



HEAT EXCHANGER RATING DATA SHEET

SI Units

1	Customer		MAN Turbo & Diesel SE		Job No.		
2	Address				Reference No.		
3	Plant Location		JOHNCO		Proposal No.		914066
4	Service of Unit		Cooler 2.2 - 2-S		Date		15.10.2014
5	Size		1200 x 7500		Rev		4
6	Surf/Unit (Gross/Eff)		534,85 / 514,88 m2		Item No.		
7	Type		BEP		Connected In		1 Parallel 1 Series
8	Shell/Unit		1		Surf/Shell (Gross/Eff)		534,85 / 514,88 m2
9	PERFORMANCE OF ONE UNIT						
10	Fluid Allocation		Shell Side		Tube Side		
11	Fluid Name		Water/Glycol 50/50		Wet CO2		
12	Fluid Quantity, Total		kg/s		41,0002		61,1073
13	Vapor (In/Out)						61,0804
14	Liquid		41,0002		41,0002		0,0269
15	Steam						
16	Water						
17	Noncondensables						
18	Temperature (In/Out)		C		26,70		36,52
19	Density		kg/m3		1058,7		1052,5
20	Viscosity		cP		3,0325		2,2916
21	Molecular Weight, Vapor						
22	Molecular Weight, Noncondensables						
23	Specific Heat		kJ/kg-C		3,3483		3,3913
24	Thermal Conductivity		W/m-C		0,4128		0,4100
25	Latent Heat		kJ/kg				2272,93
26	Inlet Pressure		bar		6,000		35,431
27	Velocity x/w		m/s		0,43 / 0,53		2,93
28	Pressure Drop, Allow/Calc		bar		1,000		0,441
29	Fouling Resistance (min)		m2-K/W		0,000090		0,040
30	Heat Exchanged		1357, kW		MTD (Corrected) 8,1 C		Overdesign 4,49 %
31	Transfer Rate, Service		325,16 W/m2-K		Calculated 339,76 W/m2-K		Clean 350,48 W/m2-K
32	CONSTRUCTION OF ONE SHELL						
33			Shell Side		Tube Side		
34	Design/Test Pressure		barG		10,000 / 45,000 /		
35	Design Temperature		C		100,00 / 120,00		
36	No Passes per Shell				1 / 1		
37	Corrosion Allowance		mm		3,00 / 0		
38	Flow Direction						
39	Connections		In mm		1 @ 8" / 1 @ 26"		
40	Size &		Out mm		1 @ 8" / 1 @ 24"		
41	Rating		Liq. Out mm		@ / @		
42	Tube No.		1135		OD 20,000 mm		Thk(Avg) 1,000 mm
43	Tube Type		Plain		Length 7,500 m		Pitch
44	Shell		Carbon steel		Material SS 316L		Layout 30
45	Channel or Bonnet		SS 316L		Shell Cover		
46	Tubesheet-Stationary		SS 316L		Channel Cover		
47	Floating Head Cover				Tubesheet-Floating		SS 316L
48	Baffles-Cross		SS 316L Type		Impingement Plate		None
49	Baffles-Long				%Cut (Diam)		Spacing(c/c)
50	Supports-Tube				Seal Type		Inlet
51	Bypass Seal Arrangement				U-Bend		Type
52	Expansion Joint				Tube-Tubesheet Joint		
53	Rho-V2-Inlet Nozzle		1524,22 kg/m-s2		Bundle Entrance 78,29		Bundle Exit 78,75 kg/m-s2
54	Gaskets-Shell Side				Tube Side		
55	Code Requirements		ASME VIII, Div. 1; U-Stamp		TEMA Class C		
56	Weight/Shell		18506,7		Filled with Water 28567,1		Bundle 6997,32 kg
57	Remarks:						
58	MDMT -17,78 °C						
59							
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SI Units

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5	Customer	MAN Turbo & Diesel SE			Job No.				
6	Address				Reference No.				
7	Plant Location	JOHNCO			Proposal No.	914066			
8	Service of Unit	Cooler 2.2 - 2-I			Date	15.10.2014		Rev 4	
9	Size	1200 x 7500			Type	BEP		Horz.	
10	Surf/Unit (Gross/Eff)	534,85 / 514,88 m2		Shell/Unit	1		Surf/Shell (Gross/Eff)	534,85 / 514,88 m2	
11	PERFORMANCE OF ONE UNIT								
12	Fluid Allocation	Shell Side			Tube Side				
13	Fluid Name	Water/Glycol 50/50			Wet CO2				
14	Fluid Quantity, Total	kg/s			41,0002		61,1193		
15	Vapor (In/Out)						61,1193		
16	Liquid	41,0002			41,0002		0,0235		
17	Steam								
18	Water								
19	Noncondensables								
20	Temperature (In/Out)	C			26,70		36,49		
21	Density	kg/m3			1058,7		1052,6		
22	Viscosity	cP			3,0325		2,2939		
23	Molecular Weight, Vapor								
24	Molecular Weight, Noncondensables								
25	Specific Heat	kJ/kg-C			3,3483		3,3911		
26	Thermal Conductivity	W/m-C			0,4128		0,4101		
27	Latent Heat	kJ/kg					2406,15		
28	Inlet Pressure	bar			6,000		35,421		
29	Velocity x/w	m/s			0,43 / 0,53		2,92		
30	Pressure Drop, Allow/Calc	bar			1,000		0,441		
31	Fouling Resistance (min)	m2-K/W			0,000090				
32	Heat Exchanged	1352, kW		MTD (Corrected) 8,1 C		Overdesign 4,86 %			
33	Transfer Rate, Service	322,86 W/m2-K		Calculated 338,57 W/m2-K		Clean 349,21 W/m2-K			
34	CONSTRUCTION OF ONE SHELL				Sketch (Bundle/Nozzle Orientation)				
35		Shell Side		Tube Side					
36	Design/Test Pressure	barG		10,000 /				45,000 /	
37	Design Temperature	C		100,00				120,00	
38	No Passes per Shell			1				1	
39	Corrosion Allowance	mm		3,00				0	
40	Flow Direction								
41	Connections	In	mm	1 @ 8"		1 @ 26"			
42	Size &	Out	mm	1 @ 8"		1 @ 24"			
43	Rating	Liq. Out	mm	@		@			
44	Tube No.	1135	OD 20,000 mm	Thk(Avg) 1,000 mm	Length 7,500 m	Pitch	Layout 30		
45	Tube Type	Plain			Material SS 316L				
46	Shell	Carbon steel		ID	OD	mm			
47	Channel or Bonnet	SS 316L			Shell Cover				
48	Tubesheet-Stationary	SS 316L			Channel Cover				
49	Floating Head Cover				Tubesheet-Floating SS 316L				
50	Baffles-Cross	SS 316L Type		%Cut (Diam)	Spacing(c/c)		Inlet		
51	Baffles-Long				Seal Type				
52	Supports-Tube				U-Bend		Type		
53	Bypass Seal Arrangement				Tube-Tubesheet Joint				
54	Expansion Joint				Type				
55	Rho-V2-Inlet Nozzle	1524,22 kg/m-s2		Bundle Entrance	78,29	Bundle Exit	78,74 kg/m-s2		
56	Gaskets-Shell Side				Tube Side				
57	-Floating Head								
58	Code Requirements	ASME VIII, Div. 1; U-Stamp			TEMA Class C				
59	Weight/Shell	18506,7		Filled with Water	28567,1	Bundle	6997,32 kg		
60	Remarks:								
61	MDMT -17,78 °C								
62									
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5	Customer	MAN Turbo & Diesel SE			Job No.					
6	Address				Reference No.					
7	Plant Location	JOHNCO			Proposal No.	914066				
8	Service of Unit	Cooler 2.2 - 2-W			Date	15.10.2014		Rev 4		
9	Size	1200 x 7500			Type	BEP Horz.		Item No.		
10	Surf/Unit (Gross/Eff)	534,85 / 514,88 m ²		Shell/Unit	1		Surf/Shell (Gross/Eff)	534,85 / 514,88 m ²		
11	PERFORMANCE OF ONE UNIT									
12	Fluid Allocation	Shell Side			Tube Side					
13	Fluid Name	Water/Glycol 50/50			Wet CO2					
14	Fluid Quantity, Total	kg/s			41,0002					
15	Vapor (In/Out)						61,1243			
16	Liquid	41,0002			41,0002					
17	Steam									
18	Water						0,0236			
19	Noncondensables									
20	Temperature (In/Out)	C			26,70		36,51			
21	Density	kg/m ³			1058,7		1052,5			
22	Viscosity	cP			3,0325		2,2927			
23	Molecular Weight, Vapor									
24	Molecular Weight, Noncondensables									
25	Specific Heat	kJ/kg-C			3,3483		3,3912			
26	Thermal Conductivity	W/m-C			0,4128		0,4100			
27	Latent Heat	kJ/kg					2405,99			
28	Inlet Pressure	bar			6,000		36,001			
29	Velocity x/w	m/s			0,43 / 0,53		2,92			
30	Pressure Drop, Allow/Calc	bar			1,000		0,441			
31	Fouling Resistance (min)	m ² -K/W			0,000090		0,040			
32	Heat Exchanged	1355, kW			MTD (Corrected) 8,1 C		Overdesign 4,53 %			
33	Transfer Rate, Service	323,96 W/m ² -K			Calculated 338,64 W/m ² -K		Clean 349,29 W/m ² -K			
34	CONSTRUCTION OF ONE SHELL				Sketch (Bundle/Nozzle Orientation)					
35		Shell Side		Tube Side						
36	Design/Test Pressure	barG		10,000 /					45,000 /	
37	Design Temperature	C		100,00					120,00	
38	No Passes per Shell			1					1	
39	Corrosion Allowance	mm		3,00					0	
40	Flow Direction									
41	Connections	In	mm	1 @ 8"		1 @ 26"				
42	Size &	Out	mm	1 @ 8"		1 @ 24"				
43	Rating	Liq. Out	mm	@		@				
44	Tube No.	1135	OD 20,000 mm	Thk(Avg) 1,000 mm	Length 7,500 m	Pitch	Layout 30			
45	Tube Type	Plain			Material	SS 316L				
46	Shell	Carbon steel		ID	OD	mm				
47	Channel or Bonnet	SS 316L			Shell Cover					
48	Tubesheet-Stationary	SS 316L			Channel Cover					
49	Floating Head Cover				Tubesheet-Floating	SS 316L				
50	Baffles-Cross	SS 316L Type		%Cut (Diam)	Spacing(c/c)		Inlet			
51	Baffles-Long				Seal Type					
52	Supports-Tube				U-Bend	Type				
53	Bypass Seal Arrangement				Tube-Tubesheet Joint					
54	Expansion Joint				Type					
55	Rho-V2-Inlet Nozzle	1524,22 kg/m-s ²		Bundle Entrance	78,29	Bundle Exit	78,74	kg/m-s ²		
56	Gaskets-Shell Side				Tube Side					
57	-Floating Head									
58	Code Requirements	ASME VIII, Div. 1; U-Stamp			TEMA Class C					
59	Weight/Shell	18506,7		Filled with Water	28567,1	Bundle	6997,32	kg		
60	Remarks:									
61	MDMT -17,78 °C									
62										
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5	Customer	MAN Turbo & Diesel SE		Job No.			
6	Address			Reference No.			
7	Plant Location	JOHNCO		Proposal No.	914066		
8	Service of Unit	Cooler 2.2 - Min. Pressure		Date	15.10.2014		Rev 4
9	Size	1200 x 7500		Item No.			
10	Surf/Unit (Gross/Eff)	534,85 / 514,88 m ²		Type	BEP	Horz.	Connected In 1 Parallel 1 Series
11	Shell/Unit	1		Surf/Shell (Gross/Eff)	534,85 / 514,88 m ²		
PERFORMANCE OF ONE UNIT							
12	Fluid Allocation	Shell Side			Tube Side		
13	Fluid Name	Water/Glycol 50/50			Wet CO2		
14	Fluid Quantity, Total	kg/s		41,0002		45,3202	
15	Vapor (In/Out)					45,3202 45,2904	
16	Liquid	41,0002		41,0002			
17	Steam						
18	Water						
19	Noncondensables						
20	Temperature (In/Out)	C		26,70 34,32		50,00 29,90	
21	Density	kg/m ³		1058,7 1053,9		52,886 58,664 V/L 1001	
22	Viscosity	cP		3,0325 2,4330		0,0173 0,0167 V/L 0,7776	
23	Molecular Weight, Vapor						
24	Molecular Weight, Noncondensables						
25	Specific Heat	kJ/kg-C		3,3483 3,3817		1,0587 1,0843 V/L 4,1873	
26	Thermal Conductivity	W/m-C		0,4128 0,4107		0,0213 0,0198 V/L 0,5951	
27	Latent Heat	kJ/kg				2410,97 2411,36	
28	Inlet Pressure	bar		6,000		28,670	
29	Velocity x/w	m/s		0,43 / 0,53		2,77	
30	Pressure Drop, Allow/Calc	bar		1,000 0,445		0,040 0,026	
31	Fouling Resistance (min)	m ² -K/W		0,000090			
32	Heat Exchanged	1051, kW		MTD (Corrected) 7,6 C		Overdesign 3,66 %	
33	Transfer Rate, Service	268,96 W/m ² -K		Calculated 278,81 W/m ² -K		Clean 285,99 W/m ² -K	
CONSTRUCTION OF ONE SHELL				Sketch (Bundle/Nozzle Orientation)			
35		Shell Side		Tube Side			
36	Design/Test Pressure	barG		10,000 / 45,000 /			
37	Design Temperature	C		100,00 120,00			
38	No Passes per Shell			1 1			
39	Corrosion Allowance	mm		3,00 0			
40	Flow Direction						
41	Connections	In mm		1 @ 8" 1 @ 26"			
42	Size &	Out mm		1 @ 8" 1 @ 24"			
43	Rating	Liq. Out mm		@ @			
44	Tube No.	1135	OD 20,000 mm	Thk(Avg) 1,000 mm	Length 7,500 m	Pitch	Layout 30
45	Tube Type	Plain		Material SS 316L			
46	Shell	Carbon steel	ID	OD mm	Shell Cover		
47	Channel or Bonnet	SS 316L		Channel Cover			
48	Tubesheet-Stationary	SS 316L		Tubesheet-Floating		SS 316L	
49	Floating Head Cover			Impingement Plate		None	
50	Baffles-Cross	SS 316L	Type	%Cut (Diam)	Spacing(c/c)	Inlet	
51	Baffles-Long			Seal Type			
52	Supports-Tube			U-Bend		Type	
53	Bypass Seal Arrangement			Tube-Tubesheet Joint			
54	Expansion Joint			Type			
55	Rho-V2-Inlet Nozzle	1524,22	kg/m-s ²	Bundle Entrance	78,29	Bundle Exit	78,64 kg/m-s ²
56	Gaskets-Shell Side			Tube Side			
57	-Floating Head						
58	Code Requirements	ASME VIII, Div. 1; U-Stamp		TEMA Class C			
59	Weight/Shell	18506,7		Filled with Water	28567,1	Bundle	6997,32 kg
60	Remarks:						
61	MDMT	-17,78 °C					
62							
63							
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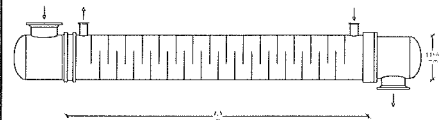
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SI Units

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5	Customer	MAN Turbo & Diesel SE			Job No.			
6	Address				Reference No.			
7	Plant Location	JOHNCO			Proposal No.	914066		
8	Service of Unit	Cooler 2.2 - Max. Pressure			Date	15.10.2014		Rev 3
9	Size	1200 x 7500			Type	BEP	Horz.	Connected In
10	Surf/Unit (Gross/Eff)	534,85 / 514,88 m ²		Shell/Unit	1		Surf/Shell (Gross/Eff)	534,85 / 514,88 m ²
11	PERFORMANCE OF ONE UNIT							
12	Fluid Allocation	Shell Side			Tube Side			
13	Fluid Name	Water/Glycol 50/50			Wet CO2			
14	Fluid Quantity, Total	kg/s			41,0002			
15	Vapor (In/Out)				61,1143			
16	Liquid	41,0002			41,0002			
17	Steam							
18	Water							
19	Noncondensables							
20	Temperature (In/Out)	C			26,70			
21	Density	kg/m ³			1058,7			
22	Viscosity	cP			3,0325			
23	Molecular Weight, Vapor							
24	Molecular Weight, Noncondensables							
25	Specific Heat	kJ/kg-C			3,3483			
26	Thermal Conductivity	W/m-C			0,4128			
27	Latent Heat	kJ/kg			3,3933			
28	Inlet Pressure	bar			6,000			
29	Velocity x/w	m/s			0,43 / 0,53			
30	Pressure Drop, Allow/Calc	bar			1,000			
31	Fouling Resistance (min)	m ² -K/W			0,440			
32	Heat Exchanged	1423, kW			MTD (Corrected)		8,0 C	
33	Transfer Rate, Service	344,49 W/m ² -K			Calculated		347,84 W/m ² -K	
34					Overdesign 0,97 %			
35					Clean 359,08 W/m ² -K			
36	CONSTRUCTION OF ONE SHELL				Sketch (Bundle/Nozzle Orientation)			
37	Design/Test Pressure	barG			Shell Side		Tube Side	
38	Design Temperature	C			10,000 /		45,000 /	
39	No Passes per Shell	mm			1		1	
40	Corrosion Allowance	mm			3,00		0	
41	Flow Direction							
42	Connections	In mm			1 @ 8"		1 @ 26"	
43	Size &	Out mm			1 @ 8"		1 @ 24"	
44	Rating	Liq. Out mm			@		@	
45	Tube No.	1135		OD	20,000 mm		Thk(Avg)	1,000 mm
46	Tube Type	Plain		Length	7,500 m		Pitch	Layout 30
47	Shell	Carbon steel		ID	OD		mm	
48	Channel or Bonnet	SS 316L		Material	SS 316L			
49	Tubesheet-Stationary	SS 316L		Channel Cover	Channel Cover			
50	Floating Head Cover			Tubesheet-Floating	SS 316L			
51	Baffles-Cross	SS 316L Type		Impingement Plate	None			
52	Baffles-Long			%Cut (Diam)	Spacing(c/c)		Inlet	
53	Supports-Tube			Seal Type				
54	Bypass Seal Arrangement			U-Bend	Type			
55	Expansion Joint			Tube-Tubesheet Joint				
56	Rho-V2-Inlet Nozzle	1524,22 kg/m-s ²		Type				
57	Gaskets-Shell Side			Bundle Entrance	78,29		Bundle Exit	78,77 kg/m-s ²
58	-Floating Head			Tube Side				
59	Code Requirements	ASME VIII, Div. 1; U-Stamp			TEMA Class C			
60	Weight/Shell	18506,7		Filled with Water	28567,1		Bundle	6997,32 kg
61	Remarks:							
62	MDMT -17,78 °C							
63								
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1			Job No.	
2			Reference No.	
3	Customer		MAN Turbo & Diesel SE	
4	Address		JOHNCO	
5	Plant Location		JOHNCO	
6	Service of Unit		Cooler 2.2 - Umblasefall	
7	Size		1200 x 7500	
8	Surf/Unit (Gross/Eff)		534,85 / 514,88 m2	
9	Type		BEP	
10	Shell/Unit		1	
11	Surf/Shell (Gross/Eff)		534,85 / 514,88 m2	

PERFORMANCE OF ONE UNIT				
Fluid Allocation		Shell Side		Tube Side
Fluid Name		Water/Glycol 50/50		Wet CO2
Fluid Quantity, Total		49,6073		78,0004
Vapor (In/Out)				77,9676
Liquid		49,6073	49,6073	0,0328
Steam				
Water				
Noncondensables				
Temperature (In/Out)		26,70	36,70	50,00 32,20
Density		1058,7	1052,4	67,873 74,990 V/L 1001
Viscosity		3,0325	2,2807	0,0177 0,0172 V/L 0,7311
Molecular Weight, Vapor				
Molecular Weight, Noncondensables				
Specific Heat		3,3483	3,3921	1,1204 1,1825 V/L 4,1866
Thermal Conductivity		0,4128	0,4100	0,0220 0,0208 V/L 0,5965
Latent Heat				2256,39 2373,51
Inlet Pressure		6,000		35,431
Velocity x/w		0,52 / 0,64		3,76
Pressure Drop, Allow/Calc		1,000	0,612	0,040 0,052
Fouling Resistance (min)		0,000090		
Heat Exchanged		1672, kW	MTD (Corrected) 8,5 C	Overdesign 4,44 %
Transfer Rate, Service		383,62 W/m2-K	Calculated 400,67 W/m2-K	Clean 415,66 W/m2-K

CONSTRUCTION OF ONE SHELL				Sketch (Bundle/Nozzle Orientation)
		Shell Side	Tube Side	
Design/Test Pressure		10,000 /	45,000 /	
Design Temperature		100,00	120,00	
No Passes per Shell		1	1	
Corrosion Allowance		3,00	0	
Flow Direction				
Connections		1 @ 8"	1 @ 26"	
Size & Out		1 @ 8"	1 @ 24"	
Rating		@	@	

44	Tube No.	1135	OD	20,000 mm	Thk(Avg)	1,000 mm	Length	7,500 m	Pitch	Layout	30
45	Tube Type	Plain		Material		SS 316L					
46	Shell	Carbon steel	ID	OD	mm	Shell Cover					
47	Channel or Bonnet	SS 316L		Channel Cover							
48	Tubesheet-Stationary	SS 316L		Tubesheet-Floating		SS 316L					
49	Floating Head Cover			Impingement Plate		None					
50	Baffles-Cross	SS 316L	Type	%Cut (Diam)	Spacing(c/c)	Inlet					
51	Baffles-Long			Seal Type							
52	Supports-Tube			U-Bend		Type					
53	Bypass Seal Arrangement			Tube-Tubesheet Joint							
54	Expansion Joint			Type							
55	Rho-V2-Inlet Nozzle	2231,35 kg/m-s2		Bundle Entrance		114,60	Bundle Exit	115,29	kg/m-s2		
56	Gaskets-Shell Side			Tube Side							
57	-Floating Head										
58	Code Requirements	ASME VIII, Div. 1; U-Stamp				TEMA Class		C			
59	Weight/Shell	18506,7		Filled with Water		28567,1		Bundle		6997,32 kg	

60 Remarks:

61 MDMT -17,78 °C

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