

WASTE HEAT BOILER SPECIFICATION SHEET

1	Project	Dung Quat Refinery Additional Sulfur Recovery Unit	Job Code	G - 6025 - 11
2	Client	Binh Son Refining & Petrochemical Co., Ltd.	Doc. No.	SS - SWHB - 100
3	Contractor	JGC Vietnam Co., Ltd.	Date	2014. 8. 21.
4	Code/Standard	ASME Sec. VIII Div. 1 / TEMA	ASME Stamp	Yes
			Revision	A
5	Service of Unit	WHB and Thermal Sulfur Condensers	Type	Single Shell
			Item No.	SG - 2501
6	Size	Shell 2650 ID x 6100 L	Installation	Horizontal
			No. of Units	1 set(s)
7	Surface/Unit, Eff.	Intentionally Blank !	Oper. Case	Design
			Sheet No.	1 of 4

PERFORMANCE of ONE UNIT

Fluid Allocation	Shell Side		Tube Side	
Fluid Name	BFW	Steam	Process Gas / Sulphur	
	Inlet	Outlet	Inlet	Outlet
Fluid Quantity, Total	1,972 kg/h		Intentionally Blank !	
Vapor	0	1,873		
Liquid	1,972	0		
Blowdown *1)		99		
Temperature °C	112	158.9		
Density kg/m ³	949.6	3.18		
Viscosity Cp	0.250	0.014		
Molecular Weight	18.0152			
Specific Heat kJ/kg. °C	4.232	2.481		
Thermal Conductivity W/m. °C	0.682	0.032		
Latent Heat kJ/kg	2,085			
Pressure, Inlet / Oper. / Inlet kg/cm ² .g	5.1	5.1		
Velocity, i / m / o m/sec				
Pressure Drop, Allowable / Cal'd kg/cm ²				
Fouling Resistance m ² .°C/W / m ² .h. °C/kcal	0.00017	/	0.00020	
Heat Duty 1,058,660 kcal/h 1,231 kW	Intentionally Blank !			

Intentionally Blank !

DESIGN, MATERIALS and CONSTRUCTION of ONE UNIT

Design / Test Press. kg/cm ² .g	Shell Side		Tube Side		SKETCH
	6.3	F/V	8.48	4.9	7.59
Design Temperature (In / Out) °C	230		220		Please refer to " General Assembly "
No. Passes per Shell			1		
Corrosion Allowance mm	3		3 * Tube 0		
Connections	2"	6"	Refer to next pages !		
Size					
Type	Flanged	Flanged			
Rating	150 lb	150 lb			

39	Tube No.	Refer to next pages !
40	Tube Type	

41	Shell	SA 516-60N	ID	2650	Thk	20	mm
42	Channel	Inlet	SA 516-60N	ID	Refer to next pages !		
43		Outlet	SA 516-60N	ID			
44	Tubesheet	SA 516-60N	Thk	30	Refer to next pages !		
45	Supports-Tube	SA 516-60N	Q'ty	2	Thk	20	Spacing : c/c 2,050 mm
46	Saddle	SA 516-60N					
47	Refer to next pages !						
48	Expansion Joint	Channel Inlet					
49	Gaskets-Shell Side	Non-asbestos			Tube Side		
50	Insulation-Shell Side	Mineral Wool	100 t	Tube Side		Refer to next pages !	
							* by Others

52	Code Requirements	ASME		TEMA Class	R	
53	Weight	Empty	22,400	Operating	49,100	Filled with Water 55,000 kg

55	Notes					
56	*1)	Blowdown Rate	:	5	% BFW Flowrate	
57	*2)					
58	*3)					
59	*4)					
60	*5)					
61	*6)					
62	*7)					

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3	Contractor	JGC Vietnam Co., Ltd.	Date	2014. 8. 21.
4	Code/Standard	ASME Sec. VIII Div. 1 / TEMA	ASME Stamp	Yes
5	Service of Unit	Waste Heat Boiler	Type	Single Shell
6	Size	Shell 2650 ID x 6100 L	Installation	Horizontal
7	Surface/Unit, Eff.	88.7 Gross	90.7 m ² Oper. Case	Design
8			Revision	A
9			Item No.	SG - 2501 A
10			No. of Units	1 set(s)
11			Sheet No.	2 of 4

PERFORMANCE of ONE UNIT

Fluid Allocation	Shell Side		Tube Side	
Fluid Name	BFW	Steam	Process Gas / Sulphur	
	Inlet	Outlet	Inlet	Outlet
Fluid Quantity, Total	1,668 kg/h		3,185 kg/h	
Vapor	0		1,585	2,838
Liquid	1,668		0	347
Blowdown *1)			83	
Temperature °C	112	158.9	961	172
Density kg/m ³	949.6	3.18	0.44	1.10
Viscosity Cp	0.250	0.014	0.044	0.020
Molecular Weight	18.0152			
Specific Heat kJ/kg. °C	4.232	2.481	1.34	1.14
Thermal Conductivity W/m. °C	0.682	0.032	0.087	0.032
Latent Heat kJ/kg	2,085		***	
Pressure, Inlet / Oper. / Inlet kg/cm ² .g	5.1	5.1	0.41	
Velocity, i / m / o m/sec			33.5	22.7
Pressure Drop, Allowable / Cal'd kg/cm ²			0.056	0.052
Fouling Resistance m ² .°C/W / m ² .h. °C/kcal	0.00017	/	0.00020	0.0009 / 0.00105
Heat Duty 896,120 kcal/h 1,042 kW MTD	191.7	°C	H. T. Rate, Clean, *1; 57.8 kcal/m ² .h. °C	
H. T. Rate, Cal'd, *1; 52.7 kcal/m ² .h. °C	H. T. Area, Req., *2; 88.7 m ²		Cleanliness Factor 91.2 %	
H. T. Rate, Service 52.7 kcal/m ² .h. °C	H. T. Area, Act., *2; 88.7 m ²		H. T. Area Margin 0.0 %	

DESIGN, MATERIALS and CONSTRUCTION of ONE UNIT

Design / Test Press. kg/cm ² .g	Shell Side	Tube Side	SKETCH	
Design Temperature (In / Out) °C		4.9	7.59	
No. Passes per Shell		220		
Corrosion Allowance mm	Intentionally Blank !	1	Please refer to " General Assembly "	
Size		3		* Tube 0
Type		ID 1150		8"
Rating		Flanged		Flanged
Tube No. 149 STR's	OD 31.8 mm	Thk, Avg. 4.55 mm	Length, Eff. 6,040 mm	
Tube Type Plain			Pitch 48 mm	
Shell SA 516-60N	ID	Intentionally Blank !		
Channel Inlet SA 516-60N	ID 1150	Thk 12 mm	Channel Cover - N/A - Thk - N/A - mm	
Channel Outlet SA 516-60N	ID 850	Thk 9 mm	Channel Cover SA 516-60N Thk 25 mm	
Tubesheet	Inlet Tubesheet - Ferrules and Refractory : Yes			
Supports-Tube	Intentionally Blank !			
Saddle	Intentionally Blank !			
Expansion Joint	Channel Inlet - N/A -	Tube-Tubesheet Joint	Strength Welding	
Gaskets-Shell Side	Non-asbestos	Channel Outlet - N/A -		
Insulation-Shell Side	Intentionally Blank !	Tube Side	Non-asbestos	
Code Requirement	Intentionally Blank !			
Weight	Intentionally Blank !			
Insulation-Shell Side	Intentionally Blank !	Tube Side	Mineral Wool 100 t * by Others	

Notes

- 56 *1) Blowdown Rate : 5 % BFW Flowrate
- 57 *2) based on Tube Outside
- 58 *3)
- 59 *4)
- 60 *5)
- 61 *6)
- 62 *7)

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3	Contractor	JGC Vietnam Co., Ltd.	Date	2014. 8. 21.
4	Code/Standard	ASME Sec. VIII Div. 1 / TEMA	ASME Stamp	Yes
5	Service of Unit	1st Sulfur Condenser	Type	Single Shell
6	Size	Shell 2650 ID x 6100 L	Installation	Horizontal
7	Surface/Unit, Eff.	32.2 Gross	32.9 m ² Oper. Case	Design
			Sheet No.	3 of 4

PERFORMANCE of ONE UNIT

Fluid Allocation	Shell Side		Tube Side	
Fluid Name	BFW	Steam	Process Gas / Sulphur	
	Inlet	Outlet	Inlet	Outlet
Fluid Quantity, Total	220 kg/h		2,881 kg/h	
Vapor	0		2,881	
Liquid	220		0	
Blowdown *1)	11			
Temperature °C	112	158.9	294	174
Density kg/m ³	949.6	3.18	0.85	0.96
Viscosity Cp	0.250	0.014	0.025	0.021
Molecular Weight	18.0152			
Specific Heat kJ/kg. °C	4.232	2.481	1.18	1.19
Thermal Conductivity W/m. °C	0.682	0.032	0.042	0.034
Latent Heat kJ/kg	2,085		***	
Pressure, Inlet / Oper. / Inlet kg/cm ² .g	5.1	5.1	0.3	
Velocity, i / m / o m/sec			25.1	22.7
Pressure Drop, Allowable / Cal'd kg/cm ²			0.05	0.043
Fouling Resistance m ² .°C/W / m ² .h. °C/kcal	0.00017	/	0.00020	0.0009 / 0.00105
Heat Duty 117,820 kcal/h 137 kW MTD	54.7	°C	H. T. Rate, Clean, *1; 73.9 kcal/m ² .h. °C	
H. T. Rate, Cal'd, *1; 66.9 kcal/m ² .h. °C	H. T. Area, Req., *2; 32.2 m ²		Cleanliness Factor 90.5 %	
H. T. Rate, Service 66.9 kcal/m ² .h. °C	H. T. Area, Act., *2; 32.2 m ²		H. T. Area Margin 0.0 %	

DESIGN, MATERIALS and CONSTRUCTION of ONE UNIT

Design / Test Press. kg/cm ² .g	Shell Side	Tube Side	SKETCH
Design Temperature (In / Out) °C		4.9 / 7.59	Please refer to " General Assembly "
No. Passes per Shell		220	
Corrosion Allowance mm	Intentionally Blank !	1	
Size		3 * Tube 0	
Type		8" / 8"	
Rating		Flanged / Flanged	
Connections		150 lb / 150 lb	
Tube No. 45 STR's	OD 38.1 mm	Thk, Avg. 2.76 mm	Length, Eff. 6,040 mm
Tube Type Plain	Material SA 179		→ ◀ ▲ □ ◇
Shell SA 516-60N	ID	Intentionally Blank !	
Channel	Inlet SA 516-60N	ID 750 Thk 9 mm	Channel Cover SA 516-60N Thk 9 mm
	Outlet SA 516-60N	ID 750 Thk 9 mm	Channel Cover SA 516-60N Thk 25 mm
Tubesheet	Inlet Tubesheet - Ferrules and Refractory : - N/A -		
Supports-Tube	Intentionally Blank !		
Saddle	Intentionally Blank !		
Expansion Joint	Channel Inlet - N/A -	Tube-Tubesheet Joint	Strength Welding
Gaskets-Shell Side	Non-asbestos	Channel Outlet - N/A -	
Insulation-Shell Side	Intentionally Blank !	Tube Side	Non-asbestos
Code Requirement	Intentionally Blank !		
Weight	Intentionally Blank !		

Notes

- *1) Blowdown Rate : 5 % BFW Flowrate
- *2) based on Tube Outside
- *3)
- *4)
- *5)
- *6)
- *7)

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2	Client	Binh Son Refining & Petrochemical Co., Ltd.	Doc. No.	SS - SWHB - 100
3	Contractor	JGC Vietnam Co., Ltd.	Date	2014. 8. 21.
4	Code/Standard	ASME Sec. VIII Div. 1 / TEMA	ASME Stamp	Yes
5	Service of Unit	2nd Sulfur Condenser	Type	Single Shell
6	Size	Shell 2650 ID x 6100 L	Installation	Horizontal
7	Surface/Unit, Eff.	32.2 Gross	32.9 m ² Oper. Case	Design
			Sheet No.	4 of 4

PERFORMANCE of ONE UNIT

Fluid Allocation	Shell Side		Tube Side	
Fluid Name	BFW	Steam	Process Gas / Sulphur	
	Inlet	Outlet	Inlet	Outlet
Fluid Quantity, Total	83	kg/h	2,653	kg/h
Vapor	0		79	2,608
Liquid	83		0	45
Blowdown *1)			4	
Temperature	112	158.9	219	165
Density	949.6	3.18	0.84	0.91
Viscosity	0.250	0.014	0.022	0.020
Molecular Weight	18.0152			
Specific Heat	4.232	2.481	1.21	1.20
Thermal Conductivity	0.682	0.032	0.037	0.033
Latent Heat	2,085		***	
Pressure, Inlet / Oper. / Inlet	5.1	5.1	0.19	
Velocity, i / m / o			23.4	22.3
				21.2
Pressure Drop, Allowable / Cal'd	kg/cm ²		0.033	0.030
Fouling Resistance	0.00017	/	0.00020	0.0009
			/	0.00105
Heat Duty	44,720	kcal/h	52	kW
			MTD	23.6
			°C	H. T. Rate, Clean, *
			64.3	kcal/m ² .h. °C
H. T. Rate, Cal'd, *	58.9	kcal/m ² .h. °C	H. T. Area, Req., *2)	
			32.2	m ²
			Cleanliness Factor	
			91.6	%
H. T. Rate, Service	58.9	kcal/m ² .h. °C	H. T. Area, Act., *2)	
			32.2	m ²
			H. T. Area Margin	
			0.0	%

DESIGN, MATERIALS and CONSTRUCTION of ONE UNIT

Design / Test Press.	Shell Side	Tube Side	SKETCH
kg/cm ² .g		4.9	7.59
Design Temperature (In / Out)		220	
No. Passes per Shell		1	
Corrosion Allowance	Intentionally Blank !	3	* Tube 0
Size		8"	8"
Connections		Flanged	Flanged
Rating		150 lb	150 lb
Tube No.	45	STR's	OD 38.1 mm
		Thk, Avg.	2.76 mm
		Length, Eff.	6,040 mm
		Pitch	48 mm
Tube Type	Plain		Material SA 179
Shell	SA 516-60N		ID Intentionally Blank !
Channel	Inlet	SA 516-60N	ID 750 Thk 9 mm
	Outlet	SA 516-60N	ID 750 Thk 9 mm
Tubesheet	Inlet Tubesheet - Ferrules and Refractory : - N/A -		
Supports-Tube	Intentionally Blank !		
Saddle	Intentionally Blank !		
Expansion Joint	Channel Inlet	- N/A -	
		Channel Outlet	- N/A -
Gaskets-Shell Side	Non-asbestos		
		Tube Side	Non-asbestos
Insulation-Shell Side	Intentionally Blank !		
		Tube Side	Mineral Wool 100 t * by Others
Code Requirement	Intentionally Blank !		
Weight	Intentionally Blank !		

Notes

- *1) Blowdown Rate : 5 % BFW Flowrate
- *2) based on Tube Outside
- *3)
- *4)
- *5)
- *6)
- *7)