



PRODUCT STANDARD
TME DIVISION, BHOPAL

TM 10456

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**BHEL GENERAL SPECIFICATION FOR CARBON STEEL CASTING FOR
COMPONENTS OF HITACHI TRACTION MOTOR TYPE HS-15250A**

0. FOREWORD :

- 0.1 This specification is for fully machined components made out of carbon steel castings intended for use in HTM type HS 15250A. The machined components namely (a) Bearing Bracket assly. / CE & PE. (b) Outer/Inner Bearing Cover/CE & PE (C) Commutator Spider, (d) Rotor Clamp are covered by this specification.

1.0 Scope :

- 1.1 This specification covers the manufacture, testing, inspection, packing and supply of fully machined carbon steel cast components of HTM type HS:15250A manufactured at BHEL before their application in the motor.

2.0 Specification :

- 2.1 The material shall conform to IS:1030'1998 Gr. 230 -450W (or Latest Version) unless otherwise covered in this specification.
- 2.2 The carbon steel casting shall be made in accordance with IS:8800'1986 (Technical Library addition for steel casting) and shall be made from electric arc or electric induction only. In case, any other process is employed prior approval from BHEL should be obtained.

2.3 Chemical Composition :

The chemical composition of steel casting when tested in accordance with IS:228'59 shall conform to IS: 1030' 1998 Gr. 230 -450W or (Latest Version).

2.4 Freedom from Defect :

All the castings shall be free from defects that shall adversely effect machining and utility of castings. To remove risers or gates by flame/art care shall be taken to make the cut at a sufficient distance from the body of the casting. The casting shall have a crystalline structure.

Revision : 00

Date: 09-03-11

Distribution

TXM
QMX
TME
TSD

Qty.

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1

Approved :

(S.Mehrotra)

Prepared:

(A.Sharma)

Checked:

(S.Anand)

Date:

09-03-11



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3.0 Test & Test Method:

As per the above standard, the following test is to be carried out in presence of inspecting authority and values to be recorded.

- i) Dimension (finished) : Minimum 20% of the offered quantity (supplier should check themselves 100%).
- ii) Chemical Analysis : Per melt heat – 1 sample.
- iii) Tensile, Yield, Elongation and impact test : Per melt heat & per heat treatment batch – 3 samples.
- iv) Bend test : ... do ...
- v) Radiographic test
- a) Radiographic examination & acceptance limit shall be done as per ASTM E-446 and ASTM E-186 as per Table-1.

TABLE - 1

Shrinkage	Upto level 3
Inclusion	Upto level 3
Gas Porosity	Upto level 3
Crack	Not Allowed
Hot tears	Not Allowed
Chaplets	Not Allowed

The casting having defects exceeding the above radiographic quality limits, shall not be accepted.

- 3b) 5% of the offered quantity selected at random are to be placed for radiography test. If any of the casting for radiography test does not conform to the radiographic acceptance limit the whole lot offered stands rejected & no reclamation will be permitted.
- c) Traceability must be ensured/available from Melt Heat and Heat treatment batch.
- vi) Magnetic particle or Liquid : 100% for the offered quantity.
Panetrant test (after finished).

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4.0 Recommended Values for Various Mechanical Test :

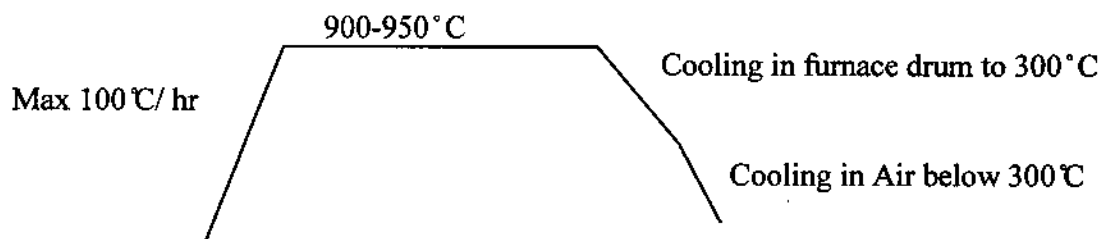
Dimensional : As per relevant drawing enclosed to BHEL tender enquiry for the casting after finished machining and not the dimension of moulded casting. Tolerances on all the important dimension after machining shall be in accordance with Annex-II of this specification. Where no tolerances is specified on machined surfaces the following general classes of tolerances shall be maintained as per IS: 919'93 Pt. 1 for Liner dimension and part-II for holes and shaft.

5.0 Heat Treatment :

All the castings shall be supplied suitably heat treated. The method of heat treatment and the relevant records of heat treatment shall be furnished to BHEL if so specified at the time of enquiry or order. Any flame or arc cutting which may be necessary shall be carried out before heat treatment.

6.0 Annealing :

The cast parts shall be annealed by the following heat cycles.



Soaking time: Max. thickness of product/25 mm hours.

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7.0 Static Balancing :

Some castings covered in this specification are components of rotating mass viz Rotor clamp, Commutator Spider. These shall be required to be checked for static unbalance as fully machined components. This specific rotating components shall be checked 100% by the supplier and records of unbalance mass and location of balancing weight removed if any shall be kept and shall be submitted in details to BHEL inspector at the time of inspection. The unbalance if any shall be corrected by milling of some material and mass at a pre-determine location. The inspector will carry out the unbalance check on 25% of the casting under reference offered in the lot at random before its acceptance. The maximum unbalance in distribution of the mass in fully machined components shall be limited to 25 ± 5 grams for Rotor Clamp and 45 ± 5 grams for commutator spider. Maximum 100 grams unbalance of Rotor Clamp is acceptable before any deletion of material.

8.0 Test :

- 8.1** As the test values obtained on the test bar do not necessary represent the properties of the casting themselves the additional tests prescribes as follows shall be carried out to prove the soundness of the castings for the various types of components. Inspector may carry out the following tests (except SN-4) on the offered material which are not subjected to radiography.

Sl.No	Test	Requirements	Method of Test
i)	Drop Test	Shall show no sign of fracture	IS :5518 '1996
ii)	Falling weight test	Shall not fracture	IS : 11240 '1985
iii)	Ringing Test	Shall pass the test	-
iv)	Static Balancing	.. do ..	-

9.0 Repair to Casting

No repair to casting shall be acceptable without prior approval of purchaser. The casting selected for repair after approval shall be done by welding in accordance with procedure laid down in IS:5530'86. Welding shall not be allowed/permitted in positions which are deciding fits and clearances.



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10.0 Marking :

Each components shall be legibly marked with the following information.

- a) Grade of casting.
- b) Number or identification mark by which batch can be traced.
- c) Manufacturer's initial or trade mark.

11.0 Information to be furnished by the Tenderers : (For New sources):

While submitting the offer, the tenderers shall furnish the following information.

- a) Facilities available for manufacture and machining and heat treatment, testing according to this specification.
- b) Clause wise comments have to be furnished by the tenderer. Vague comments like noted and understood are not acceptable. Compliance have to be clearly stated otherwise BHEL reserves the right to reject the offer.
- c) QAP must be product specific as per annexure-III. General ISO documents need not be submitted.
- d) M & P and testing facilities available.
- e) Latest ISO certification from NABCB approved body.
- f) Source and grade of raw material.

12.0 Inspection :

12.1 The successful tenderer shall have to submit prototype in one or more than one stage to the competent authority of BHEL before undertaking the bulk production/supply.

12.2 The supplier shall offer the prototype for inspection and test at his works with prior intimation to BHEL. The supplier shall provide all necessary facilities for inspection and testing. After the tests, if it is considered necessary by the authorised representative of BHEL to carry out further additional test or trial of the prototype samples at BHEL, the supplier shall arrange the same by quickest means at his cost.

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COPYRIGHT AND CONFIDENTIAL 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	12.3	Bulk inspection of all the items shall be carried out at the manufacturers premises by inspection wing of BHEL. Metallurgical test shall be carried out by the authorised representative of
	a)	BHEL or b) NABL or RDSO approved laboratory. In case of b) it should be in presence of representative of BHEL inspection cell. The cost of material consumed in testing shall be borne by the supplier.
	12.4	Splitting of the tendered quantity between minimum two tenderers is likely to be restored to (tenderer may however indicate their minimum acceptable quantity).
	13.0 <u>Packing :</u>	
	13.1	The component shall be quoted with antirust Varnished/compound after inspection & passed.
	13.2	Varnished component shall be wrapped in polythene paper followed by corrugated paper.
	13.3	The wrapped equipment shall be finally sealed in thick polythene bag.
	13.4	The sealed components shall be finally packed in wooden crates/boxes filled with saw dust to prevent transit damage of machined surface.
	14	(i) Firm's own foundry (class-A) is desirable for carbon steel casting 'or' they should have tie up with other RDSO approved class A foundry for getting raw material of specified grade. (iii) Firm should have own facility for checking of static balancing of finished product".
		Annexure (I) Tolerance on casting dimensions. Annexure (II) Tolerance and machining specifications.



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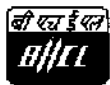
ANNEXURE 'I' OF BHEL SPECIFICATION NO. TM10456

**TOLERANCE ON CASTING STRUCTURE (CARBON STEEL CASTINGS)
OF HITACHI TRACTION MOTOR.**

Length		Thickness	
Nom. Length	Tolerance	Nom. Thickness	Tolerance
100	± 1.8	10	± 1.8
101	± 2.4	11	± 2.4
201	± 3.6	21	± 3.6
401	± 4.8	31	± 4.8
801	± 6.0	50	± 6.0
1601	± 8.4	80	± 7.2
3150	± 13.2	125	± 9.6

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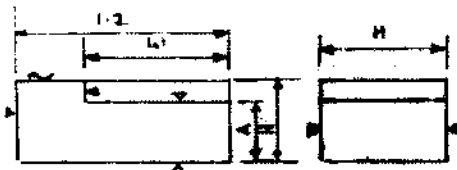
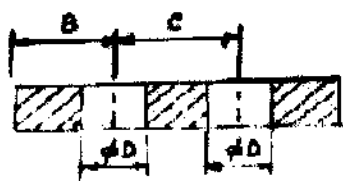
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Sl.No	Item	Description																						
1	Dimensions between both faces of machined products	Unit : mm <table><tr><th>Dimension</th><th>Tolerance</th></tr><tr><td>≤ 20</td><td>$+ 0.3$</td></tr><tr><td>$21 \leq 100$</td><td>$+ 0.5$</td></tr><tr><td>$101 \leq 500$</td><td>$+ 1$</td></tr><tr><td>$501 \leq 1000$</td><td>$+ 1.5$</td></tr><tr><td>$1001 \leq 2500$</td><td>$+ 2$</td></tr><tr><td>$2501 \leq 5000$</td><td>$+ 2.5$</td></tr><tr><td>$5001 \leq 8000$</td><td>$+ 3$</td></tr><tr><td>$8001 \leq$</td><td>$+ 3.5$</td></tr></table> Note (i) : The tolerance should not be applied to the dimension H. 	Dimension	Tolerance	≤ 20	$+ 0.3$	$21 \leq 100$	$+ 0.5$	$101 \leq 500$	$+ 1$	$501 \leq 1000$	$+ 1.5$	$1001 \leq 2500$	$+ 2$	$2501 \leq 5000$	$+ 2.5$	$5001 \leq 8000$	$+ 3$	$8001 \leq$	$+ 3.5$				
Dimension	Tolerance																							
≤ 20	$+ 0.3$																							
$21 \leq 100$	$+ 0.5$																							
$101 \leq 500$	$+ 1$																							
$501 \leq 1000$	$+ 1.5$																							
$1001 \leq 2500$	$+ 2$																							
$2501 \leq 5000$	$+ 2.5$																							
$5001 \leq 8000$	$+ 3$																							
$8001 \leq$	$+ 3.5$																							
2	Distance between center lines and distance between datum lines of machines shaft or holes.	<table><tr><th rowspan="2">Diameter (ØD)</th><th colspan="3">Tolerance</th></tr><tr><th>B.C ≤ 100</th><th>$101 \leq B,C \leq 500$</th><th>$501 \leq B,C$</th></tr><tr><td>≤ 5</td><td>$+ 0.25$</td><td rowspan="2">± 0.5</td><td>$+ 0.5$</td></tr><tr><td>$6 \leq 10$</td><td>$+ 0.5$</td><td>$+ 1$</td></tr><tr><td>$11 \leq 25$</td><td>$+ 0.75$</td><td>$+ 0.75$</td><td>$+ 1.5$</td></tr><tr><td>$26 \leq$</td><td>$+ 1$</td><td>$+ 1$</td><td>$+ 2$</td></tr></table>  Unit : mm	Diameter (ØD)	Tolerance			B.C ≤ 100	$101 \leq B,C \leq 500$	$501 \leq B,C$	≤ 5	$+ 0.25$	± 0.5	$+ 0.5$	$6 \leq 10$	$+ 0.5$	$+ 1$	$11 \leq 25$	$+ 0.75$	$+ 0.75$	$+ 1.5$	$26 \leq$	$+ 1$	$+ 1$	$+ 2$
Diameter (ØD)	Tolerance																							
	B.C ≤ 100	$101 \leq B,C \leq 500$	$501 \leq B,C$																					
≤ 5	$+ 0.25$	± 0.5	$+ 0.5$																					
$6 \leq 10$	$+ 0.5$		$+ 1$																					
$11 \leq 25$	$+ 0.75$	$+ 0.75$	$+ 1.5$																					
$26 \leq$	$+ 1$	$+ 1$	$+ 2$																					



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Sl.No	Item	Description										
3	Deviations parallelism and perpendicularity of machines parts.	Unit : mm <table><tr><th>Dimension</th><th>Deviation</th></tr><tr><td>≤ 20</td><td>0.3</td></tr><tr><td>$21 \leq 100$</td><td>0.5</td></tr><tr><td>$101 \leq 500$</td><td>1</td></tr><tr><td>$501 \leq 1000$</td><td>1.5</td></tr></table> Parallelism: $\Delta E/E$ Perpendicularity: $\Delta F/F$	Dimension	Deviation	≤ 20	0.3	$21 \leq 100$	0.5	$101 \leq 500$	1	$501 \leq 1000$	1.5
Dimension	Deviation											
≤ 20	0.3											
$21 \leq 100$	0.5											
$101 \leq 500$	1											
$501 \leq 1000$	1.5											



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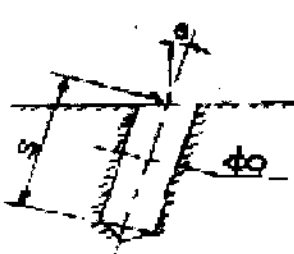
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Sl.No	Item	Description																																														
4	Drilled holes	Tolerance of diameter (Q) Unit:mm <table><tr><th>Diameter (Q)</th><th colspan="2">Tolerance</th></tr><tr><th></th><th>Max</th><th>Min</th></tr><tr><td>≤ 10</td><td>+ 0.3</td><td rowspan="13">0</td></tr><tr><td>$11 < 20$</td><td>+ 0.4</td></tr><tr><td>$21 < 30$</td><td>+ 0.5</td></tr><tr><td>$31 < 40$</td><td>+ 0.6</td></tr><tr><td>$41 < 50$</td><td>+ 0.7</td></tr><tr><td>$51 < 60$</td><td>+ 0.8</td></tr><tr><td>$61 < 70$</td><td>+ 0.9</td></tr><tr><td>$71 < 80$</td><td>+ 1.0</td></tr><tr><td>$81 < 90$</td><td>+ 1.1</td></tr><tr><td>$91 < 100$</td><td>+ 1.2</td></tr><tr><td>$101 < 110$</td><td>+ 1.3</td></tr><tr><td>$111 < 120$</td><td>+ 1.4</td></tr></table> Tolerance of depth (S) Unit: mm <table><tr><th>Diameter (Q)</th><th colspan="2">Tolerance</th></tr><tr><th></th><th>Max.</th><th>Min.</th></tr><tr><td>≤ 16</td><td>+ 3</td><td rowspan="4">0</td></tr><tr><td>$17 \leq 30$</td><td>+ 4</td></tr><tr><td>$31 \leq 50$</td><td>+ 5</td></tr><tr><td>$51 <$</td><td>+ 6</td></tr></table> Deviation of angle (θ) $\theta \leq 1'$ 	Diameter (Q)	Tolerance			Max	Min	≤ 10	+ 0.3	0	$11 < 20$	+ 0.4	$21 < 30$	+ 0.5	$31 < 40$	+ 0.6	$41 < 50$	+ 0.7	$51 < 60$	+ 0.8	$61 < 70$	+ 0.9	$71 < 80$	+ 1.0	$81 < 90$	+ 1.1	$91 < 100$	+ 1.2	$101 < 110$	+ 1.3	$111 < 120$	+ 1.4	Diameter (Q)	Tolerance			Max.	Min.	≤ 16	+ 3	0	$17 \leq 30$	+ 4	$31 \leq 50$	+ 5	$51 < $	+ 6
Diameter (Q)	Tolerance																																															
	Max	Min																																														
≤ 10	+ 0.3	0																																														
$11 < 20$	+ 0.4																																															
$21 < 30$	+ 0.5																																															
$31 < 40$	+ 0.6																																															
$41 < 50$	+ 0.7																																															
$51 < 60$	+ 0.8																																															
$61 < 70$	+ 0.9																																															
$71 < 80$	+ 1.0																																															
$81 < 90$	+ 1.1																																															
$91 < 100$	+ 1.2																																															
$101 < 110$	+ 1.3																																															
$111 < 120$	+ 1.4																																															
Diameter (Q)	Tolerance																																															
	Max.	Min.																																														
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$17 \leq 30$	+ 4																																															
$31 \leq 50$	+ 5																																															
$51 < $	+ 6																																															



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ANNEXURE - II OF BHEL SPEC.NO. TM10456

The allowable deviation in parallelism, perpendicularity and concentricity are as tabulated below :

However, those parts where no deviation is specified in the drawing should conform to the General Deviation in parallelism and perpendicularity of Machined Parts (Page 3.1.1).

Classification	Deviations (Unit: 0.001mm)							
	Class 0		Class 1		Class 2		Class 3	
Symbol	$\parallel .1$	$\odot$	$\parallel .1$	$\odot$	$\parallel .1$	$\odot$	$\parallel .1$	$\odot$
Dimension (mm)								
≤ 4	1.5	2.5	3	6	7	14	15	30
$5 \leq 6$	2		4		10		20	
$7 \leq 10$			5		12		25	
$11 \leq 16$	2.5		6		14		30	
$17 \leq 25$	3		7		16		35	80
$26 \leq 40$	3.5		8		18		40	90
$41 \leq 63$	4		10		20		50	100
$64 \leq 100$	5		12		25		60	120
$101 \leq 160$	6		15		30		70	150
$161 \leq 250$	7		18		35		80	175
$251 \leq 400$	8		20		40		100	200
$401 \leq 630$	10		25		50		120	250
$631 \leq 1000$	12		30		60		150	300
$1001 \leq 1600$	15		40		80		200	400
$1601 \leq 2500$	20		50		100		250	500
$2501 \leq 4000$	25		60		140		300	600
$4001 \leq 6300$	30		80		200		400	800

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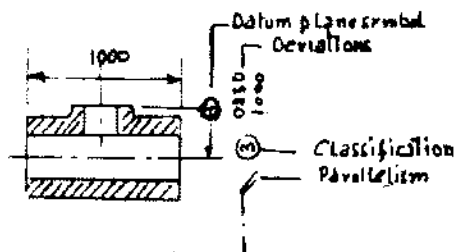
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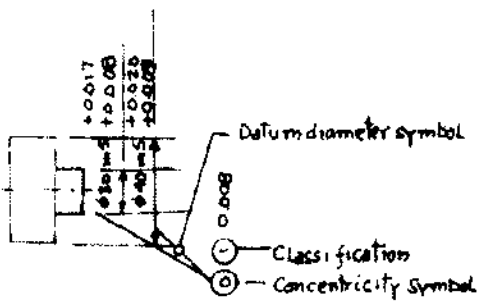
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Typical drawing examples

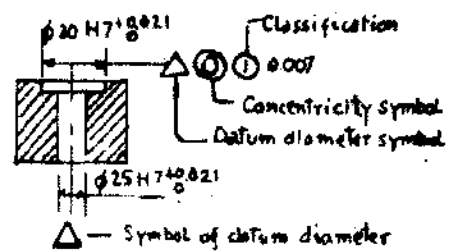
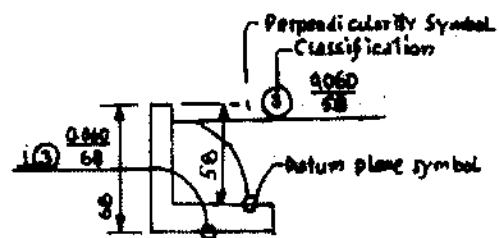
(a) Parallelism



(c) Concentricity



(b) Perpendicularity





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Annexure – III

QAP TO BE SUBMITTED BY THE VENDER SHALL COVER THE FOLLOWING ASPECTS:

- 1.0 Index Page
- 2.0 Copy of ISO 9001 certificate from NABCB registered body.
- 3.0 Organization chart clearly bringing out the quality control set up.
- 4.0 Qualification of personal manning only the quality control set up.
- 5.0 List of M & P and testing facilities.
- 6.0 Process flow chart indicating step-by-step process of manufacture of an item or a family of items for which the process is same.
- 7.0 Details of sub-vendors.

Name of item	Sub Vendors	ISO status	Inspection plan of sub vendors

The sub-vendors should have all the requisite infrastructure of manufacturing and testing facilities. Preferably under one roof.

- 8.0 Quality Assurance System –Inspection and testing plan with formats to be filled up for:
 - Incoming material
 - Process control
 - Product control

This must be furnished in the following formal.

Subject/ Products/ Process	Sample Size & its frequency of inspection	Parameters of inspection	Mode of inspection/ Equipment used	Acceptance limit/Criteria/ Specified Value as per Drg./Specn.	Format No. Where records will be kept

Note :

- 1) Sample formats used for recording must be submitted.
- 2) General ISO9001 Documents not to be submitted in QAP.
- 3) Firm must not depend only on TC for incoming material.
- 4) Record of SN 8 above shall be checked during inspections at firm's premises.
- 5) QAP has to be specific for each product based on relevant specification/drawing.

9.0 This specification is equivalent to CLW spec. No. 4TMS.095.003 Rev. 01.