Education Institute for

Equipment & Process Design

E-6003

Design and Principles

Process data

		Shell Side		Tube Side		Units
		Inlet	Outlet	Inlet	Outlet	
Fluids		Process condensate		Cooling water		
Quantity:	total	47200		166009		kg/h
	liquid	47200	47200	166009	166009	kg/h
	gas					kg/h
Operating temperature		100	65	38	48	°C
Operating pressure		1,5		4,5		bar g
Liquid:	molecular weight	18,02	18,02	18,02	18,02	kg/kmol
	density	958	980	993	989	kg/m³
	viscosity	0,283	0,434	0,681	0,567	cP
	specific heat capacity	4,213	4,184	4,175	4,177	kJ/kg/°C
	thermal conductivity	0,6768	0,6505	0,6199	0,6323	W/m/°C
	boiling temperature	106				°C
Gas:	molecular weight					kg/kmol
	density					kg/m³
	viscosity					cP
	specific heat capacity					kJ/kg/°C
	thermal conductivity					W/m/°C
	dew point					°C

Heating and Cooling Table

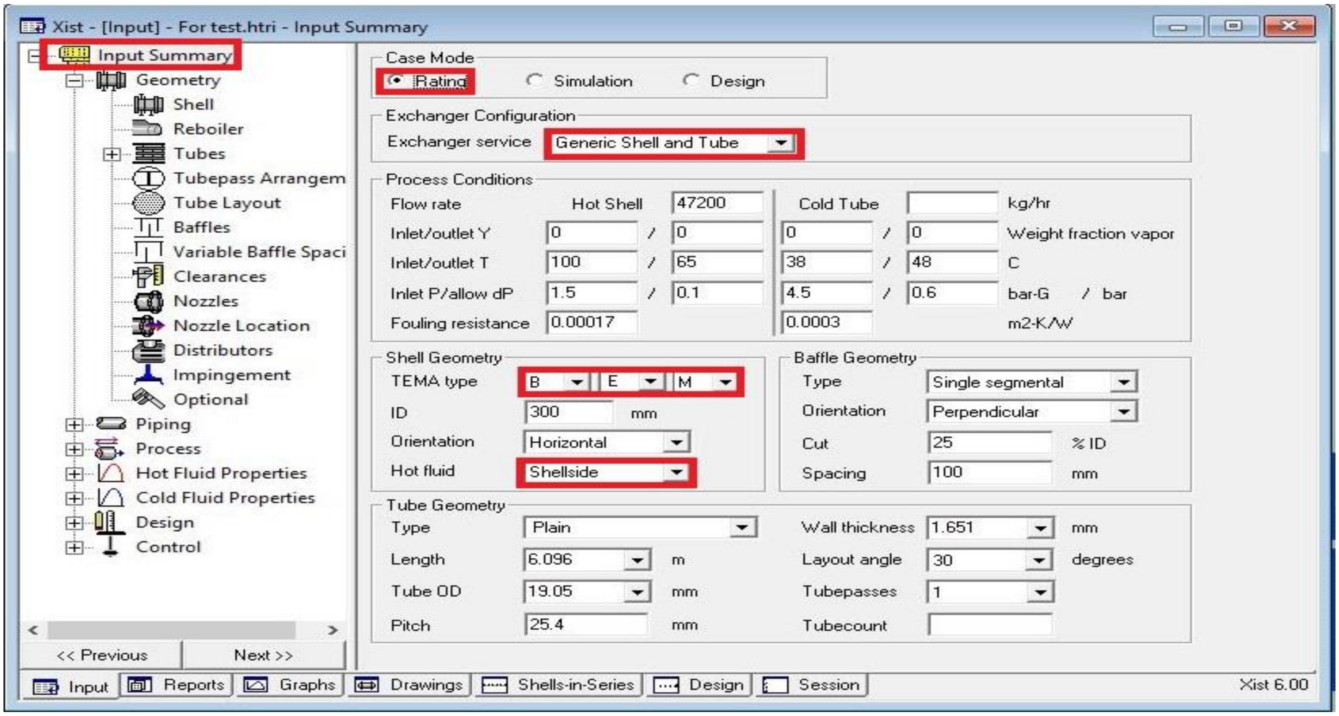
Shell side

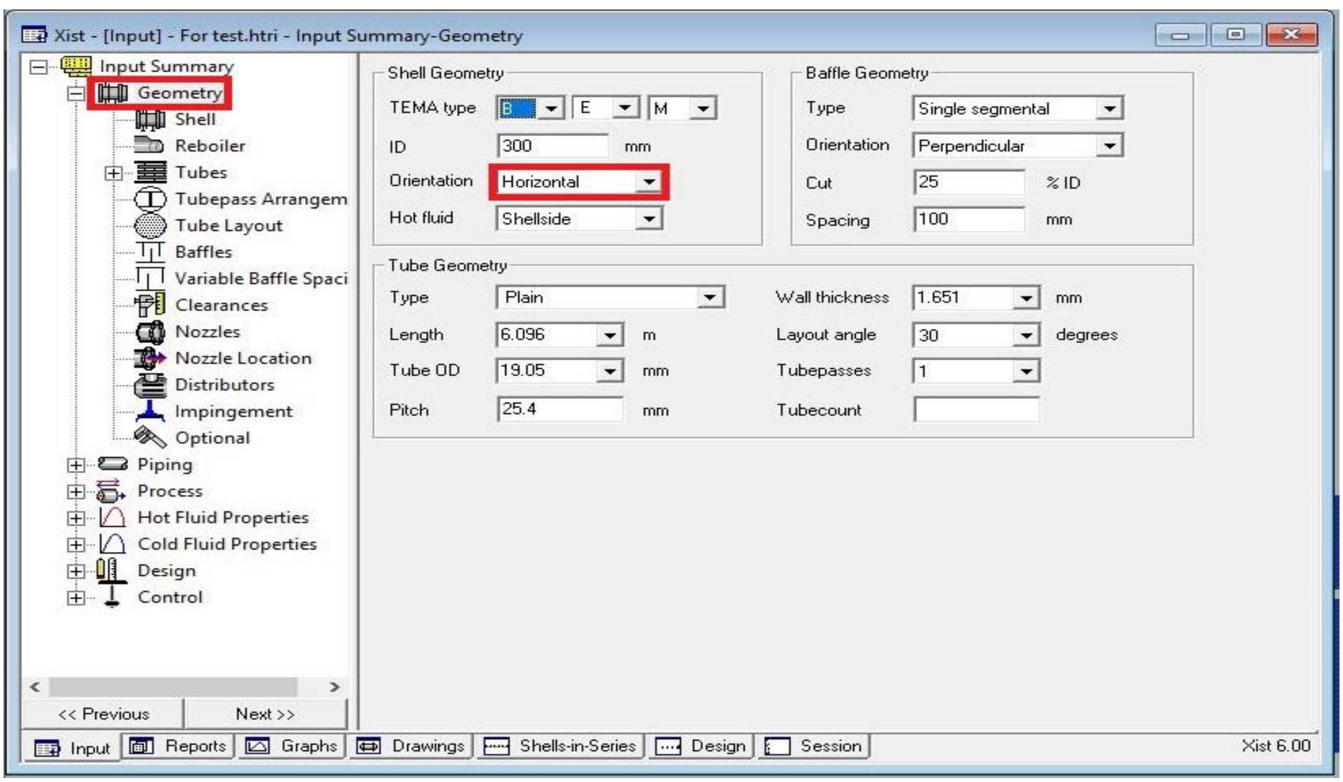
Temperature °C	Gas fraction wt %	Duty profile MW	Liquid density kg/m³	Liquid viscosity cP	Liquid heat capacity kJ/kg/°C	Liquid thermal conductivity W/m/°C	Surface tension dyn/cm
100	0,00	0,0	958	0,283	4,213	0,6768	58
96	0,00	-0,2	961	0,295	4,209	0,6746	59
92	0,00	-0,4	964	0,307	4,205	0,6723	60
88	0,00	-0,6	966	0,321	4,201	0,6697	60
84	0,00	-0,9	969	0,336	4,197	0,6670	61
81	0,00	-1,1	971	0,352	4,194	0,6641	62
77	0,00	-1,3	974	0,37	4,191	0,6609	63
73	0,00	-1,5	976	0,389	4,189	0,6576	63
69	0,00	-1,7	978	0,411	4,186	0,6541	64
65	0,00	-1,9	980	0,434	4,184	0,6505	65

Tube side

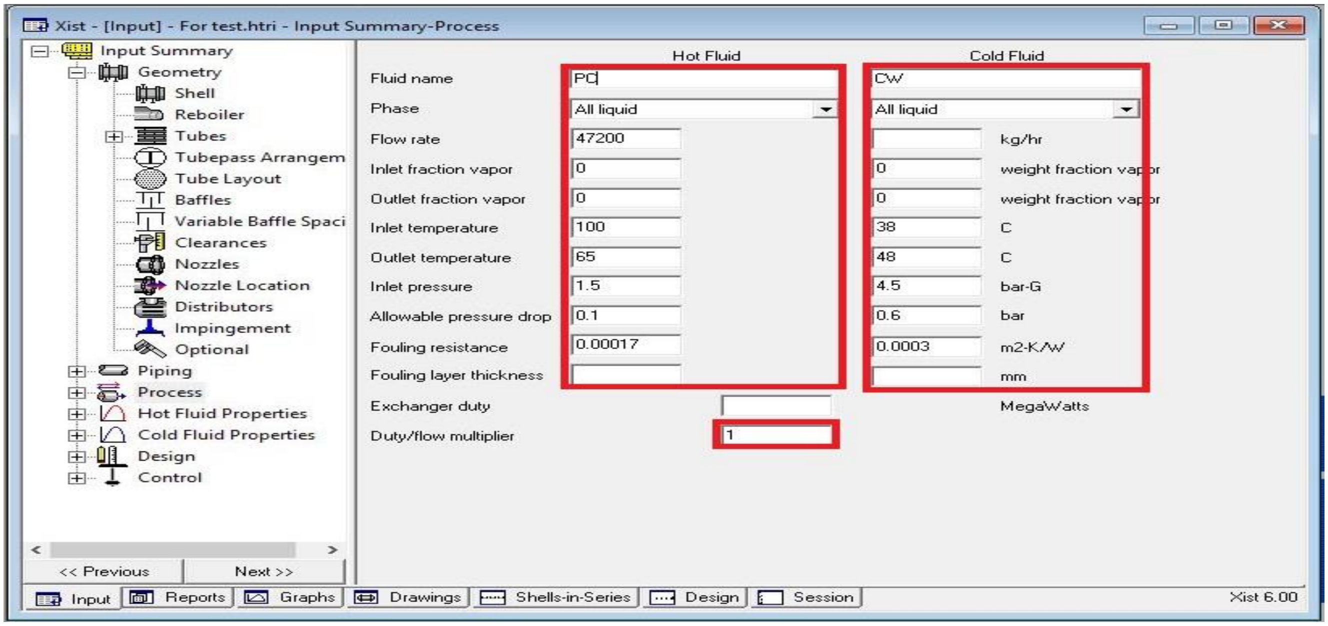
Temperature °C	Gas fraction wt %	Duty profile MW	Liquid density kg/m³	Liquid viscosity cP	Liquid heat capacity kJ/kg/°C	Liquid thermal conductivity W/m/°C	Surface tension dyn/cm
48	0,00	0,0	989	0,567	4,177	0,6323	63
47	0,00	0,2	990	0,579	4,176	0,6309	63
46	0,00	0,4	990	0,59	4,176	0,6296	64
45	0,00	0,6	991	0,602	4,176	0,6283	64
44	0,00	0,9	991	0,614	4,176	0,6269	65
42	0,00	1,1	992	0,627	4,175	0,6255	65
41	0,00	1,3	992	0,64	4,175	0,6241	66
40	0,00	1,5	992	0,653	4,175	0,6227	66
39	0,00	1,7	993	0,667	4,175	0,6213	67
38	0,00	1,9	993	0,681	4,175	0,6199	67

Open HTRI and Input Summery sheet and enter data in red areas

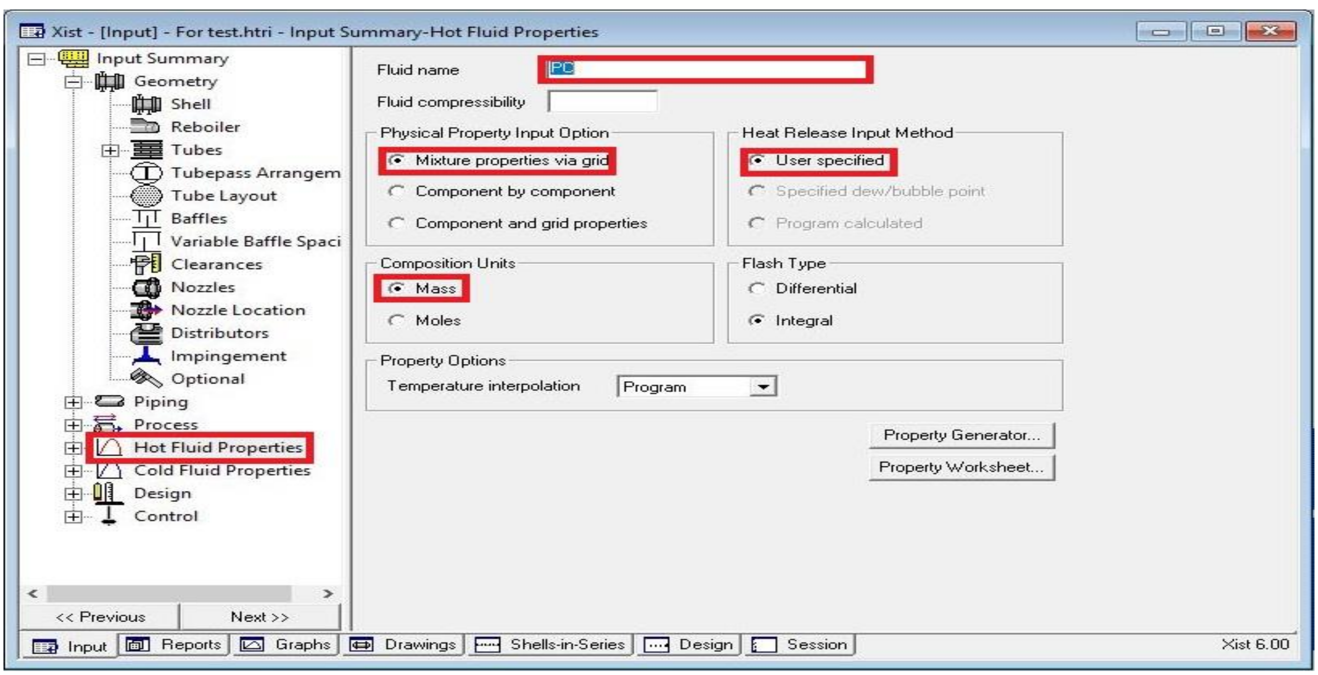


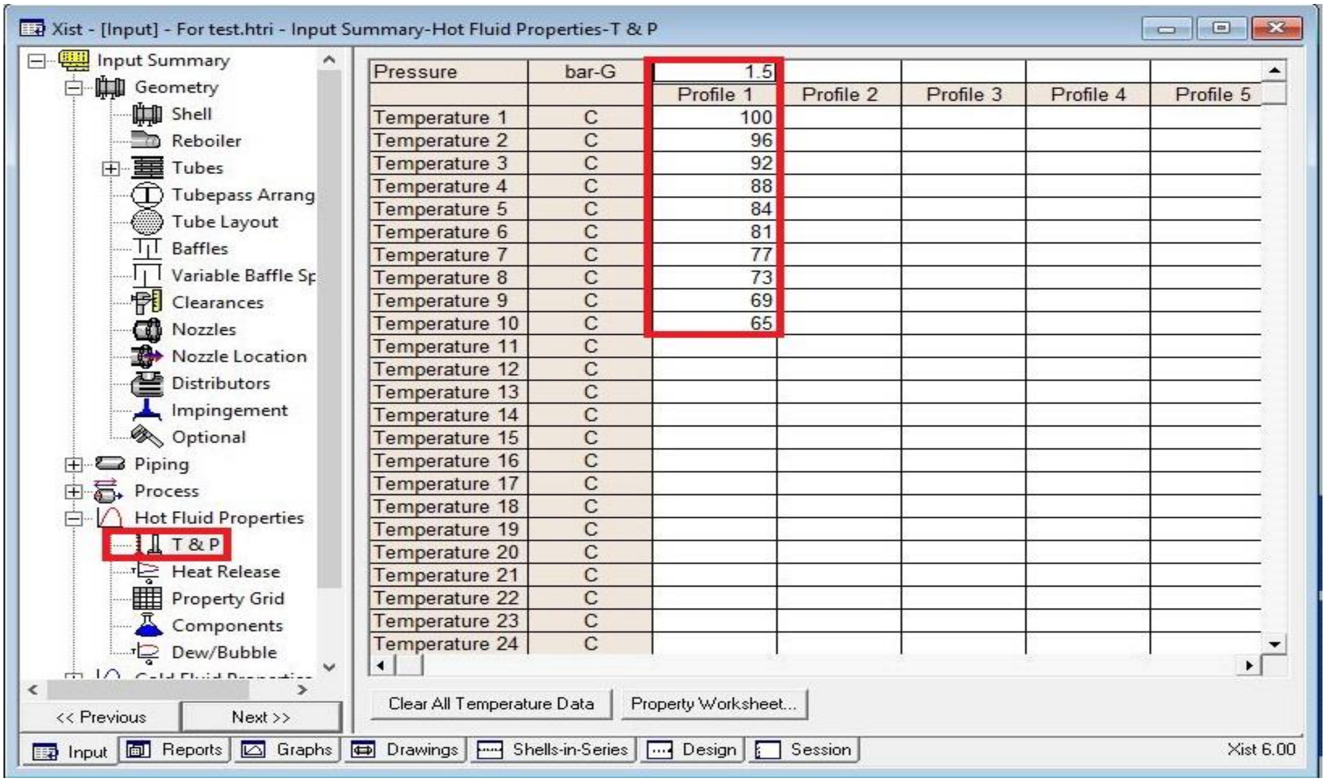


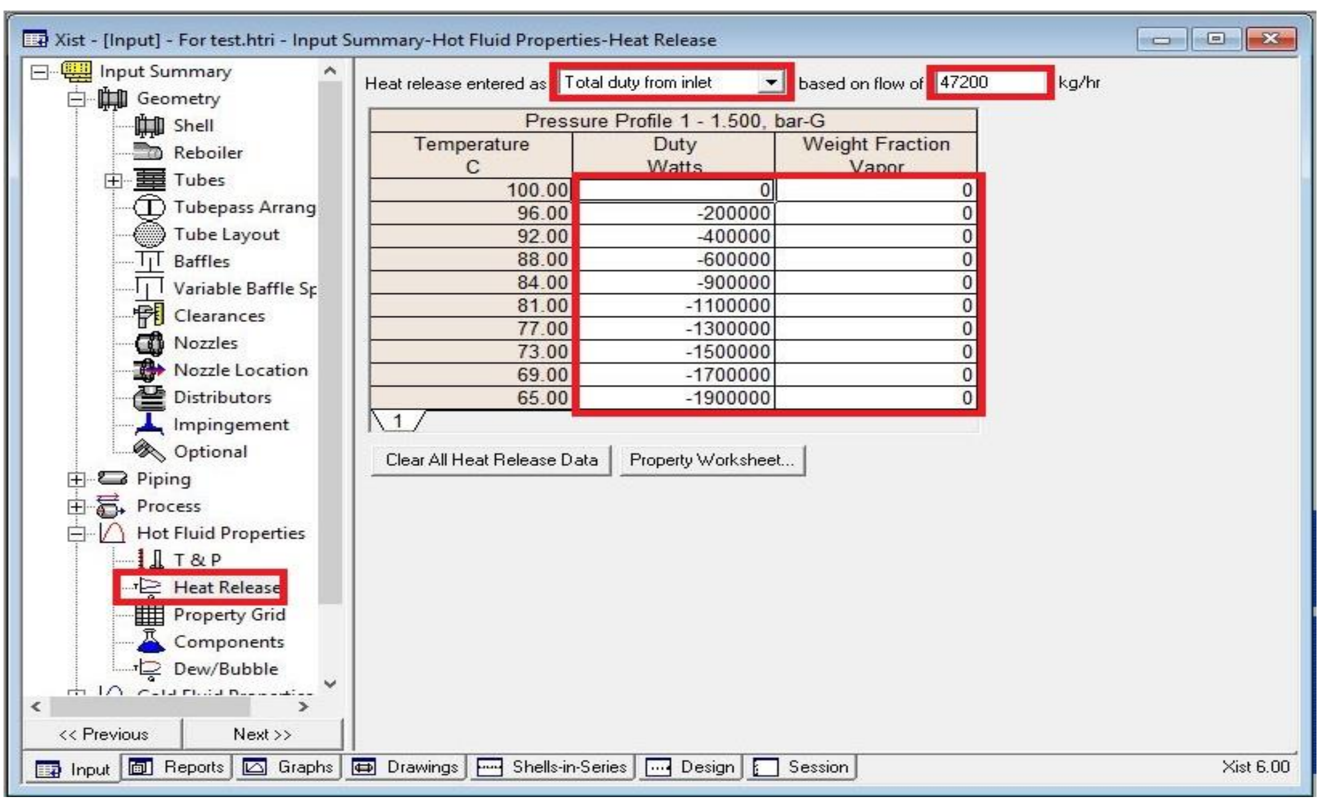
Enter operating data in process sheet in red areas

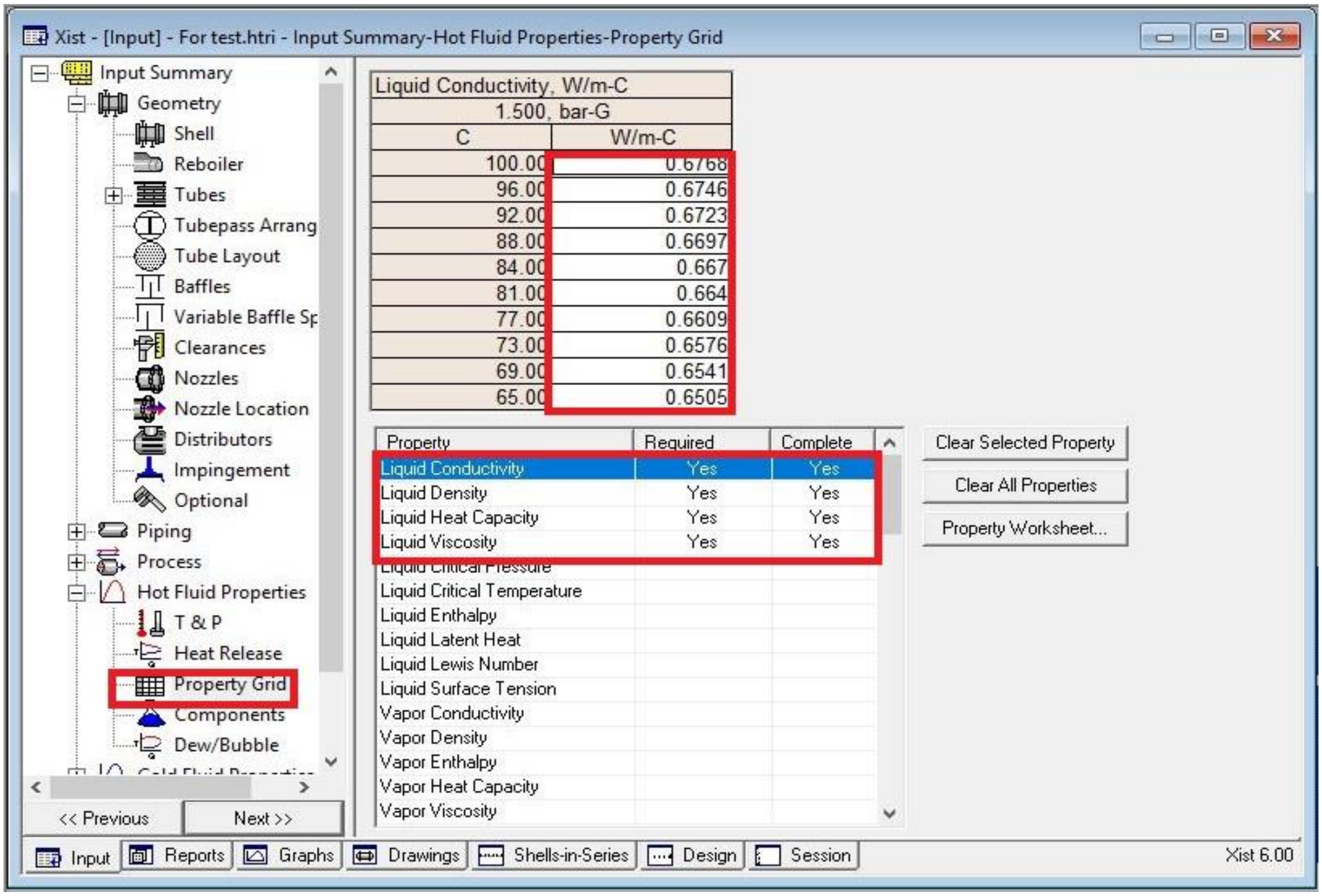


Enter heating and cooling table data in hot and cold fluid properties in red areas




Xist - [Input] - For test.htri - Input Summary-Hot Fluid Properties-T & P
Input Summary
Geometry
Shell
Reboiler
Tubes
Tubepass Arrang
Tube Layout
Baffles
Variable Baffle Sp
Clearances
Nozzles
Nozzle Location
Distributors
Impingement
Optional
Piping
Process
Hot Fluid Properties
T & P
Heat Release
Property Grid
Components
Dew/Bubble
Pressure
bar-G
1.5
Profile 1
Profile 2
Profile 3
Profile 4
Profile 5
Temperature 1 C 100
Temperature 2 C 96
Temperature 3 C 92
Temperature 4 C 88
Temperature 5 C 84
Temperature 6 C 81
Temperature 7 C 77
Temperature 8 C 73
Temperature 9 C 69
Temperature 10 C 65
Temperature 11 C
Temperature 12 C
Temperature 13 C
Temperature 14 C
Temperature 15 C
Temperature 16 C
Temperature 17 C
Temperature 18 C
Temperature 19 C
Temperature 20 C
Temperature 21 C
Temperature 22 C
Temperature 23 C
Temperature 24 C
Clear All Temperature Data
Property Worksheet...
<< Previous
Next >>
Input
Reports
Graphs
Drawings
Shells-in-Series
Design
Session
Xist 6.00

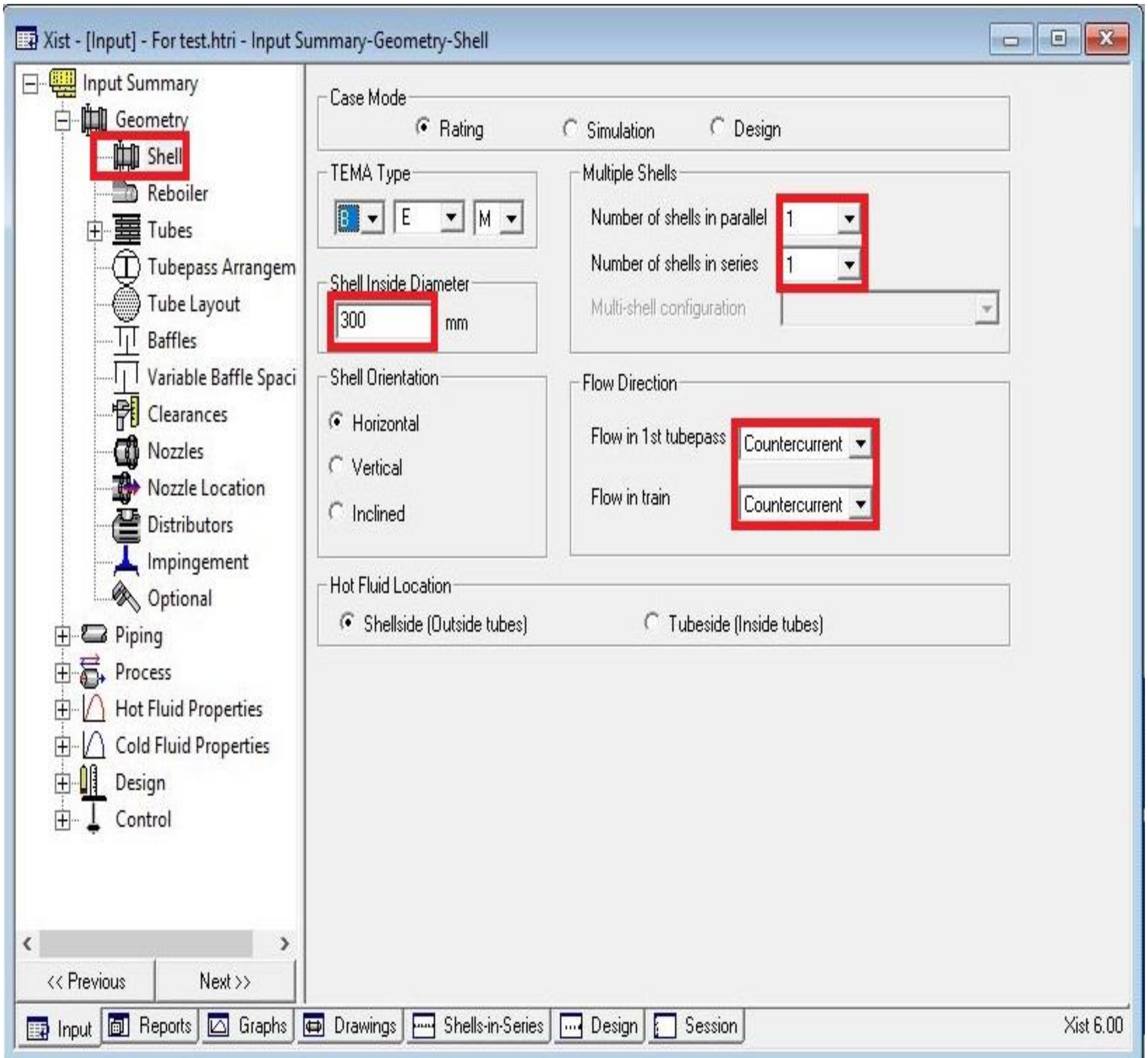

Xist - [Input] - For test.htri - Input Summary-Hot Fluid Properties-Heat Release
Heat release entered as
Total duty from inlet
based on flow of
47200
kg/hr
Pressure Profile 1 - 1.500, bar-G
Temperature C
Duty Watts
Weight Fraction Vapor
100.00 0 0
96.00 -200000 0
92.00 -400000 0
88.00 -600000 0
84.00 -900000 0
81.00 -1100000 0
77.00 -1300000 0
73.00 -1500000 0
69.00 -1700000 0
65.00 -1900000 0
Clear All Heat Release Data
Property Worksheet...
Input Summary
Geometry
Shell
Reboiler
Tubes
Tubepass Arrang
Tube Layout
Baffles
Variable Baffle Sp
Clearances
Nozzles
Nozzle Location
Distributors
Impingement
Optional
Piping
Process
Hot Fluid Properties
T & P
Heat Release
Property Grid
Components
Dew/Bubble
<< Previous
Next >>
Input
Reports
Graphs
Drawings
Shells-in-Series
Design
Session
Xist 6.00


Xist - [Input] - For test.htri - Input Summary-Hot Fluid Properties-Property Grid
Input Summary
Geometry
Shell
Reboiler
Tubes
Tubepass Arrang
Tube Layout
Baffles
Variable Baffle Sp
Clearances
Nozzles
Nozzle Location
Distributors
Impingement
Optional
Piping
Process
Hot Fluid Properties
T & P
Heat Release
Property Grid
Components
Dew/Bubble
<< Previous
Next >>
Liquid Conductivity, W/m-C
1.500, bar-G
C
W/m-C
100.00 0.6768
96.00 0.6746
92.00 0.6723
88.00 0.6697
84.00 0.667
81.00 0.664
77.00 0.6609
73.00 0.6576
69.00 0.6541
65.00 0.6505
Property
Required
Complete
Liquid Conductivity Yes Yes
Liquid Density Yes Yes
Liquid Heat Capacity Yes Yes
Liquid Viscosity Yes Yes
Liquid Critical Temperature
Liquid Enthalpy
Liquid Latent Heat
Liquid Lewis Number
Liquid Surface Tension
Vapor Conductivity
Vapor Density
Vapor Enthalpy
Vapor Heat Capacity
Vapor Viscosity
Clear Selected Property
Clear All Properties
Property Worksheet...
Input
Reports
Graphs
Drawings
Shells-in-Series
Design
Session
Xist 6.00

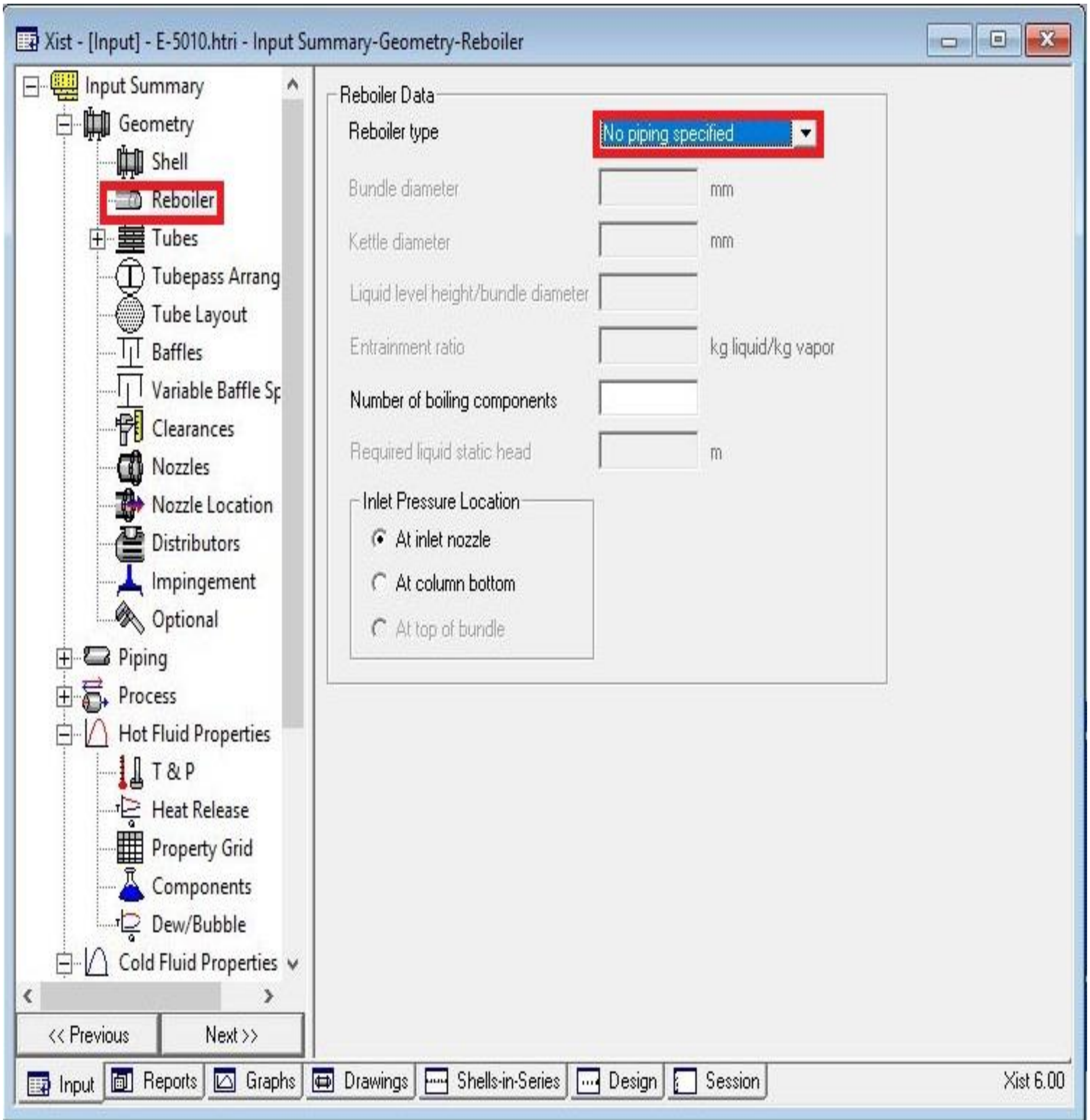
Put shell info in shell sheet in red areas

Note:

1. Initially estimate shell ID between 1.5-3 times tube-side pipeline ID, here it is 6 inch so first estimation would be 12 inch.



In Reboiler Sheet do not enter an input



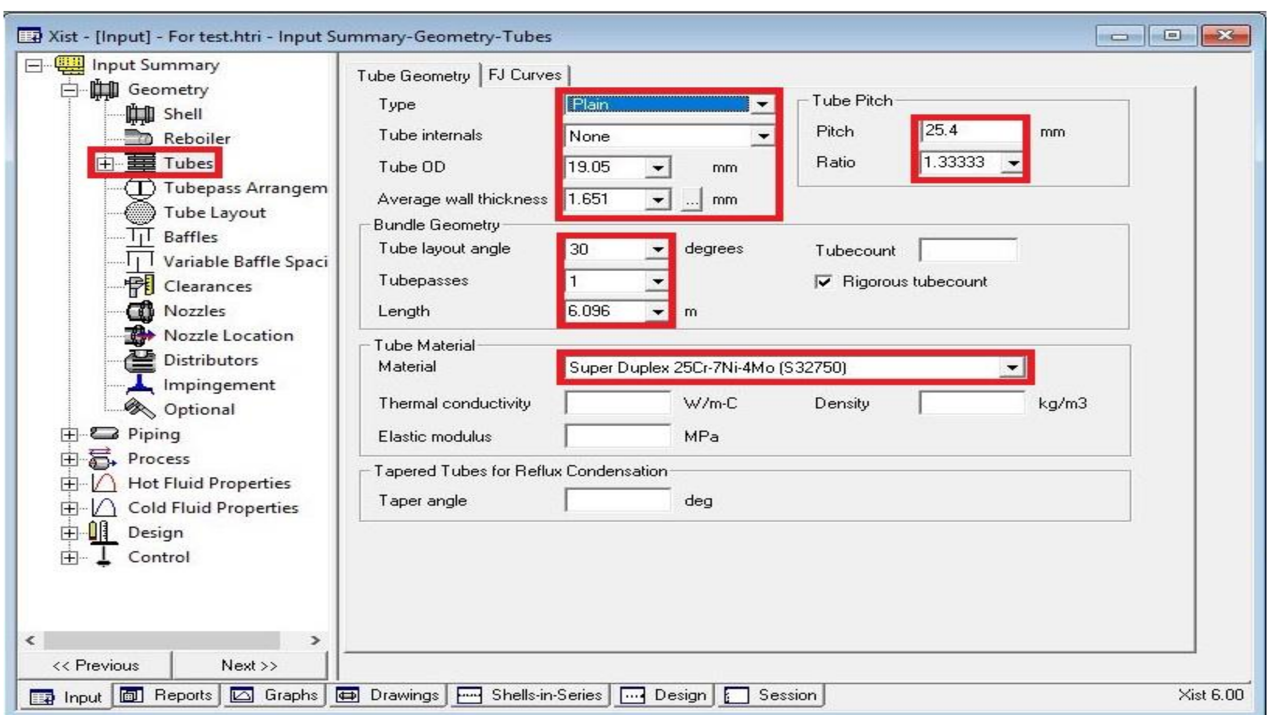
Put Tube mechanical data

Since it is cooling water, 19.05 is selected and thanks to presence of CO_2 and Ammonia in the water Duplex SS is selected.

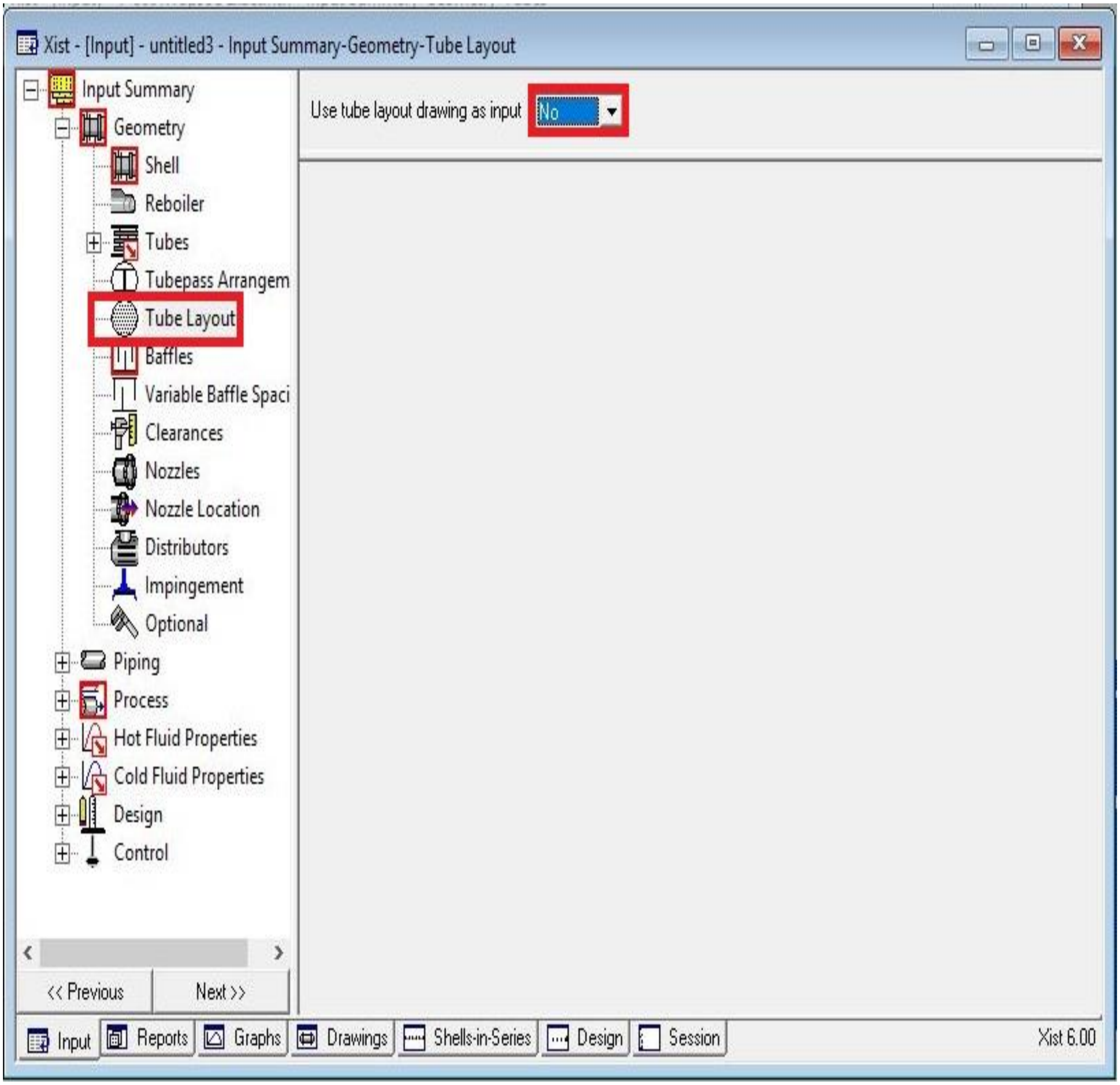
According to table below tube thickness of 1.65 is chosen.

Table 1.3 Typical diameters, thicknesses and pitch arrangement of tubes

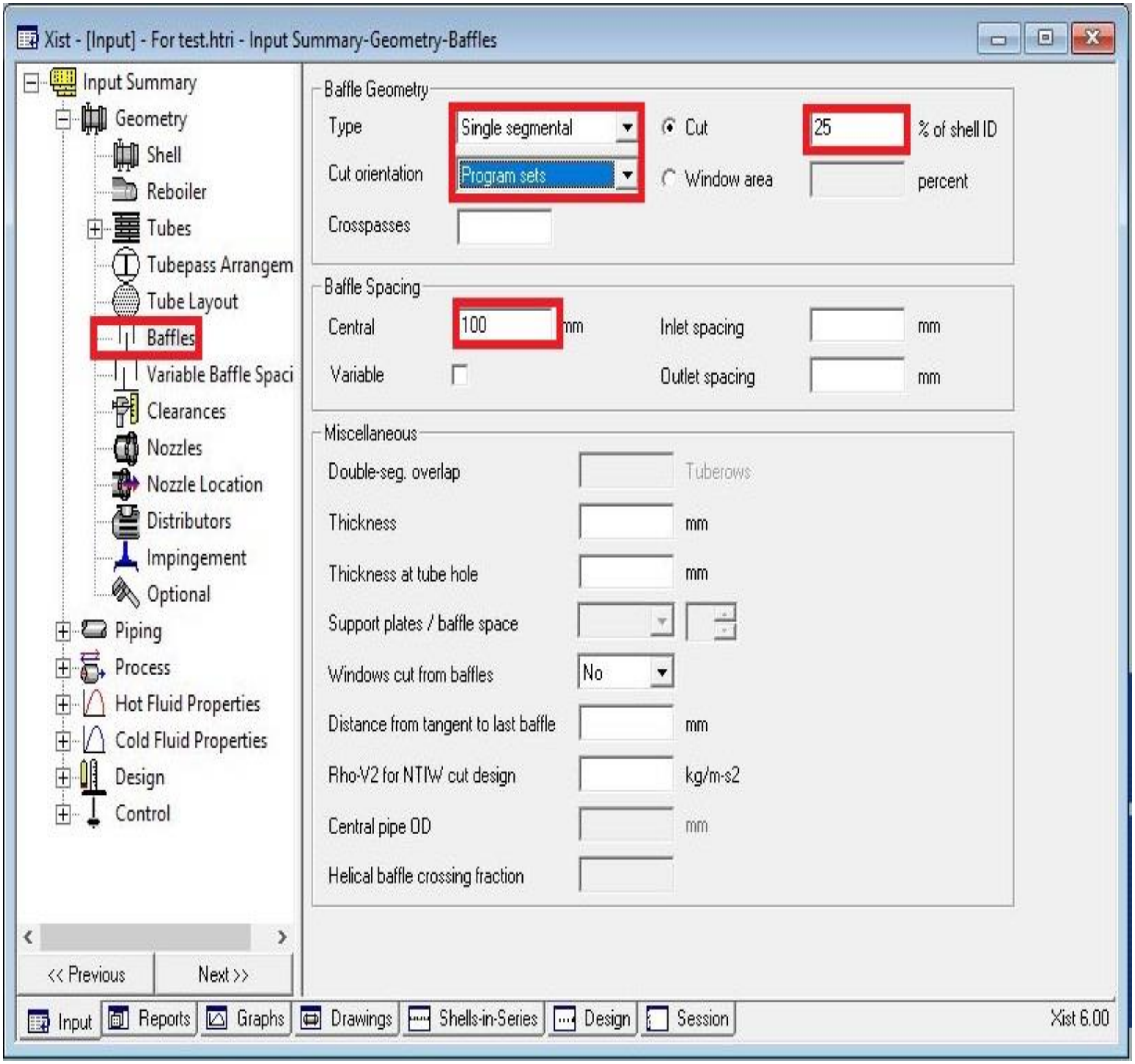
Tube outside diameter		mm	15.88	19.05	25.40	31.75
		in	$\frac{5}{8}$	$\frac{3}{4}$	1	$1\frac{1}{4}$
Tube thickness	Carbon and low-alloy steels	mm	1.65	2.11	2.77	3.40
		in	0.065	0.083	0.109	0.134
		b.w.g.	16	14	12	10
	Stainless steels, aluminium, copper and nickel alloys	mm	1.24	1.65	2.11	2.77
		in	0.049	0.065	0.083	0.109
		b.w.g.	18	16	14	12
Minimum tube pitch	Clean service (30° or 60°)	mm	19.84	23.81	31.75	39.69
		in	$\frac{25}{32}$	$\frac{15}{16}$	$1\frac{1}{4}$	$1\frac{9}{16}$
	Fouling service (45° or 90°)	mm	22.22	25.40	31.75	39.69
		in	$\frac{7}{8}$	1	$1\frac{1}{4}$	$1\frac{9}{16}$



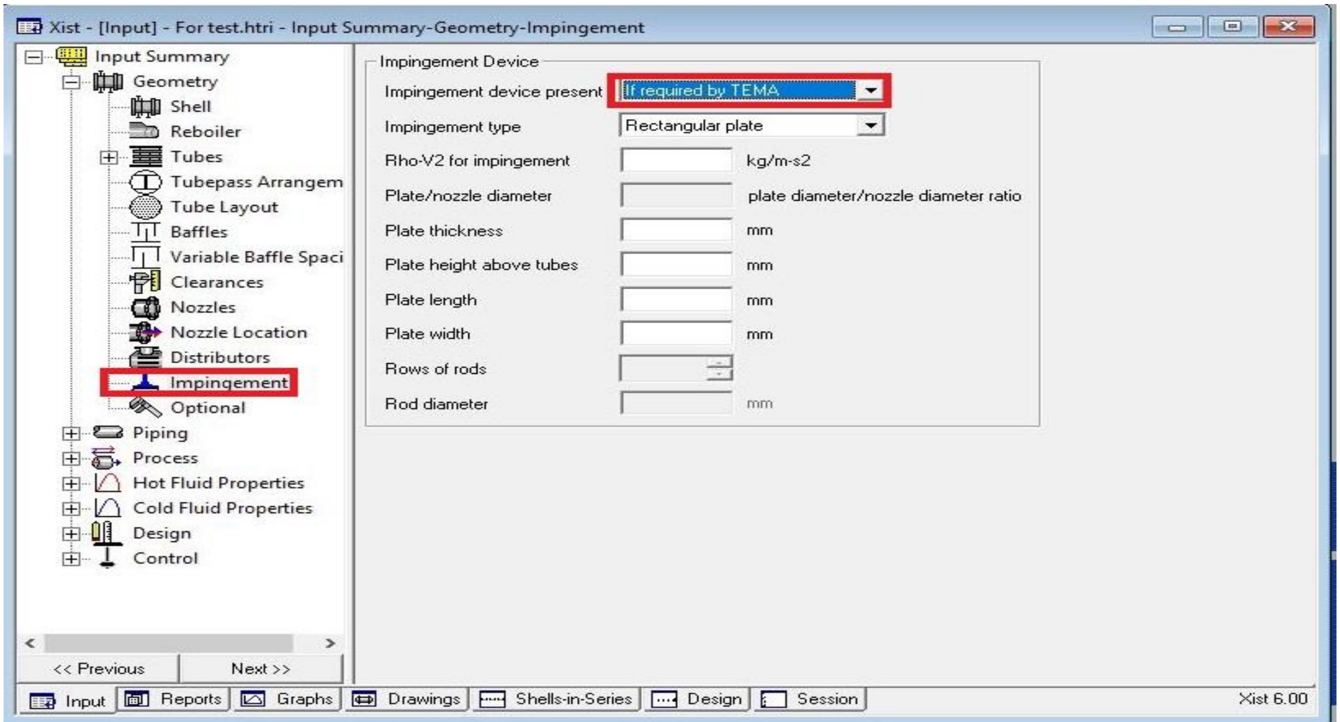
Act like below

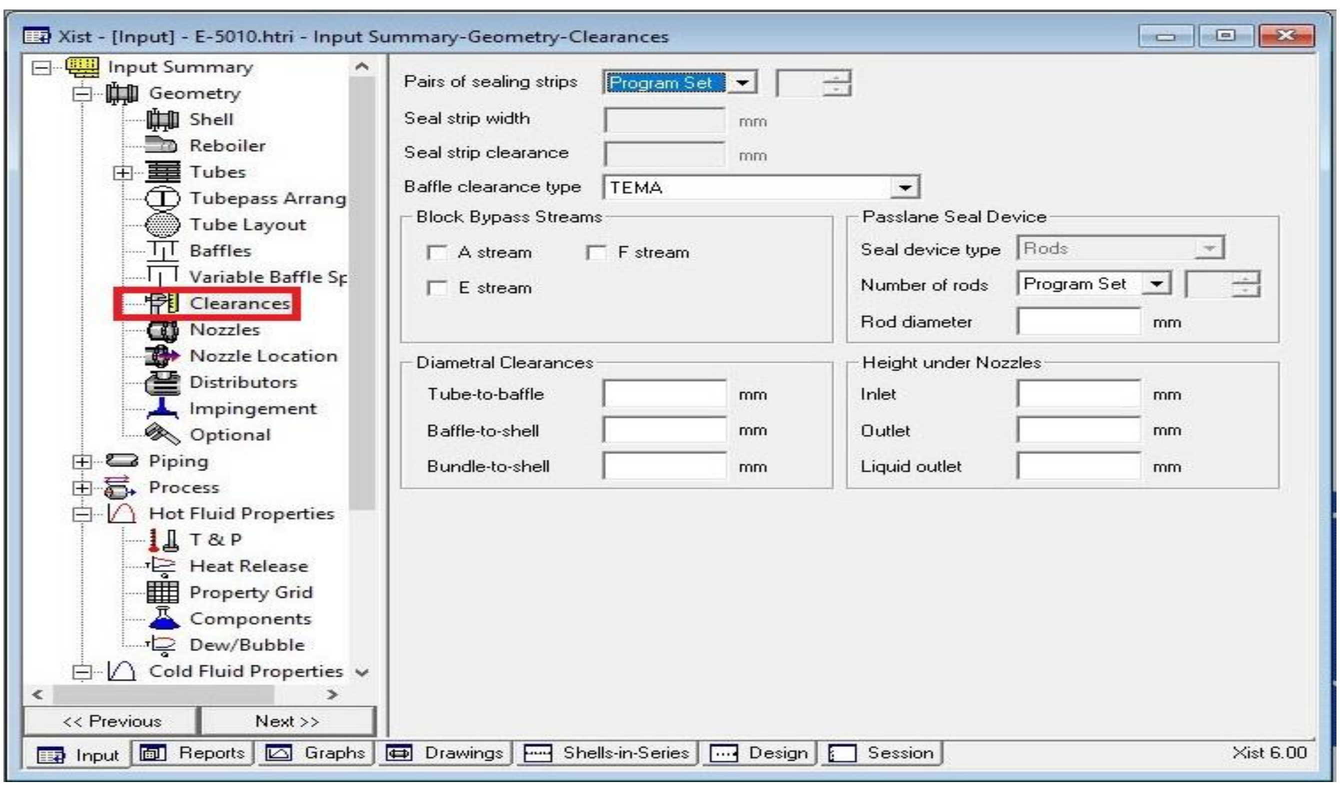


Put baffle info in baffle sheet in red areas like below

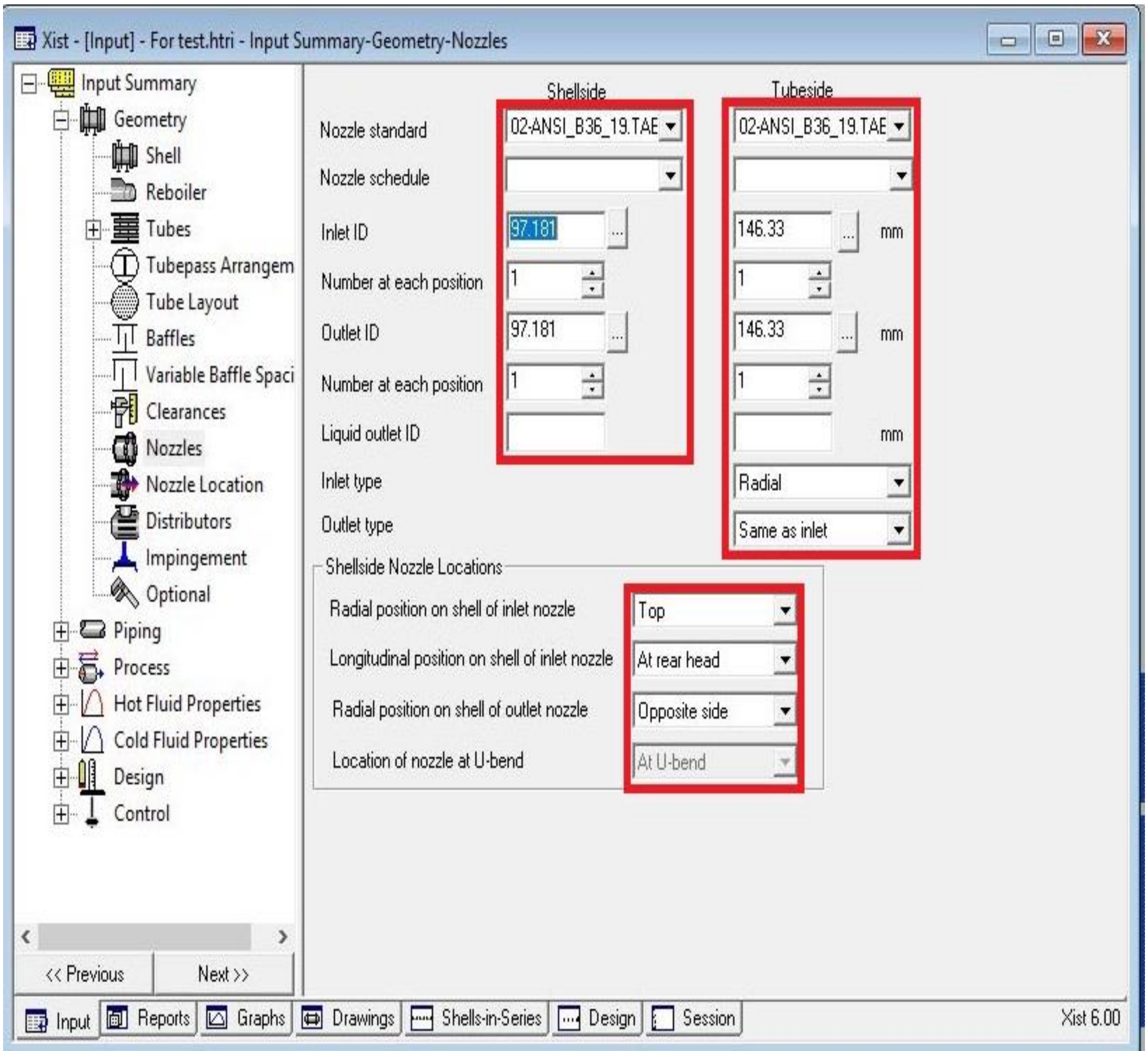


Act exactly like below for impingement sheet and Clearance

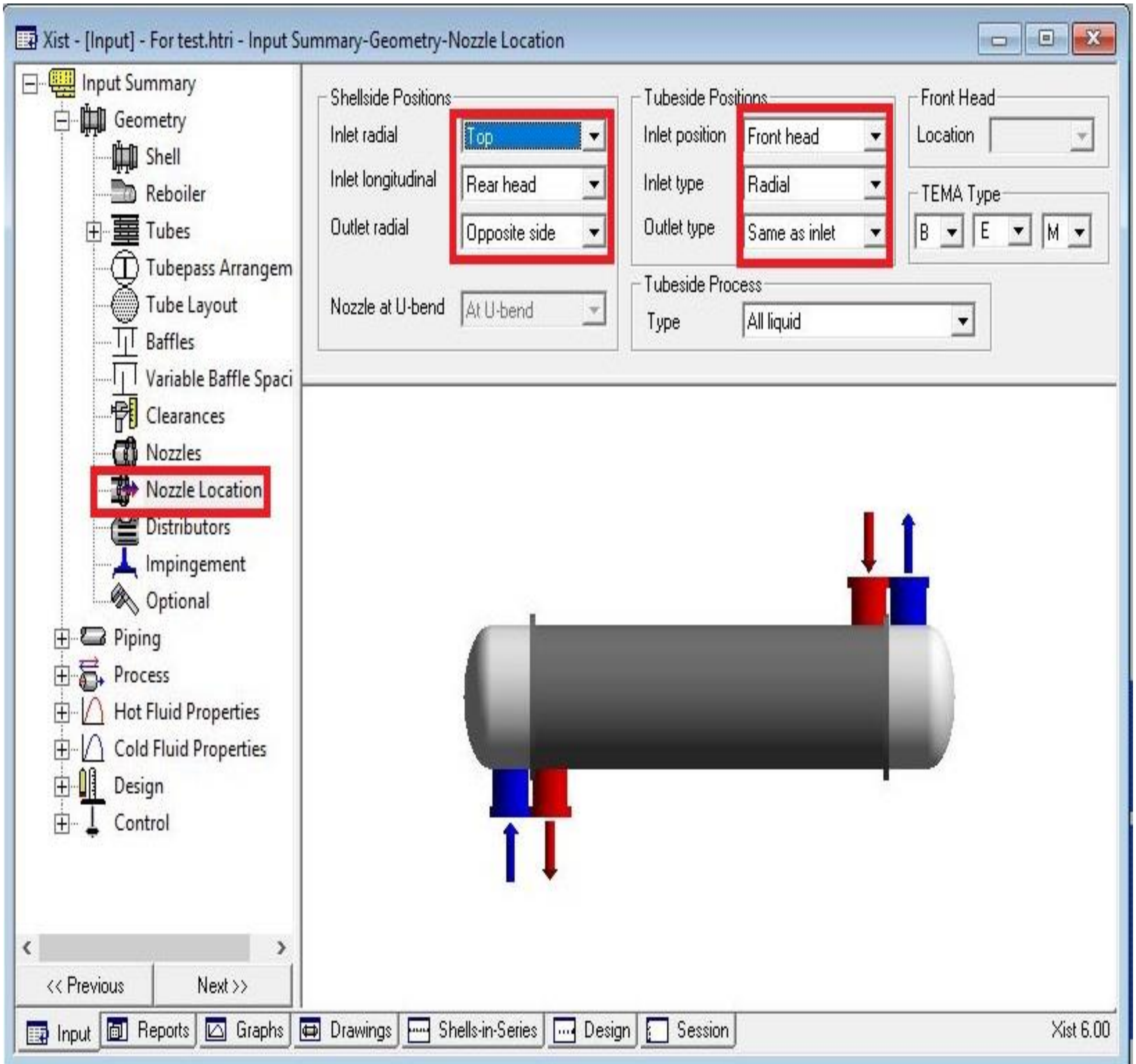




Enter nozzle info from piping info



Set nozzle location



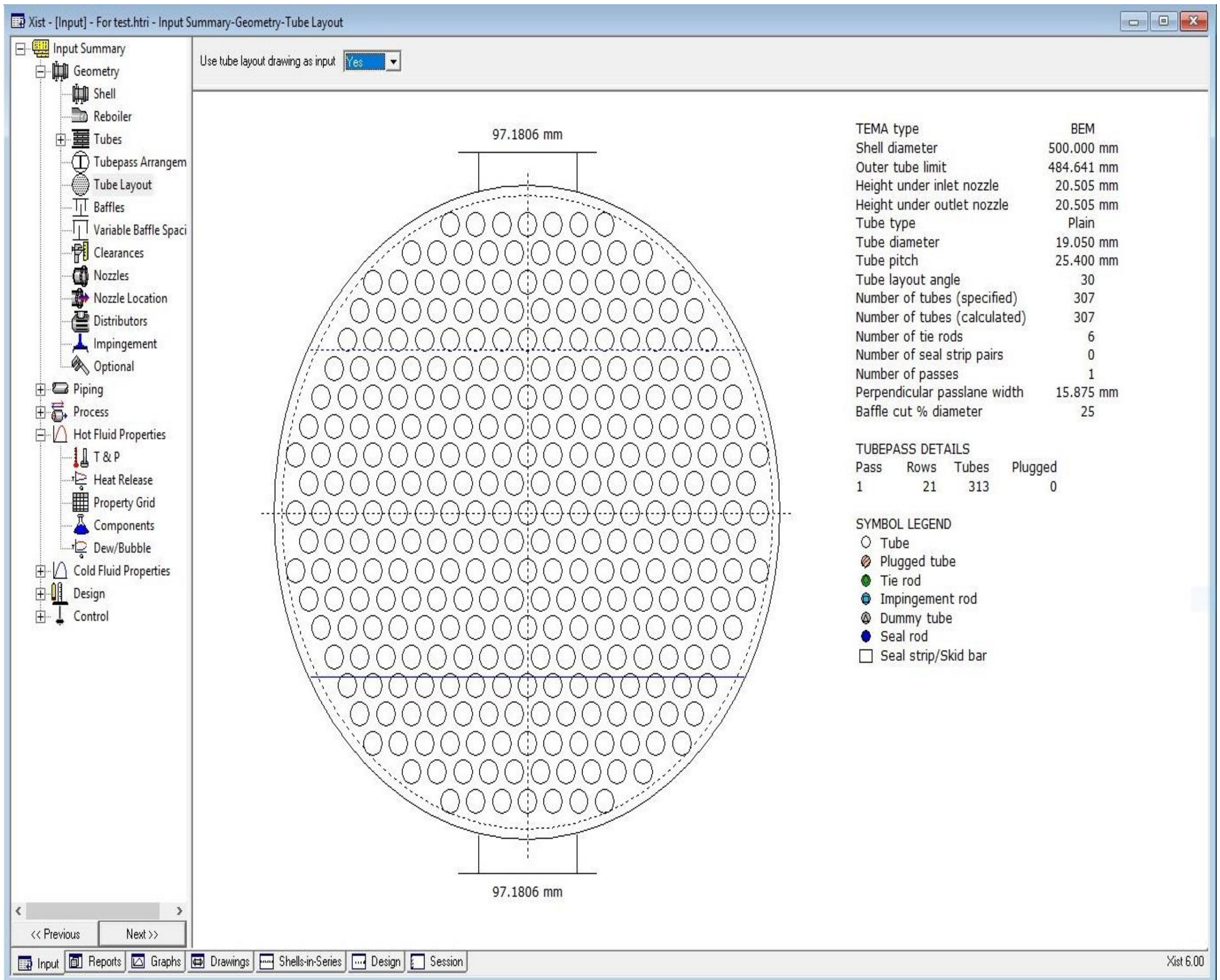
Results:

1. Now run and the dp in hot shell side becomes 1.62 bar and overdesign factor becomes -22%
2. Now increase the shell ID and overdesign factor becomes 35% and dp reduces to 0.89 bar
3. Now increase baffle spacing to 250 mm and run it again. Dp reduces to 0.215 and overdesign Factor to 33%.

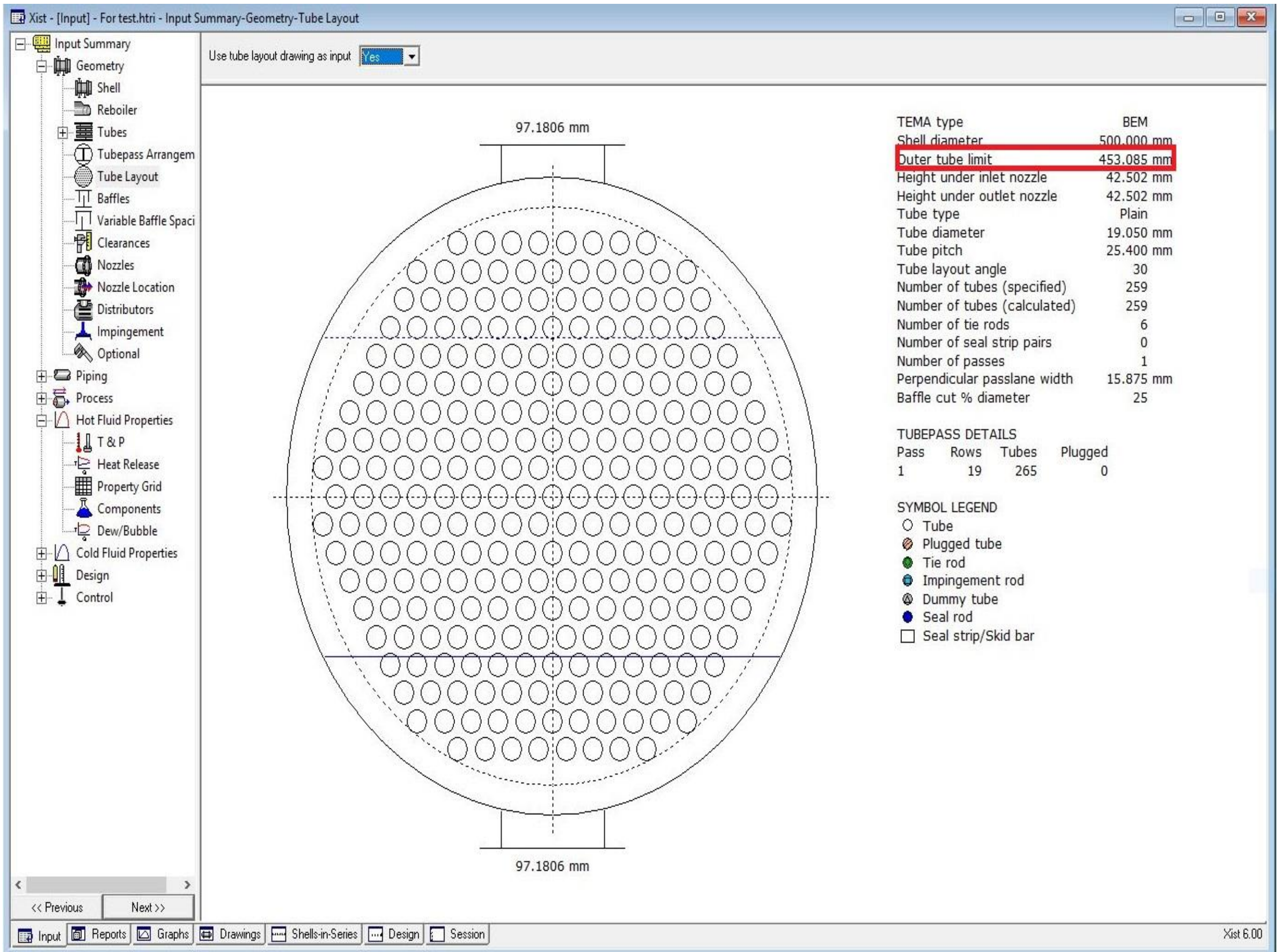
Spacing	Oversizing
100	35
250	33
300	31
350	31
400	30.5

4. Now decrease tube length to 4.87 to reduce oversize factor and run it and oversizing factor becomes 5.54%. As a result, dp also reduces to 10.17
5. Now increase Shell ID to 450mm and reduce Tube length to 4.27m simultaneously and the result is that dp becomes 0.138 bar and overdesign factor 14%

6. Now increase Shell ID to 500 mm and activate tube layout and run it and the overdesign factor becomes 40%

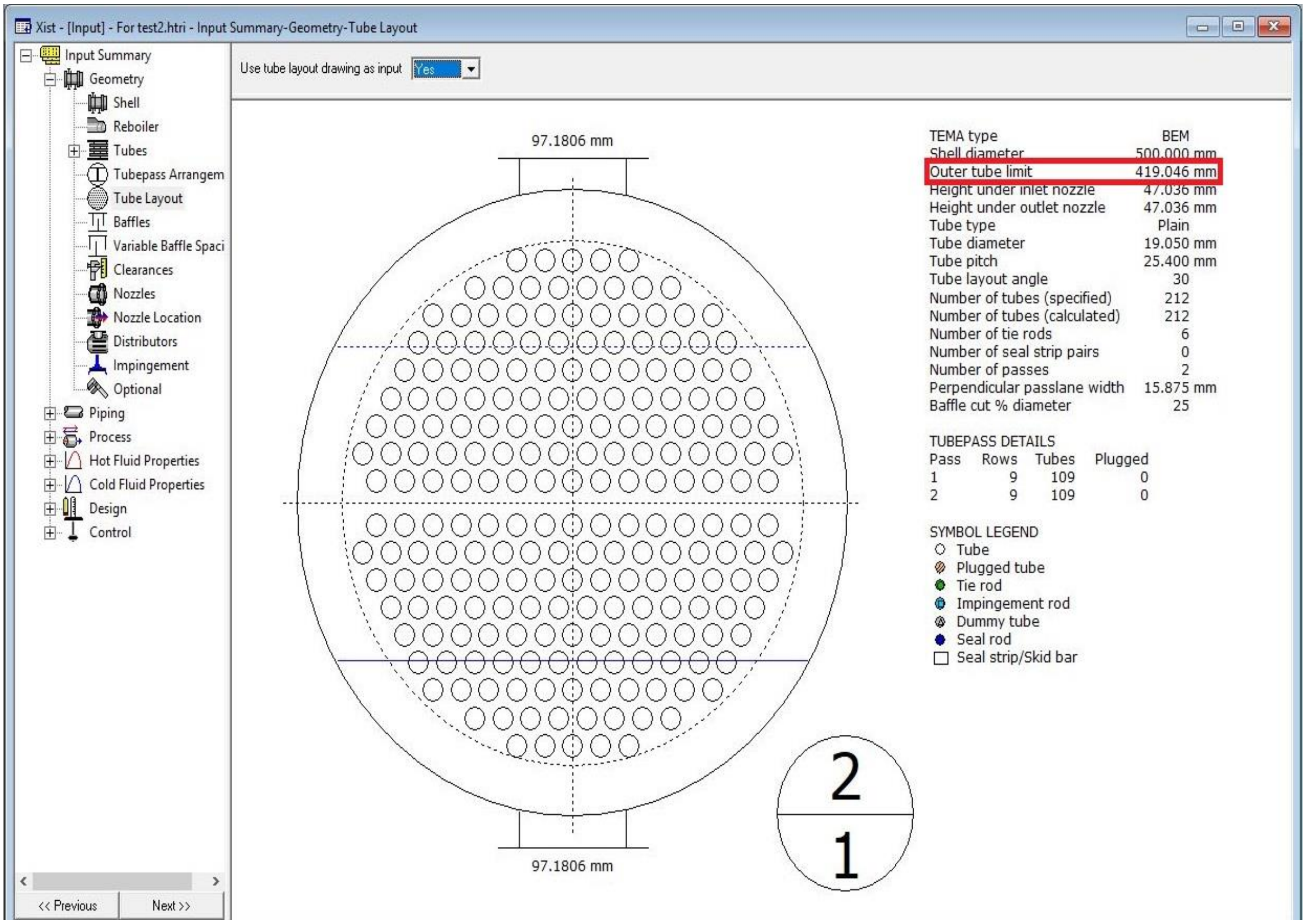


7. Now omit some tube like below and run it and the overdesign becomes 21%

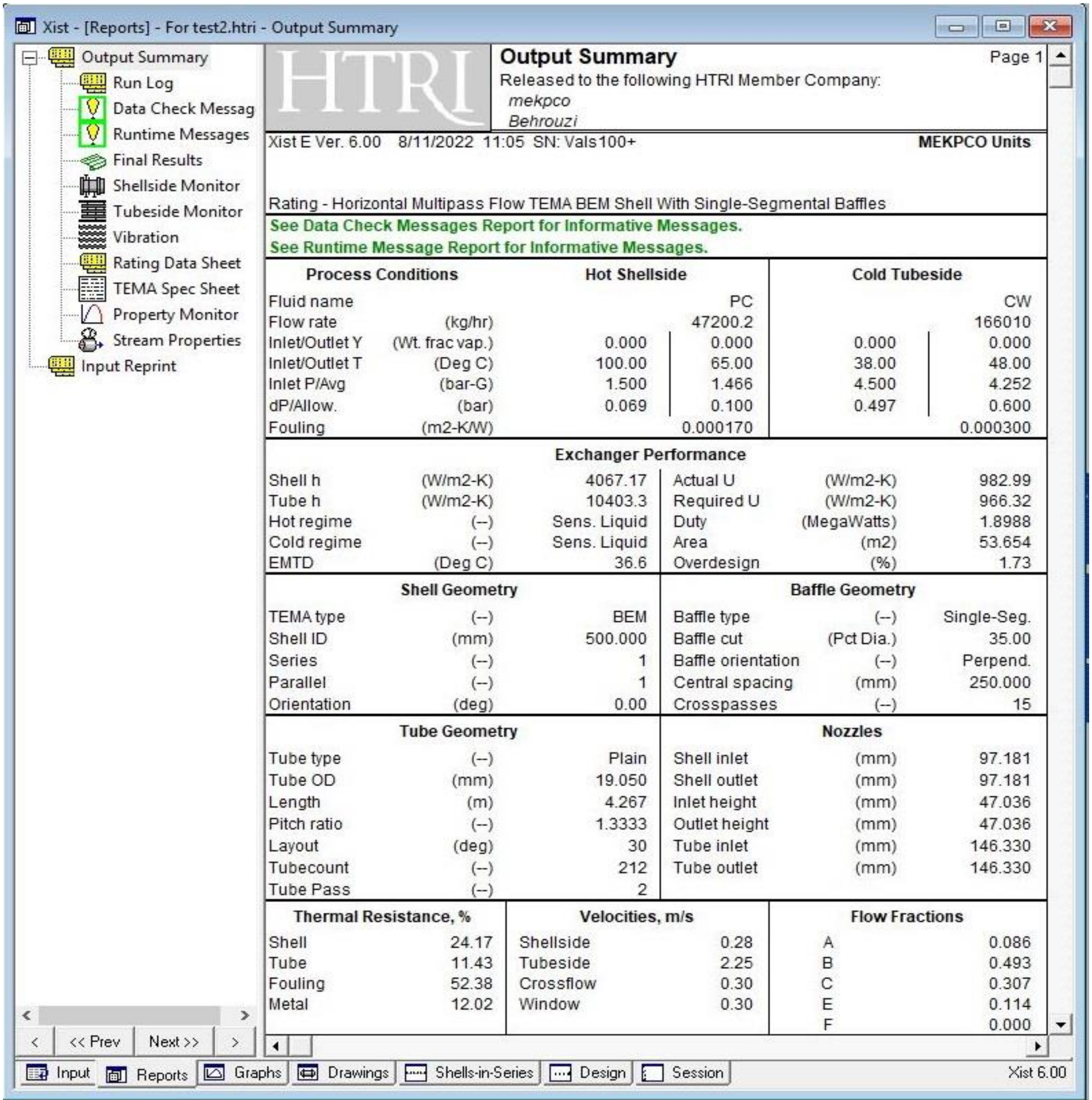


But after doing so, the water velocity in tube side reaches less than 1 m/s so we try to use double pass and by doing so, dp in tube side goes from 0.11 to 0.39 bar and tube side h goes from 5426 to 9898 and the velocity goes from 0.98 to 2.11.

8. Now omit some tubes like below and run it and overdesign factor becomes 7%



Now the only fly in the ointment is that B stream is low so different cut and spacing for baffle is tested and baffle cut of 35% is tested and the overdesign factor becomes 1.73% and B-stream increase to 50%.



HTRI **Output Summary** Page 1

Released to the following HTRI Member Company:

mekpco

Behrouzi

Xist E Ver. 6.00 8/11/2022 11:05 SN: Vals100+ **MEKPCO Units**

Rating - Horizontal Multipass Flow TEMA BEM Shell With Single-Segmental Baffles

See Data Check Messages Report for Informative Messages.

See Runtime Message Report for Informative Messages.

Process Conditions		Hot Shellside		Cold Tubeside	
Fluid name			PC		CW
Flow rate	(kg/hr)		47200.2		166010
Inlet/Outlet Y	(Wt. frac vap.)	0.000	0.000	0.000	0.000
Inlet/Outlet T	(Deg C)	100.00	65.00	38.00	48.00
Inlet P/Avg	(bar-G)	1.500	1.466	4.500	4.252
dP/Allow.	(bar)	0.069	0.100	0.497	0.600
Fouling	(m2-K/W)		0.000170		0.000300

Exchanger Performance

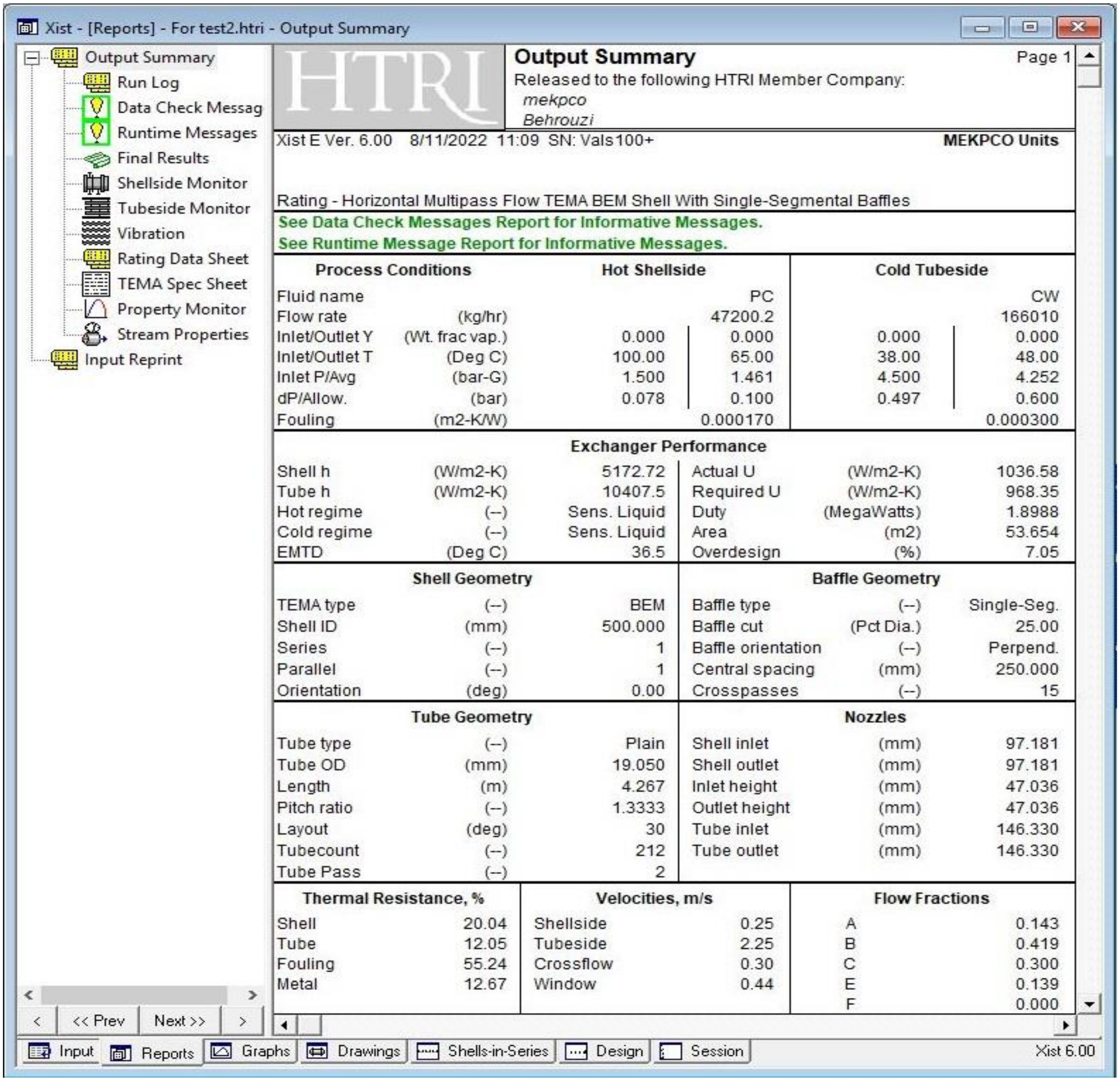
Shell h	(W/m2-K)	4067.17	Actual U	(W/m2-K)	982.99
Tube h	(W/m2-K)	10403.3	Required U	(W/m2-K)	966.32
Hot regime	(--)	Sens. Liquid	Duty	(MegaWatts)	1.8988
Cold regime	(--)	Sens. Liquid	Area	(m2)	53.654
EMTD	(Deg C)	36.6	Overdesign	(%)	1.73

Shell Geometry			Baffle Geometry		
TEMA type	(--)	BEM	Baffle type	(--)	Single-Seg.
Shell ID	(mm)	500.000	Baffle cut	(Pct Dia.)	35.00
Series	(--)	1	Baffle orientation	(--)	Perpend.
Parallel	(--)	1	Central spacing	(mm)	250.000
Orientation	(deg)	0.00	Crosspasses	(--)	15

Tube Geometry			Nozzles		
Tube type	(--)	Plain	Shell inlet	(mm)	97.181
Tube OD	(mm)	19.050	Shell outlet	(mm)	97.181
Length	(m)	4.267	Inlet height	(mm)	47.036
Pitch ratio	(--)	1.3333	Outlet height	(mm)	47.036
Layout	(deg)	30	Tube inlet	(mm)	146.330
Tubecount	(--)	212	Tube outlet	(mm)	146.330
Tube Pass	(--)	2			

Thermal Resistance, %		Velocities, m/s		Flow Fractions	
Shell	24.17	Shellside	0.28	A	0.086
Tube	11.43	Tubeside	2.25	B	0.493
Fouling	52.38	Crossflow	0.30	C	0.307
Metal	12.02	Window	0.30	E	0.114
				F	0.000

If baffle cut of 25% is selected then B-stream be as low as 41% but overdesign factor is about 7%



Xist - [Reports] - For test2.htri - Output Summary

Output Summary, Run Log, Data Check Messag, Runtime Messages, Final Results, Shellside Monitor, Tubeside Monitor, Vibration, Rating Data Sheet, TEMA Spec Sheet, Property Monitor, Stream Properties, Input Reprint

Output Summary Page 1

Released to the following HTRI Member Company:

mekpco

Behrouzi

Xist E Ver. 6.00 8/11/2022 11:09 SN: Vals100+ **MEKPCO Units**

Rating - Horizontal Multipass Flow TEMA BEM Shell With Single-Segmental Baffles

See Data Check Messages Report for Informative Messages.

See Runtime Message Report for Informative Messages.

Process Conditions		Hot Shellside		Cold Tubeside	
Fluid name			PC		CW
Flow rate	(kg/hr)		47200.2		166010
Inlet/Outlet Y	(Wt. frac vap.)	0.000	0.000	0.000	0.000
Inlet/Outlet T	(Deg C)	100.00	65.00	38.00	48.00
Inlet P/Avg	(bar-G)	1.500	1.461	4.500	4.252
dP/Allow.	(bar)	0.078	0.100	0.497	0.600
Fouling	(m2-K/W)		0.000170		0.000300

Exchanger Performance					
Shell h	(W/m2-K)	5172.72	Actual U	(W/m2-K)	1036.58
Tube h	(W/m2-K)	10407.5	Required U	(W/m2-K)	968.35
Hot regime	(--)	Sens. Liquid	Duty	(MegaWatts)	1.8988
Cold regime	(--)	Sens. Liquid	Area	(m2)	53.654
EMTD	(Deg C)	36.5	Overdesign	(%)	7.05

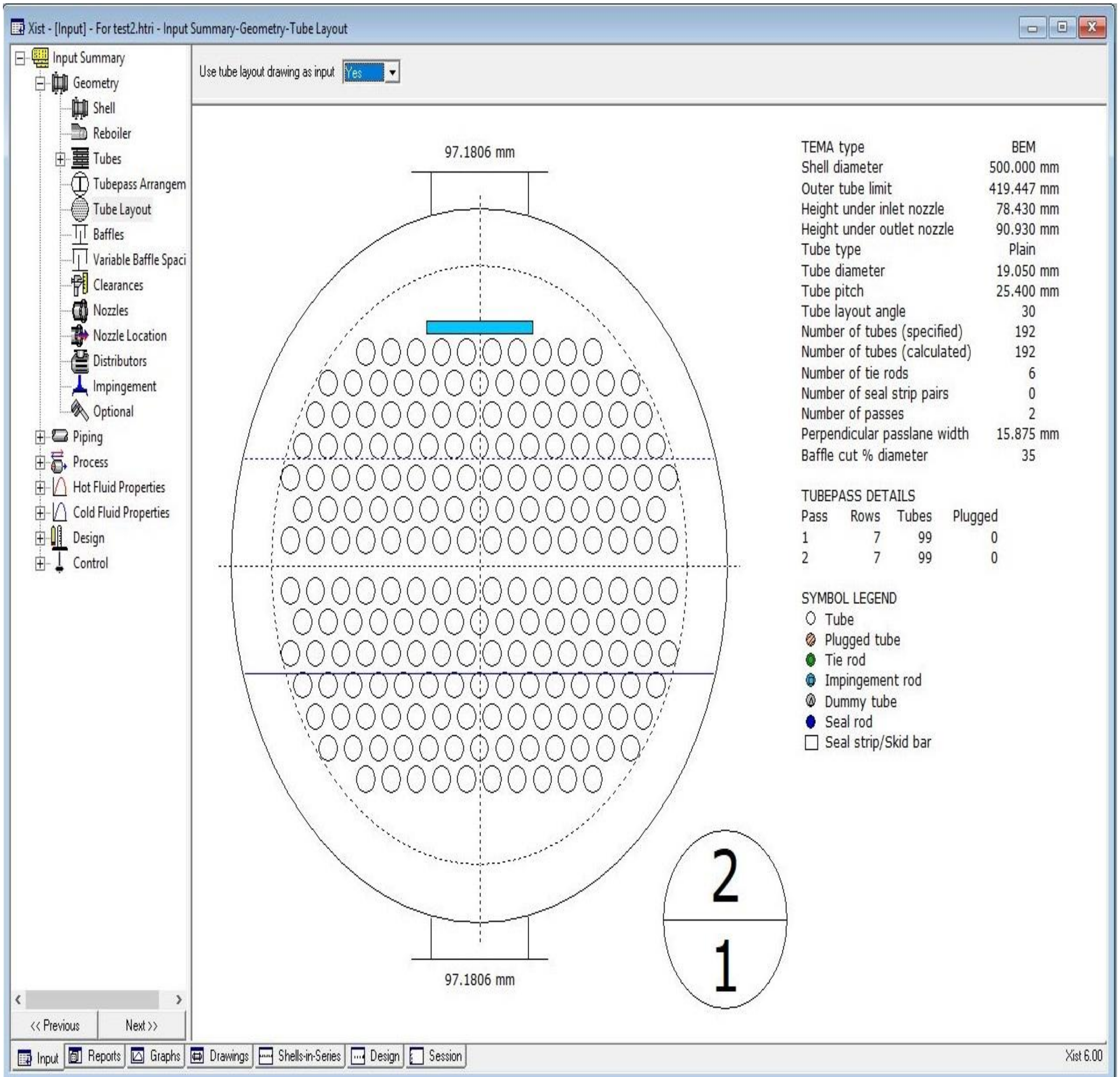
Shell Geometry			Baffle Geometry		
TEMA type	(--)	BEM	Baffle type	(--)	Single-Seg.
Shell ID	(mm)	500.000	Baffle cut	(Pct Dia.)	25.00
Series	(--)	1	Baffle orientation	(--)	Perpend.
Parallel	(--)	1	Central spacing	(mm)	250.000
Orientation	(deg)	0.00	Crosspasses	(--)	15

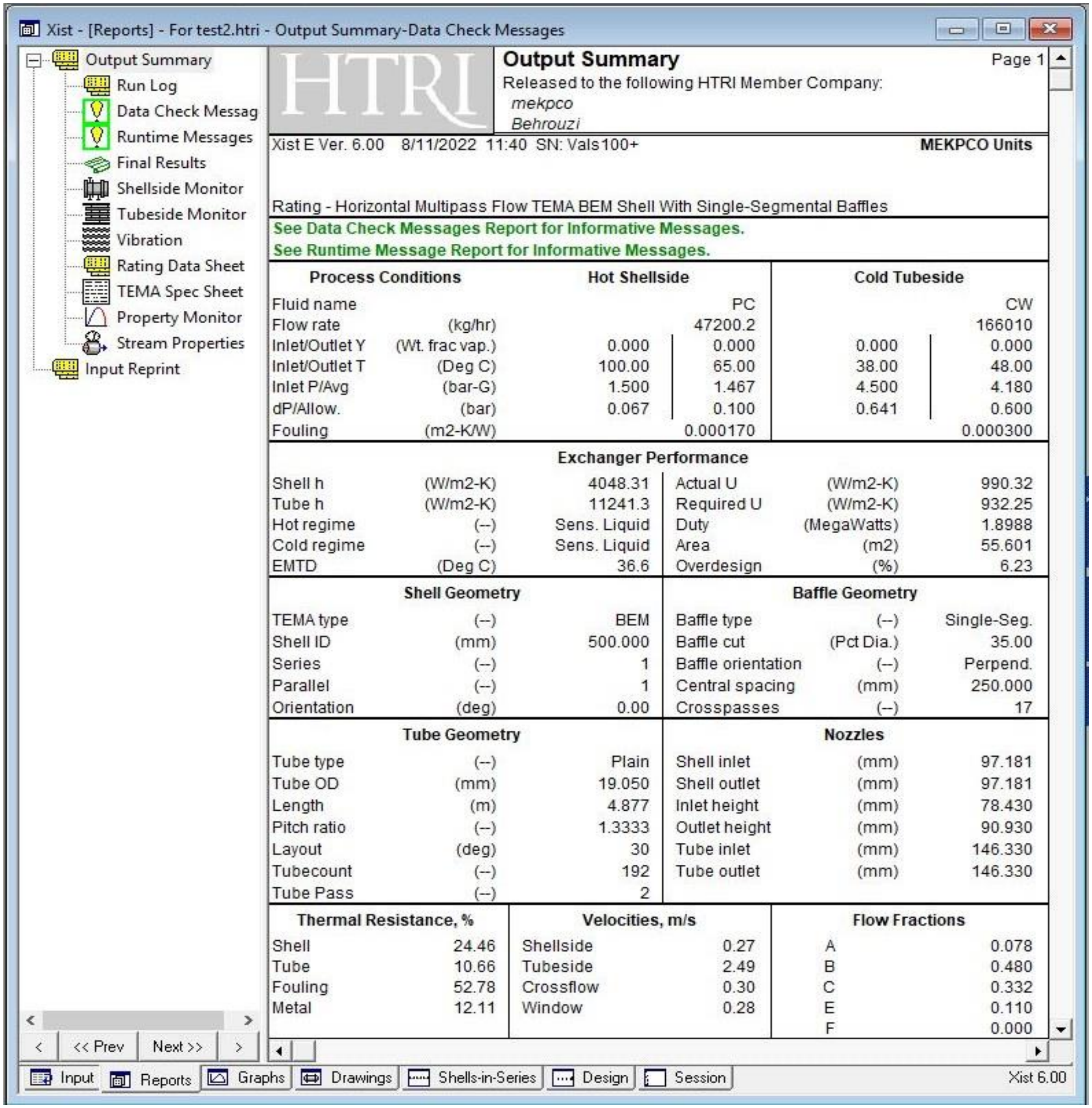
Tube Geometry			Nozzles		
Tube type	(--)	Plain	Shell inlet	(mm)	97.181
Tube OD	(mm)	19.050	Shell outlet	(mm)	97.181
Length	(m)	4.267	Inlet height	(mm)	47.036
Pitch ratio	(--)	1.3333	Outlet height	(mm)	47.036
Layout	(deg)	30	Tube inlet	(mm)	146.330
Tubecount	(--)	212	Tube outlet	(mm)	146.330
Tube Pass	(--)	2			

Thermal Resistance, %		Velocities, m/s		Flow Fractions	
Shell	20.04	Shellside	0.25	A	0.143
Tube	12.05	Tubeside	2.25	B	0.419
Fouling	55.24	Crossflow	0.30	C	0.300
Metal	12.67	Window	0.44	E	0.139
				F	0.000

Input | Reports | Graphs | Drawings | Shells-in-Series | Design | Session Xist 6.00

Now if the baffle cut 35% and increase tube length to 4.87 and run it. This results in overdesign factor of 16% and so reduce the number of tubes till the overdesign factor becomes 10%. Then activate impingement plate and omit some tubes and run it.





HTRI **Output Summary** Page 1

Released to the following HTRI Member Company:

mekpco

Behrouzi

Xist E Ver. 6.00 8/11/2022 11:40 SN: Vals100+ **MEKPCO Units**

Rating - Horizontal Multipass Flow TEMA BEM Shell With Single-Segmental Baffles

See Data Check Messages Report for Informative Messages.

See Runtime Message Report for Informative Messages.

Process Conditions		Hot Shellside		Cold Tubeside	
Fluid name			PC		CW
Flow rate	(kg/hr)		47200.2		166010
Inlet/Outlet Y	(Wt. frac vap.)	0.000	0.000	0.000	0.000
Inlet/Outlet T	(Deg C)	100.00	65.00	38.00	48.00
Inlet P/Avg	(bar-G)	1.500	1.467	4.500	4.180
dP/Allow.	(bar)	0.067	0.100	0.641	0.600
Fouling	(m2-K/W)		0.000170		0.000300

Exchanger Performance

Shell h	(W/m2-K)	4048.31	Actual U	(W/m2-K)	990.32
Tube h	(W/m2-K)	11241.3	Required U	(W/m2-K)	932.25
Hot regime	(--)	Sens. Liquid	Duty	(MegaWatts)	1.8988
Cold regime	(--)	Sens. Liquid	Area	(m2)	55.601
EMTD	(Deg C)	36.6	Overdesign	(%)	6.23

Shell Geometry			Baffle Geometry		
TEMA type	(--)	BEM	Baffle type	(--)	Single-Seg.
Shell ID	(mm)	500.000	Baffle cut	(Pct Dia.)	35.00
Series	(--)	1	Baffle orientation	(--)	Perpend.
Parallel	(--)	1	Central spacing	(mm)	250.000
Orientation	(deg)	0.00	Crosspasses	(--)	17

Tube Geometry			Nozzles		
Tube type	(--)	Plain	Shell inlet	(mm)	97.181
Tube OD	(mm)	19.050	Shell outlet	(mm)	97.181
Length	(m)	4.877	Inlet height	(mm)	78.430
Pitch ratio	(--)	1.3333	Outlet height	(mm)	90.930
Layout	(deg)	30	Tube inlet	(mm)	146.330
Tubecount	(--)	192	Tube outlet	(mm)	146.330
Tube Pass	(--)	2			

Thermal Resistance, %		Velocities, m/s		Flow Fractions	
Shell	24.46	Shellside	0.27	A	0.078
Tube	10.66	Tubeside	2.49	B	0.480
Fouling	52.78	Crossflow	0.30	C	0.332
Metal	12.11	Window	0.28	E	0.110
				F	0.000

Licensor Design

Xist - [Reports] - E-6003 TOPSEO Correted Original V1.htri - Output Summary

- Output Summary
  - Run Log
  - Data Check Messag
  - Runtime Messages
  - Final Results
  - Shellside Monitor
  - Tubeside Monitor
  - Vibration
  - Rating Data Sheet
  - TEMA Spec Sheet
  - Property Monitor
  - Stream Properties
- Input Reprint

HTRI **Output Summary** Page 1

Released to the following HTRI Member Company:

mekpco

Behrouzi

Xist E Ver. 6.00 8/11/2022 11:52 SN: Vals100+ **MEKPCO Units**

Rating - Horizontal Multipass Flow TEMA BEM Shell With Single-Segmental Baffles

See Data Check Messages Report for Informative Messages.

See Runtime Message Report for Informative Messages.

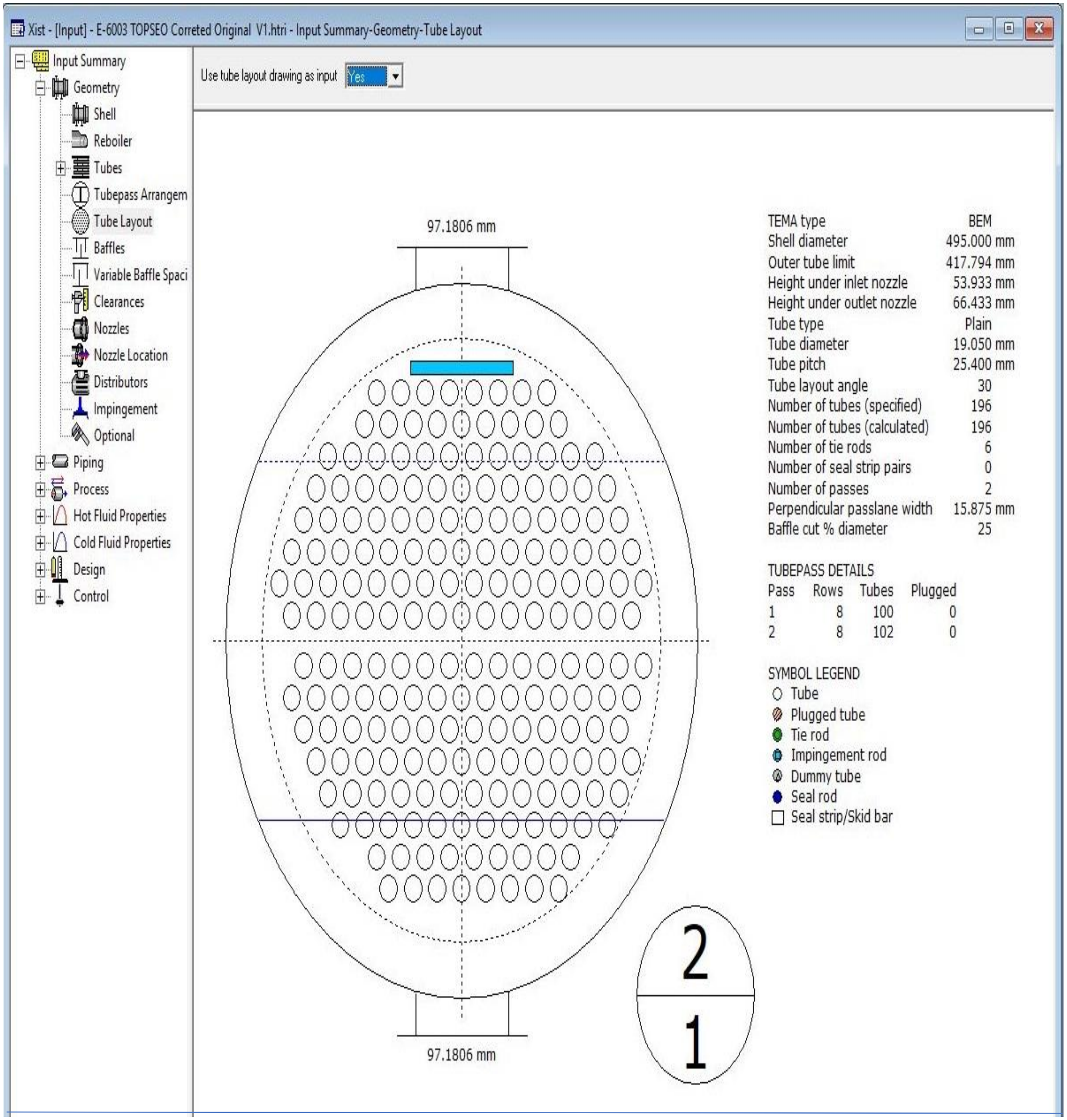
Process Conditions		Hot Shellside		Cold Tubeside	
Fluid name			PC		CW
Flow rate	(kg/hr)		47200.2		166010
Inlet/Outlet Y	(Wt. frac vap.)	0.000	0.000	0.000	0.000
Inlet/Outlet T	(Deg C)	100.00	65.00	38.00	48.00
Inlet P/Avg	(bar-G)	1.500	1.461	4.500	4.217
dP/Allow.	(bar)	0.078	0.500	0.565	0.600
Fouling	(m2-K/W)		0.000170		0.000300

Exchanger Performance					
Shell h	(W/m2-K)	5243.03	Actual U	(W/m2-K)	1058.50
Tube h	(W/m2-K)	11070.5	Required U	(W/m2-K)	1047.70
Hot regime	(--)	Sens. Liquid	Duty	(MegaWatts)	1.8988
Cold regime	(--)	Sens. Liquid	Area	(m2)	49.605
EMTD	(Deg C)	36.5	Overdesign	(%)	1.03

Shell Geometry			Baffle Geometry		
TEMA type	(--)	BEM	Baffle type	(--)	Single-Seg.
Shell ID	(mm)	495.000	Baffle cut	(Pct Dia.)	25.00
Series	(--)	1	Baffle orientation	(--)	Perpend.
Parallel	(--)	1	Central spacing	(mm)	250.000
Orientation	(deg)	0.00	Crosspasses	(--)	15

Tube Geometry			Nozzles		
Tube type	(--)	Plain	Shell inlet	(mm)	97.181
Tube OD	(mm)	19.050	Shell outlet	(mm)	97.181
Length	(m)	4.267	Inlet height	(mm)	53.933
Pitch ratio	(--)	1.3333	Outlet height	(mm)	66.433
Layout	(deg)	30	Tube inlet	(mm)	146.330
Tubecount	(--)	196	Tube outlet	(mm)	146.330
Tube Pass	(--)	2			

Thermal Resistance, %		Velocities, m/s		Flow Fractions	
Shell	20.19	Shellside	0.25	A	0.135
Tube	11.57	Tubeside	2.46	B	0.422
Fouling	56.41	Crossflow	0.31	C	0.305
Metal	11.84	Window	0.44	E	0.138
				F	0.000

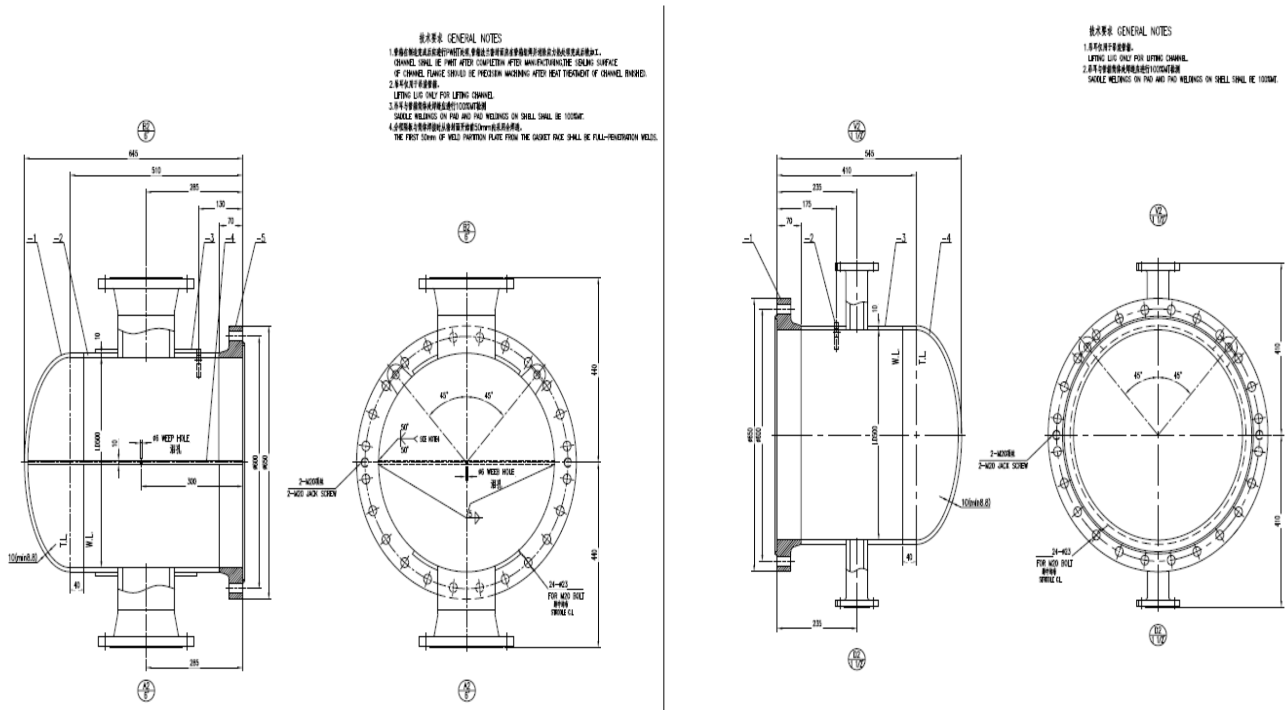

Xist - [Input] - E-6003 TOPSEO Correted Original V1.htri - Input Summary-Geometry-Tube Layout
Input Summary
Geometry
Shell
Reboiler
Tubes
Tubepass Arrangem
Tube Layout
Baffles
Variable Baffle Spaci
Clearances
Nozzles
Nozzle Location
Distributors
Impingement
Optional
Piping
Process
Hot Fluid Properties
Cold Fluid Properties
Design
Control
Use tube layout drawing as input
Yes
97.1806 mm
97.1806 mm
2
1
TEMA type BEM
Shell diameter 495.000 mm
Outer tube limit 417.794 mm
Height under inlet nozzle 53.933 mm
Height under outlet nozzle 66.433 mm
Tube type Plain
Tube diameter 19.050 mm
Tube pitch 25.400 mm
Tube layout angle 30
Number of tubes (specified) 196
Number of tubes (calculated) 196
Number of tie rods 6
Number of seal strip pairs 0
Number of passes 2
Perpendicular passlane width 15.875 mm
Baffle cut % diameter 25
TUBEPASS DETAILS
Pass Rows Tubes Plugged
1 8 100 0
2 8 102 0
SYMBOL LEGEND
Tube
Plugged tube
Tie rod
Impingement rod
Dummy tube
Seal rod
Seal strip/Skid bar

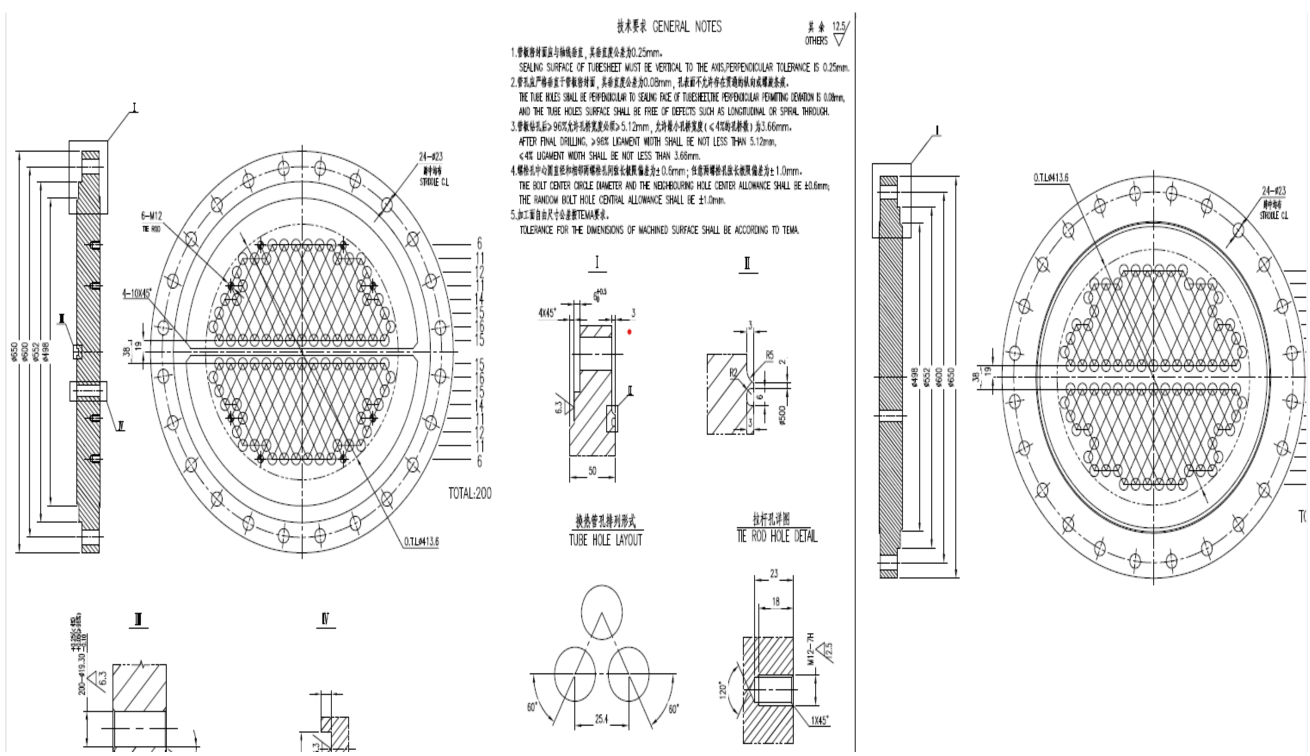
Which one should be selected?

While Topsoe design offers a heat exchanger with lower weight, that of mine offers a heat exchanger with higher overdesign factor.

By the way Topsoe configuration was also tested on my design and my configuration was slightly higher than that of Topsoe design

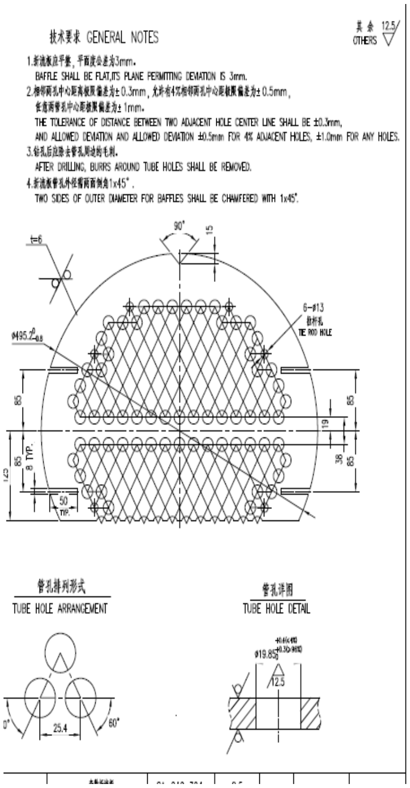
Drawings

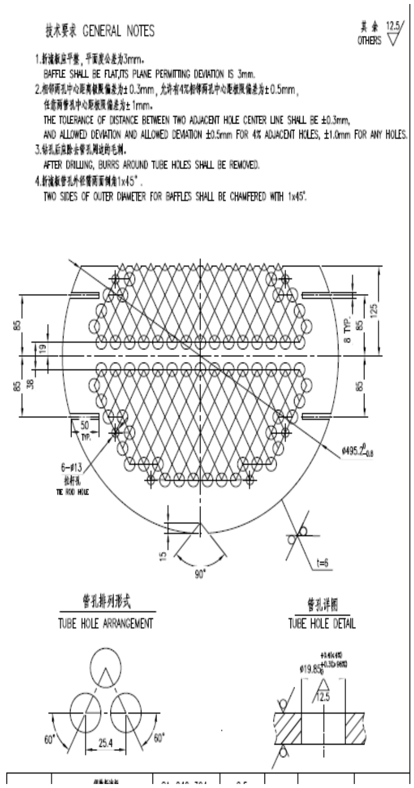

GENERAL NOTES

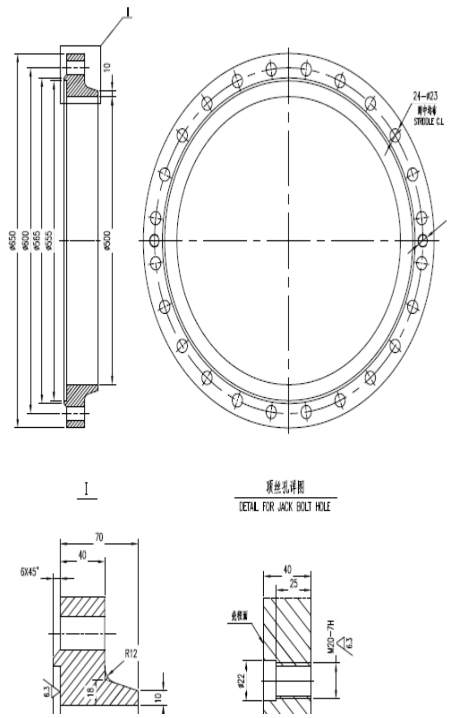

GENERAL NOTES
TOTAL:200
TUBE HOLE LAYOUT
TIE ROD HOLE DETAIL

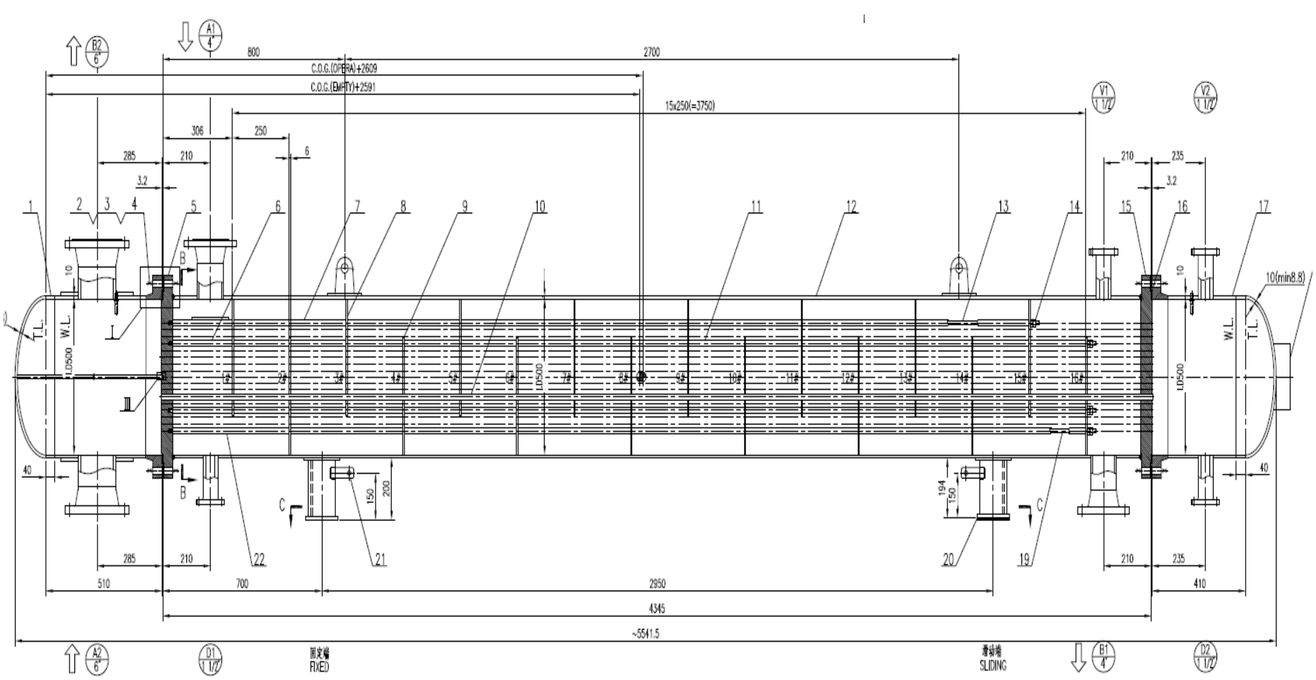
Education Institute for

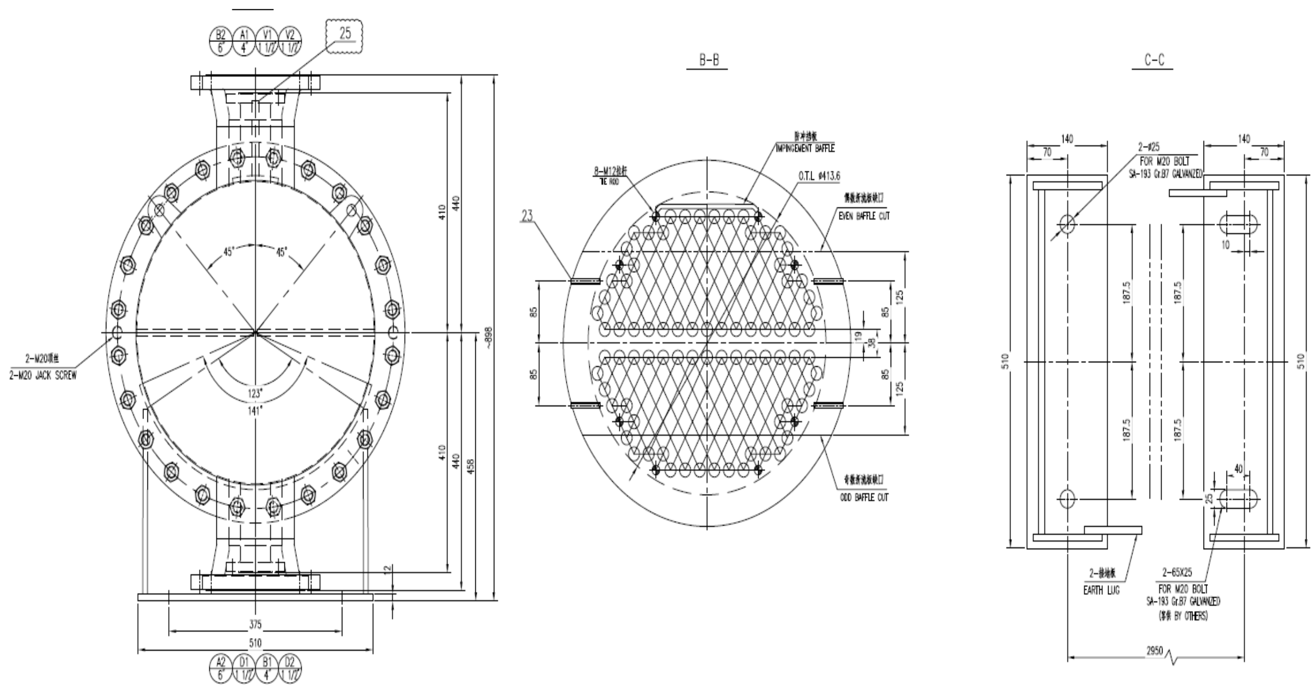
Equipment & Process Design










B-B
C-C
2-M20 JACK SCREW
IMPINGEMENT BAFFLE
O.T.L ϕ413.6
EVEN BAFFLE CUT
ODD BAFFLE CUT
EARTH LUG
FOR M20 BOLT
375
510
2950

Datasheet

Heat Exchanger Main Data					
TEMA type	BEM		Calculated surface area per unit	45,2	m²
Duty	1,9	MW	Installed surface area per unit	49,9	m²
MTD	38	°C	Shells per unit	1	
Corrected MTD	36,3	°C			

Operating Data (One Unit)

Description		Shell Side		Tube Side		Units
		Inlet	Outlet	Inlet	Outlet	
Fluids		Process condensate		Cooling water		
Quantity:	total	47200		166009		kg/h
	liquid	47200	47200	166009	166009	kg/h
	gas					kg/h
Operating temperature		100	65	38	48	°C
Operating pressure		1,5		4,5		bar g
Liquid:	molecular weight	18,02	18,02	18,02	18,02	kg/kmol
	density	958	980	993	989	kg/m³
	viscosity	0,283	0,434	0,681	0,567	cP
	specific heat capacity	4,213	4,184	4,175	4,177	kJ/kg/°C
	thermal conductivity	0,6768	0,6505	0,6199	0,6323	W/m/°C
	boiling temperature	106				°C
Gas:	molecular weight					kg/kmol
	density					kg/m³
	viscosity					cP
	specific heat capacity					kJ/kg/°C
	thermal conductivity					W/m/°C
	dew point					°C
Performance						
Pressure drop, max. allowable/calculated		/ 0,1		/ 0,6		bar
Fouling resistance		0,00017		0,00030		m²·°C/W
Film coefficient, refers to outside surface		5715,95		10667,4		W/m²/°C
Heat transfer coefficients (clean/dirty)		2631,24		/ 1171,95		W/m²/°C
Mean metal temperature		80		57		°C

Mechanical Design

	Mechanical Design Conditions				
	Design temperature (min/max)		/ 125	/ 100	°C
1	Design pressure (min/max)	1)	/ 9,0	/ 7,5	bar g
	Test pressure				bar g
	Number of passes		1	2	

General					
Construction code	ASME Sec. VIII Div. 1 or 2		Stress relieving	According to code	
TEMA Class	TEMA Class R		Design mean metal temp. diff.	30	°C
Shell					
Shell inner diameter (ID)	455	mm	Shell orientation	Horizontal	
Construction material	SS		Corrosion allowance	0	mm
Insulation purpose	Personnel protection				
Impingement plate (shell inlets)	Yes				
Front and Rear End Heads					
Front end head material	CS		Corrosion allowance	3	mm
Front end head insulation	None				
Rear end head material	CS		Corrosion allowance	3	mm
Rear end head insulation	None				

Tube Bundle							
	No. of tubes	196		Effective tube length	4250	mm
	Construction material	Duplex SS		Total tube length incl. tubesheet		mm
	Tube outer diameter (OD)	19,05	mm	Tube inner diameter (ID)	15,75	mm
	Tube pitch pattern	Triangular		Tube pitch	25,4	mm
	Minimum distance from shell side inlet nozzle to tube bundle: 55 mm					
Tubesheets							
	Construction material	SS		Corrosion allowance	0	mm
Baffles, Tie Rods and Dummy Tubes							
	Baffle type	Single segmental		Baffle cut type	Horizontal	
	Baffle spacing	250	mm	Construction material	SS	
	Baffle cut (% of shell ID)	25	%	Free baffle hole area	0,0234	m^2
	Tubes in outer baffle window	Yes				