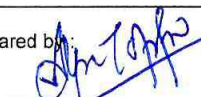
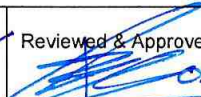


 Heat Exchanger Group BHEL - Bhopal		QUALITY ASSURANCE PLAN (QAP)							QAP No.		CDE-16-3096	
									Revision No.		01	
		ITEM		N.F. Straight Crimped Finned Tubes for OFAF Coolers					Date of Issue		08.11.19	
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S.No.	Components & Operations	Characteristics	Class	Type of Check	Quantum of check	Reference Document	Acceptance Norms	Format of Records	Agency			Remarks
1	2	3	4	5	6	7	8	9	1	2	3	
1.0 Material												
1.1	BASE TUBE (Ad. Brass)	Chemical composition analysis.	Major	T	1 No. at random per mfg. lot	(SB111 C44300)	(SB111 C44300)	TC	W	W	R	- See Note-1. - Hardness : 85 – 105 HV-5 - See Note-18. - Random selection to be done by BHEL-IA only.
		Mechanical properties including elongation, hardness, expansion, flattening & drifting.	Major	T	2 Nos. at random per mfg. lot.	--DO--	--DO--	TC	W	W	R	
		Hydraulic test at a pressure of 70 kg/cm ² (g) (See Note-04 & 05)	Critical	I + Visual	100%	--DO--	--DO--	TC	P	W	R	100% "W" by Fin Tube supplier & 20% "W" (randomly selected) by BHEL-IA - See Note- 2 & 5
		Eddy current test (See Note-02 & 04)	Critical	I + Visual	100%	ASTM E-243	ASTM E-243	TC	P	W	R	
		Mercurous Nitrate test / Ammonia vapor cracking test	Major	T	1 No. at random per mfg. lot.	ASTM B-154 / B-858	ASTM B-154 / B-858	TC	W	W	R	
		Microscopic Examination	Major	T		(SB111 C44300)	(SB111 C44300)	TC	W	W	R	- Annealed (O61) temper - See Note-03
		Heat Treatment	Critical	Visual	100%	(SB111 C44300)	(SB111 C44300)	HT data / Chart	W	R	R	
		- Dim. check (OD, TK & Length) with respect to tolerance. - Surface finish (See Note-14 & 15).	Major	I + Visual	100%	--DO--	--DO--	IR	P	W	R	100% "W" by Fin Tube supplier & 20% "W" (randomly selected) by BHEL-IA . - Thickness to be ensured. - Use calibrated Go / No-Go Ring Gauge for OD check.
		- Correlation of Material with TC & IR. - Marking of tube.	Major	Visual	100%	--DO--	--DO--	IR	P	W	R	
LEGEND: 1: Base / Fin Tube Supplier, 2: BHEL-IA, 3: Customer (e.g. NTPC / NHPC/etc. if any); P-Perform, W-Witness, R-Record review, IR/TC: Inspection Report/Test Certificate, IA : Inspection Agency, T : Testing lab to be used for check, I : Instrument used to check.												
Manufacturing Lot Size : 600 Tubes or 4500KG (total weight of tubes) from same heat lot – whichever constitute greater weight.												

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1.2	Fin (Copper Fin)	Conductivity	Major	Visual	1 Sample (selected at random) per each lot.	IS-191	97% (Min)	TC	W	W /R	R	• See Note-1 • Any of these two need to be witnessed by BHEL-IA atleast. Rest shall be reviewed.	
		Purity Check (Chemical)	Major	Visual		As per spec. IS-191	As per spec. IS-191	TC	W	W /R	R		
1.3		Solder Wire	Chemical composition analysis	Major		Visual	As per spec. (specified in BHEL's drg)	As per spec. (specified in BHEL's drg)	TC	W	R	-	See Note-1
2.0	In Process Inspection : At Fin Tube Manufacturer's end.												
2.1	Finning of Tubes	Co-relation of Base Tube & Copper Fin with actual items received.	Major	Visual	100%	TC & IR as detailed at Para-1.1 & 1.2 above.	--	IR	P	W	--	• Hold Point for BHEL-IA • Marking on base tube need to be checked with TC & IR for co-relation.	
		Finning	Major	Visual	100%	Mfr's std.	Mfr's std.	IR	P	-	-	Mfr's standard need to be approved from BHEL before start of manufacturing.	
2.2	Surface Cleanliness	Cleaning of Tubes (Inside & Outside)	Minor	Visual	100%	Mfr's standard	Mfr's standard	IR	P	-	-	• Compressed air / Pressurized Potable water (max 30PPM Chloride content) to be used for cleaning followed by drying completely. • See Note-14 & 15	
2.3	Leak Proofness	Hydraulic test	Critical	I + Visual	100%	BHEL Drg.	BHEL Drg.	IR	P	W	R	• Hold point for BHEL-IA. • See Note-5 • At 20.0 kg/cm2(g) for 10 sec (min). • 20% at random "W" by BHEL IA.	
2.4	Cut straight end of tubes	Dimensional matching	Minor	Visual + I	100%	BHEL Drg.	BHEL Drg.	IR	P	-	-	To be done if needed.	

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S.No.	Components & Operations	Characteristics	Class	Type of Check	Quantum of check	Reference Document	Acceptance Norms	Format of Records	Agency			Remarks
1	2	3	4	5	6	7	8	9	1	2	3	11
2.5	Dimensional check	TK at straight portion	Major	Visual + I	100%	BHEL Drg.	SB 111	IR	P	W	R	- Tolerance : As specified in SB-111 10% at random witnessed by BHEL IA.
		OD at straight portion	Minor	Visual + I	100%	BHEL Drg.	SB111.	IR	P	W	R	- Use calibrated "go", "no go" ring gauge. 10% at random witnessed by BHEL IA.
		Finned Length	Major	Visual + I	100%	BHEL Drg.	BHEL Drg.	IR	P	W	R	10% at random witnessed by BHEL IA. - Tolerance : As specified in drawing.
		Un-Finned Length at both ends.	Major	Visual + I	100%	BHEL Drg.	BHEL Drg.	IR	P	W	R	
		Fin Diameter	Major	Visual + I	100%	BHEL Drg.	BHEL Drg.	IR	P	W	R	
		No. of fins per meter	Major	Visual + I	100%	BHEL Drg.	BHEL Drg.	IR	P	W	R	
		Fin TK at tip	Major	Visual + I	100%	BHEL Drg.	BHEL Drg.	IR	P	W	R	10% at random witnessed by BHEL IA.
		Squareness of cut	Major	Visual + I	100%	(SB111 C44300)	(SB111 C44300)	IR	P	W	R	
2.6	Checking of surface	See Note-17 & 18.	Minor	Visual	100%	BHEL Drg.	BHEL Drg.	IR	P	W	-	10% at random witnessed by BHEL IA.
2.7	Fin adhesion check at 3 Kg load for 5 min	To ensure fin adhesion	Minor	Visual + I	1 No. per lot at random	Mf's std.	Mf's std.	IR	P	W	R	- Randomly selected by BHEL-IA. - Mfr's std. need to be approved from BHEL before start of mfg.
3.0	Final documentation.	Verification of all TCs & IRs for completeness	Major	Visual	100%	PO, Spec., drg. & QAP	BHEL Spec., Drg	IR	P	R	R	See Note-9

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4.0	Preservation, Packing, Marking and dispatch.	Marking	Major	Visual	100%	BHEL Spec. AA-0490002	BHEL Spec. AA-0490002	IR	P	W	-	- Plastic end caps to be provided on each tube as per Para-2.1 of spec. AA-0490002. - See Note-6. 10% at random witnessed by BHEL IA.	
		Packing & preservation	Major	Visual	100%	BHEL Spec. AA-0490002	BHEL Spec. AA-0490002	IR	P	R	--		
		Dispatch	Major	Visual	100%	BHEL Spec. AA-0490002	BHEL Spec. AA-0490002	IR	P	R	--		
Notes: - Testing (mechanical & chemical both) to be carried out at NABL approved lab / BHEL TSD only. - NDT (ECT) to be carried out by own in-house ISNT / ASNT NDT Level-I person under the supervision by Level-II/III person only. - Heat Treatment to be carried out by calibrated in-house furnace / set up only. All associated thermocouples & temperature recorder need to be with valid calibration record (duly calibrated by NABL approved agency). - Un-tested tube ends to be cut and discarded. Defective tubes area to be identified by permanent marking and shall be damaged & Segregated out from the finished tube lot. 'Hydrostatic Testing' of tube shall be carried out using demineralized / drinking/clean potable water followed by drying completely using hot compressed air. - Tubes shall be packed in sturdy packing as per BHEL Spec.AA-0490002 & shall be capable of withstanding mechanical damages during transit, handling & shipment. - All requirements of BHEL drawing and material specification shall be complied fully. - After receipt of items at BHEL-Bhopal, same can be checked at random to confirm all QAP requirements. Discrepancy found if any, shall be communicated to Tube Supplier for complete replacement. - Four (04) copies of all test certificates (covering all the tests / steps as mentioned in the above QAP) duly signed by BHEL-IA (as per the approved QAP) shall be furnished along-with the final dispatch documents. Sequence of documents shall be as per the QAP only with proper index sheet at top. - Final dimensional check and checking of surface (Cl.2.5 & 2.6 of QAP) to be done after hydro-testing only - Completeness of other requirements (left if any in BHEL's drawing) also needs to be ensured in totality. In case of any conflict between this QAP and other document, this QAP shall govern finally. - All instruments (used for dimension / thickness / hardness measurement) shall have proper co-related valid calibration record. Calibration shall be done by NABL approved agency only. - Reference BHEL drawing : As mentioned in Enq / PO. - Inside & Outside surface of tubes shall be free from tool marks, dents, surface cracks, wrinkles, etc. - Inside of tubes to be cleaned to remove dirt, oil, carbon deposit, etc. Tube end edge to be smooth without burrs, to be protected by end caps before dispatch. - Ensure all the fins of Finished Tubes are free from any sort of discoloration due to excessive heating. - Each base tube shall be stenciled with BHEL Order No., BHEL Spec. No., Heat No., Size of Tube and Supplier's mark at visible location for proper co-relation with TC. BHEL-IA to ensure the same at both base tube & Fin Tube supplier's end before start of finning. - Ladle analysis report of all applicable heats need to be reviewed by BHEL-IA along-with the product analysis report. These ladle analysis reports also need to be a part of dispatch documents. Ladle analysis to be done in NABL approved lab / BHEL-TSD only / supplier's own calibrated spectrometer													
								Prepared by:  ALPA TOPPO Dy. Manager (D) CDE		Reviewed & Approved By:  S.K. BISWAS Sr. DGM (D) CDE			