

**CORROSION-RESISTANT STEEL CASTINGS  
GX4CrNi13-4****1.0 GENERAL**

This specification governs the quality requirements of 13% Chromium - 4% Nickel Corrosion-resistant Steel Castings.

**2.0 APPLICATION**

Material for Hydro turbine components (Francis, Kaplan & Pelton) , boiler feed pump impeller castings and other general purposes..

**3.0 CONDITION OF DELIVERY**

Heat treated

The castings shall be delivered in any one of the following three conditions, unless otherwise called for in BHEL drawing / order.

1. Rough ground and rough machined.
2. Semi-finish ground and finish machined.
3. Finish ground and finish machined.

Castings shall not be painted.

**4.0 COMPLIANCE WITH NATIONAL / INTERNATIONAL STANDARD**

There is no national standard covering this material, However, assistance has been derived from EN 10283 -1998 Gr: GX4CrNi13-4:Corrosion resistant steel castings.

**5.0 DIMENSION AND TOLERANCES**

Castings shall be true to the pattern / drawing.

Holes for machining up to including 50mm in diameter are to be cast solid, unless otherwise stated in BHEL order / drawing.

Unless otherwise specified in BHEL order/ drawing, untoleranced dimensions for the casings shall be as per tolerance class 4 of BHEL standard AA 023 04 02.

Revisions :  
Refer 28.8.36 of MOM of MRC-FCF+ HTM

APPROVED :  
INTERPLANT MATERIAL RATIONALISATION  
COMMITTEE-MRC (FCF + HTM)

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**6.0 MANUFACTURE**

Steel for the castings shall be made by basic electric furnace process or such other process as may be agreed to between BHEL and manufacturer.

**7.0 HEAT TREATMENT**

Heat treatment shall be carried out as follows to give the properties specified. Heat between 1000-1050 °C , air cool to 95°C or lower prior to any optional intermediate tempering and prior to final tempering. The intermediate tempering temperature shall not exceed 650°C.

Final tempering temperature shall be between 590 - 620°C.

Runners and risers shall be machine cut / gas cut using Iron powder.

Test samples shall also be heat treated along with castings they represent.

**8.0 FINISH**

All castings shall be properly fettled and dressed and all surfaces shall be thoroughly cleaned.

**9.0 FREEDOM FROM DEFECTS:**

Castings shall be free from defects such as porosity, blow holes, sand inclusions, shrinkage, cavities, hard spots, cold shuts, cracks, etc., which may adversely affect machining and utility of castings.

**10.0 CHEMICAL COMPOSITION**

The melt analysis of the steel and the permissible variation in the composition of the castings from the melt analysis shall be as specified below:

Element	Melt analysis, Percent		Permissible Variation, Percent, max
	Min.	Max	
Carbon	-	0.06	± 0.01
Silicon	-	1.00	± 0.10
Manganese	-	1.00	± 0.10
Nickel	3.50	5.00	± 0.15
Chromium	12.00	13.50	± 0.30
Molybdenum	-	0.70	± 0.07
Sulphur	-	0.025	+ 0.005
Phosphorus	-	0.035	+ 0.005



## CORPORATE PURCHASE SPECIFICATION

AA 195 42

Rev. No. 08

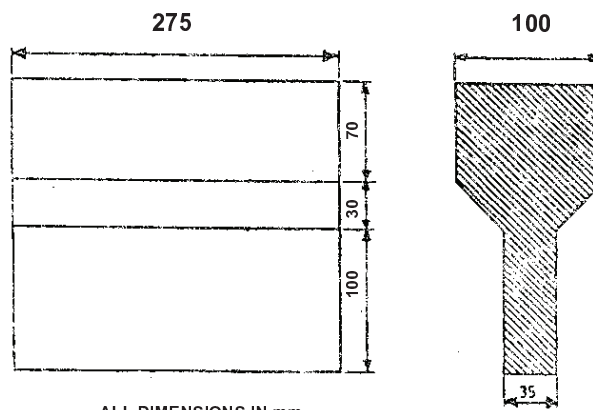
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### 11.0 TEST SAMPLES:

Manufacturers shall carry out mechanical testing as per following sampling plan:

- 11.1 Unless otherwise specified, for castings weighing up to 1000kg piece weight one keel block separately cast per melt per heat treatment batch shall be supplied according to the sketch given below. The mass of the batch shall not be greater than 5000Kg.
- 11.2 Unless otherwise specified, castings weighing more than 1000 kg shall be provided with integrally cast keel block.
- 11.3 Retest shall be carried out as per IS : 8800.
- 11.4 Keel blocks with proper identification and representative of the castings shall be supplied along with the consignment for testing at BHEL works.

### DETAILS OF KEEL BLOCK



### 12.0 MECHANICAL PROPERTIES:

The test pieces after being heat treated as per clause 7.0 above, shall show the following properties:

#### 12.1 Tensile:

The test pieces shall show the following properties, when tested in accordance with IS:1608:

Tensile strength	:	760 N/mm <sup>2</sup> , min
Yield strength (0.2% Proof Stress)	:	550 N/mm <sup>2</sup> , min.
Elongation on 50mm gauge length	:	15 percent, min.

**12.2 Homogeneity of batches (Hardness test):**

The homogeneity of the batch shall be verified by hardness test and shall have a Brinell hardness between 240-285 HB when tested in accordance with IS : 1500. The hardness shall be measured at the same location on each casting of the batch.

**12.3 Charpy Impact Value (2mm V-Notch):**

The test pieces shall show an average Charpy impact value of 50 Joules minimum over three test pieces. (However, the minimum value for one test piece shall not be less than 35 Joules). The test will be conducted on a 2mm V-Notch as per IS : 1757.

**13.0 NON-DESTRUCTIVE TESTS:**

The following tests shall be conducted:

- 1) Ultrasonic examination to BHEL standard AA 085 01 04 / AA 085 01 05.
- 2) Liquid penetrant examination to BHEL standard AA 085 01 31 .
- 3) Magnetic particle examination to BHEL standard AA 085 01 33 .

Norms of acceptance shall be as specified in BHEL order/drawing

**14.0 REPAIR OF CASTINGS**

Repair of castings shall not be carried out by the manufacturer without the prior permission of BHEL.

**15.0 TEST CERTIFICATES**

Three copies of test certificates shall be supplied unless otherwise stated in BHEL order, preferably in the test certificate format annexed to this specification (Annexure -1).

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) Dimensional inspection.
- ii) Detail of heat treatment.
- iii) Chemical composition.
- iv) Results of mechanical tests including individual hardness values.
- v) Results of NDT tests



**16.0 PACKING AND MARKING**

Castings shall be suitably packed to prevent corrosion and damage during transit. Machined surfaces shall be properly protected with anticorrosive compounds. Each package or casting (when supplied separately) shall be legibly marked with the following information.

AA 195 42: GX4CrNi13-4 Corrosion resistant steel castings

BHEL Order No.

Consignment/Identification No.

Melt No.

Weight

Supplier's Name

**17.0 REFERRED STANDARDS (Latest Publications Including Amendments):**

- |                 |                 |                 |                 |
|-----------------|-----------------|-----------------|-----------------|
| 1. AA 023 04 02 | 2. AA 085 01 04 | 3. AA 085 01 05 | 4. AA 085 01 31 |
| 5. AA 085 01 33 | 6. IS : 1757    | 7. IS : 1500    | 8. IS : 8800    |
| 9. IS: 1608     | 10. EN 10283    |                 |                 |



## ANNEXURE 1 - RECOMMENDED TEST CERTIFICATE FORMAT FOR CASTINGS

SUPPLIERS'S NAME AND ADDRESS									
1. Customer :					6. Cast No. & Date :				
2. TC No. & Date :					7. Batch No. :				
3. PO No. :					8. Heat Code :				
4. Process of Melting :					9. Spec., No. :				
5. Deoxidisation Process					10. Test Bar Size				
II. CASTING COVERED BY T.C.									
Sl. No.	Drawing No. & Item No.				Description	Quantity & Weight			
12. CHEMICAL COMPOSITION (PERCENT)									
Element	C	Si	Mn	S	P				
As per Min.									
Spec. Max.									
Actual Values.									
13. HEAT TREATMENT (To be accompanied by Recorder Chart, wherever called for)									
Condition	Temp. °C			Soaking Time. Hrs.,			Cooling Medium		
14. MECHANICAL PROPERTIES									
	T.S. N/mm <sup>2</sup>	Y.S. 0.5/0.2% Proof N/mm <sup>2</sup>	% E on GL 5.65 SO	% R.A. Mn	Hardness BHN Min. 3 Values	Impact Value, Joules	Bend		
As per Min.									
Spec. Max.									
Actual Values.									
15. Surface Finish (When called for in the order/drg)									
16. DIMENSIONAL INSPECTION									
17. NON-DESTRUCTIVE TESTS									
Nature of Test	Acceptance Level	Instrument used			Range	Results	Any other details		
Ultrasonic									
Radiographic									
Dye Penetrant/ Magnetic Particle									
18. OTHER TESTS, IF ANY (MICRO- Scope, Hydraulic, Etc.)									
19. IDENTIFICATION ON CASTING AS PER CPS.									
We hereby certify that the items mentioned above have been tested and inspected in our presence and are found to be in accordance with the drawings, specifications and purchase order.									
Signature & Seal of the Inspecting Officer (Purchase Representative)					Signature and Seal of the Chief of Quality Control Chief Metallurgist of the Supplier.				
Date :					Date :				
<b>INSTRUCTION:</b>									
a) If steel is produced by LD or Oxygen process, Nitrogen content should be furnished and shall not exceed 0.008%									
b) Test Certificates are to be furnished as per Purchase Order and Specifications, in A4 Size transparent paper.									
c) All the entries including signature should be in black ink.									
d) If testing is done by outside agencies, the original TCs shall be furnished.									
e) The actual Test Certificate may run into more than one A4 size paper, if needed, to facilitate filling up of details.									