



DEHDASHT PETROCHEMICAL INDUSTRY COMPANY



DEHDASHT HIGH DENSITY POLYETHYLENE PROJECT



Contract No

**Thermal general notes/ comments:**

- 1-Since it is not possible to input real tube material in HTRI Ver.6 and this item effect on overall U calculation, so we will check the design with HTRI Ver. 7 and inform vendor to resolve the problems if any.
- 2-all mechanical consideration shall be consider in your thermal file same as total tube sheet thk. baffles thk. floating head distance ,nozzles accepted preliminary thk.
- 3-tube passes arrangement shall be added to each report for creating thermal file or can be send the related thermal file for checking.
- 4-Tube bundle lay out shall be added to each thermal file.
- 5-By pass sealing device shall be announced based on your tube layout design. (in each items)

## Thermal Calculation for Heat Exchangers

- 1- HTRI VER. 7 has bug and problem in it's results so we can not trust it. it is not acceptable.
- 2- CLIENT comment is not acceptable. this primitive thermal calculation is for sizing a heat exchanger base on heat transfer factors. all thickness will be consider in mechanical design and rechecked.
- 3- this item will be given in heat exchanger data sheet and then in mechanical drawing.
- 4- this item will be given in heat exchanger data sheet and then in mechanical drawing.
- 5- will be given in mechanical drawing with all details. this is THERMAL calculation.

1	AP: Approved (Released for Manufacturing)					
2	AN: Approved With Minor Comments (Fabrication may Proceed)					Requisition No.: DPIC98-12-001-000-ME-MR-4150-0001-D1
	NF: Approved With Comments (Fabrication not Proceed)					
4	RJ: Rejected					
5	NR: Not be Returned					Item No. (Tag No.): PK-6101
Date:	12.12.2021	Signature:	A.AB			Vendor Doc. No.: DPIC9812-000-VD-1002-ME-CLN-0032-D1
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	
<b>REV.</b>	<b>DATE ISSUE</b>	<b>Purpose of Issue</b>	<b>PREPARED</b>	<b>CHECKED</b>	<b>APPROVED</b>	



**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 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			
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	<b>DEHDASHT PETROCHEMICAL INDUSTRY COMPANY</b>  <b>DEHDASHT HIGH DENSITY POLYETHYLENE PROJECT</b>		
<b>Contract No.: DPIC/98-12</b>	<b>DOCUMENT TITLE: Thermal Calculation for Heat Exchangers</b>	<b>POI: IFA</b>	<b>Rev.: D1</b>
	<b>DOCUMENT No: DPIC9812-000-VD-1002-ME-CLN-0032</b>	<b>Sheet 3 of 7</b>	

**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

design factor for package is 1.1  
this evaporator over design is 10%. so we have no problem in this case

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

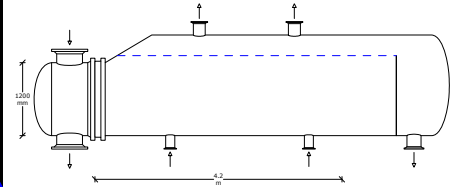
Fluid Allocation		Shell Side	Tube Side
Fluid Name		PROPYLENE	HEXANE
Fluid Quantity, Total	kg/hr		48005
Vapor (In/Out)	wt%	24	0.0
Liquid	wt%	76	100.0
Temperature (In/Out)	C	-23	-16.00
Density	kg/m3	5.7800	703.25
Viscosity	mPa-s	0.0073	0.4872
Specific Heat	kJ/kg-C	1.4050	1.9060
Thermal Conductivity	W/m-C	0.0127	0.1310
Critical Pressure	bar-G		
Inlet Pressure	bar-G		5.901
Velocity	m/s		1.96
Pressure Drop, Allow/Calc	bar	0.1	0.500
Average Film Coefficient	W/m2-K		2225.28
Fouling Resistance (min)	m2-K/W		0.000090
Heat Exchanged	1687. kW		Overdesign 8.19 %
Transfer Rate, Service	647.13 W/m2-K		Clean 875.07 W/m2-K

This is normal flowrate of package. It seems that comments on previous revision were confusing. internal package design is by vendor previous design was acceptable and comments can be ignored but this design is not acceptable since flowrate is less than design flowrate.

CONSTRUCTION OF ONE SHELL

		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 & Rating	Out in	2 @ 8	@
	Liq. Out in	@	@

Sketch (Bundle/Nozzle Orientation)



nozzle location is OK

Please recheck inlet nozzles location with considering shell side inlet flow states it is recommended to relocated on side instead of bottom.

entrainment ratio is not in TEMA STANDARD so we do not mention it in our thermal calculation. also this item is not in HTRI report and we can not edit report. any way, this kettle is designed so that no liquid escapes from it

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

entrainment ratio shall be reported in your design too.



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 m2 Shell/Unit 1 Surf/Shell (Gross/Eff) 29.80 / 29.24 m2

PERFORMANCE OF ONE UNIT

Table with columns: Fluid Allocation, Shell Side, Tube Side. Rows include Fluid Name (OIL, JACKETED WATER), Fluid Quantity, Vapor/Liquid wt%, Temperature, Density, Viscosity, Specific Heat, Thermal Conductivity, Critical Pressure, Inlet Pressure, Velocity, Pressure Drop, Average Film Coefficient, Fouling Resistance, Heat Exchanger Duty.

Corrected as much as possible no more changes can not be apply

CW velocity is too low shall be increased up to 1m/s.

nozzle location is OK and responsibility of package designer.

for carbon steel tubes 2.11 mm shall be considered as min tube thickness with 19.05mm OD.

hot fluid to be interred from top.

will be given in heat exchanger data sheet

tube pass arrangement shall be specified

will be corrected in next revision.

nozzles shall be specified

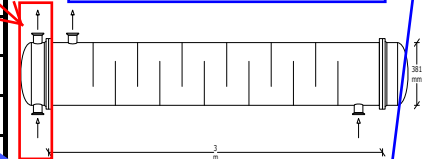
comment is not clear

Please specify real material for checking.

At your request for using HTRI software, as you know we can not specify type of material in this software in detail. in addition, type of c.s is not effect in thermal calculation in this step. material will be given in data sheet and drawing.

cut is OK.

with consider liquid fluid in the shell selected cut is so high please recheck



HEAT EXCHANGER RATING DATA SHEET											
CUS		ROCHEMICAL			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 m <sup>2</sup>		Shell/Unit		1 Surf/Shell (Gross/Eff) 558.37 / 539.62 m <sup>2</sup>					
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			
Liquid		wt%		0.0		100.0		100.0			
Temperature (In/Out)		C		80.30		48.33		37.00			
Density		kg/m <sup>3</sup>		35.807		467.05		993.59			
Viscosity		mPa-s		0.0112		0.0668		0.6914			
Specific Heat		kJ/kg-C		2.2660		3.2592		4.1773			
Thermal Conductivity		W/m-C		0.0267		0.0902		0.6252			
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			
Average Film Coefficient		W/m <sup>2</sup> -K		1306.59		5496.28					
Fouling Resistance (min)		m <sup>2</sup> -K/W		0.000200		0.000200					
Heat Exchanged		2682. kW		MTD (Corrected) 9.8 C		Overdesign 32.14 %					
Transfer Rate, Service		505.65 W/m <sup>2</sup> -K		Calculated 668.18 W/m <sup>2</sup> -K		Clean 961.77 W/m <sup>2</sup> -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 & Rating		Out in		1 @ 8		1 @ 12					
		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 16					
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-s <sup>2</sup>		Shell Entrance 264.49		Shell Exit 99.31 kg/m-s <sup>2</sup>							
		Bundle Entrance 137.59		Bundle Exit 23.96 kg/m-s <sup>2</sup>							
Weight/Shell 18042.5		Filled with Water 24647.5		Bundle 9437.36 kg							
				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			

This surface is slightly under design.

it is OK. please recheck the value.

539.62

please recheck baffle selected arrangement

it is OK



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 m <sup>2</sup>	Shell/Unit	1	Surf/Shell (Gross/Eff)	115.38 / 113.93 m <sup>2</sup>

PERFORMANCE OF ONE UNIT

Fluid Allocation	Shell Side		Tube Side			
Fluid Name	PROPYLENE		PROPYLENE			
Fluid Quantity, Total	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/m <sup>3</sup>	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	1		7.287		
Velocity	m/s			2.98		
Pressure Drop, Allow/Calc	bar	0.200		0.100	0.038	
Average Film Coefficient	W/m <sup>2</sup> -K	9		797.30		
Fouling Resistance (min)	m <sup>2</sup> -K/W	0.0		0.000170		

nozzle location is OK and responsibility of package designer.

Heat Exchanged	508. kW	MTD (Corrected)	14.2 C	Overdesign	7.70 %
Transfer Rate, Service	314.69 W/m <sup>2</sup> -K	Calculated	338.93 W/m <sup>2</sup> -K	Clean	388.11 W/m <sup>2</sup> -K

for carbon steel tubes 2.77 mm shall be considered as min tube thickness with 25.4mm OD.

hot fluid to be interred from top.

routine is 31.75mm

32 in correct

1.25 is minimum tube pitch

please select tube pitch ratio 1.25

		NO OF ONE SHELL		Nozzle Orientation	
		Shell Side	Tube Side		
Design Press		23	23+F.V		
Design Temp		125	-45/125		
No Passes per		1	3		
Flow Direction		Upward	Upward		
Connections	In in	1 @ 6	1 @ 4		
Size & Rating	Out in	1 @ 6	1 @		
	Liq. Out in	@	@		

Tube No.	241	OD	25.400 mm	Thk(Avg)	2.108 mm	Pitch	32.000 mm	Layout	30
Material	LTCS		gaskets seal strips	1					
Cross Baffle Type	PERPEND. SINGLE-S		Passlane Ser	Impingement					
Spacing(c/c)	300.000 mm		No. of Crosspasses	19					
Rho-V2-Inlet Nozzle	183.04 kg/m-s <sup>2</sup>		Shell Exit	666.43 kg/m-s <sup>2</sup>					
	Bundle Entrance		178.21		Bundle Exit		157.84		kg/m-s <sup>2</sup>

will be corrected in next revision.

design is OK. there is no problem

Dry wall mist flow, film and transition boiling regime are expected for the boiling fluid. Please resolve the problems.

Weight/SH	1929.32 kg			
Notes:	m/s	Flow Fractions		
	0.21	A	0.175	
	2.98	B	0.632	
		C	0.051	
		E	0.142	
		F	0.000	
	Fouling	12.67	Crossflow	0.29
	Metal	1.31	Window	0.30