

TECHNICAL SPECIFICATIONS

CLIENT Braskem S. A.

PROJECT Projeto Helius

RFQ NO. PJ-0602056

ARVOS OFFER NO. 23.10.014

ARVOS DOC. NO. 23.10.014TS000

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0	Apr. 27, 23	For approval		_
Rev.	Date	Description	Execution by	Approved by

ARVOS GmbH SCHMIDTSCHE SCHACK

Ellenbacher Straße 10, 34123 Kassel Germany Round-Type Transfer Line ExchangerARVOS No.:Client:Braskem S. A.Client No.:

ARVOS No.: 23.10.014

Client No.: PJ-0602056

Project: Projeto Helius Spec. No.: N - 1

2	Number of Units 3 Item No. EA-4107	7 A /B /C	7 (1	rrangement:				
	Operating Case Design (
4	Operating Case Design C		ce of one Unit	•				
5		Performan	Shell Side	<u> </u>	т.	be Side		
	Fluid		Water / Steam			ace Efflu		
	Total Fluid Entering	kg/h	•	1) 14.50		Nol. Wt.	23,84	1./
	Hydrocarbon	kg/h		1) 14.50		Nol. Wt.	23,02	+4
_	Hydrogen	kg/h				Λοί. Wt.	2,01	1.6
	Steam	kg/h	17.038 1)	2)		Λοί. Wt.	18,01	
	Operating Pressure	bar a	122,9		2,23	Out:	10,0	10
	Operating Temperature	°C	326,2		4,6	Out:	375,3	
3	Operating reinperatore	Č	020,2	111. 04	+,0	001.	075,0	
_	Density	kg/m³						
	Viscosity	cP						
_	Spec. Heat	kJ/kg°C						
	Thermal Conductivity	W/m°C						
8		,						
	Number of Passes		1			1		
	Mass Velocity	kg/m²s						
1 .	Average Velocity	m/s						
	Pressure Loss (Diff. in Static Pre					0,068		
	Fouling Resistance	m ² °C/W	0,00008	6		0		
4	Heat Exchanged	kW		5.623,4				
5	Heat Transfer Coefficient	W/m ² °C						
6	Transfer Rate Service	W/m ² °C		Refer to (O. D. o	f Inner T	Tube	
7	Log. Mean Temp. Diff.	°C						
	Required Surface	m ²		Refer to (Э. D. o	f Inner T	Tube	
	Required Tube Length	mm						
	Installed Tube Length	mm	8.600					
	Installed Surface	m ²	104,72	Refer to (Э. D. о	f Inner T	Tube	
	Steam Generated at Sat. Temp	. kg/h	17.038 1)	3)				
3								
4		Construction	n of one Unit					
_	Design Code		AD 200			AD 2		
_	Design Pressure	kg/cm²g	140,5	5		3,		
	Test Pressure	kg/cm²g	according to			ıccordin	g to code	е
_	Tube No.			7.				
9		Size	Corr. Allow.	Materi	al	Design	n Metal	Tem
	Oval Headers from Tube	o. d. 108 x 11 thk.	0	16Mo3			370	°(
	Outer Tube	o. d. 73 x 5,6 thk.	0	16Mo3			350	°(
	Inner Tube	o. d. 51 x 5 thk.	0	16Mo3			370	°(
_	Downcomer Header	o. d. 8"	3	SA 106M C			350	°(
	Riser Header	o. d. 8"	3	SA 106M C	r. B		350	°(
_	Inlet Flange 5)	18", 300 lb, RF	3	16Mo3			450	°(
	Outlet Flange	14", 300 lb	3	13CrMo4-5		450	550	°(
	Inlet Channel/Main Flange	cone 5) / DN 1250	3	16Mo3 / 1		450	0/450 550	°(
_	Outlet Channel/Main Flange	cylindrical / DN 1150 .300 kg		13CrMo4-5 / 13			550	
_	0 17, 11			with water, a	ιμμιοχ.:	•		
	For main dimensions refer to d *Remarks: 1) for clean conditions	rawing no. 23.10.014-F / 2) refer to mean pressure		re / 2) under	consider	ration of 1	% heat los	ce
		mensions are in mm / 5) ex			consider	unon or 1	/0 11 0 01 105	33
1	4) all values without al	mensions die minimi / 3) ex	asing come will be red	360				
	4) all values without al	mensions are in min / 3/ ex	damig come will be red	36u				

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Ellenbacher Straße 10, 34123 Kassel Germany Round-Type Transfer Line ExchangerARVOS No.:23.10.014Client:Braskem S. A.Client No.:PJ-0602056

Project: Projeto Helius Spec. No.: N - 2 Number of Units Arrangement: vertical upflow EA-4107 A/B/C Item No. 3 Operating Case Rating Case 1 4 **Performance of one Unit** 5 Shell Side Tube Side Water / Steam Furnace Effluent 6 Fluid Total Fluid Entering 16.500 24,434 kg/h Mol. Wt. Hydrocarbon Mol. Wt. 8 kg/h 9 Hydrogen kg/h Mol. Wt. 2,016 10 Steam 18.347 Mol. Wt. 18,016 kg/h 1) 3) Operating Pressure 11 bar a 123,9 In: 2,24 Out: 1) Operating Temperature 12 °C 326,6 823,4 Out: 378,4 In: 1) 13 kg/m³ 14 Density 2) 15 Viscosity cР 2) 16 Spec. Heat kJ/kg°C 2) 17 Thermal Conductivity W/m°C 2) 18 19 Number of Passes 1 1 20 Mass Velocity kg/m²s 21 Average Velocity m/s Pressure Loss (Diff. in Static Press.) 0,084 22 bar 1) 23 Fouling Resistance m²°C/W 0.000086 0 24 Heat Exchanged kW 6.036,4 1) Heat Transfer Coefficient W/m²°C 25 W/m²°C Transfer Rate Service Refer to O. D. of Inner Tube 26 27 Log. Mean Temp. Diff. $^{\circ}$ C 28 Required Surface m^2 Refer to O. D. of Inner Tube Required Tube Length 29 mm 30 Installed Tube Length mm 8.600 Refer to O. D. of Inner Tube 31 Installed Surface m^2 104,72 32 Steam Generated at Sat. Temp. kg/h 18.347 33 Construction of one Unit 4) 34 Design Code AD 2000 AD 2000 35 140.5 3,5 36 Design Pressure kg/cm²g 37 Test Pressure kg/cm²g according to code according to code Tube No. 38 76 39 Corr. Allow. Material Size Design Metal Temp. 40 Oval Headers from Tube o. d. 108 x 11 thk. 0 370 16Mo3 $^{\circ}C$ o. d. 73 x 5,6 thk. 41 Outer Tube 0 16Mo3 350 Inner Tube o. d. 51 x 5 thk. 0 370 °C 42 16Mo3 Downcomer Header 3 °C 43 o. d. 8" SA 106M Gr. B 350 Riser Header o. d. 8" SA 106M Gr. B 350 $^{\circ}C$ 44 3 Inlet Flange 18", 300 lb, RF °C 3 16Mo3 450 45 46 Outlet Flange 14", 300 lb 3 13CrMo4-5 550 °C Inlet Channel/Main Flange cone 5) / DN 1250 47 3 16Mo3 / 16Mo3 450/450 Outlet Channel/Main Flange cylindrical / DN 1150 48 3 13CrMo4-5 / 13CrMo4-5 550 $^{\circ}C$ Weight with water, approx.: kg 49 Weight empty, approx.: 14.300 kg 50 For main dimensions refer to drawing no. 23.10.014-HP-04.0-001-RO 1) for clean conditions / 2) refer to mean pressure and mean temperature / Remarks: 3) under consideration of 1 % heat loss 4) all values without dimensions are in mm / 5) existing cone will be reused Revision: 0 / Apr. 27, 2023

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Ellenbacher Straße 10, 34123 Kassel Germany Round-Type Transfer Line ExchangerARVOS No.:23.10.014Client:Braskem S. A.Client No.:PJ-0602056Project:Projecto HeliusSpec. No.:N - 3

•	Project: Projeto	. 101100	opo	c. No.:	N - 3		
1 Number of Units 3		A	rrangement:	vertice	al upflow		
2 Item No. EA-410	7 A/B/C				•		
3 Operating Case Rating	Case 2						
4	Performan	ce of one Uni	t				
5		Shell Side		Tı	ube Side		
6 Fluid		Water / Steam			ace Efflu	ent	
7 Total Fluid Entering	kg/h	,	1) 7.40		Mol. Wt.	23,18	38
8 Hydrocarbon	kg/h				Mol. Wt.	<u> </u>	
9 Hydrogen	kg/h				Mol. Wt.	2,01	16
10 Steam	kg/h	4.901 1	3)		Mol. Wt.	18,01	
11 Operating Pressure	bar a	120,6		1,32	Out:	<u> </u>	1
12 Operating Temperature	°C	324,8	In: 87	-	Out:	358	1
13		,	-		<u> </u>		
14 Density	kg/m³						2
15 Viscosity	cP						2
16 Spec. Heat	kJ/kg°C						2
17 Thermal Conductivity	W/m°C						2
18	,						
19 Number of Passes		1			1		
20 Mass Velocity	kg/m²s	· ·			•		
21 Average Velocity	m/s						
22 Pressure Loss (Diff. in Static Pro					0,035		1
23 Fouling Resistance	m ² °C/W	0,00008	36		0		•
24 Heat Exchanged	kW		1.644,6				1
25 Heat Transfer Coefficient	W/m ² °C						
26 Transfer Rate Service	W/m ² °C		Refer to	O. D. c	of Inner T	ube	
27 Log. Mean Temp. Diff.	°C						
28 Required Surface	m ²		Refer to (O. D. c	of Inner T	ube	
29 Required Tube Length	mm						
30 Installed Tube Length	mm	8.600					
31 Installed Surface	m^2	104,72	Refer to	O. D. c	of Inner T	ube	
32 Steam Generated at Sat. Temp	o. kg/h	•	3)				
33	<u> </u>		· 1				
34	Construction	of one Unit	4)				
35 Design Code		AD 20	,		AD 2	2000	
36 Design Pressure	kg/cm²g	140,			3,		
37 Test Pressure	kg/cm ² g	according			according		e
38 Tube No.			7			,	
39	Size	Corr. Allow.	Materi		Design	Metal ⁻	Temp.
40 Oval Headers from Tube	o. d. 108 x 11 thk.	0	16Mo3		7.31	370	°C
41 Outer Tube	o. d. 73 x 5,6 thk.	0	16Mo3			350	°C
42 Inner Tube	o. d. 51 x 5 thk.	0	16Mo3			370	°C
43 Downcomer Header	o. d. 8"	3	SA 106M C	r. B		350	°C
44 Riser Header	o. d. 8"	3	SA 106M C			350	°C
45 Inlet Flange 5)	18", 300 lb, RF	3	16Mo3			450	°C
46 Outlet Flange	14", 300 lb	3	13CrMo4-5	5		550	°C
47 Inlet Channel/Main Flange	cone 5) / DN 1250	3	16Mo3 / 1		450	/450	°C
48 Outlet Channel/Main Flange	cylindrical / DN 1150	3	13CrMo4-5 / 13			550	°C
	4.300 kg	Weight	with water, c				kg
50 For main dimensions refer to a	<u> </u>		, -	<u> </u>			<u> </u>
51 Remarks : 1) for clean condition	s / 2) refer to mean pressure	and mean temperat		conside	ration of 1	% heat los	SS
4) all values without o	limensions are in mm / 5) ex	isting cone will be re	used				

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Ellenbacher Straße 10, 34123 Kassel Germany

Requirements for Water/Steam	ARVOS No.:	23.10.014
Client: Braskem S. A.	Client No.:	PJ-0602056
Project: Projeto Helius	Spec. No.:	W/S - 1

A

Values recommended by VGB (Vereinigung der Großkesselbesitzer) for steam to turbines, demineralized boiler feed water and boiler water under consideration of alkaline operation method with combined use of volatile (ammonia - NH_3 , hydrazine - N_2H_4) and solid (trisodiumphosphate - Na_3PO_4 , sodium hydroxide NaOH) alkalizers.

В

Values specified by client.

Requirements		Unit	A	В	Notes
Steam to Turbines					
Conductivity at 25 °C	1)	μS/cm	< 0,2		
Silica		ppm	< 0,02		
Total iron		ppm	< 0,02		
Total copper		ppm	< 0,003		
Sodium		ppm	< 0,01		
Liquid entrainment		Wt. %			
Boiler Feed Water					
Oxygen	4)	ppm	not specified		
Total iron		ppm	< 0,02		
Total copper		ppm	< 0,003		
pH at 25 °C			> 9		
Silica		ppm	< 0,02		
Conductivity at 25 °C	1)	μ\$/cm	< 0,2		
_					
_					
Boiler Water					
pH at 25 °C			9,5 - 10,5		
	2)	ppm	2)		
Silica					
Silica Phosphate		ppm	< 6		

- 1) Continuous sampling behind highly acid cation exchanger.
- 2) Depending on operating pressure.
- 3) In the event of alkaline operation, only with volatile alkalizers, conductivity in boiler water should not exceed 3 μ s/cm.
- 4) If continuous operation with demineralized water cannot be guaranteed, oxygen content should not exceed 0,02 ppm.

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