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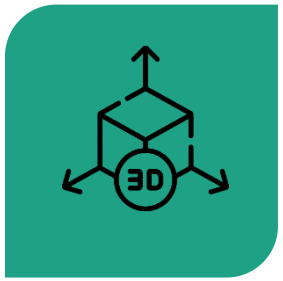
Type of Outputs



3D Schematic

Powerful 3D schematic tool with image export to AutoCAD and common formats.

Datasheets

Contains heater, burner, fan and APH data sheets in API Standard format with export options to PDF, image, and text formats.

Reports

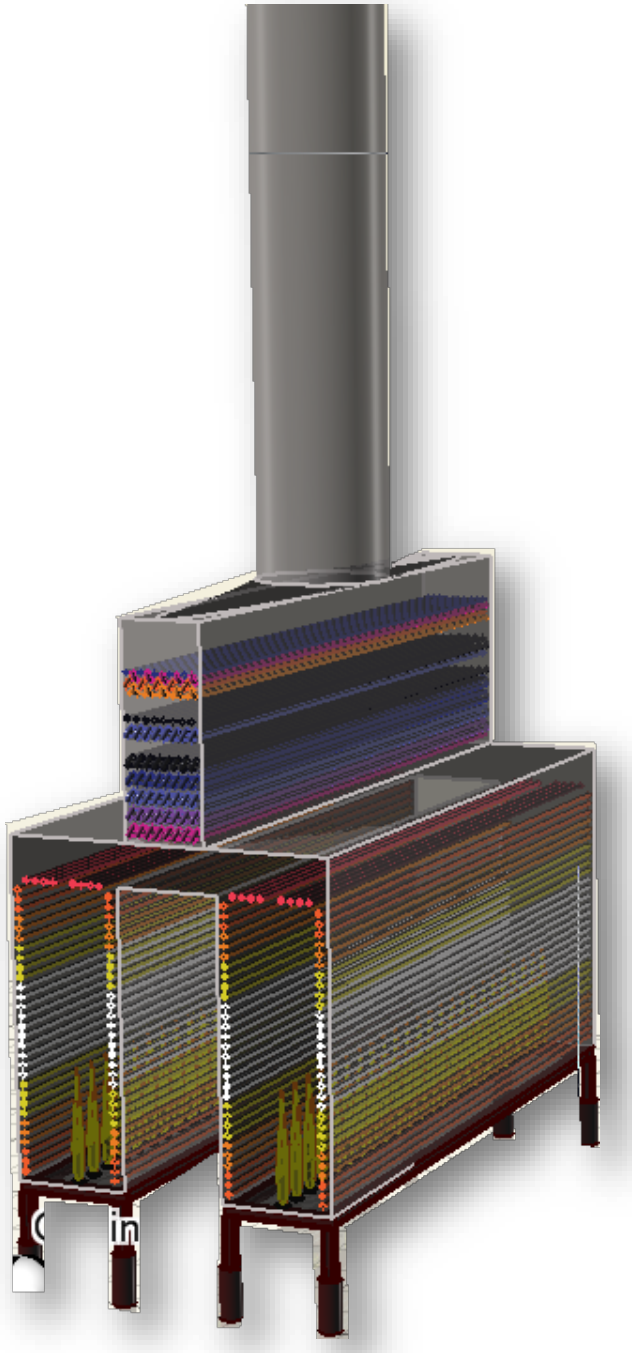
Diverse engineering reports on heater and heat transfer, with export options for PDF, MS. Word, Excel, image, etc.

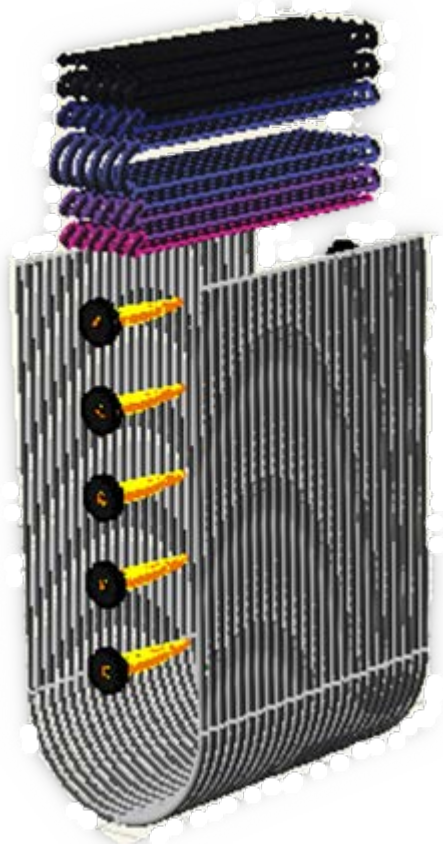
Diagrams

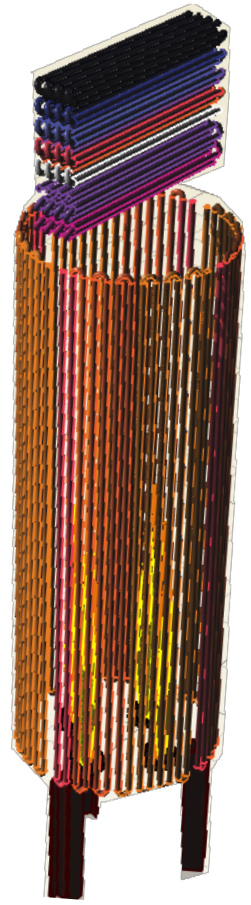
Provides versatile gas and process sides output diagrams with export option for PDF, MS. Word, Excel, image, etc.

FHinfinity© 3D Schematic


Origin







FHinfinity© Datasheets

Type of Datasheets

- ***Heater Datasheet (API-560)***
- ***Burner Datasheet (API-560)***
- ***ID Fan Datasheet (API-560)***
- ***FD Fan Datasheet (API-560)***
- ***APH Datasheet (API-560)***

Heater Datasheet

PURCHASER / OWNER:		ITEM NO.:				
SERVICE:		LOCATION:				
1	UNIT:		NUMBER REQUIRED:			Rev
2	MANUFACTURER:		REFERENCE:			
3	TYPE OF HEATER:		Cubical (Twin-Cell)			
4	TOTAL HEATER ABSORBED DUTY [MMBtu/hr]		205.7118			
5	**PROCESS DESIGN CONDITIONS**					
6	OPERATING CASE	AS SIMULATED	AS SIMULATED	AS SIMULATED	AS SIMULATED	
7	HEATER SECTION	Firebox	Tube Bank...	Tube Bank...	Tube Bank...	
8	SERVICE					
9	HEAT ABSORPTION [MMBtu/hr]	127.2436	52.9852	21.9984	3.4847	
10	FLUID	To 2H-101	To 2H-101	To 2H-101	LPS	
11	MASS FLOW RATE [lb/hr]	1250000	1250000	1250000	28219	
12	VOLUMETRIC FLOW RATE (Act.) [ft3/hr]		28191.3	26491.5	192515.7	
13	PRESSURE DROP, ALLOWABLE (CLEAN /FOULED) [Psi]					
14	PRESSURE DROP, CALCULATED [Psi]	120.146	11.436	2.17	9.574	
15	AVG. RAD. SECT. FLUX DENSITY, ALLOWABLE [Btu/hr.ft2]					
16	AVG. RAD. SECT. FLUX DENSITY, CALCULATED [Btu/hr.ft2]	10707.003	-	-	-	
17	MAX. RAD. SECT. FLUX DENSITY [Btu/hr.ft2]	18623.301	-	-	-	
18	CONV. SECT. FLUX DENSITY, (BARE TUBE) [Btu/hr.ft2]	-	7516.768	10402.716	1222.275	
19	PROCESS FLUID VELOCITY (@ OUTLET) [ft/s]	266.6	20.42	6.75	180.65	
20	PROCESS FLUID MASS VELOCITY [lb/s.ft2]	312.41 / 432.4	312.41	312.41	17.73	
21	MAX. CALC. INSIDE FILM TEMPERATURE [F]	690.59	564.89	508.46	686.47	
22	AVG. FOULING FACTOR (Gas & Process Sides) [hr.ft2.F/Btu]	0.0003	0	0	0	
23	AVG. COKE THICKNESS [inch]	0.006	0	0	0	
24	**INLET CONDITIONS:**					
25	TEMPERATURE [F]	537.75	475.05	445	420	
26	PRESSURE [Psia]	151.394	162.83	165	75	
27	LIQUID FLOW [lb/hr]	1162637.5	1250000	1250000	0	
28	VAPOR FLOW [lb/hr]	87362.5	0	0	28219	
29	LIQUID GRAVITY [@ 60 F]	0.725	0.741	0.756	-	
30	VAPOR DENSITY [lb/ft3]	1.559	-	-	0.147	
31	VISCOSITY (LIQUID/VAPOR) [cP]	0.0677 / 0.0141	0.0725 / -	0.076 / -	- / 0.0167	
32	SPECIFIC HEAT (LIQUID/VAPOR) [Btu/lb.F]	0.6091 / 0.5808	0.5864 / -	0.5737 / -	- / 0.5067	
33	THERMAL CONDUCTIVITY (LIQUID/VAPOR) [Btu/hr.ft.F]	0.0432 / 0.0223	0.04 / -	0.0422 / -	- / 0.0209	
34	**OUTLET CONDITIONS:**					
35	TEMPERATURE [F]	652.83	537.75	475.05	667.61	
36	PRESSURE [Psia]	31.249	151.394	162.83	65.426	
37	LIQUID FLOW [lb/hr]	625037.5	1162637.5	1250000	0	
38	VAPOR FLOW [lb/hr]	624962.5	87362.5	0	28219	
39	LIQUID GRAVITY [@ 60 F]	0.767	0.725	0.741	-	
40	VAPOR DENSITY [lb/ft3]	0.617	1.559	-	0.098	
41	VISCOSITY (LIQUID/VAPOR) [cP]	0.055 / 0.0137	0.0677 / 0.0141	0.0725 / -	- / 0.0225	
42	SPECIFIC HEAT (LIQUID/VAPOR) [Btu/lb.F]	0.6345 / 0.6054	0.6091 / 0.5808	0.5864 / -	- / 0.4949	
43	THERMAL CONDUCTIVITY (LIQUID/VAPOR) [Btu/hr.ft.F]	0.0502 / 0.0236	0.0432 / 0.0223	0.04 / -	- / 0.0288	

NOTE:

FIRED HEATER DATA SHEET API STD - 560 (Short Version)	UNIT: Customized US Units			
	PROJECT NUMBER		SHEET	REV
			1	

COMBUSTION DESIGN CONDITIONS			
1	OPERATING CASE	AS SIMULATED	Rev
2	TYPE OF FUEL	Fuel Oil	
3	EXCESS AIR [Fraction]	0.25	
4	CALCULATED HEAT RELEASE (LHV) [MMBtu/hr]	259.496	
5	FUEL EFFICIENCY CALCULATED, % (LHV)	79.27	
6	FUEL EFFICIENCY GUARANTEED, % (LHV)	By Vendor	
7	RADIATION LOSS, % OF HEAT RELEASE (LHV)	3	
8	FLUE GAS TEMPERATURE LEAVING RADIANT SECTION [F]	1739.07	
9	FLUE GAS TEMPERATURE LEAVING CONVECTION SECTION [F]	759.05	
10	FLUE GAS TEMPERATURE LEAVING AIR PREHEATER [F]	N/A	
11	FLUE GAS QUANTITY [lb/hr]	274061.2	
12	FLUE GAS MASS VELOCITY THROUGH CONVECTION SECTION [lb/s.ft2]	0.37 / 0.37 / 0.67	
13	DRAFT AT ARCH [inH2O]	-0.8858	
14	DRAFT AT BURNERS [inH2O]	-1.1752	
15	AIR TEMPERATURE, EFFICIENCY CALCULATION [F]	105	
16	AIR TEMPERATURE, STACK DESIGN [F]	105	
17	ALTITUDE ABOVE SEA LEVEL [ft]	2647.31	
18	VOLUMETRIC HEAT RELEASE (LHV) [Btu/hr.ft3]	7567.3	

FUEL CHARACTERISTICS

	GAS TYPE		LIQUID TYPE		COMBINATION GAS / LIQUID		
20							
21	LHV [Btu/lb]		LHV [Btu/lb]	17226.9	LHV [Btu/lb]		
22	HHV [Btu/lb]		HHV [Btu/lb]	18249.1	HHV [Btu/lb]		
23	PRESS. @ BURNER [Psia]		PRESS. @ BURNER [Psia]		PRESS. @ BURNER [Psia]		
24	TEMP. @ BURNER [F]		TEMP. @ BURNER [F]	230	TEMP. @ BURNER [F]		
25	MOLECULAR WEIGHT		VISCOSITY [cP]		MOLECULAR WEIGHT		
26			ATOMIZING STEAM TEMP. [F]	302			
27	COMPOSITION	VOL. %	ATOMIZING STEAM FLOW [lb/hr]	3012.7			
28							
29			COMPOSITION	WT. %	COMPOSITION	WT. %	
30			CARBON	84.4	TOTAL CARBON		
31			HYDROGEN	11	TOTAL HYDROGEN		
32			NITROGEN	0	TOTAL NITROGEN		
33			OXYGEN	0	TOTAL OXYGEN		
34			SULFUR	2.6	TOTAL SULFUR		
35			WATER	0	TOTAL IMPURITIES		
36			ASH	2			

BURNER DATA

38	MANUFACTURER:		SIZE / MODEL NO:			NUMBER:	48	
39	TYPE:	Conventional	LOCATION:	Floor		ORIENTATION:	Vertically-Fired	
40	HEAT RELEASE PER BURNER [MMBtu/hr]	DESIGN:	5.9468 (1)	NORMAL:	5.4062	MINIMUM:		
41	PRESSURE DROP ACROSS BURNER [inH2O]			N/A				
42	DISTANCE BURNER CENTER LINE TO TUBE CENTER LINE [ft]			HORIZONTAL:	4.271	VERTICAL:	25.833	
43	DISTANCE BURNER CENTER LINE TO UNSHIELDED REFRACTORY [ft]			HORIZONTAL:		VERTICAL:	29.724	
44	PILOT, TYPE:	Self-Inspirating (2)	Capacity [Btu/hr]	75000 (1)				
45	IGNITION METHOD:							
46	FLAME SCANNERS, LOCATION:			NUMBER:				
47	REQUIRED EMMISIONS: ppmv(d)	NOX:	300 (2)	CO:	150 (1)	SOX:	580 (2)	
48		UHC:		PARTICULATES:		200 (2)		
49								
50	NOTE:							
51	*(1) AS PER API STD 560 FOR DESIGN CASE.*							
52	*(2) SUGGESTED BY FHinfinity.*							
53								
54								
54								
54								
54								

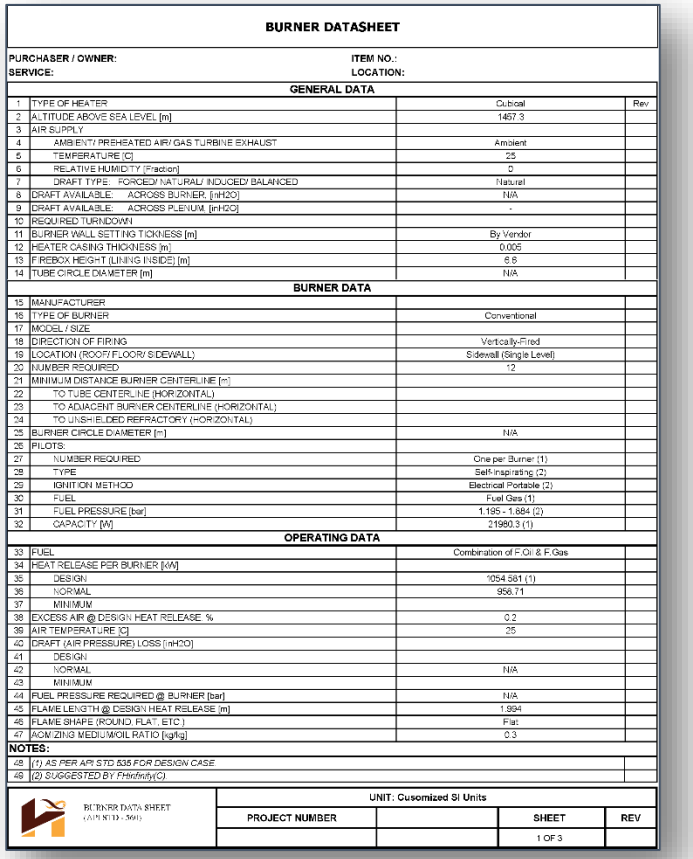
FIRED HEATER DATA SHEET API STD - 560 (Short Version)	UNIT: Customized US Units			
	PROJECT NUMBER		SHEET	REV
			2	

MECHANICAL DESIGN CONDITIONS					
1	HEATER SECTION:	Firebox	Tube Bank...	Tube Bank...	Tube Bank...
2	**COIL DESIGN:**				
3	DESIGN BASIS: TUBE WALL THICKNESS (CODE OR SPECIFICATION)	API STD. 530	API STD. 530	API STD. 530	API STD. 530
4	DESIGN BASIS: RUPTURE STRENGTH (MINIMUM OR AVERAGE)				
5	DESIGN LIFE [hr]	100,000 (1)	100,000 (1)	100,000 (1)	100,000 (1)
6	DESIGN PRESSURE, ELASTIC / RUPTURE [Psia]				
7	DESIGN FLUID TEMPERATURE [F]	704.47	587.75	525.05	717.61
8	TEMPERATURE ALLOWANCE (MIN.) [F]	25 (1)	25 (1)	25 (1)	25 (1)
9	CORROSION ALLOWANCE, TUBES / FITTINGS [inch]				
10	HYDROSTATIC TEST PRESSURE [Psia]				
11	POST WELD HEAT TREATMENT (YES OR NO)				
12	PERCENT OF WELD FULLY RADIOGRAPHED				
13	MAXIMUM TUBE METAL TEMPERATURE [F]	861.67	579.4	523.99	687.16
14	DESIGN TUBE METAL TEMPERATURE [F]	911.67	629.4	573.99	737.16
15	MINIMUM INSIDE FILM COEFFICIENT [Btu/hr.ft2.F]	469.36	419.63	419.55	48.63
16	**COIL ARRANGEMENT:**				
17	TUBE ORIENTATION: VERTICAL OR HORIZONTAL	Horizontal	Horizontal	Horizontal	Horizontal
18	TUBE MATERIAL (ASTM SPECIFICATION and/aso GRADE)	ASTM A335...	ASTM A335...	ASTM A335...	ASTM A106...
19	TUBE OUTSIDE DIAMETER [inch]	5.563	5.563	5.563	4.5
20	TUBE WALL THICKNESS, (AVERAGE) [inch]	0.258	0.258	0.258	0.237
21	NUMBER OF FLOW PATHS	8	8	8	5
22	NUMBER OF TUBES	136	80	24	40
23	NUMBER OF TUBES PER ROW (CONVECTION SECTION)	-	8	8	10
24	STRAIGHT TUBE LENGTH [ft]	60.5	60.5	60.5	60.5
25	EFFECTIVE TUBE LENGTH [ft]	60	60.5	60.5	60.5
26	BARE TUBES: NUMBER	136	80		40
27	TOTAL EXPOSED SURFACE [ft2]	11884.14	7048.93		2851
28	EXTENDED SURFACE TUBES: NUMBER	-		24	
29	TOTAL EXPOSED SURFACE [ft2]	-		6131.03	
30	TUBE LAYOUT (IN-LINE OR STAGGERED)	In-Line	Staggered	Staggered	Staggered
31	TUBE SPACING, CENT. TO CENT., HORZ. x DIAG. [inch]	10	10 x 10	10 x 10	8 x 8
32	SPACING TUBE CENT. TO FURNACE WALL [inch]	8.75			
33	CORBELS (YES OR NO)	No	No	No	No
34	CORBEL WIDTH [inch]	-	0	0	0
35	**DESCRIPTION OF EXTENDED SURFACE:**				
36	TYPE: (STUDS) (SOLID FINS)	-	BARE	STUDS	BARE
37	MATERIAL	-		Carbon St.	
38	DIMENSIONS (HEIGHT x DIA. or HEIGHT x THICK.) [inch]	-		1 x 0.5	
39	SPACING (FINS/inch) (PLANE/inch x STUDS/PLANE)	-		0.62 x 13	
40	MAXIMUM TIP TEMPERATURE, (CALCULATED) [F]	-		602.02	
41	EXTENSION RATIO	-	1	2.9	1

NOTE:

FIRED HEATER DATA SHEET API STD - 560 (Short Version)	UNIT: Customized US Units			
	PROJECT NUMBER		SHEET	REV
			3	

Burner Datasheet



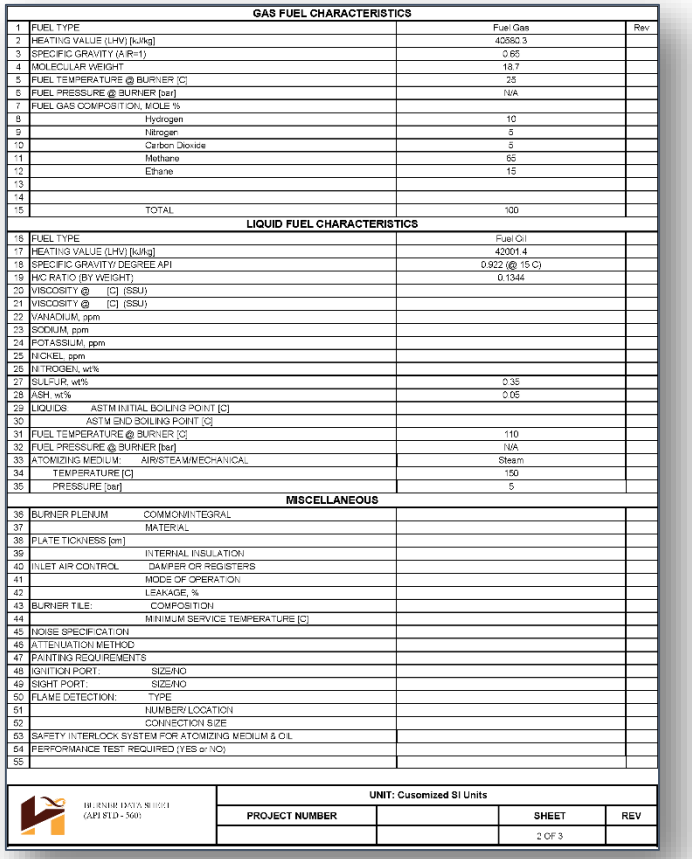
BURNER DATASHEET

PURCHASER / OWNER: ITEM NO.:
SERVICE: LOCATION:

	GENERAL DATA		
1	TYPE OF HEATER	Cubical	Rev
2	ALTITUDE ABOVE SEA LEVEL [m]	1457.3	
3	AIR SUPPLY		
4	AMBIENT/ PREHEATED AIR/ GAS TURBINE EXHAUST	Ambient	
5	TEMPERATURE [C]	25	
6	RELATIVE HUMIDITY [Fraction]	0	
7	DRAFT TYPE: FORCED/ NATURAL/ INDUCED/ BALANCED	Natural	
8	DRAFT AVAILABLE: ACROSS BURNER, [inH2O]	N/A	
9	DRAFT AVAILABLE: ACROSS PLENUM, [inH2O]	-	
10	REQUIRED TURNDOWN		
11	BURNER WALL SETTING TICKNESS [m]	By Vendor	
12	HEATER CASING THICKNESS [m]	0.005	
13	FIREBOX HEIGHT (LINING INSIDE) [m]	6.6	
14	TUBE CIRCLE DIAMETER [m]	N/A	
	BURNER DATA		
15	MANUFACTURER		
16	TYPE OF BURNER	Conventional	
17	MODEL / SIZE		
18	DIRECTION OF FIRING	Vertically-Fired	
19	LOCATION (ROOF/ FLOOR/ SIDEWALL)	Sidewall (Single Level)	
20	NUMBER REQUIRED	12	
21	MINIMUM DISTANCE BURNER CENTERLINE [m]		
22	TO TUBE CENTERLINE (HORIZONTAL)		
23	TO ADJACENT BURNER CENTERLINE (HORIZONTAL)		
24	TO UNSHIELDED REFRACTORY (HORIZONTAL)		
25	BURNER CIRCLE DIAMETER [m]	N/A	
26	PILOTS:		
27	NUMBER REQUIRED	One per Burner (1)	
28	TYPE	Self-inspirating (2)	
29	IGNITION METHOD	Electrical Portable (2)	
30	FUEL	Fuel Gas (1)	
31	FUEL PRESSURE [bar]	1.195 - 1.684 (2)	
32	CAPACITY [W]	21980.3 (1)	
	OPERATING DATA		
33	FUEL	Combination of F.Oil & F.Gas	
34	HEAT RELEASE PER BURNER [kW]		
35	DESIGN	1054.581 (1)	
36	NORMAL	956.71	
37	MINIMUM		
38	EXCESS AIR @ DESIGN HEAT RELEASE, %	0.2	
39	AIR TEMPERATURE [C]	25	
40	DRAFT (AIR PRESSURE) LOSS [inH2O]		
41	DESIGN		
42	NORMAL	N/A	
43	MINIMUM		
44	FUEL PRESSURE REQUIRED @ BURNER [bar]	N/A	
45	FLAME LENGTH @ DESIGN HEAT RELEASE [m]	1.994	
46	FLAME SHAPE (ROUND, FLAT, ETC.)	Flat	
47	ATOMIZING MEDIUM/OIL RATIO [kg/kg]	0.3	
NOTES:			
48	*(1) AS PER API STD 535 FOR DESIGN CASE*		
49	*(2) SUGGESTED BY FHinfinity(C)*		

BURNER DATA SHEET (API STD - 560)

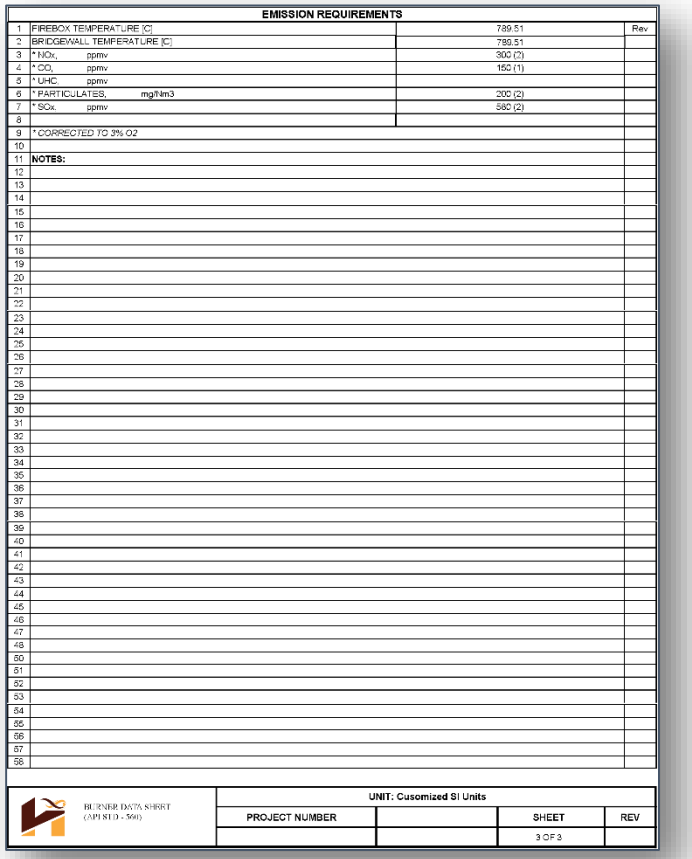
UNIT: Cusomized SI Units			
PROJECT NUMBER		SHEET	REV
		1 OF 3	



	GAS FUEL CHARACTERISTICS		
1	FUEL TYPE	Fuel Gas	Rev
2	HEATING VALUE (LHV) [kJ/kg]	42682.3	
3	SPECIFIC GRAVITY (AIR=1)	0.65	
4	MOLECULAR WEIGHT	18.7	
5	FUEL TEMPERATURE @ BURNER [C]	25	
6	FUEL PRESSURE @ BURNER [bar]	N/A	
7	FUEL GAS COMPOSITION, MOLE %		
8	Hydrogen	10	
9	Nitrogen	5	
10	Carbon Dioxide	5	
11	Methane	65	
12	Ethane	15	
13			
14			
15	TOTAL	100	
	LIQUID FUEL CHARACTERISTICS		
16	FUEL TYPE	Fuel Oil	
17	HEATING VALUE (LHV) [kJ/kg]	42001.4	
18	SPECIFIC GRAVITY DEGREE API	0.922 (@ 15 C)	
19	H/C RATIO (BY WEIGHT)	0.1344	
20	VISCOSITY @ [C] (SSU)		
21	VISCOSITY @ [C] (SSU)		
22	VANADIUM, ppm		
23	SODIUM, ppm		
24	POTASSIUM, ppm		
25	NICKEL, ppm		
26	NITROGEN, wt%		
27	SULFUR, wt%	0.35	
28	ASH, wt%	0.05	
29	LIQUIDS ASTM INITIAL BOILING POINT [C]		
30	ASTM END BOILING POINT [C]		
31	FUEL TEMPERATURE @ BURNER [C]	110	
32	FUEL PRESSURE @ BURNER [bar]	N/A	
33	ATOMIZING MEDIUM: AIR/STEAM/MECHANICAL	Steam	
34	TEMPERATURE [C]	150	
35	PRESSURE [bar]	5	
	MISCELLANEOUS		
36	BURNER PLENUM COMMON/INTEGRAL		
37	MATERIAL		
38	PLATE TICKNESS [cm]		
39	INTERNAL INSULATION		
40	INLET AIR CONTROL DAMPER OR REGISTERS		
41	MODE OF OPERATION		
42	LEAKAGE, %		
43	BURNER TILE: COMPOSITION		
44	MINIMUM SERVICE TEMPERATURE [C]		
45	NOISE SPECIFICATION		
46	ATTENUATION METHOD		
47	PAINTING REQUIREMENTS		
48	IGNITION PORT: SIZE/NO		
49	SIGHT PORT: SIZE/NO		
50	FLAME DETECTION: TYPE		
51	NUMBER/ LOCATION		
52	CONNECTION SIZE		
53	SAFETY INTERLOCK SYSTEM FOR ATOMIZING MEDIUM & OIL		
54	PERFORMANCE TEST REQUIRED (YES or NO)		
55			

BURNER DATA SHEET (API STD - 560)

UNIT: Cusomized SI Units			
PROJECT NUMBER		SHEET	REV
		2 OF 3	



	EMISSION REQUIREMENTS		
1	FIREBOX TEMPERATURE [C]	789.51	Rev
2	BRIDGEWALL TEMPERATURE [C]	789.51	
3	* NOx, ppmv	300 (2)	
4	* CO, ppmv	150 (1)	
5	* UHC, ppmv		
6	* PARTICULATES, mg/Nm3	200 (2)	
7	* SOx, ppmv	580 (2)	
8			
9	** CORRECTED TO 3% O2*		
10			
11	**NOTES:**		

BURNER DATA SHEET (API STD - 560)

UNIT: Cusomized SI Units			
PROJECT NUMBER		SHEET	REV
		3 OF 3	

ID Fan Datasheet

FAN DATASHEET

PURCHASER / OWNER:				**ITEM NO.:**					
SERVICE:				**LOCATION:**					
1	FAN MANUFACTURER:		MODEL/SIZE		ARRANGEMENT:				Rev
2	SERVICE:	Induced Draft Fan	NUMBER REQUIRED:						
3	DRIVE SYSTEM:	Electric Motor	FAN ROTATION FROM DRIVEN END:		CW		CCW		
3	GAS HANDLED:	Flue Gas	RELATIVR MOLECULAR MASS:		28.32				
5	SITE ELEVATION [ft]	0.328	FAN LOCATION:		Look I.D.Z. Duct Layout				

OPERATING CONDITION

1	**OPERATING CASE:**	**AS SIMULATED**	Rev
2	CAPACITY [lb/hr]	64232.6	
3	VOLUME FLOW RATE [SCFH]	860654	
4	Actual VOLUME FLOW RATE [ft3/hr]	3113350.1	
5	DENSITY [lb/ft3] (Operating)	0.021	
6	OPERATING TEMPERATURE [F]	1420.32	
7	RELATIVE HUMIDITY [%]	0	
8	STATIC PRESSURE AT INLET [inH2O]	4822.4268	
9	STATIC PRESSURE AT OUTLET [inH2O]	4842.4268	
10	**PERFORMANCE:**		
11	ABSORBED POWER [MMBtu/hr] (All Lossed Included)	0.5277 (1)	
12	FAN ROTATIONAL SPEED [rpm]	244.3	
13	STATIC PRESSURE RISE ACROSS FAN [inH2O]	20	
14	INLET DAMPER/ VANE POSITION		
15	DISCHARGE DAMPER POSITION		
16	FAN STATIC EFFICIECNY [%]	75	
17	STEAM RATE (TURBINE ONLY) [kg/Kw*h]		

18	**FAN CONTROL:**				**DRIVE:**							
19	AIR SUPPLY:				MAKE		TYPE:					
20	FAN CONTROL/ FURNISHED BY:				RATED kw		r/min					
21	METHOD:		INLET DAMPER		OUTLET DAMPER	ELECTRICAL AREA CLASSIFCATION:						
22			INLET GUIDE VANES:		VARIABLE SPEED:	CLASS		GROUP		DIVISION		
23	STARTING METHOD					POWER		VOLTS		ph		Hz

NOTES:

24	*(1) Effect of Summer and Winter Temperature is Ignored. Drivre Load Factor is Assumed to be 1.05.*
25	

FAN DATA SHEET (API STD - 560) (Short Version)	**UNIT: US Units**			
	PROJECT NUMBER		**SHEET**	**REV**
			1 OF 1	

FD Fan Datasheet

FAN DATASHEET

PURCHASER / OWNER:			**ITEM NO.:**			
SERVICE:			**LOCATION:**			
1	FAN MANUFACTURER:		MODEL/SIZE		ARRANGEMENT:	Rev
2	SERVICE:	Forced Draft Fan	NUMBER REQUIRED:			
3	DRIVE SYSTEM:	Electric Motor	FAN ROTATION FROM DRIVEN END:	CW	CCW	
3	GAS HANDLED:	Air	RELATIVR MOLECULAR MASS:	28.96		
5	SITE ELEVATION [ft]	0.328	FAN LOCATION:	Look F.D.Z. Duct Layout		

OPERATING CONDITION

1	**OPERATING CASE:**	**AS SIMULATED**	Rev
2	CAPACITY [lb/hr]	18464.4	
3	VOLUME FLOW RATE [SCFH]	241927.5	
4	Actual VOLUME FLOW RATE [ft3/hr]	276739.6	
5	DENSITY [lb/ft3] (Operating)	0.067	
6	OPERATING TEMPERATURE [F]	60	
7	RELATIVE HUMIDITY [%]	0	
8	STATIC PRESSURE AT INLET [inH2O]	355.5172	
9	STATIC PRESSURE AT OUTLET [inH2O]	473.1063	
10	**PERFORMANCE:**		
11	ABSORBED POWER [MMBtu/hr] (All Lossed Included)	0.325 (1)	
12	FAN ROTATIONAL SPEED [rpm]	600	
13	STATIC PRESSURE RISE ACROSS FAN [inH2O]	117.5891	
14	INLET DAMPER/ VANE POSITION		
15	DISCHARGE DAMPER POSITION		
16	FAN STATIC EFFICIECNY [%]	70	
17	STEAM RATE (TURBINE ONLY) [kg/Kw*h]		

18	**FAN CONTROL:**				**DRIVE:**							
19	AIR SUPPLY:				MAKE		TYPE:					
20	FAN CONTROL/ FURNISHED BY:				RATED kw		r/min					
21	METHOD:		INLET DAMPER	OUTLET DAMPER	ELECTRICAL AREA CLASSIFCATION:							
22			INLET GUIDE VANES:	VARIABLE SPEED:	CLASS		GROUP		DIVISION			
23	STARTING METHOD				POWER		VOLTS		ph		Hz	

NOTES:

24	*(1) Effect of Summer and Winter Temperature is Ignored. Drivre Load Factor is Assumed to be 1.05.*
25	

FAN DATA SHEET (API STD - 560) (Short Version)	**UNIT: US Units**			
	PROJECT NUMBER		**SHEET**	**REV**
			1 OF 1	

APH Datasheet

AIR PREHEATER DATASHEET

PURCHASER / OWNER: **ITEM NO.:**
SERVICE: **LOCATION:**

			Rev
1	MANUFACTURER:		
2	MODEL:		
3	NUMBER REQUIRED:		
4	RADIATION LOSS [Percent]	2	
5	NOMINAL AIR PREHEATER LMTD [F]	1142.28	
6	NOMINAL AIR PREHEATER UA VALUE [MMBtu/hr/F]	0.0028	
	PERFORMANCE DATA		
8	OPERATING CASE:	**AS SIMULATED**	
9	AIR SIDE: FLOW RATE ENTERING [lb/hr]	52623.6	
10	INLET TEMPERATURE [F]	60	
11	OUTLET TEMPERATURE [F]	312.39	
12	PRESSURE DROP: ALLOWABLE, [inH2O]	By Vendor	
13	PRESSURE DROP: CALCULATED, [inH2O]	10	
14	HEAT ABSOREBED, [MMBtu/hr]	3.2062	
15	FLUE GAS SIDE: FLOW RATE ENTERING [lb/hr]	57809.4	
16	INLET TEMPERATURE [F]	1420.32	
17	OUTLET TEMPERATURE [F]	1237.34	
18	PRESSURE DROP: ALLOWABLE, [inH2O]	By Vendor	
19	PRESSURE DROP: CALCULATED, [inH2O]	20	
20	HEAT EXCHANGED, [MMBtu/hr]	3.2716	
21	AIR BYPASS RATE [lb/hr]	2769.7	
22	TOTAL AIR FLOW RATE TO BURNERS [lb/hr]	55393.3	
23	MIX AIR TEMPERATURE [F]	300	
24	TOTAL FLUE GAS FLOW RATE TO STACK / ID FAN [lb/hr]	64232.6	
25	MIX FLUE GAS TEMPERATURE [F]	1255.88	
26	FLUE GAS COMPOSITION, Mole Fraction, (O2/N2/H2O/CO2/SOx) [Percent]	2.5399 / 72.3384 / 14.5166 / 9.6777 / 0	
27	FLUE GAS SPECIFIC HEAT [Btu/lb.F]	0.3031	
28	FLUE GAS ACID DEW POINT TEMPERATURE [F]	N/A	
29	MINIMUM METAL TEMPERATURE: ALLOWABLE [F]	N/A (1)	
30	MINIMUM METAL TEMPERATURE: CALCULATED [F]	N/A (1)	
	MISCELLANEOUS:		
32	MINIMUM AMBIENT AIR TEMPERATURE [F]	60	
33	SITE ELEVATION ABOVE SEA LEVEL [ft]	0.328	
34	RELATIVE HUMIDITY [Percent]	0	
35	EXTERNAL COLD-AIR BYPASS (YES/NO)	By Vendor	
36	COLD-END THERMOCOUPLES (YES/NO): NUMBER REQUIRED	By Vendor	
37	ACCESS DOORS: NUMBER / SIZE / LOCATION	By Vendor	
38	INSULATION (INTERNAL / EXTERNAL)	By Vendor	
39	CLEANING MEDIUM: STEAM OR WATER	By Vendor	
40	PRESSURE, [Psia]		
41	TEMPERATURE, [F]		

AIR-PREHEATER DATA SHEET

UNIT: US Units			
PROJECT NUMBER		SHEET	REV

AIR PREHEATER DATASHEET

PURCHASER / OWNER: **ITEM NO.:**
SERVICE: **LOCATION:**

MECHANICAL DESIGN:

43	DESIGN FLUE GAS TEMPERATURE [F]		
44	DESIGN PRESSURE DIFFERENTIAL [Psia]		
45	SEISMIC FACTOR		
46	PAINTING REQUIREMENTS		
47	LEAK TEST		
48	STRUCTURE WIND LOAD [kg/m2]		
49	AIR LEAKAGE (GUARANTEED MAXIMUM), %		
50			
51			
52	**NOTE:**		
53	*(1) AS PER API STD 560, TEMPERATURE ALLOWANCE = 14 C (25 F)*		
54			

AIR-PREHEATER DATA SHEET

UNIT: US Units			
PROJECT NUMBER		SHEET	REV

FHinfinity© Reports

Type of Reports

- ***Process Side Hydraulic***
- ***Heater Draft***
- ***Heater Geometry***
- ***Combustion Report***
- ***Heat Balance***
- ***Heater Transfer Data***
- ***Tube Temperature***
- ***Duct Elements***
- ***Summary & Miscellaneous***
- ***Reaction Report***

Process Side Hydraulic Report

PROCESS SIDE HYDRAULIC REPORT
FHinfinity 2018

Date 07/03/2025
Time 3:28:52 PM
Unit US Units

PROCESS HYDRAULIC DATA

** For convection section, row numbering is upward. For firebox and in case of horizontal / helical tubes, numbering is upward.*

*** Sonic Velocity for single-phase Gas flows and Critical Velocity for Two-Phase flows.*

Stream and Path

Stream Name	1
Selected Path	1

Pressure Drop Data and Method

Two Phase Pressure Drop Model	N/A
Pressure Drop Multiplier (Process Side)	1
Bend Pressure Drop Method (Process Side)	User Defined
Static Pressure Drop in Vertical Tubes	Not Included

Hydraulic Details

Section	Row / Tube *	Distance from Inlet [ft]	Temperature [F]	Pressure [Psia]	DP/DL [Psi/ft]	Mass Vapor Quality [Percent]	Linear Velocity [ft/s]	Mass Velocity [lb/s.ft2]	Residence Time [s]	Flow Regime [-]	Heat Transfer Region [-]	Sonic / Critical Velocity [ft/s]
Radiant	1	39.571	239.38	143.607	3.52E-02	100	86.83	69.23	0.46	Gas	Convective (API Method)	940.47
Radiant	2	79.142	266.05	142.13	3.73E-02	100	91.94	69.23	0.43	Gas	Convective (API Method)	961.79
Radiant	3	118.712	292.07	140.566	3.95E-02	100	97.15	69.23	0.41	Gas	Convective (API Method)	982.37

PROCESS SIDE HYDRAULIC REPORT
FHinfinity 2018

Date 07/03/2025
Time 3:28:52 PM
Unit US Units

Section	Row / Tube *	Distance from Inlet [ft]	Temperature [F]	Pressure [Psia]	DP/DL [Psi/ft]	Mass Vapor Quality [Percent]	Linear Velocity [ft/s]	Mass Velocity [lb/s.ft2]	Residence Time [s]	Flow Regime [-]	Heat Transfer Region [-]	Sonic / Critical Velocity [ft/s]
Radiant	4	158.283	316.98	138.914	4.18E-02	100	102.48	69.23	0.39	Gas	Convective (API Method)	1000.61
Radiant	5	197.854	341.39	137.176	4.39E-02	100	107.59	69.23	0.37	Gas	Convective (API Method)	1018.6
Radiant	6	237.425	365.1	135.351	4.61E-02	100	112.91	69.23	0.35	Gas	Convective (API Method)	1035.59
Radiant	7	276.996	388.07	133.436	4.84E-02	100	118.28	69.23	0.33	Gas	Convective (API Method)	1051.53
Radiant	8	316.566	410.65	131.43	5.07E-02	100	123.7	69.23	0.32	Gas	Convective (API Method)	1067.3
Radiant	9	356.137	432.37	129.331	5.31E-02	100	129.38	69.23	0.31	Gas	Convective (API Method)	1081.62
Radiant	10	395.708	453.83	127.137	5.54E-02	100	135.03	69.23	0.29	Gas	Convective (API Method)	1096.09
Radiant	11	435.279	474.51	124.843	5.80E-02	100	141.06	69.23	0.28	Gas	Convective (API Method)	1109.29
Radiant	12	474.85	494.94	122.448	6.05E-02	100	147.13	69.23	0.27	Gas	Convective (API Method)	1122.61
Radiant	13	514.42	514.69	119.946	6.33E-02	100	153.64	69.23	0.26	Gas	Convective (API Method)	1134.89
Radiant	14	553.991	534.23	117.332	6.88E-02	100	160.29	69.23	0.24	Gas	Convective (API Method)	1147.29

Heater Draft Report

HEATER DRAFT REPORT
FHinfinity 2018

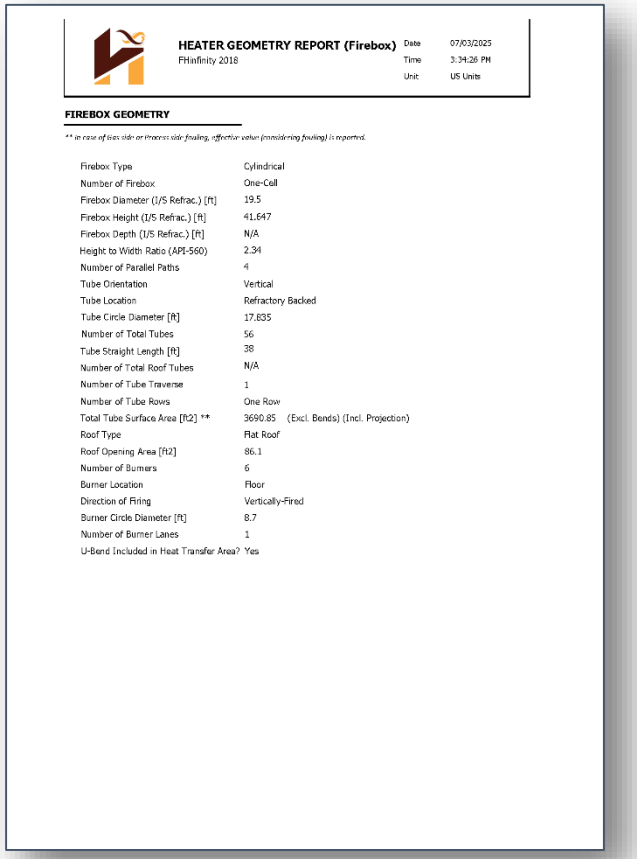
Date 07/03/2025
Time 3:31:24 PM
Unit US Units

FLUE GAS SPECIFICATION AND DRAFT DATA

Cross Flow Friction Factor Calculation Method	N/A
Ambient Temperature for Draft Calculation [F]	120
Barometric Pressure at Grade [Psia]	14.696
Ambient Heat Transfer Coefficient [Btu/hr.ft2.F]	4.12
Flue Gas Mass Flow Rate in Stack [lb/hr]	64232.6
Flue Gas Mass Velocity at Stack Outlet [lb/s.ft2]	0.91
Flue Gas Velocity at Stack Inlet [ft/s]	35.68
Flue Gas Velocity at Stack Outlet [ft/s]	34.99
Temperature Loss in Stack [F]	29.63
Stack Outer Wall Temperature [F]	249.62

Point	Elev. From Grade [ft]	Flue Gas Temperature [F]	Flue Gas Density [lb/ft3]	Flue Gas Viscosity [cP]	Flue Gas Velocity [ft/s]	Hydrostatic Pressure [inH2O]	Draft [inH2O]
End of Stack	100	1033.71	0.026	0.0363	34.99	405.4772	0
Stack-Above Damper	60.1	1058.95	0.026	0.0368	35.58	405.7828	-0.2208
Stack-Below Damper	60	1058.95	0.026	0.0368	35.58	405.7833	-0.2216
Start of Stack	53.5	1063.34	0.025	0.0368	35.68	4841.0406	4434.9503
Firebox Roof	53.049	1600	0.019	0.0456	10	4841.0425	4434.9463
Burner Level	10.442	3648.92	0.009	0.0735	5.75	4841.1583	4434.5019

Heater Geometry Report



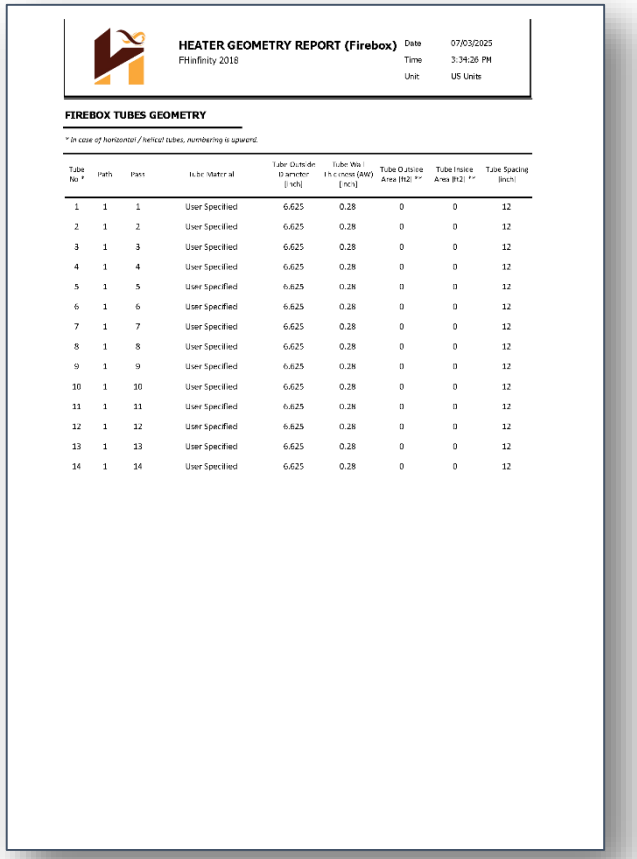
HEATER GEOMETRY REPORT (Firebox)
FHinfinity 2018

Date 07/03/2025
Time 3:34:26 PM
Unit US Units

FIREBOX GEOMETRY

*** In case of gas side or process side fouling, effective value (considering fouling) is reported.*

Firebox Type	Cylindrical
Number of Firebox	One-Cell
Firebox Diameter (I/S Refrac.) [ft]	19.5
Firebox Height (I/S Refrac.) [ft]	41.647
Firebox Depth (I/S Refrac.) [ft]	N/A
Height to Width Ratio (API-560)	2.34
Number of Parallel Paths	4
Tube Orientation	Vertical
Tube Location	Refractory Backed
Tube Circle Diameter [ft]	17.835
Number of Total Tubes	56
Tube Straight Length [ft]	38
Number of Total Roof Tubes	N/A
Number of Tube Traverse	1
Number of Tube Rows	One Row
Total Tube Surface Area [ft2] **	3690.85 (Excl. Bends) (Incl. Projection)
Roof Type	Flat Roof
Roof Opening Area [ft2]	86.1
Number of Burners	6
Burner Location	Floor
Direction of Firing	Vertically-Fired
Burner Circle Diameter [ft]	8.7
Number of Burner Lanes	1
U-Bend Included in Heat Transfer Area?	Yes



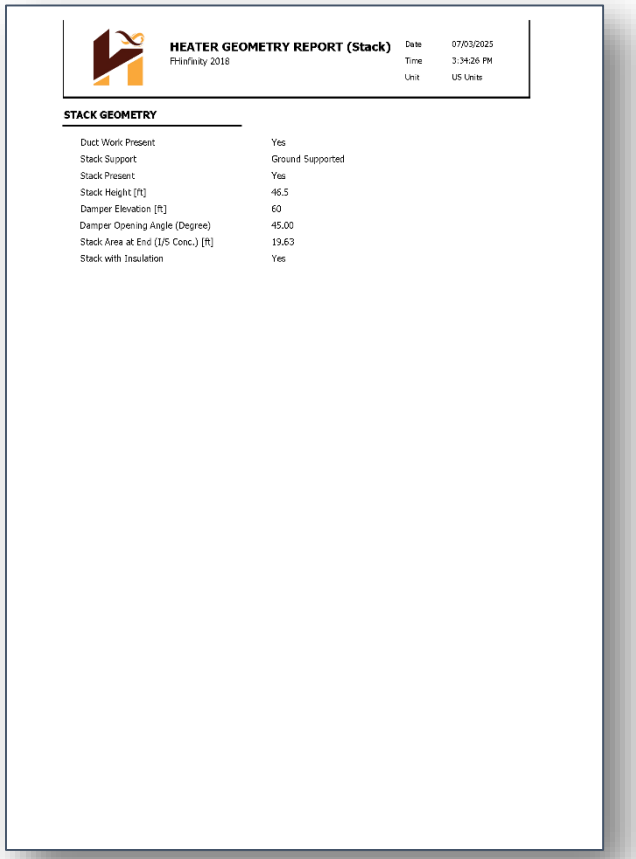
HEATER GEOMETRY REPORT (Firebox)
FHinfinity 2018

Date 07/03/2025
Time 3:34:26 PM
Unit US Units

FIREBOX TUBES GEOMETRY

** In case of horizontal / helical tubes, numbering is upward.*

Tube No.*	Path	Pass	Tube Material	Tube Outside Diameter [inch]	Tube Wall Thickness (AW) [inch]	Tube Outside Area [ft2] **	Tube Inside Area [ft2] **	Tube Spacing [inch]
1	1	1	User Specified	6.625	0.28	0	0	12
2	1	2	User Specified	6.625	0.28	0	0	12
3	1	3	User Specified	6.625	0.28	0	0	12
4	1	4	User Specified	6.625	0.28	0	0	12
5	1	5	User Specified	6.625	0.28	0	0	12
6	1	6	User Specified	6.625	0.28	0	0	12
7	1	7	User Specified	6.625	0.28	0	0	12
8	1	8	User Specified	6.625	0.28	0	0	12
9	1	9	User Specified	6.625	0.28	0	0	12
10	1	10	User Specified	6.625	0.28	0	0	12
11	1	11	User Specified	6.625	0.28	0	0	12
12	1	12	User Specified	6.625	0.28	0	0	12
13	1	13	User Specified	6.625	0.28	0	0	12
14	1	14	User Specified	6.625	0.28	0	0	12



HEATER GEOMETRY REPORT (Stack)
FHinfinity 2018

Date 07/03/2025
Time 3:34:26 PM
Unit US Units

STACK GEOMETRY

Duct Work Present	Yes
Stack Support	Ground Supported
Stack Present	Yes
Stack Height [ft]	46.5
Damper Elevation [ft]	60
Damper Opening Angle (Degree)	45.00
Stack Area at End (I/S Conc.) [ft]	19.63
Stack with Insulation	Yes

Combustion Report

COMBUSTION REPORT
FHinfinity 2018

Date 07/03/2025
Time 3:41:55 PM
Unit US Units

BURNER INLET STREAMS DATA	VALUE
Fuel Type	Fuel Gas
Oxidant Type	Preheated Air
Fuel LHV [Btu/lb]	20432
Fuel HHV [Btu/lb]	22337.3
Fuel Temperature [F]	60
Fuel Mass Flow Rate (Heater) [lb/hr]	3000
Fuel Gas Vol. Flow Rate (Heater) [SCFH]	37861.7
Fuel Specific Gravity [@ 60 F / 15 C]	1.043
Atomising Steam Flow Rate [lb/hr]	0
Steam Temperature & Pressure [F / Psia]	N/A

FUEL COMPOSITION (ULTIMATE ANALYSIS)		
Total Carbon	[Wt.%]	79.8869
Total Hydrogen	[Wt.%]	20.1131
Total Oxygen	[Wt.%]	0
Total Nitrogen	[Wt.%]	0
Total Sulfur	[Wt.%]	0
Total Ash	[Wt.%]	0
Moisture	[Wt.%]	0

COMBUSTION AIR PROPERTIES	
Total Air Flow Rate (Heater) [lb/hr]	55393.3
Air Temperature [F]	300
Excess Air Amount [Percent]	15
Relative Humidity [Percent]	0

AIR COMPOSITION (Vol. Basis)		[Wet]	[Dry]
Total Nitrogen	[Vol.%]	78	78
Total Oxygen	[Vol.%]	21	21
Total Carbon Dioxide	[Vol.%]	0	0
Total Water	[Vol.%]	0	0
Total Argon	[Vol.%]	1	1

COMBUSTION REPORT
FHinfinity 2018

Date 07/03/2025
Time 3:41:55 PM
Unit US Units

FLUE GAS CHARACTERISTICS			
Mass Basis		**[Wet]**	**[Dry]**
Carbon Dioxide	[Wt.%]	15.0382	16.5681
Water	[Wt.%]	9.2338	0
Sulfur Dioxide	[Wt.%]	0	0
Excess Oxygen	[Wt.%]	2.8696	3.1615
Nitrogen	[Wt.%]	71.5503	78.8292
Argon	[Wt.%]	1.3081	1.4412
Ash	[Wt.%]	0	0
Total	[Wt.%]	100	100
Mole (Vol.) Basis		**[Wet]**	**[Dry]**
Carbon Dioxide	[Vol.%]	9.6777	11.3211
Water	[Vol.%]	14.5166	0
Sulfur Dioxide	[Vol.%]	0	0
Excess Oxygen	[Vol.%]	2.5399	2.9712
Nitrogen	[Vol.%]	72.3384	84.6228
Argon	[Vol.%]	0.9274	1.0849
Total	[Vol.%]	100	100

Flue Gas Formed / Consumed Fuel [lb/lb]	19.5
Flue Gas Molecular Weight [lb/lbmol]	28.3
Flue Gas Mass Flow Rate [lb/hr]	58393.3
Flue Gas Volumetric Flow Rate (77 F, 14.695 psia) [ft3/hr]	807954.6
Flue Gas Temperature at Bridgewall [F]	1600
Flue Gas Tempearature at Firebox [F]	1600
Hottel Bridgewall Parameter [-]	0.05

HEAT RELEASE & FLAME PROPOERTIES	
Total Heat Release [MMBtu/hr]	61.296
Heat Release per Burner [MMBtu/hr]	10.216
Adiabatic Flame Temperature [F]	3653.92
Flame Length (Individual Burner) [ft]	0
Average Flame Emissivity [-]	0.394

Heat Balance Report

HEAT BALANCE REPORT (Overall)

FHinfinity 2018

Date 07/03/2025
Time 3:43:35 PM
Unit US Units

HEATER OVERALL HEAT BALANCE

Total Heat Released (Net) [MMBtu/hr]	61.296
Total Heat Released (Gross) [MMBtu/hr]	67.012
Total Heat Input to Heater [MMBtu/hr]	64.5037
Total Heat Absorbed [MMBtu/hr]	37.7327
Total Heat Loss [MMBtu/hr]	26.7911
Total Heat Balance Error [MMBtu/hr]	-0.0201
Heater Efficiency (Fuel) [Percent]	61.5582
Heater Efficiency (Thermal) [Percent]	58.497

FIREBOX HEAT BALANCE

Air Sensible Heat [MMBtu/hr]	3.2077
Fuel Sensible Heat [MMBtu/hr]	0
Atomizing Steam Sensible Heat [MMBtu/hr]	0
Fuel Fired (LHV) [MMBtu/hr]	61.296
Heat Loss Due to Wall Losses [MMBtu/hr]	1.2259
Heat Loss Due to Flue Gas Exit [MMBtu/hr]	25.5652
Heat Absorbed By Tubes [MMBtu/hr]	37.7327
Firebox Efficiency [Percent]	61.5582

CONVECTION SECTION HEAT BALANCE

Heat Input (Convective) [MMBtu/hr]	
Firebox Radiation Leakage [MMBtu/hr]	
Heat Loss Due to Wall Losses [MMBtu/hr]	
Heat Loss Due to Flue Gas Exit [MMBtu/hr]	
Heat Absorbed By Tubes [MMBtu/hr]	
Convection Section Efficiency [Percent]	

STACK HEAT BALANCE

Heat Input [MMBtu/hr]	25.5652
Heat Loss Due to Wall Losses [MMBtu/hr]	9.9596
Heat Loss Due to Flue Gas Exit [MMBtu/hr]	15.6055

STEAM INJECTION HEAT *(Calculated respect to injection point condition.)*

Heat Input By Injection Steam [MMBtu/hr]	0

HEAT BALANCE REPORT (Firebox)

FHinfinity 2018

Date 07/03/2025
Time 3:43:35 PM
Unit US Units

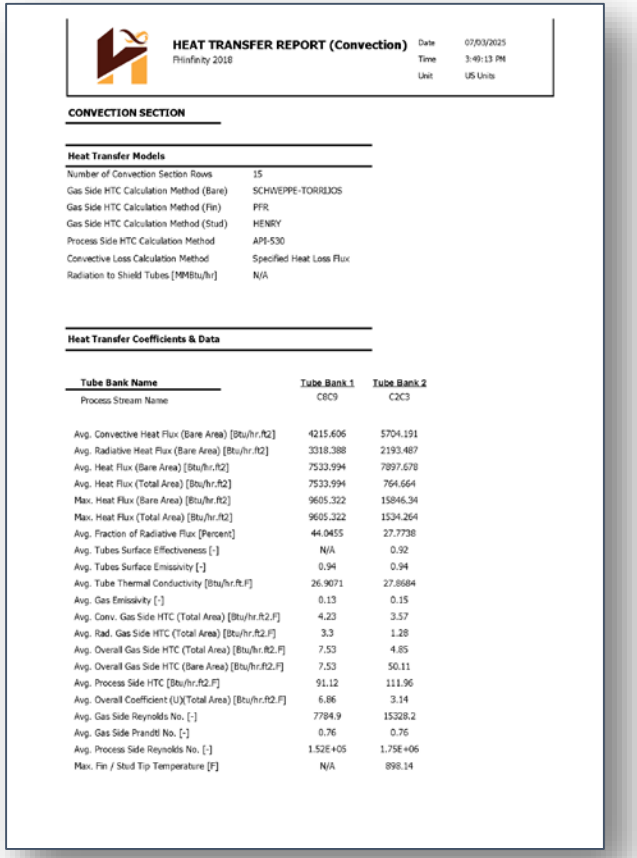
FIREBOX DETAILED HEAT BALANCE

Note) Data is shown for ONE firebox if two are present.

** Zone numbering is upward.*

Zone No *	Heat Input [MMBtu/hr]	Heat Released [MMBtu/hr]	Heat Absorb [MMBtu/hr]	Heat Loss Due to Wall Losses [MMBtu/hr]	Heat Loss Due to Flue Gas Exit [MMBtu/hr]
1	64.5037	61.296	37.7327	1.2259	25.5652

Heat Transfer Data Report



HEAT TRANSFER REPORT (Convection)
FHinfinity 2018

Date 07/03/2025
Time 3:49:13 PM
Unit US Units

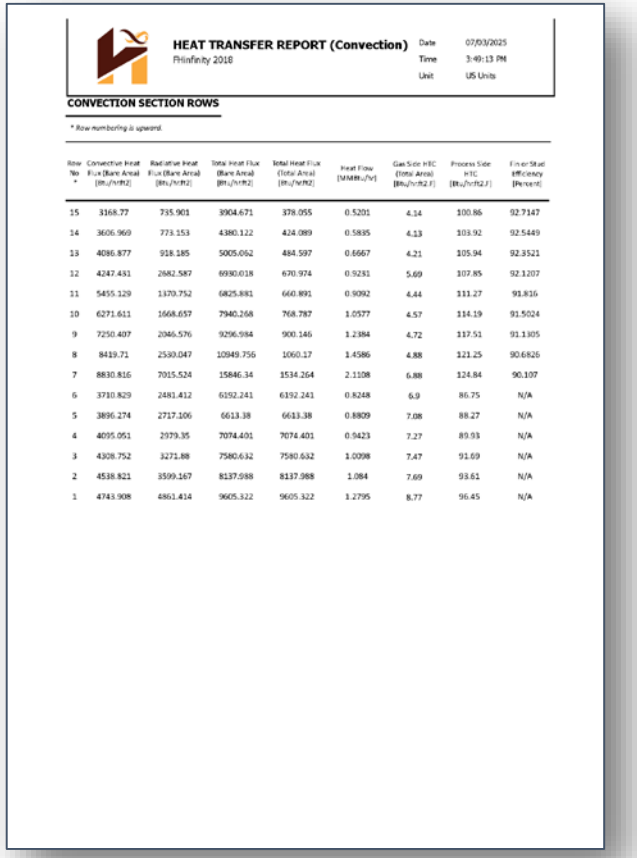
CONVECTION SECTION

Heat Transfer Models

Number of Convection Section Rows	15
Gas Side HTC Calculation Method (Bare)	SCHWEPPE-TORRIJOS
Gas Side HTC Calculation Method (Fin)	PFR
Gas Side HTC Calculation Method (Stud)	HENRY
Process Side HTC Calculation Method	API-530
Convective Loss Calculation Method	Specified Heat Loss Flux
Radiation to Shield Tubes [MMBtu/hr]	N/A

Heat Transfer Coefficients & Data

Tube Bank Name	Tube Bank 1	Tube Bank 2
Process Stream Name	C8C9	C2C3
Avg. Convective Heat Flux (Bare Area) [Btu/hr.ft2]	4215.606	5704.191
Avg. Radiative Heat Flux (Bare Area) [Btu/hr.ft2]	3318.388	2193.487
Avg. Heat Flux (Bare Area) [Btu/hr.ft2]	7533.994	7897.678
Avg. Heat Flux (Total Area) [Btu/hr.ft2]	7533.994	764.664
Max. Heat Flux (Bare Area) [Btu/hr.ft2]	9605.322	15846.34
Max. Heat Flux (Total Area) [Btu/hr.ft2]	9605.322	1534.264
Avg. Fraction of Radiative Flux [Percent]	44.0455	27.7738
Avg. Tubes Surface Effectiveness [-]	N/A	0.92
Avg. Tubes Surface Emissivity [-]	0.94	0.94
Avg. Tube Thermal Conductivity [Btu/hr.ft.F]	26.9071	27.8684
Avg. Gas Emissivity [-]	0.13	0.15
Avg. Conv. Gas Side HTC (Total Area) [Btu/hr.ft2.F]	4.23	3.57
Avg. Rad. Gas Side HTC (Total Area) [Btu/hr.ft2.F]	3.3	1.28
Avg. Overall Gas Side HTC (Total Area) [Btu/hr.ft2.F]	7.53	4.85
Avg. Overall Gas Side HTC (Bare Area) [Btu/hr.ft2.F]	7.53	50.11
Avg. Process Side HTC [Btu/hr.ft2.F]	91.12	111.96
Avg. Overall Coefficient (U)(Total Area) [Btu/hr.ft2.F]	6.86	3.14
Avg. Gas Side Reynolds No. [-]	7784.9	15328.2
Avg. Gas Side Prandtl No. [-]	0.76	0.76
Avg. Process Side Reynolds No. [-]	1.52E+05	1.75E+06
Max. Fin / Stud Tip Temperature [F]	N/A	898.14



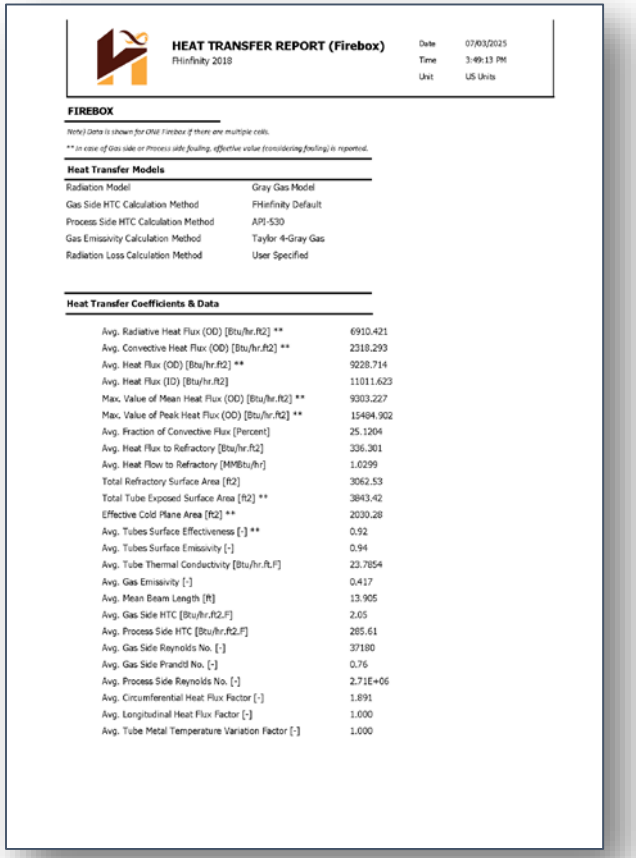
HEAT TRANSFER REPORT (Convection)
FHinfinity 2018

Date 07/03/2025
Time 3:49:13 PM
Unit US Units

CONVECTION SECTION ROWS

* Row numbering is upward.

Row No *	Convective Heat Flux (Bare Area) [Btu/hr.ft2]	Radiative Heat Flux (Bare Area) [Btu/hr.ft2]	Total Heat Flux (Bare Area) [Btu/hr.ft2]	Total Heat Flux (Total Area) [Btu/hr.ft2]	Heat Flow [MMBtu/hr]	Gas Side HTC (Total Area) [Btu/hr.ft2.F]	Process Side HTC [Btu/hr.ft2.F]	Fin or Stud efficiency [Percent]
15	3168.77	735.901	3904.671	378.055	0.5201	4.14	100.86	92.7147
14	3606.969	773.153	4380.122	424.089	0.5835	4.13	103.92	92.5449
13	4086.877	918.185	5005.062	484.597	0.6667	4.21	105.94	92.3521
12	4247.431	2682.587	6930.018	670.974	0.9231	5.69	107.85	92.1207
11	5455.129	1370.752	6825.881	660.891	0.9092	4.44	111.27	91.816
10	6271.611	1668.657	7940.268	768.787	1.0577	4.57	114.19	91.5024
9	7250.407	2046.576	9296.984	900.146	1.2384	4.72	117.51	91.1305
8	8419.71	2530.047	10949.756	1060.17	1.4586	4.88	121.25	90.6826
7	8830.816	7015.524	15846.34	1534.264	2.1108	6.88	124.84	90.107
6	3710.829	2481.412	6192.241	6192.241	0.8248	6.9	86.75	N/A
5	3896.274	2717.106	6613.38	6613.38	0.8809	7.08	88.27	N/A
4	4095.051	2979.35	7074.401	7074.401	0.9423	7.27	89.93	N/A
3	4308.752	3271.88	7580.632	7580.632	1.0098	7.47	91.69	N/A
2	4538.821	3599.167	8137.988	8137.988	1.084	7.69	93.61	N/A
1	4743.908	4861.414	9605.322	9605.322	1.2795	8.77	96.45	N/A



HEAT TRANSFER REPORT (Firebox)
FHinfinity 2018

Date 07/03/2025
Time 3:49:13 PM
Unit US Units

FIREBOX

Note) Data is shown for ONE Firebox if there are multiple cells.

*** In case of Gas side or Process side fouling, effective value (considering fouling) is reported.*

Heat Transfer Models

Radiation Model	Gray Gas Model
Gas Side HTC Calculation Method	FHinfinity Default
Process Side HTC Calculation Method	API-530
Gas Emissivity Calculation Method	Taylor 4-Gray Gas
Radiation Loss Calculation Method	User Specified

Heat Transfer Coefficients & Data

Avg. Radiative Heat Flux (OD) [Btu/hr.ft2] **	6910.421
Avg. Convective Heat Flux (OD) [Btu/hr.ft2] **	2318.293
Avg. Heat Flux (OD) [Btu/hr.ft2] **	9228.714
Avg. Heat Flux (ID) [Btu/hr.ft2]	11011.623
Max. Value of Mean Heat Flux (OD) [Btu/hr.ft2] **	9303.227
Max. Value of Peak Heat Flux (OD) [Btu/hr.ft2] **	15484.902
Avg. Fraction of Convective Flux [Percent]	25.1204
Avg. Heat Flux to Refractory [Btu/hr.ft2]	336.301
Avg. Heat Flow to Refractory [MMBtu/hr]	1.0299
Total Refractory Surface Area [ft2]	3062.53
Total Tube Exposed Surface Area [ft2] **	3843.42
Effective Cold Plane Area [ft2] **	2030.28
Avg. Tubes Surface Effectiveness [-] **	0.92
Avg. Tubes Surface Emissivity [-]	0.94
Avg. Tube Thermal Conductivity [Btu/hr.ft.F]	23.7854
Avg. Gas Emissivity [-]	0.417
Avg. Mean Beam Length [ft]	13.905
Avg. Gas Side HTC [Btu/hr.ft2.F]	2.05
Avg. Process Side HTC [Btu/hr.ft2.F]	285.61
Avg. Gas Side Reynolds No. [-]	37180
Avg. Gas Side Prandtl No. [-]	0.76
Avg. Process Side Reynolds No. [-]	2.71E+06
Avg. Circumferential Heat Flux Factor [-]	1.891
Avg. Longitudinal Heat Flux Factor [-]	1.000
Avg. Tube Metal Temperature Variation Factor [-]	1.000

Tube Temperature Report

TUBE TEMPERATURE REPORT (Conv.)
FHinfinity 2018

Date 07/03/2025
Time 3:51:52 PM
Unit SI Units

CONVECTION SECTION TUBES

** Row numbering is upward.*

Stream and Path

Stream Name	H102-02 Feed
Selected Path	1

Temperature Data

Row No *	Path	Distance from Inlet [m]	Process Fluid Temp. [C]	Film Temp. [C]	Tube Mid-Wall Temp. [C]	Tube Outside Wall Temp. [C]	Tube Skin Temp. [C]	Fin / Stud Tip Peak Temp. [C]
15	1	5.852	178.52	183.93	187.47	188.04	188.04	194.49
14	1	11.704	179.18	186.13	190.7	191.44	191.44	199.77
13	1	17.557	180.04	189.01	194.92	195.88	195.88	206.69
12	1	23.409	181.44	195.99	205.61	207.19	207.19	223.82
11	1	29.261	182.74	199	209.78	211.57	211.57	231.42
10	1	35.113	184.28	205.88	220.23	222.64	222.64	249.23
9	1	40.965	186.34	215.56	234.86	238.17	238.17	274.23
8	1	46.818	189.13	228.5	254.92	259.55	259.55	309.48
7	1	52.67	193.75	263.07	309.91	318.37	318.37	404.28
6	1	58.522	194.65	208.71	218.36	220.19	220.19	N/A
5	1	64.374	195.27	211.78	223.18	225.38	225.38	N/A
4	1	70.226	195.7	213.2	225.37	227.74	227.74	N/A
3	1	76.079	196.09	214.06	226.62	229.11	229.11	N/A
2	1	81.931	196.48	215.15	228.31	230.95	230.95	N/A
1	1	87.783	197.01	219.47	235.46	238.7	238.7	N/A

TUBE TEMPERATURE REPORT (Firebox)
FHinfinity 2018

Date 07/03/2025
Time 3:51:52 PM
Unit SI Units

FIREBOX TUBES

** In case of horizontal / helical tubes, numbering is upward.*

Stream and Path

Stream Name	H102-02 Feed
Selected Path	1

Temperature Data

Tube No *	Path	Pass	Distance from Inlet [m]	Process Fluid Temp. [C]	Tube Mid-Wall Temp. (Mean) [C]	Tube Outside Wall Temp. (Mean) [C]	Film Temp. (Peak) [C]	Tube Outside Wall Temp. (Peak) [C]	Tube Skin Temp. (Peak) [C]
1	1	1	99.844	197.94	231.38	234.29	230.26	258.57	258.57
2	1	2	111.905	198.87	232.06	234.97	230.78	259.09	259.09
3	1	3	123.967	199.73	232.69	235.6	231.25	259.56	259.56
4	1	4	136.028	200.57	233.28	236.19	231.69	259.99	259.99
5	1	5	148.089	201.37	233.82	236.74	232.08	260.37	260.37
6	1	6	160.15	202.12	234.34	237.25	232.43	260.72	260.72
7	1	7	172.211	202.99	234.94	237.86	232.88	261.16	261.16
8	1	8	184.272	203.81	235.5	238.41	233.26	261.54	261.54
9	1	9	196.334	204.52	235.96	238.87	233.57	261.84	261.84
10	1	10	208.395	205.1	236.32	239.24	233.8	262.07	262.07
11	1	11	220.456	205.74	236.76	239.67	234.09	262.36	262.36
12	1	12	232.517	206.42	237.21	240.12	234.4	262.67	262.67
13	1	13	244.578	207.08	237.65	240.56	234.7	262.96	262.96
14	1	14	256.161	207.92	238.77	241.73	235.71	264.49	264.49

Duct Report

DUCT ELEMENTS REPORT (Induc. D. Zone)
FHinfinity 2018

Date 07/03/2025
Time 3:45:36 PM
Unit US Units

I.D.Z. DUCT ELEMENT CALCULATION RESULTS

Straight Duct Insulation	External
Total Heat Loss in Duct [MMBtu/hr]	6.99
Total Pressure Loss in Duct [inH2O]	4455.2234
Total Temperature Loss in Duct [F]	536.66

Sec.	Duct Element	Diameter (Equi. Round) [ft]	Linear Velocity [ft/s]	Outlet Temp. [F]	Outlet Pres. [inH2O]	Velocity Pressue [inH2O]	Fitting Loss Coefficient [-]	Pressure Loss [inH2O]
1	Sudden Exit	3.192	107.67	1600	0	0.6525	1	0.6525
2	Rectangular Duct	1.366	551.26	1420.32	0	--	--	14.5317
3	90 D. Rect. Sec. Smooth Radius Elbow	1.366	503.17	1420.32	0	15.6127	0.22	3.4297
4	Flow Multiplier	--	--	1420.32	0	--	--	0
5	Induced Draft Fan	--	--	1420.32	0	--	--	-20
6	Air Preheater	--	--	1255.88	0	--	--	20
7	Rectangular Duct	0.498	3788.04	1063.34	0	--	--	4416.6096

DUCT ELEMENTS REPORT (Forc. D. Zone)
FHinfinity 2018

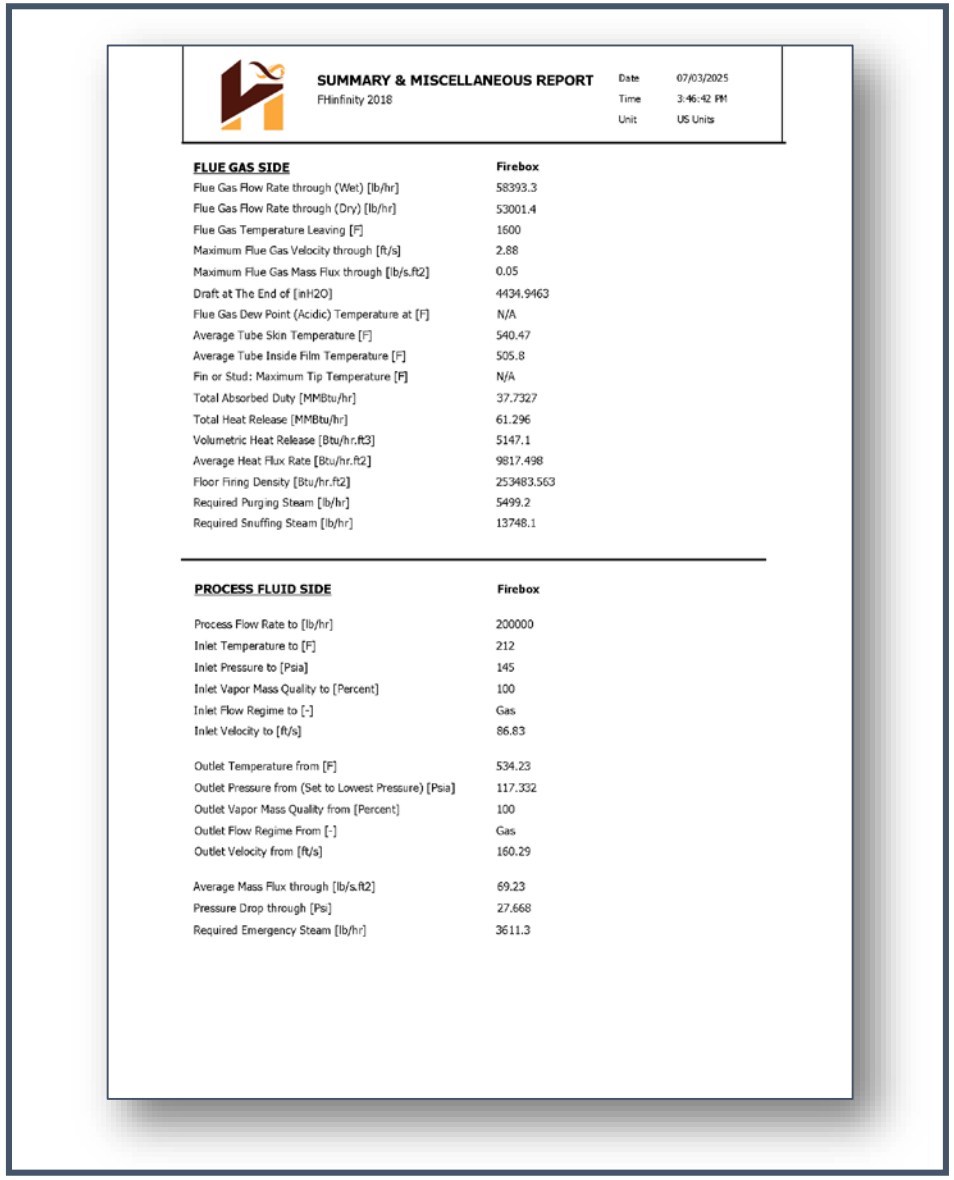
Date 07/03/2025
Time 3:45:36 PM
Unit US Units

F.D.Z. DUCT ELEMENT CALCULATION RESULTS

Ambient Pressure [inH2O]	406.7937
Straight Duct Insulation	External
Total Heat Loss in Duct [MMBtu/hr]	0.0256
Total Pressure Loss in Duct [inH2O]	114.046
Total Temperature Rise in Duct [F]	238.1

Sec.	Duct Element	Diameter (Equi. Round) [ft]	Linear Velocity [ft/s]	Outlet Temp. [F]	Outlet Pres. [inH2O]	Velocity Pressue [inH2O]	Fitting Loss Coefficient [-]	Pressure Loss [inH2O]
1	Sudden Exit	5.046	10.08	60	0	0.0232	1	0.0232
2	Rectangular Duct	1.366	128.99	60	0	--	--	1.1552
3	90 D. Rect. Sec. Smooth Radius Elbow	0.911	290.23	60	0	19.2213	0.22	4.2223
4	Round Duct	1.25	164.24	60	0	--	--	5.2237
5	Forced Draft Fan	--	--	60	0	--	--	-13.9224
6	Air Preheater	--	--	300	0	--	--	10
7	Round Duct	0.833	540.19	298.1	0	--	--	93.4216

Summary & Miscellaneous Report



SUMMARY & MISCELLANEOUS REPORT
FHinfinity 2018

Date 07/03/2025
Time 3:46:42 PM
Unit US Units

FLUE GAS SIDE	Firebox
Flue Gas Flow Rate through (Wet) [lb/hr]	58393.3
Flue Gas Flow Rate through (Dry) [lb/hr]	53001.4
Flue Gas Temperature Leaving [F]	1600
Maximum Flue Gas Velocity through [ft/s]	2.88
Maximum Flue Gas Mass Flux through [lb/s.ft2]	0.05
Draft at The End of [inH2O]	4434.9463
Flue Gas Dew Point (Acidic) Temperature at [F]	N/A
Average Tube Skin Temperature [F]	540.47
Average Tube Inside Film Temperature [F]	505.8
Fin or Stud: Maximum Tip Temperature [F]	N/A
Total Absorbed Duty [MMBtu/hr]	37.7327
Total Heat Release [MMBtu/hr]	61.296
Volumetric Heat Release [Btu/hr.ft3]	5147.1
Average Heat Flux Rate [Btu/hr.ft2]	9817.498
Floor Firing Density [Btu/hr.ft2]	253483.563
Required Purging Steam [lb/hr]	5499.2
Required Snuffing Steam [lb/hr]	13748.1

PROCESS FLUID SIDE	Firebox
Process Flow Rate to [lb/hr]	200000
Inlet Temperature to [F]	212
Inlet Pressure to [Psia]	145
Inlet Vapor Mass Quality to [Percent]	100
Inlet Flow Regime to [-]	Gas
Inlet Velocity to [ft/s]	86.83
Outlet Temperature from [F]	534.23
Outlet Pressure from (Set to Lowest Pressure) [Psia]	117.332
Outlet Vapor Mass Quality from [Percent]	100
Outlet Flow Regime From [-]	Gas
Outlet Velocity from [ft/s]	160.29
Average Mass Flux through [lb/s.ft2]	69.23
Pressure Drop through [Psi]	27.668
Required Emergency Steam [lb/hr]	3611.3

FHinfinity© Diagrams

Type of Diagrams

- ***Tube Metal Temperature (Mean)***
- ***Tube Metal Temperature (Peak)***
- ***Tube Skin Temperature (Mean)***
- ***Tube Skin Temperature (Peak)***
- ***Mean Heat Flux***
- ***Peak Heat Flux***
- ***Heat Absorption Rate***
- ***Heat Absorption Rate (Accu.)***

Type of Diagrams

(Gas-Side)

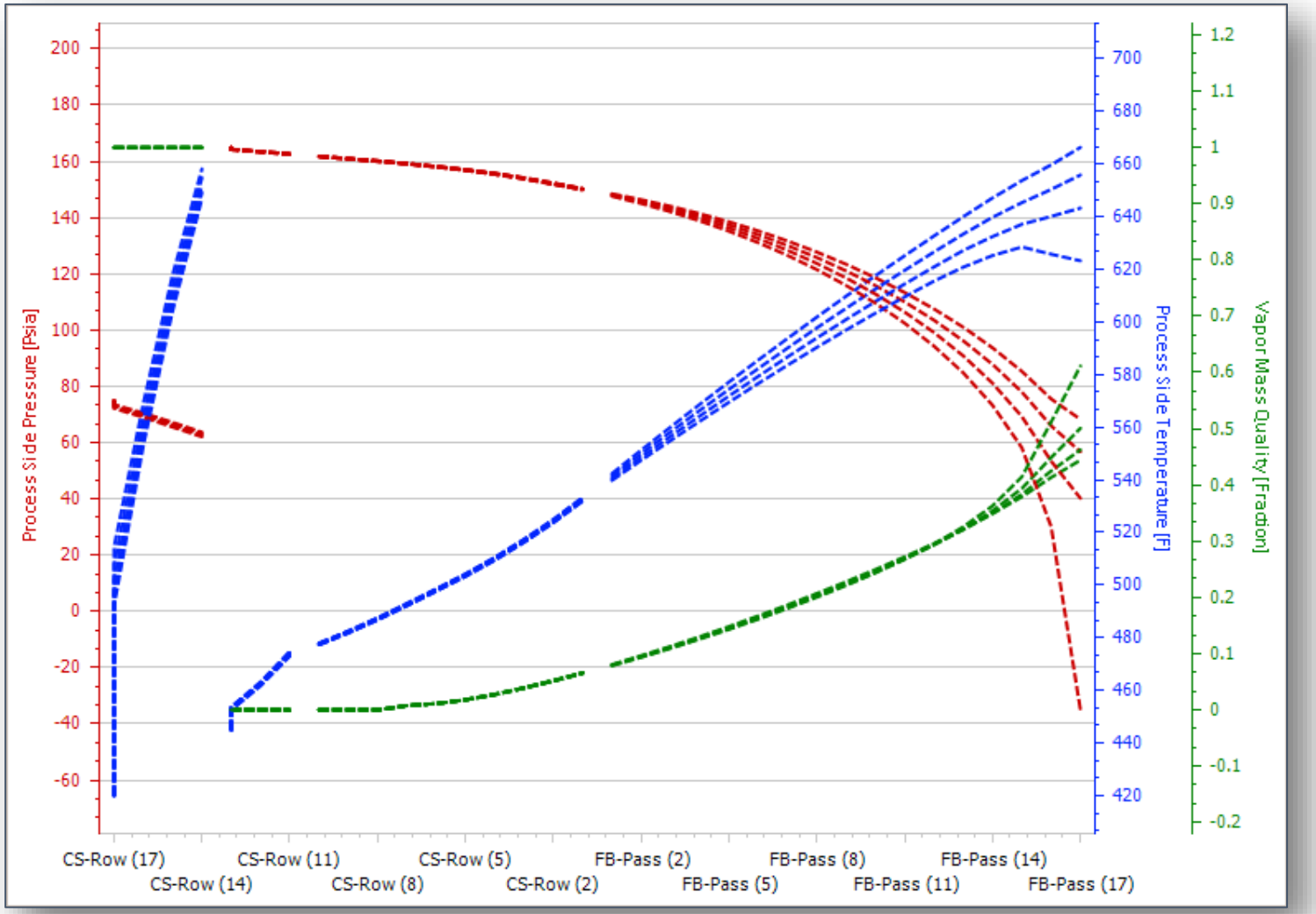
- ***Flame Heat Release***
- ***Flue Gas Composition***
- ***Gas-Side Draft***
- ***Gas-Side Pressure***
- ***Gas-Side Velocity***
- ***Gas-Side HTC***
- ***Gas-Side Mass Flux***
- ***Gas-Side Temperature***
- ***Gas-Side Reynolds No***

Type of Diagrams

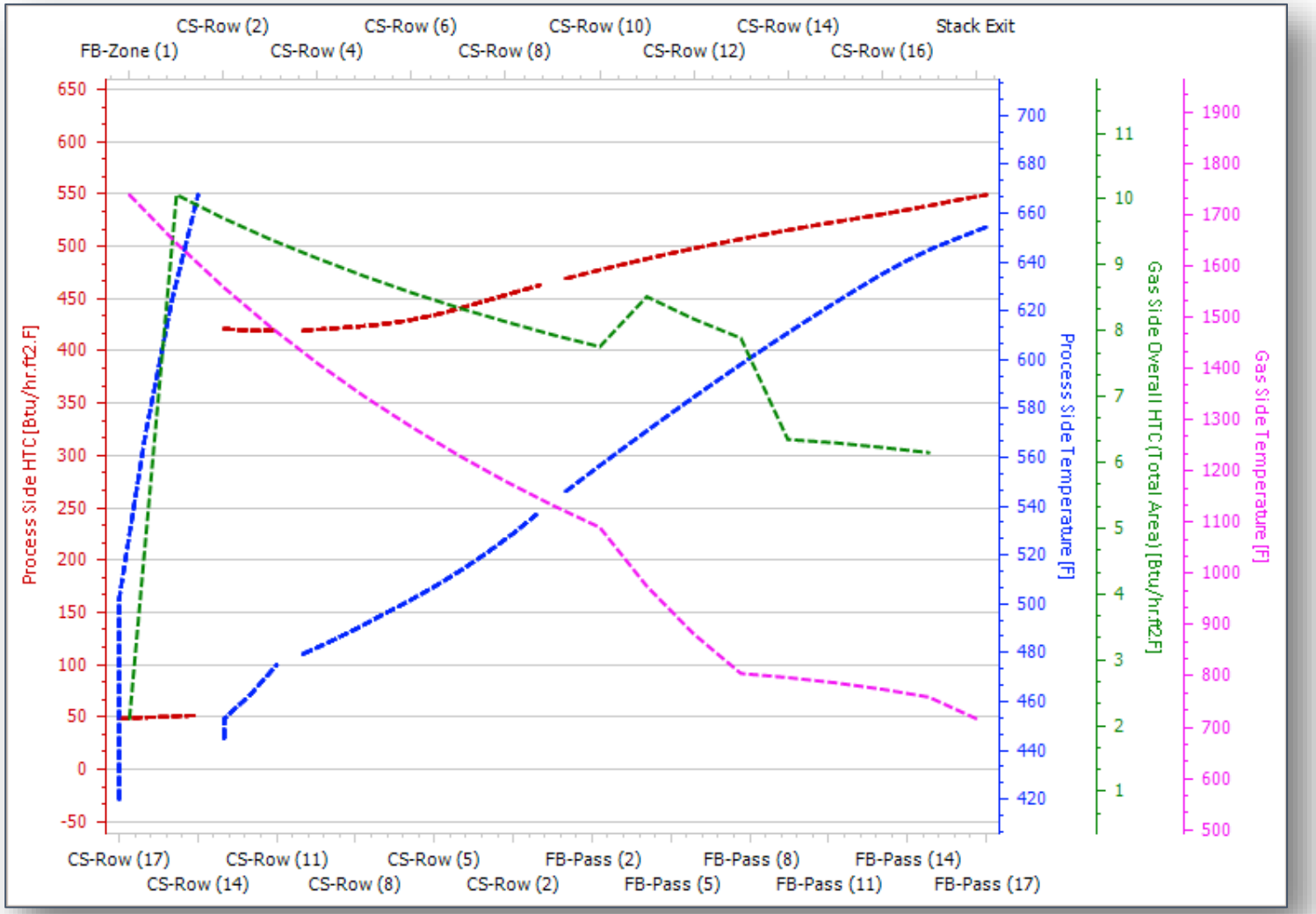
(Process-Side)

- *Process-Side Temperature*
- *Process-Side Pressure*
- *Process-Side Vapor Fraction*
- *Process-Side Flow Regime*
- *Process-Side Heat Trans. Region*
- *Process-Side HTC*
- *Process-Side Mass Flux*
- *Process-Side Reynolds No*
- *Process-Side Velocity*
- *Process-Side Sonic Velocity*
- *Process-Side Composition (Reaction Case)*

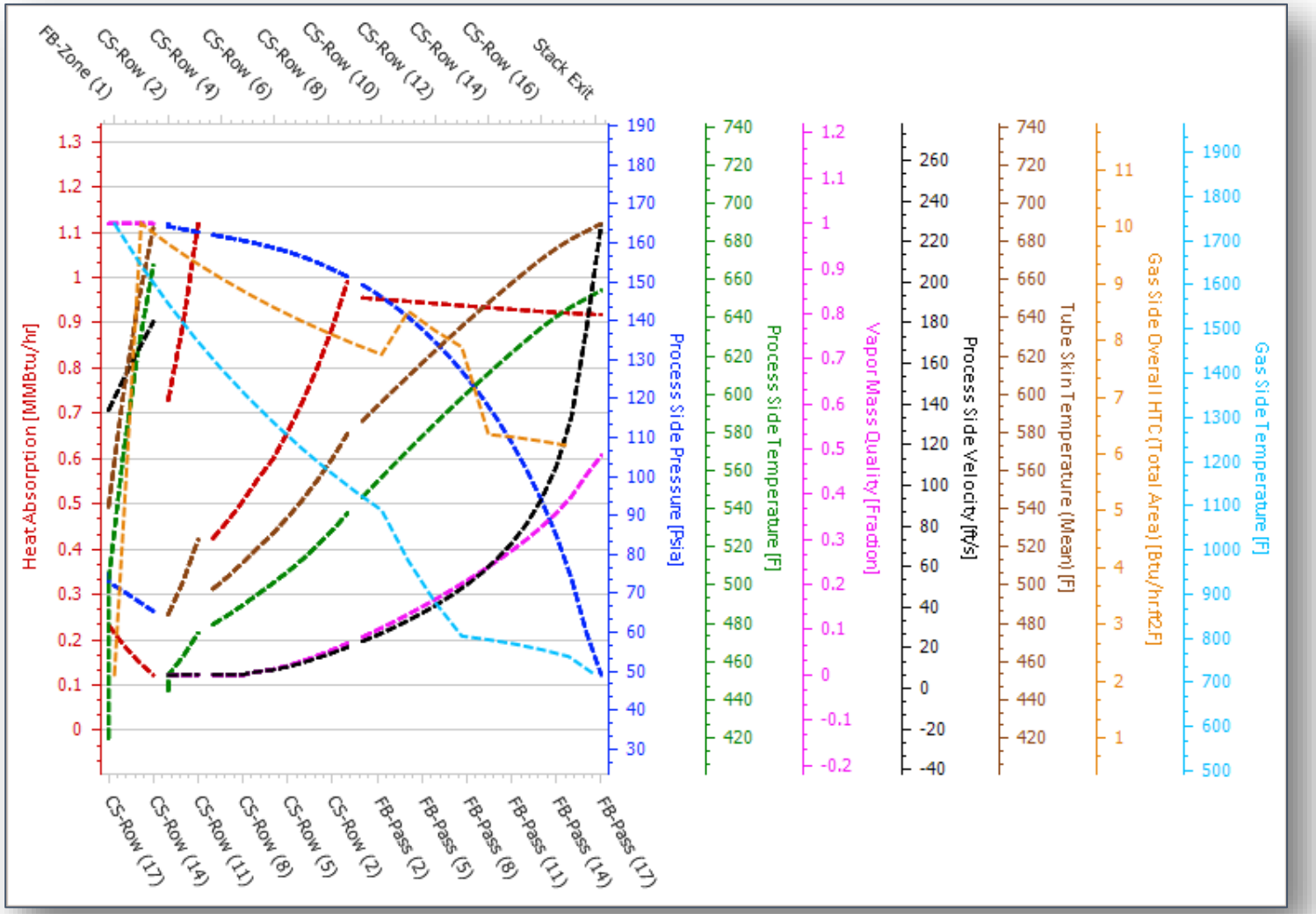
Diagrams


Process Side Pressure [Psia]
200
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
Process Side Temperature [F]
700
680
660
640
620
600
580
560
540
520
500
480
460
440
420
Vapor Mass Quality [Fraction]
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
CS-Row (17)
CS-Row (14)
CS-Row (11)
CS-Row (8)
CS-Row (5)
CS-Row (2)
FB-Pass (2)
FB-Pass (5)
FB-Pass (8)
FB-Pass (11)
FB-Pass (14)
FB-Pass (17)

Diagrams


FB-Zone (1)
CS-Row (2)
CS-Row (4)
CS-Row (6)
CS-Row (8)
CS-Row (10)
CS-Row (12)
CS-Row (14)
CS-Row (16)
Stack Exit
Process Side HTC [Btu/hr.ft2.F]
Process Side Temperature [F]
Gas Side Overall HTC (Total Area) [Btu/hr.ft2.F]
Gas Side Temperature [F]
650
600
550
500
450
400
350
300
250
200
150
100
50
0
-50
700
680
660
640
620
600
580
560
540
520
500
480
460
440
420
11
10
9
8
7
6
5
4
3
2
1
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
CS-Row (17)
CS-Row (14)
CS-Row (11)
CS-Row (8)
CS-Row (5)
CS-Row (2)
FB-Pass (2)
FB-Pass (5)
FB-Pass (8)
FB-Pass (11)
FB-Pass (14)
FB-Pass (17)

Diagrams


FB-Zone (1)
CS-Row (2)
CS-Row (4)
CS-Row (6)
CS-Row (8)
CS-Row (10)
CS-Row (12)
CS-Row (14)
CS-Row (16)
Stack Exit
Heat Absorption [MMBtu/hr]
Process Side Pressure [Psia]
Process Side Temperature [F]
Vapor Mass Quality [Fraction]
Process Side Velocity [ft/s]
Tube Skin Temperature (Mean) [F]
Gas Side Overall HTC (Total Area) [Btu/hr-ft2-F]
Gas Side Temperature [F]
CS-Row (17)
CS-Row (14)
CS-Row (11)
CS-Row (8)
CS-Row (5)
CS-Row (2)
FB-Pass (2)
FB-Pass (5)
FB-Pass (8)
FB-Pass (11)
FB-Pass (14)
FB-Pass (17)

The End

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