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)

1- HTRI VER. 7 has bug and problem in it's results so we can not trust it. it is not acceptable.
NEC REPLY: All softwares in Nargan Co. are verified and reliable. So we will check the design and send you the warnings and errors which shall be resolve.
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.
NEC REPLY: Since some mechanical design factors affect on effective surface such as tube sheet THK, may cause o change the design,it is necessary to recheck the design after finalization of mechanical calculations. Also, thermal design approval will be depend on final checking including mechanical parameters.
3- this item will be given in heat exchanger data sheet and then in mechanical drawing.
NEC REPLY: OK. but thermal calculation will be checked and approved using this data, so thermal calculation always shall be submitted with mechanical drawing together for checking.
4- this item will be given in heat exchanger data sheet and then in mechanical drawing.
NEC REPLY: OK. but thermal calculation will be checked and approved using this data, so thermal calculation always shall be submitted with mechanical drawing together for checking.
5- will be given in mechanical drawing with all details. this is THERMAL calculation.
NEC REPLY: OK. but thermal calculation will be checked and approved using this data, so thermal calculation always shall be submitted with mechanical drawing together for checking.

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**

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			
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Page	Rev-D0	Rev-D1	Rev-D2	Rev-D3	Rev-D4
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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

design factor for package is 1.1
this evaporator over design is 10%. so we have no problem in this case
NEC REPLY: This flowrate causes less duty than design duty. Flowrate shall be corrected.

REV D1

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

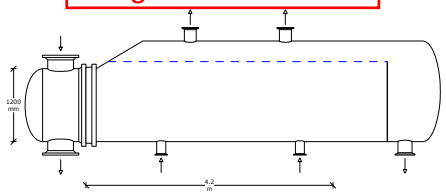
Fluid Allocation		Shell Side		Tube Side	
Fluid Name		PROPYLENE		HEXANE	
Fluid Quantity, Total	kg/hr	19500.1		748005	
Vapor (In/Out)	wt%	24.0	100.0	0.0	0.0
Liquid	wt%	76.0	0.0	100.0	100.0
Temperature (In/Out)	C	-23.98	-23.98	-16.00	-20.27
Density	kg/m3	5.7800 V/L 578.8	5.7800		
Viscosity	mPa-s	0.0073 V/L 0.141	0.0073		
Specific Heat	kJ/kg-C	1.4050 V/L 2.214	1.4050		
Thermal Conductivity	W/m-C	0.0127 V/L 0.128	0.0127		
Critical Pressure	bar-G				
Inlet Pressure	bar-G	1.607			
Velocity	m/s		0.37		
Pressure Drop, Allow/Calc	bar	0.100	5.441e-3		
Average Film Coefficient	W/m2-K	1899.56			
Fouling Resistance (min)	m2-K/W	0.000170			

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.

Heat Exchanged	1687. kW	MTD (Corrected)	5.6 C	
Transfer Rate, Service	647.13 W/m2-K	Calculated	700.11 W/m2-K	

CONSTRUCTION OF ONE SHELL

	Shell Side	Tube Side
Design Pressure		3
Design Temperature		/ 125
No Passes per Shell		
Flow Direction	Upward	Downward
		1 @ 18
		1 @ 18
		@



nozzle location is OK
NEC REPLY: As per HTRI software manual, Flashing feed inlet nozzles shall be located in vapor space.

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
NEC REPLY: Entrainment ratio is reported in HTRI result. However this comment is relaxed since downstream equipment is oil flooded compressor.

) 2.108 mm		Length	4.200		
CARBON STEEL					
) 1656.09 mm					
%Cut (Diam)					
mm					
Shell Entrance	189.05	Shell Exit	13.71	kg/m-s2	
Bundle Entrance		Bundle Exit		kg/m-s2	
th 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

entrainment ratio shall be reported in your design too.

HTRI

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 (

PERFORMANCE OF ONE UNIT

Fluid Allocation		Shell Side			
Fluid Name		OIL			
Fluid Quantity, Total	kg/hr	12672.1			
Vapor (In/Out)	wt%	0.0	0.0		
Liquid	wt%	100.0	100.0	100.0	100.0
Temperature (In/Out)	C	80.30	50.00	37.00	
Density		873.20			
Viscos					
Specifi					
Therma					0.6352
Critical					
Inlet Pressure	bar-G	20.887			01
	m/s				0.64
low/Calc	bar	0.200			0.094
fficient	W/m2-K	607.25			.85
Fouling Resistance (min)	m2-K/W	0.000170			0.000200

Heat Exchanged 209. kW | MTD (Corrected) 20.1 C | Overdesign 19.15 %

Transfer Rate, Service 356.40 W | 4 W/m2-K | Clean 511.55 W/m2-K

UCTIO | Sketch (Bundle/Nozzle Orientation)

		Shell Side	Tube Side
Design		25.000	25.000
Design		120.00	190.00
No Pas		1	4
Flow Di		Upward	Upward
Connections	In mm	1 @ 3	1 @ 3
		1 @ 3	1 @ 3
		@	@

Thk(Avg) 1.245 mm | Length 3.000 m | Pitch

Material C.S. | Pairs seal strips 1

Kettle ID mm

NGLE-SEG. %Cut (Diam) 30.00 | lone

Inlet 371.734 mm | No. of Crosspasses 13

-s2 | Shell Entrance 434.66 | Shell Exit

54.21 | Bundle Exit

Fille | Bundle

		sistance, %	Velocities, m/s		Flow Fractions
	Shell	69.93	Shellside	0.18	A 0.074
	Tube	12.11	Tu		0.551
		16.99	Cr		0.071
		0.97	W		0.129
					0.175

Corrected as much as possible no more changes can not be apply
NEC REPLY: will be checked. Cooling water velocity in carbon steel tubes shall be within 1-3m/s.

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

will be given in heat exchanger data sheet
NEC REPLY: OK. but thermal calculation will be checked and approved using this data, so thermal calculation always shall be submitted with mechanical drawing together for checking.

nozzle location is OK and responsibility of package designer.
NEC REPLY: Shell side inlet nozzle shall be located on top of shell to optimize the exchanger design.

will be corrected in next revision.
NEC REPLY: Closed.

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

hot fluid to be interred from top.

tube pass arrangement shall be specified

nozzles shall be specified

comment is not clear
NEC REPLY: Comment is ignored.

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.
NEC REPLY: Selecting correct material affect on thermal coefficient and roughness of tubes. So, please specify real material in this data sheet or submit any data sheets which is included required data.

Please specify real material for checking.

cut is OK.
NEC REPLY: Comment is ignored.

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

HEAT EXCHANGER RATING DATA SHEET

This surface is slightly under design.

it is OK.
please recheck the value.
NEC REPLY:
Please send HTRI file for checking.

CUS ROCHEMICAL GE PK-6101 REV. D1

Service of Unit CONDENSER o. E-PK6101-2

Type BEM Orient cted 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

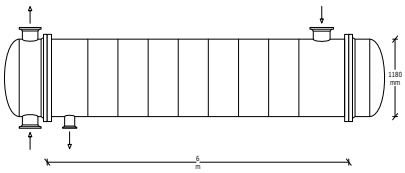
Fluid Allocation		Shell Side		Tube Side	
Fluid Name		PROPYLENE		JACKETED WATER	
Fluid Quantity, Total	kg/hr	27623		289299	
Vapor (In/Out)	wt%	100.0	0.0	0.0	0.0
Liquid	wt%	0.0	100.0	100.0	100.0
Temperature (In/Out)	C	80.30	48.33	37.00	45.00
Density	kg/m3	35.807	467.05	993.59	990.48
Viscosity	mPa-s	0.0112	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 I 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

ndle Entranc 137.59 Bundle Exit 23.96 kg/m-s2

Weight/Shell 18042.5 24647.5 Bundle 9437.36 kg

please recheck baffle selected arrangement

it is OK
NEC REPLY:
Comment is ignored.

	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

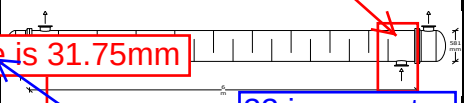
PERFORMANCE OF ONE UNIT

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		.94	17.360 V/L 526.8	17.110
Viscosity	mPa-s		394	0.0087 V/L 0.093	0.0087
Specific Heat	kJ/kg-C		837	1.6500 V/L 2.578	1.6550
Thermal Conductivity	W/m-C		062	0.0162 V/L 0.108	0.0165
Critical Pressure	bar-G				
Inlet Pressure	bar-G			7.287	
Velocity	m/s		21		2.98
Pressure Drop, Allow/Calc	bar		20	0.100	0.038
Average Film Coefficient	W/m2-K			797.30	
Fouling Resistance (min)	m2-K/W			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	

N OF ONE SHELL /Nozzle Orientation)

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



Tube No. 241 OD 25.400 mm Thk(Avg) 2.108 mm Pitch 32.000 m

T Material LTCS seal strips

S Kettle ID mm ane Seal Rod No

Cross Baffle Type PERPEND. SINGLE-SEG. %Cut (Diam) 28.00 Impingement Plate None

Spacing(c/c) 300.000 mm Inlet 412.227 mm No. of Cross

Rho-V2-Inlet Nozzle 183.04 kg/m-s2 Shell Entrance 752.43 Shell Exit

Bundle Entranc 178.21 Bundle Exit

Weight/Sh 1929.32

Notes:

	m/s
	0.21
	2.98
Fouling 12.67	Crossflow 0.29
Metal 1.31	Window 0.30

nozzle location is OK and responsibility of package designer.
NEC REPLY: Shell side inlet nozzle shall be located on top of shell to optimize the exchanger design.

for carbon steal 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
NEC REPLY:
It is by vendor.
Closed.

1.25 is minimum tube pitch
NEC REPLY: It is by vendor.
Closed.

will be corrected in next revision.
NEC REPLY: Closed.

please select tube pitch ratio1.25

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

design is OK. there is no problem
NEC REPLY:
thermal file to be submitted for checking.