Heat Exchangers Data Sheet (Condenser, Evaporator, Oil Cooler, Economizer)

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Rev.	DATE	PURPOSE OF ISSUE	PREPARED	CHECKED	APPROVED
05					
04					
03					
02					
01	14-July-25	IFR	A.M	F.T	A.M
00	29-Apr-25	IFR	A.M	F.T	A.M

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Heat Exchanger Specification Sheet

1	For: Gachsaran Polymer Industries Company (GPIC)						Condenser: TAG: E-6104	
2	Project: HDPE							
3	PO No.: GPIC-PT-MA-PO-000-3029							
4	Site: -							
5	Service: Propylene Refrigeration Package							
6	Size: 1095 - 6000 mm	Type: BIM	Horizontal		Connected in: 1 parallel		1 series	
7	Surf/unit(eff.) 584.1 m²	Shells/unit 1			Surf/shell(eff.)		584.1 m²	
8	**PERFORMANCE OF ONE UNIT**							
9	Fluid allocation		Shell Side		Tube Side			
10	Fluid name		Propylene		WATER			
11	Fluid quantity, Total	kg/h	27463		290000			
12	Vapor (In/Out)	kg/h	27463	0	0	0		
13	Liquid	kg/h	0	27463	290000	290000		
14	Noncondensable	kg/h	0	0	0	0		
15								
16	Temperature (In/Out)	°C	77.02	47.62	37	44.84		
17	Bubble / Dew point	°C	48.59 / 48.59	48.58 / 48.58	/	/		
18	Density Vapor/Liquid	kg/m³	35.84 /	/ 460.44	/ 993.06	/ 990.04		
19	Viscosity	cp	0.0111 /	/ 0.0604	/ 0.7192	0.619		
20	Molecular wt, Vap		42.08					
21	Molecular wt, NC							
22	Specific heat	kJ/(kg-K)	2.0217 /	/ 3.204	/ 4.1774	/ 4.1775		
23	Thermal conductivity	W/(m-K)	0.0252 /	/ 0.0911	/ 0.6220	/ 0.6314		
24	Latent heat	kJ/kg	282.7	282.7				
25	Pressure (abs)	bar	19.68	19.67376	6.5	6.17041		
26	Velocity (Mean/Max)	m/s	0.37 / 0.8		1.12 / 1.12			
27	Pressure drop, allow./calc.	bar	0.1	0.00624	0.5	0.32959		
28	Fouling resistance (min)	m²-K/W	0.0002		0.0002	0.00026 Ao based		
29	Heat exchanged 2644.1 kW				MTD (corrected)	7.69 °C		
30	Transfer rate, Service 588.6		Dirty 659		Clean 943		W/(m²-K)	
31	**CONSTRUCTION OF ONE SHELL**						**Sketch**	
32			Shell Side		Tube Side			
33	Design/Vacuum/test pressure	bar	25 / 1 / 32.5		28 / / 36.4			
34	Design temperature / MDMT	°C	125 / -45		190 / -29			
35	Number passes per shell		1		4			
36	Corrosion allowance	mm	3		3			
37	Connections	In in	2 10 / 300 ANSI		1 8 / 300 ANSI			
38	Size/Rating	Out	1 6 / 300 ANSI		1 8 / 300 ANSI			
39	Nominal	Intermediate	/ 300 ANSI		/ 300 ANSI			
40	Tube #: 1676 OD: 19.05 Tks. Average 2.11 mm		Length: 6000 mm		Pitch: 23.81 mm		Tube pattern:30	
41	Tube type: Plain	Insert:None		Fin#:	#/m	Material:SA-334 6 K03006		
42	Shell SA-516 70 K02700-Normalized	ID 1095 mm			Shell cover -			
43	Channel or bonnet SA-516 70 K02700-Normalized				Channel cover -			
44	Tubesheet-stationary SA-350 LF2 K03011 1-Normalized -				Tubesheet-floating -			
45	Floating head cover -				Impingement protection Round plate			
46	Baffle-cross SA-516 70 K02700-Normalized	Type Single segmental	Cut(%d) 40.87		Vertic Spacing: c/c 480 mm			
47	Baffle-long -	Seal Type			Inlet 495.74 mm			
48	Supports-tube U-bend	0			Type			
49	Bypass seal		Tube-tubesheet joint		Expanded & seal welded (2 grooves)(App.A 'f')			
50	Expansion joint -		Type None					
51	RhoV2-Inlet nozzle 161	Bundle entrance 120			Bundle exit 11 kg/(m-s²)			
52	Gaskets - Shell side	Spiral-Wound Metal Fib	Tube side		Spiral-Wound Metal Fib			
53	Floating head -							
54	Code requirements ASME Code Sec VIII Div 1		TEMA class R - refinery service					
55	Weight/Shell 15047.6	Filled with water 20624.5	Bundle 10303.6 kg					
56	Remarks 1. GA DRAWING WILL BE SUBMITTED TO SHOW ALL THE NOZZLES							
57	2. MATERIAL ON SHELL SIDE IS DESIGNED FOR -45C							
58								

Thermal Details - Vibration Analysis - Fluid Elastic Instability HTFS

Shell number: Shell 1
Fluid Elastic Instability Analysis

Vibration tube number		1	2	4	5
Vibration tube location		Inlet row, centre	Outer window, left	Baffle overlap	Bottom Row
Vibration		No	No	No	No
W/Wc for heavy damping (LDec=0.1)		0.02	0.06	0.02	0.02
W/Wc for medium damping (LDec=0.03)		0.03	0.11	0.03	0.03
W/Wc for light damping (LDec=0.01)		0.06	0.2	0.06	0.06
W/Wc for estimated damping		0.02	0.09	0.02	0.02
Estimated log Decrement		0.07	0.05	0.07	0.07
Tube natural frequency	**cycle/s**	194.16	53.98	194.16	194.16
Natural frequency method		Exact Solution	Exact Solution	Exact Solution	Exact Solution
Dominant span					
Tube effective mass	**kg/m**	1.17	1.17	1.17	1.17

Vibration tube number		6	8
Vibration tube location		Inlet row, end	Outer window, right
Vibration		No	No
W/Wc for heavy damping (LDec=0.1)		0.09	0.07
W/Wc for medium damping (LDec=0.03)		0.16	0.12
W/Wc for light damping (LDec=0.01)		0.28	0.22
W/Wc for estimated damping		0.12	0.09
Estimated log Decrement		0.05	0.06
Tube natural frequency	**cycle/s**	53.98	49.53
Natural frequency method		Exact Solution	Dominant Span
Dominant span			Mid-space
Tube effective mass	**kg/m**	1.17	1.17

Note: W/Wc = ratio of actual shellside flowrate to critical flowrate for onset of fluid-elastic instability

Tube material density	kg/m³	7841.74
Tube axial stress	N/mm²	15.82
Tube material Young's Modulus	N/mm²	201571.3
U-bend longest unsupported length	mm	

Resonance Analysis (HTFS)

Shell number: Shell 1
Resonance Analysis

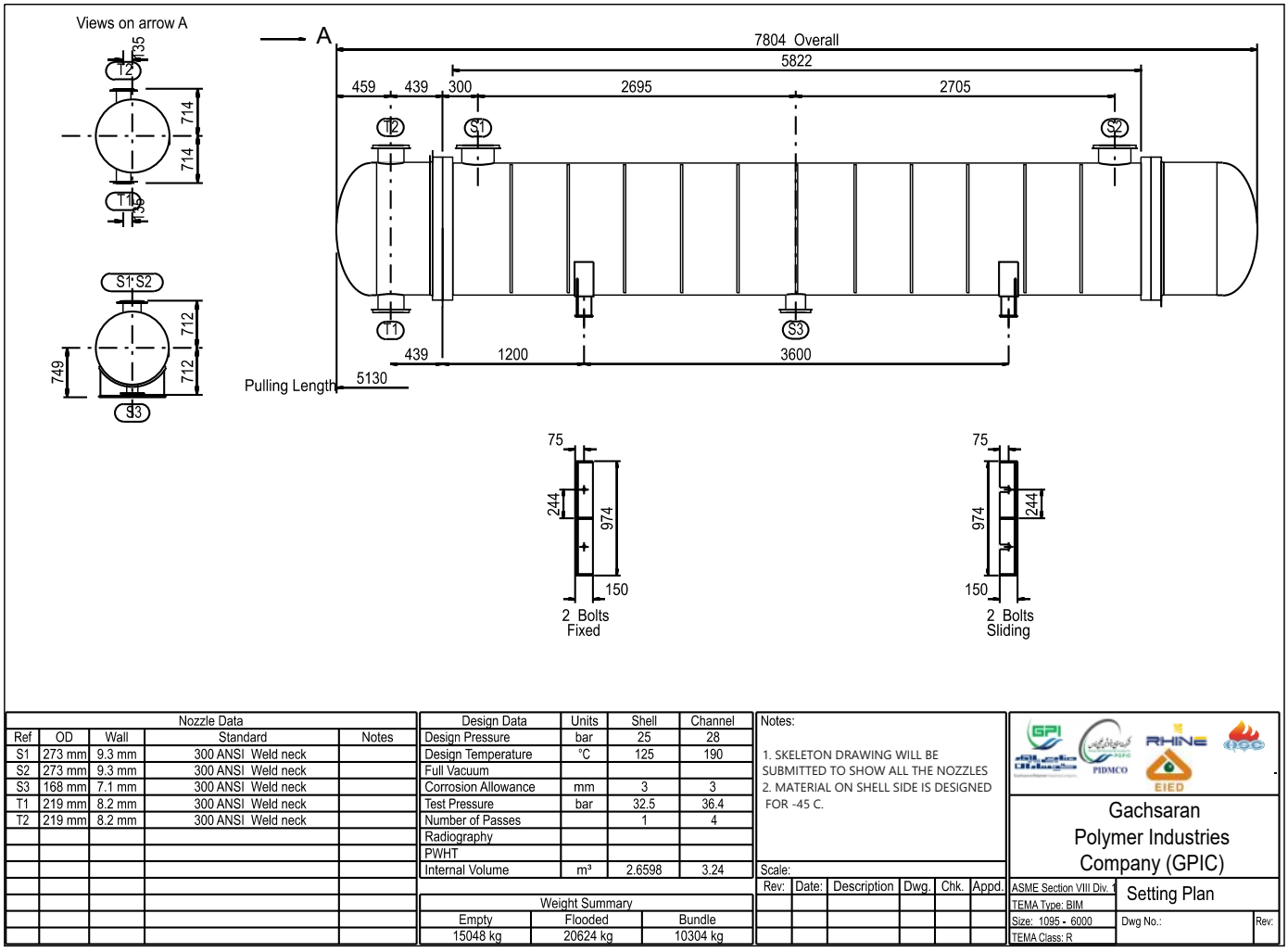
Vibration tube number		1	1	1	2
Vibration tube location		Inlet row, centre	Inlet row, centre	Inlet row, centre	Outer window, left
Location along tube		Inlet	Midspace	Outlet	Inlet
Vibration problem		No	No	No	No
Span length	mm	495.74	480	495.74	975.74
Frequency ratio: Fv/Fn		0.4	0.07	0.02	0.33
Frequency ratio: Fv/Fa		0.58	0.12	0	0.14
Frequency ratio: Ft/Fn		0.43	0.05	0.01	0.21
Frequency ratio: Ft/Fa		0.63	0.08	0	0.09
Vortex shedding amplitude	mm				
Turbulent buffeting amplitude	mm				
TEMA amplitude limit	mm				
Natural freq., Fn	cycle/s	194.16	194.16	194.16	53.98
Acoustic freq., Fa	cycle/s	132.65	115.82	1160.4	132.65
Flow velocity	m/s	1.85	0.41	0.14	0.74
X-flow fraction		1	0.75	0.75	0.75
RhoV2	kg/(m*s2)	120	12	9	19
Strouhal No.		0.8	0.46	0.46	0.46

Vibration tube number		2	2	4	4	4
Vibration tube location		Outer window, left	Outer window, left	Baffle overlap	Baffle overlap	Baffle overlap
Location along tube		Midspace	Outlet	Inlet	Midspace	Outlet
Vibration problem		No	No	No	No	No
Span length	mm	960	975.74	495.74	480	495.74
Frequency ratio: Fv/Fn		0.25	0.06	0.09	0.07	0.02
Frequency ratio: Fv/Fa		0.12	0	0.14	0.12	0
Frequency ratio: Ft/Fn		0.16	0.04	0.06	0.05	0.01
Frequency ratio: Ft/Fa		0.08	0	0.09	0.08	0
Vortex shedding amplitude	mm					
Turbulent buffeting amplitude	mm					
TEMA amplitude limit	mm					
Natural freq., Fn	cycle/s	53.98	53.98	194.16	194.16	194.16
Acoustic freq., Fa	cycle/s	115.82	1160.4	132.65	115.82	1160.4
Flow velocity	m/s	0.41	0.14	0.74	0.41	0.14
X-flow fraction		0.75	0.75	0.75	0.75	0.75
RhoV2	kg/(m*s2)	12	9	19	12	9
Strouhal No.		0.46	0.46	0.46	0.46	0.46

Vibration tube number		5	5	5	6	6	6
Vibration tube location		Bottom Row	Bottom Row	Bottom Row	Inlet row, end	Inlet row, end	Inlet row, end
Location along tube		Inlet	Midspace	Outlet	Inlet	Midspace	Outlet
Vibration problem		No	No	No	No	No	No
Span length	**mm**	495.74	480	495.74	975.74	960	975.74
Frequency ratio: Fv/Fn		0.09	0.07	0.03	1.43	0.44	0.06
Frequency ratio: Fv/Fa		0.14	0.12	0.01	0.58	0.2	0
Frequency ratio: Ft/Fn		0.06	0.05	0.04	1.55	0.47	0.04
Frequency ratio: Ft/Fa		0.09	0.08	0.01	0.63	0.22	0
Vortex shedding amplitude	**mm**						
Turbulent buffeting amplitude	**mm**						
TEMA amplitude limit	**mm**						
Natural freq., Fn	**cycle/s**	194.16	194.16	194.16	53.98	53.98	53.98
Acoustic freq., Fa	**cycle/s**	132.65	115.82	1160.4	132.65	115.82	1160.4
Flow velocity	**m/s**	0.74	0.41	0.15	1.85	0.41	0.14
X-flow fraction		0.75	0.75	1	0.75	0.75	0.75
RhoV2	**kg/(m*s2)**	19	12	11	120	12	9
Strouhal No.		0.46	0.46	0.8	0.46	0.46	0.46

Vibration tube number		8	8	8
Vibration tube location		Outer window, right	Outer window, right	Outer window, right
Location along tube		Inlet	Midspace	Outlet
Vibration problem		No	No	No
Span length	**mm**	495.74	960	495.74
Frequency ratio: Fv/Fn		0.36	0.28	0.07
Frequency ratio: Fv/Fa		0.14	0.12	0
Frequency ratio: Ft/Fn		0.23	0.18	0.05
Frequency ratio: Ft/Fa		0.09	0.08	0
Vortex shedding amplitude	**mm**			
Turbulent buffeting amplitude	**mm**			
TEMA amplitude limit	**mm**			
Natural freq., Fn	**cycle/s**	49.53	49.53	49.53
Acoustic freq., Fa	**cycle/s**	132.65	115.82	1160.4
Flow velocity	**m/s**	0.74	0.41	0.14
X-flow fraction		0.75	0.75	0.75
RhoV2	**kg/(m*s2)**	19	12	9
Strouhal No.		0.46	0.46	0.46

Setting Plan



Nozzle Data				
Ref	OD	Wall	Standard	Notes
S1	273 mm	9.3 mm	300 ANSI Weld neck	
S2	273 mm	9.3 mm	300 ANSI Weld neck	
S3	168 mm	7.1 mm	300 ANSI Weld neck	
T1	219 mm	8.2 mm	300 ANSI Weld neck	
T2	219 mm	8.2 mm	300 ANSI Weld neck	

Design Data	Units	Shell	Channel
Design Pressure	bar	25	28
Design Temperature	°C	125	190
Full Vacuum			
Corrosion Allowance	mm	3	3
Test Pressure	bar	32.5	36.4
Number of Passes		1	4
Radiography			
PWHT			
Internal Volume	m³	2.6598	3.24

Weight Summary		
Empty	Flooded	Bundle
15048 kg	20624 kg	10304 kg

Notes:

1. SKELETON DRAWING WILL BE SUBMITTED TO SHOW ALL THE NOZZLES
2. MATERIAL ON SHELL SIDE IS DESIGNED FOR -45 C.

Scale:

Rev:	Date:	Description	Dwg.	Chk.	Appd.

Gachsaran Polymer Industries Company (GPIC)

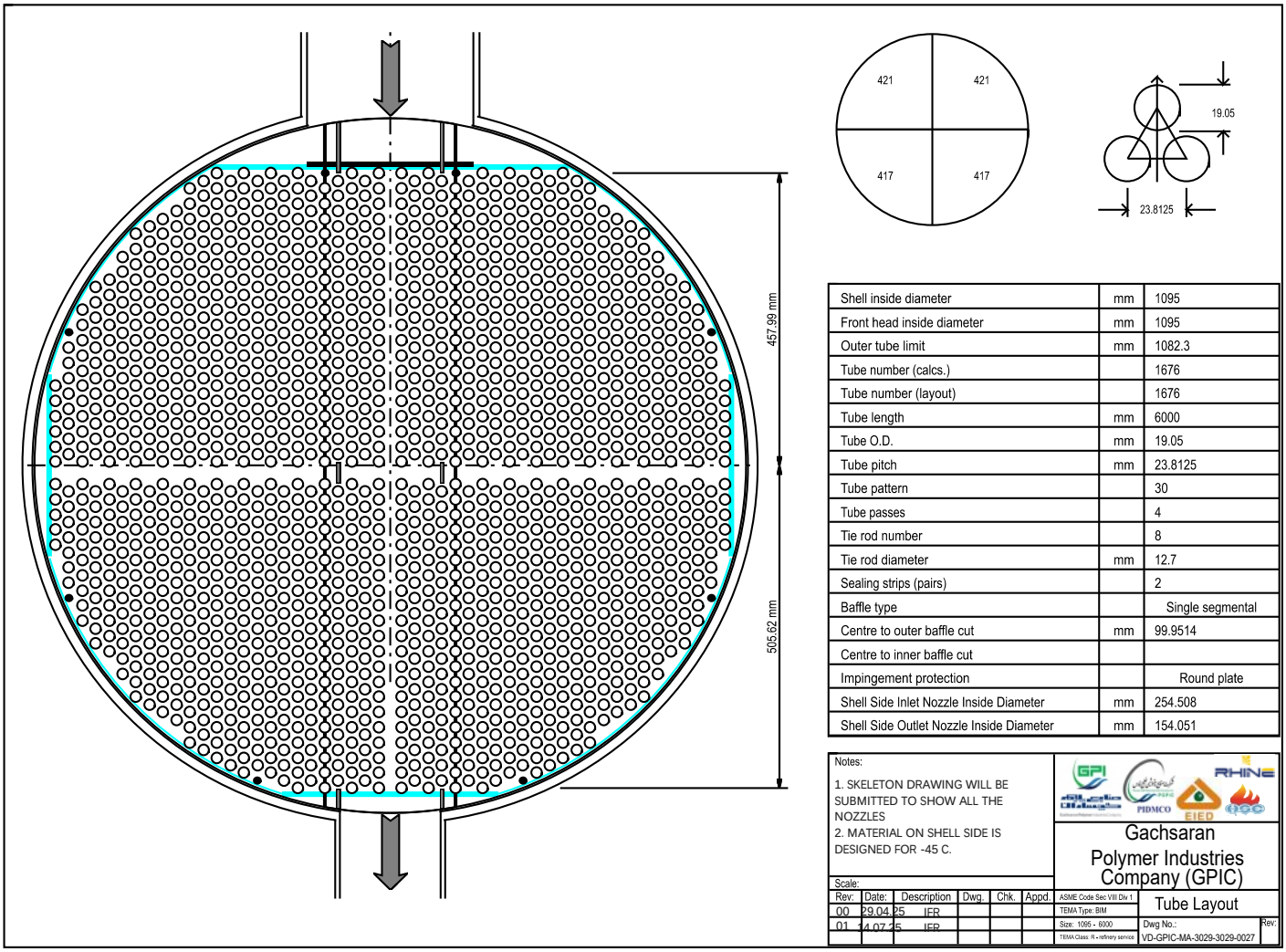
ASME Section VIII Div. 1
TEMA Type: BIM
Size: 1095 - 6000
TEMA Class: R

Setting Plan

Dwg No.:

Rev:

Tubesheet Layout



Shell inside diameter	mm	1095
Front head inside diameter	mm	1095
Outer tube limit	mm	1082.3
Tube number (calcs.)		1676
Tube number (layout)		1676
Tube length	mm	6000
Tube O.D.	mm	19.05
Tube pitch	mm	23.8125
Tube pattern		30
Tube passes		4
Tie rod number		8
Tie rod diameter	mm	12.7
Sealing strips (pairs)		2
Baffle type		Single segmental
Centre to outer baffle cut	mm	99.9514
Centre to inner baffle cut		
Impingement protection		Round plate
Shell Side Inlet Nozzle Inside Diameter	mm	254.508
Shell Side Outlet Nozzle Inside Diameter	mm	154.051

Notes:

1. SKELETON DRAWING WILL BE SUBMITTED TO SHOW ALL THE NOZZLES
2. MATERIAL ON SHELL SIDE IS DESIGNED FOR -45 C.

Scale:

Rev:	Date:	Description	Dwg.	Chk.	Appd.
00	29.04.25	IFR			
01	14.07.25	IFR			

Gachsaran Polymer Industries Company (GPIC)

Tube Layout

ASME Code Sec VIII Div 1
TEMA Type: BIM
Size: 1095 - 6000
TEMA Class: R - refinery service

Dwg No.: VD-GPIC-MA-3029-3029-0027

Rev:

Heat Exchanger Specification Sheet

1	For: Gachsaran Polymer Industries Company (GPIC)							
2	Project: HDPE						Chiller: TAG: E-6101	
3	PO No.: GPIC-PT-MA-PO-000-3029							
4	Site: -							
5	Service: Propylene Refrigeration Package							
6	Size: 1118 - 6096 mm	Type: BXU	Horizontal		Connected in: 1 parallel		1 series	
7	Surf/unit(eff.) 624.6 m²	Shells/unit 1			Surf/shell(eff.)		624.6 m²	
8	**PERFORMANCE OF ONE UNIT**							
9	Fluid allocation		Shell Side		Tube Side			
10	Fluid name		Propylene		Hexane			
11	Fluid quantity, Total	kg/h	22140		712800			
12	Vapor (In/Out)	kg/h	6824	22140	0	0		
13	Liquid	kg/h	15316	0	712800	712800		
14	Noncondensable	kg/h	0	0	0	0		
15								
16	Temperature (In/Out)	°C	-24.497	-24.58	-16	-20.5		
17	Bubble / Dew point	°C	-24.77 / -24.77	-24.85 / -24.85	/	/		
18	Density Vapor/Liquid	kg/m³	5.5692 / 580.75	5.6747 /	/ 691.99	/ 695.76		
19	Viscosity	cp	0.0073 / 0.140	0.0072 /	/ 0.4568	/ 0.4840		
20	Molecular wt, Vap		42.08	42.08				
21	Molecular wt, NC							
22	Specific heat	kJ/(kg-K)	1.401 / 2.2122	1.4002 /	/ 1.9674	/ 1.949		
23	Thermal conductivity	W/(m-K)	0.0128 / 0.134	0.0127 /	/ 0.1341	/ 0.1356		
24	Latent heat	kJ/kg	410.1	410.1				
25	Pressure (abs)	bar	2.617	2.60925	7	6.65947		
26	Velocity (Mean/Max)	m/s	0.83 / 1.26		2 / 2			
27	Pressure drop, allow./calc.	bar	0.01	0.00775	0.7	0.34053		
28	Fouling resistance (min)	m²-K/W	0.0002		0.0001	0.00013 Ao based		
29	Heat exchanged 1759.2 kW				MTD (corrected)	5.39 °C		
30	Transfer rate, Service 522.4		Dirty 578		Clean 713.5	W/(m²-K)		
31	**CONSTRUCTION OF ONE SHELL**						**Sketch**	
32			Shell Side		Tube Side			
33	Design/Vacuum/test pressure	bar	25 / 1 / 32.5		25 / 1 / 32.5			
34	Design temperature / MDMT	°C	125 / -45		125 / -45			
35	Number passes per shell		1		2			
36	Corrosion allowance	mm	3		3			
37	Connections In	in	4 6.065 / 300 ANSI		1 13.25 / 300 ANSI			
38	Size/Rating Out		4 6.065 / 300 ANSI		1 13.25 / 300 ANSI			
39	ID Intermediate		/ 300 ANSI		/ 300 ANSI			
40	Tube #: 826 U's OD: 19.05 Tks. Average 2.11 mm		Length: 6096 mm		Pitch: 23.81 mm		Tube pattern:30	
41	Tube type: Plain		Insert:None		Fin#:	#/m	Material:SA-334 6 K03006	
42	Shell SA-516 70 K02700-Normalized		ID 1117.6 mm		Shell cover SA-516 70 K02700-Normalized			
43	Channel or bonnet SA-516 70 K02700-Normalized				Channel cover -			
44	Tubesheet-stationary SA-350 LF2 K03011 1-Normalized		-		Tubesheet-floating -			
45	Floating head cover -				Impingement protection Square plate			
46	Baffle-cross SA-516 70 K02700-Normalized	Type Unbaffled		Cut(%d)		Spacing: c/c		mm
47	Baffle-long -	Seal Type				Inlet		mm
48	Supports-tube U-bend	1		Type				
49	Bypass seal		Tube-tubesheet joint		Expanded & seal welded (2 grooves)(App.A 'f')			
50	Expansion joint -	Type None						
51	RhoV2-Inlet nozzle 403	Bundle entrance 2		Bundle exit 8		kg/(m-s²)		
52	Gaskets - Shell side Flat Metal Jacket Fibe	Tube side	Flat Metal Jacket Fibe					
53	Floating head -							
54	Code requirements ASME Code Sec VIII Div 1	TEMA class R - refinery service						
55	Weight/Shell 15264.6 Filled with water 22374.2	Bundle 10609.8 kg						
56	Remarks 1. GA DRAWING WILL BE SUBMITTED TO SHOW ALL THE NOZZLES							
57	2. MATERIAL ON SHELL and TUBE SIDES ARE DESIGNED FOR -45C							
58								

Thermal Details - Vibration Analysis - Fluid Elastic Instability HTFS

Shell number: Shell 1

Fluid Elastic Instability Analysis

Vibration tube number		3	4
Vibration tube location		Bottom Row	Top row
Vibration		No	No
W/Wc for heavy damping (LDec=0.1)		0.05	0.05
W/Wc for medium damping (LDec=0.03)		0.09	0.09
W/Wc for light damping (LDec=0.01)		0.16	0.16
W/Wc for estimated damping		0.08	0.08
Estimated log Decrement		0.04	0.04
Tube natural frequency	**cycle/s**	45.73	45.73
Natural frequency method		Dominant Span	Dominant Span
Dominant span		Mid-space	Outlet
Tube effective mass	**kg/m**	1.01	1.01

Note: W/Wc = ratio of actual shellside flowrate to critical flowrate for onset of fluid-elastic instability

Tube material density	kg/m³	7841.74
Tube axial stress	N/mm²	0
Tube material Young's Modulus	N/mm²	205282.1
U-bend longest unsupported length	mm	702.75

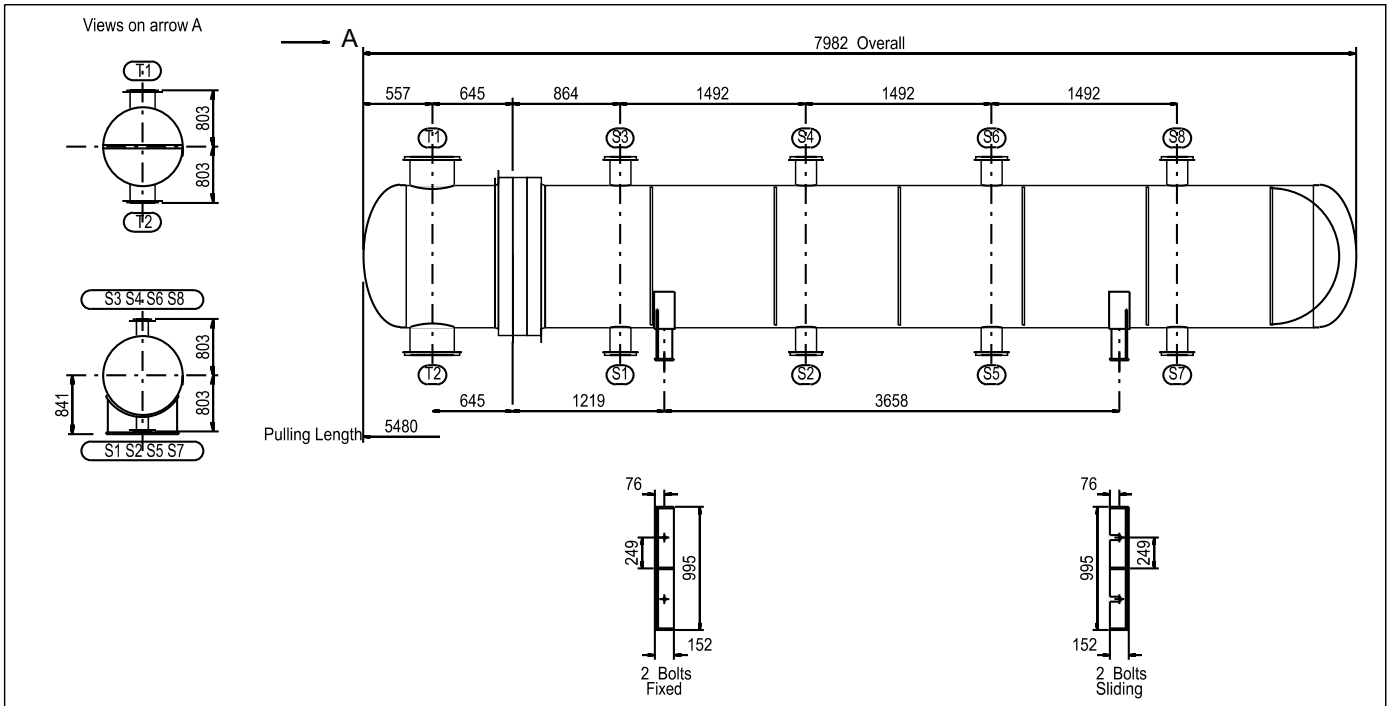
Resonance Analysis (HTFS)

Shell number: Shell 1

Resonance Analysis

Vibration tube number		3	4
Vibration tube location		Bottom Row	Top row
Location along tube		Midspace	Midspace
Vibration problem		No	No
Span length	**mm**	752.48	996.16
Frequency ratio: Fv/Fn		0.19	0.61
Frequency ratio: Fv/Fa		0.12	0.22
Frequency ratio: Ft/Fn		0.12	0.39
Frequency ratio: Ft/Fa		0.08	0.14
Vortex shedding amplitude	**mm**		
Turbulent buffeting amplitude	**mm**		
TEMA amplitude limit	**mm**		
Natural freq., Fn	**cycle/s**	45.73	45.73
Acoustic freq., Fa	**cycle/s**	71.97	126.91
Flow velocity	**m/s**	0.37	1.14
X-flow fraction		1	1
RhoV2	**kg/(m*s2)**	2	7
Strouhal No.		0.46	0.46

Setting Plan



Nozzle Data				
Ref	OD	Wall	Standard	Notes
S1	168 mm	7.1 mm	300 ANSI Weld neck	
S2	168 mm	7.1 mm	300 ANSI Weld neck	
S3	168 mm	7.1 mm	300 ANSI Weld neck	
S4	168 mm	7.1 mm	300 ANSI Weld neck	
S5	168 mm	7.1 mm	300 ANSI Weld neck	
S6	168 mm	7.1 mm	300 ANSI Weld neck	
S7	168 mm	7.1 mm	300 ANSI Weld neck	
S8	168 mm	7.1 mm	300 ANSI Weld neck	
T1	356 mm	9.5 mm	300 ANSI Weld neck	
T2	356 mm	9.5 mm	300 ANSI Weld neck	

Design Data	Units	Shell	Channel
Design Pressure	bar	25	25
Design Temperature	°C	125	125
Full Vacuum			
Corrosion Allowance	mm	3	3
Test Pressure	bar	32.5	32.5
Number of Passes		1	2
Radiography			
PWHT			
Internal Volume	m³	3.3696	2.9943

Weight Summary		
Empty	Flooded	Bundle
15264 kg	22374 kg	10609 kg

Notes:

Scale:

Rev:	Date:	Description	Dwg.	Chk.	Appd.
00	29.04.25	IFR			
01	14.07.25	IFR			

Gachsaran Polymer Industries Company (GPIC)

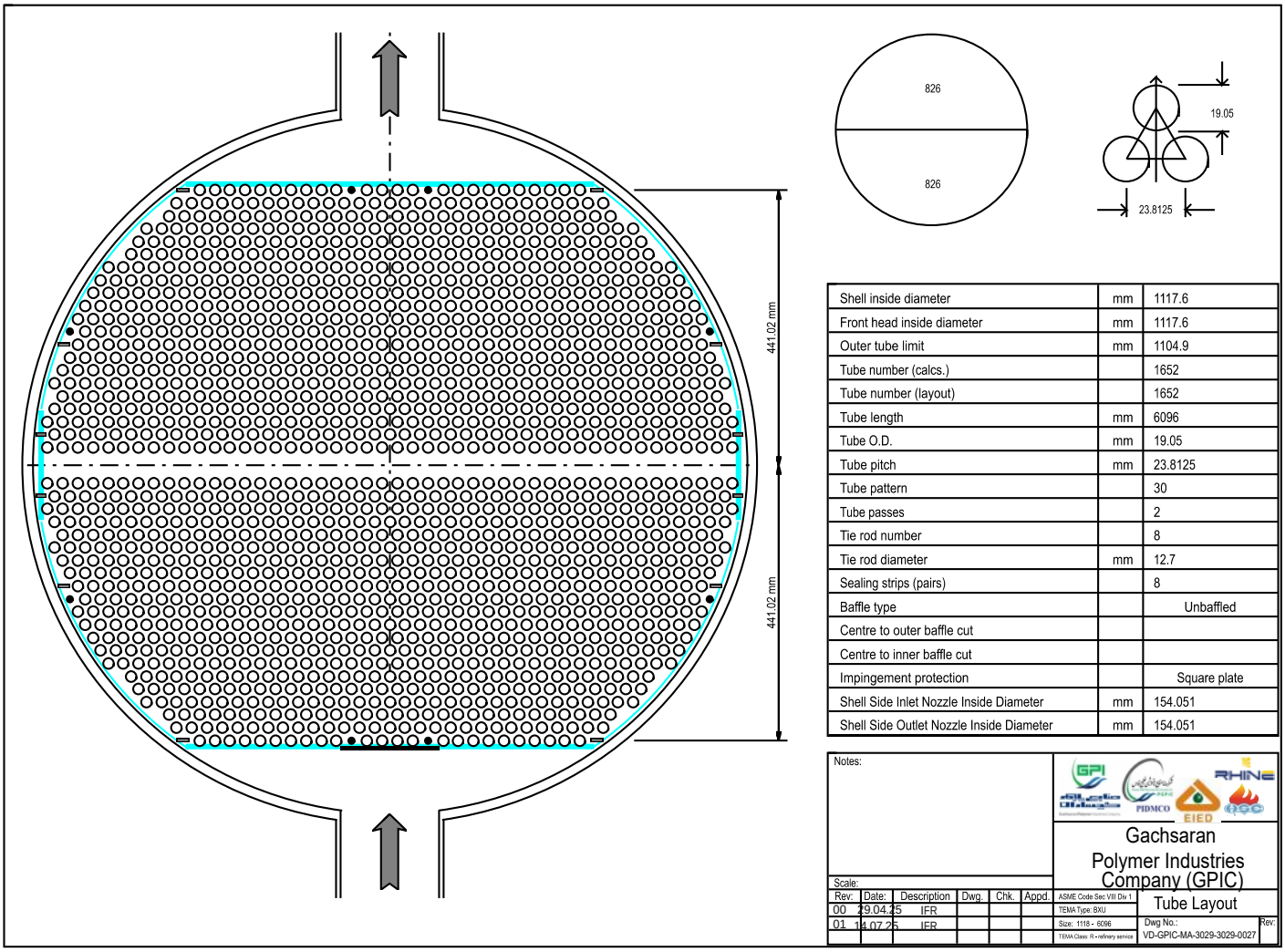
ASME Section VIII Div. 1
TEMA Type: BXU
Size: 1118 - 6096
TEMA Class: R

Setting Plan

Dwg No.: VD-GPIC-MA-3029-3029-0027

Rev:

Tubesheet Layout



Shell inside diameter	mm	1117.6
Front head inside diameter	mm	1117.6
Outer tube limit	mm	1104.9
Tube number (calcs.)		1652
Tube number (layout)		1652
Tube length	mm	6096
Tube O.D.	mm	19.05
Tube pitch	mm	23.8125
Tube pattern		30
Tube passes		2
Tie rod number		8
Tie rod diameter	mm	12.7
Sealing strips (pairs)		8
Baffle type		Unbaffled
Centre to outer baffle cut		
Centre to inner baffle cut		
Impingement protection		Square plate
Shell Side Inlet Nozzle Inside Diameter	mm	154.051
Shell Side Outlet Nozzle Inside Diameter	mm	154.051

Notes:

Scale:

Rev:	Date:	Description	Dwg.	Chk.	Appd.
00	29.04.25	IFR			
01	14.07.25	IFR			

Gachsaran Polymer Industries Company (GPIC)

Tube Layout

ASME Code Sec VIII Div.1
TEMA Type: BXU
Size: 1118 - 6096
TEMA Class: R - refinery service

Dwg No.: VD-GPIC-MA-3029-3029-0027 Rev:

TEMA Sheet

Heat Exchanger Specification Sheet

1	For: Gachsaran Polymer Industries Company (GPIC)					
2	Project: HDPE				Oil Cooler TAG: E-6102	
3	PO No.: GPIC-PT-MA-PO-000-3029					
4	Site: -					
5	Service: Propylene Refrigeration Package					
6	Size: 381 - 5250 mm Type: AEU Horizontal			Connected in: 1 parallel	1 series	
7	Surf/unit(eff.) 51.7 m²	Shells/unit 1		Surf/shell(eff.)	51.7 m²	
8	**PERFORMANCE OF ONE UNIT**					
9	Fluid allocation	Shell Side		Tube Side		
10	Fluid name	Lube Oil - PAG		Water		
11	Fluid quantity, Total kg/h	15095		40000		
12	Vapor (In/Out) kg/h	0	0	0	0	
13	Liquid kg/h	15095	15095	40000	40000	
14	Noncondensable kg/h	0	0	0	0	
15						
16	Temperature (In/Out) °C	92.5	50.19	37	44.65	
17	Bubble / Dew point °C	/	/	/	/	
18	Density Vapor/Liquid kg/m³	/ 873.48	/ 916.33	/ 993.06	/ 989.96	
19	Viscosity mPa-s	/ 12.2583	/ 36.3211	/ 0.7192	/ 0.6161	
20	Molecular wt, Vap					
21	Molecular wt, NC					
22	Specific heat kJ/(kg-K)	/ 2.054	/ 1.962	/ 4.1774	/ 4.1776	
23	Thermal conductivity W/(m-K)	/ 0.1507	/ 0.1582	/ 0.6220	/ 0.6318	
24	Latent heat kJ/kg					
25	Pressure (abs) bar	24.2	24.04908	6.5	6.02248	
26	Velocity (Mean/Max) m/s	0.16 / 0.34		1.6 / 1.62		
27	Pressure drop, allow./calc. bar	0.7	0.15092	0.5	0.47751	
28	Fouling resistance (min) m²-K/W	0.0002		0.0002	0.00026 Ao based	
29	Heat exchanged 355.9 kW			MTD (corrected) 24.64 °C		
30	Transfer rate, Service 279.1	Dirty 305.9		Clean 355.6 W/(m²-K)		
31	**CONSTRUCTION OF ONE SHELL**				**Sketch**	
32		Shell Side		Tube Side		
33	Design/Vacuum/test pressure bar	28 / 1 / 36.4		28 / / 36.4		
34	Design temperature / MDMT °C	125 / -29		190 / -29		
35	Number passes per shell	1		4		
36	Corrosion allowance mm	3		3		
37	Connections In in	1 3 / 300 ANSI		1 4 / 300 ANSI		
38	Size/Rating Out	1 3 / 300 ANSI		1 4 / 300 ANSI		
39	Nominal Intermediate	/ 300 ANSI		/ 300 ANSI		
40	Tube #: 81 U's OD: 19.05 Tks. Average 2.11 mm Length: 5250 mm Pitch: 23.81 mm Tube pattern:30					
41	Tube type: Plain Insert:None Fin#: #/m Material:SA-179 K01200					
42	Shell SA-516 70 K02700-Normalized ID 381 mm			Shell cover SA-516 70 K02700-Normalized		
43	Channel or bonnet SA-516 70 K02700-Normalized			Channel cover SA-516 70 K02700-Normalized		
44	Tubesheet-stationary SA-266 2 K03506-Normalized -			Tubesheet-floating -		
45	Floating head cover -			Impingement protection None		
46	Baffle-cross SA-516 70 K02700-Normalized Type Single segmental Cut(%d) 19.19			Horiz.Spacing: c/c 300 mm		
47	Baffle-long - Seal Type			Inlet 0 mm		
48	Supports-tube U-bend 0			Type		
49	Bypass seal		Tube-tubesheet joint	Expanded & seal welded (2 grooves)(App.A 'f')		
50	Expansion joint -		Type None			
51	RhoV2-Inlet nozzle 885	Bundle entrance 71		Bundle exit 26 kg/(m-s²)		
52	Gaskets - Shell side Spiral-Wound Metal Fib		Tube side	Spiral-Wound Metal Fib		
53	Floating head -					
54	Code requirements ASME Code Sec VIII Div 1		TEMA class	C - general service		
55	Weight/Shell 1573.9 Filled with water 2139.9		Bundle 867.8 kg			
56	Remarks 1. GA DRAWING WILL BE SUBMITTED TO SHOW ALL THE NOZZLES					
57	2. MATERIAL ON SHELL and TUBE SIDES ARE DESIGNED FOR -29C					
58	3. THIS COOLER IS DESIGNED TO COVER UNLOADED COMPRESSOR WHERE HEAT LOAD IS HIGHEST					

Thermal Details - Vibration Analysis - Fluid Elastic Instability HTFS

Shell number: Shell 1
Fluid Elastic Instability Analysis

Vibration tube number		1	2	4	5
Vibration tube location		Inlet row, centre	Outer window, bottom	Baffle overlap	Bottom Row
Vibration		No	No	No	No
W/Wc for heavy damping (LDec=0.1)		0.03	0.12	0.06	0.08
W/Wc for medium damping (LDec=0.03)		0.06	0.21	0.11	0.15
W/Wc for light damping (LDec=0.01)		0.1	0.37	0.2	0.26
W/Wc for estimated damping		0.04	0.1	0.08	0.07
Estimated log Decrement		0.09	0.13	0.07	0.13
Tube natural frequency	**cycle/s**	102.93	48.2	174.45	52.59
Natural frequency method		Dominant Span	Dominant Span	Dominant Span	Dominant Span
Dominant span		Mid-space	U-bend	U-bend	U-bend
Tube effective mass	**kg/m**	1.48	1.48	1.48	1.48

Vibration tube number		6	8
Vibration tube location		Inlet row, end	Outer window, top
Vibration		No	No
W/Wc for heavy damping (LDec=0.1)		0.03	0.04
W/Wc for medium damping (LDec=0.03)		0.06	0.08
W/Wc for light damping (LDec=0.01)		0.1	0.14
W/Wc for estimated damping		0.04	0.05
Estimated log Decrement		0.09	0.09
Tube natural frequency	**cycle/s**	102.93	102.93
Natural frequency method		Dominant Span	Dominant Span
Dominant span		Mid-space	Mid-space
Tube effective mass	**kg/m**	1.48	1.48

Note: W/Wc = ratio of actual shellside flowrate to critical flowrate for onset of fluid-elastic instability

Tube material density	kg/m³	7841.74
Tube axial stress	N/mm²	0
Tube material Young's Modulus	N/mm²	201576.8
U-bend longest unsupported length	mm	876.79

Resonance Analysis (HTFS)

Shell number: Shell 1
Resonance Analysis

Vibration tube number		1	1	1	2
Vibration tube location		Inlet row, centre	Inlet row, centre	Inlet row, centre	Outer window, bottom
Location along tube		U-bend	Midspace	Outlet	U-bend
Vibration problem		No	No	No	No
Span length	mm	94.77	600	399.2	576.79
Frequency ratio: Fv/Fn		0.07	0.11	0.04	0.32
Frequency ratio: Fv/Fa		0	0	0	0.01
Frequency ratio: Ft/Fn		0.04	0.07	0.03	0.2
Frequency ratio: Ft/Fa		0	0	0	0
Vortex shedding amplitude	mm				
Turbulent buffeting amplitude	mm				
TEMA amplitude limit	mm				
Natural freq., Fn	cycle/s	102.93	102.93	102.93	48.2
Acoustic freq., Fa	cycle/s	2434.88	2380.22	2377.41	2434.88
Flow velocity	m/s	0.28	0.15	0.17	0.63
X-flow fraction		1	0.76	1	0.76
RhoV2	kg/(m*s2)	71	26	26	344
Strouhal No.		0.46	0.46	0.46	0.46

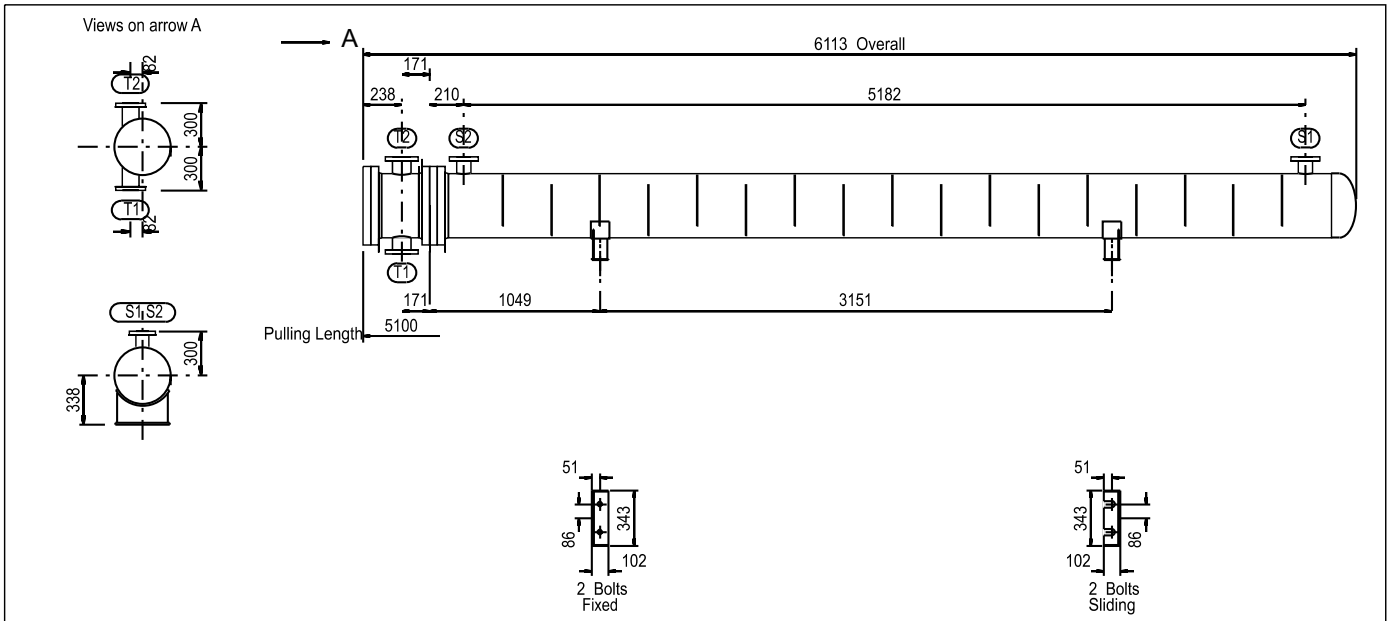
Vibration tube number		2	2	4	4
Vibration tube location		Outer window, bottom	Outer window, bottom	Baffle overlap	Baffle overlap
Location along tube		Midspace	Outlet	U-bend	Midspace
Vibration problem		No	No	No	No
Span length	**mm**	600	699.2	431.41	300
Frequency ratio: Fv/Fn		0.32	0.06	0.1	0.1
Frequency ratio: Fv/Fa		0.01	0	0.01	0.01
Frequency ratio: Ft/Fn		0.2	0.04	0.06	0.06
Frequency ratio: Ft/Fa		0	0	0	0
Vortex shedding amplitude	**mm**				
Turbulent buffeting amplitude	**mm**				
TEMA amplitude limit	**mm**				
Natural freq., Fn	**cycle/s**	48.2	48.2	174.45	174.45
Acoustic freq., Fa	**cycle/s**	2380.22	2377.41	2434.88	2380.22
Flow velocity	**m/s**	0.2	0.11	0.71	0.22
X-flow fraction		0.76	0.76	0.76	0.76
RhoV2	**kg/(m*s2)**	45	12	440	58
Strouhal No.		0.46	0.46	0.46	0.46

Vibration tube number		4	5	5	5	6
Vibration tube location		Baffle overlap	Bottom Row	Bottom Row	Bottom Row	Inlet row, end
Location along tube		Outlet	U-bend	Midspace	Outlet	U-bend
Vibration problem		No	No	No	No	No
Span length	mm	399.2	539.39	600	699.2	244.39
Frequency ratio: Fv/Fn		0.02	0.22	0.22	0.04	0.07
Frequency ratio: Fv/Fa		0	0	0	0	0
Frequency ratio: Ft/Fn		0.01	0.14	0.14	0.03	0.04
Frequency ratio: Ft/Fa		0	0	0	0	0
Vortex shedding amplitude	mm					
Turbulent buffeting amplitude	mm					
TEMA amplitude limit	mm					
Natural freq., Fn	cycle/s	174.45	52.59	52.59	52.59	102.93
Acoustic freq., Fa	cycle/s	2377.41	2434.88	2380.22	2377.41	2434.88
Flow velocity	m/s	0.13	0.48	0.15	0.09	0.28
X-flow fraction		0.76	0.76	0.76	0.76	0.76
RhoV2	kg/(m*s2)	15	199	26	7	71
Strouhal No.		0.46	0.46	0.46	0.46	0.46

Vibration tube number		6	6	8	8
Vibration tube location		Inlet row, end	Inlet row, end	Outer window, top	Outer window, top
Location along tube		Midspace	Outlet	U-bend	Midspace
Vibration problem		No	No	No	No
Span length	**mm**	600	399.2	281.79	600
Frequency ratio: Fv/Fn		0.11	0.04	0.24	0.15
Frequency ratio: Fv/Fa		0	0	0.01	0.01
Frequency ratio: Ft/Fn		0.07	0.03	0.15	0.1
Frequency ratio: Ft/Fa		0	0	0.01	0
Vortex shedding amplitude	**mm**				
Turbulent buffeting amplitude	**mm**				
TEMA amplitude limit	**mm**				
Natural freq., Fn	**cycle/s**	102.93	102.93	102.93	102.93
Acoustic freq., Fa	**cycle/s**	2380.22	2377.41	2434.88	2380.22
Flow velocity	**m/s**	0.15	0.17	1	0.2
X-flow fraction		0.76	0.76	0.76	0.76
RhoV2	**kg/(m*s2)**	26	26	868	45
Strouhal No.		0.46	0.46	0.46	0.46

Vibration tube number		8
Vibration tube location		Outer window, top
Location along tube		Outlet
Vibration problem		No
Span length	**mm**	399.2
Frequency ratio: Fv/Fn		0.04
Frequency ratio: Fv/Fa		0
Frequency ratio: Ft/Fn		0.03
Frequency ratio: Ft/Fa		0
Vortex shedding amplitude	**mm**	
Turbulent buffeting amplitude	**mm**	
TEMA amplitude limit	**mm**	
Natural freq., Fn	**cycle/s**	102.93
Acoustic freq., Fa	**cycle/s**	2377.41
Flow velocity	**m/s**	0.18
X-flow fraction		0.76
RhoV2	**kg/(m*s2)**	30
Strouhal No.		0.46

Setting Plan



Nozzle Data				
Ref	OD	Wall	Standard	Notes
S1	89 mm	5.5 mm	300 ANSI Weld neck	
S2	89 mm	5.5 mm	300 ANSI Weld neck	
T1	114 mm	6 mm	300 ANSI Weld neck	
T2	114 mm	6 mm	300 ANSI Weld neck	

Design Data	Units	Shell	Channel
Design Pressure	bar	28	28
Design Temperature	°C	125	190
Full Vacuum			
Corrosion Allowance	mm	3	3
Test Pressure	bar	36.4	36.4
Number of Passes		1	4
Radiography			
PWHT			
Internal Volume	m^3	0.3862	0.196

Weight Summary		
Empty	Flooded	Bundle
1574 kg	2140 kg	868 kg

Notes:

Scale:

Rev:	Date:	Description	Dwg.	Chk.	Appd.
00	29.04.25	IFR			
01	14.07.25	IFR			

Gachsaran Polymer Industries Company (GPIC)

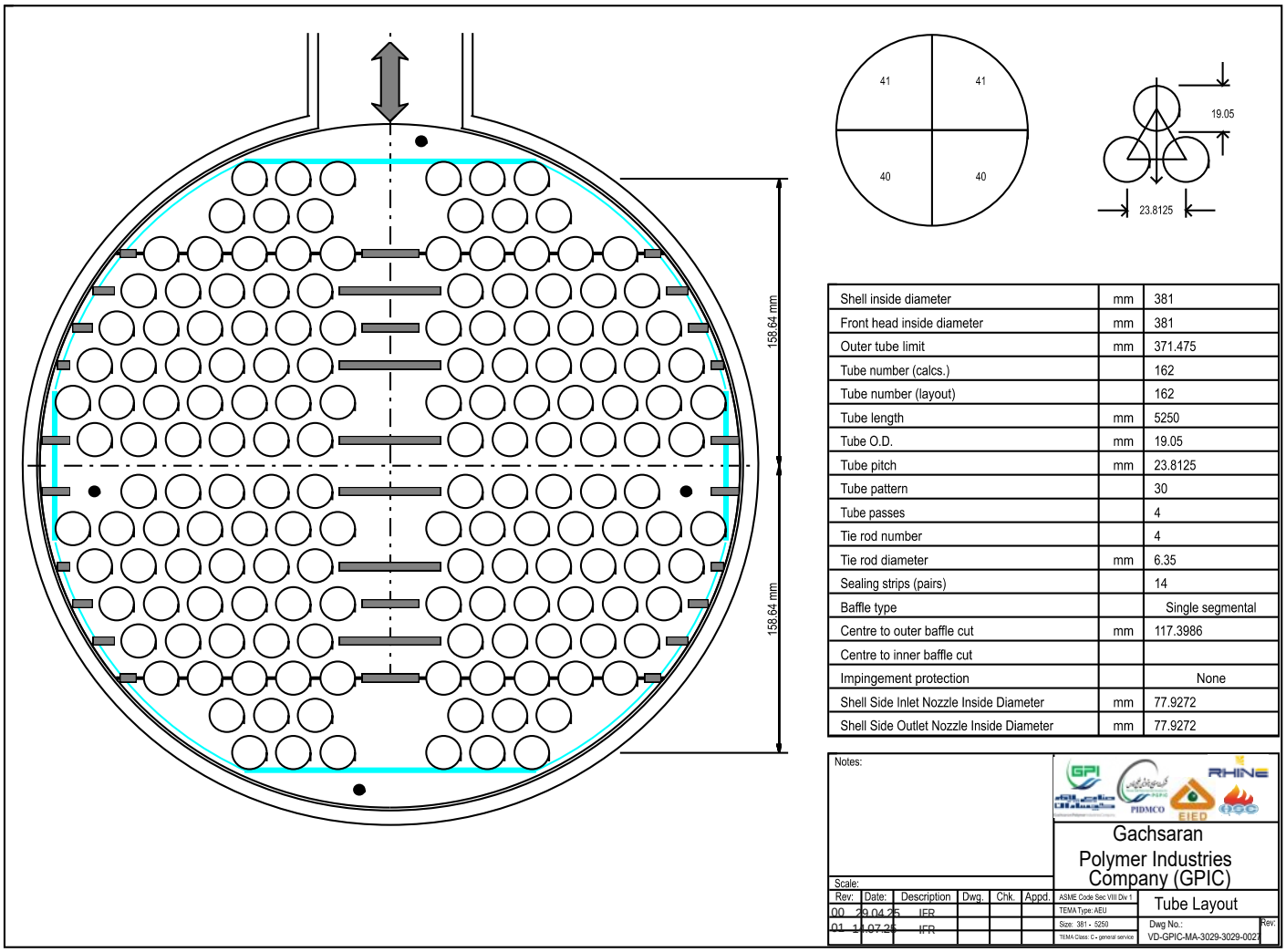
ASME Section VIII Div. 1
TEMA Type: AEU
Size: 381 - 5250
TEMA Class: C

Setting Plan

Dwg No.: VD-GPIC-MA-3029-3029-0027

Rev:

Tubesheet Layout



Shell inside diameter	mm	381
Front head inside diameter	mm	381
Outer tube limit	mm	371.475
Tube number (calcs.)		162
Tube number (layout)		162
Tube length	mm	5250
Tube O.D.	mm	19.05
Tube pitch	mm	23.8125
Tube pattern		30
Tube passes		4
Tie rod number		4
Tie rod diameter	mm	6.35
Sealing strips (pairs)		14
Baffle type		Single segmental
Centre to outer baffle cut	mm	117.3986
Centre to inner baffle cut		
Impingement protection		None
Shell Side Inlet Nozzle Inside Diameter	mm	77.9272
Shell Side Outlet Nozzle Inside Diameter	mm	77.9272

Notes:

Scale:

Rev:	Date:	Description	Dwg.	Chk.	Appd.
00	29.04.25	IFR			
01	14.07.25	IFR			

ASME Code Sec VIII Div 1
TEMA Type: AEU
Size: 381 - 5250
TEMA Class: C - general service

Gachsaran Polymer Industries Company (GPIC)

Tube Layout

Dwg No.: VD-GPIC-MA-3029-3029-0027

Rev.

U-bend Schedule

Number of U-tubes	U-bend diameter	U-bend length	U-tube length
	mm	mm	mm
8	57.15	89.77	10589.77
8	80.96	127.18	10627.18
8	104.78	164.58	10664.58
8	128.59	201.98	10701.98
8	152.4	239.39	10739.39
8	176.21	276.79	10776.79
6	200.02	314.2	10814.2
6	223.84	351.6	10851.6
6	247.65	389.01	10889.01
6	271.46	426.41	10926.41
4	295.27	463.82	10963.82
3	319.09	501.22	11001.22
2	342.9	538.63	11038.63

Heat Exchanger Specification Sheet

1	For: Gachsaran Polymer Industries Company (GPIC)							
2	Project: HDPE					Economizer TAG: E-6103		
3	PO No.: GPIC-PT-MA-PO-000-3029							
4	Site: -							
5	Service: Propylene Refrigeration Package							
6	Size: 356 - 2438.4 mm	Type: BEM	Horizontal		Connected in: 1 parallel	1 series		
7	Surf/unit(eff.) 22.6 m²	Shells/unit 1			Surf/shell(eff.) 22.6 m²			
8	**PERFORMANCE OF ONE UNIT**							
9	Fluid allocation		Shell Side		Tube Side			
10	Fluid name		Propylene		Propylene			
11	Fluid quantity, Total	kg/h	22140		5323			
12	Vapor (In/Out)	kg/h	0	0	1679	5323		
13	Liquid	kg/h	22140	22140	3644	0		
14	Noncondensable	kg/h	0	0	0	0		
15								
16	Temperature (In/Out)	°C	47.62	27.05	5.905	7.65		
17	Bubble / Dew point	°C	/	/	5.95 / 5.95	5.74 / 5.74		
18	Density Vapor/Liquid	kg/m³	/ 460.43	/ 500.65	14.57 / 536.08	14.310 /		
19	Viscosity	cP	/ 0.0603	/ 0.0802	0.0084 / 0.1018	0.0084 /		
20	Molecular wt, Vap				42.08	42.08		
21	Molecular wt, NC							
22	Specific heat	kJ/(kg-K)	/ 3.308	/ 2.765	1.602 / 2.506	1.604 /		
23	Thermal conductivity	W/(m-K)	/ 0.0911	/ 0.997	0.0162 / 0.1086	0.0164 /		
24	Latent heat	kJ/kg			365.3	365.3		
25	Pressure (abs)	bar	19.677		6.96			
26	Velocity (Mean/Max)	m/s	0.63 / 0.77		3.78 / 7.65			
27	Pressure drop, allow./calc.	bar	0.25	0.07017	0.05	0.04167		
28	Fouling resistance (min)	m²-K/W	0.0002		0.0002	0.00026 Ao based		
29	Heat exchanged 384.7	kW			MTD (corrected) 30.45	°C		
30	Transfer rate, Service 559.9		Dirty 634.8		Clean 894.1	W/(m²-K)		
31	**CONSTRUCTION OF ONE SHELL**				**Sketch**			
32			Shell Side		Tube Side			
33	Design/Vacuum/test pressure	bar	25 / 1 / 32.5		25 / 1 / 32.5			
34	Design temperature / MDMT	°C	125 / -45		125 / -45			
35	Number passes per shell		1		2			
36	Corrosion allowance	mm	3		3			
37	Connections In	in	1 4" / 300 ANSI		1 3 " / 300 ANSI			
38	Size/Rating Out		1 4" / 300 ANSI		1 6 " / 300 ANSI			
39	Nominal Intermediate		/ 300 ANSI		/ 300 ANSI			
40	Tube #: 160	OD: 19.05	Tks. Average 2.11	mm	Length: 2438.4 mm	Pitch: 23.81 mm	Tube pattern:30	
41	Tube type: Plain	Insert:None		Fin#:	#/m	Material:SA-334 6 K03006		
42	Shell SA-516 70 K02700 Normalized	ID 355.6	mm	Shell cover -				
43	Channel or bonnet SA-516 70 K02700 Normalized			Channel cover -				
44	Tubesheet-stationary SA-350 LF2 K03011 1-Normalized	-		Tubesheet-floating -				
45	Floating head cover -			Impingement protection None				
46	Baffle-cross SA-516 70 K02700 Normalized	Type Single segmental	Cut(%d) 33.9	Horiz	Spacing: c/c 171.5	mm		
47	Baffle-long -	Seal Type		Inlet 234.9 mm				
48	Supports-tube U-bend	0	Type					
49	Bypass seal	Tube-tubesheet joint	Expanded & seal welded (2 grooves)(App.A 'f')					
50	Expansion joint -	Type None						
51	RhoV2-Inlet nozzle 1990	Bundle entrance 376	Bundle exit 344	kg/(m-s²)				
52	Gaskets - Shell side Spiral-Wound Metal Fib	Tube side	Spiral-Wound Metal Fib					
53	Floating head -							
54	Code requirements ASME Code Sec VIII Div 1	TEMA class R - refinery service						
55	Weight/Shell 918	Filled with water 1158.5	Bundle 431.1	kg				
56	Remarks 1. GA DRAWING WILL BE SUBMITTED TO SHOW ALL THE NOZZLES							
57	2. MATERIAL ON SHELL and TUBE SIDES ARE DESIGNED FOR -45C							
58								

Thermal Details - Vibration Analysis - Fluid Elastic Instability HTFS

Shell number: Shell 1
Fluid Elastic Instability Analysis

Vibration tube number		1	2	4	5
Vibration tube location		Inlet row, centre	Outer window, bottom	Baffle overlap	Bottom Row
Vibration		No	No	No	No
W/Wc for heavy damping (LDec=0.1)		0.01	0.02	0.01	0.01
W/Wc for medium damping (LDec=0.03)		0.01	0.04	0.01	0.01
W/Wc for light damping (LDec=0.01)		0.02	0.07	0.02	0.02
W/Wc for estimated damping		0.01	0.04	0.01	0.01
Estimated log Decrement		0.04	0.04	0.04	0.04
Tube natural frequency	**cycle/s**	384.18	384.18	1268.63	384.18
Natural frequency method		Exact Solution	Exact Solution	Exact Solution	Exact Solution
Dominant span					
Tube effective mass	**kg/m**	1.12	1.12	1.12	1.12

Vibration tube number		6	8
Vibration tube location		Inlet row, end	Outer window, top
Vibration		No	No
W/Wc for heavy damping (LDec=0.1)		0.01	0.02
W/Wc for medium damping (LDec=0.03)		0.01	0.04
W/Wc for light damping (LDec=0.01)		0.02	0.07
W/Wc for estimated damping		0.01	0.04
Estimated log Decrement		0.04	0.04
Tube natural frequency	**cycle/s**	384.18	384.18
Natural frequency method		Exact Solution	Exact Solution
Dominant span			
Tube effective mass	**kg/m**	1.12	1.12

Note: W/Wc = ratio of actual shellside flowrate to critical flowrate for onset of fluid-elastic instability

Tube material density	kg/m³	7841.74
Tube axial stress	N/mm²	10.13
Tube material Young's Modulus	N/mm²	203646.1
U-bend longest unsupported length	mm	

Resonance Analysis (HTFS)

Shell number: Shell 1
Resonance Analysis

Vibration tube number		1	1	1	2
Vibration tube location		Inlet row, centre	Inlet row, centre	Inlet row, centre	Outer window, bottom
Location along tube		Inlet	Midspace	Outlet	Inlet
Vibration problem		No	No	No	No
Span length	**mm**	234.95	342.9	406.4	406.4
Frequency ratio: Fv/Fn		0.06	0.01	0.01	0.02
Frequency ratio: Fv/Fa		0.01	0	0	0
Frequency ratio: Ft/Fn		0.04	0.01	0	0.01
Frequency ratio: Ft/Fa		0	0	0	0
Vortex shedding amplitude	**mm**				
Turbulent buffeting amplitude	**mm**				
TEMA amplitude limit	**mm**				
Natural freq., Fn	**cycle/s**	384.18	384.18	384.18	384.18
Acoustic freq., Fa	**cycle/s**	3566.82	3422.54	3413.24	3566.82
Flow velocity	**m/s**	0.9	0.14	0.1	0.32
X-flow fraction		1	0.55	0.55	0.55
RhoV2	**kg/(m*s2)**	376	9	5	49
Strouhal No.		0.46	0.46	0.46	0.46

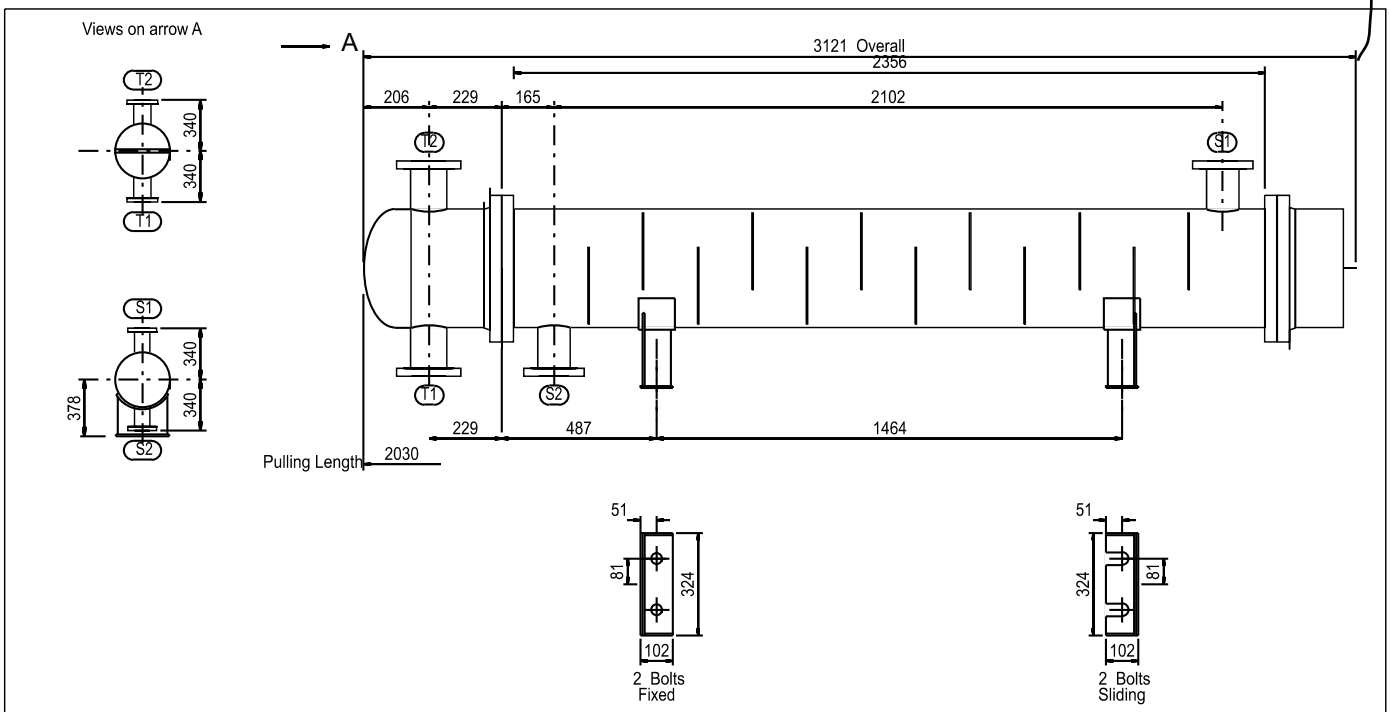
Vibration tube number		2	2	4	4
Vibration tube location		Outer window, bottom	Outer window, bottom	Baffle overlap	Baffle overlap
Location along tube		Midspace	Outlet	Inlet	Midspace
Vibration problem		No	No	No	No
Span length	**mm**	342.9	234.95	234.95	171.45
Frequency ratio: Fv/Fn		0.03	0.03	0.01	0.01
Frequency ratio: Fv/Fa		0	0	0	0
Frequency ratio: Ft/Fn		0.02	0.02	0.01	0.01
Frequency ratio: Ft/Fa		0	0	0	0
Vortex shedding amplitude	**mm**				
Turbulent buffeting amplitude	**mm**				
TEMA amplitude limit	**mm**				
Natural freq., Fn	**cycle/s**	384.18	384.18	1268.63	1268.63
Acoustic freq., Fa	**cycle/s**	3422.54	3413.24	3566.82	3422.54
Flow velocity	**m/s**	0.42	0.45	0.45	0.57
X-flow fraction		0.55	0.55	0.55	0.55
RhoV2	**kg/(m*s2)**	86	106	93	163
Strouhal No.		0.46	0.46	0.46	0.46

Vibration tube number		4	5	5	5	6
Vibration tube location		Baffle overlap	Bottom Row	Bottom Row	Bottom Row	Inlet row, end
Location along tube		Outlet	Inlet	Midspace	Outlet	Inlet
Vibration problem		No	No	No	No	No
Span length	**mm**	234.95	406.4	342.9	234.95	234.95
Frequency ratio: Fv/Fn		0.01	0.01	0.01	0.05	0.06
Frequency ratio: Fv/Fa		0	0	0	0.01	0.01
Frequency ratio: Ft/Fn		0.01	0	0.01	0.03	0.04
Frequency ratio: Ft/Fa		0	0	0	0	0
Vortex shedding amplitude	**mm**					
Turbulent buffeting amplitude	**mm**					
TEMA amplitude limit	**mm**					
Natural freq., Fn	**cycle/s**	1268.63	384.18	384.18	384.18	384.18
Acoustic freq., Fa	**cycle/s**	3413.24	3566.82	3422.54	3413.24	3566.82
Flow velocity	**m/s**	0.41	0.11	0.14	0.82	0.9
X-flow fraction		0.55	0.55	0.55	1	0.55
RhoV2	**kg/(m*s2)**	87	5	9	344	376
Strouhal No.		0.46	0.46	0.46	0.46	0.46

Vibration tube number		6	6	8	8
Vibration tube location		Inlet row, end	Inlet row, end	Outer window, top	Outer window, top
Location along tube		Midspace	Outlet	Inlet	Midspace
Vibration problem		No	No	No	No
Span length	**mm**	342.9	406.4	234.95	342.9
Frequency ratio: Fv/Fn		0.01	0.01	0.03	0.03
Frequency ratio: Fv/Fa		0	0	0	0
Frequency ratio: Ft/Fn		0.01	0	0.02	0.02
Frequency ratio: Ft/Fa		0	0	0	0
Vortex shedding amplitude	**mm**				
Turbulent buffeting amplitude	**mm**				
TEMA amplitude limit	**mm**				
Natural freq., Fn	**cycle/s**	384.18	384.18	384.18	384.18
Acoustic freq., Fa	**cycle/s**	3422.54	3413.24	3566.82	3422.54
Flow velocity	**m/s**	0.14	0.1	0.49	0.42
X-flow fraction		0.55	0.55	0.55	0.55
RhoV2	**kg/(m*s2)**	9	5	113	86
Strouhal No.		0.46	0.46	0.46	0.46

Vibration tube number		8
Vibration tube location		Outer window, top
Location along tube		Outlet
Vibration problem		No
Span length	**mm**	406.4
Frequency ratio: Fv/Fn		0.02
Frequency ratio: Fv/Fa		0
Frequency ratio: Ft/Fn		0.01
Frequency ratio: Ft/Fa		0
Vortex shedding amplitude	**mm**	
Turbulent buffeting amplitude	**mm**	
TEMA amplitude limit	**mm**	
Natural freq., Fn	**cycle/s**	384.18
Acoustic freq., Fa	**cycle/s**	3413.24
Flow velocity	**m/s**	0.3
X-flow fraction		0.55
RhoV2	**kg/(m*s2)**	46
Strouhal No.		0.46

Setting Plan



Nozzle Data				
Ref	OD	Wall	Standard	Notes
S1	102 mm	5.7 mm	300 ANSI Weld neck	
S2	102 mm	5.7 mm	300 ANSI Weld neck	
T1	114 mm	6 mm	300 ANSI Weld neck	
T2	114 mm	6 mm	300 ANSI Weld neck	

Design Data	Units	Shell	Channel
Design Pressure	bar	25	25
Design Temperature	°C	125	125
Full Vacuum			
Corrosion Allowance	mm	3	3
Test Pressure	bar	32.5	32.5
Number of Passes		1	2
Radiography			
PWHT			
Internal Volume	m³	0.127	0.1307

Weight Summary		
Empty	Flooded	Bundle
918 kg	1158 kg	431 kg

Notes:

Scale:

Rev:	Date:	Description	Dwg.	Chk.	Appd.
00	29.04.25	IFR			
01	14.07.25	IFR			

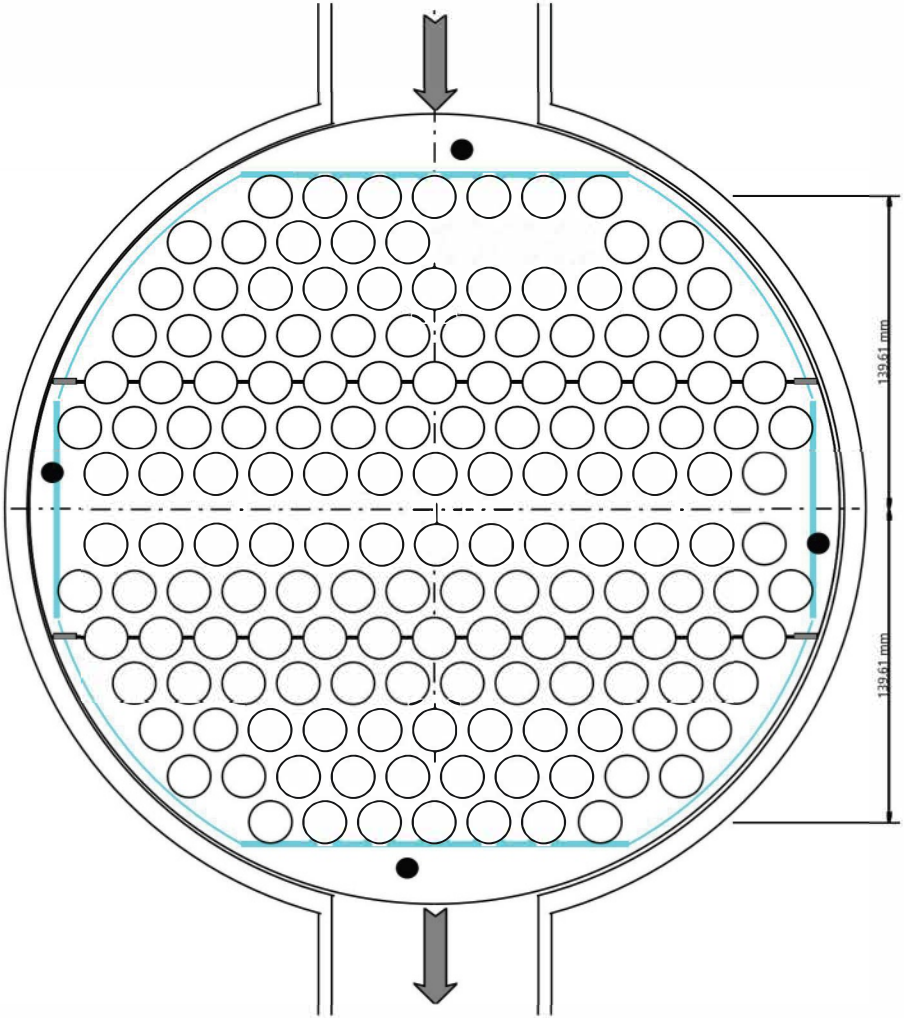
Gachsaran Polymer Industries Company (GPIC)

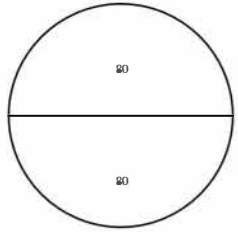
ASME Section VIII Div. 1
TEMA Type: BEM
Size: 356 - 2438
TEMA Class: R

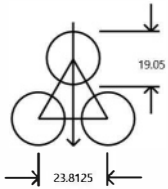
Setting Plan

Dwg No.: VD-GPIC-MA-3029-3029-0027

Rev:







Shell inside diameter	mm	355.6
Front head inside diameter	mm	355.6
Outer tube limit	mm	342.9
Tube number (calcs.)		160
Tube number (layout)		160
Tube length	mm	2438.4
Tube O.D.	mm	19.05
Tube pitch	mm	23.8125
Tube pattern		30
Tube passes		2
Tie rod number		4
Tie rod diameter	mm	9.55
Sealing strips (pairs)		2
Baffle type		Single segmental
Centre to outer baffle cut	mm	57.1194
Centre to inner baffle cut		
Impingement protection		None
Shell Side Inlet Nozzle Inside Diameter	mm	90.1192
Shell Side Outlet Nozzle Inside Diameter	mm	90.1192

Notes:

Scale:

Rev:	Date:	Description	Dwg.	Chk.	Appd.
00	29.04.25	IFR			
01	14.07.25	IFR			

Gachsaran
Polymer Industries
Company (GPIC)

ASME Section VIII Div. 1
TEMA Type: BEM
Size: 356 - 2438
TEMA Class: R

Setting Plan

Dwg No.: VD-GPIC-MA-3029-3029-0027

Rev: