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FORGED COMPONENTS - HARDENED STAINLESS STEEL

1.0.0 **GENERAL:**

This specification governs the quality requirements of hardened corrosion resisting stainless steel forged components.

2.0.0 **COMPLIANCE TO INTERNATIONAL STANDARD:**

The steel grade complies in general with JIS G4303 SUS 420J2Q.

3.0.0 **APPLICATION:**

These components are required for Casing rings, Neck bushes, Inter stage bushings, Balancing bushings, etc. of Boiler feed pumps, Booster Pumps and Condensate extraction pumps for Super critical power plants.

4.0.0 **CONDITION OF DELIVERY:**

4.1.0 The components shall be manufactured from forgings.

4.2.0 The forged components shall meet the chemical and mechanical requirements indicated at cl.no.6.0.0 & 7.0.0.

4.3.0 All the components shall be supplied in machined condition with 6.3 micron surface finish, as per the dimensions and tolerances indicated in the variant table.

4.4.0 All machined components shall be supplied in 'Whole Hardened' condition indicated at cl.no.5.3.0.

4.5.0 Weld repair of the forgings shall not be accepted.

5.0.0 **HEAT TREATMENT**:

The recommended heat treatment for the forged rings is as follows.

5.1.0 Annealing: All the forged rings along with the test pieces shall be annealed by heating to 800°C - 900°C followed by slow cooling or air cooling.

5.2.0 The test pieces shall be quenched & tempered as follows :

Quenching: Heating to 920°C - 980°C followed by oil quenching.

Tempering: Heating to 600°C - 750°C followed by rapid cooling.

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5.3.0 **WHOLE HARDENING**:

The machined components along with test sample shall be heat treated to achieve a hardness of HRC 40-45 (371-421BHN) throughout the component. The required heat treatment procedure and cycle shall be decided by the manufacturer.

The recommended whole hardening heat treatment for the machined rings is given below for guidance.

Hardening: Heating to 830°C±5°C soaking for 120 minutes, further heating to 950°C±5°C soaking for 90 minutes, followed by air cooling.

1st stage tempering: Heating to 180°C±5°C soaking for 150 minutes, followed by air cooling.

2nd stage tempering: Heating to 560°C±5°C soaking for 150 minutes, followed by air cooling.

6.0.0 **CHEMICAL COMPOSITION:**

Element		C	Si	Mn	Cr	Ni	P	S
Melt analysis	Min.	0.26	--	--	12.0	--	--	--
	Max.	0.40	1.00	1.00	14.0	0.6	0.04	0.03

7.0.0 **MECHANICAL PROPERTIES**:

7.1.0 The test samples after heat treatment cycle mentioned at clause no. 5.2.0 shall confirm to the following mechanical properties.

Tensile strength N/mm²	Proof stress N/mm²	% Elongation L=5d	Reduction of area	Charpy Impact J/cm² 2mm-U Notch	Hardness BHN Min.
740 Min.	540 Min.	12 Min.	40 Min.	29 Min.	217

7.2.0 All the machined components shall be tested for hardness after 'whole hardening' heat treatment cycle mentioned at cl.no.5.3.0. The hardness throughout the component shall be HRC 40-45 (371-421BHN) and test certificate shall be furnished.

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8.0.0 **TEST SAMPLES:**

8.1.0 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.5.1.0 & 5.2.0. The tensile test shall be carried out in accordance with IS-1608 or any reputed national/international standard.

8.2.0 Chemical analysis as per cl.no.6.0.0 and Mechanical test as per cl.no.7.1.0 shall be conducted on one sample.

8.3.0 Second sample shall be taken for 'whole hardening' along with the machined rings of each melt. Hardness test shall be conducted on the second sample and shall be preserved at supplier works for future use.

9.0.0 **NON DESTRUCTIVE TESTS:**

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

9.2.0 Ultrasonic Test:

100% area of the component shall be tested ultrasonically as per BHEL standard AA0850118 and the acceptance norm shall be category-2 of above standard.

9.3.0 Dye penetrant Test:

Dye penetrant Test shall be done on 100% area of the component as per BHEL standard AA0850131 and the acceptance norm shall be AA0850130.

10.0.0 **INSPECTION AT SUPPLIER'S WORKS:**

10.1.0 All the components 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.

10.2.0 Supplier shall prepare their internal manufacturing quality plan which shall include the activities mentioned at cl.no.11.3.0 and shall offer the same for review by the inspector.

10.3.0 Scope of inspection at supplier's works shall include the following:

a) Identification and stamping of test samples for each melt.
b) Review of chemical analysis report.
c) Witness of Mechanical tests on the test samples.
d) Witness of Hardness test on all the components.

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e) Dimensional inspection of all the components.
f) Review of heat treatment charts.

11.0.0 **TEST CERTIFICATES:**

11.1.0 Supplier shall furnish 2 copies of test certificates of Chemical analysis, Hardness test on the machined components, Mechanical properties on heat treated test samples as per cl.no.5.1.0 & 5.2.0, NDT reports, HT charts and dimensional reports.

11.2.0 Following information shall be included in all the test certificates.

1. BHEL Drawing no, Specification No: FP50671
2. BHEL Order No. & Item no.
3. BHEL Material code & Item description
4. Supplier's name
5. Melt No. or Heat No.
6. Forging Sl.no. per melt

12.0.0 **MARKING AND PACKING:**

12.1.0 Following details shall be printed with non-erasable ink or engraved on each of the machined component.

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

12.2.0 Each machined component shall be wrapped with polythene paper and packed individually in a hard board box. Following details shall be marked on each box cases. All such boxes shall be packed in a suitable packing case, which shall be marked with the BHEL PO no., Item nos. & Quantities.

a. BHEL Purchase order no. & Item No.
b. 12 digit Material code, Specn No. & Drawing no.
c. Name of the Supplier.

13.0.0 **REJECTION AND REPLACEMENT:**

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

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14.0.0 VARIANT TABLE:

All dimensions are in mm; Tolerances: OD (+) 1.0; ID (-) 1.0; L (+) 2.0

VAR. NO.	SIZE OD/ID x L	PUMP TYPE	APPLICATION	WT. Kg.	FINAL M/C DRG.	MATL CODE
1	340/262 x 40	MDG455	Casing ring 1st stage, Coup side	11.6	21804215014	FP9750671015
2	340/268 x 40	MDG455	Casing ring 1st stage, End side	10.8	21804215015	FP9750671023
3	340/272 x 42	MDG455	Casing ring 2nd&3rd stage & Casing ring 4th&5th stage	10.8	21804215016 21804215017	FP9750671031
4	350/212 x 146	MDG455	Inter stage bushing center (split)	69.8	21804215018	FP9750671040
5	350/212 x 41	MDG455	Inter stage bushing 2nd & 4th stages (split)	19.6	21804215019 21814215020	FP9750671058
6	350/212 x 46	MDG455 MDG455-NSS	Balancing bushing coup side (split)	21.9	21804215021 21804215048	FP9750671066
7	280/218 x148	MDG455	Balancing bushing end side	28.2	21804415070	FP9750671074
8	303/189 x 51	MDG405	Casing ring 1st stage, Coup. & End sides	17.7	21804215022 21804215023	FP9750671082
9	303/239 x 38	MDG405	Casing ring 2nd&3rd stage & Casing ring 4th&5th stage	8.1	21804215024 21804215025	FP9750671090
10	236/152 x 46	MDG405	Neck bush Coup & End sides	9.2	21804314666 21804415071	FP9750671104
11	316/204 x 135	MDG405	Inter stage bushing center (split)	48.5	21804215026	FP9750671112
12	310/204 x 32	MDG405	Inter stage bushing 2nd & 4th stages (split)	10.8	21804215027 21804215028	FP9750671120
13	310/204 x 38	MDG405	Balancing bushing coup side (split)	12.8	21804215029	FP9750671139
14	264/210 x 132	MDG405	Balancing bushing end side	20.8	21804415072	FP9750671147
15	254/192 x 34	MDG346	Casing ring 1st stage coup side	5.8	21804215038	FP9750671155
16	254/197 x 34	MDG346	Casing ring 1st stage end side	5.4	21804215039	FP9750671163
17	254/202 x 36	MDG346	Casing ring 2nd & 3rd coup side Casing ring 4th, 5th & 6th end side	5.3	21804215040	FP9750671171
18	182/122 x 46	MDG346	Neck Bush coup & end sides	5.2	21804215041 21804314668 21804415075	FP9750671180
19	264/176 x 131	MDG346	Inter stage bushing center (split)	31.3	21804215042	FP9750671198
20	264/176 x 31	MDG346	Inter stage bushing 2nd, 4th & 5th stages (split)	7.4	21804215043 21804215044	FP9750671201

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VAR. NO.	SIZE OD/ID x L	PUMP TYPE	APPLICATION	WT. Kg.	FINAL M/C DRG.	MATL CODE
21	264/176 x 36	MDG346	Balancing bushing coup side (split)	8.6	21804215045	FP9750671210
22	254/171 x 141	MDG346	Balancing bush end side	30.6	21804415076	FP9750671228
23	430/378 x 52	MLC450	Casing ring coup sides TD & MD	13.5	21891114981 21891114983	FP9750671236
24	430/386 x 52	MLC450	Casing ring end sides TD & MD	11.5	21891114982 21891114984	FP9750671244
25	379/242 x 58	MLC400	Casing ring, Coup.& End sides, TD & MD	30.4	21891114977 21891114978 21891114979 21891114980	FP9750671252
26	362/291 x 48	144RND-660 144RND-800	Casing ring 1st stage	13.7	21812814943	FP9750671260
27	374/302 x 50	144RND-660 144RND-800	Casing ring 2nd & over	15.0	21812913004	FP9750671279
28	346/275 x 48	144RND-PV	Casing ring, 1st stage, 660&800	13.0	21812814944	FP9750671287
29	340/262 x 44	MDG455-NSS	Casing ring 1st stage, Coup side	12.7	21804215046	FP9750671295
30	340/268 x 44	MDG455-NSS	Casing ring 1st stage, End side	11.9	21804215047	FP9750671309
31	241/166 x 46	MDG455-NSS	Neck bush suction cover & casing cover	8.6	21804314665 21804415069	FP9750671317
32	287/212 x 37	MDG366	Casing Ring,1st stage Coupling side	8.5	21804215030	FP9750671325
33	287/217 x 37	MDG366	Casing Ring,1st stage End side	8.0	21804215031	FP9750671333
34	287/232x36	MDG366	Casing ring 2nd&3rd stage & Casing ring 4th 5th & 6th stage	6.3	21804215032 21804215033	FP9750671341
35	222/133x43	MDG366	Neck bush Coup. side & End side	8.4	21804314667 21804415073	FP9750671350
36	294/182x134	MDG366	Inter stage bushing center (split)	44.1	21804215034	FP9750671368
37	294/182x32	MDG366	Inter stage bushing 2nd , 4th & 5th stages (split)	10.5	21804215035 21804215036	FP9750671376
38	294/182x39	MDG366	Balancing Bushing Coup. Side (split)	12.8	21804215037	FP9750671384
39	254/170 x 133	MDG366	Balancing bushing (End side)	29.2	21804415074	FP9750671392
40	406/352x52	MLC450-NSS	Casing ring, Coup. Side, TD	13.1	21891114985	FP9750671406

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VAR. NO.	SIZE OD/ID x L	PUMP TYPE	APPLICATION	WT. Kg.	FINAL M/C DRG.	MATL CODE
41	406/360x52	MLC450-NSS	Casing ring, End side, TD	11.3	21891114986	FP9750671414
42	324/246x45	MDG436	Casing Ring, Coup Side Casing Ring, End side Casing Ring 2nd & 3rd Stage Casing Ring 4th, 5th ,6th Stage	12.3	21804215061 21804215062 21804215063 21804215064	FP9750671422
43	330/195x140	MDG436	Inter Stage Bushing Centre (split)	61.2	21804215065	FP9750671430
44	330/195x45	MDG436	Inter Stage Bushing 2nd (split) Inter Stage Bushing 4th,5th (split) Balancing Bush Coup Side(split)	19.7	21804215066 21804215067 21804215068	FP9750671449
45	280/190x150	MDG436	Balancing Bush End Side	39.2	21804415077	FP9750671457

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RECORD OF REVISIONS

Rev. No.	Date	Revision Details	Revised By	Approved By
01	11.05.16	OD dimensions corrected for split type wearing rings.	JNM	MSR
02	29.09.16	Technical requirements got corrupted in Rev-01. All the technical requirements are restored to Rev-00. Dimensions in Variant table are same as Rev-01.	MSRAM	KHRK
03	21.11.16	Dimns&wts. of var.nos. 04,05,06,11, 12,13,19,20,21,36,37,38 revised and are now same as Rev-01. These were indicated wrongly in Rev-02.	MSRAM	KHRK
04	08.09.2017	VARIANTS 42,43,44 & 45 ADDED	PRANAV	MSR
05	02.02.2018	DIM. L CORRECTED IN VAR 45	PRANAV	MSR
06	08.03.2019	Size, weight and application corrected for var.no.42,43,44&45.	MSRAM	KHRK