

**SEWON CELLONTECH****TUBULAR HEAT EXCHANGER**

SHEET 2 OF 21

CUSTOMER	MEG Energy Corp.	REV	MADE BY	CHECKED BY	APPROVED BY	DATE
LOCATION	CANADA	0	-	-	-	07-01-2013
JOB NO.	511036	1	-	-	-	08-14-2013
SERVICE	Blowdown Disposal / Glycol Exchanger	2	-	-	-	09-26-2013
ITEM NO.	3A-E-325A/B (Max Duty Case)					

Total	2	Shells, Connected in	1	Parallel	2	Series Shells	Install	<input checked="" type="checkbox"/> Hor. <input type="checkbox"/> Vert.	Size	1,120.0 ID - 6,096.0 L
Code	ASME Sec.VIII Div.1 (STAMP), TEMA, API660	TEMA Type	AFU (Note 13)	TEMA Class	R	Effective Area	301.34	m <sup>2</sup> /Shell		

**PERFORMANCE OF ONE BATTERY**

PERFORMANCE OF ONE EXCHANGER									
		SHELL SIDE				TUBE SIDE			
		INLET		OUTLET		INLET		OUTLET	
Fluid Circulated		TEG/Water(60/40 wt%)				MP Blowdown			
		205102				207611			
Total Fluid	kg/hr								
Vapor	kg/hr	MW							
Liquid	kg/hr	MW	205102		205102	207611		207611	
Steam	kg/hr								
Water	kg/hr				207611		207611		
Noncondensable	kg/hr	MW							
Operating Temperature	°C	40.00		85.00		95.00		60.00	
Operating Pressure	kPaa	994.015				1455.02			
Density	kg/m3	L / v	1078.0		1044.0	962.00		983.00	
Viscosity	cP	L / v	4.6610		1.7770	0.2940		0.4630	
Thermal Conductivity	W/m·°C	L / v	0.3281		0.3381	0.6782		0.6532	
Specific Heat	kJ/kg·°C	L / v	3.2231		3.3841	4.2081		4.1831	
Latent Heat	kJ/kg								
Bubble / Dew Point	°C	/		/		/		/	
Critical Press. / Temp.	kPaa / °C	/		/		/		/	
Velocity	m/sec	0.62				1.68			
Pressure Drop	kPa.	Allow.	120.000	Calc.	107.133	Allow.	165.000	Calc.	163.508
Fouling Resistance	m <sup>2</sup> ·°C/kW	0.088				0.176			
Film Coefficient	W/m <sup>2</sup> -K	2,482.86				8,993.31			
Overall Coefficient	W/m <sup>2</sup> -K	Clean	1756.50	Calc.		1161.58	Design	1092.47	
Heat Duty	KW	8,469.00				LMTD	°C	MTD	12.9 °C

**CONSTRUCTION**

Design Pressure	Design Temperature	1500.0 / FV kPa.G	-29 / 214 °C	1950.0 / FV kPa.G	-29 / 214 °C
No. of Passes		2		8	
Tubes No.	238U / Shell, Size	31.75 mm	Thickness 2.11 (Min.) mm ( BWG: 14 )	Length	6,096.0 mm
Shell	1120 mm ID	Tube Pitch	39.69 mm	Layout angle	45 °, Effective
Baffles	Cross Baffle 11+1S (Note 2) ea / Shell, Type	Single Seg. (Vert.)	Cut	26.0 % Dia.	Spacing c/c
pv <sup>2</sup>	Inlet Nozzle	641.90	Entrance	1,530.45	Outlet Nozzle
Material	Tube	SA 179 Seamless	Shell & Cover	SA 516 GR. 70N	Channel & Cover
	Tube Sheet	SA 266 GR.2	Baffle	Carbon Steel	Expansion Joint
Estimated Weight	Empty Weight	kg	Bundle Weight	- kg	Full Water Weight
Corrosion Allowance	Shell side	3.2 mm	Tube side	3.2 mm	Tube Joints:
Insulation	Shell side	64 mm	Tube side	64 mm	Rolled (two grooves) and Expanded

Insulation	Outer side	CV	FWN	INSULATION	Outer side	CV	FWN	INSULATION	
MEAN METAL TEMPERATURE	Temperature, °C				Pressure, kPa.G				
	Shell		Tube		Shell		Tube		
Normal Operating	-		-		-		-		
Startup	-		-		-		-		
NOZZLE	SHELL SIDE				TUBE SIDE				
	Tag	No	NPS	Remarks	Tag	No	NPS	Remarks	
	Inlet	S1	1	12		T1	1	8	
	Outlet	S2	1	12		T2	1	8	
	Vent			(Note 8 & 9)				(Note 9)	
	Drain			(Note 8 & 9)				(Note 9)	
	Thermowell								
	Util. Con.								
RATING	RFWN 300#				RFWN 300#				

CSA approval is required for electric components and installation. The heat exchanger is located in a non-hazardous area.
7) Seller is to supply and install 64mm thick mineral fiber insulation.
8) Each shell and channel shall be provided with a NPS 2" (300#, RFWN or RFLWN) vent and drain. Channel vent & drain between shells shall be provided with a 90° elbow.
Vents and drains shall come complete with blind flange, gasket, bolts & nuts.
9) Each process nozzle shall be provided with one 1" 300# RFLWN (complete with blind flange, gasket, bolts & nuts).
10) Exchangers shall be stacked. Per API 660, exchangers shall be hydrotested stacked.
11) During normal operation 3A-E-325 is not operating. 3A-E-325 operates only when MVC evaporator is down.
12) EHT design shall use voltage of 277 VAC.
13) Bundles shall be removable.

**Remarks**

- Seller shall verify and guarantee thermal rating of the unit.
- Full support at the U-bend tangent line shall be trimmed beyond the top and the bottom tube rows as much as possible.
- Exchanger is to be designed for future field hydrotest in the fully corroded condition.
- Exchangers to be designed for liquid full condition at S.G. = 1.079

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SEWON CELLONTECH

## TUBULAR HEAT EXCHANGER

SHEET 3 OF 21

CUSTOMER	MEG Energy Corp.	REV	MADE BY	CHECKED BY	APPROVED BY	DATE
LOCATION	CANADA	0	-	-	-	07-01-2013
JOB NO.	511036	1	-	-	-	08-14-2013
SERVICE	Blowdown Disposal / Glycol Exchanger	2	-	-	-	09-26-2013
ITEM NO.	3A-E-325A/B (Min Duty Case)					

Total	2	Shells, Connected in	1	Parallel	2	Series Shells	Install	<input checked="" type="checkbox"/> Hor. <input type="checkbox"/> Vert.	Size	1,120.0 ID - 6,096.0 L
Code	ASME Sec.VIII Div.1 (STAMP), TEMA, API660 TEMA Type AFU						TEMA Class	R	Effective Area	301.34 m <sup>2</sup> /Shell

## PERFORMANCE OF ONE BATTERY

				SHELL SIDE				TUBE SIDE			
				INLET		OUTLET		INLET		OUTLET	
Fluid Circulated				TEG/Water(60/40 wt%)				MP Blowdown			
Total Fluid		kg/hr	152546				154412				
Vapor	kg/hr	MW									
Liquid	kg/hr	MW	152546		152546		154412		154412		
Steam	kg/hr										
Water	kg/hr						154412		154412		
Noncondenable	kg/hr	MW									
Operating Temperature °C			40.00		85.00		95.00		60.00		
Operating Pressure kPaa			994.015				1455.02				
Density	kg/m3	L / v	1078.0		1044.0		962.00		983.00		
Viscosity	cP	L / v	4.6610		1.7770		0.2940		0.4630		
Thermal Conductivity	W/m·°C	L / v	0.3281		0.3381		0.6782		0.6532		
Specific Heat	kJ/kg·°C	L / v	3.2231		3.3841		4.2081		4.1831		
Latent Heat	kJ/kg										
Bubble / Dew Point	°C		/		/		/		/		
Critical Press. / Temp.	kPaa / °C		/		/		/		/		
Velocity	m/sec		0.47		1.25						
Pressure Drop	kPa.		Allow.	100.000	Calc.	62.465	Allow.	100.000	Calc.	93.264	
Fouling Resistance	m <sup>2</sup> ·°C/kW		0.088		0.176						
Film Coefficient	W/m <sup>2</sup> -K		2,118.10		7,114.33						
Overall Coefficient	W/m <sup>2</sup> -K		Clean	1487.03	Calc.		1037.21	Design	813.03		
Heat Duty	KW		6,299.00				LMTD	°C	MTD	12.9 °C	

## CONSTRUCTION

Design Pressure	Design Temperature	/	kPa.G	/	°C	/	kPa.G	/	°C
No. of Passes									
Tubes No.	/ Shell, Size	mm	Thickness (Min.) mm	( BWG : )	Length	mm			
Shell	mm ID	Tube Pitch	mm	Layout angle °	Leffective	- mm			
Baffles	Cross Baffle	ea / Shell, Type	Cut	- % Dia.	Spacing c/c	mm	End	- mm	
pv <sup>2</sup>	Inlet Nozzle	355.08	Entrance	851.35	Outlet Nozzle	366.65	kg/m·sec <sup>2</sup>	Impingement plate	
Material	Tube		Shell & Cover		Channel & Cover				
	Tube Sheet		Baffle		Expansion Joint				
Estimated Weight	Empty Weight	kg	Bundle Weight	kg	Full Water Weight	kg			
Corrosion Allowance	Shell side	mm	Tube side	mm	Tube Joints :				
Insulation	Shell side	mm	Tube side	mm					

MEAN METAL TEMPERATURE	Temperature, °C		Pressure, kPa.G	
	Shell	Tube	Shell	Tube
Normal Operating	-	-	-	-
Startup	-	-	-	-

NOZZLE	SHELL SIDE				TUBE SIDE			
	Tag	No	NPS	Remarks	Tag	No	NPS	Remarks
Inlet								
Outlet								
Vent								
Drain								
Liquid Outlet								
Thermowell								
Util. Con.								
RATING								

## Blowdown Disposal Water Analysis

Water Analysis (mg/l as ion unless noted)		
	Normal	Max.
Ca <sup>++</sup>	0.36	0.44
Mg <sup>++</sup>	0.36	0.44
Na <sup>+</sup>	3707	10709
K <sup>+</sup>	5.92	36.12
Fe <sup>++</sup>	4.47	8.29
Cu <sup>++</sup>	0.22	0.75
Ba <sup>++</sup>	0.31	3.04
Sr <sup>++</sup>	0.89	8.22
HCO <sub>3</sub> <sup>-</sup>	0.0	0.0
CO <sub>3</sub> <sup>-</sup>	127	333
OH <sup>-</sup>	305	775
SO <sub>4</sub> <sup>-</sup>	18.81	39.60
Cl <sup>-</sup>	4929	14529
Silica ppm as SiO <sub>2</sub>	214.1	282.1
Sulphides ppm as S <sup>-</sup>	0.0	0.0
TOC ppm as TOC	0.48	4.83
TDS ppm as ion	9314	26706
TSS ppm TSS	0.0	0.0
Oil & Grease ppm oil in water	0.0	0.0
Total Hardness ppm as CaCO <sub>3</sub>	2.36	2.89
P-Alk (ppm as CaCO <sub>3</sub> )	1004	2559
M-Alk (ppm as CaCO <sub>3</sub> )	1111	2837
Dissolved O <sub>2</sub>	-	-
Estimated pH	12.16	12.61