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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 FOR STUD BOLTS</u> 1.0.0 GENERAL: This specification governs the quality requirements of heat treated high tensile alloy steel forged bars used for stud bolts of MHI design Boiler Feed Pumps and Feed Booster Pumps. 2.0.0 COMPLIANCE TO INTERNATIONAL STANDARD: The steel grade complies in general with JIS G4053 SCM440, 'Low Alloyed Steels for Machine Structural use'. 3.0.0 CONDITION OF DELIVERY: 3.1.0 The forged bars shall have chemical composition indicated at cl.no.6.0.0. 3.2.0 The forged bars shall be manufactured from fully killed steel.. 3.3.0 The forged bars shall be made as hot-forged with forming ratio of 4S or over. 3.4.0 The forged bars shall be supplied in machined condition with 6.3 micron surface finish, as per the dimensions and tolerances indicated in the variant table. 3.5.0 The forged bars shall be supplied in Heat treated condition to achieve the specified mechanical properties indicated 6.0.0. 3.6.0 Weld repair of the forgings shall not be accepted. 4.0.0 HEAT TREATMENT: 4.1.0 The forged bars shall be heat treated to give the specified mechanical properties. The heat treatment cycle shall be decided by the forging supplier. The test pieces shall also be heat treated along with the forged bars. 4.2.0 The recommended heat treatment cycle is given below for reference. <u>Quenching:</u> Heating to 920°C - 980°C followed by oil quenching. <u>Tempering:</u> Heating to 600°C - 750°C followed by rapid cooling.					
Ref. Doc		Revisions : Refer to record of revisions :	Prepared : M.S.RAM	Approved : KHRK	Date : 07.05.16

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5.0.0 CHEMICAL COMPOSITION:

Carbon %	Silicon %	Manganese %	Phosphorus % max.	Sulphur % max.	Chromium %	Nickel % max.	Molybdenum %
0.38 to 0.43	0.15 to 0.35	0.60 to 0.90	0.03	0.03	0.90 to 1.20	0.25	0.15 to 0.30

6.0.0 MECHANICAL PROPERTIES:

6.1.0 The test samples after heat treatment cycle mentioned at clause no. 5.0.0 shall confirm to the following mechanical properties.

Tensile strength N/mm ²	Yield stress N/mm ²	Elongation L=5d %	Reduction of area %	Hardness BHN
981 Min.	834 Min.	12 Min.	45 Min.	285-352

6.2.0 All the forged bars shall be tested for hardness after heat treatment cycle mentioned at cl.no.5.0.0.

7.0.0 TEST SAMPLES:

7.1.0 Minimum two samples per melt shall be drawn, identified and stamped by the inspector. The test pieces shall be heat treated as per cl.no.5.0.0. The tensile test shall be carried out in accordance with IS-1608 or any reputed national/international standard.

7.2.0 First sample: Chemical analysis shall be done as per cl.no.5.0.0. Mechanical test shall be done for the actual mechanical properties of the forging before heat treatment. Test report shall be furnished indicating the actual values of mechanical properties given at cl.no.6.1.0.

7.3.0 Second sample: Sample shall be taken for heat treatment along with the forged bars. Mechanical test shall be conducted on the heat treated sample and the properties shall be as per cl.no.6.1.0. Test report shall be furnished indicating the actual values of mechanical properties against those specified at cl.no.6.1.0.

8.0.0 NON DESTRUCTIVE TESTS:

Following NDTs shall be carried out on 100% quantity of the components, after heat treatment and machining.

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8.1.0 <u>Ultrasonic Test:</u> 100% area of the component shall be tested ultrasonically as per BHEL standard AA0850118 and the acceptance norm shall be category-2. 8.2.0 <u>Magnetic particle examination:</u> 100% magnetic particle examination shall be carried out after heat treatment and rough machining as per AA0850102 category-2. 9.0.0 INSPECTION AT SUPPLIER'S WORKS: 9.1.0 All the forged bars shall be inspected at supplier's works by BHEL inspector or BHEL appointed Third Party Inspection Agency (TPIA). The inspector shall have free entry and access to all areas where manufacture of the ordered forgings is carried out. All reasonable facilities shall be provided to him including labour where necessary. The inspector shall be given sufficient advance intimation to witness/inspect the components at various stages during manufacture. 9.2.0 Supplier shall prepare their internal manufacturing quality plan which shall include the activities mentioned at cl.no.9.3.0 and shall be submitted for approval. 9.3.0 Scope of inspection at supplier's works shall include the following: - Identification and stamping of test samples for each melt. - Review of chemical analysis report. - Review of Mechanical tests on test sample before heat treatment - Witness of Mechanical test on heat treated sample. - Witness of hardness test on all the heat treated forged bars. - Dimensional inspection of all the forged bars. - Review of heat treatment charts. 10.0.0 TEST CERTIFICATES: 10.1.0 Supplier shall furnish 2 copies of test certificates of Chemical analysis, Hardness test on the machined forged bars, Mechanical properties as per 6.0.0 of test samples before and after heat treatment, NDT reports, HT charts and dimensional reports. 10.2.0 Following information shall be included in all the test certificates. - BHEL Drawing no, Specification No: FP50677 - BHEL Order No. & Item no. - BHEL Material code & Item description - Supplier's name - Melt No. or Heat No. - Forging Sl.no. per melt			

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11.0.0 MARKING AND PACKING:

11.1.0 Following details shall be printed with non-erasable ink or engraved on each of the forged bar.

- 12 digit Material code, Specn No. & Var.no.
- Melt No. / Heat no.
- BHEL / BHEL approved Inspector's Stamp (may be punched on the un-tolerated surfaces).

11.2.0 The forged bars shall be packed in suitable packing case to protect from damage and corrosion during transport. The packing case shall be marked with the following details.

- BHEL Purchase order no., Item No.& quantity
- 12 digit Material code, Specn No. & Drawing no.
- Name of the Supplier.

12.0.0 REJECTION AND REPLACEMENT:

The final decision regarding acceptance or rejection rests with BHEL, if found the forging is not complying with this specification at any time during further operations. The supplier shall replace the rejected forgings at his own cost.

13.0.0 VARIANT TABLE:

All dimensions are in mm; Tolerances: OD (+3.0 / -0.0); L (+5.0 / -0.0)

VAR. NO.	SIZE OD x L	PUMP TYPE	APPLICATION	WT. Kg.	FINAL M/C DRG. (inf)	MATL CODE
01	φ 125 x 650	MDG455	M115x3x640 Casing/Casing cover	63.0	11801116174	FP9750677013
02	φ 120 x 630	MDG405	M110x3x619 Casing/Casing cover	56.0	21801114809	FP9750677021
03	φ 125 x 600	MDG366	M115x3x585 Casing/Casing cover	58.0	21801114829	FP9750677030
04	φ 105 x 590	MDG346	M95x3x576 Casing/Casing cover	40.0	21801114816	FP9750677048
05	φ 55 x 235	MLC450	M45x4.5x225	4.5	31891115411-02	FP9750677056
06	φ 50 x 200	MLC400	M39x4x191 Casing/Casing cover	3.1	31891115411-01	FP9750677064
07	φ 135 x 730	MDG436	M125x3x720 Casing/Casing cover	82.0	21801114841	FP9750677072

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RECORD OF REVISIONS					
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	01	17.01.18	Var. No.07 is added.	JNM	MSR

