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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>TECHNICAL SPECIFICATION FOR ROUGH MACHINED SHAFT FORGINGS FOR C.W. PUMPS</u> 1.0 <u>GENERAL :</u> This standard specifies the quality requirements for the shaft forgings used for Cooling Water Pumps. 2.0 <u>CONDITIONS OF DELIVERY :</u> 2.1 Forging shall be rough machined as per the dimensions indicated against the relevant variant number shown in the accompanying Table-1. 2.2 Material shall be indicated against the relevant variant number shown in the accompanying Table – 1. 3.0 <u>COMPLIANCE WITH NATIONAL STANDARDS :</u> This standard complies with National / Plant standards indicated against the relevant Variant Number shown in the accompanying Table – 1. 4.0 <u>DIMENSIONS AND TOLERANCES :</u> 4.1 The forging shall be supplied in rough machined condition (Ra 6.3) as per dimensions indicated against relevant Variant Number shown in the accompanying Table. When the forging are made out of ingots the minimum reduction ratio shall be 4:1. 4.2 No scratch, bruise shall be found on machined surface Tolerances on diameter shall be + 0.5 mm and on length $\pm$ 0.5 mm. Negative tolerance on diameter is not permitted. 4.3 Maximum permissible run out shall be 0.15 mm.. 5.0 <u>HEAT TREATMENT:</u> The heat treatment shall be as recommended by the Plant / National standard indicated against the relevant Variant Number as shown in the accompanying Table-1. Stress relieving shall be done to remove machining stress and this temperature shall be less than the tempering temperature.			
		Ref. Doc	Revisions : Refer to record of revisions :	Prepared : RE	Approved : GRR



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6.0 FREEDOM FROM DEFECTS:

Forging shall be free from defects such as cracks, flakes, seams, segregation, harmful non-metallic inclusions and other defects which may effect the utility of the forging.

7.0 CHEMICAL COMPOSITION :

The chemical composition shall be as per the Plant / National standard indicated against the relevant Variant Number shown in the accompanying Table-1.

8.0 MECHANICAL PROPERTIES :

Mechanical properties shall be as per the Plant / National standard indicated against the relevant Variant Number in the accompanying Table-1.

9.0 NON-DESTRUCTIVE TESTS :

a) After heat treatment and rough machining, the shaft forging shall be subjected to 100% Ultrasonic examination as per standard AA0850118 and acceptance shall as per AA0850102 and category-2. Frequency shall be minimum 2 MHz and back wall echo minimum 80%.

10.0 INSPECTION :

Forging shall be supplied with M/s.Lloyds inspection and certification.

11.0 TEST CERTIFICATES :

The supplier shall furnish 5 copies of the test certificates duly certified by M/s. Lloyds (in English) containing the following information.

a) Dimensional report

b) Chemical Analysis

c) Mechanical Properties

d) Heat treatment chart

e) NDT result (UT)

f) BHEL Order no., supplied name, Drg. No. / FP Standard with Var. No. description of item, Project Name.

Ref. Doc	
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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.		12.0 <u>MARKINGS :</u> The following details shall be engraved on each forging for identification : FP standard No. with Variant, Material code, Melt No. / Heat No. 13.0 <u>PRESERVATION AND PACKING :</u> The forging shall be properly protected from damaged and corrosion during transport. Machined surfaces shall be protected with non-greasy anti-corrosive coating. Painting is not permitted. 14.0 <u>REJECTION AND REPLACEMENT :</u> If it is found that forging is not as per the specification requirement at any time during further operation at BHEL works, the forging is liable for rejection and the vendor shall replace the rejected forging free of cost.	
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TEST PIECE

ϕD

L

B

L+B

VAR NO.	DESCRIPTION	DIMENSIONS			MATERIAL SPECIFICATION	MATERIAL CODE	REMARKS
		L	ϕD	B			
01	PUMP SHAFT	3050	160	50	ASTM A473 TYPE 316	FP9750205014	GANDHINAGAR
02	INTER SHAFT-1	2600	160	50	ASTM A473 TYPE 316	FP9750205022	GANDHINAGAR
03	INTER SHAFT-2	3125	200	50	ASTM A473 TYPE 316	FP9750205030	GANDHINAGAR
04	DRIVE SHAFT	2150	175	50	ASTM A473 TYPE 316	FP9750205049	GANDHINAGAR
05	PUMP SHAFT	3160	160	50	ASTM A473 TYPE 420 (H & T)	FP9750205057	KHAPERKHEDA
06	COLUMN SHAFT	4140	160	50	ASTM A473 TYPE 420 (H & T)	FP9750205065	KHAPERKHEDA
07	DRIVE SHAFT	3850	200	50	ASTM A473 TYPE 420 (H & T)	FP9750205073	KHAPERKHEDA
08	PUMP SHAFT	2850	150	50	ASTM A473 TYPE 316	FP9750205081	KOLAGHAT
09	COLUMN SHAFT	1300	150	50	ASTM A473 TYPE 316	FP9750205090	KOLAGHAT
10	DRIVE SHAFT	3050	180	50	ASTM A473 TYPE 316	FP9750205103	KOLAGHAT

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VAR NO.	DESCRIPTION	DIMENSIONS			MATERIAL SPECIFICATION	MATERIAL CODE	REMARKS	
		L	ØD	B				
11	PUMP SHAFT	3240	160	150	ASTM A473 TYPE 420 (H&T)	FP9750205111	TENUGHAT	PRODUCT STANDARD PUMPS HYDERABAD
12	INTERMEDIATE SHAFT-I	3560	160	150	ASTM A473 TYPE 420 (H&T)	FP9750205120	TENUGHAT	
13	INTERMEDIATE SHAFT-II	3210	160	150	ASTM A473 TYPE 420 (H&T)	FP9750205138	TENUGHAT	
14	DRIVE SHAFT	4250	200	150	ASTM A473 TYPE 420 (H&T)	FP9750205146	TENUGHAT	
15	PUMP SHAFT	4300	160	150	ASTM A473 TYPE 410 (H&T)	FP9750205154	ANPARA	
16	INTERMEDIATE SHAFT-I	3600	160	150	ASTM A473 TYPE 410 (H&T)	FP9750205162	ANPARA	
17	INTERMEDIATE SHAFT-II	3620	160	150	ASTM A473 TYPE 410 (H&T)	FP9750205170	ANPARA	
18	HEAD SHAFT	4020	200	150	ASTM A473 TYPE 410 (H&T)	FP9750205189	ANPARA	
19	DRIVE SHAFT	3320	185	150	ASTM A473 TYPE 410 (H&T)	FP9750205197	ANPARA	
20	PUMP SHAFT	3075	155	-	AA19320	FP9750205200	KOTA, MUDDANUR	
21	INTERMEDIATE SHAFT	3360	155	-	AA19320	FP9750205219	KOTA, MUDDANUR	
22	DRIVE SHAFT	3610	205	-	AA19320	FP9750205227	KOTA	
23	HEAD SHAFT	3150	170	-	AA19320	FP9750205235	MUDDANUR	
24	DRIVE SHAFT	1950	170	-	AA19320	FP9750205243	MUDDANUR	
25	PUMP SHAFT	3970	155	-	AA19320	FP9750205251	VIJAYAWADA	
26	INTER SHAFT	2875	155	-	AA19320	FP9750205260	VIJAYAWADA	
27	DRIVE SHAFT	4155	200	-	AA19320	FP9750205278	VIJAYAWADA	FP 50205 Rev. No. 23 PAGE 5 OF 9
28	PUMP SHAFT	2810	130	-	ASTM A743-306 L	FP9750205286	AL-ARISH	

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VAR NO.	DESCRIPTION	DIMENSIONS			MATERIAL SPECIFICATION	MATERIAL CODE	REMARKS	
		L	ØD	B				
29	INTER SHAFT	2700	130	-	ASTM A743-306 L	FP9750205294	AL-ARISH	PRODUCT STANDARD PUMPS HYDERABAD
30	HEAD SHAFT	3090	130	-	ASTM A743-306 L	FP9750205308	AL-ARISH	
31	DRIVE SHAFT	3380	180	-	ASTM A743-306 L	FP9750205316	AL-ARISH	
32	PUMP SHAFT	2670	120	-	AA19320	FP9750205324	NEEPCO	
33	INTER SHAFT	3540	120	-	AA19320	FP9750205332	NEEPCO	
34	DRIVE SHAFT	3900	160	-	AA19320	FP9750205340	NEEPCO	
35	PUMP SHAFT	3160	155	-	AA19320	FP9750205359	KOTHAGUDEM TPS	
36	INTER SHAFT	2730	155	-	AA19320	FP9750205367	KOTHAGUDEM TPS	
37	DRIVE SHAFT	2450	170	-	AA19320	FP9750205375	KOTHAGUDEM TPS	
38	INTER SHAFT	2180	155	-	AA19320	FP9750205383	GANDHINAGAR	
39	DRIVE SHAFT	1480	170	-	AA19320	FP9750205391	GANDHINAGAR	
40	PUMP SHAFT	3360	155	-	AA19320	FP9750205405	DVC MEJIA UNIT-4	
41	INTERMEDIATE SHAFT	3010	155	-	AA19320	FP9750205413	DVC MEJIA UNIT-4	
42	DRIVE SHAFT	2950	165	-	AA19320	FP9750205421	DVC MEJIA UNIT-4	
43	PUMP SHAFT	3290	170	-	BS 970 316 S16	FP9750205430	NORTH MADRAS	
44	INTERMEDIATE SHAFT	2550	170	-	BS 970 316 S 16	FP9750205448	NORTH MADRAS	
45	DRIVE SHAFT	2625	200	-	BS 970 316 S 16	FP9750205456	NORTH MADRAS	
46	PUMP SHAFT	3500	160	-	ASTM A473 S316	FP9750205464	METTUR	
47	INTERMEDIATE SHAFT	2850	160	-	ASTM A473 S316	FP9750205472	METTUR	
48	DRIVE SHAFT	4450	200	-	ASTM A473 S316	FP9750205480	METTUR	
49	PUMP SHAFT	4000	200	-	AA19320	FP9750205499	DVC MEJIA 500MW	
50	DRIVE SHAFT	2500	200	-	AA19320	FP9750205502	DVC MEJIA 500MW	
51	PUMP SHAFT	4000	200	-	BS 970 316 S16	FP9750205510	SIKKA	
52	PUMP SHAFT	3500	200	-	BS 970 316 S16	FP9750205529	NORTH CHENNAI	
53	DRIVE SHAFT	2500	200	-	BS 970 316 S16	FP9750205537	NORTH CHENNAI	
54	PUMP SHAFT	3500	200	-	AA19320	FP9750205545	ANPARA 500 MW	

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	Rev. No.	Date	Revision Details	Revised By	Approved By
	01	05/01/87	VAR. NOS. 5 TO 12 ADDED	RE	GRR
	02	21/01/87	VAR. NOS. 13 TO 20 ADDED	RE	GRR
	03	24/04/93	VAR. NOS. 21 TO 34 ADDED	RE	GRR
	04	08/12/93	VAR. NOS. 35 TO 37ADDED	RE	GRR
	05	03/03/94	VAR. NOS. 35,36,37 REVISED 3160 WAS 3120, 2730 WAS 2810 AND 2450 WAS 2920.	RE	GRR
	06	29/03/95	VAR. NOS. 38 &39 ADDED.	RE	GRR
	07	22/06/95	GENERALLY REVISED IN LINE WITH EMI-011	RE	GRR
	08	26/06/02	VAR. Nos.: 40, 41 & 42 ADDED.	SAHU	BRK
	09	07/11/02	DIMENSIONS REVISED AT VAR. Nos. 40, 41 & 42.	SAHU	BRK
	10	28/04/06	VAR.NOS. 43, 44 & 45 ADDED	MSR	BRK
	11	04/07/06	VAR.NOS. 46, 47 & 48 ADDED	MSR	BRK
	12	26/05/08	VAR.NOS. 49 & 50 ADDED	HRK	BRK
	13	22/08/08	VAR NO. 51 ADDED	HRK	BRK
	14	22/12/09	VAR NO. 52 ADDED	SATISH	KHRK
	15	27/12/09	VAR NO. 53 ADDED	SATISH	KHRK
	16	12/02/10	VAR NO. 54 ADDED	SATISH	KHRK
	17	18/03/10	VAR NO. 55 & 56 ADDED	SATISH	KHRK
Ref. Doc.	18	25/03/10	VAR NO. 57 ADDED	SATISH	KHRK
	19	15/04/13	VAR NO. 58 ADDED	SATISH	KHRK

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	Rev. No.	Date	Revision Details	Revised By	Approved By	
	20	07/01/14	VAR NO. 59 & 60 ADDED	SATISH	KHRK	
	21	03/06/15	VAR NO. 61 to 65 ADDED	SATISH	KHRK	
	22	08/09/16	VAR NO. 66 ADDED	SATISH	KHRK	
	23	08/09/16	SPEC. GENERALLY REVISED	SATISH	KHRK	
	Ref. Doc.					

