

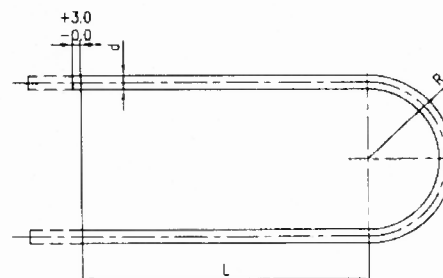
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

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DRG. NO. 3-175-01-01667

SL. NO.	RADIUS "R"	H.P. HEATER NO. 5A/5B			H.P. HEATER NO. 6A/6B		
		THK / BWG	QTY.	DEVELOPED LENGTH	THK / BWG	QTY.	DEVELOPED LENGTH
1	31.7	12 AVG.	48	18500	12 MIN.	48	22100
2	49.6	12 AVG.	52	18556	12 MIN.	52	22156
3	67.5	13 Min.	51	18612	12 AVG.	51	22212
4	85.4	13 Min.	50	18668	12 AVG.	50	22268
5	103.2	13 Min.	53	18724	13 Min.	53	22324
6	121.1	13 Min.	50	18780	13 Min.	50	22380
7	139.0	13 Min.	49	18837	13 Min.	49	22437
8	156.9	13 Min.	50	18893	13 Min.	50	22493
9	174.7	13 Min.	51	18949	13 Min.	51	22549
10	192.6	13 Min.	50	19005	13 Min.	50	22605
11	210.5	13 Min.	49	19061	13 Min.	49	22661
12	228.4	13 Min.	48	19118	13 Min.	48	22718
13	246.2	13 Min.	47	19173	13 Min.	47	22773
14	264.1	13 Min.	46	19230	13 Min.	46	22830
15	282.0	13 Min.	45	19286	13 Min.	45	22886
16	299.9	13 Min.	44	19342	13 Min.	44	22942
17	317.7	13 Min.	39	19398	13 Min.	39	22998
18	335.6	13 Min.	38	19454	13 Min.	38	23054
19	353.5	13 Min.	39	19511	13 Min.	39	23111
20	371.4	13 Min.	40	19567	13 Min.	40	23167
21	389.2	13 Min.	37	19623	13 Min.	37	23223
22	407.1	13 Min.	36	19679	13 Min.	36	23279
23	425.0	13 Min.	33	19735	13 Min.	33	23335
24	443.0	13 Min.	32	19792	13 Min.	32	23392
25	460.7	13 Min.	29	19847	13 Min.	29	23447
26	478.6	13 Min.	26	19904	13 Min.	26	23504
27	496.5	13 Min.	23	19960	13 Min.	23	23560
28	514.4	13 Min.	16	20016	13 Min.	16	23616
29	532.2	13 Min.	10	20072	13 Min.	10	23672
TOTAL / HEATER			1181 U			1181 U	
TOTAL DEVELOPED LENGTH FOR TUBE BUNDLE (12 BWG MIN.)/HEATER						2212.88	
TOTAL DEVELOPED LENGTH FOR TUBE BUNDLE (12 BWG AVG.)/HEATER				1852.88		2246.23	
TOTAL DEVELOPED LENGTH FOR TUBE BUNDLE (13 BWG MIN.)/HEATER				20786.17		22431.54	
ESTIMATED WEIGHT OF TOTAL NUMBER OF TUBES PER HEATER IN Kgs./HEATER			20029			24010	



H.P. HEATER-5A/5B	H.P. HEATER-6A/6B
L = 9200	L = 11000
d = 5/8 INCH	d = 5/8 INCH
MATERIAL CODE HE9718587292	MATERIAL CODE HE9718567306

NOTES:-

1. MATERIAL SA 688 TP 304 WITH CARBON MAX. 0.05% AS PER ASME SEC - II PART - A, YEAR OF EDITION AND ADDENDA AS PER P.O./INDENT.
2. TECHNICAL REQUIREMENTS AS PER PRODUCT STANDARD
HE 5 1103 REV. (LATEST AS PER P.O./INDENT) AND AS PER MATL. SPECIFICATION.
3. QUALITY REQUIREMENTS INSPECTION & CERTIFICATION AS PER QUALITY PLAN :- HY/HE/004/U-TUBES REV. (LATEST AS PER P.O./INDENT)
4. INSPECTION :- M/S LLOYD'S & CIR. (NO CIR IF IMPORTED)
5. HYDRO TEST PRESSURE ON EACH TUBE = 495 Kg/sq.cm (g)
6. a) MINIMUM WALL THICKNESS = $+20\%$
 -0%
b) Avg. WALL THICK. = $\pm 10\%$
c) 12 BWG = 2.77 mm.(0.109")
d) 13 BWG = 2.42 mm.(0.095")
7. a) MAXIMUM WORKING PRESSURE (DESIGN PRESSURE) : 330 Kg/sq.cm (g)
b) MAXIMUM WORKING TEMP. (DESIGN TEMP.) : 273°C
c) OPERATING MEDIUM : SHELL SIDE - STEAM & DRAIN
TUBE SIDE - FEED WATER.

TYPE OF PRODUCT OR
NAME OF CUSTOMER/PROJECT

525 MW.



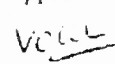




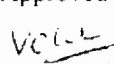
BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD


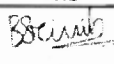

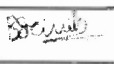



DRN.	NAME	SIGN.	DATE	NO. OF
01	KIRAN	kiran	08.03.08	VAR.
02	B.SRINIVAS		08.03.08	NA

DEPT.	GRADE OF TOLDIM	SCALE	WEIGHT (KG)	REF. TO ASSY DRG.	ITEM NO.	NO. OF ITEMS
HEE	C/V/F	NTS	NA	NA	NA	NA
CODE	405					
TITLE			DRAWING NO.		REV.	
U - TUBE FOR			3-175-01-01667		03	
H.P. HEATER 5A/5B & 6A/6B			SHEET No. 1		NO OF SHEETS	

REV.	DATE	ALTERED	CHECKED	APPD	REV.	DATE	ALTERED	CHECKED	APPD
01	13.09.11		KRTI	SAHOO	02	08.06.15	AKS	kiran	
DRG. REVISED AS SHOWN AS					DRG. REVISED AS SHOWN AS				

ID-106-1 Rev-5 Form No.		PRODUCT STANDARD HEAT EXCHANGERS HYDERABAD		HE 5 1103	
				REV. NO. 18	
				PAGE 1 OF 3	
<p align="center"> <u>SPECIFICATION FOR SS WELDED TUBES FOR HP HEATERS, LP HEATERS</u> <u>AND DRAIN COOLERS</u> </p> <ol style="list-style-type: none"> Bend/straight tubes shall conform to SA 688 TP 304/304L with maximum carbon limited to 0.05% in case of 304 and 0.035% incase of 304L. (The material specification shall be as per drawing/PO and ASME Sec II Part A edition and addenda as indicated in the drawing/P.O.) Eddy current test shall be done as per supplementary requirement 'S1' of specification SA 688. Heat treatment of straight tube and bent portion shall be carried out as per SA688. Straight tubes/straight tubes of U-Tubes before U-bending shall be bright annealed (both inside and out surfaces). U bend shall be purged with inert gas during Heat Treatment of U-bent portion. Flaring test on each lot atleast two tests from each lot are to be conducted as per SA 450. Longitudinal welds of tubes shall be ultrasonic tested. For tubes supplied in bent conditions, tube thinning shall be governed by the following formula. $t = t_o (1 + d/4R)$ where t = specified minimum tube wall thickness. t_o = Thickness after bending d = Outside diameter of tube R = Center line bend radius Minimum thickness, ovality etc., achieved for minimum bend radius tube for each thickness shall be proved. Hot bending to form U tubes shall not be acceptable. Bending, heat treatment and hydrotest shall be as per Quality Plan latest revision and relevant drawing. Each tube shall be hydrotested to test pressure mentioned in the drawing/P.O. Corrosion test shall be carried out as per requirement of SA 688 TP 304/304L Inspection and certification shall be as per ASME Sec. II Part A edition & Addenda as indicated in the drawing / P.O. & enclosed quality plan. Incase of Lloyds inspection ,where the material is sourced from suppliers other than India ,the certification shall be in IBR form III C duly signed by Lloyds Register. 					
Ref.Doc.	Revisions:	Prepared:	Approved	Date:	
	Refer to record of revisions			24.09.2004	

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<p>11. Packing shall be seaworthy and capable for withstanding mechanical damage. Tube ends shall be capped or plugged for protection against ingress of moisture / water during transit and storage.</p> <p>12. -----</p> <p>13. Tubes inside & outside surfaces shall be tested for residual chloride salt contamination to limit as per of SA 688. The same shall be reported in T.Cs. Procedure of measuring residual chloride contamination shall be furnished.</p> <p>14. Cleanliness of inside surface of all U-tube shall be confirmed by blowing close fitting acetone soaked felt plugs. Inert gas or N2 / dry oil free compressor air shall be used for blowing.</p> <p>15. Inspection agency: Third party inspection agency. Additionally D.O.B. in case of H.P.Heaters (For Indegenious suppliers only).</p> <p style="padding-left: 40px;">a) The extent/ quantum of witness by Third party inspection agency shall be indicated as follows . However Vendor to carry out the tests on 100% of tubes.</p> <p style="padding-left: 80px;">i) Eddy current testing: 10% online and 100% for offline</p> <p style="padding-left: 80px;">ii) Ultrasonic testing (UST): 10%</p> <p style="padding-left: 80px;">iii) Hydro testing: 100%</p> <p>16. Product markings shall be as per SA 688.</p> <p>17. ----</p> <p>18. Packing and marking standard ref. no. for:</p> <p style="padding-left: 40px;">(a) Straight tubes - AA0490002</p> <p style="padding-left: 40px;">(b) U – tubes - AA0490003.</p> <p>19. In case of indigenous vendors the raw strip used for manufacturing tubes shall be procured from BHEL approved vendors.</p> <p>20. The residual circumferential stresses after tube straightening and U-bending shall be kept as low as possible .In any case these shall be limited to 4kg/mm² (compressive or tensile). One specimen shall be tested per lot. The procedure for residual stress measurement shall be approved by BHEL.</p>					
Ref Doc.	Revisions: Refer to record of revisions	Prepared: 	Approved 	Date: 24.09.2004	

TD-106-3 Rev-5 Form No.		PRODUCT STANDARD HEAT EXCHANGERS HYDERABAD		No. HE 51103	
				REV NO 18	
				PAGE 3 OF 3	
RECORD OF REVISIONS					
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	09	02-07-93	STANDARD REWRITTEN AS PER NEW FORMAT	B.U.G	D.S
	10	23-06-93	QUALITY PLAN Nos. IN CLAUSE No. 7 AND 11 ARE REVISED	M.R.RAO	V.C.K
	11	10-06-96	TITLE & CL. No. 10 & 14 REVISED CL. No. 15 & 16 ADDED	M.R.RAO	V.C.K
	12	26-06-98	CLAUSE No. 17 ADDED	B.U.G.	V.S
	13	22-01-03	STANDARD REVISED INLINE WITH SQP AND PRQC MEETING DT:28-12-02	B.S	V.S
	14	06-05-04	REVISED INLINE WITH MOM DT:30-03-04	B.S	V.C.K
	15	24-09-04	REVISED INLINE WITH MOM DT:24-09-04	B.S	V.C.K
	16	12-01-07	CL. no. 10 Revised.		
	17	04-09-07	CL. N0s. 1, 11 and 12 are revised. CL. NO 19 ADDED.		
	18	10-11-08	CL. NO 20 ADDED.		
Ref.Doc.					

SL NO		COMPONENTS		CHARACTERISTICS		CLASS		TYPE OF CHECK		QUANTUM OF CHECK		REFERENCE DOCUMENT		ACCEPTANCE NORMS		FORMAT OF RECORD		QP No. : HY/HE/004/ U-TUBE Rev. : 05 Date : 05.01.2010									
																		BHEL HYDERABAD-32 ITEM: WELDED SS 'U' TUBES FOR HP HEATERS & LP HEATERS BHEL Spec. No. : HE 51103 Rev. 18				BHEL Drg. No. : As per P.O.		Page 1 of 3			
																		STANDARD QUALITY PLAN									
																		AGENCY S M C				REMARKS					
1.0		RAW MATERIAL INSPECTION																									
1.1		Coil		a) Identification of coil markings w.r.t. TC		Major		Visual		100%		Test Certificate		HE 51103 Rev.18		TC & Inspn. Record				P		V		V		Note 1	
				b) Visual & Dimn. Exam		Major		Visual & Measurt.		100%		Test Certificate		HE 51103 Rev.18		TC & Inspn. Record				P		V		V			
1.2		Verification of Coil Test Certificate		a) Chemical comp.		Major		Visual & Measurt.		100%		Test Certificate		HE 51103 Rev.18		TC & Inspn. Record		✓				P		V		C: 0.05% max for TP 304.	
				b) Mech. Properties		Major		Visual & Measurt.		100%		Test Certificate		HE 51103 Rev.18		TC & Inspn. Record		✓				P		V		C: 0.035% max for TP 304L.	
2.0		IN PROCESS INSPECTION																									
2.1		Tube Forming & Welding		Welding parameters		Major		Visual		Periodic checking		Mfr. Std.		Mfr. Std.		Inspn. Record						P					
2.2		ID Bead Rolling		ID Bead Height		Major		Measurt.		Random		Mfr. Std.		Mfr. Std.		-do-		✓				P		V			
2.3		OD Bead Grinding		Surface Condition		Major		Visual		100%		Mfr. Std.		Mfr. Std.		-do-						P					
2.4		Intermediate / final drawing		Solution annealing after drawing operation		Major		Heat treatment		100%		Mfr. Std.		Mfr. Std.		-do-						P				Note 2	
2.5		Tube washing		Surface condition		Major		Visual		100%		Mfr. Std.		Mfr. Std.		-do-						P					
2.6		Bright Annealing		Solution Annealing in inert atmosphere		Major		Heat treatment		100%		Mfr. Std. & SA688		Mfr. Std. & SA688		HT Chart		✓				P		V		Note 3	
2.7		Final sizing		OD & surface condition		Major		Measurt.		100%		HE 51103 Rev.17		HE 51103 Rev.18		Inspn. Record						P					
2.8		Straightening		Straightness		Major		Visual		100%		HE 51103 Rev.17		HE 51103 Rev.18		Inspn. Record						P					
2.9		Eddy Current test		Internal flaws		Major		NDE		100%		ASTM E426 & SA688 S1		ASME SA450		Supplier TC		✓				P		W *		* 10% for online & 100% for offline	
2.10		Ultrasonic test		Internal flaws		Major		NDE		100%		ASTM E213		ASME SA450		Supplier TC		✓				P		W #		#10%	

Legend: *D- Documents marked (✓) to be included by Supplier in Documentation Package. S - Sub Vendor P - Perform C of C : Certificate of Compliance M - Vendor / Manufacturer W - Witness Mfr. : Manufacturer C - BHEL/ Inspection Agency V - Verify Measurt.: Measurement												PREPARED BY:  Y C Venkateswara Rao DGM / QA		APPROVED BY: K.S.Rao SrDGM/QA	
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SL NO		COMPONENTS		CHARACTERISTICS		CLASS		TYPE OF CHECK		QUANTUM OF CHECK		REFERENCE DOCUMENT		ACCEPTANCE NORMS		FORMAT OF RECORD		* D		AGENCY			REMARKS		
																				S				M	C
		BHEL HYDERABAD-32		STANDARD QUALITY PLAN								QP No. : HY/HE/004/ U-TUBE		Rev. : 05		Date : 05.01.2010					Page 2 of 3				
				ITEM: WELDED SS 'U' TUBES FOR HP HEATERS & LP HEATERS								BHEL Spec. No. : HE 51103 Rev. 18		BHEL Drg. No. : As per P.O.											

Legend: *D- Documents marked (✓) to be included by Supplier in Documentation Package.
S - Sub Vendor **P** - Perform **C of C** : Certificate of Compliance
M - Vendor / Manufacturer **W** - Witness **Mfr.** : Manufacturer
C - BHEL/ Inspection Agency **V** - Verify **Measurt.**: Measurement

PREPARED BY:

Y C Venkateswara Rao
Y C Venkateswara Rao
DGM / QA

APPROVED BY:

K.S.Rao
SrDGM/QA

Pre-Qualifications Criteria for S.S. Welded 'U' TUBES

Sl.No.	BHEL Requirement	Vendor's Confirmation	Deviations if any
1	The vendor shall be in the Business of manufacture of S.S. Welded 'U' tubes for Feed Water Heaters used in Thermal / Nuclear Power Plants.		
2	Copies of previous Purchase orders executed (minimum Five) and spread over five years for similar tubes shall be enclosed.		
3	Vendor should have minimum capacity of executing around 50,000 'U' tubes per annum.		
4	S.S. Strips used for manufacture of tubes shall be preferably from following vendors.		
	1) Outokumpo 2) Ugine 3) Krupp Thyssen 4) Acerinox 5) SAIL (Salam SS) 6) Jindal		
5	Inspection shall be vide M/s. Lloyds / BHEL / IBR authorised Inspection Agencies.		
6	The vendor shall have inspection requirements of, bright annealing, Eddy current test, UT, Inert Gas, 'U' bending, Hydro test etc.		
7	UT of all tubes irrespective of thickness with OD and ID notch. UT has to be tube done for mother pipe in addition to final tube as per SA1016 clause 25.6.3.		
8	Bead flushing and cold drawn tubes only are required.		
9	Maximum Residual stress shall be 3 kg/mm^2 . Procedure for measurement of residual stress shall be furnished to BHEL for approval.		
10	Roller straightening of tubes is not permitted. Stretch straining is required.		
11	Vendor should have in house Test facilities. Out sourcing is not permitted.		
12	NDT Level-III person shall be available in Vendors rolls.		
13	Bright Annealing 'on line' or 'off line' with sufficient soaking time and temperature – required. Furnace calibration is required for evaluation.		
14	Hydro test pressure shall be 1.5 times the design pressure as indicated in the enquiry.		

Sl.No.	BHEL Requirement	Vendor's Confirmation	Deviations if any
15	Latest Version of ASME code shall be used.		
16	Manufacturing process plan (MPP) shall be submitted along with offer for review.		
17	Corrosion test shall be as per para 13 of SA688 complying the supplementary requirement of S4 of SA688.		
18	Simulated PWHT on one sample tube shall be carried out for each lot as per the below cycle.		
	Rate of Heating 55°C / hr from 300°C.		
	Rate of cooling 55°C / hr upto 300°C		
	Soaking time - 20 Hrs with temperature 510 - 540°C.		
	After the above test the sample shall meet the corrosion test as per ASTM A 262 Practice.		