



## CORPORATE PURCHASE SPECIFICATION

AA 193 33

Rev. No. 09

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## CARBON STEEL FORGINGS, CLASS 4

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## 1.0 GENERAL:

This specification governs the quality requirements of Carbon Steel Forgings, class 4.

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## 2.0 APPLICATION:

Suitable for general engineering purposes.

## 3.0 CONDITION OF DELIVERY:

Normalised/Normalised and tempered.

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

## 4.0 COMPLIANCE WITH NATIONAL STANDARDS:

The forgings shall comply, in general with the requirement of the following National standards and also meet the requirements of this specification.

IS::2004: 1991(RA 2001) (RA-2006) } Carbon Steel Forgings For General Engineering

Gr: Class 4 (45C8), } Purposes.

↑

## 5.0 DIMENSIONS AND TOLERANCES:

The dimensions and tolerances shall be as specified in the order/ drawing. Wherever these are not specified, specified, the machining allowances and tolerances shall be as specified below:

For finish machined drawings :  $3 \pm 1$  mm

For rough machined drawings :  $\pm 1$  mm

Revisions : 36<sup>th</sup> MOM OF MRC+HTM

APPROVED :  
INTERPLANT MATERIAL RATIONALISATION  
COMMITTEE-MRC (FC&F+HTM)

Rev. No. 09

Amd.No.

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**6.0 MANUFACTURE:**

Forgings shall be manufactured from steel produced by the open hearth, electric or such other process as may be agreed to between BHEL and the manufacturer.

Steel shall be fully killed.

Sufficient discard shall be made from each ingot to ensure freedom from pipe, segregation and other defects.

The amount of hot working and finishing temperature shall be such as to ensure complete soundness and adequate uniformity of structure and mechanical properties after heat treatment. The forgings shall not be overheated.

The minimum reduction ratio when forgings are made out of ingots shall be 4:1.

For sizes above 250 mm ruling section, the minimum reduction ratio shall be 3.5:1

**Note:** Raw material like Ingots/Blooms/Billets required for forgings should be procured from BHEL approved sources along with test certificate."

**7.0 HEAT TREATMENT:**

Forgings shall be normalised / normalised and tempered at suitable temperature to achieve the mechanical properties specified. ↑

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

**8.0 FINISH:**

As mentioned in the drawing.


**9.0 FREEDOM FROM DEFECTS:**

The forging shall be free from defects, such as cracks, fold, flakes, seams, segregation, nonmetallic inclusions and other defects which may affect the utility of the forging.

**10.0 CHEMICAL COMPOSITION:**

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

Element	Melt analysis, percent		Permissible variation, percent
	Min.	Max.	
Carbon	0.40	0.50	± 0.03
Silicon	0.15	0.35	± 0.03
Manganese	0.60	0.90	± 0.04
Sulphur	---	0.040	+ 0.005
Phosphorus	---	0.040	+ 0.005

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**Notes:**

- Elements not quoted above shall not be added to the steel, other than for the purpose of finishing the heat and shall not exceed the following limits:
 

Element	Percent, max.
Nickel	0.30
Chromium	0.30
Copper	0.25
Molybdenum	0.05
Vanadium	0.05
Tin	0.05
Boron	0.0003
- When steel is aluminium killed or killed with both aluminium and silicon, the requirements of minimum silicon content shall not apply. For aluminium killed steel the total aluminium content shall be with in 0.02 to 0.05 percent.
- $Mo \leq 0.15\%$ , limiting to meeting conditions of  $Cr + Mo + Ni = 0.5\%$ .

**11.0 TEST SAMPLES:**


11.1 Unless otherwise specified in the order/drawing, test samples shall be taken form each melt and each heat treatment batch. Test samples should be cut from the heat treated forgings by cold process only and shall no further heat treatment.

Test samples shall be taken form locations indicted on the drawing, leaving enough material, if required for testing at BHEL's end, integral with forgings.

The samples shall be cylindrical or rectangular in shape and cut at a distance of 12.5mm below the heat treated surface.

11.2 When integral test pieces are not called for, a test sample, having similar reduction ratio and heat treatment, as the forgings it represents, shall be provided per heat, per heat treatment batch, for check testing at BHEL, along with the forgings. The samples shall be properly identified and correlated with the Heat/Heat treatment Batch No./ Test Certificate No. Test samples shall be taken, at a distance of 12.5mm below the heat-treated surface.

11.3 Test samples shall generally be taken in the longitudinal direction. However, for economic reasons or where the size/ configuration does not permit the same, test samples may be taken in the transverse or radial direction.

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12.0 MECHANICAL PROPERTIES:

The test pieces, after being heat treated as per clause 7.0 above, shall show the following properties upto a limiting ruling section of 800 mm. Properties for thicker sections shall be subject to agreement between BHEL and the manufacturer. Test methods are specified below:

12.1 Tensile test : IS:1608

12.2 Hardness test (Brinell) : IS:1500


12.3 Charpy Impact Value (2mm U-Notch) : IS:1499

This test applicable for forgings of sizes above 16mm only.

Property	Sample (See Cl.11.3)	Limiting ruling section, mm			
		Upto & incl 100	>100 & upto 300	> 300 & upto 500	>500 & upto 800
Tensile strength N/mm <sup>2</sup>	Longitudinal/ Transverse/ Radial/Tangential	620	620	530	530
Yield strength min, N/mm <sup>2</sup>	Longitudinal/ Transverse/ Radial/Tangential	320	320	275	275
Elongation on 5.65 √So gauge length percent, min	Longitudinal	15	14	15	13
	Transverse	8	7	8	6
	Radial	10	9	10	8
	Tangential	11	10	10	9
Reduction in area, percent min.	Longitudinal	38	35	32	30
	Transverse	23	21	19	18
	Radial	25	24	21	19
	Tangential	30	28	24	23
*Hardness, Brinell,HB	—	175-207	175-207	149-197	149-197
Charpy Impact Value (2mm, U-Notch) min.,Joules	Longitudinal	31	27	23	23
	Transverse	16	14	12	12
	Radial	19	16	14	14
	Tangential	24	21	16	16

**Note:** 1. Unless otherwise stated on the order/drawing, small forgings of non-critical nature weighing less than 300kg shall be accepted on the basis of chemical composition and hardness.

\* 2. Hardness test can be conducted only, when tensile test can not be performed.

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13.0

ULTRASONIC TESTS:

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13.1

For forgings ordered by BHEL, Hyderabad: Unless other wise specified on the drawing, ultrasonic test shall be carried out as per BHEL standard AA 085 01 18 and norms of acceptance shall be as per category 2.

3.13.2

For forgings ordered by other units: If specified on the drawing/order, ultrasonic test shall be carried out as per BHEL standard AA 085 01 18 and norms of acceptance shall be as per category 2, unless otherwise specified.

14.0

ADDITIONAL TESTS:

If specified in the drawing/order, the following tests shall be conducted:

14.1

Bend Test (Longitudinal):

The test pieces (230mm long and 32 mm square with edges rounded off, where the dimensions permit) shall be capable of being bent cold by direct pressure without fracture, until the sides are parallel, round a mandrel having a diameter of 44 mm when tested as per IS:1599.

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14.2

Magnetic particle test.

14.3

Any other tests: Norms of acceptance shall be as specified in the drawing/order.

15.0

SCOPE OF THIRD PARTY INSPECTION:

Wherever, separate quality plan is not attached, the scope of third party inspection shall be as follows:

1.

Review of supplier's declared chemical composition.

2.

Selection of test samples for mechanical tests and witness of mechanical tests.

3.

Witness of Non-destructive tests as applicable.

4.

Review of HT charts.

5.

Dimensional inspection.

16.0

TEST CERTIFICATE:

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 following details shall be furnished in the test certificate:

i)

Reduction ratio

ii)

Dimensional Inspection.

iii)

Chemical composition including trace elements.

iv)

Results of mechanical tests.

v)


Results of Ultrasonic test

vi)

Details of heat treatment

vii)

Results of additional tests called for in the drawing/order.

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**17.0 PACKING & MARKING:**

Forgings shall be suitably packed to prevent corrosion and damage during transit.

Machined surfaces shall be properly protected with anticorrosive compounds.

Each package or forging (when supplied separately) shall be legibly marked with the following information:

AA 193 33 : Carbon Steel Forgings, Class 4

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BHEL Order No.

Suppliers Name

Consignment/ Identification No.

Batch No.

Weight.

**18.0 REFERRED STANDARDS (Latest publications Including Amendments):**

1) AA 085 01 18

2) IS:1499

3) IS:1500

4) IS:1599

5) IS: 1608

6) IS: 2004



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**ANNEXURE-I: RECOMMENDED TEST CERTIFICATE FORMAT FOR FORGINGS**

SUPPLIER'S NAME AND ADDRESS														
TEST CERTIFICATE FOR FORGINGS														
1. Customer:					9. Reduction Ratio } Ingot to Bloom Bloom to Blank									
2. TC No. & Date:					10. Batch No.:									
3. PO No.:					11. Heat/Melt No.									
4. Process of Melting Ingot:					12. Spec. No.									
5. Deoxidisation Process:					13. Test Bar Size & Nos.									
6. Forging Method:					14. Supplier of the ingot/billet/ Bloom and TC reference.									
7. BHEL's Reference for Approval of Bloom														
8. Discard: Top _____%, Bottom _____%														
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														
	T.S. N/mm <sup>2</sup>	Y.S. 0.5/0.2% Proof N/mm <sup>2</sup>	% Elongation 5.65√So GL	% R.A. Min.	Hardness BHN (Min. 3 values)	Impact Value Joules	Bend Test							
							Angle of bend	Dia of mandrel	Result					
As Per Specn.	Min.													
	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.														
SIGNATURE, NAME & SEAL OF THE INSPECTING OFFICER DATE:										SIGNATURE, NAME & SEAL OF THE CHIEF OF QUALITY CONTROL/ CHIEF METALLURGIST OF THE SUPPLIER DATE:				
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.														

156250/2024/HEP-EXM20500



## AMENDMENT - NOTIFICATION

AA 085 01 18 REV.No. 01

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AA 085 01 18:ULTRASONIC TESTING CLASSIFICATION AND ACCEPTANCE  
STANDARDS FOR STEEL FORGINGS, BILLETS AND BLOOMS

1.0 PAGE 1 OF 6; Cl 1.0 SCOPE:

Last sentence of the para is modified as follows:

"This standard does not apply to austenitic steel forgings for which AA 085 01 19 may be referred to."

2.0 Cl 3.2 Sensitivity:

Title of the left hand column of the table is modified as "Frequency, MHz" in place of Frequency range, MHz.

3.0 PAGE 2 OF 6; Cl 5.0 COUPLANT:

Last line is modified as "or water shall be used."

4.0 Cl 6.1: Eight line is modified as follows:

"shall not exceed 150mm/second. The following techniques"

Please see instructions on the reverse.

Ref:	Amd. No.	Approved	Issued	Date	Cum. Sr. No.
Cl:10.2.4 of MOM	01	WG-NDT	CORP. R&D	15.1.96	A 1822



## INSTRUCTIONS

**Changes to be incorporated in the controlled copies  
for "AMENDMENT -- NOTIFICATION".**

- a) The "AMD. No." of this "Amendment Notification" shall be recorded against the sheet / clause, being amended, on the margin.
- b) This, "Amendment Notification" shall be filed over the concerned preface sheet of the Specification / or First sheet of the standard or over the previous Amendment, if any.



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AA 085 01 18

REV.No. 01

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**ULTRASONIC TESTING, CLASSIFICATION AND ACCEPTANCE  
STANDARDS FOR STEEL FORGINGS, BILLETS AND BLOOMS**

**1.0 SCOPE:**

This standard deals with the ultrasonic testing of steel forgings, billets and blooms. The procedure covers pulse echo direct contact manual ultrasonic flaw detection technique. This standard does not apply to austenitic steel forgings.

**2.0 PERSONNEL REQUIREMENT:**

Personnel performing non-destructive examination and evaluation shall be qualified to the recommended practice SNT - TC - 1A or any other recognised practice.

**3.0 EQUIPMENT CHARACTERISTICS:****3.1 Frequency range:**

The ultrasonic equipment shall be suitable for operating at frequencies within the range of 0.5 to 6 MHz.

**3.2 Sensitivity:**

The sensitivity of the equipment shall be tested to ensure that the number of full screen back wall echo is not less than that given below, when the appropriate probe is placed on the metalised surface of plastic insert of the Indian Standard reference block (IS:4904)/IIW block.

<u>Frequency range, MHz</u>	<u>Min.No. of full screen back echoes</u>
1	5
2	4
4 to 6	2

**3.3 Resolution:**

The resolution of the equipment and probe combined shall be such as to show separately indications of the three grooves in the IIW - VI block.

**Revision:**

C1.9.4 OF MOM OF WG(NDT)

**Approved:**INTERPLANT STANDARDIZATION  
COMMITTEE - ( WG-NDT )

Rev.No. 01

Amd.No.

Reaffirmed

Prepared

CFFP  
HARDWARIssued  
CORP. R&D

Dt. of 1st issue

Jan '80

Dt. Jan '95

Dt.

Year:

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**4.0 SURFACE CONDITION:**

The test surface shall be free from loose scales, rust and such other extraneous material that would interfere with the ultrasonic energy transmission. In case of machined surface, it is desirable to have a surface finish of 6.25 microns or better. A gramophone record type of finish and tear produced by machining tools shall be avoided since these give rise to spurious echoes and cause probe wear.

**5.0 COUPLANT:**

To ensure adequate transmission of ultrasonic energy between the probe and the test object, a suitable couplant having good wetting characteristics such as oil, grease, water, glycerine or cellulose paste shall be used.

**6.0 TESTING TECHNIQUE:**

6.1 Selection of testing technique shall be made after giving due consideration to the method of manufacture and shape of the object tested. Testing technique should be such that each and every part of the object volume is scanned at least once. Successive scans shall overlap a minimum of 15% of the probe width. Uniform contact shall be maintained between probe and object and scanning speed shall not exceed 100 mm/ second. The following techniques are considered to be minimum for providing adequate coverage.

**6.2 Scanning Scheme (Solid And Hollow Forgings):**

Complete length of the forging shall be scanned radially from sides / cylindrical surface through 360° using longitudinal wave probe. Whenever practicable the forging shall be scanned in axial direction also. Hollow forgings, and when necessary, solid forgings also shall be scanned using appropriate shear wave probes to detect axial and radial cracks. Hollow forgings are the forgings made hollow on the press by punching or ring rolling operation.

**6.3 Solid Rectangular Forgings, Billets And Blooms:**

Complete length of the object shall be scanned from two adjacent faces and whenever practicable one end face using longitudinal wave probe.

6.4 Radial cracks on round sections which can not be detected by normal testing method may be subjected to other crack detection methods such as MPI.

**7.0 SCANNING:****7.1 Probes and Frequency:**

Overall scanning shall be done using 2 MHz nominal, 20-25 mm diameter probes except when large grain size and path length make it necessary to use a lower frequency. Smaller probes may be used when necessary. However, for forgings intended for backing material for white metal lined bearings, the examination shall be carried out by 4 MHz probes.



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7.2 Time Base Calibration:

The time base shall be calibrated using a calibration block or a known dimension of forging under examination.

7.3 Sensitivity:7.3.1 When Calibrated Attenuator Is Not Available:

Reference sensitivity of equipment shall be set such that the maximum acceptable defect equivalent flat bottomed hole in the test block is equal to 75% of the full screen height. Testing shall be carried out at the highest sensitivity possible.

7.3.2 When Calibrated Attenuator Is Available:

The sensitivity of the equipment during scanning shall be set 6 dB more than the sensitivity required to give a full screen height echo from the maximum acceptable size of defect.

Note: The above sensitivity level adjustment is purely for scanning purposes. Once a defect is encountered, the sensitivity shall be brought down to estimate the size of defect for evaluation of the material under test.

8.0 ESTIMATION OF FLAW SIZE:8.1 Large Size Flaws:

The size of large flaws can be estimated by moving the probe in all directions and plotting the midpoint of the probe when echo falls to 50 percent or 6 dB.

8.2 Small Size Flaws:8.2.1 When Calibrated Attenuator Is Not Available:

8.2.1.1 The size of the flaw may be estimated by comparing with the echoes of the flat bottomed holes at appropriate depths in a test block of ultrasonically similar material.

8.2.1.2 The size of the flaw may also be estimated by moving probe successively in all the four directions at right angles to each other and plotting the mid point of the probe when echo height falls to 50% or 6 dB. Due allowance shall also be made for beam spread, depth and orientation of flaw and diameter of the forging if the scanning is done from the curved surface.

8.2.2 When Calibrated Attenuator Is Provided With The Equipment:

The size of the flaw (smaller than the beam spread) can be estimated accurately in millimetres of equivalent circular flaw with the help of Krautkramer's DGS (Distance - gain - size) diagram. Method of estimating flaw size using a DGS diagram is given in Annexure - A.

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9.0 CLASSIFICATION OF FORGINGS, BILLETS AND BLOOMS:

9.1 Forgings, billets and blooms are classified into the following five categories depending upon the defect size admissibility for the purpose of ultrasonic testing:

CategoryUnacceptable defects

- |   |  |
|---|--|
| 1 | (i) Cracks, flakes, seams & laps.<br>(ii) Defects giving indication larger than that from a 2 mm diameter equivalent flaw.<br>(iii) Groups of defects with maximum indication less than that from a 2 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 70%.<br>(iv) Defects giving indications of 1 to 2 mm diameter equivalent flaw separated by a distance less than four times the size of the larger of the adjacent flaws. |
| 2 | (i) Cracks, flakes, seams & laps.<br>(ii) Defects giving indication larger than that from a 4 mm diameter equivalent flaw.<br>(iii) Groups of defects with maximum indication less than that from a 4 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 50%.<br>(iv) Defects giving indications of 2 to 4 mm diameter equivalent flaw separated by a distance less than four times the size of the larger of the adjacent flaws. |
| 3 | (i) Cracks, flakes, seams & laps.<br>(ii) Defects giving indication larger than that from a 6 mm diameter equivalent flaw.<br>(iii) Groups of defects with maximum indication less than that from a 6 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 40%.<br>(iv) Defects giving indications of 3 to 6 mm diameter equivalent flaw separated by a distance less than four times the size of the larger of the adjacent flaws. |
| 4 | (i) Cracks, flakes, seams & laps.<br>(ii) Defects giving indication larger than that from a 10 mm diameter equivalent flaw.<br>(iii) Groups of defects with maximum indication less than that from a 10 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 20%.   |



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- (iv) Defects giving indications of 5 to 10 mm diameter equivalent flaw separated by a distance less than four times the size of the larger of the adjacent flaws.
- 5 (i) Cracks, flakes, seams & laps.
- (ii) Defects giving indication larger than that from a 15 mm diameter equivalent flaw.
- (iii) Groups of defects with maximum indication less than that from a 15 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 10%.

**Note:** Loss of back wall echo not attributable to the presence of defects or geometry and exceeding the limits mentioned in item (iii) of each category of unacceptable defects shall be a cause for rejection.

**ANNEXURE - A**

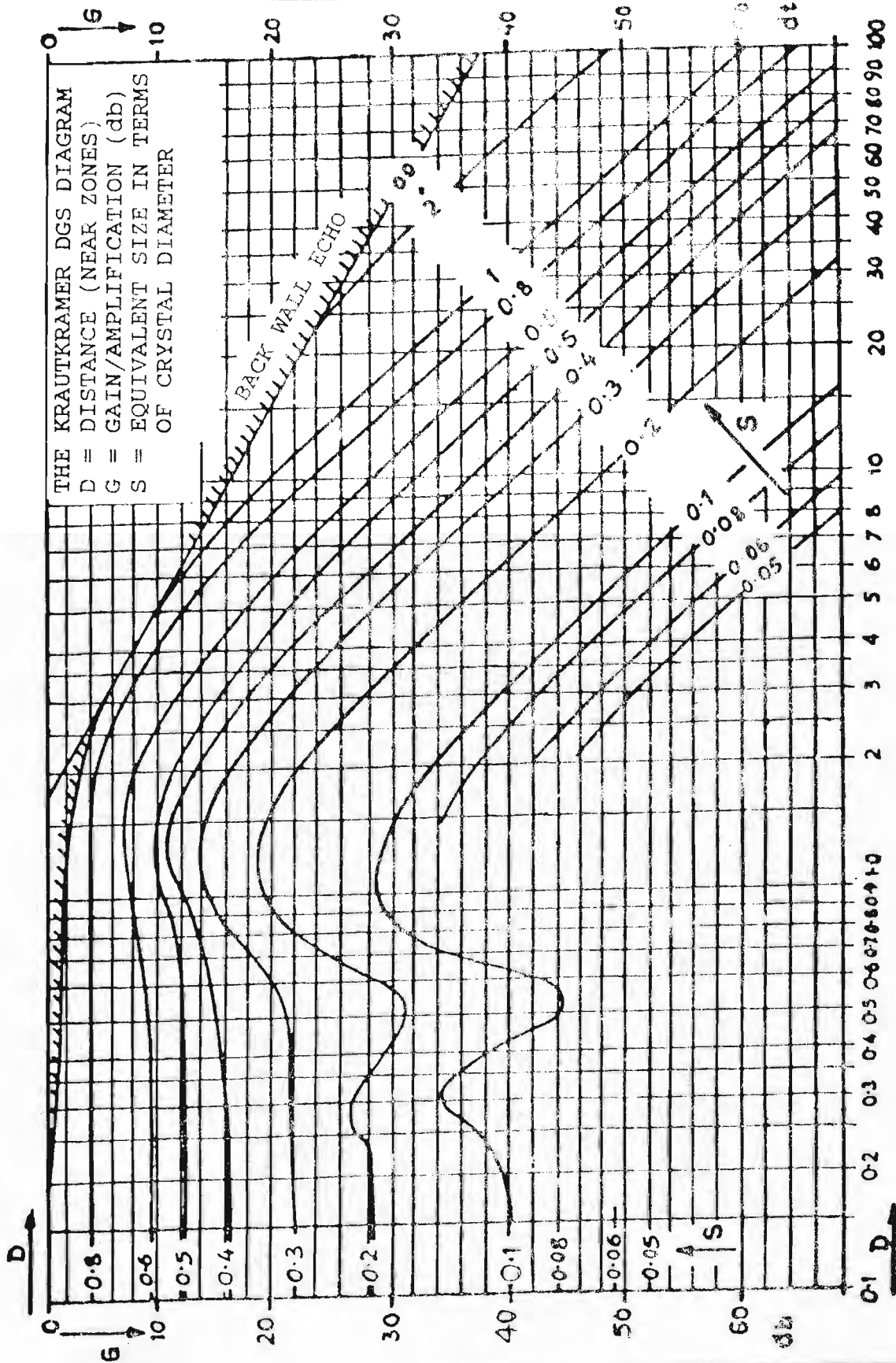
The equivalent flaw size curves of the DGS diagram is prepared by plotting the amplitude in decibels from a series of circular reflectors with increasing distance from the probe in water and so the graph incorporates only the loss in water. When it is found that the attenuation in the material under test is more (this can be checked using back echo curve of DGS diagram), this shall be taken into account while calculating the flaw size. Corrections will not be required for majority of heat treated forgings when tested with 2-4 MHz probes.

A step by step method of estimating flaw size using universal DGS diagram is given below:


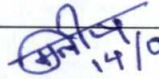

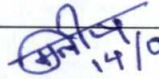
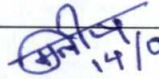

- (a) Adjust the depth range of the equipment to the required depth.
- (b) Adjust the back echo to 70% of screen height from a defect free area parallel wall of the material under test or ultrasonically similar test block and note the dB value (A) on the calibrated gain control.
- (c) Mark on the back echo curve of the diagram, the back wall of the distance in terms of near field in millimetres in the case of universal DGS diagram.
- (d) Move the probe to the defective area and get the maximum defect echo. Read off the flaw depth. Increase the gain with the calibrated gain control until echo height reaches 70% of screen height. Note the attenuator reading in dB (B).
- (e) Calculate the gain (G) in dB by subtracting 'A' from 'B'. Count off the gain 'G' downwards from the marked point on the back echo curve, and then move horizontally to intersect the vertical line from the base line corresponding to the flaw depth 'D' in terms of near field in the case of universal diagram.

(f) Note the equivalent flaw size curve passing through the above point. Multiply the reduced flaw dimension (S) of the curve by the probe diameter to give the equivalent flaw size in millimetres.


ANNEXURE - A  
KRAUTKRAMER'S DGS DIAGRAM






		 <p style="text-align: center;"><b>PRODUCT STANDARD</b> <b>TME DIVISION, BHOPAL</b></p>	<p style="text-align: center;"><b>TM 94217</b> <b>REV.06</b></p> <p style="text-align: center;"><b>PAGE 01 OF 09</b></p>												
<p style="writing-mode: vertical-rl; transform: rotate(180deg);"><b>COPYRIGHT AND CONFIDENTIAL</b></p> <p style="writing-mode: vertical-rl; transform: rotate(180deg);">The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company</p>		<p style="text-align: center;"><b><u>SPECIFICATION FOR AIR DRYING PAINT FINISH FOR TRACTION MACHINES</u></b> <b>(THIS SPEC. SUPERSEEDS SPEC. NO. BP0674184)</b></p>													
		<p><b>1. <u>GENERAL:</u></b></p> <p>This standard details the process to be followed to provide the standard paint finish for traction motors, traction generators/alternators, motor generators, motor alternators &amp; ECC, Auxiliary machines, oil rig motors &amp; alternators for application in Indian Railways/Oil Rigs. This standard also covers the painting requirements of traction machines/oil rig machines for coastal areas/export. The finishing of the outer surfaces of the field coils and armature, including commutators and creepage surfaces, is covered by the appropriate Insulation Process Specifications where a special finish is required, it will be called for on the appropriate drawings and specification sheets.</p> <p><b>2. <u>COMPLIANCE WITH STANDARDS:</u></b></p> <p>This standard to be used along with corporate standard AA0674123.</p> <p><b>3. <u>MATERIALS:</u></b></p> <p><b>3.1 <u>Materials Required:</u></b></p> <p>The finish painting of different traction machines/oil rig machines shall be as per table-4 of the specification unless otherwise mentioned in the drawing/work order/MID.</p> <p><b>Note:</b> The materials shall be used after ensuring that material TC's is as per the requirement of paint specification &amp; expiry date of paint is not crossed.</p> <p><b>3.1.1 Primer Paint:</b></p> <p>i) Anti Corrosive priming paint to AA56101 (Red). ii) Inorganic ethyl zinc silicate primer to AA56113.</p> <p><b>3.1.2 Intermediate Paint:</b></p> <p>i) High build intermediate epoxy paint to AA56112.</p> <p><b>3.1.3 Finish Paints:</b></p> <p>i) <b>Polyurethane finishing paint to AA56142:</b> For requirements of Industrial, Oil rigs &amp; Traction machines including for coastal areas &amp; export. ii) <b>Paint to AA56128 (Aluminum):</b> For blower motors.</p>													
		<table border="1"> <tr> <td> Revision : 06 Date: 14.05.2021 </td> <td> Distribution </td> <td> Qty. </td> <td colspan="3"> Approved :  (M. Verma) </td> </tr> <tr> <td></td> <td> TXM TAM TGM/TNX QTM TME </td> <td> 1 1 1 1 2 </td> <td> Prepared:  (J. Kumar) </td> <td> Checked:  (R. Chaudhry) </td> <td> Date:  14.05.21 </td> </tr> </table>				Revision : 06 Date: 14.05.2021	Distribution	Qty.	Approved :  (M. Verma)				TXM TAM TGM/TNX QTM TME	1 1 1 1 2	Prepared:  (J. Kumar)
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		 <p><b>PRODUCT STANDARD</b> <b>TME DIVISION, BHOPAL</b></p> <p>TME/2021</p>	<p><b>TM 94217</b> <b>REV.06</b></p> <p><b>PAGE 02 OF 09</b></p>																											
<p style="writing-mode: vertical-rl; transform: rotate(180deg);"> <b>COPYRIGHT AND CONFIDENTIAL</b>            The information on this document is the property of <b>BHARAT HEAVY ELECTRICALS LIMITED</b>            It must not be used directly or indirectly in any way detrimental to the interest of the company         </p>		<p>iii) Oil Resistant Air Drying Synthetic Enamel to AA56132 (Jasmine Yellow shade): For surfaces in contact with lubricant.</p> <p>iv) Epoxy Red Gel Coat (Base, Hardner &amp; Diluent ) to BP27476 or Anti Tracking Red Insulating Varnish to BP 27599 or Becktol Red- Prop of M/s Dr Beck &amp; Co.Pune: For coils &amp; insulation.</p> <p>v) Anti Tracking Epoxy based finishing paint to CIT-033: For interior surfaces of frame &amp; pole pads.</p> <p>vi) Silicone based finishing paint to CIT-064: For field coils &amp; pole assy. and connections.</p> <p>vii) Grey Insulating Enamel to BP 27595: For terminal box interiors.</p> <p><b>3.1.4 Thinners:</b></p> <p>The application of thinners for different primer/finish paints are as given in clause 3.2.</p> <p>i) White Spirit Gr. 145/205 to AA56701.</p> <p>ii) Xylole-Industrial Solvent Grade to AA56703.</p> <p>iii) Special Thinner for Epoxy Red Gel Coat/MEK.</p> <p>iv) Derusting Solution (hydrochloric acid/sulphuric acid) to BP0690086.</p> <p><b>3.2 Consistency of Materials at normal shop temperature in cup No.4 of IS:3944:</b></p> <table border="1"> <thead> <tr> <th>Paint</th> <th>Thinner</th> <th>Applicant</th> <th>Consistency in Seconds to 27° C</th> </tr> </thead> <tbody> <tr> <td>AA56101 (Red)</td> <td>White spirit</td> <td>Spray</td> <td>30<sub>+2</sub> sec</td> </tr> <tr> <td>AA56128 (Aluminum)</td> <td>White spirit</td> <td>Spray</td> <td>30<sub>+2</sub> sec</td> </tr> <tr> <td>AA56142</td> <td>As recommended by supplier</td> <td>Spray</td> <td>30<sub>+2</sub> sec</td> </tr> <tr> <td>AA56132(Jasmine Yellow)</td> <td>White Spirit</td> <td>Spray</td> <td>30<sub>+2</sub> sec</td> </tr> <tr> <td>BP25795</td> <td>Xylole</td> <td>Spray</td> <td>30<sub>+2</sub> sec</td> </tr> <tr> <td>BP27476/ BP2799 Becktol Red.</td> <td>Special Thinner/ MEK</td> <td>Spray</td> <td>30 – 40 sec</td> </tr> </tbody> </table> <p>For application by spray, the paints shall be obtained ready for use or thinned down to the flow time shown on the chart when measured at the shop temperature. The consistency of the paint require adjustment, the appropriate thinner given in the above chart shall be used.</p>	Paint	Thinner	Applicant	Consistency in Seconds to 27° C	AA56101 (Red)	White spirit	Spray	30 <sub>+2</sub> sec	AA56128 (Aluminum)	White spirit	Spray	30 <sub>+2</sub> sec	AA56142	As recommended by supplier	Spray	30 <sub>+2</sub> sec	AA56132(Jasmine Yellow)	White Spirit	Spray	30 <sub>+2</sub> sec	BP25795	Xylole	Spray	30 <sub>+2</sub> sec	BP27476/ BP2799 Becktol Red.	Special Thinner/ MEK	Spray	30 – 40 sec
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<p style="writing-mode: vertical-rl; transform: rotate(180deg);"> <b>COPYRIGHT AND CONFIDENTIAL</b>            The information on this document is the property of <b>BHARAT HEAVY ELECTRICALS LIMITED</b>            It must not be used directly or indirectly in any way detrimental to the interest of the company         </p>	<p><b>3.3 <u>Compatibility chart for Primer Paint, Intermediate Paint &amp; Finish Paint:</u></b></p>										
	<table border="1"> <thead> <tr> <th>Primer Paint</th> <th>Intermediate Paint</th> <th>Finish Paint</th> </tr> </thead> <tbody> <tr> <td>AA56113</td> <td>AA56112</td> <td>AA56142</td> </tr> <tr> <td>AA56101</td> <td>-</td> <td>AA56128</td> </tr> </tbody> </table>		Primer Paint	Intermediate Paint	Finish Paint	AA56113	AA56112	AA56142	AA56101	-	AA56128
	Primer Paint	Intermediate Paint	Finish Paint								
AA56113	AA56112	AA56142									
AA56101	-	AA56128									
<p>For achieving better quality of painting, the combinations of primer paint, intermediate paint &amp; finish paint as mentioned in above table shall be used.</p>											
	<p><b>3.4 <u>MIXING OF PAINTS:</u></b></p> <p><b>3.4.1</b> Before application, any skin formed on the paint in the tin shall be carefully removed, any settled pigment broken up and loosened, and the paint shall be thoroughly stirred to ensure complete and uniform mixing of the constituents. Care shall be taken to avoid air entry into the paint whilst stirring.</p> <p><b>3.4.2 <u>AA56113 PRIMER:</u></b></p> <p>AA56113 primer as supplied consists of two separate ingredients viz primer base and accelerator. Shortly before use mix together primer base and accelerator in the proportion 1:1 by volume or as recommended by supplier, care being taken not to entrain air while mixing. It is important that only small quantity of primer which can be consumed within 4 hours can be mixed. Further thinning of the paint prepared as above is not required for application by spraying.</p> <p><b>3.4.3 <u>EPOXY RED GEL COAT (BP27476):</u></b></p> <p>This consist of 3 parts viz Epoxy red gel coat, Hardner EH411 and Diluent C. These to be mixed in the ratio 100:40:10 by weight. Should the consistency of the paint require adjustment the same to be done by using special Thinner/MEK.</p> <p><b>4. <u>APPLICATION :</u></b></p> <p>A complete paint (as per Table 1, 2, 3 &amp; 4) should be applied so that the equipment has a well finished appearance &amp; adequate protection against corrosion. It is important that each coat of paint is completely dry before the next is applied. <b>The paint shall be applied by spraying/air less spraying only.</b></p> <p><b>5. <u>PROCESS FOR PAINTING OF TRACTION/OIL RIG/INDUSTRIAL MACHINE COMPONENTS:</u></b></p> <p>For the painting of Traction/Oil rig/Industrial machines components, the process mentioned in painting scheme no. 8 of annexure-II(a) of corporate standard AA0674123 shall be followed.</p>										



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TABLE NO. 1

FINISHING PAINT FOR NON-ROTATING PARTS OF TRACTION MACHINES

Part	Traction Motors		Other Machines	
	Paint	Coats	Paint	Coats
Exterior surfaces of machines including gearcase	AA56142 (Black)	2	AA56142 (Traffic Green)	2
	AA56142 (Traffic Green)	2	AA56142 (Light Grey)	2
	AA56142 (Light Grey)	2		2
Interior Surface of machines	CIT-033 (See note-2)	2	CIT-033 (See note-2)	2
Surface in contact with Lubricant	AA56132 (Jasmine Yellow)	2	AA56132 (Jasmine Yellow)	2
		2		2
Terminal Box Interiors	BP27476/ BP27599 Becktol Red.	2	BP 27595	2
Field coils & pole assy. and Connections	CIT-064	2	CIT-064	2
Brush gear and brush gear Insulators	Plant Standard BP0674183 to be followed			

**NOTES:**

1. Light alloy & glass fibre cover and other readily detachable parts in the traction machines shall not be painted.
2. Interior surface of frames & pole pads to be painted with CIT-033 for adjacent coils, cable etc.
3. Epoxy bonded components must not be painted prior to bonding.
4. The paint/colour of finish painting in different traction machines/oil rig machines is mentioned in table-4 of this specification.



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**TABLE-2**  
**FINISHING PAINT FOR ROTATING PART OF TRACTION MACHINES**

Part	Paint	Coats	Remarks
<b>Steel Fans:</b>			
1) TM4601, TM4603	AA56142 (Traffic Green)	2	-
2) AG3101, AG2702, TA10102	AA56142 (Light Grey)	2	

**TABLE-3**  
**FINISHING PAINT FOR MISCELLANEOUS EQUIPMENT**

Equipment	Part	Paint	Coats
Eddy Current Clutch and gear boxes surface	Steel surfaces	AA56142 (Traffic Green)	2
	Coil	See Insulation Spec.	-
	Interior of gear box	AA56132	2

**TABLE-4**  
**PAINT/COLOUR FOR FINISH PAINTING OF DIFFERENT TRACTION/OIL RIG MACHINES**

**Note:** The finish painting of different traction machines/oil rig machines shall be as per table-4 of the specification unless otherwise mentioned in the drawing/work order/MID.

Type of machine	Paint/Colour*
<b>A) Traction Motors:</b>	
TM4906AZ	AA56142(Black)
TM4907BZ	
TM4603AZ	
HS15250A	
TM3701AZ	
TM4605AZ	
TM5002AZ	AA56142 (Light grey) (631 export) & Black for WDP2
TM4303CZ/BY & TM4303DY	AA56142 Traffic Green for CZ/BY (EMU & MEMU application) & Black for DY (DEMU application)

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Type of Machine	Paint/Colour*
IM3601AZ	AA56142(Light Grey)
IM3301AZ/IM3302AZ	
TAO-659	
OIM5101AZ	
IM4504AZ	
IM4506AZ	
6FRA6068	As per customer/BHEL drawing
6FXA7059	
OM4903BX/CX	AA56142(Traffic Green)
TM4601BY/BX	AA56142(Black)
IM4507AZ/BZ	
B) Traction Alternators & Generators:	
All traction alternators, Generators, AG's & Gear boxes	AA56142(Light Grey)
ECC9005/2/M	AA56142(Traffic Green)
BM2101AZ	AA56128 (Aluminium)
DY3423/M	
MG51BX/CW	AA56142(Black)
AG903CW	
AG1404AZ	
NA5105AZ (490KW)	
TG5005AZ (500KW MMG)	IS:14209 (Colour: Pista green shade 216 of IS:5)
TG10932AZ (1MW MMG)	
NA6401AZ (1350KW)	

**Note:-**

(\*) – Latest customer PO/specification/drawing/Engineering information/MID shall be referred for any changes in paint grade/colour of a machine.

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3) Measurement of Primer & Intermediate Paint Thickness (As per AA0674105):

Sl. no.	Description of Paint	Acceptance criteria
i.	Measurement of primer paint thickness after one coat of primer paint as per clause 2.1.1, 2.1.2 & 2.1.3 of AA0674105.	60-90 microns
ii.	Measurement of total paint thickness (primer + intermediate) after one coat of intermediate paint as per clause 2.1.1, 2.1.2 & 2.1.3 of AA0674105.	120-180 microns

4) Inspection for Process Control (After Finish Painting):

Sl. no.	Type of inspection	Acceptance criteria
i.	Visual inspection of finished components for various paint film defects such as gloss, uniformity of shade, wrinkle, orange peel effect, blistering etc.	Free from paint film defects.
ii.	Measurement of total thickness of paint as per clause 2.1.1, 2.1.2 & 2.1.3 of AA0674105.	160-220 microns with high spots of 250 microns

5) Adhesion by Tape Test (As per AA0674105):


Sl. no.	Description of Test	Acceptance criteria
i.	Test is carried out by the application of a cross-cut test in accordance with BHEL Standard AA0674105.	Detachment of small flakes of the coating at the intersections of the cuts. A cross cut area not significantly greater than 5% is affected.

**Note:** The sample size for quality checking of painting of traction machines should be as per IS: 2500 Part-2, Level 4 and AQL 1% as mentioned below:-




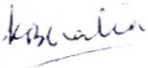
<u>Lot size</u>	<u>Sample size</u>
2 to 8	3
9 to 15	3
16 to 25	4
26 to 50	5
51 to 100	7
101 to 150	10
151 to 300	15
301 to 500	20


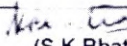
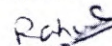

**Imp.:** When sample size equals or exceeds lot size, every item in the lot shall be inspected.

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	<div style="text-align: right;"><u><b>Annexure-II</b></u></div> <div style="text-align: center;"><u><b>Checklist for Painting of Traction Machines</b></u></div> <p>Machine type: _____ Machine/Component no.: _____</p> <p>Date of Painting: _____</p> <table border="1"> <thead> <tr> <th>Sl. No.</th><th>Check points as per the requirement of annexure-I</th><th>Checking Remark (100%TP &amp; 20%QC)</th></tr> </thead> <tbody> <tr> <td>1.</td><td><b>Checking of Painting Material:</b> i. Expiry date of primer &amp; intermediate paint ii. Expiry date of finish paint iii. Verification of supplier's TC as per paint specification</td><td>(ok/not ok) (ok/not ok) (ok/not ok)</td></tr> <tr> <td>2.</td><td><b>Surface Preparation (Before Primer Painting):</b> i. Visual inspection for absence of sharp edges or protrusions ii. Visual inspection for absence of grease &amp; varnish iii. Visual inspection for absence of light rust iv. Visual inspection for absence of widely spread rust v. Visual inspection for condition of surface as per the requirement of clause 5 vi. Surface finish of the component</td><td>(ok/not ok) (ok/not ok) (ok/not ok) (ok/not ok) (ok/not ok) .....microns (ok/not ok)</td></tr> <tr> <td>3.</td><td><b>Measurement of Primer &amp; Intermediate Paint Thickness:</b> i. Paint thickness after one coat of primer paint ii. Total paint thickness (primer + intermediate ) after one coat of intermediate paint</td><td>.....microns (ok/not ok) .....microns (ok/not ok)</td></tr> <tr> <td>4.</td><td><b>Inspection for Process Control (After Finish Painting):</b> i. Visual inspection of finished component for absence of paint film defects ii. Total thickness of paint</td><td>(ok/not ok) .....microns (ok/not ok)</td></tr> <tr> <td>5.</td><td><b>Adhesion by Tape Test (As per AA0674105):</b> i. Adhesion by tape test</td><td>(ok/not ok)</td></tr> </tbody> </table> <p><u><b>Abbreviations:-</b></u>  TP – Task Performer, QC – QTM/BHEL Authorized Quality Inspection Agency  <b>Note:</b> 1) For the components supplied by the supplier in finish painted condition, the supplier to furnish dully filled checklist for each component along with consignment.  2) The acceptance criteria shall be as per annexure-I.</p> <div style="display: flex; justify-content: space-between; margin-top: 20px;"> <div>(Task performer's signature)</div> <div>(QC's signature)</div> </div>			Sl. No.	Check points as per the requirement of annexure-I	Checking Remark (100%TP & 20%QC)	1.	<b>Checking of Painting Material:</b> i. Expiry date of primer & intermediate paint ii. Expiry date of finish paint iii. Verification of supplier's TC as per paint specification	(ok/not ok) (ok/not ok) (ok/not ok)	2.	<b>Surface Preparation (Before Primer Painting):</b> i. Visual inspection for absence of sharp edges or protrusions ii. Visual inspection for absence of grease & varnish iii. Visual inspection for absence of light rust iv. Visual inspection for absence of widely spread rust v. Visual inspection for condition of surface as per the requirement of clause 5 vi. Surface finish of the component	(ok/not ok) (ok/not ok) (ok/not ok) (ok/not ok) (ok/not ok) .....microns (ok/not ok)	3.	<b>Measurement of Primer &amp; Intermediate Paint Thickness:</b> i. Paint thickness after one coat of primer paint ii. Total paint thickness (primer + intermediate ) after one coat of intermediate paint	.....microns (ok/not ok) .....microns (ok/not ok)	4.	<b>Inspection for Process Control (After Finish Painting):</b> i. Visual inspection of finished component for absence of paint film defects ii. Total thickness of paint	(ok/not ok) .....microns (ok/not ok)	5.	<b>Adhesion by Tape Test (As per AA0674105):</b> i. Adhesion by tape test	(ok/not ok)
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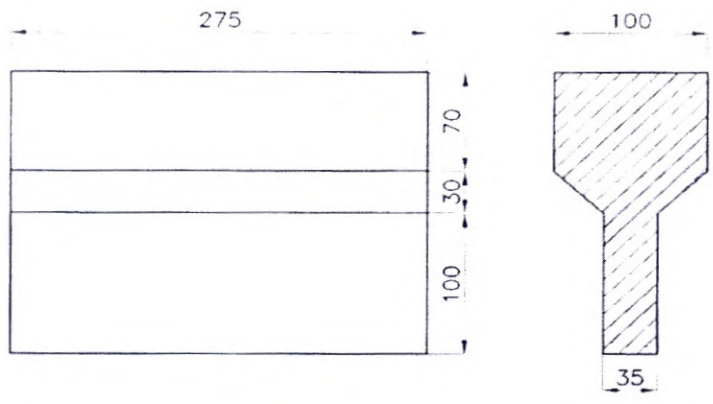


<div><div><div>BHARAT HEAVY ELECTRICALS LIMITED , BHOPAL</div><div>TRACTION MACHINES ENGINEERING DIVISION</div></div><div>TME/2013</div></div>			
PRODUCT STANDARD CONCURRENT SHEET			
<div>GENERAL INFORMATION : Original PS date: 20.02.2013 with revision-00</div> <div>PRODUCT STANDARD NO. : TM 10583</div> <div>DESCRIPTION : Carbon Steel Castings - 295 N/mm<sup>2</sup> YS</div>			
REVISION NO.	DETAILS OF REVISION		
	NAME	SIGNATURE	DATE
PREPARED BY:	RAHUL CHAUDHRY		20.02.2013
AGREED BY	REMARK DEPTT./SEC	SIGNATURE	DATE
M.VERMA	TME		20.02.2013
S.K.BHATIA	TME		20.02.2013


	<b>PRODUCT STANDARD</b> <b>TME DIVISION, BHOPAL</b>		<b>TM10583</b> <b>REV.00</b>		
			<b>PAGE 01 OF 06</b>		
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<b>COPYRIGHT AND CONFIDENTIAL</b> The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company	<b>CARBON STEEL CASTINGS – 295 N/mm<sup>2</sup> YS</b>				
	<b>1.0 GENERAL :</b>  This specification governs the quality requirements of Carbon steel castings having an yield strength of 295 N/mm <sup>2</sup> minimum and is based on corporate purchasing specification AA19512 rev.07 except chemical composition, mechanical properties & hardness value (which are as per Rev.04 of AA19512).				
	<b>2.0 APPLICATION:</b>  Suitable for general engineering purposes.				
	<b>3.0 CONDITION OF DELIVERY:</b>  Heat treated. Rough machining of the castings shall be carried out, unless otherwise specified on BHEL order/drawing. Castings shall not be painted.				
<b>4.0 DIMENSIONS AND TOLERANCES :</b>  The castings shall be true to the pattern/ drawing. Holes for machining up to and including 50 mm in diameter are to be cast solid, unless otherwise stated in BHEL order/drawing. Unless otherwise specified in BHEL drawing/order, untoleranced dimensions for the castings shall be as per tolerance class-4 of BHEL standard AA 023 04 02.					
<b>5.0 MANUFACTURE:</b>  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.  The steel shall be fully killed.					
Revision : 00  Date : 20.02.2013	Distribution	Qty.	Approved :  (S.K.Bhatia)		
	TME TXM QTM	1 1 1	Prepared:  (R.Chaudhry)	Checked:  (M.Verma)	Date:  20.02.2013




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<p style="writing-mode: vertical-rl; transform: rotate(180deg);">             COPYRIGHT AND CONFIDENTIAL              The information on this document is the property of <b>BHARAT HEAVY ELECTRICALS LIMITED</b>              It must not be used directly or indirectly in any way detrimental to the interest of the company           </p>	<p><b>6.0 FREEDOM FROM DEFECTS:</b></p> <p>The 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.</p> <p>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.</p>																	
	<p><b>7.0 HEAT TREATMENT :</b></p> <p>Heat treatment shall be carried out at suitable temperatures to give the properties specified.</p> <p>Any flame or arc cutting which may have to be done, shall be carried out before heat treatment.</p> <p>Test pieces shall also be heat treated along with the castings they represent.</p>																	
	<p><b>8.0 FINISH :</b></p> <p>All castings shall be properly fettled and dressed and all surfaces shall be thoroughly cleaned.</p> <p>Machined surfaces shall have the surface finish as indicated in the drawing.</p>																	
	<p><b>9.0 CHEMICAL COMPOSITION :</b></p> <p>The melt analysis of steel and the permissible variation in the composition of the castings from the melt analysis shall be as specified below :</p> <table border="1"> <thead> <tr> <th>Element</th> <th>Melt analysis, Percent, Max</th> <th>Permissible variation, percent, max</th> </tr> </thead> <tbody> <tr> <td>* Carbon</td> <td>0.45</td> <td>+ 0.04</td> </tr> <tr> <td>Silicon</td> <td>0.60</td> <td>+ 0.05</td> </tr> <tr> <td>* Manganese</td> <td>1.00</td> <td>+ 0.10</td> </tr> <tr> <td>Sulphur</td> <td>0.050</td> <td>+ 0.005</td> </tr> <tr> <td>Phosphorus</td> <td>0.050</td> <td>+ 0.005</td> </tr> </tbody> </table>	Element	Melt analysis, Percent, Max	Permissible variation, percent, max	* Carbon	0.45	+ 0.04	Silicon	0.60	+ 0.05	* Manganese	1.00	+ 0.10	Sulphur	0.050	+ 0.005	Phosphorus	0.050
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	<p><b>NOTE:</b></p> <p>1. * For each reduction of 0.01% carbon below the maximum specified, an increase of 0.04% manganese above the maximum specified shall be permitted upto a maximum of 1.1%.</p>																	

	<p align="center"><b>PRODUCT STANDARD</b> <b>TME DIVISION, BHOPAL</b></p>	<p align="center"><b>TM10583</b> <b>REV.00</b></p>								
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<p align="center">COPYRIGHT AND CONFIDENTIAL The information on this document is the property of <b>BHARAT HEAVY ELECTRICALS LIMITED</b> It must not be used directly or indirectly in any way detrimental to the interest of the company</p>	<p><b>10.0 TEST SAMPLES:</b> Manufactures shall carryout mechanical testing as per following sampling plan.</p> <p><b>10.1</b> Unless otherwise specified for castings weighing up to 500 kg piece weight 3 keel blocks, separately cast per melt per heat treatment batch shall be supplied according to the sketch given below;</p> <p><b>10.2</b> Unless otherwise specified, castings weighing more than 500 kg shall be provided with integrally cast keel blocks.</p> <p><b>10.3</b> Retests shall be carried out as per IS: 8800.</p> <p><b>10.4</b> Keel blocks with proper identification and representative of the castings shall be supplied along with the consignment for testing at BHEL works.</p> <p align="center"><b>DETAILS OF KEEL BLOCK</b></p>  <p align="center"><b>ALL DIMENSIONS IN mm</b></p>									
	<p><b>11.0 MECHANICAL PROPERTIES:</b> The test pieces, after being heat treated as per clause CI. 6 above, shall show the following properties:</p> <p><b>11.1 Tensile:</b> The test pieces shall show the following properties, when tested in accordance with IS: 1608.</p> <table border="0"> <tr> <td>Tensile strength</td><td>:</td><td>540 N/mm<sup>2</sup>, min</td></tr> <tr> <td>Yield strength</td><td>:</td><td>295 N/mm<sup>2</sup>, min</td></tr> <tr> <td>Elongation on 5.65 √So gauge length</td><td>:</td><td>14 percent, min</td></tr> </table>		Tensile strength	:	540 N/mm <sup>2</sup> , min	Yield strength	:	295 N/mm <sup>2</sup> , min	Elongation on 5.65 √So gauge length	:
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	<b>PRUDUCT STANDARD</b> <b>TME DIVISION, BHOPAL</b>	<b>TM10583</b> <b>REV.00</b>
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<b>COPYRIGHT AND CONFIDENTIAL</b> The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED It must not be used directly or indirectly in any way detrimental to the interest of the company	<p><b>11.2 Charpy Impact Value (V-Notch):</b></p> <p>The test pieces shall show a Charpy Impact Value of 18.0 Joules at 20<sup>0</sup> C, when tested to IS: 1757/BS 131 Part-2.</p> <p><b>11.3 Hardness (Brinell):</b> 160-205 HB.</p> <p><b>12.0 NON-DESTRUCTIVE TESTS:</b></p> <p>The following tests shall be conducted:</p> <ul style="list-style-type: none"> <li>i) Ultrasonic examination to BHEL standard AA 085 01 04/AA 085 01 05.</li> <li>ii) Liquid penetrant examination to BHEL standard AA 085 01 31.</li> <li>iii) Magnetic particle examination to BHEL standard AA 085 01 33 and norms of acceptance as per BHEL standard AA 085 01 34.</li> </ul> <p>Norms of acceptance shall be as per level 2 of above referred BHEL standards.</p> <p><b>13.0 REPAIR OF CASTINGS :</b></p> <p>Repair of castings shall not be carried out by the manufacturer without the prior permission of BHEL.</p> <p><b>14.0 TEST CERTIFICATES :</b></p> <p>Test certificates shall be supplied unless otherwise stated in BHEL order, preferably in the test certificate format annexed to this specification (Annexure-1).</p> <p>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.</p> <p>The test certificate shall bear the following information:</p> <ul style="list-style-type: none"> <li>i) Dimensional inspection.</li> <li>ii) Details of heat treatment.</li> <li>iii) Chemical composition.</li> <li>iv) Results of mechanical tests.</li> <li>v) Results of NDT tests.</li> </ul>	

	<p align="center"><b>PRODUCT STANDARD</b> <b>TME DIVISION, BHOPAL</b></p>	<p align="center"><b>TM10583</b> <b>REV.00</b></p>
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<p align="center">COPYRIGHT AND CONFIDENTIAL</p> <p>The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED It must not be used directly or indirectly in any way detrimental to the interest of the company</p>	<p><b>15.0 PACKING AND MARKING :</b></p>	
	<p>Castings shall be suitably packed to prevent corrosion and damage during transit.</p> <p>Machined surfaces shall be properly protected with anticorrosive compounds.</p> <p>Each package shall be legibly marked or casting (when supplied separately) shall be punched, with the following information:</p> <p>TM 10583: Carbon Steel Casting BHEL PO No. Consignment/Identification No. Melt No. Weight Supplier's Name.</p>	
	<p><b>16.0 REJECTION AND REPLACEMENT :</b></p>	
	<p>If the castings do not comply with the requirements of this specification during receipt inspection at BHEL or if any defect is found during the course of preparation, machining, testing or erection such casting shall be rejected notwithstanding any previous certification of satisfactory testing and/or inspection.</p> <p>The manufacturer shall replace the rejected castings at his own cost and the rejected castings shall be taken back by the supplier after fulfilling the commercial terms and conditions.</p>	





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**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 VSO	% R.A. Min	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-SCOPIC, 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)

Date :

**Signature & Seal of the Chief of Quality Control**  
Chief Metallurgist of the Supplier

Date :

**INSTRUCTION:**

- Test Certificates are to be furnished as per Purchase Order and Specifications.
- All the entries including signature should be in black Ink.
- If testing is done by outside agencies, the original TCs shall be furnished.
- The actual test Certificate may run into more than one A4 size paper, if needed, to facilitate filling up of details.

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