



DEHDASHT PETROCHEMICAL INDUSTRY COMPANY
DEHDASHT HIGH DENSITY POLYETHYLENE PROJECT



Contract No.: DPIC/98-12

DOCUMENT TITLE: Thermal Calculation for Heat Exchangers

POI: IFA

Rev.: D1

DOCUMENT No: DPIC9812-000-VD-1002-ME-CLN-0032

Sheet 1 of 7

Thermal Calculation for Heat Exchangers

PURCHASER'S COMMENT/APPROVAL STATUS

Purchaser: NARGAN

1 AP: Approved (Released for Manufacturing)

2 AN: Approved With Minor Comments (Fabrication may Proceed)

3 NF: Approved With Comments (Fabrication not Proceed)

4 RJ: Rejected

5 NR: Not be Returned

Requisition No.: DPIC98-12-001-000-ME-MR-4150-0001-D1

Item No. (Tag No.): PK-6101

Vendor Doc. No.: DPIC9812-000-VD-1002-ME-CLN-0032-D1

Date: XX.XX.XX

Signature:



D1 02-Dec-21 IFA R.GOUDARZI DR.A.NEJATI DR.A.NEJATI

D0 30-Oct-21 IFA R.GOUDARZI DR.A.NEJATI DR.A.NEJATI

REV.	DATE ISSUE	Purpose of Issue	PREPARED	CHECKED	APPROVED
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Sheet 2 of 7

TABULATION OF REVISED PAGES

Page	Rev-D0	Rev-D1	Rev-D2	Rev-D3	Rev-D4
1	x	x			
2	x	x			
3	x	x			
4		x			
5		x			
6		x			
7		x			
8					
9					
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21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					

Page	Rev-D0	Rev-D1	Rev-D2	Rev-D3	Rev-D4
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
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	<p align="center">DEHDASHT PETROCHEMICAL INDUSTRY COMPANY</p> <p align="center">DEHDASHT HIGH DENSITY POLYETHYLENE PROJECT</p>		
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	<p>DOCUMENT No: DPIC9812-000-VD-1002-ME-CLN-0032</p>	<p align="center">Sheet 3 of 7</p>	

PURPOSE:

The purpose of this document is to calculate Heat exchangers.

Thermal calculation is done by "ASPEN EXCHANGER DESIGN AND RATING V11".

ATTACHMENTS:

Thermal calculation sheets for heat exchangers as below:

- 1- E-6101 (Hexane Cooler)
- 2- E-PK6101-1A/B (Oil Cooler)
- 3- E-PK6101-2 (Propylene Condenser)
- 4- E-PK6101-3 (Economizer)



HEAT EXCHANGER RATING DATA SHEET

CUSTOMER		DEHDASHT PETROCHEMICAL		PACKAGE		PK-6101		REV D1	
Service of Unit		EVAPORATOR		Item No.		E-PK6101-2			
Type	BKU	Orientation		Horizontal		Connected In	1	Parallel	1 Series
Surf/Unit (Gross/Eff)		478.25 / 467.95 m2		Shell/Unit		1		Surf/Shell (Gross/Eff) 478.25 / 467.95 m2	
PERFORMANCE OF ONE UNIT									
Fluid Allocation		Shell Side				Tube Side			
Fluid Name		PROPYLENE				HEXANE			
Fluid Quantity, Total		kg/hr		19500.1		748005			
Vapor (In/Out)		wt%		24.0 100.0		0.0 0.0			
Liquid		wt%		76.0 0.0		100.0 100.0			
Temperature (In/Out)		C		-23.98 -23.98		-16.00 -20.27			
Density		kg/m3		5.7800 V/L 578.8 5.7800		703.25 706.94			
Viscosity		mPa-s		0.0073 V/L 0.141 0.0073		0.4872 0.5147			
Specific Heat		kJ/kg-C		1.4050 V/L 2.214 1.4050		1.9060 1.8875			
Thermal Conductivity		W/m-C		0.0127 V/L 0.128 0.0127		0.1310 0.1325			
Critical Pressure		bar-G							
Inlet Pressure		bar-G		1.607		5.901			
Velocity		m/s		0.37		1.96			
Pressure Drop, Allow/Calc		bar		0.100 5.441e-3		0.500 0.289			
Average Film Coefficient		W/m2-K		1899.56		2225.28			
Fouling Resistance (min)		m2-K/W		0.000170		0.000090			
Heat Exchanged		1687. kW		MTD (Corrected) 5.6 C		Overdesign 8.19 %			
Transfer Rate, Service		647.13 W/m2-K		Calculated 700.11 W/m2-K		Clean 875.07 W/m2-K			
CONSTRUCTION OF ONE SHELL					Sketch (Bundle/Nozzle Orientation)				
		Shell Side		Tube Side					
Design Pressure		barG		23.+F.V 23					
Design Temperature		C		-45 /125 -45 / 125					
No Passes per Shell		1		2					
Flow Direction		Upward		Downward					
Connections		In in		2 @ 8 1 @ 18					
Size &		Out in		2 @ 8 1 @ 18					
Rating		Liq. Out in		@ @					
Tube No.		1740 OD 19.050 mm		Thk(Avg) 2.108 mm		Length 4.200 m		Pitch 24.000 mm Layout 90	
Tube Type		Plain		Material CARBON STEEL		Pairs seal strips 0			
Shell ID		1200.00 mm		Kettle ID 1656.09 mm		Passlane Seal Rod No. 0			
Cross Baffle Type		SUPPORT		%Cut (Diam)		Impingement Plate None			
Spacing(c/c)		820.213 mm		Inlet mm		No. of Crosspasses 1			
Rho-V2-Inlet Nozzle		301.62 kg/m-s2		Shell Entrance 189.05		Shell Exit 13.71 kg/m-s2			
				Bundle Entrance		Bundle Exit kg/m-s2			
Weight/Shell		17048.3		Filled with Water 27339.3		Bundle 7711.71 kg			
Notes: Supports/baffle space = 4.				Thermal Resistance, %		Velocities, m/s		Flow Fractions	
				Shell 36.86		Shellside 0.37		A 0.000	
				Tube 40.40		Tubeside 1.96		B 1.000	
				Fouling 19.99		Crossflow 0.28		C 0.000	
				Metal 2.75		Window 0.00		E 0.000	
								F 0.000	



HEAT EXCHANGER RATING DATA SHEET

CUSTOMER		DEHDASHT PETROCHEMICAL		PACKAGE		PK-6101		REV. D1			
Service of Unit				OIL COOLER		Item No. E-PK6101-1A/B					
Type		BEM		Orientation		Horizontal		Connected In 1 Parallel 1 Series			
Surf/Unit (Gross/Eff)				29.80 / 29.24 m ²		Shell/Unit		1			
Surf/Shell (Gross/Eff)				29.80 / 29.24 m ²							
PERFORMANCE OF ONE UNIT											
Fluid Allocation			Shell Side			Tube Side					
Fluid Name			OIL			JACKETED WATER					
Fluid Quantity, Total		kg/hr		12672.1			22549.0				
Vapor (In/Out)		wt%		0.0		0.0		0.0			
Liquid		wt%		100.0		100.0		100.0			
Temperature (In/Out)		C		80.30		50.00		37.00			
Density		kg/m ³		873.29		886.00		993.59			
Viscosity		mPa-s		1.6365		2.1900		0.6914			
Specific Heat		kJ/kg-C		2.0871		1.8530		4.1773			
Thermal Conductivity		W/m-C		0.1500		0.1500		0.6252			
Critical Pressure		bar-G									
Inlet Pressure		bar-G		20.887			5.901				
Velocity		m/s		0.18			0.64				
Pressure Drop, Allow/Calc		bar		0.200		0.024		1.000			
Average Film Coefficient		W/m ² -K		607.25			4032.85				
Fouling Resistance (min)		m ² -K/W		0.000170			0.000200				
Heat Exchanged		209. kW		MTD (Corrected)		20.1 C		Overdesign 19.15 %			
Transfer Rate, Service		356.40 W/m ² -K		Calculated		424.64 W/m ² -K		Clean 511.55 W/m ² -K			
CONSTRUCTION OF ONE SHELL						Sketch (Bundle/Nozzle Orientation)					
			Shell Side		Tube Side						
Design Pressure			barG		25.000					25.000	
Design Temperature			C		120.00					190.00	
No Passes per Shell			1		4						
Flow Direction			Upward		Upward						
Connections			In mm		1 @ 3					1 @ 3	
Size & Rating			Out mm		1 @ 3		1 @ 3				
Connections			Liq. Out mm		@		@				
Tube No.		166 OD 19.050 mm		Thk(Avg)		1.245 mm		Length 3.000 m			
Pitch		24.000 mm		Layout		30					
Tube Type Plain		Material C.S.		Pairs seal strips		1					
Shell ID		381.000 mm		Kettle ID		mm		Passlane Seal Rod 1 3			
Cross Baffle Type		PERPEND. SINGLE-SEG.		%Cut (Diam)		30.00		Impingement Plate None			
Spacing(c/c)		200.000 mm		Inlet		371.734 mm		No. of Crosspasses 13			
Rho-V2-Inlet Nozzle		623.71 kg/m-s ²		Shell Entrance		434.66		Shell Exit 428.43 kg/m-s ²			
Bundle Entrance		54.21		Bundle Exit		53.44		kg/m-s ²			
Weight/Shell		945.72		Filled with Water		1348.85		Bundle 330.78 kg			
Notes:				Thermal Resistance, %		Velocities, m/s		Flow Fractions			
				Shell 69.93		Shellside 0.18		A 0.074			
				Tube 12.11		Tubeside 0.64		B 0.551			
				Fouling 16.99		Crossflow 0.23		C 0.071			
				Metal 0.97		Window 0.22		E 0.129			
								F 0.175			



HEAT EXCHANGER RATING DATA SHEET

CUSTOMER		DEHDASHT PETROCHEMICAL		PACKAGE		PK-6101		REV. D1	
Service of Unit		CONDENSER		Item No.		E-PK6101-2			
Type	BEM	Orientation		Horizontal		Connected In		1 Parallel 1 Series	
Surf/Unit (Gross/Eff)		558.37 / 539.62 m2		Shell/Unit		1		Surf/Shell (Gross/Eff) 558.37 / 539.62 m2	
PERFORMANCE OF ONE UNIT									
Fluid Allocation		Shell Side				Tube Side			
Fluid Name		PROPYLENE				JACKETED WATER			
Fluid Quantity, Total		kg/hr		27623		289299			
Vapor (In/Out)		wt%		100.0 0.0		0.0 0.0			
Liquid		wt%		0.0 100.0		100.0 100.0			
Temperature (In/Out)		C		80.30 48.33		37.00 45.00			
Density		kg/m3		35.807 467.05		993.59 990.48			
Viscosity		mPa-s		0.0112 0.0668		0.6914 0.5960			
Specific Heat		kJ/kg-C		2.2660 3.2592		4.1773 4.1774			
Thermal Conductivity		W/m-C		0.0267 0.0902		0.6252 0.6352			
Critical Pressure		bar-G							
Inlet Pressure		bar-G		18.924		5.901			
Velocity		m/s		0.52		1.00			
Pressure Drop, Allow/Calc		bar		0.100 0.016		1.000 0.251			
Average Film Coefficient		W/m2-K		1306.59		5496.28			
Fouling Resistance (min)		m2-K/W		0.000200		0.000200			
Heat Exchanged		2682. kW		MTD (Corrected) 9.8 C		Overdesign 32.14 %			
Transfer Rate, Service		505.65 W/m2-K		Calculated 668.18 W/m2-K		Clean 961.77 W/m2-K			
CONSTRUCTION OF ONE SHELL						Sketch (Bundle/Nozzle Orientation)			
		Shell Side		Tube Side					
Design Pressure		barG		23.000+F.V. 23.000					
Design Temperature		C		125.00 190.00					
No Passes per Shell		1		4					
Flow Direction		Downward		Upward					
Connections	In in	1 @ 14		1 @ 12					
Size &	Out in	1 @ 8		1 @ 12					
Rating	Liq. Out in	@		@					
Tube No.		1866 OD 19.050 mm		Thk(Avg) 2.108 mm		Length 5.000 m		Pitch 24.000 mm Layout 60	
Tube Type Plain		Material C.S		Pairs seal strips 1					
Shell ID 1180.00 mm		Kettle ID mm		Passlane Seal Rod 1 6					
Cross Baffle Type PARALLEL SINGLE-SEG.		%Cut (Diam) 35.00		Impingement Plate Circular plate					
Spacing(c/c) 550.000 mm		Inlet 853.652 mm		No. of Crosspasses 8					
Rho-V2-Inlet Nozzle 215.87 kg/m-s2		Shell Entrance 264.49		Shell Exit 99.31 kg/m-s2					
		Bundle Entrance 137.59		Bundle Exit 23.96 kg/m-s2					
Weight/Shell 18042.5		Filled with Water 24647.5		Bundle 9437.36 kg					
Notes:		Thermal Resistance, %		Velocities, m/s		Flow Fractions			
		Shell 51.14		Shellside 0.52		A 0.112			
		Tube 15.61		Tubeside 1.00		B 0.630			
		Fouling 30.53		Crossflow 0.63		C 0.035			
		Metal 2.72		Window 0.57		E 0.131			
						F 0.092			



HEAT EXCHANGER RATING DATA SHEET

CUSTOMER		DEHDASHT PETROCHEMICAL		PACKAGE		PK-6101		REV. D1			
Service of Unit		ECONOMIZER		Item No.		E-PK6101-3					
Type	BEM	Orientation		Horizontal		Connected In		1 Parallel 1 Series			
Surf/Unit (Gross/Eff)		115.38 / 113.93 m2		Shell/Unit		1		Surf/Shell (Gross/Eff) 115.38 / 113.93 m2			
PERFORMANCE OF ONE UNIT											
Fluid Allocation		Shell Side				Tube Side					
Fluid Name		PROPYLENE				PROPYLENE					
Fluid Quantity, Total		kg/hr		19500.1		7042.97					
Vapor (In/Out)		wt%		0.0 0.0		29.0 100.0					
Liquid		wt%		100.0 100.0		71.0 0.0					
Temperature (In/Out)		C		48.55 16.00		12.37 15.00					
Density		kg/m3		461.40 520.94		17.360 V/L 526.8		17.110			
Viscosity		mPa-s		0.0598 0.0894		0.0087 V/L 0.093		0.0087			
Specific Heat		kJ/kg-C		3.3321 2.5837		1.6500 V/L 2.578		1.6550			
Thermal Conductivity		W/m-C		0.0897 0.1062		0.0162 V/L 0.108		0.0165			
Critical Pressure		bar-G									
Inlet Pressure		bar-G		19.007		7.287					
Velocity		m/s		0.21		2.98					
Pressure Drop, Allow/Calc		bar		0.200 0.020		0.100 0.038					
Average Film Coefficient		W/m2-K		966.96		797.30					
Fouling Resistance (min)		m2-K/W		0.000170		0.000170					
Heat Exchanged		508. kW		MTD (Corrected) 14.2 C		Overdesign 7.70 %					
Transfer Rate, Service		314.69 W/m2-K		Calculated 338.93 W/m2-K		Clean 388.11 W/m2-K					
CONSTRUCTION OF ONE SHELL						Sketch (Bundle/Nozzle Orientation)					
		Shell Side		Tube Side							
Design Pressure		barG		23 23+F.V							
Design Temperature		C		125 -45/125							
No Passes per Shell		1		3							
Flow Direction		Upward		Upward							
Connections		In in		1 @ 6 1 @ 4							
Size & Rating		Out in		1 @ 6 1 @ 6							
		Liq. Out in		@ @							
Tube No.		241 OD 25.400 mm		Thk(Avg) 2.108 mm		Length 6.000 m		Pitch 32.000 mm		Layout 30	
Tube Type		Plain		Material LTCS		Pairs seal strips		1			
Shell ID		581.000 mm		Kettle ID		mm		Passlane Seal Rod No		0	
Cross Baffle Type		PERPEND. SINGLE-SEG.		%Cut (Diam) 28.50		Impingement Plate		None			
Spacing(c/c)		300.000 mm		Inlet 412.227 mm		No. of Crosspasses		19			
Rho-V2-Inlet Nozzle		183.04 kg/m-s2		Shell Entrance 752.43		Shell Exit 666.43		kg/m-s2			
		Bundle Entranc		178.21		Bundle Exit 157.84		kg/m-s2			
Weight/Shell		3695.82		Filled with Water 5374.40		Bundle 1929.32		kg			
Notes:				Thermal Resistance, %		Velocities, m/s		Flow Fractions			
				Shell 35.05		Shellside 0.21		A 0.175			
				Tube 50.97		Tubeside 2.98		B 0.632			
				Fouling 12.67		Crossflow 0.29		C 0.051			
				Metal 1.31		Window 0.30		E 0.142			
								F 0.000			