



CORPORATE PURCHASING SPECIFICATION

AA19501

Rev No. 06

PAGE 1 of 5

HIGH MAGNETIC PERMEABILITY STEEL CASTINGS, ANNEALED - GRADE 1

1.0 GENERAL:

This specification governs the quality requirements of High Magnetic Permeability Steel Castings, Grade 1.

2.0 APPLICATION:

For Yokes and parts of electrical machines, not subjected to high stress.

3.0 CONDITION OF DELIVERY:

Fully annealed.

Rough machining of the castings shall be carried out, unless otherwise specified in BHEL order/drawing.

Castings shall not be painted.

4.0 COMPLIANCE WITH NATIONAL STANDARDS:

The castings shall comply with the requirements of the following national standard and also meet the requirement of this specification.

IS: 4491 – 1994 (Grade:1) : Steel Castings of High Magnetic Permeability.

5.0 DIMENSIONS AND TOLERANCES:

The castings shall be true to the pattern / drawing. Holes for machining up to and including 50mm in diameter are to be cast solid, unless otherwise stated on BHEL order/drawing.

Unless otherwise specified in the order/drawing, untoleranced dimensions for the castings shall be as per tolerance class 4 of BHEL standard AA0230402

6.0 MANUFACTURE:

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

Steel shall be fully killed.

Revisions:			APPROVED:		
Cl 29.6.26 of MOM of MRC-FCF+HTM			INTERPLANT MATERIAL RATIONALISATION COMMITTEE – MRC(FCF+HTM)		
Rev No.06	Amd No.	Reaffirmed	Prepared	Issued	Dt. of 1 st Issue
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AA19501

Rev No. 06

PAGE 2 of 5

CORPORATE PURCHASING SPECIFICATION



7.0 HEAT TREATMENT:

Castings shall be fully annealed as per the following cycle to give the properties specified.

Heat the castings up to a temperature of 900°C minimum, the rate of heating not exceeding 80°C per hour. Furnace temperature at the time of loading shall be within 200°C. Soak for 1 hour per 25 mm of section minimum. Cool the castings in the closed furnace at a cooling rate not exceeding 100°C per hour. Temperature at the time of unloading shall not be more than 200°C, Heat treatment chart should be furnished to BHEL for scrutiny and records.

Any flame or arc cutting which may have to be done, shall be carried out before heat treatment.

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

8.0 FINISH:

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

The machined surfaces shall have the surface finish as indicated in the drawing.

9.0 FREEDOM FROM DEFECTS:

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

When it is necessary to remove risers by flame cutting, care shall be taken to make the cut at a sufficient distance from the body of the casting so as to prevent any defect being introduced into the casting due to local heating.

10.0 CHEMICAL COMPOSITION:

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

Element	Melt analysis percent max.	Permissible variation percent
Carbon	0.15	+ 0.02
Silicon	0.60	+ 0.05
Manganese	0.50	+ 0.04
Sulphur	0.040	+ 0.005
Phosphorus	0.040	+ 0.005
*Nickel	0.40	+ 0.03
*Chromium	0.25	+ 0.04
*Molybdenum	0.15	+ 0.03
*Copper	0.30	+ 0.03

* Residual elements: Total not to exceed 0.80 percent



CORPORATE PURCHASING SPECIFICATION

AA19501

Rev No.06

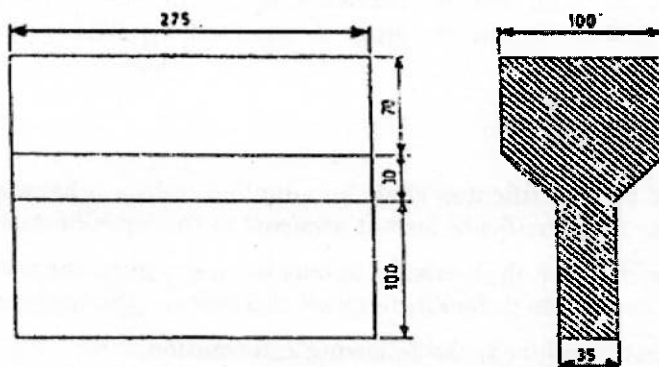
PAGE 3 of 5

11.0 TEST SAMELES:

Manufacturers shall carryout mechanical testing as per following sampling plan.

- 11.1 Unless otherwise specified, for castings weighing up to 500 kg. piece weight one keel block, separately cast per melt per heat treatment batch shall be supplied according to the sketch given below:
- 11.2 Unless otherwise specified castings weighing more than 500 kg shall be provided with integrally cast keel block.
- 11.3 Retests 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



ALL DIMENSIONS IN mm


12.0 MECHANICAL PROPERTIES:

The test pieces, after being heat treated as per clause Cl.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	:	340 – 430 N/mm ²
Yield strength or 0.5% Proof Stress	:	190 N/mm ² , min.
Elongation on $5.65\sqrt{S_0}$ gauge in length	:	22 percent, min.
Reduction in area	:	40 percent, min.

AA19501 Rev No. 06 PAGE 4 of 5	<h2 style="margin: 0;">CORPORATE PURCHASING SPECIFICATION</h2>	
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12.2 Bend:

The test pieces shall be capable of being bent cold, without any sign of fracture, through an angle of 120° round a mandrel, having a diameter 3 times the thickness or diameter of the test piece, when tested in accordance with IS:1599

13.0 ADDITIONAL TESTS:

The following tests shall be conducted:

1. Non-destructive test as per BHEL standard AA0850104
2. Liquid penetrant inspection as per BHEL standard AA0850131
3. Magnetic Particle Examination as per BHEL standard AA0850133

Norms of acceptance shall be as specified in the above standard.

14.0 REPAIR OF CATINGS:

Repair of castings shall not be carried out by the manufacturer without the prior permission of BHEL. Repair welding, if accepted by BHEL, shall be carried out in accordance with IS: 5530

15.0 TEST CERTIFICATES:

Three copies of test certificates shall be supplied unless otherwise stated in the 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 dispatch documents to facilitate quick clearance of the material.

The test certificate shall bear the following Information.

Dimensional Inspection.
 Details of heat treatment.
 Chemical composition.
 Results of mechanical tests.
 Results of additional tests called for in BHEL order/drawing.


16.0 PACKING AND MARKING:

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

AA19501:High Magnetic Permeability Steel Castings, Annealed - Grade 1
 BHEL Order No.:
 Consignment/Identification No.:
 Melt No.
 Weight
 Supplier's name

17.0 REFERRED STANDARDS (Latest publications including amendments):

1. AA0230402	2. AA0850104	3. AA0850131
4. AA0850133	5. IS: 1599	6. IS: 1608
7. IS: 4491	8. IS: 5530	9. IS: 8800

	<h1 style="margin: 0;">CORPORATE PURCHASING SPECIFICATION</h1>	AA19501 Rev No.06 PAGE 5 of 5
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ANNEXURE - 1:
RECOMMENDED TEST CERTIFICATE FORMAT FOR FORGINGS

SUPPLIER'S NAME AND ADDRESS									
TEST CERTIFICATE FOR FORGINGS									
1. Customer: 2. TC No. & Date: 3. PO No.: 4. Process of Melting Ingot: 5. Deoxidisation Process: 6. Forging Method: 7. BHEL's Reference for Approval of Bloom 8. Discard: Top _____%; Bottom _____%	9. Reduction Ratio } Ingot to Bloom } Bloom to Blank 10. Batch No.: 11. Heat/Melt No. 12. Spec.No. 13. Test Bar Size & Nos. 14. Supplier of the ingot/billet/ Bloom and TC reference.								
15. FORGINGS COVERED BY TEST CERTIFICATE									
S.No.	Drawing No. & Item No.	Description	Quantity & Weight						
16. CHEMICAL COMPOSITION (PERCENT)									
Element	C	Si	Mn	S	P				
As Per Specn.	Min.								
	Max.								
Actual Values									
17. HEAT TREATMENT (To be accompanied by Recorder Chart, Whenever called for)									
Condition	Heating Rate, °C/hr.	Temp. °C	Soaking Time, Hrs.	Cooling Rate, °C/hr	Cooling Medium				
18. MECHANICAL PROPERTIES									
	Y.S. N/mm ²	Y.S. 0.5/0.2% Proof N/mm ²	% Elongation 5.65√So GL	% R.A. Min.	Hardness BHN (Min. 3 values)	Impact Value Joules	Bend Test		
As Per Specn.	Min.						Angle of bend	Dia of mandrel	Result
	Max.								
Actual Values									
19. SURFACE FINISH (When called for in the order/drg.)									
20. DIMENSIONAL INSPECTION									
21. NON-DESTRUCTIVE TESTS									
Nature of Test	Acceptance level	Instrument used	Range	Results	Any other detail				
Ultrasonic									
Radiographic									
Dye penetrant/ Magnetic Particle									
22. METALLOGRAPHIC EXAMINATION (To be conducted if called for and photo micrographs to be attached along with a report)									
Location of Sample	Etchant used	Magnification	Constituent observed	Relative %					
Microstructure	Macroetch	Inclusion Rating							
23. OTHER TESTS IF ANY (MICROSCOPIC, SULPHUR PRINTS, ETC)									
24. IDENTIFICATION OF FORGINGS AS PER PURCHASE SPEC.									
We hereby certify that the items mentioned above have been tested and inspected in our presence and are found to be in accordance with drawings, specifications and purchase order. <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> SIGNATURE, NAME & SEAL OF THE INSPECTING OFFICER DATE: </div> <div style="width: 45%;"> SIGNATURE, NAME & SEAL OF THE CHIEF OF QUALITY CONTROL/ CHIEF METALLURGIST OF THE SUPPLIER DATE: </div> </div>									
INSTRUCTIONS a) Details of all heat treatment processes carried out should be furnished sequentially in 17. b) Test certificates are to be furnished as per Purchase order and specification, in A4 size preferably in transparent paper. c) All the entries including signature should be in block colour ink. d) If testing is done by outside agencies, the original TCs shall be furnished. e) The actual TC may run into more than one A4 size paper, if needed, to facilitate filling up of details.									