

		WUXi Zhicheng Biochemical Engineering Equipment Co.,Ltd					PROJECT : WORPAR Product Name: OIL/STEAM HEAT EXCHANGE ITEM: W521B.1 (19-X-751) Work order: WZA21-19 Prepared by: LIYAN Approved by : SHAOHONGYU Date : 2021.6.10			
INSPECTION AND TEST PLAN FOR SHELL AND TUBE HEAT EXCHANGERS										
Sl. No.	Component/ Operation	Type of Check/ Inspection parameters	Quantum of Check	Reference Document	Acceptance Norm	Form of Record	Inspection classification			
							Vendor	DeSmet	TPI *	
1.00 Procedures :										
1.1	PT Procedure	Surface flaws	See below	Codes, Specifications	Codes, Specifications	PT Procedure	R 6.11	R 6.11		
1.2	RT Procedure	Surface flaws & weld defects	See below	Codes, Specifications	Codes, Specifications	RT Procedure	R 6.11	R 6.11		
1.3	Pressure Test Procedure	Leakage	See below	Codes, Specifications	Codes, Specifications	Pressure Test Procedure	R 6.11	R 6.11		
1.4	Ultrasonic Test Procedure	Material / weld defects	See below	Codes, Specifications	Codes, Specifications	Ultrasonic Test Procedure	R NA	R NA		
1.5	Tube Expansion Procedure	Establish tube expansion procedure	See below	Codes, Specifications	Codes, Specifications	Tube Expansion Procedure	R 6.11	R 6.11		
1.6	Welding	Establish Weld Procedures Qualification Test Qualification of welders	100%	Codes, Specifications	Codes, Specifications	WPS PQR WPQ	W 6.11	R 6.11		
2.00 Material :										
2.1	Materials for Shell, dished end, baffles, flanges tubesheets, tubes	Visual & Dimensions Review Material Certificated and Test Report Co-relation of Heat markings w.r.t. Mill Test Certificates Quality and dimensions 3.2certification and retest PMI detection	100%	Equipment Drawings	Material Specifications	Material Certificates Laboratory Test Reports if applicable PMI report	W 21.7.10	R 21.7.10		
3.00 In - Process										
3.1	Tube sheet machining	Tube sheet dimensions Tube hole orientation Tube holes size checking with gauges Tube hole finish Groove dimension/ spacing Pass partition groove orientation and dimension	100% 100% 10% 100%	Equipment Drawings	Equipment Drawings	Inspection Report	W 21.7.28	RI 21.7.29		
3.2	Drilling of baffles	Baffle dimensions Tube hole orientation/ Dimensions Surface finish (free of burrs, sharp edges, ...)	100% 10% 100%	Equipment Drawings	Equipment Drawings	Inspection Report	W 21.7.28	RI 21.7.29		
3.3	Formed Dished Ends	Dimensional Check Check for minimum thickness	100%	Vessel Drawings	Codes, Specifications	Inspection Report R.T Report	W	R+W		

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		Dish profile, Radiography 100% on weld					W 21.8.15	RI 21.8.15	
3.4	Shell Forming : ovality, circumference, center line misalignment, Off set	Ovality, circumference Center line misalignment Off set	100%	Vessel Drawings	Codes, Specifications	Inspection Report	W 21.7.17	RI 21.7.17	
3.5	Shell Welding Long seam/C. seams Joints	Root gap Weld preparation Root reinforcement Radiography	100% **	Vessel Drawings	Codes, Specifications	Inspection Report R.T Report	W 21.7.19	RI 21.7.19	
3.6	Fit - up Nozzles	Dimensions Orientation Elevation Stand out Edge preparation	100%	Equipment Drawings	Equipment Drawings	Inspection Report	W 21.8.13	RI 21.8.13	
3.7	Fit - up of attachments	Dimensions Orientation Elevation	100%	Equipment Drawings	Equipment Drawings	Inspection Report	W 21.8.14	RI 21.8.14	
3.8	Tube bundle assembly	Parallellity of Tube sheets Straighness of tube bundle Spacing of Baffles Tightness of spacers Passing of Tubes into Tube holes	100%	Equipment Drawings	Equipment Drawings	Inspection Report	W 21.8.16	RI 21.8.16	
3.9	Insertion of bundle in shell	Tube bundle assembly and inside shell	100%	Equipment Drawings	Equipment Drawings	Inspection Report	W 21.8.17	RI 21.8.17	
3.10	Final Tube sheet / baffle / Shell assembly and fit-up for welding	Dimensions Weld edge preparations	100%	Equipment Drawings	Equipment Drawings	Inspection Report	W 21.9.13	RI 21.9.13	
3.11	Tube Expansion	Visual / dimensional check Orientations Geometry Surface finish	10%	Tube expansion procedure	Equipment Drawings	Inspection Report	W 21.10.3	R+RI 21.10.3	
3.12	Tube to tube sheet welding (if applicable)	Visual DP Test	100%	Equipment Drawings	Equipment Drawings	Inspection Report	W 21.9.16	R+RI 21.9.16	
3.13	Shell and Tube sheets welding	Visual DP	100%	Equipment Drawings	Equipment Drawings	Inspection Report	W 21.9.14	R+W 21.9.14	

4.0 Final Inspection/Testing

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4.1	Final Inspection of vessel	Visual Dimensional	100%	vessel drawings	Vessel drawings Specifications	As built drawing	H 2021.11.7	H 11.7	
4.2	Hydro tests Shell side Tube side	Pressure test	100%	Equipment Drawings	Equipment Drawings	Inspection Report	W 2021.11.8	W/R 11.8~12.8	
5.0 Surface preparation/Release									
5.1	Sand blasting & Painting on C.S surfaces Pickling & passivation on S.S. surfaces	Visual, workmanship, surface cleanliness Stain free surface	100%	Desmet specification	Desmet specification	Inspection Report	W 2021.12.1	W 12.1	
5.2	Packing	Varification of packing list, visual, Packing quality	100%	Desmet specification	Desmet specification	Inspection Report	W 2021.12.1	W 12.1	
5.3	Documents	Review all documents	100%	Drawing & P.O	Drawing & P.O	Documents	W 2021.12.1	W 12.1	
* Depends from Code or DB requirements, for DP Test quantity and location to be defined by inspector ** Extent of radiography on the shell dependent from applied code or DB requirements H/W to be defined by DB inspector *** Note: for bend $r/D < 5$ (r= bending radius, D= outside diameter of tube) shall use seamless tube to prevent weld joint cracking on welded tube for small bending radius.									
Inspection Classification : H : Hold point requiring inspection R : Review of document/ Radiographs W : Witnessing/inspection of the stage RI : Random Inspection									