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.: D3
	DOCUMENT No: DPIC9812-000-VD-1002-ME-CLN-0032	Sheet 1 of 3	

Previous revision comments shall be implemented as per agreement in meeting in order to consider flowrate 1.1x748000 for 1750 kw duty

Thermal Calculation for Heat Exchangers

PURCHASER'S COMMENT/APPROVAL STATUS	
1	AP: Approved (Released for Manufacturing)
✖	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: 06.03.2022	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-D3

REV.	DATE ISSUE	Purpose of Issue	PREPARED	CHECKED	APPROVED
D3	27-Jan-22	IFA	R.GOUDARZI	DR.A.NEJATI	DR.A.NEJATI
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

This document is the property of DPIC Any unauthorized attempt to reproduce it, in any form, is strictly prohibited.

TABULATION OF REVISED PAGES

Page	Rev-D0	Rev-D1	Rev-D2	Rev-D3	Rev-D4
1	x	x	x	x	
2	x	x	x	x	
3	x	x	x		
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
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					
51					
52					
53					
54					
55					
56					
57					
58					
59					
60					
61					
62					
63					
64					
65					
66					
67					
68					
69					
70					

This document is the property of DPIC Any unauthorized attempt to reproduce it, in any form, is strictly prohibited.

PURPOSE:

The purpose of this document is to calculate Heat exchangers.

Thermal calculation is done by “HTRI V.6”.

ATTACHMENTS:

Thermal calculation sheets for heat exchangers as below:

1- E-6101 (Evaporator)

2- E-PK6101-1A/B (Oil Cooler)

3- E-PK6101-2 (Condenser)

4- E-PK6101-3 (Economizer)

This document is the property of DPIC Any unauthorized attempt to reproduce it, in any form, is strictly prohibited.

HEAT EXCHANGER RATING DATA SHEET

CUSTOMER	DEHDASHT PETROCHEMICAL	PACKAGE PK-6101	REV. D3
Service of Unit	EVAPORATOR	Item No. E-6101	
Type BKU	Orientation Horizontal	Connected In 1 Parallel 1 Series	
Surf/Unit (Gross/Eff) 478.26 / 467.96 m2	Shell/Unit 1	Surf/Shell (Gross/Eff) 478.26 / 467.96 m2	

PERFORMANCE OF ONE UNIT

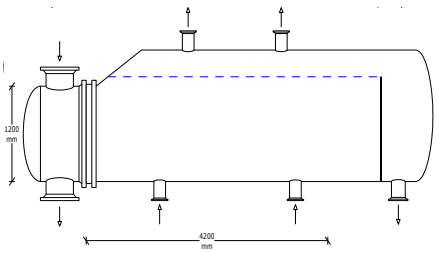
Fluid Allocation		Shell Side		Tube Side	
Fluid Name		PROPYLENE		HEXANE	
Fluid Quantity, Total	kg/hr	19500.0		748000	
Vapor (In/Out)	wt%	24.0	100.0	0.0	0.0
Liquid	wt%	76.0	0.0	100.0	100.0
Temperature (In/Out)	C	-23.98	-23.98	-16.00	-20.27
Density	kg/m3	5.7800 V/L 578.8	5.7800	703.25	706.94
Viscosity	cP	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 0.1276	0.0127	0.1310	0.1325
Critical Pressure	bar				
Inlet Pressure	bar	2.620		6.914	
Velocity	m/s		0.37		2.36
Pressure Drop, Allow/Calc	bar	0.100	5.441e-3	0.500	0.438
Average Film Coefficient	W/m2-K	1901.08		2630.35	
Fouling Resistance (min)	m2-K/W	0.000170		0.000090	

Heat Exchanged	1688. kW	MTD (Corrected) 5.6 C	Overdesign 9.29 %
Transfer Rate, Service	647.54 W/m2-K	Calculated 707.73 W/m2-K	Clean 896.16 W/m2-K

CONSTRUCTION OF ONE SHELL

			Shell Side	Tube Side
Design Pressure		barG	23.0 + F.V.	23.0
Design Temperature		C	-45.0 / 135.0	-45.0 / 135.0
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) 820.222 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 18895.9	Filled with Water 28951.8		Bundle 9559.24 kg		

Notes: Supports/baffle space = 4.

Thermal Resistance, %		Velocities, m/s		Flow Fractions	
Shell	37.23	Shellside	0.37	A	0.000
Tube	37.93	Tubeside	2.36	B	1.000
Fouling	21.03	Crossflow	0.28	C	0.000
Metal	3.81	Window	0.00	E	0.000
				F	0.000

HEAT EXCHANGER RATING DATA SHEET

CUSTOMER	DEHDASHT PETROCHEMICAL	PACKAGE PK-6101	REV. D2
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 m2	Shell/Unit 1	Surf/Shell (Gross/Eff) 29.80 / 29.24 m2

PERFORMANCE OF ONE UNIT

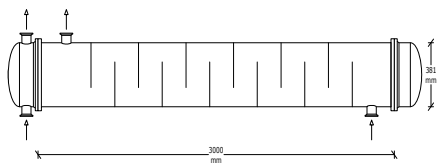
Fluid Allocation		Shell Side		Tube Side	
Fluid Name		OIL		JACKETED WATER	
Fluid Quantity, Total	kg/hr	12586.0		22395.6	
Vapor (In/Out)	wt%	0.0	0.0	0.0	0.0
Liquid	wt%	100.0	100.0	100.0	100.0
Temperature (In/Out)	C	80.30	50.00	37.00	45.00
Density	kg/m3	873.29	886.00	993.59	990.48
Viscosity	cP	1.6365	2.1900	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	19.900		6.914	
Velocity	m/s		0.18		0.79
Pressure Drop, Allow/Calc	bar	0.200	0.024	1.000	0.144
Average Film Coefficient	W/m2-K	604.80		4882.14	
Fouling Resistance (min)	m2-K/W	0.000170		0.000200	

Heat Exchanged	208. kW	MTD (Corrected) 20.1 C	Overdesign 18.49 %
Transfer Rate, Service	353.96 W/m2-K	Calculated 419.40 W/m2-K	Clean 510.93 W/m2-K

CONSTRUCTION OF ONE SHELL

			Shell Side	Tube Side
Design Pressure		barG	25.0	25.0
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)



Tube No.	166 OD 19.050 mm	Thk(Avg) 2.108 mm	Length 3000. mm	Pitch 24.000 mm	Layout 30
Tube Type	Plain	Material CARBON STEEL		Pairs seal strips	1
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 325.001 mm		No. of Crosspasses	13
Rho-V2-Inlet Nozzle	615.27 kg/m-s2	Shell Entrance	428.77	Shell Exit 422.62	kg/m-s2
		Bundle Entrance	69.96	Bundle Exit 41.59	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	69.35	Shellside	0.18	A	0.074
	Tube	11.03	Tubeside	0.79	B	0.551
	Fouling	17.91	Crossflow	0.23	C	0.071
	Metal	1.71	Window	0.22	E	0.129
					F	0.175

HEAT EXCHANGER RATING DATA SHEET

CUSTOMER	DEHDASHT PETROCHEMICAL	PACKAGE PK-6101	REV. D3
Service of Unit	CONDENSER	Item No. E-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

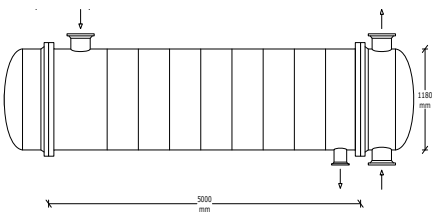
Fluid Allocation		Shell Side		Tube Side	
Fluid Name		PROPYLENE		JACKETED WATER	
Fluid Quantity, Total	kg/hr	26500.0		289043	
Vapor (In/Out)	wt%	100.0	0.0	0.0	0.0
Liquid	wt%	0.0	100.0	100.0	100.0
Temperature (In/Out)	C	80.30	48.40	37.00	45.00
Density	kg/m3	35.722	466.87	993.59	990.48
Viscosity	cP	0.0111	0.0668	0.6914	0.5960
Specific Heat	kJ/kg-C	2.2644	3.2608	4.1773	4.1774
Thermal Conductivity	W/m-K	0.0267	0.0902	0.6252	0.6352
Critical Pressure	bar				
Inlet Pressure	bar	19.900		6.914	
Velocity	m/s		0.59		1.01
Pressure Drop, Allow/Calc	bar	0.100	0.018	1.000	0.267
Average Film Coefficient	W/m2-K	1283.36		5642.08	
Fouling Resistance (min)	m2-K/W	0.000170		0.000200	

Heat Exchanged	2627. kW	MTD (Corrected) 9.7 C	Overdesign 27.98 %
Transfer Rate, Service	529.86 W/m2-K	Calculated 678.11 W/m2-K	Clean 954.60 W/m2-K

CONSTRUCTION OF ONE SHELL

			Shell Side	Tube Side
Design Pressure		barG	23.0 + F.V.	23.0
Design Temperature		C	-45.0 / 135.0	190.00
No Passes per Shell			1	4
Flow Direction			Downward	Upward
Connections	In	in	1 @ 12	1 @ 12
Size &	Out	in	1 @ 8	1 @ 12
Rating	Liq. Out	mm	@	@

Sketch (Bundle/Nozzle Orientation)



Tube No.	1802 OD 19.050 mm	Thk(Avg) 2.108 mm	Length 5000. mm	Pitch 24.000 mm	Layout 60
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)	500.000 mm	Inlet 854.001 mm		No. of Crosspasses	9
Rho-V2-Inlet Nozzle	262.35 kg/m-s2	Shell Entrance	346.94	Shell Exit 22.16	kg/m-s2
		Bundle Entrance	131.60	Bundle Exit 18.48	kg/m-s2
Weight/Shell	17846.3	Filled with Water	24472.1	Bundle	9249.03 kg

Notes:	Thermal Resistance, %		Velocities, m/s		Flow Fractions	
	Shell	52.84	Shellside	0.59	A	0.114
	Tube	15.43	Tubeside	1.01	B	0.545
	Fouling	28.96	Crossflow	0.70	C	0.039
	Metal	2.76	Window	0.59	E	0.139
					F	0.162

HEAT EXCHANGER RATING DATA SHEET

CUSTOMER	DEHDASHT PETROCHEMICAL	PACKAGE PK-6101	REV. D3
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 / 113.79 m2	Shell/Unit 1	Surf/Shell (Gross/Eff) 115.39 / 113.79 m2	

PERFORMANCE OF ONE UNIT

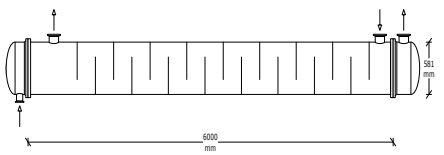
Fluid Allocation		Shell Side		Tube Side	
Fluid Name		PROPYLENE		PROPYLENE	
Fluid Quantity, Total	kg/hr	19500.0		7002.45	
Vapor (In/Out)	wt%	0.0	0.0	29.0	100.0
Liquid	wt%	100.0	100.0	71.0	0.0
Temperature (In/Out)	C	48.40	16.00	12.37	15.00
Density	kg/m3	461.73	520.93	17.360 V/L 526.76	17.110
Viscosity	cP	0.0599	0.0894	0.0087 V/L 0.0933	0.0087
Specific Heat	kJ/kg-C	3.3267	2.5839	1.6500 V/L 2.578	1.6550
Thermal Conductivity	W/m-K	0.0898	0.1061	0.0162 V/L 0.1081	0.0165
Critical Pressure	bar				
Inlet Pressure	bar	19.900		8.300	
Velocity	m/s		0.21		3.39
Pressure Drop, Allow/Calc	bar	0.200	0.019	0.100	0.048
Average Film Coefficient	W/m2-K	937.52		934.72	
Fouling Resistance (min)	m2-K/W	0.000170		0.000170	

Heat Exchanged	506. kW	MTD (Corrected) 14.1 C	Overdesign 10.61 %
Transfer Rate, Service	314.50 W/m2-K	Calculated 347.86 W/m2-K	Clean 402.08 W/m2-K

CONSTRUCTION OF ONE SHELL

			Shell Side	Tube Side
Design Pressure		barG	23.0	23.0 + F.V.
Design Temperature		C	-45.0 / 135.0	-45.0 / 135.0
No Passes per Shell			1	3
Flow Direction				Upward
Connections	In	in	1 @ 6	1 @ 4
Size &	Out	in	1 @ 6	1 @ 6
Rating	Liq. Out	mm	@	@

Sketch (Bundle/Nozzle Orientation)



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 350.000 mm		No. of Crosspasses 18		
Rho-V2-Inlet Nozzle 182.91 kg/m-s2	Shell Entrance 751.84		Shell Exit 666.39	kg/m-s2	
	Bundle Entrance 247.02		Bundle Exit 45.60	kg/m-s2	
Weight/Shell 4228.95	Filled with Water 5845.51		Bundle 2416.66 kg		

Notes:	Thermal Resistance, %		Velocities, m/s		Flow Fractions	
	Shell	37.10	Shellside	0.21	A	0.175
	Tube	47.59	Tubeside	3.39	B	0.632
	Fouling	13.49	Crossflow	0.29	C	0.051
	Metal	1.82	Window	0.30	E	0.142
					F	0.000