								

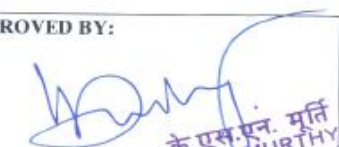
HYQA/QP/VSQP Rev.01

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BHEL HYDERABAD-32		STANDARD QUALITY PLAN FOR VENDOR ITEMS						QP No. : BHEL / HY19593 REV.03 Rev. No. : 00 DATE : 08-11-2014 PAGE : 2 OF 4					
		ITEM : STAINLESS STEEL CASTINGS(Gr.X4CrNi13-4)											
SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
									D	S	M	C	
1.6a	WPS/PQR for repair welding, if any (based on internal NDT)	Record review	Major	Review	100%	HY19593 Rev03 & BHEL Drg.	HY19593 Rev03 & BHEL Drg.	Defectogram, WPS/PQR, Welding records	✓		P	V	Defectogram shall be submitted to BHEL for written permission for any weld repair.
1.6b	Welder qualification	Record review	Major	Review	100%	HY19593 Rev03 & BHEL Drg.	HY19593 Rev03 & BHEL Drg.	Welding qualification records			P	V	
1.7	Rough Machining	Dimensional Inspection	Major	Measrt.	100%	HY19593 Rev03 & BHEL Drg.	HY19593 Rev03 & BHEL Drg.	DIR	✓		P	V	
1.8	Stress Relieving followed by shot blasting	Record review	Major	Review	100%	HY19593 Rev03 & BHEL Drg.	HY19593 Rev03 & BHEL Drg.	HT Charts, TC	✓		P	V	
2.0	FINAL INSPECTION												
2.1a	Test Sample	Mechanical prop. (checked on test samples identified by TPIA)	Major	Each Casting	Each Casting	HY19593 Rev03 & BHEL Drg.	HY19593 Rev03 & BHEL Drg.	Test Certificate	✓		P	W	
2.1b	Test sample & casting	Hardness	Major	Hardness	Weld Repaired areas, casting & test coupon	HY19593 Rev03 & BHEL Drg.	HY19593 Rev03 & BHEL Drg.	Test Report	✓		P	W	Hardness values shall be reported for both on casting, test coupon & weld repaired areas

Drg No. : As per BHEL PO.		BHEL Spec. No : HY 19593 Rev.03		PREPARED BY:		APPROVED BY:	
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ITEM : STAINLESS STEEL CASTINGS(Gr.X4CrNi13-4)				Rev. No. : 00									
								DATE : 08-11-2014					
								PAGE : 3 OF 4					
SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY			REMARKS
										S	M	C	
2.2	Casting	Final Dimension	Critical	Dimensional Measurement	100%	HY19593 Rev03 & BHEL Drg.	HY19593 Rev03 & BHEL Drg.	Dimn. Report	✓		P	W	
2.3		Visual Inspection	Critical	Surface finish, cleaning of internal surfaces, holes, opening etc.	Each Casting	HY19593 Rev03 & BHEL Drg.	HY19593 Rev03 & BHEL Drg.	Inspection report	✓		P	W	
2.4		Soundness of Casting	Critical	MPI	BHEL Drg./ Spec/ approved MPP	HY19593 Rev03 & BHEL Drg.	HY19593 Rev03 & BHEL Drg.	MPI Report	✓		P	W	
			Critical	LPI	BHEL Drg./ Spec/ approved MPP	HY19593 Rev03 & BHEL Drg.	HY19593 Rev03 & BHEL Drg.	LPI Report	✓		P	W	
			Critical	UT	BHEL Drg./ Spec/ approved MPP	HY19593 Rev03 & BHEL Drg.	HY19593 Rev03 & BHEL Drg.	UT Report	✓		P	W	
2.5		Marking and Punching	Critical	Visual	Each Casting	HY19593 Rev03 & BHEL Drg.	HY19593 Rev03 & BHEL Drg.	Test Report	✓		P	V	Markings on the castings shall be co-related with TC.
2.6	Preservation & Despatch	Visual Inspection	Major	Visual	Each Casting	HY19593 Rev03 & BHEL Drg.	HY19593 Rev03 & BHEL Drg.	Test Report	✓		P	V	

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HYQA/QP/VSQP Rev.01					

- 1) BHEL specification and drawing shall prevail over quality plan in case of any mismatch.
- 2) This QAP is not applicable for the first time supplies or customer/project specific requirements for which a separate QAP shall be submitted by vendors. In such case, additional requirement of customer/ project, purchase order & approved MPP shall also be added in the QAP and same shall be complied with.
- 3) Radiographic test shall be carried out if specified in BHEL Drg.

Drg No. : As per BHEL PO. Legend: *D- Documents marked (✓) to be included by Supplier in Documentation Package. S - Sub Vendor M - Vendor / Manufacturer C -Customer (BHEL) / Inspection Agency	BHEL Spec. No : HY 19593 Rev.03 P - Perform W - Witness V - Verify	PREPARED BY:  11/11/14	APPROVED BY:  के.एस.एन. मुर्ति K.S.N. MURTHY अ.म.प्र./गुणवत्ता आश्वासन AGM/Quality Assurance - प्ल. हैड/ BHEL, HYD.
HYQA/QP/VSQP Rev.01			