




		BHEL HYDERABAD-32		STANDARD QUALITY PLAN					QP No. : HY/HE/011/ U-TUBE					
				ITEM: WELDED SS 'U' TUBES FOR HP HEATERS & LP HEATERS					Rev. : 04					
				BHEL Spec. No. : HE 51396 Rev. 02					BHEL Drg. No. : As per P.O.					
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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		
1.0	RAW MATERIAL INSPECTION													
1.1	Coil	a) Identification of coil markings w.r.t. TC	Major	Visual	100%	Test Certificate	HE 51396 Rev. 02	TC & Inspn. Record		P	V	V	Note 1	
		b) Visual & Dimn. Exam	Major	Visual & Measurt.	100%	Test Certificate	HE 51396 Rev. 02	TC & Inspn. Record		P	V	V		
1.2	Verification of Coil Test Certificate	a) Chemical comp.	Major	Visual & Measurt.	100%	Test Certificate	HE 51396 Rev. 02	TC & Inspn. Record	✓		P	V	C: 0.05% max for TP 304.	
		b) Mech. Properties	Major	Visual & Measurt.	100%	Test Certificate	HE 51396 Rev. 02	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.	Inspn. Record			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 51396 Rev. 02	HE 51396 Rev. 02	Inspn. Record			P			
2.8	Straightening	Straightness	Major	Visual	100%	HE 51396 Rev. 02	HE 51396 Rev. 02	Inspn. Record			P			
2.9	Eddy Current test	Internal flaws	Major	NDE	100%	ASTM E426 & SA688 S1	ASME SA1016	Supplier TC	✓		P	W *	*10% for online or 100% for offline	

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2.10	Ultrasonic test (for thickness 14 BWG & heavier)	Internal flaws	Major	NDE	100%	ASTM E213	ASME SA1016	Supplier TC	✓		P	W #	# 10%
2.11	Cut to length with allowance	Length	Major	Measurt	100%	HE 51396 Rev.02 & PO	HE 51396 Rev.02 & PO	Inspn. Record			P		
2.12	Inspection of straight tubes	OD, Thickness, Length, Straightness, Edge burrs., surface condition	Major	Visual & Measurt.	100%	Mfr. Std.	Mfr. Std.	Inspn. Record			P	V	
2.13	U-bending of tubes	Centre line bend radius (CLR), Wall thinning	Major	Visual	100%	Mfr. Std.	Mfr. Std.	Inspn. Record			P	V	Note 4
2.14	Stress relieving of U- bend portion	Solution Annealing	Major	Visual	100%	SA688 TP304 / PO	SA688 TP304 / PO	Inspn. Record			P	V	Note 5
2.15	Residual circumferential stress	Stresses	Major	Measurt	One specimen per lot	HE 51396 Rev.02	Max. 4Kg/mm2	Inspn. Record				W	Procedure for residual stress measurement as approved by BHEL to be followed
3.0	FINAL INSPECTION												
3.1	Hydrostatic testing	Pressure, Time, Leakage	Major	Visual	100%	ASTM SA1016	ASTM SA1016	Supplier TC	✓		P	W	CHP Note 6
3.2	Cut to length & deburr	Length, edge condition	Major	Measurt	100%	HE 51396 Rev.02 & PO	HE 51396 Rev.02 & PO	Insp. Record			P		


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3.3	Dimn. conformity & visual exam.	OD, CLR, Thickness, wall thinning, Length, ovality, leg spacing, plane of bend, curvature, edge burrs, surface condition	Major	Visual & Measurt.	100%	Drg. / PO	Drg. / PO	Insp. Record	✓		P	W *	* Verify & Random witness		
3.4	Test on Tubes	a. Chemical composition	Major	Chemical	As per Spec.	SA688 TP304, SA1016 & PO	SA688 TP304, SA1016 & PO	Suppliers TC	✓		P	V	C: 0.05% max for TP 304. C: 0.035% max for TP 304L.		
		b. Tensile testing	Major	Mech.	-do-	-do-	-do-	Suppliers TC	✓		P	W			
		c. Hardness testing	Major	Mech.	-do-	-do-	-do-	Suppliers TC	✓		P	W			
		d. Reverse Bend test	Major	Mech.	-do-	-do-	-do-	Suppliers TC	✓		P	W			
		e. Flattening test	Major	Mech.	As per Spec.	SA688 TP304, SA1016 & PO	SA688 TP304, SA1016 & PO	Suppliers TC	✓		P	W			
		f. Flaring test (2 samples)	Major	Mech.	-do-	-do-	-do-	Suppliers TC	✓		P	W			
		g. Flanging test	Major	Mech.	-do-	-do-	-do-	Suppliers TC	✓		P	W			
		h. Inter granular corrosion testing	Major	Met.	As per Spec.	SA688 TP304, SA1016 & PO	SA688 TP304, SA1016 & PO	Suppliers TC	✓		P	V			
4.0	Packing & despatch	Verification of all TCs for completion.	Major	Visual	100%	PO, Spec, Drg. & QP	PO, Spec, Drg. & QP	Insp. Record			P	V			
		Identification, preservation & packing	Major	Visual	100%	PO / Drg & AA0490003	PO / Drg & AA0490003	Insp. Record			P	V	Note 7		



Notes :

- 1) In case of indigenous vendors, the raw strip used for manufacturing the tubes shall be procured from BHEL approved Vendors.
- 2) Intermediate solution annealing shall also be done in Bright Annealing furnace only.
- 3) Straight tubes shall be cleaned and bright annealed at a temperature of 1040°C min. followed by quenching to below 370° C.
- 4) Hot bending to form 'U' tubes shall not be permitted.

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- 5) U bend area plus approximately 150mm of each leg beyond tangent point of the U bend shall be heat treated.
- 6) 'Hydrostatic testing' of tubes shall be carried out with demineralised water. Chloride content of DM water shall not be more than 10 ppm max.
- 7) Tubes shall be packed in sea worthy packing & shall be capable of with standing mechanical damages during transit.
- 8) Project specific requirements, if any, as per P.O. shall also be complied with.
- 9) Lubricants used in tube drawing operation shall be non-chlorinated (50 ppm chlorides or less). All cleaning compounds shall be chloride and caustic free. Each cleaning operation shall be followed by a rinse or rinses with water, the final rinse shall be with demineralised water containing not more than 10 ppm chlorides.

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