



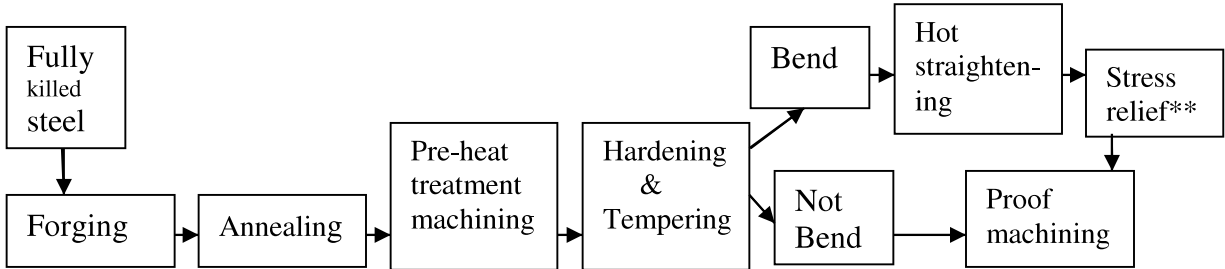




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<b>COPYRIGHT AND CONFIDENTIAL</b> The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company	<h1 style="margin: 0;">SPECIFICATION OF</h1> <h2 style="margin: 0;"><u>ARMATURE SHAFT (ROUGH MACHINED) FOR HITACHI</u></h2> <h2 style="margin: 0;"><u>TRACTION MOTOR HS15250A</u></h2>				
	Revision : 03  Date: 31.12.2020	Distribution  TME TXM QTM	Qty.  1 1 1	Approved :  (M. Verma)  Prepared by:  A. Shukla	Checked:  A. Sharma

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<b><u>SPECIFICATION OF ARMATURE SHAFT (ROUGH MACHINED) FOR HITACHI TRACTION MOTOR HS15250A</u></b>		
<div><div>COPYRIGHT AND CONFIDENTIAL</div><div>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</div></div>	<b>0. <u>FORWARD :</u></b>	
	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 BHEL would like to purchase the component in forged & rough machined condition to Drg. No. 34394060058 (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 BHEL do not undertake to supply drawing for forgings necessary jigs, fixture and tools, templates and / or process sheets or any other such details. BHEL 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 BHEL production.	
	<b>1. <u>SCOPE :</u></b>	
	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 BHEL before their application in the motor.	
	<b>2.0 <u>SPECIFICATION :</u></b>	
	2.1 Alloy steels shall conform to BS-970, Part-3 1991 Grade 826M31 and shall be heat treated to condition “V” (Hardness between 300-330HB)	
	<b>3.0 <u>MANUFACTURING METHOD :</u></b>	
3.1 Material to be used :-		

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<p><b>COPYRIGHT AND CONFIDENTIAL</b></p> <p>The information on this document is the property of <b>BHARAT HEAVY ELECTRICALS LTD.</b> It must not be used directly or indirectly in any way detrimental to the interest of the company</p>	<p>(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%.</p> <p><b>3.2 MANUFACTURING PROCESS:</b></p> <p>(a) The following shall be the standard. If different, approval must be obtained in writing from the purchaser.</p>  <pre> graph LR     A[Fully killed steel] --&gt; B[Forging]     B --&gt; C[Annealing]     C --&gt; D[Pre-heat treatment machining]     D --&gt; E[Hardening &amp; Tempering]     E --&gt; F[Bend]     E --&gt; G[Not Bend]     F --&gt; H[Hot straightening]     H --&gt; I[Stress relief**]     G --&gt; J[Proof machining]     I --&gt; J   </pre> <p><b>**</b>-See note of Table-2.</p> <p>(b) For the bend of less than 1.5mm after hardening and tempering, the straightening and stress relief are not required.</p> <p><b>3.3 FORGING :-</b></p> <p>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.</p> <p>S* – Notation for solid forging.</p> <p>Forging Ratio for solid forging = <math>\frac{\text{Original Section}}{\text{Reduced Section}} = 5</math></p> <p><b>4.0 CHEMICAL COMPOSITION :</b></p> <p>The chemical composition and mechanical properties of the material is as per steel 826M31 of BS 970, Part -3'1991.</p> <p><b>5.0 FREEDOM FROM DEFECTS:</b></p>	
	<p>5.1 <b>Internal Soundness:</b> The steel shall be free from piping, harmful segregation and other internal defects. For ingots, sufficient discards to be given front hot top ends to get raw material (steel ingots) in clean condition.</p> <p>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.</p>	


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	<b>7.0 <u>DIMENSIONS:</u></b>  7.1 The dimensions furnished in the relevant drawing enclosed to the BHEL's tender enquiry are for proof machining after forging.  <b>7.2 <u>CENTRE HOLE:</u></b>  The armature shaft shall be provided with center hole at both ends and the dimensions and shape shall be as specified on the drawing.  <b>8.0 <u>HEAT TREATMENT:</u></b>  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 ½ 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 4 copies.	

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	<b>Heat treatment</b>	<b>Equipment to be used</b>	<b>Recording Item</b>	<b>Checking method</b>
	Annealing	Electrical resistance furnace	Temperature and cooling rate	Thermograph
	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.			

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	<div><div><div><div><div><div></div><div>TENSION TEST PIECE</div></div><div><div><div><div><div><div></div><div>TEST PIECE</div></div><div><div><div><div><div><div></div><div>ØD</div></div><div><div><div><div><div><div></div><div>200</div></div></div><div><div><div><div><div><div></div><div>ØD</div></div><div><div><div><div><div><div></div><div>MAIN BODY DIMENSION</div></div></div></div></div></div></div><div><div><div><div><div><div></div><div>D/2</div></div><div><div><div><div><div><div></div><div>IMPACT TEST PIECE</div></div></div></div></div></div></div></div></div></div></div></div></div></div></div></div></div></div></div></div></div></div></div></div></div></div></div></div>	
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<b>COPYRIGHT AND CONFIDENTIAL</b> The information on this document is the property of <b>BHARAT HEAVY ELECTRICALS LTD.</b> It must not be used directly or indirectly in any way detrimental to the interest of the company	<b>9.6 <u>MAGNA FLUX TEST:</u></b>  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 BHEL's inspector.	
	<b>9.7 <u>ULTRASONIC TEST:</u></b>  Supplier shall carry out ultrasonic test on 100% proof machined shafts. Ultrasonic Test to be carried out as per RDSO code of procedure MC-149 Rev-1/ May-2013. Test results / records shall be shown to the inspecting authority as per stipulation in the P.O. However, BHEL 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.	
	<b>9.8 <u>RESILIENCE TEST / IMPACT TEST:</u></b>  Resilience / Impact test shall be carried out in presence of BHEL's representative and the values shall be recorded. Any value less than 70% of min. value is treated as rejection.	
	<b>9.9 <u>HARDNESS:</u></b>  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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	12.	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.
	13.	Bending fatigue limit not S-N curve	One fatigue tester	1) Bending fatigue limit at 10 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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	11.1 The successful tenderer shall have to submit prototype in one or more than one stage to the competent technical authority of BHEL 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 BHEL. Prototype test will be required for 1 <sup>st</sup> supply only.	
	11.2 For physical test a sufficient quantity of integrated sample to be supplied to BHEL before prototype inspection. The test piece shall be grated / oxy-cut without affecting heat treatment in presence of an authorised representative of BHEL. 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 Any shortcoming / 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.	
	11.4 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.	
	11.5 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.	
	11.6 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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<b>COPYRIGHT AND CONFIDENTIAL</b> The information on this document is the property of <b>BHARAT HEAVY ELECTRICALS LTD.</b> It must not be used directly or indirectly in any way detrimental to the interest of the company	<p>11.7 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 as per RDSO code of procedure MC-149 Rev-1/May-2013, on 100% proof machined shaft and Test results / records shall be produced to the Inspection authority.</p> <p>One bar having additional length of 300 mm other than specified length shall be provided along with each consignment per heat per heat treatment batch (material testing may be done by BHEL, at its cost).</p> <p>For e.g.: If bar length is 1325 mm then one bar per heat per heat treatment batch shall be of (1325+300) i.e. 1625 mm length.</p> <p>The bar shall be properly identified and correlated with heat and heat treatment batch no., test certificate no.</p> <p>Alternatively, BHEL Bhopal may at their discretion and cost can destroy one shaft taken randomly per heat per heat treatment batch for testing.</p>	
	11.8 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.	
	11.9 Splitting of the tendered quantity between minimum two tenderers is likely to be restored. The tenderer may however indicate their minimum acceptable quantity.	
	<b>12.0 Marking :</b>	
	12.1 Each shaft shall be legible marked with the following information at the end of the shaft with Hand steel punch.	
	i) Grade of steel ii) Number of identification mark by which it can be traced from which metal it was made. iii) 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.	

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