

 Heat Exchanger Group BHEL - Bhopal			QUALITY ASSURANCE PLAN (QAP)						QAP No. Revision No.		CDE-09-2706 04	
			ITEM	N.F. Straight Crimped Finned Tubes for Hydro Coolers					Date of Issue Page		25.11.2020 01 of 04	
S.No.	Components & Operations	Characteristics		Class	Type of Check	Quantum of check	Reference Document	Acceptance Norms	Format of Records	Agency 1 2 3		
1	2	3	4	5	6	7	8	9	10			11
1.0	Material											
1.1	Base Tube (90-10 Cu/Ni)	Chemical composition analysis	Major	T	1 No. at random per Heat Lot.	AA12130 Rev.06 (SB111 C70600)	AA12130 Rev.06 (SB111 C70600)	TC	W	W	-	See Note-1
		Mechanical test including Elongation, Hardness, Flattening, Expansion	Major	T	2 Nos. at random per mfg. Lot	---do---	---do---	TC	W	W	-	- Hardness Vickers HV 5: 110 (Max). - See Note-1
		Eddy current test	Major	I + Visual	100%	CL. 13.1.1 of SB-111 (E243)	CL. 13.1.1 of SB-111 (E243)	IR	W	W	-	- See Note-02 & 04 100% "W" by Tube Supplier & 10% (at random) "W" by BHEL-IA.
		Hydraulic test	Critical	I + Visual	100%	---do---	---do---	IR	W	W	-	- At 70kg/cm2(g) - See Note-05 100% "W" by Tube Supplier & 10% (at random) "W" by BHEL-IA.
		Heat Treatment Bright Annealed	Critical	Visual	100%	AA12130 Rev.06 (SB111 C70600)	AA12130 Rev.06 (SB111 C70600)	HT data / Chart	W	R	-	- Annealed (O61) temper - See Note-3
		Mercurous nitrate or 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	-	See Note-1
		Microscopical examination				As specified in SB-111	As specified in SB-111					
		Dim check (i.e. OD., TK & Length) with respect to tolerance and straightness	Minor	I + Visual	100%	---do--- & BHEL drg.	---do--- & BHEL drg.	IR	W	W	-	100% "W" by Tube Supplier & 10% (at random) "W" by BHEL-IA. - See Note-14 & 15. - See Note-16 for marking on Base Tube. - Use calibrated "go", "no go" ring gauge for OD check.
		Surface finish										
- Correlation of Material with TC & IR. - Marking of tube.	Major	Visual	100%	--DO--	--DO--	IR	P	W	-			

LEGEND: 1: Base / Fin Tube Supplier, 2: BHEL-IA, 3: Customer, 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-1897 / IS-191	97% (Min)	TC	W	W*	-	• See Note-17 • (*) Either of these 02 need to be "W" by BHEL-IA. Rest will be "R".
		Purity Check	Major	Visual		IS-1897 / IS-191	IS-1897 / IS-191 (Cu-ETP)	TC	W	W*	-	
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-17
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	-	-	
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
												• Hold point for BHEL-IA. • See Note-5
2.3	Leak Proofness	Hydraulic test	Critical	I + Visual	100%	BHEL Drg.	BHEL Drg.	IR	P	W	-	• At 20.0 kg/cm ² (g) for 10 sec (min). • 10% 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	-	-	


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2.5	Dimensional check	TK at straight portion	Major	Visual + I	100%	BHEL Drg.	BHEL Drg.	IR	P	W	-	[= 1.016 / 0.914 ± 0.11] : As applicable. 10% at random witnessed by BHEL IA.
		OD at straight portion	Minor	Visual + I	100%	BHEL Drg.	BHEL Drg.	IR	P	W	-	[=12.7 / 9.5 ± 0.064] - 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	-	10% at random witnessed by BHEL IA. - Tolerance = ± 1.0 mm for finned / un-finned length.
		Un-Finned Length at both ends.	Major	Visual + I	100%	BHEL Drg.	BHEL Drg.	IR	P	W	-	
		Fin Diameter	Major	Visual + I	100%	BHEL Drg.	BHEL Drg.	IR	P	W	-	
		No. of fins per meter	Major	Visual + I	100%	BHEL Drg.	BHEL Drg.	IR	P	W	-	
		Fin TK at tip	Major	Visual + I	100%	BHEL Drg.	BHEL Drg.	IR	P	W	-	- Tolerance : 0.25 mm (max). 10% at random witnessed by BHEL IA.
		Squareness of cut	Major	Visual + I	100%	AA12130 Rev.06 (SB111 C70600)	AA12130 Rev.06 (SB111 C70600)	IR	P	W	-	
		Uniformity of fins	Major	Visual	100%	BHEL Drg.	BHEL Drg.	IR	P	W	-	
2.6	Checking of surface	See Note-15 & 16.	Minor	Visual	100%	BHEL Drg.	BHEL Drg.	IR	P	W	-	10% at random witnessed by BHEL IA.
2.7	Fin adhesion check	To ensure fin adhesion	Minor	Visual + I	1 No. per lot at random	Mfg. Std. duly approved by BHEL	Mfg. Std. duly approved by BHEL	IR	P	W	-	- Randomly selected by BHEL-IA. - Load = 3 kg for 5 minutes (minimum)
3.0	Final documentation.	Verification of all TCs & IRs for completeness	Major	Visual	100%	PO, Specn, drg & QAP	BHEL Spec., Drg	IR	P	R	-	See Note-09


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4.0	Preservation, Packing, Marking and dispatch.	Marking	Major	Visual	100%	Para-4.2 & 4.3 of BHEL Spec. AA-0490002	Para-4.2 & 4.3 of 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 - as applicable) to be carried out at NABL approved lab / BHEL TSD only. - NDT (ECT & Liquid penetration test) 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 water followed by drying completely using dry 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. - Each base tube shall be stenciled with BHEL Order No., BHEL Spec. No., Heat No., Size of Tube and Supplier's mark for proper co-relation with TC. BHEL-IA to ensure the same at both base tube & Fin Tube supplier's end. - Conductivity & Purity Check (Wet analysis or using spectrometer) of Copper Fin and Chemical analysis of solder wire to be done at NABL approved lab or lab having in-house calibrated instruments (duly calibrated by NABL approved lab). Traceable to NABL is not allowed. BHEL-IA to ensure the same during inspection. PMI tester is not allowed.														
						Prepared by :  ARUN KUMAR SINGH Dy.Mgr. (D) CDE		Reviewed by :  LALIT ASNANI DGM (D) CDE		Approved by : S.P.VATSA AGM (D) CDE				

