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PROJECT

Ingeniería Básica Proyecto Mejoras en Unidad de Destilación Reactiva U-107 Para Estabilidad y Cumplimiento de 10 PPM Azufre

1	11/04/2024	Aprobado para Construcción - Actualización donde se indique	Robert Pérez (RPM)	David Cepeda (DCJ)	Jaime Viloria (JVA)
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DOCUMENT EC		DOCUMENT TITLE			
107-DS-ME01-0307		Hoja de Datos Modificaciones Intercambiador de Calor E-101 A/B			
DOCUMENT ECP					
GRC-107-MEE-HD-000006					

Company: **ECOPETROL SA**

Rev: 1

Date: 11/04/24

Pag: 1 de 7

Location: **CARTAGENA, COLOMBIA**Equipment: **E-101 A/B**Case Operation: **S1C2**Service of Unit: **CDHYDRO FEED PREHEATERS**

Project: **Mejoras en Unidad de Destilación Reactiva U-107 Para Estabilidad y Cumplimiento de 10 PPM Azufre**

HEAT EXCHANGER SPECIFICATION SHEET										Page 4
Released to the following company: INTERCOL EPC LEONARDO MOSQUERA										US Units
					Job No.					
Customer					Reference No.					
Address					Proposal No.					
Plant Location					Date		Rev			
Service of Unit					Item No.					
Size	21 x 144.02 inch		Type	BEU	Horizontal	Connected In	1	Parallel	2	Series
Surf/Unit (Gross/Eff)	1621,2 / 1584,7 ft ²		Shell/Unit	2		Surf/Shell (Gross/Eff)	810,62 / 792,33 ft ²			
PERFORMANCE OF ONE UNIT										
Fluid Allocation			Shell Side			Tube Side				
Fluid Name			LCN Feed			Stabilizer Column Bottoms				
Fluid Quantity, Total Vapor (In/Out)			lb/hr 194208			138978				
Liquid			194208			194208		138978		138978
Steam										
Water										
Noncondensables										
Temperature (In/Out)			F 91,00			270,00		408,00		183,00
Specific Gravity			0,7260			0,6250		0,5817		0,7212
Viscosity			cP 0,3390			0,1540		0,1120		0,2820
Molecular Weight										
Molecular Weight, Noncondensables										
Specific Heat			Btu/lb-F 0,4740			0,5950		0,6810		0,5160
Thermal Conductivity			Btu/hr-ft-F 0,0734			0,0559		0,0450		0,0654
Latent Heat			Btu/lb							
Inlet Pressure			psia 168,30					136,70		
Velocity			ft/sec 2,38					5,87		
Pressure Drop, Allow/Calc			psi 15,000			7,708		9,000		8,935
Fouling Resistance (min)			ft ² -hr-F/Btu 0,00098					0,00098		
Heat Exchanged			18648036 Btu/hr			MTD (Corrected)		97,9		F
Transfer Rate, Service			120,25 Btu/ft ² -hr-F			Clean		171,62 Btu/ft ² -hr-F		Actual 123,95 Btu/ft ² -hr-F
CONSTRUCTION OF ONE SHELL										
			Shell Side			Tube Side			Sketch (Bundle/Nozzle Orientation)	
Design/Test Pressure			psig 220,00 /			170,00 /				
Design Temperature			F 340,00			630,00				
No Passes per Shell			1			4				
Corrosion Allowance			inch 0,1250			0,1250				
Connections			in inch 1 @ 6,0650			1 @ 6,0650				
Size & Rating			Out inch 1 @ 6,0650			1 @ 6,0650				
			@			@				
Tube No.			172U		OD	0,7500 inch		Thk(Avg)	0,0830 inch	
Tube Type			Plain		Material	SA-214 Tube (W) K01807		Pitch 0,9375 inch		
Shell			SA-516 70 Pl. K02700		ID	21,000		OD	21,750 inch	
Channel or Bonnet			SA-516 70 Pl. K02700					Shell Cover SA-516 70 Pl. K02700 (Integ.)		
Tubesheet-Stationary			SA-105 Forgings K03504					Channel Cover		
Floating Head Cover								Tubesheet-Floating		
Baffles-Cross			Carbon steel		Type	%Cut (Diam) 25		Spacing(c/c)	8,0000	
Baffles-Long					Seal Type	U-Bend Carbon steel		Inlet 18,383 inch		
Supports-Tube								Type Full support		
Bypass Seal Arrangement			pairs seal strips		Tube-Tubesheet Joint					
Expansion Joint					Type					
Rho-V2-Inlet Nozzle			lb/ft-sec ²		Bundle Entrance			Bundle Exit		lb/ft-sec ²
Gaskets-Shell Side			Mtl. Jkt. Flat/Grafoil (SS)		Tube Side			Mtl. Jkt. Flat/Grafoil (SS)		
- Floating Head										
Code Requirements			ASME		TEMA Class					
Weight/Shell			lb		Filled with Water			lb		
Remarks:										

Company: ECO PETROL SA

Rev: 1

Date: 11/04/24

Pag: 2 de 7

Location: CARTAGENA, COLOMBIA

Equipment: E-101 A/B

Case Operation: S1C2

Service of Unit: CDHYDRO FEED PREHEATERS

Project: Mejoras en Unidad de Destilación Reactiva U-107 Para Estabilidad y Cumplimiento de 10 PPM Azufre



Output Summary

Page 1

Released to the following company:
 INTERCOL EPC
 LEONARDO MOSQUERA

Xist 9 (32 bit) 19/09/2023 21:17 SN: 46639-

US Units

Summary Unit

Rating - Horizontal

No Data Check Messages.

No Runtime Messages.

Process Conditions		Cold Shellside		Hot Tubeside	
Fluid name		LCN Feed		Stabilizer Column Bottoms	
Total flow rate	(1000-lb/hr)		194,21		138,98
Inlet/Outlet Y	(Wt. frac vap.)	0,0000	0,0000	0,0000	0,0000
Inlet/Outlet T	(Deg F)	91,00	270,00	408,00	183,00
Inlet P/Avg	(psia)	168,30		136,70	132,23
dP/Allow.	(psi)	7,708	15,000	8,935	9,000
Fouling	(ft2-hr-F/Btu)		0,00098		0,00098

Exchanger Performance					
Shell h	(Btu/ft2-hr-F)	372,60	Actual U	(Btu/ft2-hr-F)	123,95
Tube h	(Btu/ft2-hr-F)	448,05	Required U	(Btu/ft2-hr-F)	120,25
Hot regime	(-)	Sens. Liquid	Total duty	(MM Btu/hr)	18,648
Cold regime	(-)	Sens. Liquid	Eff. area	(ft2)	1584,7
EMTD	(Deg F)	97,9	Overdesign	(%)	3,08

Shell Geometry			Baffle Geometry		
TEMA type	(-)	BEU	Baffle type		
Shell ID	(inch)	21,000	Baffle cut	(Pct Dia.)	25
Series	(-)	2	Baffle orientation	(-)	Perpend.
Parallel	(-)	1	Central spacing	(inch)	8,0000
Orientation	(deg)	0,00	Crosspasses	(-)	15

Tube Geometry			Nozzles		
Tube type	(-)	Plain	Shell inlet	(inch)	6,0650
Tube OD	(inch)	0,7500	Shell outlet	(inch)	6,0650
Length	(ft)	12,001	Inlet height	(inch)	1,1941
Pitch ratio	(-)	1,2500	Outlet height	(inch)	1,1941
Layout	(deg)	30	Tube inlet	(inch)	6,0650
Tube count	(-)	344	Tube outlet	(inch)	6,0650
Tube Pass	(-)	4			

Thermal Resistance; %		Velocities; ft/sec			Flow Fractions	
Shell	33,27		Min	Max	A	0,230
Tube	35,55	Tubeside	5,37	6,63	B	0,340
Fouling	27,72	Crossflow	1,70	2,55	C	0,041
Metal	3,46	Longitudinal	1,88	2,48	E	0,148
					F	0,240

Company: ECOPETROL SA

Rev: 1

Date: 11/04/24

Pag: 3 de 7

Location: CARTAGENA, COLOMBIA

Equipment: E-101 A/B

Case Operation: S1C2

Service of Unit: CDHYDRO FEED PREHEATERS

Project: Mejoras en Unidad de Destilación Reactiva U-107 Para Estabilidad y Cumplimiento de 10 PPM Azufre

**Series Summary**

Page 2

Released to the following company:

INTERCOL EPC

LEONARDO MOSQUERA

Xist 9 (32 bit) 19/09/2023 21:17 SN: 46639-

US Units

Summary Unit

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

Shell #	1	2
Unit	Shell 1	Shell 2
Performance		
Overdesign (%)	3,95	2,16
Overall U (Btu/ft ² -hr-F)	127,65	120,24
Required U (Btu/ft ² -hr-F)	122,80	117,70
Unit Duty (MM Btu/hr)	10,564	8,0839
Shellside h (Btu/ft ² -hr-F)	386,63	358,78
Tubeside h (Btu/ft ² -hr-F)	471,35	425,71
Shellside delta P (psi)	3,951	3,757
Tubeside delta P (psi)	4,590	4,345
EMTD (F)	108,6	86,7
Process Conditions		
Inlet T, Shell (F)	173,63	91,00
Outlet T, Shell (F)	270,00	173,63
Inlet T, Tube (F)	408,00	288,26
Outlet T, Tube (F)	288,26	183,00
Inlet Y, Shell (Wt. fraction)	0,0000	0,0000
Outlet Y, Shell (Wt. fraction)	0,0000	0,0000
Inlet Y, Tube (Wt. fraction)	0,0000	0,0000
Outlet Y, Tube (Wt. fraction)	0,0000	0,0000
Geometry		
Shell type (-)	E	E
Parallel (-)	1	1
Effective area (ft ²)	792,33	792,33
Shell orientation (-)	Horizontal	Horizontal
Shell ID (inch)	21,000	21,000
Shellside fluid (-)	Cold	Cold
Baffle type (-)	Single-Seg.	Single-Seg.
Baffle cut (Pct Dia.)	25	25
Baffle orientation (-)	Perpend.	Perpend.
Central spacing (inch)	8,0000	8,0000
Crosspasses (-)	15	15
Tube type (-)	Plain	Plain
Tube Pass (-)	4	4
Tubecount (-)	344	344
Tube length (ft)	12,001	12,001
Tube OD (inch)	0,7500	0,7500
Tube layout angle (-)	30	30
Pitch ratio (-)	1,2500	1,2500

Company: **ECOPETROL SA**

Rev: 1

Date: 11/04/24

Pag: 4 de 7

Location: **CARTAGENA, COLOMBIA**Equipment: **E-101 A/B**

Case Operation: **S2C1**

Service of Unit: **CDHYDRO FEED PREHEATERS**

Project: **Mejoras en Unidad de Destilación Reactiva U-107 Para Estabilidad y Cumplimiento de 10 PPM Azufre**



HEAT EXCHANGER SPECIFICATION SHEET

Released to the following company:

INTERCOL EPC

LEONARDO MOSQUERA

Page 4

US Units

Customer

Address

Plant Location

Service of Unit

Job No.

Reference No.

Proposal No.

Date

Item No.

Size

Surf/Unit (Gross/Eff)

21 x 144,02 inch

1621,2 / 1584,7 ft2

Type

BEU

Horizontal

Connected In

1

Parallel

2

Series

Shell/Unit

2

Surf/Shell (Gross/Eff)

810,62 / 792,33 ft2

PERFORMANCE OF ONE UNIT

Fluid Allocation		Shell Side		Tube Side	
Fluid Name		LCN Feed		Stabilizer Column Bottoms	
Fluid Quantity, Total		183406		192314	
Vapor (In/Out)					
Liquid		183406		192314	
Steam					
Water					
Noncondensables					
Temperature (In/Out)		F		F	
		91,00		413,00	
Specific Gravity		0,7260		0,5994	
Viscosity		cP		0,1200	
		0,3380		0,2330	
Molecular Weight					
Molecular Weight, Noncondensables					
Specific Heat		Btu/lb-F		0,6690	
		0,4940		0,5580	
Thermal Conductivity		Btu/hr-ft-F		0,0456	
		0,0734		0,0604	
Latent Heat		Btu/lb			
Inlet Pressure		psia		139,10	
		153,30			
Velocity		ft/sec		8,21	
		2,29			
Pressure Drop, Allow/Calc		psi		9,000	
		15,000		16,299	
Fouling Resistance (min)		ft2-hr-F/Btu		0,00098	
		0,00098		0,00098	
Heat Exchanged		19414975 Btu/hr		MTD (Corrected) 131,5 F	
Transfer Rate, Service		93,20 Btu/ft2-hr-F		Actual 135,35 Btu/ft2-hr-F	

CONSTRUCTION OF ONE SHELL

Design/Test Pressure		Shell Side		Tube Side	
Design Temperature		340,00		630,00	
No Passes per Shell		1		4	
Corrosion Allowance		0,1250		0,1250	
Connections		1 @ 6,0650		1 @ 6,0650	
Size & Rating		1 @ 6,0650		1 @ 6,0650	
		@		@	

Sketch (Bundle/Nozzle Orientation)

Tube No. 172U

OD 0,7500 inch

Thk(Avg) 0,0830 inch

Length 12,001 ft

Pitch 0,9375 inch

Tube Type Plain

Material SA-179 Tube (S) K01200

Tube pattern 30

Shell SA-516 70 Pl. K02700

ID 21,000

OD 21,750 inch

Shell Cover SA-516 70 Pl. K02700

(Integ.)

Channel or Bonnet SA-516 70 Pl. K02700

Channel Cover

Tubesheet-Stationary SA-105 Forgings K03504

Tubesheet-Floating

Floating Head Cover

Impingement Plate None

Baffles-Cross Carbon steel

Type

%Cut (Diam) 25

Spacing(c/c) 8,0000

Inlet 18,383 inch

Baffles-Long

Seal Type

Supports-Tube

U-Bend Carbon steel

Type Full support

Bypass Seal Arrangement

pairs seal strips

Tube-Tubesheet Joint

Expansion Joint

Type

Rho-V2-Inlet Nozzle

lb/ft-sec2

Bundle Entrance

Bundle Exit

lb/ft-sec2

Gaskets-Shell Side

Mtl. Jkt. Flat/Grafoil (SS)

Tube Side

Mtl. Jkt. Flat/Grafoil (SS)

- Floating Head

Code Requirements ASME

TEMA Class

Weight/Shell

lb

Filled with Water

lb

Bundle

lb

Remarks:

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Company: ECOPETROL SA

Rev: 1

Date: 11/04/24

Pag: 5 de 7

Location: CARTAGENA, COLOMBIA

Equipment: E-101 A/B

Case Operation: S2C1

Service of Unit: CDHYDRO FEED PREHEATERS

Project: Mejoras en Unidad de Destilación Reactiva U-107 Para Estabilidad y Cumplimiento de 10 PPM Azufre



Output Summary

Page 1

Released to the following company:

INTERCOL EPC

LEONARDO MOSQUERA

Xist 9 (32 bit) 19/09/2023 21:28 SN: 46639-

US Units

Summary Unit

Rating - Horizontal

No Data Check Messages.

No Runtime Messages.

Process Conditions		Cold Shellside		Hot Tubeside	
Fluid name		LCN Feed		Stabilizer Column Bottoms	
Total flow rate	(1000-lb/hr)		183,41		192,31
Inlet/Outlet Y	(Wt. frac vap.)	0,0000	0,0000	0,0000	0,0000
Inlet/Outlet T	(Deg F)	91,00	285,00	413,00	249,00
Inlet P/Avg	(psia)	153,30		139,10	130,95
dP/Allow.	(psi)	6,956	15,000	16,299	9,000
Fouling	(ft2-hr-F/Btu)		0,00098		0,00098
Exchanger Performance					
Shell h	(Btu/ft2-hr-F)	367,65	Actual U	(Btu/ft2-hr-F)	135,35
Tube h	(Btu/ft2-hr-F)	597,88	Required U	(Btu/ft2-hr-F)	93,20
Hot regime	(--)	Sens. Liquid	Total duty	(MM Btu/hr)	19,415
Cold regime	(--)	Sens. Liquid	Eff. area	(ft2)	1584,7
EMTD	(Deg F)	131,5	Overdesign	(%)	45,23
Shell Geometry			Baffle Geometry		
TEMA type	(--)	BEU	Baffle type		
Shell ID	(inch)	21,000	Baffle cut	(Pct Dia.)	25
Series	(--)	2	Baffle orientation	(--)	Perpend.
Parallel	(--)	1	Central spacing	(inch)	8,0000
Orientation	(deg)	0,00	Crosspasses	(--)	15
Tube Geometry			Nozzles		
Tube type	(--)	Plain	Shell inlet	(inch)	6,0650
Tube OD	(inch)	0,7500	Shell outlet	(inch)	6,0650
Length	(ft)	12,001	Inlet height	(inch)	1,1941
Pitch ratio	(--)	1,2500	Outlet height	(inch)	1,1941
Layout	(deg)	30	Tube inlet	(inch)	6,0650
Tube count	(--)	344	Tube outlet	(inch)	6,0650
Tube Pass	(--)	4			
Thermal Resistance; %		Velocities; ft/sec		Flow Fractions	
Shell	36,82	Min	Max	A	0,230
Tube	29,08	Tubeside	7,60 8,92	B	0,340
Fouling	30,29	Crossflow	1,61 2,45	C	0,041
Metal	3,81	Longitudinal	1,78 2,39	E	0,148
				F	0,241

Company: ECOPETROL SA

Rev: 1

Date: 11/04/24

Pag: 6 de 7

Location: CARTAGENA, COLOMBIA

Equipment: E-101 A/B

Case Operation: S2C1

Service of Unit: CDHYDRO FEED PREHEATERS

Project: Mejoras en Unidad de Destilación Reactiva U-107 Para Estabilidad y Cumplimiento de 10 PPM Azufre



Series Summary

Page 2

Released to the following company:

INTERCOL EPC

LEONARDO MOSQUERA

Xist 9 (32 bit) 19/09/2023 21:28 SN: 46639-

US Units

Summary Unit

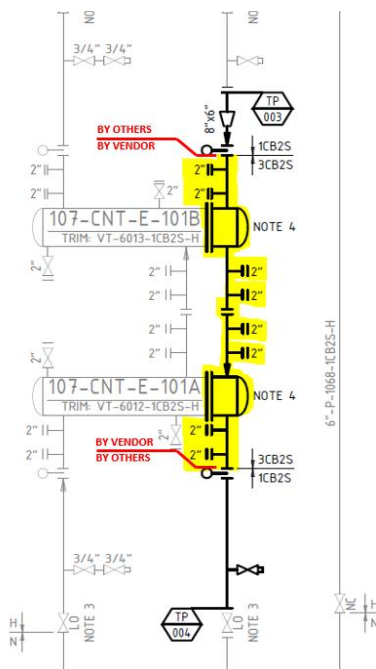
Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

Shell #	1	2
Unit	Shell 1	Shell 2
Performance		
Overdesign (%)	44,66	45,83
Overall U (Btu/ft ² -hr-F)	138,32	132,39
Required U (Btu/ft ² -hr-F)	95,62	90,78
Unit Duty (MM Btu/hr)	9,4788	9,9362
Shellside h (Btu/ft ² -hr-F)	379,06	356,43
Tubeside h (Btu/ft ² -hr-F)	620,94	575,55
Shellside delta P (psi)	3,578	3,378
Tubeside delta P (psi)	8,330	7,969
EMTD (F)	125,1	138,1
Process Conditions		
Inlet T, Shell (F)	195,00	91,00
Outlet T, Shell (F)	285,00	195,00
Inlet T, Tube (F)	413,00	336,62
Outlet T, Tube (F)	336,62	249,00
Inlet Y, Shell (Wt. fraction)	0,0000	0,0000
Outlet Y, Shell (Wt. fraction)	0,0000	0,0000
Inlet Y, Tube (Wt. fraction)	0,0000	0,0000
Outlet Y, Tube (Wt. fraction)	0,0000	0,0000
Geometry		
Shell type (--)	E	E
Parallel (--)	1	1
Effective area (ft ²)	792,33	792,33
Shell orientation (--)	Horizontal	Horizontal
Shell ID (inch)	21,000	21,000
Shellside fluid (--)	Cold	Cold
Baffle type (--)	Single-Seg.	Single-Seg.
Baffle cut (Pct Dia.)	25	25
Baffle orientation (--)	Perpend.	Perpend.
Central spacing (inch)	8,0000	8,0000
Crosspasses (--)	15	15
Tube type (--)	Plain	Plain
Tube Pass (--)	4	4
Tubecount (--)	344	344
Tube length (ft)	12,001	12,001
Tube OD (inch)	0,7500	0,7500
Tube layout angle (--)	30	30
Pitch ratio (--)	1,2500	1,2500

Company: **ECOPETROL SA**Rev: **1**Date: **11/04/24**Pag: **7 de 7**Location: **CARTAGENA, COLOMBIA**Equipment: **E-101 A/B**Service of Unit: **CDHYDRO FEED PREHEATERS**Project: **Mejoras en Unidad de Destilación Reactiva U-107 Para Estabilidad y Cumplimiento de 10 PPM Azufre****REMARKS**

1. The VENDOR shall perform its own thermal, hydraulic and mechanical design and calculate actual drop pressure and outlet properties for hot stream and cold stream.
2. The corrosion allowance in tube side only applies for front head and tubesheet.
3. Materials thickness and weights shall be verified by VENDOR based in calculations.
4. The VENDOR shall guarantee the exchanger thermally and mechanically, and shall also guarantee against damages caused by flow-induced vibration per the shell-and-tube. The output properties, total duty and drop pressure shall be confirmed by VENDOR, and final values shall update the hydraulic study.
5. PWHT and impact test requirements shall be applied during the manufacturing process as recommended by ASME Section VIII Div 1.
6. Materials indicated in this data sheet are for reference. The VENDOR must verify the materials according to the operating conditions, fluids and client specification 000-SP-ME07-0006 Heat Exchanger Materials Specifications.
7. The VENDOR shall include a update of name plate according typical specification 166000-000-DG-MV09-0072. The name plate material shall be stainless
8. The VENDOR shall supply and install insulation supports and clips in accordance with technical specification 166000-000-SP-MU10-0004 Insulation Materials And Application - Hot Service.
9. Insulation: Tube Side: HC. Insulation to be supplied and installed by a third part.
10. Any specified corrosion allowances shall be added to the minimum calculated thickness. The commercial thicknesses selected by VENDOR must be greater than the calculated thicknesses (including corrosion thickness).
11. Nozzles shall have a projection to permit bolt dismantling without insulation removal, according typical specification 166000-000-DG-MV09-0055 Nozzle Projections.
12. The VENDOR shall supply mechanical rating and detailed drawings approved for construction and AS-BUILT, including final loads and reactions according wind and seismic loads for civil studies. All consideration according TEMA, ASME Sec. VIII Div 1 and Client Standard recomendations.
13. The VENDOR shall review and validate all drawings contained in Annex III of the document 107-SP-ME07-0302. Drawings from a preliminary thermal and mechanical study by INTERCOL SA.
14. Manufacturer shall design, supply and install lifting lugs for: exchangers lift operations and channel covers removal. According typical specification 166000-000-DG-MV09-0020 Vessel Lifting Lug Detail (Erection WT.<20 Tons [18144 kg] and 166000-000-DG-MV09-0021 Vessel Lifting Lug Detail (Erection WT.>20 Tons [18144 kg]).
15. The VENDOR shall consider nozzle loads according the document 000-SP-MU10-0015 Equipment Nozzle Loads Specification.
16. The VENDOR shall include two couplings on each nozzle (tube side) according his mechanical calculations.
17. If the VENDOR considers using clad, it must ensure suitability taking into account typical specification 000-DG-MV09-0062, 000-DG-MV09-0063, 000-DG-MV09-0064 and 000-DG-MV09-0065.
18. Tubesheet, bundle, baffles, impigment plate, tie-rods, channel and all necessary parts shall be replaced to achieve new process required duty. The scope of VENDOR can be seen below.

1



1