

		Heat Exchanger Group BHEL - Bhopal		QUALITY ASSURANCE PLAN (QAP)				QAP		CDE-17-3142		
								Revision No.		03		
								Date of Issue		11.09.2019		
				ITEM		Bare Rubber Bellow for R.E. Joint (Pr. Balance & Compensating Type)				Page		01 of 07
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
1.0 Raw Material Inspection												
1.1	Polymer Identification on Neoprene Rubber	Qualitative analysis	Major	Testing + T	One sample from each batch	IS 3400 Part-22	Presence of Chloroprene	TC	P	R	R	Will be done at govt./NABL approved Lab.
1.2	Neoprene Rubber	a) Tensile Strength	Major	Testing + T	----do----	IS 3400 Part -1	Minimum 120 Kg./sq.cm (g)	TC	P	R	R	----do----
		b) Elongation	Major	Testing + T	----do----	----do----	Minimum 350 %	TC	P	R	R	----do----
		c) Shore hardness	Major	Measurement + I	----do----	ASTM D-2240	As per Drg. 60/65 ± 5° shore-A	TC	P	R	R	----do----
1.3	Natural Rubber	a) Adhesion of fabric to rubber	Major	Testing + T	----do----	IS 3400 Part -5	25 lbs/liner inch. width without stripping	TC	P	R	R	----do----
		b) Adhesion of rubber to metal	Major	Testing + T	----do----	IS 3400 Part -14 Method - A	60 lbs/liner inch. width without stripping	TC	P	R	R	----do----
LEGEND : 1. Bare Bellow Supplier or his Sub vendor, 2. BHEL-IA, 3. Customer (NTPC / TANGENCO / APGENCO / etc.) – as mentioned in the Enquiry / PO. 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 to be used to check												

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1.0 Raw Material Inspection (Contd./-)												
1.4	Neoprene Rubber	a) Ozone resistance test	Major	Testing + T	One sample from each batch	ASTM D-1149-B or IS-3400 PART-20	No cracks for 72 hours in Ozone concentration @ 50 PPHM	TC	P	R	R	Will be done at govt./NABL approved Lab.
		b) Hydro-stability test	Major	Testing + T	One sample from each batch	ASTM-D-3137	±10% variation in tensile strength after 96 hours and ±5% change in volume.	TC	P	R	R	----do----
		c) Blow Lamp Test	Major	Testing + T	One sample from each batch	IS-3181 Annex "H"	Able to extinguish itself within 4 seconds.	TC	P	R	R	----do----
		d) Kerosene dip test on Neoprene after dipping for one hour	Major	Testing + T	One sample from each batch	Mfg. Standard	No visible defects or cracks & ±10% swelling in Volume is acceptable.	TC	P	R	R	----do----

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1.0 Raw Material Inspection (Contd./-)												
1.5	Reinforcement Fabric	Physical & Mechanical Properties	Major	Testing + T	One sample per entire supply	ASTM-D-5035 (Strip Method)	Minimum Breaking Load = 700 lbs./inch width	TC	P	R	R	Will be done at govt. approved Lab.
1.6	Reinforcement Ring	Mechanical test (Tensile Strength)	Major	Testing + T	One sample per entire supply	IS:1570 Part-1 Fe690/As per Drg.	690 MPa (Min)/ As per material Spec.	TC	P	R	R	----do----
1.7	MS Split Retainer Rings	Chemical & Mechanical test (T.S.,Y.S. & EL)	Major	Testing + T	One sample / Heat & Heat Batch	As per BHEL Appd. Drg..	As per BHEL Appd. Drg.	MTC	P	R	R	
2.0 In Process Controls.												
2.1	MS Split Retainer Rings	a)Dimensional check	Major	Measurement + I	100%	As per BHEL approved drawing	As per BHEL approved drawing	IR	P	R	-	
		b) Galvanizing (Retainer Ring) If Applicable	Major	Measurement + I	100%	Coating thickness 0.100mm - 0.130mm	Coating thickness 0.100mm to 0.130mm & free from defects	IR	P	R	-	

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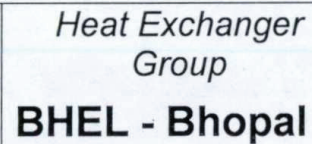
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2.2	Manufacturing	a) Vulcanizing	Major	Visual	100%	Mfr. Std.	Min. 2 hrs. curing	--	P	R	-	Refer Note-5&7 below.
		b) Surface after curing (02 Hrs. Min.)	Major	Visual	100%	Mfr. Std.	No defects.	--	P	R	-	--
3.0	Final Inspection											
3.1	Rubber Bellows	Dimensional conformity and compactness	Critical	Measurement + I	100%	As per BHEL approved drawing	As per BHEL approved drawing	IR	P	W	W*	• CHP • (*) 01 No. selected at random by customer out of total offered quantity.
3.2	Functional Test on Rubber Bellows	Vacuum test at 30mm Hg (abs) for 10 Minutes (Min.)	Critical	Visual + I	100%	As per BHEL approved drawing	No leakage & deformation	IR	P	W	W*	
		Hydrostatic Test at 2 times the design Pressure for 30minutes (min)	Critical	Visual + I	100%	As per BHEL approved drawing	No leakage & deformation	IR	P	W	W*	

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3.2	Functional Test on Rubber Bellows (Contd./-)	Deflection test (Lateral, Compression & Elongation) at 30 mm Hg. (abs) vacuum & at 0 to Design pressure (g) at an interval of 1 Kg/cm ² (g) for deflection of 5, 10, 15, 20 & 25 mm (as applicable)	Critical	Visual + I	100%	As per BHEL approved drawing	As per BHEL approved drawing	IR	P	W	W*	• CHP • (*) 01 No. selected at random by customer out of total offered quantity.
3.3	Combined Movement Test at Design Pressure	Compressed & Lateral Movement in each direction then Elongation & Lateral Movement in each direction	Critical	Visual + I	100%	As per BHEL approved drawing	As per BHEL approved drawing	IR	P	W	W*	• Testing can also be done in pair.
3.4	Checking of surface	Surface smoothness	Major	Visual	100%	---	Absence of surface irregularities, cracks, dent mark, etc.	IR	P	W	-	
3.5	Final documentation	Verification of all TCs & IRs for completeness	Major	Visual	100%	PO, Specn, drg & QAP	PO, Specn, drg & QAP	IR	P	R	R	See Note-9

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4.0	Preservation, Packing, Marking and dispatch.	Marking	Major	Visual	100%	Identification No. as mentioned in the Enq./PO documents.	Identification No. to be embossed on outer periphery of the bellows. Indelible ink can also be used for Identification.	IR	P	W	-	Each bellow to be stickered (non-tempered type) by BHEL-IA after completion of all inspection stages and before box-up.
		Packing, Preservation & Dispatch	Major	Visual	100%	Mfg. Standard.	Suitable sturdy wooden box to be used to avoid damage during transit & storage.		P	R	-	



QUALITY ASSURANCE PLAN (QAP)

ITEM

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(Pr. Balance & Compensating Type)**

QAP

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Revision No.

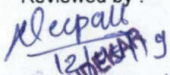
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Notes: 1. Drilling holes on the rubber bellow flange will be coated with self-vulcanizing rubber and also on the periphery of the flanges. 2. Surface check on bellows after Curing to be free from any visual defects. 3. During hydrostatic and vacuum tests, change in circumferential at top portion of the arch shall not to exceed 1.5% of the measured circumference at normal position. Test Certificate to include these dimensions also in addition to circumference. 4. After 24 hours of test, permanent set will be measured and it should be within +/-0.5%. Initial measurement on circumferential and dimension overarch shall be taken when fitted on test bay. 5. Two layers of inner cover with staggered lap joint and flange compactness internal records to be verified by BHEL during final inspection. 6. In the event of combined forces for a pair of bellows exceeding 85% of the acceptance value, each bellow of that pair shall be tested for lateral defection test individually at 0kg/cm² (g) pressure. The result obtained individually shall be extrapolated for design pressure in same ratio as for the combined pair and the acceptance of the bellow shall be determined accordingly. 7. Before Vulcanizing Operation: Dimensional check, flange compactness before curing, Staggered Lap Joints (Circumferential & Longitudinal – meeting spec. IS-4682 Part-1). 8. 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. 9. Life cycle test shall be carried out on each size, design & type of bellows. In case it was already carried out for same type, size and design, then TC shall be reviewed by BHEL-IA & Customer for approval & acceptance during inspection which also needs to be a part of complete IR. Burst test is not required as the pressure required is about 10 times of test pressure and it is un-safe. 10. In case of ambiguity (if any) found in the other specification/Document, this QAP may please be treated as final.												
Prepared by :  Anil Kumar Dy. Engineer-CDE						Reviewed by :  Deepak Maundekar Dy. Manager-CDE		Approved by :  S. K. Biswas Sr. DGM/DCDE				

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