

SPECIFICATION OF
ARMATURE SHAFT (ROUGH MACHINED)
FOR
HITACHI TRACTION MOTOR
TYPE HS- 15250A

APPROVED BY

BY: CEE/TMD

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SPECIFICATION OF ARMATURE SHAFT FOR HITACHI TRACTION MOTOR TYPE-HS-15250-A	NO. 4 TMS 095.005 REV 0 DATE 04/05/2019	1	2	3

Signature Not
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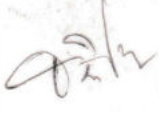


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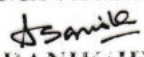

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ALTERATION SHEET

ALT.	DESCRIPTION	AUTHORITY	DATE	SIGN.
1.	Clause 9.7 at page no.8 modified. Inspection contents and criteria no.9 at page no.10 deleted. Clause no.11.8 at page no.12 of 13 modified. Ref: CLW/TM/10109 Dt. 10.12.2010	Dy.CEE/TMD	10.12.2010	
2.	Clause 15.0 at page 13 added vide note no. EL/TM/2013 DT. 7.6.2011	Dy.CEE/TMD	15.7.2011	
3.	CLAUSE NO.9.7 AT PAGE NO.8 AND CLAUSE NO.11.8 AT PAGE NO.12 MODIFIED VIDE L.NO.CLW/TM/18439 dt. 26.02.2016	DY.CEE/TMD.	26.02.2016	

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SPECIFICATION OF ARMATURE SHAFT FOR HITACHI TRACTION MOTOR TYPE-IIS-15250-A	CHITTARANJAN LOCOMOTIVE WORKS CHITTARANJAN NO. 4 TMS .095. 005 REV.0 DATE: 04 /05/2010	<table border="1"> <tr> <td>1</td> <td>2</td> <td>3</td> </tr> <tr> <td></td> <td></td> <td></td> </tr> </table>	1	2	3			
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**SPECIFICATION OF ARMATURE SHAFT FOR
HITACHI TRACTION MOTOR HS 15250 A.**

0. FORWARD:

- 0.1 This specification is prepared for manufacturing proof machined Armature Shaft for Hitachi Traction Motor to Model HS-15250A made out of alloy steels intended for use in 630 KW, 2150 rpm.(max.) Traction Motor.
- 0.2 CLW would like to purchase the component in forged & rough machined condition to Drg. No. 3TWD .095. 010 (latest version) from Indian Trade having expertise and experience in this type of work.
- 0.3 The tenderers are requested to study carefully the Drawing and Specification before they submit their offer.
- 0.4 The tenderers are to note that CLW do not undertake to supply drawings for forgings, necessary jigs, fixtures and tools, templates and/or process sheets or any other such details. CLW may, however, comment/suggest alteration/modification to the suppliers, drawings and methods if required during the manufacture, testing / inspection of the prototype and/or use of the material in CLW production.

1. SCOPE:

- 1.1 This specification covers the manufacture, testing, inspection, packing and supply of forged and rough machined Armature Shaft of Hitachi Traction Motor type HS-15250A manufactured at CLW before their application in the Motor.

2.0 SPCIFICATION:

- 2.1 Alloy steels shall confirm to BSS-970, Part-3 1991Grade 826M31 and shall be heat treated to condition "V". (Hardness between 300-330HB)

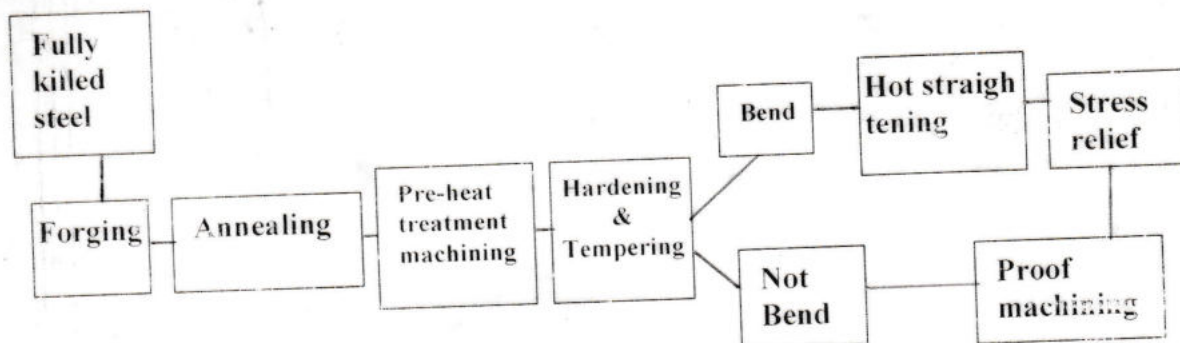
3.0 MANUFACTURING METHOD:

- 3.1 Material to be used:-
- (a) The material shall be procured from the killed bloom and must be free of flow and Crack.
- (b) The Ultrasonic test shall be conducted and acceptable products shall be used.
- (c) The material must assure the cleanliness of less than 0.15%

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3.2 MANUFACTURING PROCESS:

- (a) The following shall be the standard. If different, approval must be obtained in writing from the purchaser.



- (b) For the bend of less than 1.5 mm after hardening and tempering, the straightening and stress relief are not required.

3.3 FORGING:

The forging shall be done so that the forging ratio shall be 5S* (Ingot) or higher. Utmost attention shall be paid to the overheating so that there shall be no serious oxidation and decarbonization.

*S – Notation for solid forging.

$$\text{Forging Ratio for solid forging} = \frac{\text{Original Section}}{\text{Reduced Section}} = 5$$

4.0 CHEMICAL COMPOSITION:

The chemical composition and Mechanical properties of the material is as per specification 826M31 of BS 970, Part-3:1991.

5.0 FREEDOM FROM DEFECTS:

- 5.1 Internal Soundness: The steel shall be free from piping, harmful segregation and other internal defects. For Ingots, sufficient discards to be given from hot top ends to get raw material (steel ingots) in clean condition.

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- 5.2 Blooms, billets, slab and block bars intended for application of hot forging and subsequent proof machining shall have a high standard of surface quality and the surface conditioning shall be such as to remove defects detrimental to end products.

6.0 MECHANICAL PROPERTIES:

The Mechanical properties shall be as per BS:970 Part-3'1991.

7.0 DIMENSIONS:

- 7.1 The dimensions furnished in the relevant drawing enclosed to the CLW's tender enquiry are for proof machining after forging.

- 7.2 CENTRE HOLE: The Armature Shaft shall be provided with Center hole at both ends and the dimensions and shape shall be as specified on the drawing.

8.0 HEAT TREATMENT :

- 8.1 Heat treatment shall be carried out in a Furnace which must have a calibrated Time - Temperature Graph recorder for verification. Soaking temperature as per BS:970'1991 and soaking time for Annealing & Quenching shall not be less than $\frac{1}{2}$ an hour per inch of major diameter + 1 hour and Tempering shall be carried out at above 570°C. The soaking time to achieve the desired properties shall be at the rate of 1 hour per inch of major diameter of Shaft. The Instruments used for measuring temperature in the furnace must be calibrated annually. This calibration of Thermocouple used in the furnace shall also to be calibrated annually to ensure correct soaking & homogenization during heat treatment.

The quenching of the shaft shall be done in worm oil, preferably around 40°C.

- 8.2 The heat treatment curve with the contents shown in table-1 shall be prepared and submitted in 4copies.

TABLE-1
CONTENTS OF HEAT TREATMENT CURVE

Heat treatment	Equipment to be used	Recording Item	Checking method
Annealing	Electrical Resistance Furnace	Temperature and Cooling rate	Thermograph

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Hardening	Heavy oil refining furnace	Time and temperature of soaking	Thermograph and Hardness Tester
Tempering	Indication of heavy oil burning or gas burning	Hardness and tempering temperature	Thermograph and Hardness Tester.
Hot Straightening	Straightening	Log book/ Process sheet	Straightness
Stress relief	H.T Furnace	Time Temperature Cycle	Thermograph

8.3 The heat treatment pattern as per table-2 (The water quenching must be approved in advance).

8.4 For the deformation of less than 1.5 mm, after hardening and tempering, the straightening and stress relief are not required.

8.5 Standard holding time is 1 hour per diameter of 25.4 mm.

TABLE -2 :
HEAT TREATMENT PATTERN

Material	Item	Normalizing	Annealing	Hardening	Tempering	Straightening	Stress relief
BS-970 826M31	Heat treatment temperature		820°C to 870 °C	820°C to 870 °C	570°C to 670°C	---	*Tempering Temperature minus 50°C
	Holding Time						
	Cooling method		Furnace cooling	Oil cooling	Water cooling		Air cooling
	Cooling speed						

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* This stipulation is a guideline. The actual temperature for stress relieving should be judiciously selected so that the mechanical properties and micro-structure do not adversely affected.

9.0 TESTS AND TEST METHODS:

9.1 Mechanical properties shall be determined on the test piece collected from: the test piece attached at the end of main body for each melting and heat treatment batch and the values should be as Clause 6.0. The Testing machines must be calibrated annually to get the correct & unusually accepted report.

9.1.1 The size of the test piece in Tension Test piece and Impact Test piece.

9.1.2 The outside diameter of the test piece attached to the main body and the test piece collecting diameter shall be as specified in the drawing. The outside diameter of the test piece shall be same as the diameter of the roughly machined main body dimension shown in Fig-1.

9.1.3 The hardness shall be the surface hardness of the main body and the main body surface hardness measuring position is as specified on the drawing.

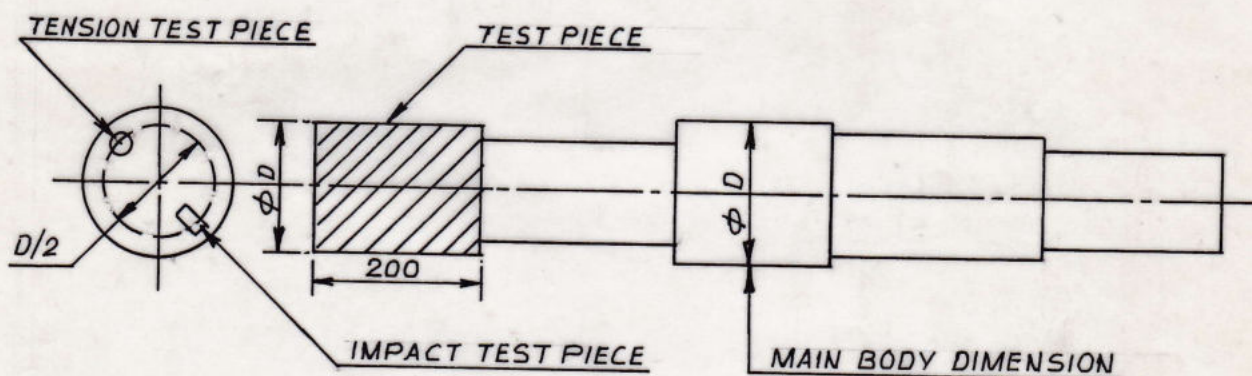


Fig-1. Size of the Test Piece Attached to Main Body and Test Piece collecting Position.

9.1.4 The hardness is the surface hardness of the main body and the hardness of the test piece shall be the reference value.

9.1.5 The yield point is the proof stress at tension set of 0.2%.(if sharp yield point is not observed)

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9.2 DIMENSIONAL CHECKS:

The armature shaft after rough machining shall be inspected for dimensions to the relevant drawings. The suppliers shall provide the necessary measuring instruments, gauges, templates etc. for the purpose of inspection.

9.3 CHEMICAL COMPOSITION TEST (Product analysis):

The chemical composition of the shaft shall conform to the requirements given in BS: 970, Grade- 826 M 31.(Permissible deviation shall be as per BS: 970,1991)

9.4 GRAIN SIZE:

The austenitic grain size of the Armature Shaft shall be determined in accordance with BS EN ISO 643 or ASTM E 112 (Method of determination of the austenitic grain size of steel).

9.5 INCLUSION CONTENT:

The inclusion content of the steel shall be tested as per ASTM E 45 method A Chart 1 and the rating shall be 1.5 A B C D (max.) in thick and thin series.

9.6 MAGNA FLUX TEST:

To determine the cracks of transverse nature and not very deep, magna flux test shall be done at the firm's premises on 100% shafts after proof machining and heat treatment in presence of CLW's inspector.

9.7 ULTRASONIC TEST:

Supplier shall carry out Ultrasonic Test on 100% Proof machined Shafts. Test results/ records shall be shown to the Inspecting authority as per stipulation in the P.O. However, CLW shall also carry out Magna flux Test and Ultrasonic test before using these shafts on the shop floor. If defect is noticed that shaft has to be replaced by firm.

* ULTRASONIC TEST TO BE CARRIED OUT AS PER RDSO CODE OF PROCEDURE MC-149/SEPT-10 * REV-1/MAY-2013

9.8 RESILIENCE TEST / IMPACT TEST:

Resilience / Impact test shall be carried out in presence of CLW's representative and the values shall be recorded. Any value less than 70% of min. value is treated as rejection.

9.9 HARDNESS:

Hardness test shall be carried out on test coupons as well as on the 100 % proof machined shaft forgings and values shall be recorded. The value of hardness to be between 300 to 330 HB.

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10.0 INSPECTION CONTENTS AND CRITERIA-

10.1 The inspection contents and criteria are shown in the following table.

Inspection contents and criteria

No	Inspection Item	Inspecting Instrument	Contents	Criteria
1.	Comparison in detail with inspection report		Comparison in detail with the inspection report submitted by the supplier	Delivered product must conform to the inspection report and the contents must satisfy the specified value.
2.	Visual inspection	Visual	Check to see that no harmful defects as forging crack or flow on the surface	No harmful defects shall be found.
3.	Dimensional inspection	Scale vernier gauge	Measure the dimensions	Dimensional tolerance specified on the drawing and ordering specification shall be satisfied.
4.	Hardness measurement	Brinell hardness tester	Measure the Brinell hardness after proof machining	Clause 9.9 must be satisfied.
5.	Tension test	Amster tension tester or similar (UTM)	Measure the yield point, tensile strength elongation and reduction in area	Clause 6.0 must be satisfied.
6.	Impact test	Charpy impact tester or similar	Impact value is measured on the test piece taken out of the same material as for item No.5	- do -
7.	Chemical		Ladle analysis values are used	Specification in clause 4.0 must be satisfied.
8.	Magnetic particle inspection	White kerosene	i) Shaft energization fluorescent magnetic particle inspection. The energizing current is 700	i) There shall be no open streak fissure. ii) There shall be no flow that crosses the axial

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			to 1000A per diameter of 25 mm.	direction at 45° or more. iii) There shall be no flow of 3 mm or larger at the corner
			ii) Working sensitivity must be such that a flow of 15 to 100 μ . can be detected. iii) After completion of testing, demagnetization must be made to less than 10 gauss.	iv) Length of one flow must be less than 7mm, total length of flows less than 14mm and no. of flows not more than 4 per 10x10 cm.
9.	Ultrasonic flow detection		Standard test piece 1. Frequency 5 MHZ 2. Couplant machine oil 3. Total sensitivity radial direction V15-20 80% 4. All face orthogonal flaw detection is adopted but it is omitted for the difficult shape.	1. Bottom echo shall be saturated 2 or more times in the radial direction. 2. Flow echo must have the ratio of less than 0.3 against the transmitted pulse. 3. F1/B1 \leq 10-30% must be continuous. 4. Continuous length shall be 50 mm.
10	Non-metallic inclusion	Microscope	Microscopic testing method for the non-metallic inclusion in steel.	
11.	Macrostructure		Macro-structure detecting method of steel.	There should be no detrimental defect.
12.	Microstructure & Grain size	Microscope	Shall be checked after quenching & tempering.	There should be no abnormal structure. Free ferrite content less than 5% ASTM G/S no. 6(min)
13.	Transition temperature	Charpy impact tester or similar	The temperature range is -50°C to +50°C and measuring points are -50°C, -20°C, 0°C +20°C & +50°C.	Brittle rupture 50% is the transition temperature.
14.	Bending fatigue limit not S-N curve	One fatigue tester	1) Bending fatigue limit at 10^7 times is sought. 2) Number of turns shall be reported by the maker.	1) The target for the bending fatigue limit is tensile strength x 0.5 or more. 2) Data shall be submitted.

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11.0 INSPECTION:

- 11.1 The successful tenderer shall have to submit prototype in one or more than one stage to the competent technical authority of CLW/Chittaranjan before undertaking bulk production/ supply. The initial prototype may comprise of one number and to be followed by a larger prototype lot of 6/12/18 Nos as per the requirement of Dy.CEE/TMD/CLW/CRJ. Prototype test will be required for 1st supply only.
- 11.2 For Physical test a sufficient quantity of integrated sample to be supplied to Dy.CEL/TMD/CLW/CRJ before prototype inspection. The test piece shall be grated / oxvent without affecting heat treatment in presence of an authorized representative of Dy.CEE/TMD. The method of the forged shaft for the purpose of chemical analysis and mechanical tests including re-tests shall be in accordance with the methods of sampling of alloy steels.
- 11.3 The supplier shall offer the prototype for inspection and test at his works with prior intimation to Dy.CEE/TMD and Addl.C & M/CLW/CRJ/West Bengal-713331. They shall provide all necessary facilities for inspection and testing. After the tests, if it is considered necessary by the authorized representative of Dy.CEE/TMD to carry out further additional test or trial of the prototype samples at Chittaranjan, the supplier shall arrange the same by quickest means.
- 11.4 Any shortcomings / defects in the design and workmanship of the component shall be pointed out after the test to enable the manufacturer to incorporate the necessary improvements before bulk supply is commenced without affecting the guaranteed delivery or performance characteristics.
- 11.5 The supplier shall provide all facilities to the inspecting authority at his works to inspect and test the component at various stages of manufacture and also for complete component.
- 11.6 Any testing and approval by the purchaser of the design, drawing and prototype shall in no way absolve the supplier of his responsibility under the terms of contract for the item supplied.
- 11.7 The supplier shall not offer any item of series production to the inspecting officer authorized under the contract, until the prototype has been finally approved.

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11.8 Routine inspection:: The supplier shall offer the material after proof machining to the Inspection authority as per stipulation in the P.O for dimensional inspection. Before offering the material for inspection supplier shall carry out Ultrasonic Test on 100% proof machined shaft and Test results / records shall be produced to the Inspection authority. During Inspection Test piece to be collected at random and Stamped & Sealed sample to be sent to CLW/CRJ for metallurgical Test.

(ALT 2)

(ALT 1)

AS PER RDSO
CODE OF PROC-
DURE MC-149/
REV-1/MAY-2013

(ALT 3)

OR NABL ACCREDITED LABORATORY

11.9 Supplier has to submit original invoice for procurement of Steel for forging. Quantity of Steel procured must be in correlation with no. of shafts as per P.O.

11.10 Splitting of the tendered quantity between minimum two tenderers is likely to be restored. The tenderer may however indicate their minimum acceptable quantity.

12.0 MARKING:

12.1 Each Shaft shall be legibly marked with the following information at the end of the shaft with Hand steel punch.

- Grade of steel
- Number of identification mark by which it can be traced from which metal it was made.
- Manufacturer's initial or trade mark.

12.2 The Armature Shaft complying with the requirement of this standard will be after inspection, legibly marked with an acceptance by the purchaser's inspector.

13.0 INFORMATION TO BE FURNISHED BY THE TENDERER:

13.1 While submitting the offer the tenderer shall furnish the following information-

- List of M&P. Test facilities and manufacturing process sheet.
- Details of material offered and source of raw material and its grade.
- Quality Control System and Quality Assurance Plan adopted by tenderer.
- Heat treatment furnace calibration certificate. shall be submitted alongwith the offer.
- All Mechanical testing equipments calibration certificate shall be submitted alongwith the offer.
- Past performance for similar type of item.
- Tenderer may furnish additional details / information as relevant to establish their capacity to undertake the manufacturing of items covered by this specification.
- Tenderer shall also furnish all the relevant details as asked for in BID DOCUMENTS without fail.

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- i) 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 CLW reserves the right to reject the offer.

14.0 PACKING:

- 14.1 The component shall be suitably packed to prevent transit/ long storing damage.
 14.2 The component shall be coated with anti-rust grease after inspection and passed.
 14.3 Grease component shall be wrapped in polythene paper followed by corrugated paper.
 14.4 The wrapped component shall then be sealed in thick polythene bag.
 14.5 The sealed component shall be finally packed in wooden crates/Boxes filled with saw dust to prevent transit damage.

- 15.0 Metallurgical testing for prototype supplies shall be carried out by Dy.C.C.&M/CLW/CRTJ OR NABL approved laboratory for which sample to be drawn, stamped & sealed by authorized representative of Dy.CEE/TMD/CLW/CRTJ and for bulk supplies metallurgical test shall be done by Dy.C.C.&M/CLW/CRTJ OR NABL approved laboratory, to be witnessed by authorised representative of CLW Zonal Inspection cell.

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