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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. <u>FORGED BARS-ROUGH MACHINED, FOR PUMP SHAFTS</u> 1.0 <u>GENERAL</u> This standard specifies the quality requirements of rough machined forged bars as per the details given in TABLE-1, intended for Pumps Shafts of BFP, BP & CEP. 2.0 <u>CONDITION OF DELIVERY</u> 2.1 Forgings shall be supplied in rough machined condition with surface finish of 6.3 microns or better. 2.2 Forgings shall be hardened and tempered before rough machining. 2.3 Forgings shall be stress relieved after rough machining. 2.4 Nearest equivalent BHEL material specification : AA19321. 3.0 <u>NEAREST EQUIVALENT INTERNATIONAL STANDARDS</u> Nearest equivalent international standard : DIN 17440-1996, Gr-X20Cr13 (1.4021) 4.0 <u>DIMENSIONS, TOLERANCES & HEAT TREATMENT</u> 4.1 <u>DIMENSIONS:</u> The forgings shall be supplied in rough machined condition as per the dimensions given in TABLE-1. The minimum reduction ratio when forgings are made of ingots shall be 4:1 4.2 <u>TOLERANCES:</u> Tolerances on diameter shall be (+) 2 mm and on length (+) 5 mm. Maximum permissible run out shall be 0.5 mm. 4.3 <u>HEAT TREATMENT:</u> Forgings shall be heat treated and tempered to give the mechanical properties specified. Test pieces shall also be heat treated along with the forgings they represent.						
Ref. Doc		Revisions : Refer to record of revisions :		Prepared : TSR	Approved : JGC	Date : 15.05.91



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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.		Stress relieving shall be done to remove machining stresses and this temperature shall be less than the tempering temperature. 5.0 <u>FREEDOM FROM DEFECTS</u> Forgings shall be free from defects such as cracks, flakes, seams, segregation, harmful non-metallic inclusions and other defects which may affect the utility of the forgings. Bars shall be free from internal and surface defects. 5.1 Inclusion rating per each melt and heat treatment batch as per ASTM: E45, 2 thin series for all types. (for Var. No. 10,11 & 12 only.) 6.0 <u>CHEMICAL COMPOSITION</u> <table border="1" data-bbox="334 814 1414 1022"> <thead> <tr> <th>Carbon %</th> <th>Silicon % max.</th> <th>Manganese % max.</th> <th>Phosphorus % max.</th> <th>Sulphur % max.</th> <th>Chromium %</th> <th>Nickel % max.</th> </tr> </thead> <tbody> <tr> <td>0.16 to 0.25</td> <td>1.00</td> <td>1.50</td> <td>0.04</td> <td>0.03</td> <td>12.00 to 14.00</td> <td>1.00</td> </tr> </tbody> </table> 7.0 <u>MECHANICAL PROPERTIES</u> <table border="1" data-bbox="334 1161 1414 1331"> <thead> <tr> <th>Tensile strength N/mm²</th> <th>Yield stress N/mm² min.</th> <th>Elongation % Min.</th> <th>Charpy Impact (Iso-V-notch) J, min.</th> <th>Reduction in area % min.</th> <th>Hardness HB</th> </tr> </thead> <tbody> <tr> <td>750 - 950</td> <td>550</td> <td>12</td> <td>15</td> <td>50</td> <td>217 - 241</td> </tr> </tbody> </table> 7.1 Percentage reduction test to be done. (for Var. No. 10,11 & 12 only) 8.0 <u>NON DESTRUCTIVE TESTS</u> 8.1 100% Ultrasonic examination shall be carried out after heat treatment and rough machining as per AA0850118 and acceptance standard AA0850102 category 2. Frequency shall be 2 MHz minimum and back wall echo, minimum 80%. 8.2 100% magnetic particle examination shall be carried out after heat treatment and rough machining as per AA0850102 category 2. 9.0 <u>INSPECTION:</u> Forgings shall be supplied with inspection and certification by BHEL or BHEL nominated Third Party Inspection Agency (TPIA).				Carbon %	Silicon % max.	Manganese % max.	Phosphorus % max.	Sulphur % max.	Chromium %	Nickel % max.	0.16 to 0.25	1.00	1.50	0.04	0.03	12.00 to 14.00	1.00	Tensile strength N/mm ²	Yield stress N/mm ² min.	Elongation % Min.	Charpy Impact (Iso-V-notch) J, min.	Reduction in area % min.	Hardness HB	750 - 950	550	12	15	50	217 - 241
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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.		10.0 <u>TEST CERTIFICATES :</u> 5 copies of test certificates (in English) shall be furnished, duly certified by Inspection Agency containing the following information. a) Dimension report b) Chemical analysis c) Mechanical properties d) Heat treatment chart e) NDT results (Ultrasonic and Magnetic Particle) f) BHEL order No, Supplier name, Spen&Var. no., dimension of forging 11.0 <u>MARKING :</u> The following details shall be engraved on each forging for easy identification. Specn No: Eg. FP50443, VAR.No.xx, Dimension : ODxL Melt No:/Heat No: 12.0 <u>PRESERVATION & PACKING</u> The forgings shall be properly protected from damage and corrosion during transport. Machined surfaces shall be protected with anti-greasy, anticorrosive coating. Painting is not permitted. <u>Note:-</u> 1) Clause nos. 5.1 & 7.1 are applicable for Var. No. 10, 11 & 12 only. 2) Clause no. 8.2 is not applicable for Var. No. 10, 11 & 12. 13.0 <u>REJECTION AND REPLACEMENT :</u> The final decision regarding acceptance or rejection rests with BHEL, if the forging is not found as per specification or drawing at any time during further operation on the forging. The supplier shall replace the rejected forging at his own cost.		
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		Rev. No.	Date	Revision Details	Revised By	Approved By
		01	04/09/95	GENERALLY REVISED IN LINE WITH EMI-011	TSR	JGC
		02	18/05/02	Var Nos.10, 11 & 12 ADDED.	MSR	BRK
		03	15/10/03	Mech properties TS, YS & Elongation in line with specn AA19321. Heat treatment and nearest equivalent specns revised.	MSR	BRK
		04	18/02/13	Charpy Impact value changed to 15 in line with AA19321, Rev 07.	ASJK	BRK
		05	22.10.15	Extra length of 250mm for test piece deleted. Table-1 dimensions and weights revised. Standard generally revised. Cl.no. 2.0 & 4.0 revised.	MSR	KHRK
		Ref. Doc.				