PPI / NARGAN	**DEHDASHT PETROCHEMICAL INDUSTRY COMPANY** **DEHDASHT HIGH DENSITY POLYETHYLENE PROJECT**	شرکت صنایع پتروشیمی خلیج فارس Persian Gulf Petrochemical Industries Co PGPIC شرکت صنایع پتروشیمی دهدشت (سهامی عام)
Contract No.: DPIC/98-12	**DOCUMENT TITLE: Thermal Calculation for Heat Exchangers**	**POI: IFA** / **Rev.: D2**
	DOCUMENT No: DPIC9812-000-VD-1002-ME-CLN-0032	**Sheet 1 of 3**

Refer to item C.5 of TCL please submit simulation file of refrigeration cycle and HTRI thermal files.

Please check the comments reply on revision D1 and implement the unclosed ones.

Thermal Calculation for

GENERAL COMMENT:
1- As per Doc. No. DPC-PR-CRT-0001 equipment design criteria (MR attachment) 10% safety overdesign shall be considered on design case for heat exchanger sizing.
2- MDMT=-45C to be considered for all equipment.
3- Please recheck design condition of all equipment. Design condition of each eq shall be in conjunction of downstream and upstream eq.

PURCHASER'S COMMENT/APPROVAL STATUS	
1	AP: Approved (Released for Manufacturing)
X	AN: Approved With Minor Comments (Fabrication may Proceed)
3	NF: Approved With Comments (Fabrication not Proceed)
4	RJ: Rejected
5	NR: Not be Returned
Date: 09.01.2022	Signature: A.AB

Purchaser: NARGAN

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-D2

REV.	DATE ISSUE	Purpose of Issue	PREPARED	CHECKED	APPROVED
D2	24-Dec-21	IFA	R.GOUDARZI	DR.A.NEJATI	DR.A.NEJATI
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

KASRAVAND Engineering & Construction

TABULATION OF REVISED PAGES

Page	Rev-D0	Rev-D1	Rev-D2	Rev-D3	Rev-D4
1	x	x	x		
2	x	x	x		
3	x	x	x		
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36					
37					
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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. D2
Type BKU	Orientation Horizontal	Connected In 1 Parallel 1 Series	
Surf/Unit (Gross/Eff) 478.25 / 467.95 m2	Shell/Un	25 / 467.95 m2	

This flowrate causes less duty than design duty. Flowrate shall be corrected.

PERFORM

Fluid Allocation		Shell Side		Tube Side	
Fluid Name		PROPYLENE		HEXANE	
Fluid Quantity, Total	kg/hr	19500.0		748000	
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	cP	0.0073 V/L 0.1408	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-K	0.0127 V/L 0.1275	0.0127	0.1309	0.1324
Critical Pressure	bar				
Inlet Pressure	bar	2.620		6.914	
Velocity			0.37		2.36
Pressure Drop, Allow/		.100	5.441e-3	0.500	0.438
Average Film Coefficient	W/m2-K	1900.65		629.72	
Fouling Resistance (min)	m2-K/W	0.000170		0.000090	

Design duty is 1750KW.

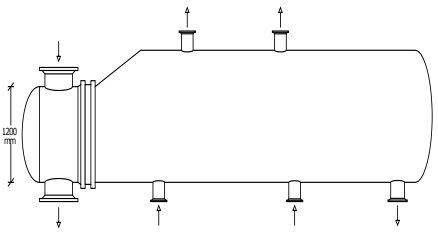
-45/135

Heat Exchanged	1688. kW	MTD (Corrected) 5.6 C	Overdesign 9.29 %
Transfer Rate, Service	647.45 W/m2-K	Calculated 707.61 W/m2-K	Clean 895.96 W/m2-K

CONSTRUCTION OF ONE SHELL

			Shell Side	Tube Side
Design Pressure		barG	23.0 + F.V	23.0
Design Temperature		C	-45/125.0	-45/125.0
No Passes per Shell			1	2
Flow Direction			Upward	Downward
Connections	In	in	2 @ 8	1 @ 20
Size &	Out	in	2 @ 8	1 @ 20
Rating	Liq. Out	mm	@	@

Sketch (Bundle/Nozzle Orientation)



Tube No. 1740	OD 19.050 mm	Thk(Avg) 2.769 mm	Length 4200. mm	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 301.61 kg/m-s2		Shell Entrance 189.05		Shell Exit 13.71	kg/m-s2
		Bundle Entrance		Bundle Exit	kg/m-s2
Weight/Shell 18895.7		Filled with Water 28951.6		Bundle 9559.12 kg	

Notes: Supports/baffle space = 4.

Thermal Resistance, %		Velocities, m/s		Flow Fractions	
Shell	37.23	Shellside	0.37	A	0.000
Tube	37.94	Tubeside	2.36	B	1.000
Fouling	21.02	Crossflow	0.28	C	0.000
Metal	3.81	Window	0.00	E	0.000
				F	0.000

HTRI

HE ATA SHEET

Based on mechanical data (Tubesheet THK) eff surface is less than 29.24m2. Please input all data for checking before print the result.

CUSTOMER	DEHDASHT PETROCHEMICAL	GE PK-6101	REV. D2
Service of Unit	OIL COOLER	E-PK6101-1A/B	
Type	BEM	Orientation ed In 1 Parallel 1 Series	
Surf/Unit (Gross/Eff)	29.80 / 29.24 m2	Sh ell (Gross/Eff) 29.80 / 29.24 m2	

PER

Cooling water velocity in carbon steel tubes shall be within 1-3m/s.

Please check the Flow rate with PFD-027

Fluid Allocation		Shell Side		Tube	
Fluid Name		OIL		JACKETED WATER	
Fluid Quantity, Total	kg/hr	12672.0		225	
Vapor (In/Ou		0.0	0.0	0.0	0.0
Liquid		100.0	100.0	100.0	100.0
Temperature		80.30	50.00	37.00	45.00
Density	kg/m3	873.29	886.00	993.59	990.48
Viscosity	cP	1.6365	2.1900	0.6914	0.5960
Specific Heat	kJ/kg-C	2.0871	1.8530	4.1773	4.1774
Thermal Conductivity	W/m-K	0.1500	0.1500	0.6252	0.6352
Critical Pressure	bar				
Inlet Pressure	bar	21.900		6.914	
Velocity	m/s		0.18		0.79
Pressure Drop, Allow/Calc	bar	0.200	0.024		0.146
Average Film Coefficient	W/m2-K	607.19			.65
Fouling Resistance (min)	m2-K/W	0.000170			0200

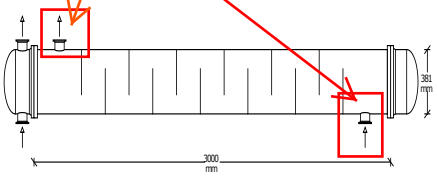
-45/135

For optimum performance inlet nozzle shall be located at top of shell and outlet at bottom of shell.

Heat Exchanged	209. kW	MTD (Corrected)	20.1 C	08 %
Transfer Rate, Service	356.38 W/m2-K	Calculated	420.80 W/m2-K	W/m2-K

CONSTRUCTION OF ONE SHELL			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	in	1 @ 3	1 @ 3
Size &	Out	in	1 @ 3	1 @ 3
Rating	Liq. Out	mm	@	@

Sketch (Bundle/Nozzle Orientation)



there is discrepancy between No. baffle and cross pass.

Tube No.	166 OD 19.050 mm	Thk(Avg) 2.108 mm	Length 3000. mm	ayout 30	
Tube Type	Plain	Material CARBON STEEL		Pair	
Shell ID	381.001 mm	Kettle ID	mm	Passlane Seal Rod No. 3	
Cross Baffle Type	PERPEND. SINGLE-SEG.	%Cut (Diam) 30.00		Impingement Plate	None
Spacing(c/c)	200.000 mm	Inlet 371.752	mm	No. of Crosspasses	13
Rho-V2-Inlet Nozzle	623.71 kg/m-s2	Shell Entrance	434.65	Shell Exit 428.41	kg/m-s2
		Bundle Entrance	54.21	Bundle Exit 53.43	kg/m-s2
Weight/Shell	1111.57	Filled with Water	1493.53	Bundle 496.63	kg

Notes:	Thermal Resistance, %		Velocities, m/s		Flow Fractions	
	Shell	69.30	Shellside	0.18	A	0.074
	Tube	11.01	Tubeside	0.79	B	0.551
	Fouling	17.97	Crossflow	0.23	C	0.071
	Metal	1.71	Window	0.22	E	0.129
					F	0.175

HTRI

HEAT E SHEET

This surface is under design Please send the thermal file for checking or increase the surface.

CUSTOMER	DEHDASHT PETROCHEMICAL	PK-6101	REV. D2
Service of Unit	CONDENSER	PK6101-2	
Type	BEM	Orientation Horizontal	Connected In 1 Parallel 1 Series
Surf/Unit (Gross/Eff)	539.22 / 521.12 m2	Shell/Unit 1	Surf/Shell (Gross/Eff) 539.22 / 521.12 m2

PERFORMANCE OF ONE UNIT

Fluid Allocation		Shell Side		Tube Side	
Fluid Name		PROPYLENE		JACKETED WATER	
Fluid Quantity, Total	kg/hr	27623.0		289043	
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	35.806	467.05	993.59	990.48
Viscosity	cP	0.0112	0.0668	0.6914	0.5960
	kg-C	2.2660	3.2592	4.1773	4.1774
	m-K	0.0267	0.		0.6352
		19.937		6.914	
	s				1.01
Pressure Drop, Allow/Calc	bar	0.100	0		0.267
Average Film Coefficient	W/m2-K	1284.73		5641.46	
Fouling Resistance (min)	m2-K/W	0.000200		0.000200	

Propylene fouling factor in E-6101 and E-6101-3 is considered 0.0017w/m2k Please clarify.

Nozzle allocation is changed wrongly. Please revers same as previous revision.

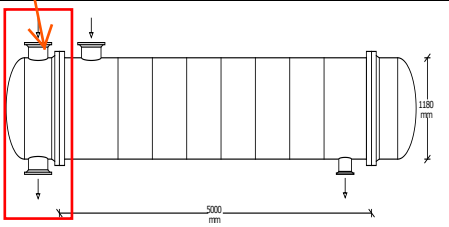
-45/135

Heat Exchanged	2682. kW	MTD (Corrected) 9.8 C	Overdesign 26.63 %
Transfer Rate, Service	525.10 W/m2-K	Calculated 664.93 W/m2-K	Clean 955.33 W/m2-K

CONSTRUCTION OF ONE SHELL

			Shell Side	Tube Side
Design Pressure		barG	23.0 + F.V	23.0
Design Temperature		C	125.00	190.00
No Passes per Shell			1	4
Flow Direction			Downward	Downward
Connections	In	in	1 @ 12	1 @ 12
Size &	Out	in	1 @ 8	1 @ 12
Rating	Liq. Out	mm	@	@

Sketch (Bundle/Nozzle Orientation)



Discrepancy with DWG.

Tube No.	1802 OD 19.050 mm	Thk(Avg) 2.108 mm	Length 5000. mm	Pitch 2	
Tube Type	Plain	Material CARBON STEEL		Pairs seal strips	1
Shell ID	1180.00 mm	Kettle ID mm		Passlane Seal Rod No.	21
Cross Baffle Type	PARALLEL SINGLE-SEG.	%Cut (Diam) 35.00		Impingement Plate	Circular plate
Spacing(c/c)	550.000 mm	Inlet 853.686 mm		No. of Crosspasses	8
Rho-V2-Inlet Nozzle	284.39 kg/m-s2	Shell Entrance	376.09	Shell Exit 24.06	kg/m-s2
		Bundle Entrance	142.77	Bundle Exit 10.48	kg/m-s2
Weight/Shell	17792.0	Filled with Water	24424.7	Bundle	9194.71 kg

Notes:	Thermal Resistance, %		Velocities, m/s		Flow Fractions	
	Shell	51.76	Shellside	0.63	A	0.107
	Tube	15.14	Tubeside	1.01	B	0.556
	Fouling	30.40	Crossflow	0.74	C	0.040
	Metal	2.71	Window	0.69	E	0.130
					F	0.167

HEAT EXCHANGER RATING DATA SHEET

CUSTOMER	DEHDASHT PETROCHEMICAL		PACKAGE	PK-6101	REV. D2
Service of Unit	ECONOMIZER		Item No.	E-PK6101-3	
Type	BEM	Orientation Horizontal	Connected In	1 Parallel 1 Series	
Surf/Unit (Gross/Eff)	115.39 / 113.93 m2	Shell/Unit 1	Surf/Shell (Gross/Eff)	115.39 / 113.93 m2	

PERFORMANCE OF ONE UNIT

Fluid Allocation		Shell Side		Tube Side	
Fluid Name		PROPYLENE		PROPYLENE	
Fluid Quantity, Total	kg/hr	19500.0		7038.39	
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 526.76	17.110
Viscosity	cP	0.0598	0.0894	0.0087 V/L 0.0933	0.0087
Specific Heat	kJ/kg-C	3.3320	2.5836	1.6500 V/L 2.578	1.6550
Thermal Conductivity	W/m-K	0.0897	0.1061	0.0162 V/L 0.1081	0.0165
Critical Pressure	bar				
Inlet Pressure	bar	20.020		8.300	
Velocity	m/s		0.21		3.42
Pressure Drop, Allow/Calc	bar	0.200	0.020		0.049
Average Film Coefficient	W/m2-K	967.84		42.07	
Fouling Resista		0.000170		00170	

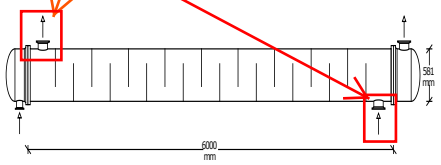
-45/135

For optimum performance inlet nozzle shall be located at top of shell and outlet at bottom of shell.

Heat Exchanged	508. kW	MTD (Corrected)	14.2 C	2.28 %
Transfer Rate, Service	314.62 W/m2-K	Calculated	353.27 W/m2-K	W/m2-K

CONSTRUCTION OF ONE SHELL

Sketch (Bundle/Nozzle Orientation)



			Shell Side	Tube Side
Design Pressure		barG	23.0	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 &	Out	in	1 @ 6	1 @ 6
Rating	Liq. Out	mm	@	@

Tube No.	241	OD 25.400 mm	Thk(Avg) 2.769 mm		Length 6000. mm	Pitch 32.000 mm	Layout 30
Tube Type	Plain		Material CARBON STEEL			Pairs seal strips	1
Shell ID	581.001 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 412.257	mm		No. of Crosspasses	19
Rho-V2-Inlet Nozzle	183.04 kg/m-s2		Shell Entrance	752.37		Shell Exit 666.38	kg/m-s2
			Bundle Entrance	178.17		Bundle Exit 157.81	kg/m-s2
Weight/Shell	4178.64		Filled with Water	5795.66		Bundle	2412.12 kg

Dry wall mist flow, film and transition boiling regime are expected for the boiling fluid.
Please resolve the problems or send the thermal file for checking.

						Flow Fractions	
					side	0.21	A 0.175
					side	3.42	B 0.632
					sflow	0.29	C 0.051
			Metal	1.85	Window	0.30	E 0.142
							F 0.000