

 LCI Furnaces DIVISION OF LOCHABER CORNWALL INC CONTINUOUS BELT IR FURNACE	EQUIPMENT SPECIFICATIONS	DOC NBR: 15-004 - 802-101401 R2	
		MODEL: TF-618	CUSTOMER: TBD
		SERIAL NBR: 2015260	SHT 1 OF 1 PRNT 02/24/21

Equipment Model	Application: Fuel Cell Processing (890 C)
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Model	Base Equipment	Control Zones	Furnace Heated Length	Nominal Furnace Belt Width
TF-618	Continuous Belt Controlled Atmosphere Furnace	4	60 in 152 cm	18.0 in 46 cm

Equipment Arrangement					
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Phase	Process	Max Temperature (typ)	Length	Process Gas	Temperature (typ)
Phase 1	IR Furnace, 4 Zones	960 °C	60 in 152 cm	FG	200-960 C
	Transition Tunnel with Stack		20 in 51 cm	FG	600-750 C
Phase 2	Gas Convective Cooling, Exterior Fan Heat Removal		63 in 160 cm	N2	100-400 C
	Exit Baffle		4 in 10 cm	N2	150-250 C

Process Sections					
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Function	Name	Location	Length	Process Gas	Avg Temperature (typ)
	Load Station	Entrance load area	24.0 in 61 cm		ambient
IR Furnace	ENTRANCE BAFFLE	Entrance barrier	15.0 in 38 cm	N2	50 °C
	ZONE 1	Heating chamber 1	10.0 in 25 cm	FG	890 °C
	ZONE 2	Heating chamber 1	20.0 in 51 cm	FG	900 °C
	ZONE 3	Heating chamber 2	20.0 in 51 cm	FG	890 °C
	ZONE 4	Heating chamber 2	10.0 in 25 cm	FG	890 °C
Cooling	RAPID COOL TRANSITION				
	TRANSITION TOP	Cooling Isolatin Trans	15.0 in 38 cm	N2	740 °C
	WATER COOLING TOP	Cooling Section 1	45.0 in 114 cm	N2	361 °C
	WATER COOLING BOT	Cooling section 2	45.0 in 114 cm	N2	200 °C
	FREE COOLING	Cooling section	47.5 in 121 cm	none	100 °C
Product Unload	Unload Station	Exit station	24.0 in 61 cm		200 °C
	Total		275.5 in 700 cm		

Process Gas					
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	Actual Condions		Typical, Low O2		Typical, VL O2		Max (all flowmeters open full)	
Furnace Replenishment Rate	2.6 rep/min		4.0 rep/min		6.4 rep/min			
	Temp °C	Press psi	Min Flow scfh	Min Flow sL/m	Typical scfh	Typical sL/m	Max Compressor scfh	sL/m
N2 Supply	21	70	477	225	693	327	1,694	799
TOTAL PROCESS GAS			847	400	1,604	757	2,876	1 357

Exhaust Gas								
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	Temp °C	Press in H2O	Min Flow scfh	Min Flow sL/m	Typical scfh	Typical sL/m	Maximum Exhaust scfh	sL/m
N2 & FG mix	200	6	604	285	1173	554	3,282	3 282

Cabinet Ventilation					
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Cabinet Ventilation Fans (vent to room or exhaust system)	Flowrate	0 cfm 0 m3/h	(2 x 2 pair 10-inch fans)		
	Temperature	<122°F <50°C			

Transport System					
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Belt width	18.0 in 45.7 cm	Belt Edge Heater(s): 60-inch, pair			
Belt type	Balanced spiral weave				
Product height	2 in (5.1 cm) above belt level.		Baffle plate clearance: 0.25" above belt		
Belt speed range	MAIN	7.5 - 75 inches per minute		19.05 - 190.5 cm per minute	
Belt speed range	ALT	0.3 - 4 inches per minute		0.762 - 10.16 cm per minute	
Conveyor height	36.0 in	+/- 1.5 in	adjustable	91.4 cm	+/-3.8 cm adjustable

Electrical System					
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Voltage required	480 Vac, 60 Hz, 3 Ph				
Maximum power (Connected Pwr)	100.2 kW, 120.5 A				
Typical (operating) power required	55.1 kW, 66.2 A				


Materials of Construction					
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Heating Chamber	304 Stainless steel	Cooling	304 Stainless Steel	Belt	Nichrome V, 80%Ni,20%Cr, <1% Fe
Baffle & Eductor	304 Stainless steel	Belt support	Quartz rod, Quartz tube	Frame	Steel, powder coated
Heating element	Quartz, near infrared	Belt Return	UHMW-PE	Cover Panels	18GA Steel, powder coated

Furnace Dimensions						
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		Length	Width	Height (floor to stack)	Furnace Sect	Coolg Sectn	Weight
Furnace, English	Net	276 in	50.0 in	67.0 in +/- 1.5 in			4000 LB
Furnace, Metric	Net	7.00 m	1.27 m	1.70 m +/- 0.04 mm			1820 kg
Crate, English	Furnace, Gross	284 in	58 in	87 in		Gross Wt:	4400 LB
Crate, Metric	Furnace, Gross	7.20 m	1.47 m	2.20 m		Gross Wt:	590 kg

Standard Conditions	Pressure	14.7 psia 101.3 kPa	Temperature	70 °F 21 °C
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 LCI Furnaces DIVISION OF LOCHABER CORNWALL INC	DATA SHEET				DOC NBR:	15-004	802-101501-00	R0
	IR FURNACE SYSTEM POWER & CURRENT				MODEL:	TF-618	APVL:	SLB 4/16/15
					SERIAL NBR:	2015260	CONF:	JMC 4/16/15
	Customer: TBD					PRINT:	02/24/21	SHT 1 of 1

INPUT TABLE		Entry OK?	VALID
Enter Line Voltage:	480 Vac	TRUE	
(208,220,380,400,415,480)			
Limit Lamps to Max Rating? (Y/N)	Y	TRUE	
Line Frequency (50/60)	60 Hz	TRUE	
Number of Phases:	3 Φ	TRUE	
Lamp Length (6, 9, 15, 24, 36)	18 inches	TRUE	
Typical Operating %	54 %	TRUE	

SUMMARY OF RESULTS	
Max Power:	100.2 kW
Max Current:	120.5 A
Typical Power:	55.0 kW
Typical Current:	66.2 A

HARDWARE	
Lamps: 56	SCRs: 10
EMs: 7	TCs: 4
EM IDCs: 7	
Nbr strings: 28	
Nbr Lamps in 10" zone: 6	AOV-25: 5
	AITM: 2

CONFIGURATION	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Zone 9	Zone 10	Zone 11	Zone 12	Totals
Length (6,6.7,7.5,10,14.3,15,20,30) in.	10	20	20	10									60 in.
Length Entry OK?	TRUE	TRUE	TRUE	TRUE									
(F)urn., (1) SCR-Zn, (D)ryer	F	F	F	F									4
Zone Type OK?	TRUE	TRUE	TRUE	TRUE									
No. Lamps in Series/String (1-5)	2	2	2	2									
Lamps/String OK?	TRUE	TRUE	TRUE	TRUE									
No. Lamps in Top/Bottom Power	6/6	8/8	8/8	6/6									Plenum: 240
SCR PHASE	Zone Entry OK?	VALID	VALID	VALID	VALID								Lamp Balance (kW)
Top Lamp Phase (1/2/3):	1	2	3	1									Phase 1: 39.6
Bottom Lamp Phase (1/2/3):	1	2	3	1									Phase 2: 26.4
SCR POWER													Phase 3: 26.4
Rated Lamp Voltage	225	225	225	225									<-- Vrms
Max. Lamp Wired Voltage	225	225	225	225									
50% Power SCR Cal Span Setting	285	285	285	285									
Max. Lamp Wired Power (W)	1650	1650	1650	1650									
No. Strings per SCR	3	4	4	3									
Max. Current per String (A)	7.3	7.3	7.3	7.3									
No. Lamps in Zone	12	16	16	12									56
No. SCRs in Zone	2	2	2	2									8
No. Strings in Furnace Zones	6	8	8	6									28
													Nbr. lamp strings per element monitor: 4
Top Lamp Power (kW)	9.9	13.2	13.2	9.9									
Bottom Lamp Power (kW)	9.9	13.2	13.2	9.9									
Total Power/Zone (kW)	19.8	26.4	26.4	19.8									92.4
Current Required Top SCR (A)	22.0	29.3	29.3	22.0									
Current Required Bottom SCR (A)	22.0	29.3	29.3	22.0									
Color Temp (K) (nominal: 2500K)	2500	2500	2500	2500									
Peak Wavelength (µm)	1.16	1.16	1.16	1.16									
% Energy NIR (<2 µm)	67%	67%	67%	67%									
% Energy MW (2-4 µm)	33%	33%	33%	33%									
Estimated Lamp Life (hrs)	5000 hr	5000 hr	5000 hr	5000 hr									
Lumen Output vs. Rated (%)	100	100	100	100									

Furnace Total	Number of Item?	Voltage (Vac)	Current (Amps)	Power (kW) Max	Power (kW) Typical	Phase Assigned	EH in EM? (y/n)	Other Items
Lamps	56	480	as above	92.4	49.9	as above	N	10" Cabinet or CACT Fans, 117 Vac, 0.30/029 A for 50/60 Hz
PC, Monitor	1	117	1.3	0.2	0.2	1	TRUE	4" Box (Muffin) Fans, product cooling, 117 Vac, 0.16 A
Belt, Opto22, EM	1	117	2.1	0.2	0.2	1		Cross-flow Fans, product cooling, 230 Vac, 1.27 A max
UC (Pump & Gen)	1	117	10.0	1.2	1.2	1	OK	Lower Cabinet Blowers (Impellers), 230 Vac, 0.72 A max
UC (Tank Heater)		117	8.4					H2 Igniters, 120 Vac, 5 A 24 Vdc PS, 120 Vac, 2 A
UCD (Blower)		117	2.0					No more than 8 SCRs/phase per TRx xfmr 24 Vac secondary
UCD (Heater)		480	16.0					TR1: 4 TR2: 4 TR3: 2
Edg Htr 1 Length	60	480	12.0	5.8	3.1	2	OK	EH1 Ω: 81 Current: 6.0 A Cal Span: 305 Vac
Edg Htr 2 Length								EH2 Ω: Current: Cal Span:
Edg Htr 3 Length								EH3 Ω: Current: Cal Span:
Cabinet Vent Fan 10"	0	117	0.29					Cabinet/CACT/Control Box Fans: 1.74 A
CACT Fans 10"	6	117	0.29	0.2	0.2	1	OK	
CACT Fans 4"	0	117	0.16					
Control Box Fans 4"	0	117	0.16					
Prod Cooling fans	6	117	0.16	0.1	0.1	1	OK	
OA & Pump	1	117	1.0	0.1	0.1	1	OK	
Furnace Totals:				100.2	55.0			

PHASE	PHASE BALANCING			TOTAL
	1	2	3	ALL
LAMP PWR, kW	39.6	26.4	26.4	92.4
EH/OTHER	2.0	3.1	0.0	5.1
TOTAL	41.6	29.5	26.4	97.5



LCI Furnaces
DIVISION OF LOCHABER CORNWALL INC

**SPECIFICATION,
UPS**

DOC NBR:	15-004	802-101421	R 0
MODEL:	TF-618	APVL	JCLARK 9/9/14
S/N:	2015260	PM	JCLARK 9/9/14
SIZE: A	PRNT 04/08/16	SHT	1 of 1

CUSTOMER GE FUEL CELLS

Part Number	Qty	Description
UPS-650D	1	Uninterruptible Power Supply, 650 VA, 400 W, Multistar™

Specifications

Power	650VA/400W		
Technology	Line Interactive		
Input	Input Voltage Range	145V-275Vac/90Vac-140Vac±3%	
	Nominal Input Voltage	220/230/240/110/120Vac	
	Input Frequency	50/60Hz	
	Max.Input Current	2.6A/5.2A	
Output	Nominal Output Voltage	220/230/240/110/120Vac	
	Max.Output Current	1.8A/3.6A	
	Output Voltage Range(Normal Mode)	220/230/240/110/120Vac+10%-15%	
	Output Voltage Range(Battery Mode)	220/230/240/110/120Vac±10%	
	Output Frequency(Normal Mode)	Synchronized (Sine Wave)	
	Output Frequency(Battery Mode)	50/60Hz	
	Wave Form	Step Wave	
	Power Factor	0.6	
Efficiency	>90%		
Transfer Time	< 10ms		
Batteries & Runtime	Battery Type	Maintenance-free Sealed Lead-Acid Battery Leakproof	
	Included Battery Modules	1×12V/7.0Ah	
	Runtime	Full Load	2 Minutes
		Half Load	7 Minutes
	Charge Time	<5 Hours(90%)	
LCD Status Display	Output Voltage,Normal,Fault,Battery,Overload,Battery		
Audible Alarm	Buzzer	AC Unusual/Battery Low Voltage/Overload/Short Circuit/PCB Failed,Beep for 240Seconds	
Interface Port(s)	Interface	RS-232/USB	
	Control Software	UPSlion2000	
Cold-start Capability	Yes		
Protection	Surge Protection and Filtering	High Voltage,Low Voltage,Surge,Spike	
	Overload Protection	120%-150%	
	Battery Low Voltage Protection	10V	
	Output Short Circuit Protection	Output auto cut off,Buzzer beeping	
	EMI Filter	Yes	
	Tel/Fax/Modem Jack/USB	Yes. Optional	
Regulatory Approvals	CE		
Operating Conditions	Operating Temperature	0-40°C	
	Storage Temperature	-15-45°C	
	Operating Relative Humidity	10%RH-95%RH,Non-condensing	
Dimension	Inner Box(mm)	385*125*230	
	Unit Weight(kgs)	6.8	

0	ORIGINAL RELEASE	JCLARK	9Sep14
REVISION	DESCRIPTION	BY	DATE



I/O Channel Assignments

Analog Module Thermocouple Input 1 (TC 1)

Channel	Description
0	Thermocouple Input Zone 1
1	Thermocouple Input Zone 2
2	Thermocouple Input Zone 3
3	Thermocouple Input Zone 4
4	Thermocouple Input Water In
5	Thermocouple Input Water Out

Analog Module Output (AO1)

Channel	Description
0	SCR ZONE 1 TOP
1	SCR ZONE 1 BOTTOM
2	SCR ZONE 2 TOP
3	SCR ZONE 2 BOTTOM
4	SCR ZONE 3 TOP
5	SCR ZONE 3 BOTTOM
6	SCR ZONE 4 TOP
7	SCR ZONE 4 BOTTOM
8	SCR EDGE HEAT RIGHT
9	SCR EDGE HEAT LEFT
10	Motor Control Signal Control

Analog Module Input (AI1)

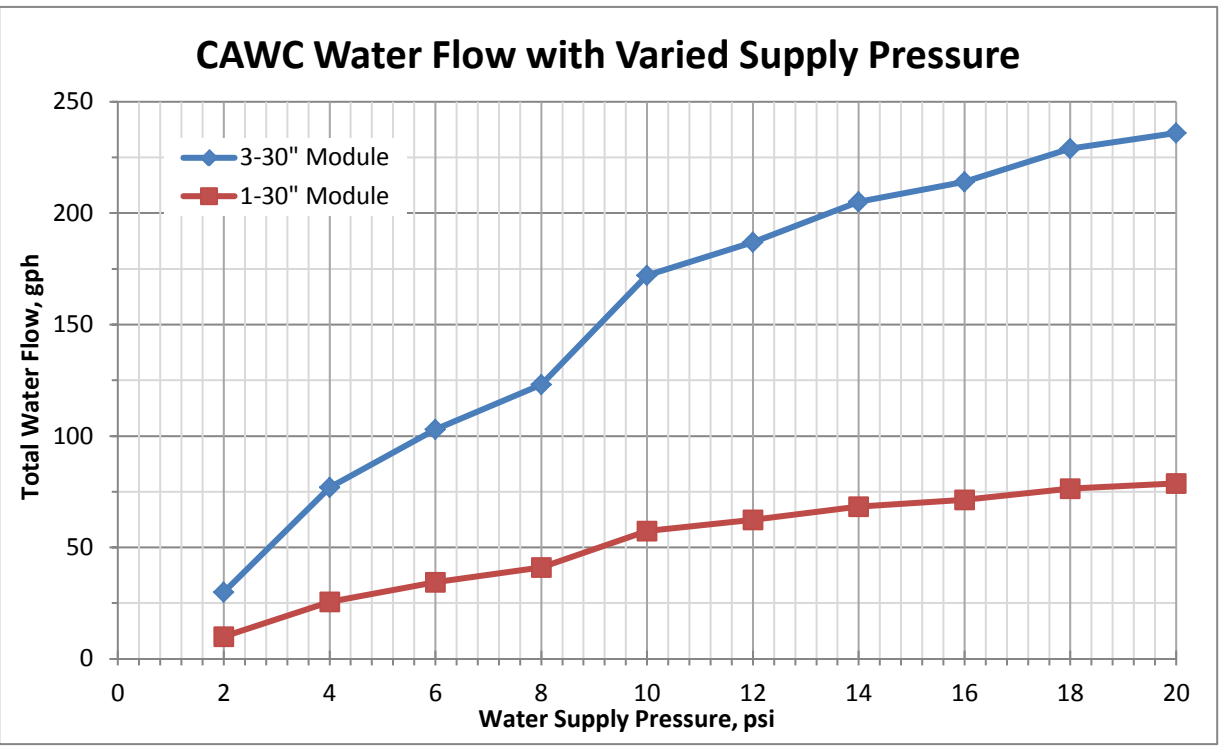
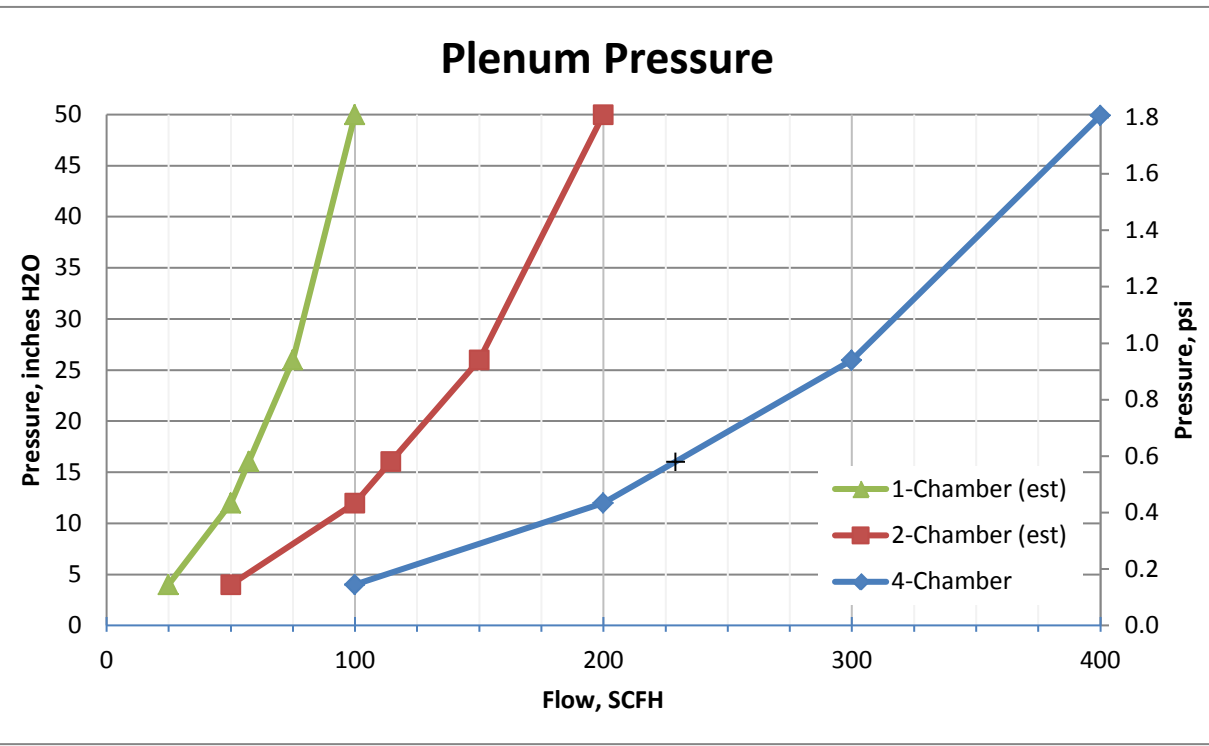
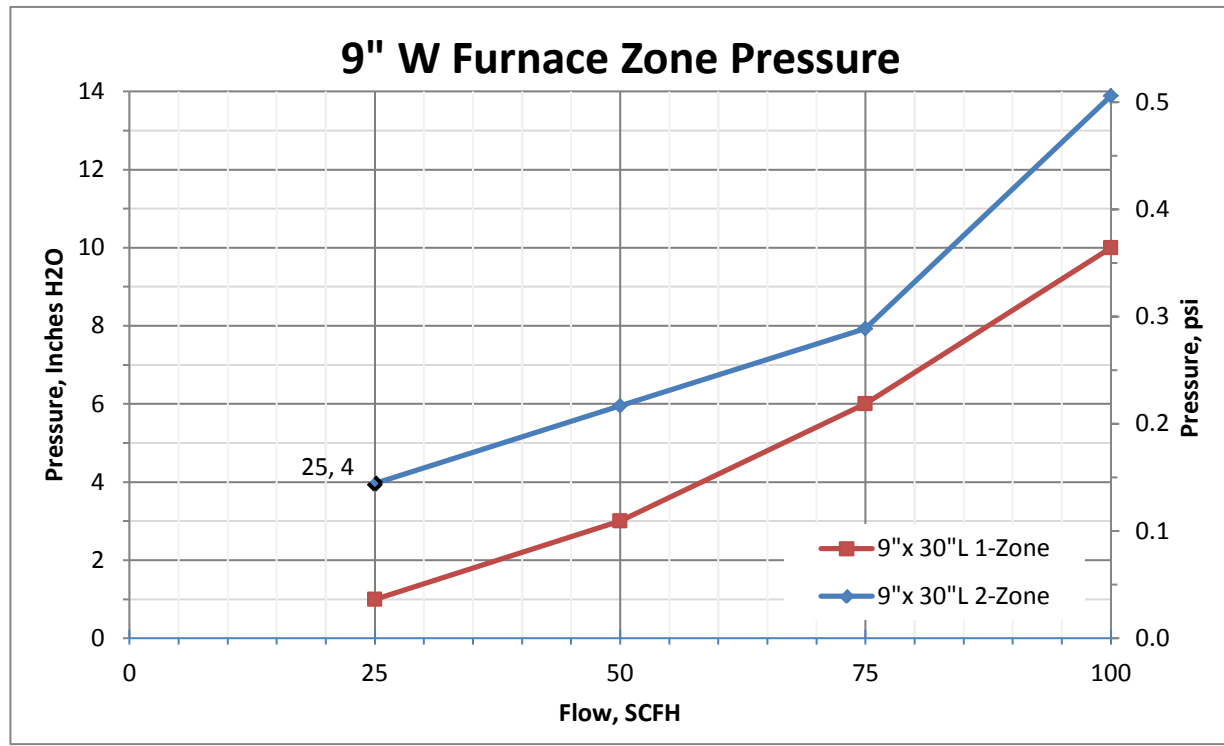
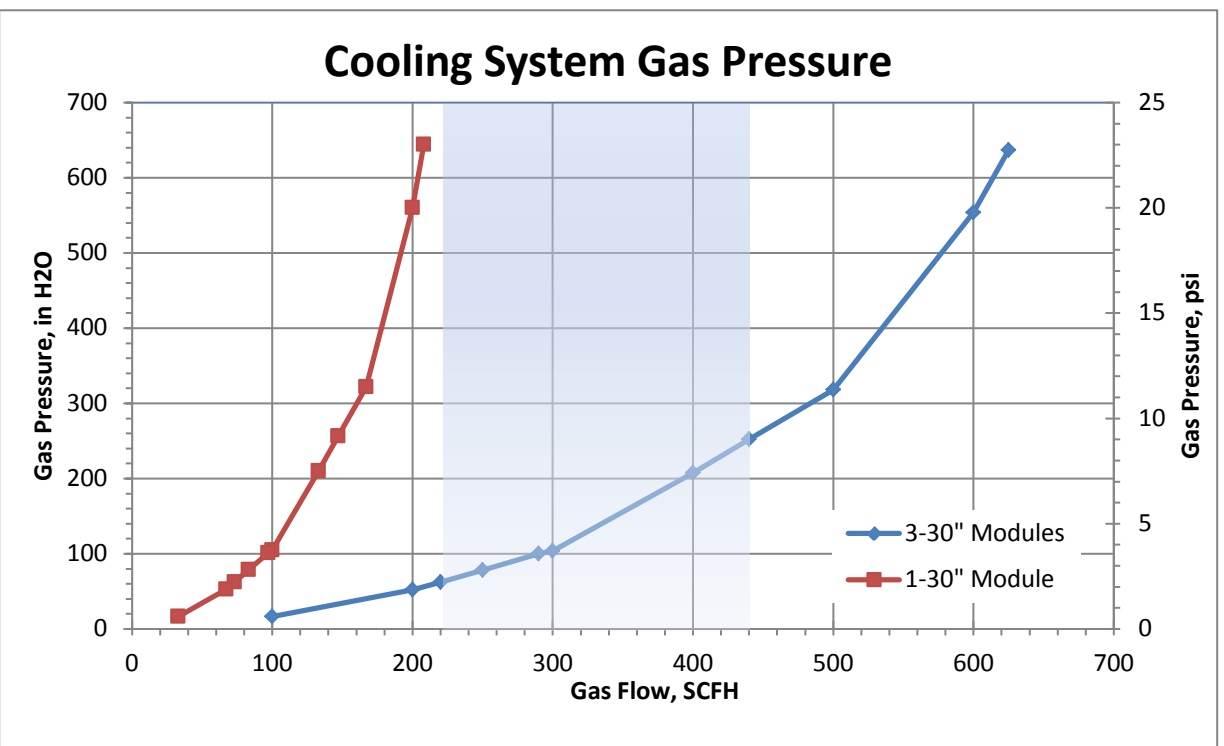
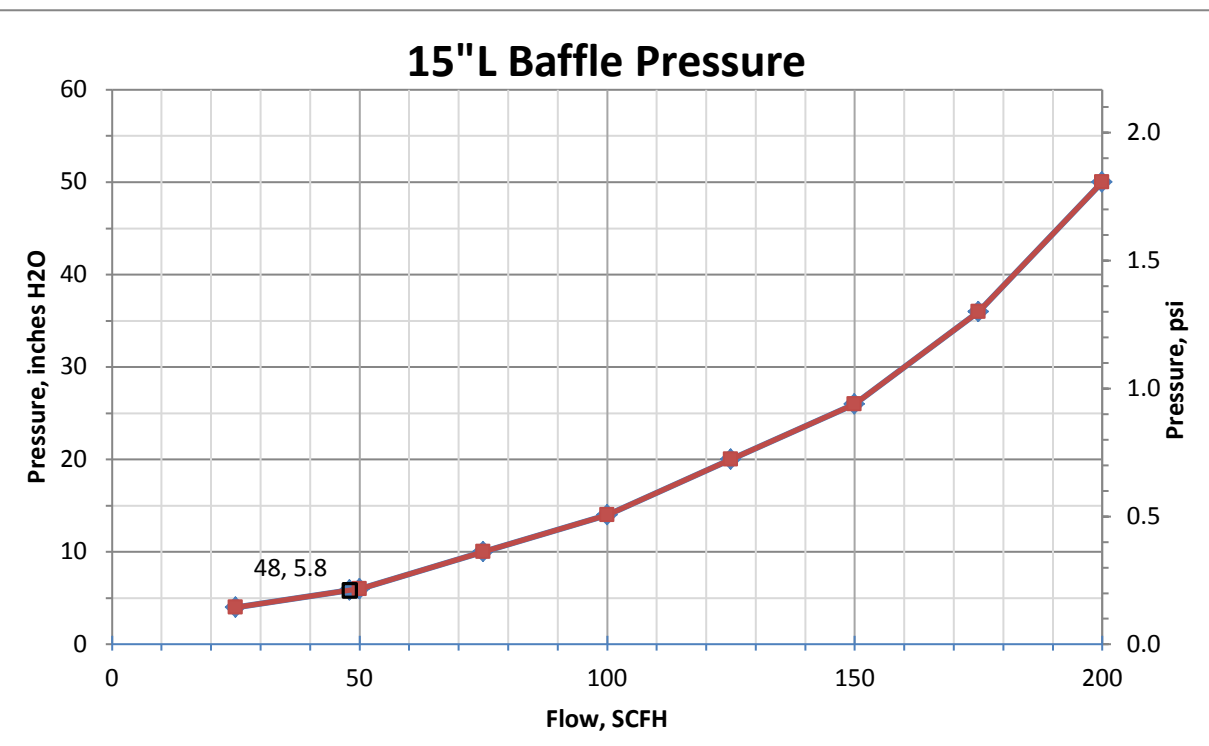
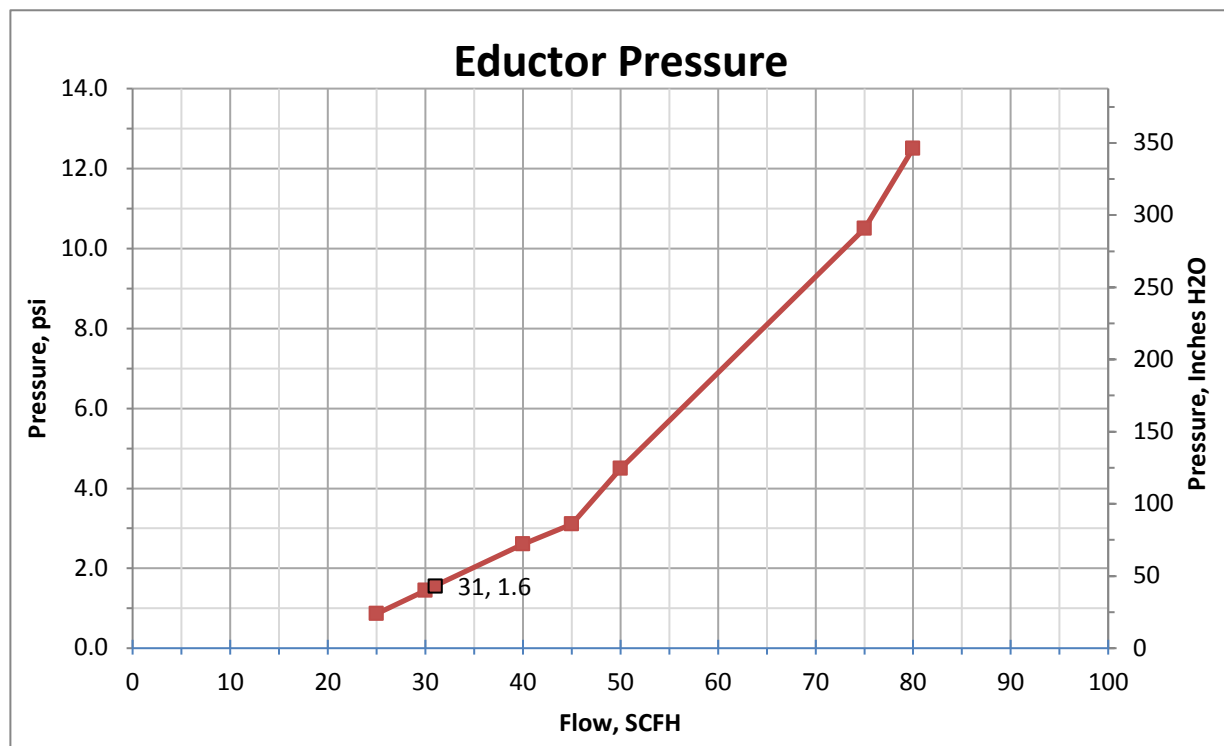
Channel	Description
0	Motor Control Signal Feedback
1	Oxygen Analyzer Feed Back

Digital Module DO 1

Channel	Description	
0	Main Power	Output
1	Lamp Power	Output
2	Alarm	Output
3	Auto OFF	Output
4	Light Tower Yellow	Output
5	Light Tower Green	Output
6	Oxygen Valve Source	Output
7	Oxygen Valve Zone 1	Output
8	Oxygen Valve Zone 2	Output
9	Oxygen Valve Zone 3	Output
10	Oxygen Analyzer ON/OFF	Output
11	CDA Main Valve	Output
12	Nitrogen Main Valve	Output
13	Forming Gas Main Valve	Output

Digital Module DI 1

Channel	Description	
0	Air Flow Sensor CDA	Input
1	Air Flow Sensor NITROGEN	Input
2	Air Flow Sensor FORMING GAS	Input
3	Transport Motion Fault	Input
4	SMEMA Sensor Entrance	Input
5	SMEMA Sensor Exit	Input



NOTES:

PROCESS GAS TO PLENUMS, EDUCTORS, CHAMBERS, BAFFLES & CAWC

For each gas element tested, the flow was varied and the pressure drop determined by temporary installation of a test pressure gage. Pressures were recorded at each flow.

CAWC COOLING WATER


For the water cooling section, all 6 water flowmeters were opened full and the pressure varied from 2-20 psig.

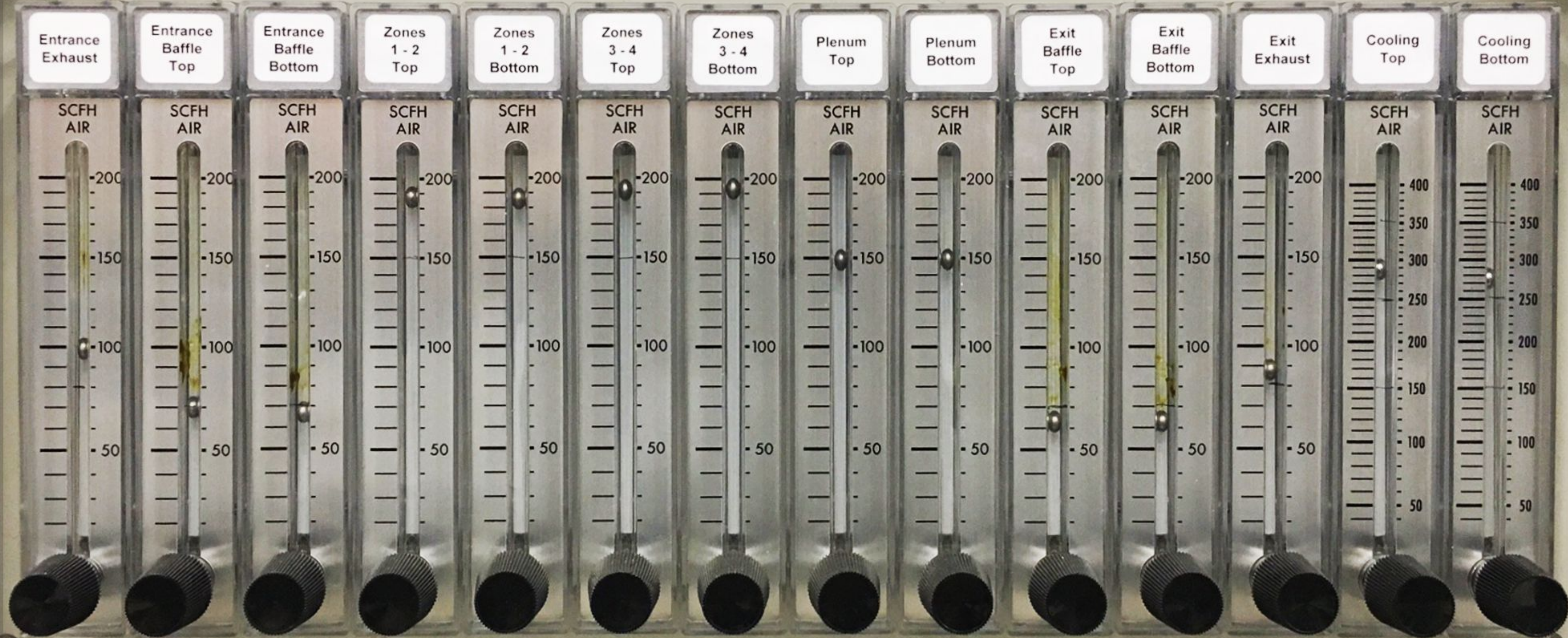
Flows were recorded for each flow meter at each pressure setting and then summed for total water flow through the CAWC as a function of inlet pressure.

Tests on the CAWC were run as follows:

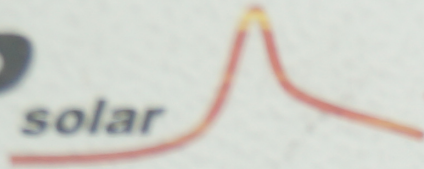
- 1) Furnace operating with last zone at approx. 450-460C. CAWC COOLING AIR turned off. Cooling water set to 8 psig. CAWC cooling water varied from 0 to 60 gph (1 gpm). Temperature profiles of the furnace were run at each of 5 Total Water Flow settings. Inlet & outlet water temp recorded
- 2) Furnace operating with last zone at approx. 450-460C. Cooling water set to 8 psig, Total Water Flow set to 48 gph (8 gph in each of 6 CAWC chambers). CAWC COOLING AIR increased from 0 to 400 scfh. Temperature profiles of the furnace were run at each of 6 water flow settings.

Data suggests the furnace cooling system be operated with 40 to 60 gph Total Water Flow through the CAWC and improve cooling performance by running the CAWC cooling gas at 200-300 SCFH.

REV		DESCRIPTION		BY		DATE		APPROVALS		DATE		 LCI Furnaces DIVISION OF LOCHABER CORNWALL INC 675 N ECKHOFF STREET STE D ORANGE, CALIFORNIA 92868 USA (714) 935-0302 www.furnacepros.com		TITLE: IR FURNACE PRESSURE AND FLOW CHARACTERISTICS JOB: STD DOCUMENT NUMBER: 802-101470 SIZE: B PRNT: 11/28/12 SN: ALL SHEET 1 OF 1	
								DWN	JMC	6/11/11					
								CHKD	SBARBER	6/15/11					
								ENGR	JMC	6/22/11					
								PM	JMC	7/28/11					



TP solar



INNOVATIVE FURNACE TECHNOLOGIES

Serial Number	2015260
Model Number	TF-618-FG
Input Service	480 Vac, 3 Wire / Neutral / Ground
Frequency	50 / 60 Hz
Peak Power	100 KW
Peak Amps	120 Amps
Water Input	19 LPM @ 4 Bar
Peak Flow	2000 SCFH
Max Input Pressure	75 PSI
Process Exhaust	350 SCFH
Cabinet Exhaust 1 & 2	500 CFM Each
Manufactured Date	01-2016

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TPSI