

TD-106-1 Rev No. 5		Form No.	बी एच ई एल BHEL HYDERABAD		PRODUCT STANDARD PUMPS HYDERABAD		FP50692 Rev No. 00 Page 1 of 6	
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.			DUPLEX STAINLESS STEEL CASTINGS FOR CW PUMPS					
			1.0 GENERAL					
			This standard specifies the quality requirements of duplex stainless steel castings for impeller, impeller cone, suction liner, gland & stuffing box for CW pumps.					
			2.0 CONDITION OF DELIVERY					
			2.1 Castings shall be supplied in either finish machined condition to dimensions given in drawings or rough machined condition to dimensions given in drawings or rough machined condition providing required allowance for finish machining as indicated in drawings. 2.2 Castings shall be hardened and tempered before rough machining. 2.3 Castings shall be stress relieved after rough machining. 2.4 Casings shall be finish machined after stress relieving, in case of supply of finish machined castings.					
			3.0 COMPLIANCE WITH NATIONAL STANDARDS					
			This specification complies in general with the requirements of ASTM A890					
			4.0 DIMENSIONS, TOLERANCES & HEAT TREATMENT					
			4.1 DIMENSIONS: The castings shall be supplied with dimensions indicated in drawings, considering condition of supply stipulated in those drawings. The dimensional inspection is as per the BHEL standard mentioned in the variant table.					
			4.2 TOLERANCES: Tolerances for all machined dimensions shall be ± 0.50 mm unless stated otherwise.					
			4.3 MANUFACTURE:					
			The steel shall be made by electric furnace process with or without separate refining such as Argon Oxygen Decarburization (AOD). Any other process of steel making shall be referred to BHEL for approval. The steel castings shall be made from fully killed steel.					
Ref. Doc	Revisions :		Prepared :		Approved :		Date :	
	Refer to record of revisions :		SUDHEER		M.S.RAM		18.12.18	



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		4.3 <u>HEAT TREATMENT:</u> For ASTM A890 Gr. 4A: Heat to 1120 deg. C minimum for sufficient time to heat casting uniformly to temperature and water quench, or the casting may be furnace cooled to 1010 deg. C minimum, hold for 15 min minimum and then water quench. A rapid cool by other means may be employed in lieu of water quench. <u>Note:</u> Proper heat treatment of these alloys is usually necessary to enhance corrosion resistance and in some cases to meet mechanical properties. Minimum heat-treat temperatures are specified; however, it is sometimes necessary to heat-treat at higher temperatures, hold for some minimum time at temperature and then rapidly cool the castings in order to enhance the corrosion resistance and meet mechanical properties.																																			
		5.0 <u>CHEMICAL COMPOSITION:</u> The analysis of the steel shall conform to the following requirements. <u>ASTM A890 Gr.4A</u> <table border="1"> <thead> <tr> <th colspan="2">Element</th> <th>C</th> <th>Si</th> <th>Mn</th> <th>Cr</th> <th>Ni</th> <th>Mo</th> <th>S</th> <th>P</th> <th>Cu</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Ladle Analysis</td> <td>Min</td> <td>-</td> <td>-</td> <td>-</td> <td>21.00</td> <td>0.10</td> <td>2.50</td> <td>-</td> <td>-</td> <td></td> </tr> <tr> <td>Max.</td> <td>0.03</td> <td>1.00</td> <td>1.50</td> <td>23.50</td> <td>0.30</td> <td>3.50</td> <td>0.02</td> <td>0.04</td> <td>1.00</td> </tr> </tbody> </table>				Element		C	Si	Mn	Cr	Ni	Mo	S	P	Cu	Ladle Analysis	Min	-	-	-	21.00	0.10	2.50	-	-		Max.	0.03	1.00	1.50	23.50	0.30	3.50	0.02	0.04	1.00
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6.0 <u>MECHANICAL PROPERTIES:</u> The mechanical properties tested shall be as follows: <u>ASTM A890 Gr.4A</u> <table border="1"> <thead> <tr> <th>Tensile Strength N/mm2 min</th> <th>Yield Strength (0.2% offset) N/mm2 min</th> <th>Elongation in 50 mm Min. %</th> </tr> </thead> <tbody> <tr> <td>620</td> <td>415</td> <td>25.0</td> </tr> </tbody> </table>				Tensile Strength N/mm2 min	Yield Strength (0.2% offset) N/mm2 min	Elongation in 50 mm Min. %	620	415	25.0																												
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6.1 <u>Test specimen:</u> Tensile test may be conducted as per any reputed international standard, on a separately cast test specimen for each heat/melt and heat treatment batch. The size of test specimen shall be selected appropriate to the casting thickness and to carry out repeat tests if required. Heat no./melt no. of the casting shall be stamped on the test coupons. The test specimen shall be heat treated together with the castings for all subsequent heat treatments of the casting.																																					
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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.			6.2 RETEST: In case of failure due to mechanical causes like machining etc. the supplier shall test another specimen from the same casting/lot. If the results of the mechanical tests for any heat of castings do not conform to the requirements specified in this specification, the castings may be reheat treated and tested at the manufacturer's option. Testing after reheat treatment shall consist of the full number of specimens taken from locations as specified in the specification / order. 7.0 TESTS: The following tests shall be performed on all the castings. 7.1 LIQUID PENETRANT TEST: Liquid penetrant test shall be done on all the surfaces including the repair welding area. Test procedure is as per ASME Sec.V Article 6 & 24. Acceptance criteria is as per ASME Sec.VIII Div. 1 Appendix 7 and following additional criteria: i. Size of indication for linear defect shall not exceed 2mm. Extract of ASME Sec.VIII Div. 1 Appendix 7 is as follows: 1. Surface indications determined by liquid penetrant examination are unacceptable if they exceed the following limits: a. All cracks and hot tears. b. Any group of more than six linear indications other than those in (a) above in any rectangular area of 38mmx150mm or less or any circular area having a diameter of 88mm or less, these areas being taken in the most unfavorable location relative to the indications being evaluated. c. Other linear indications more than 6mm long for thickness up to 19mm inclusive, more than one-third of the thickness in length for the thickness from 19mm to 57mm, and more than 19mm long for thickness over 57mm (aligned acceptable imperfections separated from one another by a distance equal to the length of the longer imperfection are acceptable. d. All indications on nonlinear imperfections which have any dimension exceeding 5mm. 7.2 RADIOGRAPHY TEST: Test procedure is as per ASME Sec.V Article 2 & 22. Acceptance criteria is as per ASME Sec.VIII Div. 1 Appendix 7 and following criteria:	
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The maximum acceptable severity levels for imperfections shall be as follows: <table border="1"> <thead> <tr> <th rowspan="2">Imperfection category</th> <th colspan="3">Maximum Severity level</th> </tr> <tr> <th>Thickness < 1 in.</th> <th>Thickness 1in. to < 2 in.</th> <th>Thickness 2in. to < 4.5 in.</th> </tr> </thead> <tbody> <tr> <td>A- Gas porosity</td> <td>1</td> <td>2</td> <td>2</td> </tr> <tr> <td>B- Sand and slag</td> <td>2</td> <td>3</td> <td>2</td> </tr> <tr> <td>C- Shrinkage (four types)</td> <td>1</td> <td>3</td> <td>-</td> </tr> <tr> <td>Type 1</td> <td>-</td> <td>-</td> <td>1</td> </tr> <tr> <td>Type 2</td> <td>-</td> <td>-</td> <td>2</td> </tr> <tr> <td>Type 3</td> <td>-</td> <td>-</td> <td>3</td> </tr> <tr> <td>D- Cracks</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>E- Hot tears</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>F- Inserts</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>G- Mottling</td> <td>0</td> <td>0</td> <td>-</td> </tr> </tbody> </table> 7.3 MICRO STRUCTURE: Micro structure inspection shall be carried out for Impeller castings on boss. Abnormal content shall not be observed by micro structure inspection. 7.4 FERRITE INSPECTION: Test Piece and actual casting shall be checked with ferrite meter, and report shall be submitted. 7.5 CORROSION RESISTANCE TEST: Corrosion resistance test shall be conducted as per method ASTM G48 Type A. These test specimen shall be prepared for each charge of foundry. 8.0 REPAIR WELDING: Major defects found during liquid penetrant test shall be repaired by approved welding procedure. Repair welding shall be done by qualified welder authorized by official organization. Necessary information of welder shall be included in the welding procedure. Following points shall be observed strictly, when weld repair is carried out. - Defect shall be removed completely and well-grooved. - Groove shall be LPI tested and no defect shall be found. - Defect record shall be made and submitted. - Strain due to welding shall be avoided. - In case of repair welding of major defect, the base metal of the casting shall be pre-heated before welding and stress relieved after welding.					Imperfection category	Maximum Severity level			Thickness < 1 in.	Thickness 1in. to < 2 in.	Thickness 2in. to < 4.5 in.	A- Gas porosity	1	2	2	B- Sand and slag	2	3	2	C- Shrinkage (four types)	1	3	-	Type 1	-	-	1	Type 2	-	-	2	Type 3	-	-	3	D- Cracks	0	0	0	E- Hot tears	0	0	0	F- Inserts	0	0	0	G- Mottling	0	0	-
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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.		f. Major defect = Depth of any cavity being prepared for repair welding exceeds 20% of the wall thickness or 25mm, whichever is smaller (or) any cavity being prepared for welding is greater than 65 sq.cm. g. Minor defect = Any defect smaller than major defect h. Basically flat position welding shall be done after welding. i. Welding rod to be used for repair welding after rough machining shall be equivalent material to the base metal. j. Repair of minor defects shall be applied stress relieving. k. For major repair, solution heat treatment shall be done again. l. After any repair welding, liquid penetrant examination shall be carried out. 9.0 <u>INSPECTION AND QUALITY PLAN:</u> 9.1 Supplier shall submit their manufacturing quality plan for BHEL approval. 9.2 Castings shall be supplied with inspection and certification by BHEL or BHEL nominated Third Party Inspection Agency (TPIA). 10.0 <u>TEST CERTIFICATES:</u> The supplier shall furnish 2 copies of following test certificates (in English) duly certified by the inspection agency. The test certificates shall consists of the information like BHEL order No, material spec, Var.no. Supplier's name, description of item etc. a) Dimension report b) Chemical analysis c) Mechanical properties d) Heat treatment charts for Hardening, tempering and stress relieving e) LPI report. f) RT test record g) Micro structure photograph h) Ferrite inspection record i) Corrosion resistance test record j) Repair welding procedure and record k) Other Inspection/test record indicated in the manufacturing drawing 11.0 <u>MARKING:</u> The following details shall be punched/etched on each casting at specified location. Matl code : Melt No: / Heat No : Name of supplier :		
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12.0 PRESERVATION & PACKING: The castings shall be properly protected from damage and corrosion during transport. 13.0 VARIANT TABLE: <table><tr><td>V a r . N o .</td><td>Drawing No.</td><td>Project</td><td>Item</td><td>Type Duplex material</td><td>of SS</td><td>Dimensio nal Inspectio n Procedure</td><td>Material Code</td></tr><tr><td>0 1</td><td>11823617129</td><td>Udangudi 2x660M W Stg- I</td><td>CV- CWP Impeller</td><td>ASTM A890 Gr.4A</td><td></td><td>FP13580</td><td>FP9713211014</td></tr></table>								V a r . N o .	Drawing No.	Project	Item	Type Duplex material	of SS	Dimensio nal Inspectio n Procedure	Material Code	0 1	11823617129	Udangudi 2x660M W Stg- I	CV- CWP Impeller	ASTM A890 Gr.4A		FP13580	FP9713211014
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