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 Heat Exchanger Group BHEL - Bhopal		QUALITY ASSURANCE PLAN (QAP)					QAP No.		CDE-09-2712		
							Revision No.		01		
ITEM 90/10 Cu Ni Crimped Finned Bell Mouthed Tubes							Date of Issue		13.06.2020		
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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		3	4	5	6	7	8	9	10	11	
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.
		Packing & preservation	Major	Visual	100%	BHEL Spec. AA-0490002	BHEL Spec. AA-0490002	IR	P	R	• See Note-6.
		Dispatch	Major	Visual	100%	BHEL Spec. AA-0490002	BHEL Spec. AA-0490002	IR	P	R	• 10% at random witnessed by BHEL IA.

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.
- In case of local finned tube supplier and for NTPC project, TC review need to be done by NTPC-RIO at supplier's works 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 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.

Prepared By,	Reviewed by,	Approved by,
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									1	2	3					
1	2	3	4	5	6	7	8	9	10			11				
2.5	Dimensional check	TK at straight portion	Major	Visual + I	100%	BHEL Drg.	BHEL Drg.	IR	P	W	R	• [= 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	R	• [=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	R					
		Un-Finned Length at both ends.	Major	Visual + I	100%	BHEL Drg.	BHEL Drg.	IR	P	W	R	• 10% at random witnessed by BHEL IA.				
		Fin Diameter	Major	Visual + I	100%	BHEL Drg.	BHEL Drg.	IR	P	W	R	• Tolerance = ± 1.0 mm for finned / un-finned length.				
2.6	Checking of surface	No. of fins per meter	Major	Visual + I	100%	BHEL Drg.	BHEL Drg.	IR	P	W	R	• Tolerance : 0.25 mm (max). • 10% at random witnessed by BHEL IA.				
		Fin TK at tip	Major	Visual + I	100%	BHEL Drg.	BHEL Drg.	IR	P	W	R					
		Squareness of cut	Major	Visual + I	100%	AA12130 Rev.06 (SB111 C70600)	AA12130 Rev.06 (SB111 C70600)	IR	P	W	R					
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	R	• 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	R	See Note-09				

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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	• See Note-18
1.3	Solder Wire	Purity Check (Chemical)	Major	Visual		As per spec. IS-191	As per spec. IS-191	TC	W	W*	R	• (*) Either of these 02 need to be "W" by BHEL-IA. Rest will be "R".
		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-18
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	-	-	• Compressed air / Pressurized Potable water (max 30PPM Chloride content) to be used for cleaning followed by drying completely. • See Note-15 & 16
2.2	Surface Cleanliness	Cleaning of Tubes (Inside & Outside)	Minor	Visual	100%	Mfr's standard	Mfr's standard	IR	P	-	-	• 20% at random "W" by BHEL IA
2.3	NDT of Bell joint	D.P. Test after proper cleaning of joint	Major	I+Visual	100%	ASME Sec.-V, Article-6	ASME Sec.-VIII Div.-1, Appendix-8	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	Leak Proofness	Hydraulic test	Critical	I + Visual	100%	BHEL Drg.	BHEL Drg.	IR	P	W	R	
2.5	Cut straight end of tubes	Dimensional matching	Minor	Visual + I	100%	BHEL Drg.	BHEL Drg.	IR	P	-	-	

[Signature]
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1				3				1 2 3																			
2				5				10																			
Material				6				9																			
1.0				4				8																			
1				7				11																			
Base Tube including Bell (90-10 Cu/Ni)				1 No. at random per Heat Lot.				AA12130 Rev.06 (SB111 C70600)				TC				W R R				See Note-1							
Chemical composition analysis				T				AA12130 Rev.06 (SB111 C70600)				TC				W R R				Hardness Vickers HV 5 : • 110 (Max). • See Note-1							
Mechanical test including Elongation, Hardness, Flattening, Expansion				T				---do---				---do---				W R R				See Note-02 & 04 • 100% "W" by Tube Supplier & 10% (at random) "W" by BHEL-IA.							
Eddy current test				I + Visual				100%				CL. 13.1.1 of SB-111 (E243)				IR				W W R				At 70kg/cm2(g) • See Note-05 • 100% "W" by Tube Supplier & 20% (at random) "W" by BHEL-IA.			
Hydraulic test				I + Visual				100%				---do---				IR				W W R				Annealed (O61) temper • See Note-3			
Heat Treatment Bright Annealed				Visual				100%				AA12130 Rev.06 (SB111 C70600)				HT data / Chart				W R R				See Note-1			
Mercurous nitrate or Ammonia Vapor cracking test				T				1 No. at random per mfg. Lot				ASTM B-154 / B-858 As specified in SB-111				TC				W W R				100% "W" by Tube Supplier & 10% (at random) "W" by BHEL-IA.			
Microscopical examination				I + Visual				100%				---do---				IR				W W R				See Note-15 & 16. • See Note-17 for marking on Base Tube. • Use calibrated "go", "no go" ring gauge for OD check.			
Dim check (i.e. OD, TK & Length) with respect to tolerance and straightness				Visual				100%				---do---				IR				P W R							
Surface finish				Major				100%				---DO---				IR				W W R							
Correlation of Material with TC & IR.				Major				100%				---DO---				IR				W W R							
Marking of tube.				Major				100%				---DO---				IR				W W R							

LEGEND: 1: Base / Fin Tube Supplier, 2: BHEL-IA, 3: Customer (e.g. NTPC / NHPC/etc. if applicable as mentioned in the P.O.); 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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