

Heat Exchanger Design, Inc.





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HEAT EXCHANGER SPECIFICATION SHEET										Page 1
Customer MEG Energy					Job No. 4565B-1, 2, & 3					
Address					Reference No. PO# P-5330-01					
Plant Location Christina Lake, AB					Proposal No. 111-13					
Service of Unit HP BFW Minimum Flow Recycle Cooler					Date 4/10/2013					Rev 2a
Size 400 x 25.4 x 1219.2mm Type SH 16D92-04-00-TV-6B8B					Item No. 3A-E-397 A-B-C					
Surf/Unit (Gross/Eff) 24.63 / 24.09 m2					Shell/Unit 1					Surf/Shell (Gross/Eff) 24.63 / 24.09 m2
PERFORMANCE OF ONE UNIT										
Fluid Allocation			Shell Side				Tube Side			
Fluid Name			TEG / H2O (60/40 wt%)				BFW			
Fluid Quantity, Total kg/hr			49402.2				258583			
Vapor (In/Out)										
Liquid			49402.2				258583			
Steam										
Water										
Noncondensables										
Temperature (In/Out) C			40.00				105.00			
Specific Gravity			1.0789				1.0268			
Viscosity mN-s/m2			4.6610				1.3460			
Molecular Weight, Vapor										
Molecular Weight, Noncondensables										
Specific Heat kJ/kg-C			3.2230				3.4560			
Thermal Conductivity W/m-C			0.3280				0.3400			
Latent Heat kJ/kg										
Inlet Pressure kPa			994.002				2294.00			
Velocity m/s			0.41				2.55			
Pressure Drop, Allow/Calc kPa			100.000				4.507			
Fouling Resistance (min) m2-K/W			NOTE 5				NOTE 5			
Heat Exchanged MegaWatts 2.9789			MTD (Corrected)				119.4 C			
Transfer Rate, Service 1035.79 W/m2-K			Clean 1706.81 W/m2-K				Actual 1706.81 W/m2-K			
CONSTRUCTION OF ONE SHELL										
			Shell Side				Tube Side			
Design/Test Pressure kPaG			3339/FV / Code				4340/FV / Code			
Design Temperature C			-28.9 / 210				-28.9 / 210			
No Passes per Shell			1				1			
Corrosion Allowance mm			3.2				3.2 (Except tubes)			
Connections			In inch 6" 300# RFWN				8" 300# RFWN			
Size & Rating			Out inch 6" 300# RFWN				8" 300# RFWN			
Intermediate										
Tube No. 92			OD 25.400 mm				Thk(Avg) 2.108 mm			
Tube Type Plain							Length 1.2192 m			
Shell SA-106B			406.4mm OD				Pitch 31.750 mm			
Channel or Bonnet SA-516-70N							Layout 60			
Tubesheet-Stationary SA-516-70N							Material SA-179 (smls)			
Floating Head Cover N/A							Shell Cover SA-516-70N			
Baffles-Cross A-36			Type SINGLE-SEG. (Vert.)				Channel Cover N/A			
Baffles-Long N/A							Tubesheet-Floating N/A			
Supports-Tube A-36							Impingement Plate None			
Bypass Seal Arrangement							Spacing(c/c) 304.801			
Expansion Joint N/R							Seal Type			
Rho-V2-Inlet Nozzle 617.43 kg/m-s2							U-Bend Type			
Gaskets-Shell Side Kammpro Type							Tube-Tubesheet Joint Strength Welded			
-Floating Head N/A							Type			
Code Requirements ASME Section VIII, Div. I							Bundle Entrance 0.00			
Weight/Shell 1626.07			Filled with Water 2089.82				Bundle Exit 0.00 kg/m-s2			
Remarks: 1. This is HED's standard separated head Hairpin Exchanger with independent bolting. 2. Three (3) identical exchangers are required. 3. 50mm thick mineral wool insulation is included per specification. 4. 15% overdesign has been considered to account for potential fouling. 5. U-bends are stress relieved.										

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HAIRPIN HEAT EXCHANGER DATA SHEET													REV			
SERVICE		HP BFW Minimum Flow Recycle Cooler					DATASHEET NO.		DS-CL03A-E-300-E397							
SIZE		(L x W x H) 2249 x 689 x 1207 mm		TYPE		Multi-Tube		HORIZ/VERT		Horizontal		CONNECTED IN		1 Parallel / 1 Series		
SHELLS / UNIT		1		SURFACE / SHELL (gross / eff) (m ²)		24.63 / 24.09		SURFACE / UNIT (gross / eff)(m ²)		24.63 / 24.09 (Note 1)						
MANUFACTURER		Heat Exchanger Design, Inc.		MODEL NO.		SH16D92-04-00-TV-6B8B		TAG Number		3A-E-397 A/B/C (Note 1)						
PERFORMANCE (Note 1)														0A1		
		(IN)		SHELL SIDE		(OUT)		(IN)		TUBE SIDE		(OUT)				
FLUID CIRCULATED				TEG / H2O (60/40 wt%)						BFW (Note 3 and 4)						
TOTAL FLUID		kg / hr		49,402		49,402		258,583		258,583						
VAPOR		kg / hr		0		0		0.0		0						
LIQUID		kg / hr		49,402		49,402		258,583		258,583						
STEAM		kg / hr		0.0		0.0		0.0		0.0						
NONCONDENSABLE		kg / hr		0.0		0.0		0.0		0.0						
FLUID VAPORISED/CONDENSED		kg / hr		0.0		0.0		0.0		0.0						
DENSITY - LIQUID / VAPOUR		kg / m ³		1078.4 / -		1026.3 / -		865.9 / -		876.5 / -						
VISCOSITY - LIQUID / VAPOUR		cP		4.661 / -		1.346 / -		0.134 / -		0.1410 / -						
SPECIFIC HEAT (LIQ / VAP)		kJ / (kg.°C)		3.223 / -		3.456 / -		4.490 / -		4.446 / -						
THERMAL COND (L/V)		W / (m.°C)		0.328 / -		0.340 / -		0.665 / -		0.671 / -						
MOLE WT - VAPOUR		MW		-		-		-		-						
MOLE WT - NONCONDENSABLES		MW		-		-		-		-						
LATENT HEAT		kJ / kg		-		-		-		-						
TEMPERATURE		°C		40.0		105.0		199.3		190.0						
INLET PRESSURE		kPa(a)		994				2294								
VELOCITY		m / s		0.41				2.55								
PRESSURE DROP		kPa		ALLOW	100	CALC	4.51	ALLOW	100	CALC	13.67					
FOULING RESISTANCE		(m ² .°C) / kW		Note 2				Note 2								
HEAT EXCHANGED		kW		2,978.9				MTD CORRECTED (°C)		119.4						
TRANSFER RATE		W / (m ² .°C)		SERVICE	1035.8	CLEAN	1706.8	ACTUAL	1706.8							
DESIGN - MATERIAL - CONSTRUCTION																
DESIGN / TEST PRESSURE		kPa(g)		3339 / FV / Per Code		4340 / FV / Per Code										
MDMT / DESIGN TEMPERATURE		°C		-28.9 / 210		-28.9 / 210										
NO. PASSES PER SHELL				1		1										
CORROSION ALLOWANCE		mm		3.2		3.2 (Except Tubes)										
CONNECTIONS		INLET		6" - 300# RFWN		8" - 300# RFWN										
SIZE &		OUTLET		6" - 300# RFWN		8" - 300# RFWN										
RATING		INTERMEDIATE														
TUBES:	MATERIAL	SA-179 (SMLS)		NO.	92 U's	OD (mm)	25.4	THK. (mm)	2.11 (Avg)	NOMINAL LENGTH (m)	1.2192					
TUBE LAYOUT		60°		TUBE PITCH		31.75		TUBE TO TUBESHEET JOINT		Strength Welded (Note 8)						
SHELL:	MATERIAL	SA-106 B		ID (mm)		381		OD (mm)	406.4							
FINS:	MATERIAL	N/A		HGT.	N/A	THK.	N/A	NO. / TUBE	N/A							
TUBE CLOSURE TYPE:		Separated Head		RETURN BONNET MATERIAL		SA-516-70N		TUBESHEET	SA-516-70N	CHANNEL	SA-516-70N					
LIFTING LUGS:		Yes		GROUNDING LUG:		Yes		NAME PLATE:		Yes						
INSULATION:		SHELL:		50mm thick mineral wool		CHANNEL:		50mm thick mineral wool								
TUBE SUPPORTS:		A-36		BAFFLES:	Material	A-36	Type	Single Segmental	Cut (%)	33 Vertical	Spacing (mm)	305	0A1			
EXCHANGER SUPPORT BRACKET:		A-36														
GASKETS:		SHELL SIDE:		Kammpro Type		TUBE SIDE:		Kammpro Type								
pV ² - INLET NOZZLE		617.43 kg/m-s2		BUNDLE ENTRANCE		0.00 kg/m-s2		BUNDLE EXIT		0.00 kg/m-s2						
CODE REQUIREMENTS		ASME Section VIII, Division 1.		TEMA CLASS												
WEIGHT/SHELL (kg)		1630 (*)		FILLED WITH WATER (kg)		2100 (*)										
Notes: (*) Seller to confirm or specify.																
1) Three identical heat exchangers (Tag #s 3A-E-397A, 3A-E-397B & 3A-E-397C) are required. Flow and duty shown above is for one heat exchanger only.																
2) Fouling factors used in the design are zero for both sides. 15% design margin has been added to the area to account for potential fouling.																
3) Refer to Page 3 for BFW analysis.																
4) The exchanger can experience sudden shock when the tube side will be exposed to water ranging from 40°C to as high as 200°C.																
5) When practical, pressure component weld shall be of full penetration type.																
6) Seller shall provide 50 mm thick mineral wool insulation for personnel protection. Insulation shall be per Project Specification MEG-ENG-MEC-SP-1102.																
7) Exchanger shall be designed for future field hydrotest in the fully corroded condition.																
8) Tube-to-tubesheet welding procedures shall be qualified and tested in accordance with ASME Section IX, QW-193.																
9) Surface preparation and painting shall be per Project Specification MEG-ENG-MEC-SP-1101.																
10) NPS 1 connections complete with blind flanges for field hydrotest shall be provided at the highest and lowest points on the shell and on inlet/outlet nozzles of the tube. Also, tap and drill shall be provided at the highest and lowest points of the tube channels to ensure complete draining.																
11) Hardness test is required. Hardness 200 HBW maximum on both tube side and shell side.																
12) Spot radiography (10% minimum) is required for tube side and shell side butt welds capable of being radiographed.																
13) Channel and shell heads as well as U-tube bends shall be stress relieved.																
14) This document is designated for the Standard Package Catalogue per MEG Standard DMG-BAS-ST-0012.																
REVISIONS						 MEG Energy Corp.  SNC • LAVALIN										
REV. NO.	DATE	BY	CHK	APP	DESCRIPTION	PROJECT		CLRP Phase 3A Central Plant Facility: EPC								
0A1	12-June-2014	TA	SY	CS	Re-Issued for Purchase	JOB NO.		511036	Tag No.	3A-E-397A/B/C						
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HAIRPIN HEAT EXCHANGER DATA SHEET



SERVICE HP BFW Minimum Flow Recyle Cooler DATASHEET NO. DS-CL03A-E-300-E397

HP BFW Minimum Flow Recycle Properties

Temperature	Pressure	Heat Flow	Density	Specific Heat	Viscosity	Thermal Conductivity	
°C	kPa(g)	MW	kg/m3	kJ/kg-°C	cP	W/m-°C	
190.0	2100.0	0.000	876.5	4.446	0.141	0.671	
190.6	2106.7	0.199	875.8	4.448	0.141	0.671	
191.2	2113.4	0.398	875.1	4.451	0.140	0.670	
191.9	2120.0	0.596	874.4	4.454	0.140	0.670	
192.5	2126.7	0.795	873.7	4.457	0.139	0.670	
193.1	2133.4	0.994	873.0	4.460	0.139	0.669	
193.7	2140.0	1.192	872.3	4.463	0.138	0.669	
194.3	2146.7	1.391	871.6	4.466	0.138	0.668	
195.0	2153.4	1.589	870.9	4.469	0.137	0.668	
195.6	2160.0	1.788	870.2	4.472	0.137	0.668	
196.2	2166.7	1.986	869.5	4.475	0.137	0.667	
196.8	2173.3	2.185	868.7	4.478	0.136	0.667	
197.4	2180.0	2.383	868.0	4.481	0.136	0.666	
198.0	2186.7	2.582	867.3	4.484	0.135	0.666	
198.7	2193.3	2.780	866.6	4.487	0.135	0.666	
199.3	2200.0	2.979	865.9	4.490	0.134	0.665	

TEG / Water Properties

Temperature	Pressure	Heat Flow	Density	Specific Heat	Viscosity	Thermal Conductivity	
°C	kPa(g)	MW	kg/m3	kJ/kg-°C	cP	W/m-°C	
40.0	900.0	0.000	1078.4	3.223	4.661	0.328	
44.5	893.3	0.199	1075.3	3.239	4.089	0.329	
49.0	886.6	0.398	1072.0	3.255	3.623	0.331	
53.4	879.9	0.598	1068.7	3.271	3.241	0.332	
57.8	873.2	0.797	1065.4	3.287	2.924	0.333	
62.3	866.6	0.996	1062.0	3.303	2.659	0.334	
66.6	859.9	1.195	1058.6	3.318	2.434	0.335	
71.0	853.2	1.395	1055.2	3.334	2.243	0.336	
75.3	846.5	1.594	1051.7	3.350	2.077	0.337	
79.7	839.8	1.792	1048.1	3.365	1.933	0.337	
83.9	833.2	1.991	1044.6	3.381	1.806	0.338	
88.2	826.5	2.189	1041.0	3.396	1.694	0.338	
92.5	819.8	2.388	1037.3	3.411	1.594	0.339	
96.7	813.2	2.586	1033.7	3.426	1.503	0.339	
100.9	806.6	2.783	1030.0	3.441	1.421	0.339	
105.0	800.0	2.979	1026.3	3.456	1.346	0.340	

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HAIRPIN HEAT EXCHANGER DATA SHEET

SERVICE *HP BFW Minimum Flow Recyle Cooler* DATASHEET NO. *DS-CL03A-E-300-E397*

BFW Analysis

Water Analysis (mg/l) - Normal Case			
	Normal	Maximum	
Ca ⁺⁺	0.07		
Mg ⁺⁺	0.07		
Na ⁺	1809		
K ⁺	6.10		
Fe ⁺⁺	1.40		
Cu ⁺⁺	0.00		
Mn ⁺⁺	0.13		
Ba ⁺⁺	0.51		
Sr ⁺⁺	1.39		
HCO ₃ ⁻	0.00		
CO ₃ ⁻⁻	281.5		
OH ⁻	3.34		
SO ₄ ⁻⁻	6.69		
Cl ⁻	2455	< 4190	
Silica (ppm as SiO ₂)	44.30	< 50	
Sulphides (ppm as S ⁻²)	0.00		
TOC (ppm as TOC)	0.815	< 350	
TDS (ppm as ion)	4609	< 8,000	
TSS (ppm TSS)	0.00		
Oil & Grease (ppm oil in water)	0.0		
Total Hardness (ppm as CaCO ₃)	0.488	< 0.50	
P-Alk (ppm as CaCO ₃)	244.6		
M-Alk (ppm as CaCO ₃)	479.4		
Total Alkalinity (ppm as CaCO ₃)		< 600	
CO ₂	---		
Dissolved O ₂	---		
Estimated pH	11.0		

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