Process Insights

Premium Insights Into Process

9800CXi Calorimeter™

Installation, Operation and Maintenance Manual

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Process Insights
Caution
Hot Surface
SIEMENS
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Section 1 – General Information

Section 1.1 - Letter from Corporate

Dear Valued Customer,

During the past several years, we have experienced extraordinary growth and change at Process Insights, due to our continued commitment to teamwork, technology-focused product strategies and to our policy of placing the trust of our customers above all else. We have successfully reached key milestones, expanded research and development initiatives, achieved significant technological advancements, and initiated our position as a premier manufacturer and developer of analytical instrumentation. In the face of challenging economic conditions, we are finding new ways to provide solutions to an evolving industry landscape to ensure PROCESS INSIGHTS remains the brightest light on the marketplace.

The upcoming years will be exciting as we continue to broaden our business efforts and move from promise to product. We have set increasingly ambitious goals but possess the passionate vision and resources to achieve them. We have the knowledge, experience, and expertise to bring specialty products to this niche market, and we know the steps we need to take are simply an extension of what we have been doing successfully since our inception. Simultaneously, we plan to continue responding to market challenges and expand our line of analyzers with products incorporating enhanced features to engage a wider customer base.

One of our customers has described our success story as "more a marathon than a sprint." We take pride in this characterization and embrace it as the philosophy for our operations as a successful business is built on sustainable and reliable growth. In recent years, we've grown our business substantially, yet managed to never waver from our promise to deliver the very best products and service to our valued customers. PROCESS INSIGHTS is building the analyzer tools of tomorrow, hearing the markets' demands and we are ready to meet the challenges. Watch us closely; the next five years will be a defining notch in PROCESS INSIGHTS's timeline.

We credit each of our devoted employees for making these past years such a success in turbulent times. We would also like to extend our thanks to our customers and our suppliers for their unfailing sense of devotion, responsibility, guidance, and support, without which we would surely not have come this far.

Thank you for the purchase of this PROCESS INSIGHTS product and please trust in our commitment to your complete satisfaction. Should you have any concerns, please do not hesitate to contact us for support.
Sincerely,

Process Insights

Section 1.2 - Conditions for Proper Use

The 9800CXi Calorimeter is designed to be installed, operated, and maintained as specified in this manual. Failure to operate the analyzer as specified may produce erroneous data and possible equipment failure which may void the warranty. Some of the conditions for proper and improper use of the 9800CXi Calorimeter are provided as follows:

1. Read the manual carefully prior to using the analyzer.

2. Keep the manual near the analyzer for reference.

3. Improper usage of the analyzer may void the warranty.

4. The general codes for working with chemicals and electrical equipment must be observed while using the analyzer.

5. Use PPE (coveralls, protective gloves, goggles, and hard hat) as required when working on the analyzer.

6. If faults occur when the analyzer is running and the user cannot rectify it, then please contact your local partner or PROCESS INSIGHTS Technical Support.

7. Electrical and electronic devices must be disposed according to the local regulations.

8. The packaging crate material can be recycled. Please dispose appropriately.

9. Bear in mind the potential hazards while using different hydrocarbon samples.

10. PROCESS INSIGHTS does not carry out construction work. The installation of the analyzer and options will be provided by the end user.

11. The analyzer is shipped in a wooden crate. Use of a forklift or a lifting device is strongly recommended to unpack the analyzer from the crate. Use of PPE is strongly recommended during this process to prevent any injury.

12. The analyzer does not come installed with a power cord and must be provided by the end user. It should meet the power rating of the analyzer, the hazardous location code, and the local electric code.

13. The analyzer is supplied with conduit hubs for the power and communication cables. The end user will provide the conduit sealing fitting, sealing cement and filler. Conduit sealing fitting, sealing cement and filler must be properly installed and sealed as per the local hazardous location codes and the manufacturer's instruction. If a cable gland is used instead, then it must be installed and sealed as per the local hazardous location codes and the manufacturer's instruction. Cable/conduit glands used for power and communications entry into the unit must

be sealed to maintain overpressure in the enclosure. They must have a minimum IP rating of 65.

14. An earth connection point is provided inside and outside the pressurized enclosures. These connections must be used to join the instrument's metalwork to the earth-ground plane. The external earth wire must be protected so that it cannot become accidentally loosened or damaged by twisting. It must be sized in accordance with local rules for electrical installations and must not be smaller in area than 4 square millimeters (7894 circular mils). The purpose of these connections is to direct any electrical current, internally, or externally generated, into an external ground rod that will eliminate or minimize any damage to personnel and equipment. To achieve the redirection of current, the resistance between the earth-ground connection and the external earth-ground lug must be kept below 0.1 ohms. Use 1/4-20 nut and 1/4" external-tooth lock washer to fasten the earth wire to the analyzer.

15. A manual or automatic power disconnect that removes all power from the analyzer is required to be installed near the unit and should be easily reached. The disconnect must be rated for the hazardous location code. Disconnect must be rated for two times the rated current of the analyzer. It must be labeled as the disconnecting device for the intended analyzer. Wires connecting from the external circuits to the analyzer must be rated for the hazardous location code. Wires and its insulation should be rated for 600V. Install Earth Fault protection per the Hazardous location code.

16. It is necessary to keep an appropriate distance between the analyzer sides and opposite walls, such that the analyzer doors can be swung open, and maintenance can be done. Note the wall to which the analyzer is to be mounted should have the strength of a concrete wall. For mounting the analyzer use four corrosion resistant, Grade 8 or better, 3/8-16 x 1-1/4" (min) long bolts and flat washers. Make sure the analyzer is oriented horizontally. Use of a forklift or a lifting device is strongly recommended. If the analyzer is mounted on the supplied frame, then anchor the frame to a leveled ground or foundation with four corrosion resistant, Grade 8 or better, 3/8-16 x 1-1/4" (min) long bolts and flat washers.

17. For systems that comes installed with X & Z-Purge, follow the purge section to properly operate it.

18. For safety reasons, the purge can only be bypassed by authorized personnel with the key. Those without authorization are not permitted to bypass the purge monitoring device.

19. Utility gases such as Sample, Calibration standards, zero grade air and instrument air will be provided and connected to the analyzer by the end user. Leak check and connection integrity will be performed by the end user per the Swagelok instruction. If another brand fittings are used, then follow the manufacturer's instruction. All external tubing must be instrument grade, debris free, chemically cleaned, and passivated.

20. If the analyzer is not installed upon receipt, the analyzer must be stored in a dry and frost-free environment at a maximum temperature of 122°F (50°C), preferably in its original packing, and

protected against direct sunlight and (rain) water. The storage period should not be more than six months.

21. The analyzer is designed to continuously analyze gaseous samples from a sample handling system and display the Calorific value of the sample. Operation for any use other than specified may damage the analyzer and/or cause personal injury to the operator. The results obtained from any other use cannot be guaranteed.

22. The standard configuration of the analyzer is not intended for extended use in corrosive environments.

23. The best accuracy and precision are obtained when the analyzer is in a temperature-controlled environment.

24. To ensure safe operation, the purge system should always be engaged during operation of the analyzer except after the area has been determined to be non-hazardous and repairs or tests must be performed that require the purge system to be bypassed.

25. Air and other gas supplied to the analyzer must be filtered and meet specified requirements.

26. All cautions and warnings in this manual, on tags and in other publications pertaining to the installation, operation and maintenance of the analyzer must be read and observed. Failure to consider the warning and caution messages can lead to severe personal injury, equipment damage, void of the warranty and impair the protection provided by the equipment.

27. Instrument should be sheltered from direct sun and rain. If the instrument is to be used for measuring very low concentrations, it should be in a climate-controlled area. Ambient temperature should be per the analyzer specification.

28. The analyzer must be calibrated correctly before running samples.

29. In certain high-energy disturbances on the power and interconnection lines, product may have a temporary loss of function or degradation of performance. After the disturbances, the operator may have to power cycle or restart the instrument to resume its normal function.

30. For purging the enclosures with protective gases, holes between the electronics enclosure and furnace enclosure should be free of any obstruction and should not be modified.

31. A verification dossier (Hard copy or electronic) shall be kept up to date throughout the operating lifetime of the installation to keep the records of following.

    - Additional assessments to relevant explosion protections: Area classification documents with plans showing the classification and extent of the hazardous areas including the zoning, Gas classification group, Temperature class and ambient temperature. Assessment of consequences of ignition.
    - Plant changes.
    - Manufacturer’s instructions for selection, installation and initial inspection.

- Documents demonstrating how Specific Conditions of use for Ex Equipment have been met, e.g. for equipment with certificate numbers which have the suffix “X”.
- Documentation relating to the suitability of the Ex-Equipment for the area and environment to which it will be exposed, for example temperature ratings, Type of Protection, degree of protection (IP Code) and corrosion resistance.
- Plans showing types and details of wiring systems and cable routing.
- Records of selection criteria for cables, cable entry systems and conduits for compliance with the requirements for the Type of Protection.
- Drawings of conduit installation and location of the conduit.
- Drawings and schedules relating to circuit identification.
- Records of the initial inspection.
- Evidence of competency for personnel responsible for verifying compliance of the installation.

Section 1.4 - Warnings and Cautions

This manual provides caution and warning messages as listed below. Failure to consider these messages can lead to severe personal injury, instrument damage and/or void of warranty.

1.WARNING: 	**VOLTAGE SPECIFIED ON THE SERIAL NUMBER PLATE OF THE ANALYZER MUST MATCH THAT OF THE END USER POWER SUPPLY.**
2. WARNING: 	**POWER TO ANALYZER MUST BE SUPPLIED FROM AN EXTERNAL POWER BREAKER.**
3. WARNING: 	**SEVERE ELECTRIC SHOCK HAZARD MAY EXIST WHEN POWER IS APPLIED WHILE SERVICING INTERNAL COMPONENTS. THE ANALYZER MUST BE SWITCHED OFF FROM THE MAIN BREAKER BEFORE WORKING ON LIVE PARTS.**
4. WARNING: 	**SEVERE ELECTRIC SHOCK HAZARD MAY EXISTS WHEN CONTACT IS MADE WITH THE AC VOLTAGE COMPONENTS. DO NOT ATTEMPT TO REPAIR OR TEST THE AC VOLTAGE SECTION WITHOUT USING THE APPROPRIATE TEST METER WITH INSULATED PROBES.**
5. WARNING: 	**A POOR GROUND CONNECTION MAY PRESENT A SEVERE SHOCK HAZARD. AN EARTH CONNECTION POINT IS PROVIDED IN THE MAIN ENCLOSURE. THIS CONNECTION MUST BE USED TO JOIN THE INSTRUMENT'S METALWORK TO THE EARTH-GROUND PLANE. IT MUST BE SIZED IN ACCORDANCE WITH LOCAL ELECTRIC CODE.**
6. WARNING: 	**WHEN IGNITABLE COMBUSTIBLE MATERIALS ARE PRESENT, THE ANALYZER ENCLOSURE MUST NOT BE OPENED UNTIL A COOLDOWN IS OBSERVED, OTHERWISE AN EXPLOSION DANGER EXISTS.**
7. WARNING:	**HIGH-PRESSURE GASES SHOULD BE HANDLED WITH EXTREME CARE. ENSURE THAT ALL RELEVANT SAFETY PRECAUTIONS ARE CAREFULLY FOLLOWED FOR GAS LINES, REGULATORS, GAS PURIFIERS, ETC.**

8. WARNING: 	**AFTER CONNECTING THE TUBINGS AND BEFORE CONTINUING WITH INSTALLATION AND OPERATION. ENSURE THE SAMPLE AND ALL GAS FLOW (INSIDE AND OUTSIDE THE ANALYZER) IS LEAK FREE BY PERFORMING A LEAK TEST WITH HELIUM LEAK DETECTOR (RECOMMENDED) OR LIQUID SOLUTION.**
9. WARNING: 	**SEVERE BURNS CAN RESULT WHEN WORKING AROUND A HOT COMBUSTION CHAMBER. ALLOW THE COMBUSTION CHAMBER TO COOL DOWN SUFFICIENTLY BEFORE PERFORMING MAINTENANCE.**
10. WARNING: 	**SEVERE BURNS CAN RESULT WHEN WORKING AROUND A HOT FURNACE. ALLOW THE FURNACE TO COOL DOWN SUFFICIENTLY BEFORE PERFORMING MAINTENANCE.**
11. WARNING: 	**SEVERE BURNS CAN RESULT WHEN REPLACING THE THERMOCOUPLE. ALLOW THE FURNACE TO COOL DOWN SUFFICIENTLY BEFORE PERFORMING MAINTENANCE.**
12. WARNING: 	**SEVERE BURNS CAN RESULT WHEN REPLACING THE HEATERS. ALLOW THE HEATERS TO COOL DOWN SUFFICIENTLY BEFORE PERFORMING MAINTENANCE.**
13. WARNING: 	**THE OXYGEN SENSOR ASSEMBLY IS VERY HOT. SEVERE BURNS CAN RESULT WHEN REPLACING THE OXYGEN SENSOR. ALLOW THE SENSOR TO COOL DOWN SUFFICIENTLY BEFORE PERFORMING MAINTENANCE.**
14. WARNING: 	**SEVERE BURNS CAN RESULT WHEN REPLACING THE SAMPLE VALVE AND SSO/ARV VALVE. ALLOW THE SAMPLE ENCLOSURE TO COOL DOWN SUFFICIENTLY BEFORE PERFORMING MAINTENANCE.**
15. WARNING:	**POTENTIAL ELECTROSTATIC CHARGING HAZARD. WHEN CLEANING THE EXTERIOR PAINTED SURFACE OF THE UNIT IN A HAZARDOUS AREA, USE A DAMP CLOTH TO AVOID POTENTIAL ELECTROSTATIC CHARGING.**
16. CAUTION: 	**BECOME FAMILIAR WITH THE LOCATION AND USE OF ALL CONTROLS, INDICATORS, CONNECTIONS AND ACCESSORIES AND CAREFULLY READ ALL INSTRUCTIONS AND WARNING LABELS PRIOR TO OPERATING ANY PORTION OF THE SYSTEM.**

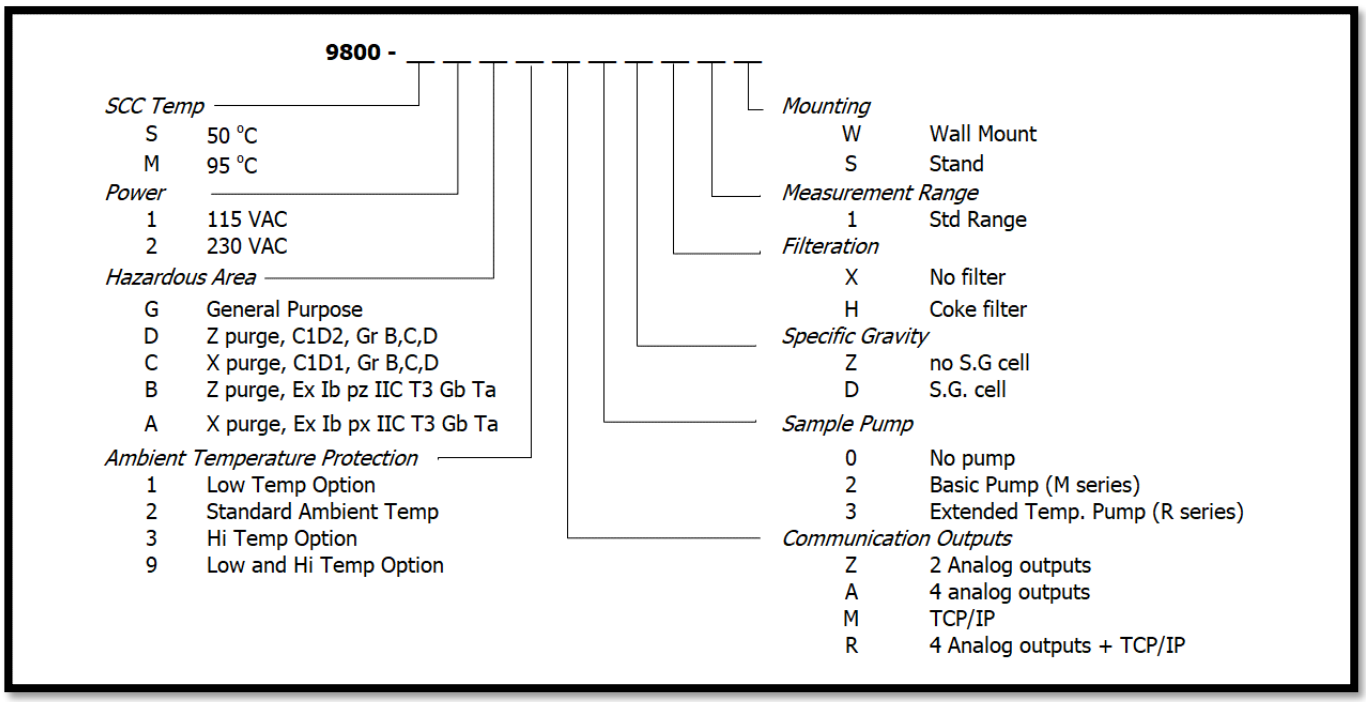
17. CAUTION: 	**THE ANALYZER SHOULD BE SHELTERED FROM DIRECT SUNLIGHT AND PRECIPITATION EXPOSURE.**
18. CAUTION: 	**FOLLOW INSTALLATION DRAWINGS AND SCHEMATICS IN THIS MANUAL BEFORE STARTING THE ANALYZER.**
19. CAUTION: 	**SERIOUS INSTRUMENT DAMAGE CAN OCCUR IF THE OPERATOR IS NOT PROPERLY TRAINED.**
20. CAUTION: 	**DO NOT ATTEMPT TO OPERATE THE ANALYZER UNTIL ALL INSTALLATION AND SETUP PROCEDURES OUTLINED IN THE PREVIOUS LISTED SECTIONS OF THIS MANUAL HAVE BEEN SUCCESSFULLY COMPLETED.**
21. CAUTION: 	**FITTINGS SHOULD BE TIGHTENED ACCORDING TO THE STANDARD INDUSTRY PRACTICE.**
22. CAUTION: 	**DEPRESSURIZE THE SYSTEM BEFORE REMOVING ANY FITTING.**
23. CAUTION: 	**ALL FITTINGS ARE COVERED WITH TAPE WHEN SHIPPING. ENSURE ALL TAPES ARE REMOVED AND DISCARDED TO PREVENT TUBE CLOGGING**
24. CAUTION: 	**DO NOT EXCEED RECOMMENDED PRESSURES. IF HIGHER PRESSURES ARE USED, SEVERE AND IRREPARABLE DAMAGE MAY BE DONE TO COMPONENTS.**
25. CAUTION: 	**AS WITH ANY TOOL, IF NOT USED PROPERLY HAZARD OF PINCH, PUNCTURE AND SQUEZE CAN OCCUR.**
26. CAUTION: 	**ELECTRICAL COMPONENT DAMAGE MAY OCCUR WHEN USING A LIQUID LEAK DETECTOR. CARE SHOULD BE TAKEN NOT TO WET ANY ELECTRICAL OR ELECTRONIC COMPONENTS.**

27. CAUTION: 	**MOST LIQUID LEAK DETECTORS CONTAIN SULFUR COMPOUNDS THAT CAN CONTAMINATE THE GAS SUPPLY LINE AND INSTRUMENT FLOW PATH COMPONENTS. CARE SHOULD BE TAKEN NOT TO WET OR CONTAMINATE THE ANALYTICAL FLOW SYSTEM WHEN USING A LIQUID LEAK DETECTOR.**
28. CAUTION: 	**ONLY A QUALIFIED PERSON SHOULD PERFORM ANY MAINTENANCE WORK ON THE ANALYZER. THE PERSON SHOULD BE HAVE UNDERGONE COMPREHENSIVE TRAINING AND SHOULD BE VERY FAIMILAR WITH THE ANALYZER OPERATION. IDEALLY, ANY MAINTENANCE WORK SHOULD ONLY BE PREFORMED BY A PROCESS INSIGHTS SERVICE ENGINEER.**
29. PROHIBITED: 	**THE ANALYZER SHOULD NOT BE MODIFIED IN ANY WAY. ANY MODIFICATIONS TO THE ANALYZER HARDWARE, ESPECIALLY TO AND FROM THE FURNACE, CAN POTENTIALLY MAKE THE SYSTEM UNSTABLE. MODIFICATIONS TO THE FLOW PATH ARE PROHIBITED AS IT CAN COMPROMISE ANALYZER INTEGRITY AND POSSIBLY CAUSE CATASTROPHIC FAILURE.**

Caution and warning labels placed on the analyzer are listed below. Failure to consider these messages can lead to severe personal injury, instrument damage and/or void of warranty.

	**HOT SURFACE HAZARD**
	**ELECTRIC SHOCK HAZARD**
	**CAUTION. REFER MANUAL BEFORE OPERATING**
	**PROHIBITED**

Section 1.5 – 9800 CXi Part Number



Section 1.6 - Installation

The analyzer installation, start-up, and maintenance are handled through the PROCESS INSIGHTS Service Department. This manual merely provides pre-installation information for the analyzer and should not be used as guidelines to install and start-up the analyzer. It is strongly recommended that a PROCESS INSIGHTS Service Engineer be present during the start-up.

Section 1.6.1 - Installation Checklist

To operate two different 9800 CXi models—standard temperature and mid-temperature—certain basic requirements must be met. The SCS compartment of the standard temperature and mid-temp model are heated to different factory set temperatures.

- Instrument air for valve actuation
- Instrument air for purging enclosure
- Bottled air is not a sustainable source for instrument air
- Zero Air used as reference air
- Calibration Standards – specified per project documentation.
- Sample return line, vent lines tubes per engineering documentation
- AC Power
- DCS to analyzer communication wiring

In case compressed gas is used:

1) The compressor shall be appropriately specified for area classification.

2) The intake line shall be made on non-combustible material if passing through a classified location.
3) The power source should either be:
   a) Supplied before any device capable of de-energizing the equipment.
   b) Or supplied separately.

Section 1.7 – Spare Parts

Section 1.7.1 - 9800 CXi Standard Temperature Spare Parts List

SAMPLE CONDITIONING COMPARTMENT SPARE PART			
Item#	**Replacement Interval**	**PN**	**Description**
1	5 Year	CAL.98.M.10853	Three Stream Switching Valve w/ ARV
2	1-2 Year	CAL.98.M.10849	Diaphragm Valve, 6-Port, 1/16” fitting,.75mm bore
3	5 Year	10618-05002	Particulate and Coalescing Filter, 0.1 µm (Fast Loop)
4	1 Year	CAL.S1.M.11978	Particulate and Coalescing Filter Service Kit (Fast Loop)
5	1 Year	23124-00003	Inline Filter, 1/8T
6	3-5 Year	CAL.98.M.0010	(Air) Filter Regulator
7	1-2 Year	CAL.98.M.0241	Replacement air filter element (for Air Filter Regulator)
8	3-5 Year	CAL.98.M.10800	Flow Indicator 1-30 Slpm W/o Valve (Fast Loop)
9	3-5 Year	CAL.98.M.0315	Flow Indicator,100-1,000ccm, CO2, No Valve
10	3-5 Year	CAL.98.M.0114	Pressure Regulator, 0-60 psi
11	3-5 Year	CAL.98.M.11955	Pressure Regulator, Preset, 45 PSI
12	3-5 Year	ESS.98.M.0213	Pressure Gauge, 0-100psi, 1/8 NPT
13	3-5 Year	CAL.98.M.10916	Pressure Gauge, 0 - 30 PSIG. BTM, 1/4 NPT
14	3-5 Year	CAL.98.M.10902	Pressure Gauge, 0 - 30 PSIG. BTM, 1/8 NPT
15	3-5 Year	CAL.98.M.0162	Air Manifold Valve
16	3-5 Year	23023-00002	Metering Valve, 1/8 in
17	1-2 Year	11258-00001	Thermocouple, Sample Encl (Type K)
18	1-2 Year	60097-00005	Thermocouple, Single, S (Furnace)
19	3 Year	23242-00001	Pressure Switch
20	5 Year	CAL.98.E.0107	Heater, 300W, 120V (qty 2)
21	5 Year	CAL.98.E.0310	Heater, 300W, 230 VAC (qty 2)
22	3 Year	CAL.19.M.12020	Capillary Tubing, 1/16" OD x 0.005" ID x 20 cm L
23	3 Year	CAL.19.M.12021	Capillary Tubing, 1/16" OD x 0.005" ID x 10 cm L
24	3 Year	CAL.19.M.12022	Sample Loop, 200 µL

FURNACE COMPARTMENT SPARE PART			
Item#	**Replacement Interval**	**PN**	**Description**
1	3-5 Year	CAL.S3.M.10601	Furnace Assembly, 110/220 VAC
2	3 Year	CAL.98.E.10720-192	Fuse, Thermal Cutoff

ELECTRONICS COMPARTMENT SPARE PART			
Item#	**Replacement Interval**	**PN**	**Description**
1	5 Year	CAL.98.E.10852	7" HMI (General Purpose)
2	5 Year	CAL.98.E.11919	Hazardous HMI
3	5 Year	CAL.98.E.10847	PLC

4	5 Year	CAL.98.E.10837	CM 1241, RS422/485, 9 PIN SUB D (FEMALE)
5	5 Year	CAL.98.E.10838	Analog Input SM 1231, 65mA, 4ch
6	5 Year	CAL.98.E.10840	Analog Output SM 1232, 4ch
7	5 Year	CAL.98.E.10841	AC-DC, 24V, 5A, 100-240V In, Din Rail Mount, Smart
8	5 Year	CAL.98.E.10846-10	Programmed Temperature Controller
9	5 Year	CAL.98.E.10836	Compact Switch Module Siemens CSM 1277
10	5 Year	CAL.98.E.10867-10	Programmed Amplifier, O2 Sensor, 24VDC, 9800 Calorimeter
11	1 Year	CAL.98.M.11998	Spare Oxygen Sensor, 150 VAC, CAL 9800
12	1 Year	CAL.98.M.11999	Spare Oxygen Sensor, 230 VAC, CAL 9800
13	5 Year	CAL.98.E.0071	Surge Protector, 115 VAC
13	5 Year	CAL.98.E.0072	Surge Protector, 230 VAC
14	1 Year	CAL.98.E.0123	Thermocouple
15	5 Year	CAL.98.E.0059	Relay, Power, SPDT, 24 VDC, 6 A (for Global Alarm)
16	5 Year	CAL.98.E.0075	Relay, Solid State, SPST-NO, 10 A, 280 VAC, DIN Rail
17	N/A	CAL.S1.E.11944	Fuse Kit, 115 VAC, CAL 9800,
18	N/A	CAL.S1.E.11945	Fuse Kit, 230 VAC, CAL 9800

PURGE			
Item#	**Replacement Interval**	**PN**	**Description**
1	5 Year	23135-00001	Z - Purge
2	5 Year	23135-00005	X - Purge, 115 VAC
3	5 Year	23135-00003	X - purge, 230 VAC
4	5+ Year	11254-00001	Purge Backup Vent
4	5 Year	CAL.98.M.0008	Flame Arrestor, UL CSA
5	5 Year	CAL.98.M.12014	Flame Arrestor, ATEX/ IECEx
6	5 Year	11526-00001	Relay, Din Rail, 24 VDC, 8A

Density Meter			
Item#	**Replacement Interval**	**PN**	**Description**
1	5+ Year	CAL.98.M.0003	Oval Density Meter
2	5 Year	CAL.98.E.10844	Safe Barrier, MTL 7715+
3	5 Year	CAL.98.E.10845	Safe Barrier, MTL 7710+
4	5 Year	CAL.98.E.10843	Frequency Transducer
5	5 Year	CAL.98.M.10801	Flow Indicator,100-1,000ccm, with Valve
6	5 Year	CAL.98.E.10842	AC-DC, 1-Ph, 12V, 2A, 230VAC/120-240VDC

Pump			
Item#	**Replacement Interval**	**PN**	**Description**
1	3-5 Year	CAL.98.M.10895	Pump, Basic, CAL 9800 (M series)
2	1 Year	CAL..98.M.11943	M – pump service kit
3	3-5 Year	CAL.98.M.0015	HD Pump C1D2, 115/230 VAC (R series)
4	1 Year	CAL.98.M.0224	Kit, Pump Repair, Diaphragm, PTFE (R pump)
5	3-5 Year	CAL.98.M.11974	HD Pump, 115/230 VAC, ATEX IECEx
6	3-5 Year	XD0.98.M.5022	Coalescing Filter
7	1 Year	XD0.98.M.5023	Service Filter Element
8	3-5 Year	CAL.98.M.0117	Check Valve
9	3-5 Year	CHA.98.M.0013	Back Pressure Regulator - 0-10 psig

Heater & Cooler			
Item#	**Replacement Interval**	**PN**	**Description**
1	5 Year	CAL.70.M.0032	Electronics Cabinet Heater, 115 VAC
2	5 Year	CAL.98.E.10776	Electronics Cabinet Heater, 230 VAC
2	5 Year	CAL.98.M.10922	Vortex Cooler, UL, CSA
3	5 Year	CAL.98.M.11933	Vortex Cooler, ATEX/ IECEx

Section 1.7.2 - 9800 CXi Mid Temperature Spare Parts List

SCC SPARE PART			
Item#	**Replacement Interval**	**PN**	**Description**
1	5 Year	CAL.98.M.10853	Three Stream Switching Valve w/ ARV
2	1-2 Year	CAL.98.M.10849	Diaphragm Valve, 6-Port, 1/16” fitting,.75mm bore
3	5 Year	10618-05002	Particulate and Coalescing Filter, 0.1 µm (Fast Loop)
4	1 Year	CAL.S1.M.11978	Particulate and Coalescing Filter Service Kit (Fast Loop)
5	1 Year	23124-00003	Inline Filter, 1/8T
6	3-5 Year	CAL.98.M.0010	(Air) Filter Regulator
7	1-2 Year	CAL.98.M.0241	Replacement air filter element (for Air Filter Regulator)
8	3-5 Year	CAL.98.M.0315	Flow Indicator,100-1,000ccm, CO2, No Valve
9	3-5 Year	23109-06005	REGULATOR, PRESSURE, 0-25
10	3-5 Year	CAL.98.M.0101	Regulator, 100 psi
11	3-5 Year	CAL.98.M.11955	Pressure Regulator, Preset, 45 PSI
12	3-5 Year	CAL.98.M.12053	Pressure Gauge, 0-30 psi, 1/4" NPT, BTM Conn, 302 F (qty 2)
13	3-5 Year	CAL.98.M.11983	Pressure Gauge, 0-100 psi, 1/4" NPT, BTM Conn, 302 F
14	3-5 Year	CAL.98.M.0162	Air Manifold Valve (qty 2)
15	3-5 Year	23023-00002	Metering Valve, 1/8 in
16	1-2 Year	11258-00001	Thermocouple, Sample Encl (Type K)
17	1-2 Year	60097-00005	Thermocouple, Single, S (Furnace)
18	3 Year	23242-00001	Pressure Switch

19	5 Year	CAL.98.E.12051	HEATER, 300 W, 115 VAC, 3 m cable, Bi Standard (qty 2)
20	5 Year	CAL.98.E.12052	HEATER, 300 W, 230 VAC, 3 m cable, Bi Standard (qty 2)
21	3 Year	CAL.19.M.12020	Capillary Tubing, 1/16" OD x 0.005" ID x 20 cm L
22	3 Year	CAL.19.M.12021	Capillary Tubing, 1/16" OD x 0.005" ID x 10 cm L
23	3 Year	CAL.19.M.12022	Sample Loop, 200 µL
24	3-5 Year	CAL.98.M.11948	Eductor, MIDTEMP, CAL9800

FURNACE COMPARTMENT SPARE PART			
Item#	**Replacement Interval**	**PN**	**Description**
1	3-5 Year	CAL.S3.M.10601	Furnace Assembly, 110/220 VAC
2	3 Year	CAL.98.E.10720-192	Fuse, Thermal Cutoff

ELECTRONICS COMPARTMENT SPARE PART			
Item#	**Replacement Interval**	**PN**	**Description**
1	5 Year	CAL.98.E.10852	7" HMI (General Purpose)
2	5 Year	CAL.98.E.11919	Hazardous HMI
3	5 Year	CAL.98.E.10847	PLC
4	5 Year	CAL.98.E.10837	CM 1241, RS422/485, 9 PIN SUB D (FEMALE)
5	5 Year	CAL.98.E.10838	Analog Input SM 1231, 65mA, 4ch
6	5 Year	CAL.98.E.10840	Analog Output SM 1232, 4ch
7	5 Year	CAL.98.E.10841	AC-DC, 24V, 5A, 100-240V In, Din Rail Mount, Smart
8	5 Year	CAL.98.E.10846-10	Programmed Temperature Controller
9	5 Year	CAL.98.E.10836	Compact Switch Module Siemens CSM 1277
10	5 Year	CAL.98.E.10867-10	Programmed Amplifier, O2 Sensor, 24VDC, 9800 Calorimeter
11	1 Year	CAL.98.M.11998	Spare Oxygen Sensor, 150 VAC, CAL 9800
12	1 Year	CAL.98.M.11999	Spare Oxygen Sensor, 230 VAC, CAL 9800
13	5 Year	CAL.98.E.0071	Surge Protector, 115 VAC
13	5 Year	CAL.98.E.0072	Surge Protector, 230 VAC
14	1 Year	CAL.98.E.0123	Thermocouple
15	5 Year	CAL.98.E.0059	Relay, Power, SPDT, 24 VDC, 6 A (for Global Alarm)
16	5 Year	CAL.98.E.0075	Relay, Solid State, SPST-NO, 10 A, 280 VAC, DIN Rail
17	N/A	CAL.S1.E.11944	Fuse Kit, 115 VAC, CAL 9800,
18	N/A	CAL.S1.E.11945	Fuse Kit, 230 VAC, CAL 9800

PURGE			
Item#	**Replacement Interval**	**PN**	**Description**
1	5 Year	23135-00001	Z - Purge
2	5 Year	23135-00005	X - Purge, 115 VAC
3	5 Year	23135-00003	X - purge, 230 VAC
4	5+ Year	11254-00001	Purge Backup Vent
4	5 Year	CAL.98.M.0008	Flame Arrestor, UL CSA
5	5 Year	CAL.98.M.12014	Flame Arrestor, ATEX/ IECEx
6	5 Year	11526-00001	Relay, Din Rail, 24 VDC, 8A

Density Meter			
Item#	**Replacement Interval**	**PN**	**Description**
1	5+ Year	CAL.98.M.12015	Oval Density Cell, High Temp, PTFE
2	5 Year	CAL.98.E.10844	Safe Barrier, MTL 7715+
3	5 Year	CAL.98.E.10845	Safe Barrier, MTL 7710+
4	5 Year	CAL.98.E.10843	Frequency Transducer
5	5 Year	CAL.98.M.10801	Flow Indicator,100-1,000ccm, with Valve
6	5 Year	CAL.98.E.10842	AC-DC, 1-Ph, 12V, 2A, 230VAC/120-240VDC

Section 1.8 – Recommended PM and Consumable Spare Parts and List

Section 1.8.1 - 9800 CXi Standard Temperature Spare Parts List

Recommended 9800 CXi Standard Temperature PM and Consumable Spare Parts List			
Item#	**Replacement Interval**	**PN**	**Description**
1	1 Year*	CAL.S1.M.11978	Particulate and Coalescing Filter Service Kit (Fast Loop)
2	1 Year*	CAL.98.M.0241	Replacement air filter Element (for Air Filter Regulator)
3	1 Year*	23124-00003	Inline Filter, 1/8T
4	1 Year	CAL.98.M.11998	Spare 115 VAC Sensor Detector Unit
5	1 Year	CAL.98.M.11999	Spare 230 VAC Sensor Detector Unit
6	1 Year	CAL..98.M.11943	Service Kit, Pump, CAL 9800 (M Pump)
7	1 Year	CAL.98.M.0224	Kit, R Pump Repair, Diaphragm, PTFE (UL, CSA)
8	1 Year	CAL.98.M.12076	Service Kit, HD Pump, 115/230 VAC, ATEX IECEx
9	1-2 Year	11258-00001	Thermocouple, Sample Encl (Type K)
10	1-2 Year	60097-00005	Thermocouple, Single, S (Furnace)
11	1-2 Year	CAL.98.M.10849	Diaphragm Valve, 6-Port, 1/16” fitting,.75mm bore
12	1-3 Year	CAL.S1.E.11944	Fuse Kit, 115 VAC, CAL 9800
13	1-3 Year	CAL.S1.E.11945	Fuse Kit, 230 VAC, CAL 9800
14	3 Year	CAL.98.E.10720-192	Fuse, Thermal Cutoff
15	3-5 Year	CAL.S3.M.10601	Furnace Assembly, 110/220 VAC

Section 1.8.2 - 9800 CXi Mid Temperature Spare Parts List

Recommended 9800 CXi Mid Temperature PM and Consumable Spare Parts List			
Item#	**Replacement Interval**	**PN**	**Description**
1	1 Year*	CAL.S1.M.11978	Particulate and Coalescing Filter Service Kit (Fast Loop)
2	1 Year*	CAL.98.M.0241	Replacement air filter Element (for Air Filter Regulator)
3	1 Year*	23124-00003	Inline Filter, 1/8T
4	1 Year	CAL.98.M.11998	Spare 115 VAC Sensor Detector Unit
5	1 Year	CAL.98.M.11999	Spare 230 VAC Sensor Detector Unit
6	1 Year	CAL.98.M.0224	Kit, R Pump Repair, Diaphragm, PTFE (UL, CSA)
7	1 Year	CAL.98.M.12076	Service Kit, HD Pump, 115/230 VAC, ATEX IECEx
8	1-2 Year	11258-00001	Thermocouple, Sample Encl (Type K)
9	1-2 Year	60097-00005	Thermocouple, Single, S (Furnace)
10	1-2 Year	CAL.98.M.10849	Diaphragm Valve, 6-Port, 1/16” fitting,.75mm bore
11	1-3 Year	CAL.S1.E.11944	Fuse Kit, 115 VAC, CAL 9800
12	1-3 Year	CAL.S1.E.11945	Fuse Kit, 230 VAC, CAL 9800
13	3 Year	CAL.98.E.10720-192	Fuse, Thermal Cutoff
14	3-5 Year	CAL.S3.M.10601	Furnace Assembly, 110/220 VAC

**** These are the minimum recommended replacement intervals; customers are urged to use their discretion to choose the schedule for parts replacement. This only lists typical recommended parts, any other parts if needed, will be additional. Please take this into account when planning for budgetary purposes.***

Section 1.9 - Warranty

PROCESS INSIGHTS warrants that all products supplied will be of merchantable quality and will comply with the specification agreed for them.

PROCESS INSIGHTS offers warranty for a period of twelve months from installation of the product or fifteen months from delivery to the customer, whichever is the shorter, all Products and spare parts sold hereunder.

PROCESS INSIGHTS will repair or replace defective and/or nonconforming parts without charge for material or labor service during the warranty period.

Products that have been repaired or replaced during the warranty period are themselves warranted only for the remaining portion of the original one (1) year.

Repairs, adjustments and service performed after the expiration of the one (1) year warranty period shall be charged to the owner/purchaser at the then current prices for parts, labor, and travel related expenses.

Exceptions to this warranty are:

- Defects, damage, or nonconformity resulting from abuse, misuse, neglect, lack of reasonable care, unauthorized modification, or the attachment of improper devices to the products.
- Installation, operation, and maintenance of the products in a manner that does not meet PROCESS INSIGHTS specifications will void this warranty.
- All requests for service or repair under this warranty must be received within the warranty period by PROCESS INSIGHTS or its authorized representative.

The warranties contained in this agreement are in lieu of all other warranties, expressed or implied, including the warranties of merchantability and fitness for a particular purpose.

Statements made by any persons, including representatives of PROCESS INSIGHTS, which are inconsistent or in conflict with the terms of this warranty shall not be binding upon PROCESS INSIGHTS unless reduced to writing and approved by an officer of the company.

Liability covered under this warranty is limited to the original cost of the PROCESS INSIGHTS supplied equipment. PROCESS INSIGHTS will not be liable for consequential damages including but not limited to loss of production, throughput, or off specification product due to user or equipment error.

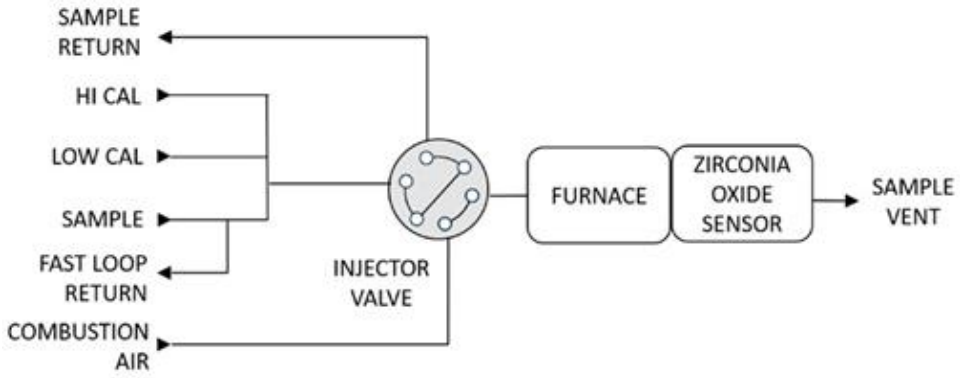
This warranty shall be governed by and construed in accordance with the laws of the State of Texas.

Section 2 – Principle of Operation, Specifications, and Drawings

Section 2.1 – Principle of Operation: Residual Oxygen Measurement

The PROCESS INSIGHTS 9800CXi™ Calorimeter uses the measuring principle based on the analysis of the residual oxygen content in fuel or flare gas after combustion of the sample. A small constant volume of sample gas is injected into a continuous flow of combustion air with each measurement cycle, providing a precisely maintained air/fuel ratio profile.

The air-fuel mixture is oxidized in the combustion furnace and the residual oxygen concentration of the combustion sample is measured by a Zirconia Oxide sensor. The residual oxygen provides an accurate method of measuring Heating Value with optional measurement of WOBBE Index correlated to Specific Gravity of the sample gas. Higher temperature reduces the maintenance of the instrument.



The majority of the sample gas will return to the process gas stream through the fast loop so there is no hazardous hydrocarbon emission. Only a small amount of sample gas and air mixture is completely burned in the combustion process resulting in extremely low, non-hazardous (CO2) emissions.

Section 2.2 - Features

Features

- Zero HC Emissions
- Fast Response Injection Style
- Direct Measurement of Calorific Heating Value
- BTU Measurement Range 0-3000 BTU/scf
- Handles High Sulfur Concentrations
- H2 Measurement Option
- Industrial PLC System, Touchscreen HMI
- High Temperature Combustion
- Flameless / No Flameouts

- Built for Indoor and Outdoor Environments
- Precise Measurement of Air Fuel Ratio

Additional Features

- Compact, sturdy O2 Cell is designed to be cost-effective.
- Analyzer layout designed for ease of maintenance and service.
- Internal sample system with multiple temperature option.
- Full measurement range 0-3000 BTU/scf without the need for a specific gravity meter

Section 2.3 - Analyzer Construction

The 9800CXi Calorimeter is housed in a powder-coated NEMA4x (IP65) cabinet suitable for outdoor installations without additional temperature-controlled shelter. For extreme climate conditions, the standard operating temperature range of the 9800CXi Calorimeter can be extended with the addition of a cabinet heater and/or vortex cooler. The enclosure is wall-mounted with an optional stand. The analyzer cabinet has three compartments:

- Sample Enclosure (air/fuel mixing, gas selection manifold, sample injection)
- Furnace Enclosure (complete sample combustion)
- Electronics Enclosure (all electronics components – PLC, HMI, etc.)

The Sample Enclosure contains the sample selection, the gas mixing system, and the sample injection valve. The components in this compartment are intrinsically safe. The Sample Enclosure is heated to reduce the probability of condensation of heavier hydrocarbons. The Sample Enclosure is designed to maintain the sample in a gas phase for injecting a representative sample during each injection.

The Electronics and Furnace enclosures can optionally be purged for installation in area-classified locations.

The Electronics Enclosure contains the Zirconia Oxide sensor assembly as well as the industrial PLC system and touchscreen HMI. The PLC and its I/O modules perform all instrumentation control functions and calculations. The results are displayed on the touchscreen HMI and are discussed further in this manual. The available results are Heating Value, WOBBE Index in BTU/SCF or MJ/Nm3, Residual O2 in %, O2 Cell voltage in mV, Specific Gravity (optional), and CARI (Combustion Air Requirement Index). The analyzer also provides 4 Analog Output channels that can be individually configured for the required process value. In addition, the analyzer is Modbus-ready and provides all process data via Modbus over TCP/IP. The Modbus map is discussed in a later section of this manual.

The 9800CXi Calorimeter is a low-maintenance analyzer designed to minimize service downtime. The analyzer is PLC-based thereby reducing the number of electronic components required to be maintained and stocked. It is not necessary to power down the furnace to replace the O2 sensor, thereby minimizing the sensor replacement time. The higher furnace temperature ensures complete oxidization of any molecular-bound Sulfur compounds, virtually eliminating the typical accumulation of un-combusted Sulfur products in the furnace vent thereby reducing instrument maintenance. In conjunction with proper sample conditioning, the 9800CXi is designed to operate unattended for extended periods.

Section 2.4 - Specifications

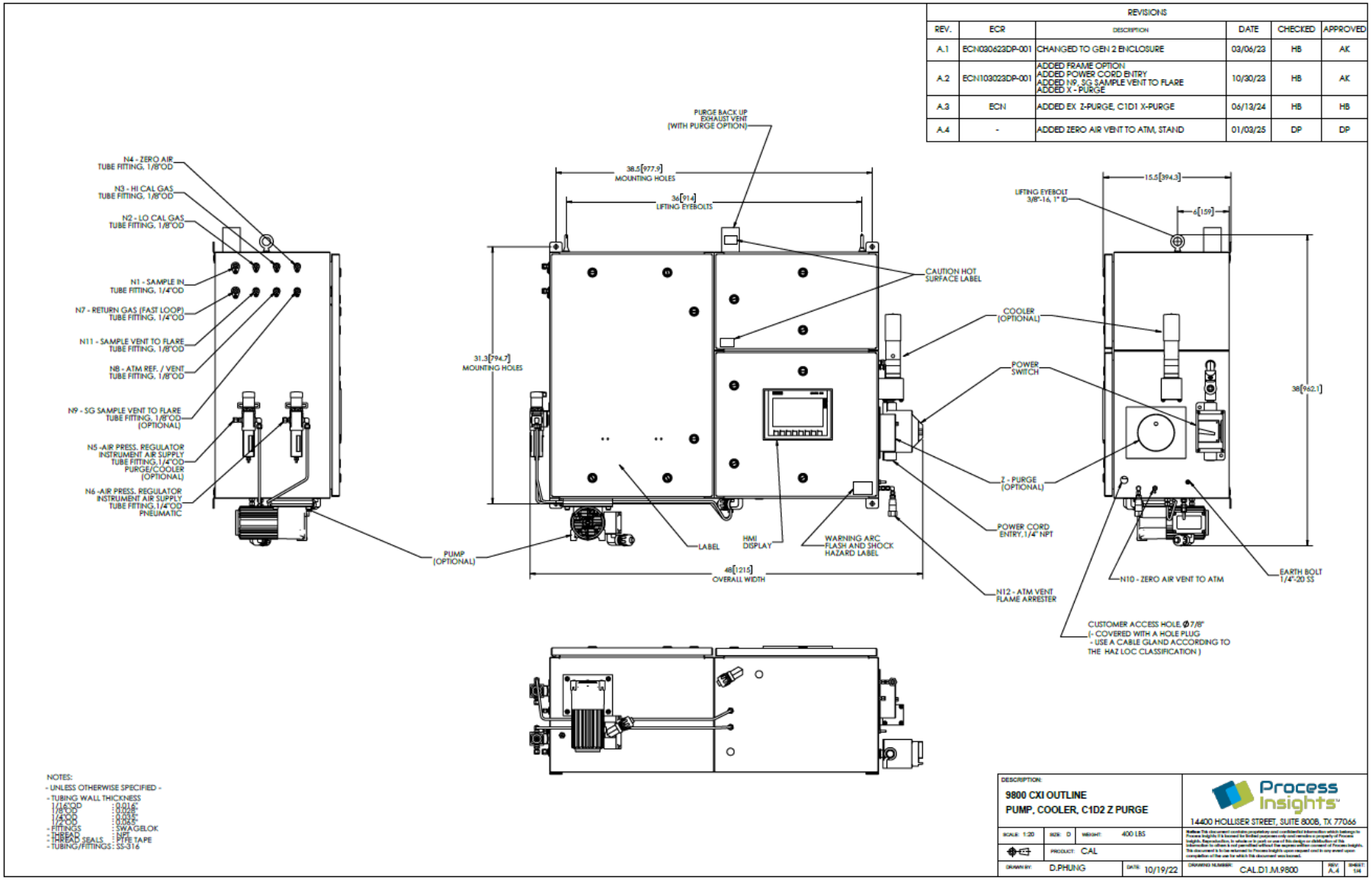
Model:	**9800CXi Calorimeter**
Sample Gas:	Natural gas, Fuel gas, Refinery gas, Biogas, Flare gas, etc.
Heating Value:	0-3000 BTU/SCF (0-118 MJ/Nm3)
Wobbe Index:	0-2750 BTU/SCF (0-108 MJ/Nm3)
CARI Index:	0-20
Specific Gravity (optional):	Range: 0.2-2.2 RSD
Accuracy:	± 1% full scale
Repeatability:	±0.5 of measured values
Response Time:	< 30 sec
Power Supply option (max):	115 Vac, 20 A, 60 Hz, +/-10% 230 Vax, 10 A, 50 Hz, +/-10%
Outputs/Inputs:	2 Analog Outputs, 4 Analog Outputs (optional), 4 Digital Outputs
Communication:	Modbus over TCP/IP
Enclosure:	IP65 NEMA 4X
Hazardous Areas:	Z purge, C1D2, Gr B,C,D X purge, C1D1, Gr B,C,D Z purge, Ex Ib pz IIC T3 Gb Ta X purge, Ex Ib px IIC T3 Gb Ta
Dimensions:	Std temp: 30" H x 40" W x 14" D (762mm x 1016mm x 356 mm) Mid Temp: 36" H x 54" W x 15.5" D (762mm x 1117mm x 356mm)
Weight (w/o frame):	Std Temp: 350 lbs. (158 kg) Mid Temp: 400 lbs (180 kg)
Mounting:	Wall mount with optional stand
Location:	Indoor or Outdoor. If outdoor, a three-sided shelter is recommended.
Ambient Temperature:	Standard: 0°C (32°F) to +40°C (104°F), Configuration dependent: -20°C (-4°F) to +55°C (104°F)
Altitude	Maximum 2000m above sea level
Humidity	0-80%
Pollution degree	2
Transient overvoltage	Overvoltage Category II
Air Consumption:	180 SCFH (Analyzer), 296 SCFH (with Purge) @ 80 psig
Instrument grade Air	(Dry, dirt-free, Particles ≤ 5µ, oil-free, ISA grade Hydrocarbon free and -40^{o}C /-40^{o}F dew point) Pneumatics: 80 - 100 psig Purge/Cooler: 80 - 100 psig Air Amplifier (Mid Temp only): 80 - 100 psig
Zero grade Air	Cylinder Size 300, Total Hydrocarbons < 0.1 PPM (Air is a colorless, odorless, nonflammable gas. A synthetic blend of oxygen and nitrogen): 80 - 100 psig

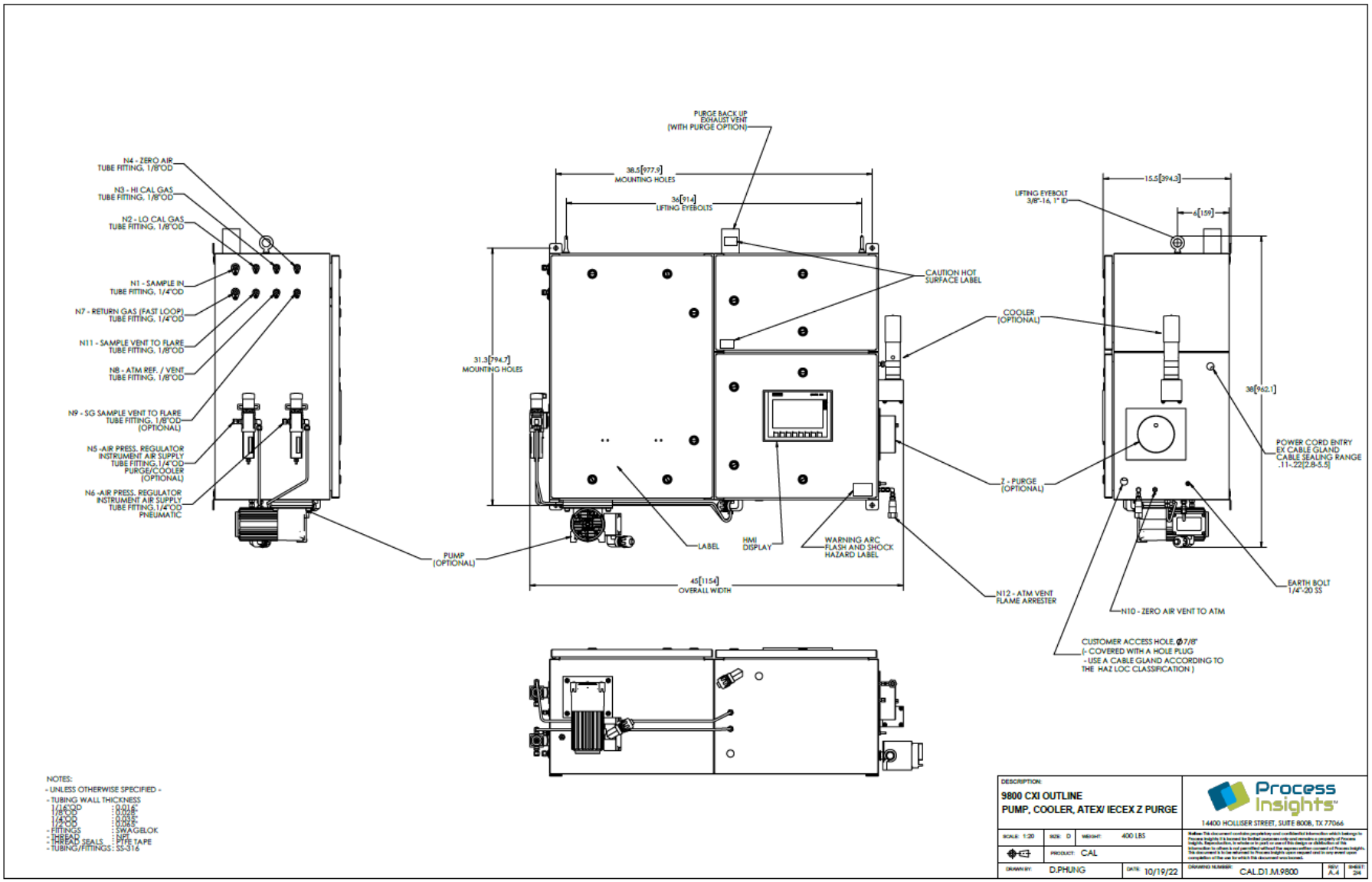
Sample	5 - 60 psig (Sample usage 200 µL / 30 sec)
Calibration Gases	5 - 10 psig
Furnace temperature	1000°C
SCS Temperature	Standard: 50°C Mid-Temp: 95°C
9800 CXi Standard Temperature Setpoint	O2 Sensor Temperature: 800°C Furnace Temperature: 1000°C Sample Temperature: 50°C Electronics Temperature: 45°C (monitored only)
9800 CXi Mid Temperature Setpoint	O2 Sensor Temperature: 800°C Furnace Temperature: 1000°C Sample Temperature: 95°C Electronics Temperature: 45°C (monitored only)
Purge Dilution Time	30 minutes
Minimum enclosure overpressure setting	0.3 inch H_2O (1.25 mbar)

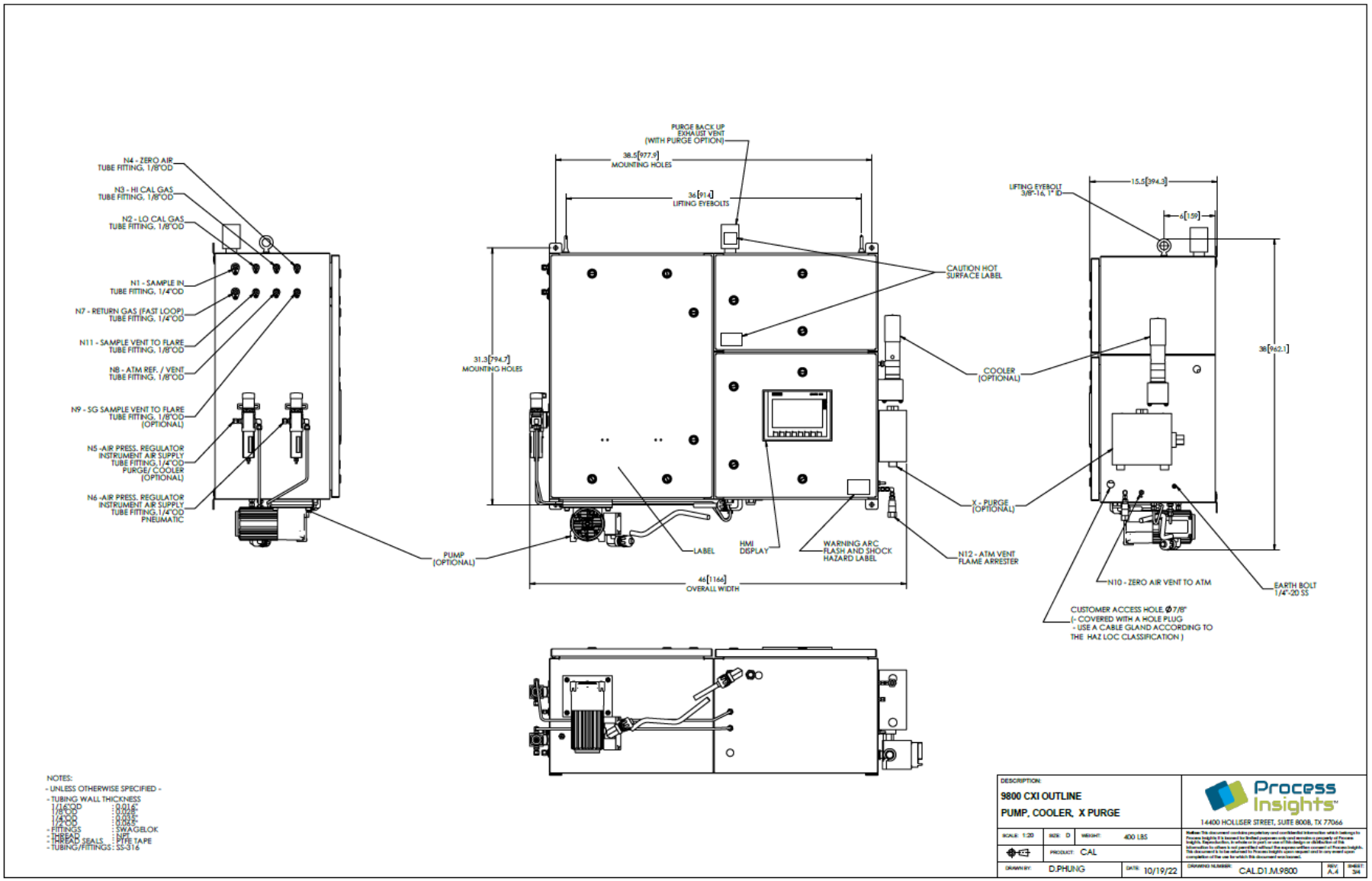
Section 2.5 - Drawings

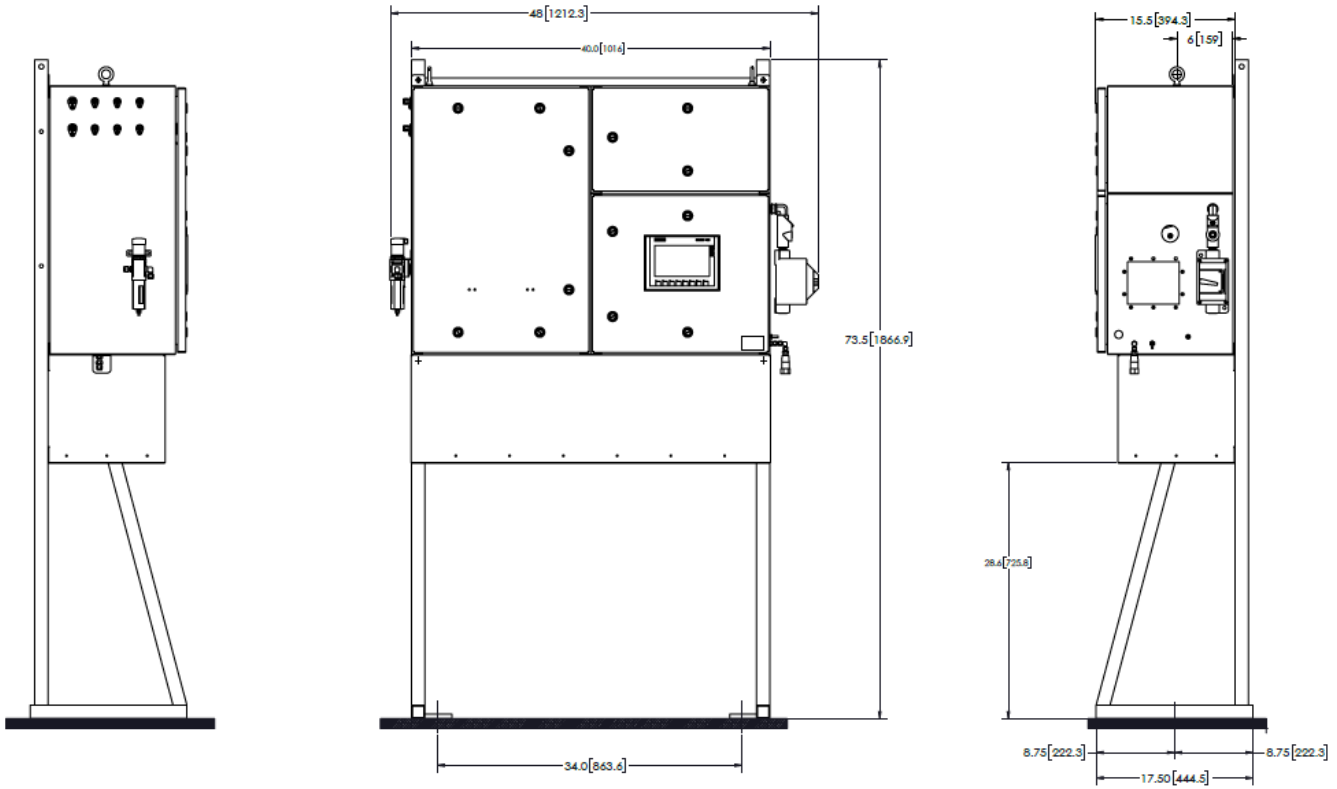
Section 2.5.1 – 9800 CXi Calorimeter Outline (Generic)

9800 CXi Standard Temp Calorimeter Outline




N4 - ZERO AIR
TUBE FITTING, 1/8"OD
N3 - HI CAL GAS
TUBE FITTING, 1/8"OD
N2 - LO CAL GAS
TUBE FITTING, 1/8"OD
N1 - SAMPLE IN
TUBE FITTING, 1/4"OD
N7 - RETURN GAS (FAST LOOP)
TUBE FITTING, 1/4"OD
N11 - SAMPLE VENT TO FLARE
TUBE FITTING, 1/8"OD
N8 - ATM REF. / VENT
TUBE FITTING, 1/8"OD
N9 - SG SAMPLE VENT TO FLARE
TUBE FITTING, 1/8"OD
(OPTIONAL)
N5 -AIR PRESS. REGULATOR
INSTRUMENT AIR SUPPLY
TUBE FITTING, 1/4"OD
PURGE/COOLER
(OPTIONAL)
N6 -AIR PRESS. REGULATOR
INSTRUMENT AIR SUPPLY
TUBE FITTING, 1/4"OD
PNEUMATIC
PUMP
(OPTIONAL)
PURGE BACK UP
EXHAUST VENT
(WITH PURGE OPTION)
38.5[977.9]
MOUNTING HOLES
36[914]
LIFTING EYEBOLTS
31.3[794.7]
MOUNTING HOLES
CAUTION HOT
SURFACE LABEL
LABEL
HMI
DISPLAY
WARNING ARC
FLASH AND SHOCK
HAZARD LABEL
45[1154]
OVERALL WIDTH
15.5[394.3]
LIFTING EYEBOLT
3/8"-16, 1" ID
6[159]
COOLER
(OPTIONAL)
38[962.1]
POWER CORD ENTRY
EX CABLE GLAND
CABLE SEALING RANGE
.11-.22[2.8-5.5]
Z - PURGE
(OPTIONAL)
N12 - ATM VENT
FLAME ARRESTER
EARTH BOLT
1/4"-20 SS
N10 - ZERO AIR VENT TO ATM
CUSTOMER ACCESS HOLE, Ø7/8"
(- COVERED WITH A HOLE PLUG
- USE A CABLE GLAND ACCORDING TO
THE HAZ LOC CLASSIFICATION)
NOTES:
- UNLESS OTHERWISE SPECIFIED -
- TUBING WALL THICKNESS
1/16"OD : 0.016"
1/8"OD : 0.028"
1/4"OD : 0.035"
1/2"OD : 0.065"
- FITTINGS : SWAGELOK
- THREAD : NPT
- THREAD SEALS : PTFE TAPE
- TUBING/FITTINGS : SS-316
DESCRIPTION:
9800 CXI OUTLINE
PUMP, COOLER, ATEX/ IECEX Z PURGE
SCALE: 1:20
SIZE: D
WEIGHT: 400 LBS
PRODUCT: CAL
DRAWN BY: D.PHUNG
DATE: 10/19/22
Process Insights
14400 HOLLISER STREET, SUITE 800B, TX 77066
DRAWING NUMBER: CAL.D1.M.9800
REV: A.4
SHEET: 2/4


N4 - ZERO AIR
TUBE FITTING, 1/8"OD
N3 - HI CAL GAS
TUBE FITTING, 1/8"OD
N2 - LO CAL GAS
TUBE FITTING, 1/8"OD
N1 - SAMPLE IN
TUBE FITTING, 1/4"OD
N7 - RETURN GAS (FAST LOOP)
TUBE FITTING, 1/4"OD
N11 - SAMPLE VENT TO FLARE
TUBE FITTING, 1/8"OD
N8 - ATM REF. / VENT
TUBE FITTING, 1/8"OD
N9 - SG SAMPLE VENT TO FLARE
TUBE FITTING, 1/8"OD
(OPTIONAL)
N5 -AIR PRESS. REGULATOR
INSTRUMENT AIR SUPPLY
TUBE FITTING, 1/4"OD
PURGE/ COOLER
(OPTIONAL)
N6 -AIR PRESS. REGULATOR
INSTRUMENT AIR SUPPLY
TUBE FITTING, 1/4"OD
PNEUMATIC
PUMP
(OPTIONAL)
PURGE BACK UP
EXHAUST VENT
(WITH PURGE OPTION)
38.5[977.9]
MOUNTING HOLES
36[914]
LIFTING EYEBOLTS
31.3[794.7]
MOUNTING HOLES
CAUTION HOT
SURFACE LABEL
COOLER
(OPTIONAL)
X - PURGE
(OPTIONAL)
N12 - ATM VENT
FLAME ARRESTER
LABEL
HMI
DISPLAY
WARNING ARC
FLASH AND SHOCK
HAZARD LABEL
46[1166]
OVERALL WIDTH
LIFTING EYEBOLT
3/8"-16, 1" ID
15.5[394.3]
6[159]
38[962.1]
N10 - ZERO AIR VENT TO ATM
EARTH BOLT
1/4"-20 SS
CUSTOMER ACCESS HOLE Ø7/8"
(- COVERED WITH A HOLE PLUG
- USE A CABLE GLAND ACCORDING TO
THE HAZ LOC CLASSIFICATION)
NOTES:
- UNLESS OTHERWISE SPECIFIED -
- TUBING WALL THICKNESS
1/4"OD : 0.035"
1/8"OD : 0.028"
1/4"OD : 0.035"
1/4"OD : 0.065"
- FITTINGS : SWAGELOK
- THREAD : NPT
- THREAD SEALS : PTFE TAPE
- TUBING/FITTINGS: SS-316
DESCRIPTION:
9800 CXI OUTLINE
PUMP, COOLER, X PURGE
Process Insights
14400 HOLLISER STREET, SUITE 800B, TX 77066
SCALE: 1:20
SIZE: D
WEIGHT: 400 LBS
PRODUCT: CAL
DRAWN BY: D.PHUNG
DATE: 10/19/22
DRAWING NUMBER: CAL.D1.M.9800
REV: A.4
SHEET: 3/4



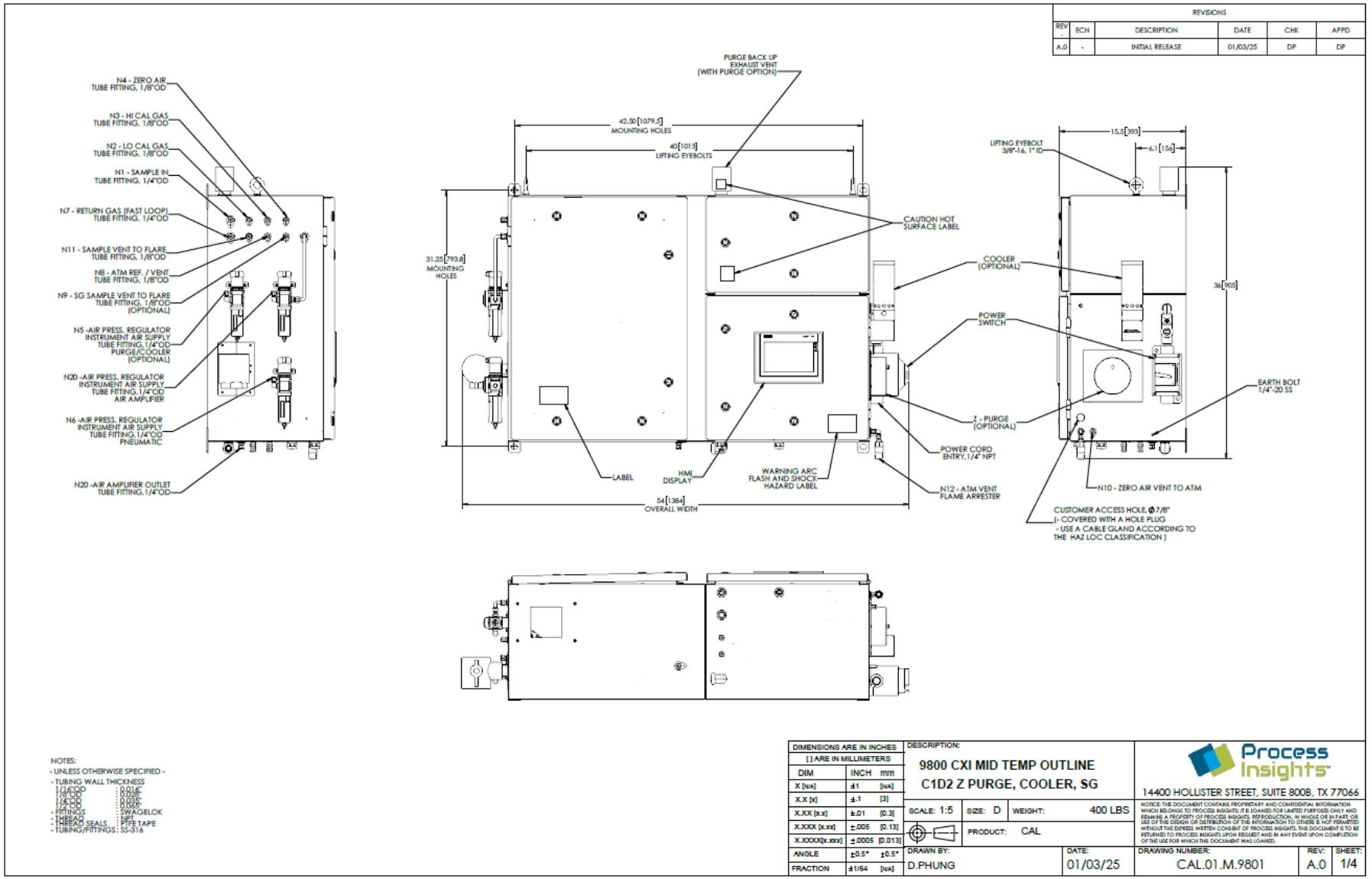
NOTES:
- UNLESS OTHERWISE SPECIFIED -
- TUBING WALL THICKNESS
1/4"OD : 0.014"
1/8"OD : 0.028"
1/4"OD : 0.035"
1/4"OD : 0.065"
- FITTINGS : SWAGELOK
- THREAD : NPT
- THREAD SEALS : PTFE TAPE
- TUBING/FITTINGS : SS-316

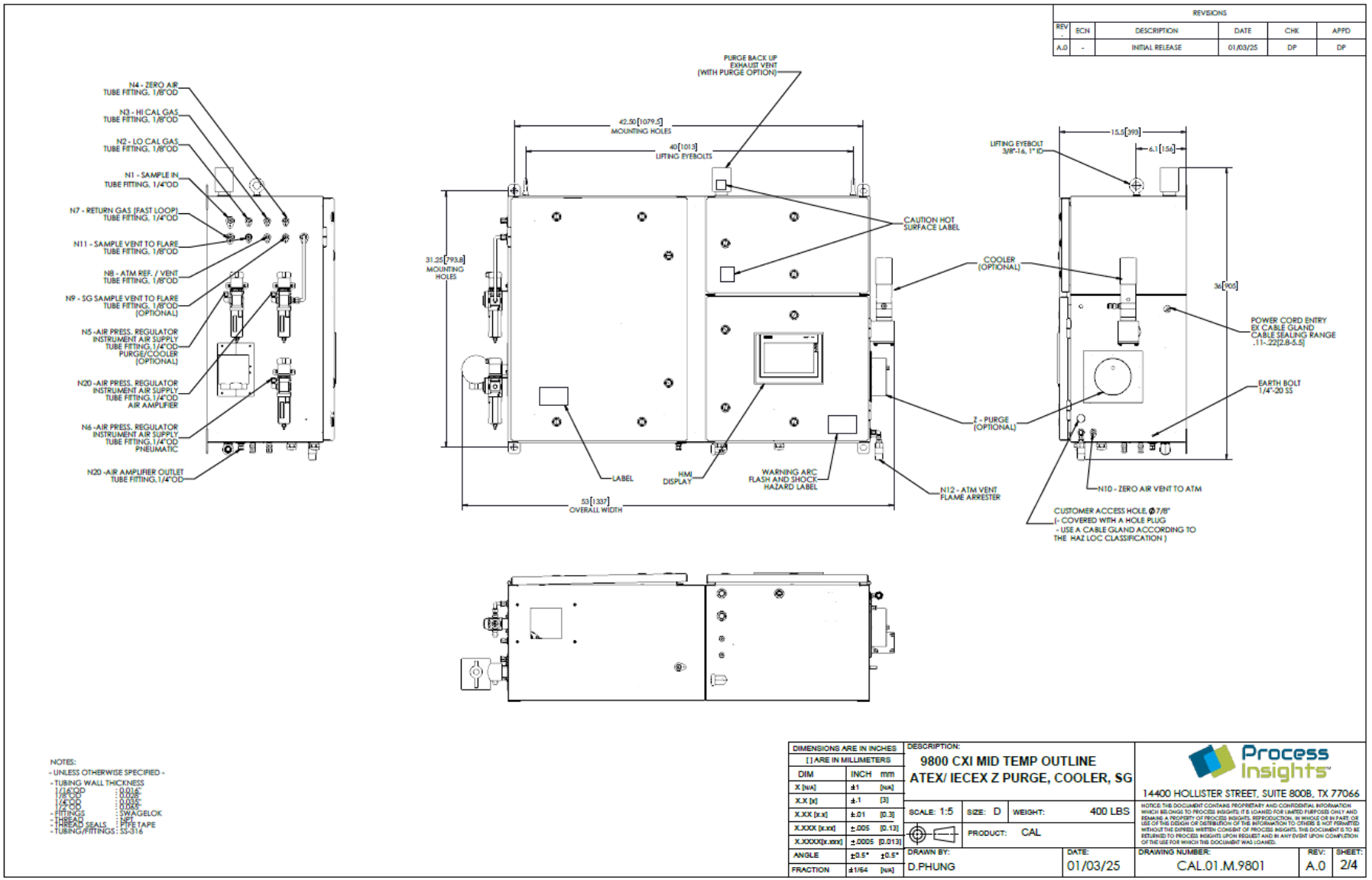
DESCRIPTION:
9800 CXI OUTLINE
PUMP, COOLER, C1D1 Z PURGE

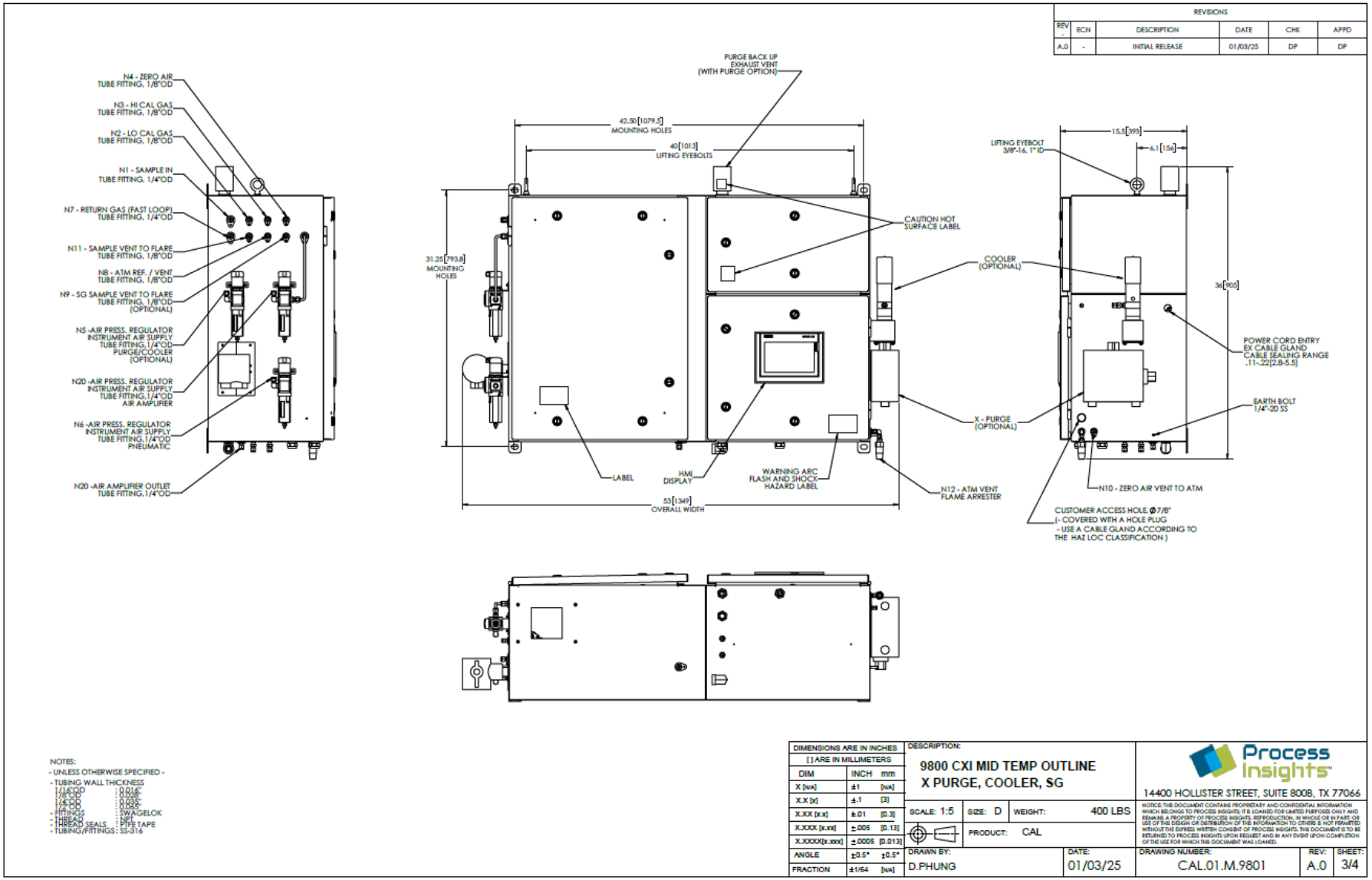
Process Insights™
14400 HOLLISER STREET, SUITE 800B, TX 77066

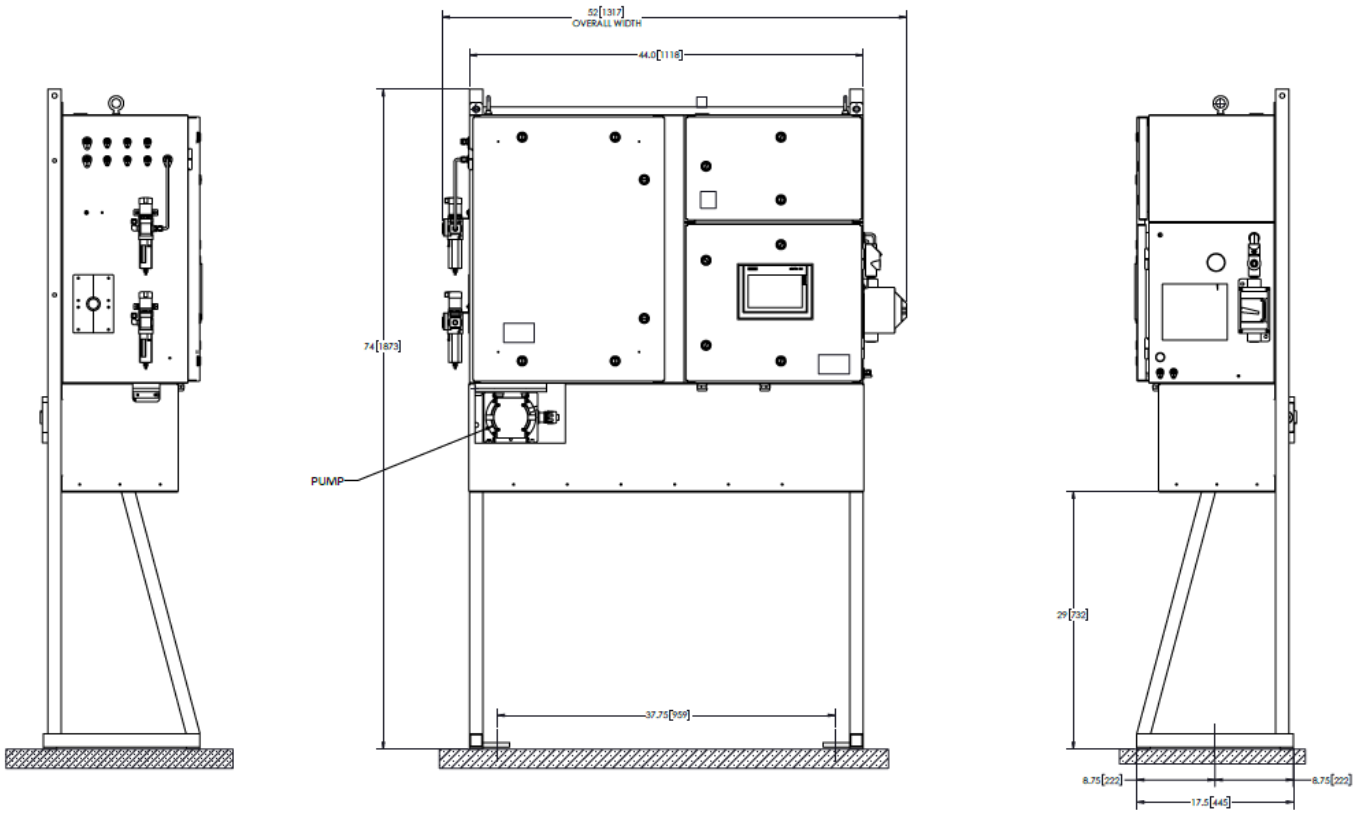
SCALE: 1:20	SIZE: D	WEIGHT: 400 LBS	
	PRODUCT: CAL		
DRAWN BY: D.PHUNG	DATE: 10/19/22	DRAWING NUMBER: CAL.D1.M.9800	REV: A.4

9800 CXi Mid Temp Calorimeter Outline




REVISIONS
REV
ECN
DESCRIPTION
DATE
CHK
APPD
A.0
-
INITIAL RELEASE
01/03/25
DP
DP
N4 - ZERO AIR TUBE FITTING, 1/8"OD
N3 - HI CAL GAS TUBE FITTING, 1/8"OD
N2 - LO CAL GAS TUBE FITTING, 1/8"OD
N1 - SAMPLE IN TUBE FITTING, 1/4"OD
N7 - RETURN GAS (FAST LOOP) TUBE FITTING, 1/4"OD
N11 - SAMPLE VENT TO FLARE TUBE FITTING, 1/8"OD
N8 - ATM REF. / VENT TUBE FITTING, 1/8"OD
N9 - SG SAMPLE VENT TO FLARE TUBE FITTING, 1/8"OD (OPTIONAL)
N5 -AIR PRESS. REGULATOR INSTRUMENT AIR SUPPLY TUBE FITTING,1/4"OD PURGE/COOLER (OPTIONAL)
N20 -AIR PRESS. REGULATOR INSTRUMENT AIR SUPPLY TUBE FITTING,1/4"OD AIR AMPLIFIER
N6 -AIR PRESS. REGULATOR INSTRUMENT AIR SUPPLY TUBE FITTING,1/4"OD PNEUMATIC
N20 -AIR AMPLIFIER OUTLET TUBE FITTING,1/4"OD
PURGE BACK UP EXHAUST VENT (WITH PURGE OPTION)
42.50 [1079.5] MOUNTING HOLES
40 [1013] LIFTING EYEBOLTS
31.25 [793.8] MOUNTING HOLES
CAUTION HOT SURFACE LABEL
COOLER (OPTIONAL)
Z - PURGE (OPTIONAL)
LABEL
HMI DISPLAY
WARNING ARC FLASH AND SHOCK HAZARD LABEL
N12 - ATM VENT FLAME ARRESTER
53 [1337] OVERALL WIDTH
LIFTING EYEBOLT 3/8"-16, 1" ID
15.5 [393]
6.1 [156]
36 [906]
POWER CORD ENTRY EX CABLE GLAND CABLE SEALING RANGE .11-.22[2.8-5.5]
EARTH BOLT 1/4"-20 SS
N10 - ZERO AIR VENT TO ATM
CUSTOMER ACCESS HOLE, Ø7/8" (- COVERED WITH A HOLE PLUG - USE A CABLE GLAND ACCORDING TO THE HAZ LOC CLASSIFICATION)
NOTES:
- UNLESS OTHERWISE SPECIFIED -
- TUBING WALL THICKNESS
1/4"OD : 0.035"
- FITTINGS : SWAGELOK
- THREADS : NPT
- THREAD SEALS : PTFE TAPE
- TUBING/FITTINGS : SS-316
DIMENSIONS ARE IN INCHES
[ ] ARE IN MILLIMETERS
DIM | INCH | mm
X [N/A] | ±1 | [N/A]
X.X [x] | ±.1 | [3]
X.XX [x.x] | ±.01 | [0.3]
X.XXX [x.xx] | ±.005 | [0.13]
X.XXXX[x.xxx] | ±.0005 | [0.013]
ANGLE | ±0.5° | ±0.5°
FRACTION | ±1/64 | [N/A]
DESCRIPTION:
9800 CXI MID TEMP OUTLINE
ATEX/ IECEX Z PURGE, COOLER, SG
SCALE: 1:5
SIZE: D
WEIGHT: 400 LBS
PRODUCT: CAL
DRAWN BY: D.PHUNG
DATE: 01/03/25
Process Insights
14400 HOLLISTER STREET, SUITE 800B, TX 77066
NOTICE: THE DOCUMENT CONTAINS PROPRIETARY AND CONFIDENTIAL INFORMATION WHICH BELONGS TO PROCESS INSIGHTS; IT IS LOANED FOR LIMITED PURPOSES ONLY AND REMAINS A PROPERTY OF PROCESS INSIGHTS. REPRODUCTION, IN WHOLE OR IN PART, OR USE OF THIS DESIGN OR DISTRIBUTION OF THE INFORMATION TO OTHERS IS NOT PERMITTED WITHOUT THE EXPRESS WRITTEN CONSENT OF PROCESS INSIGHTS. THIS DOCUMENT IS TO BE RETURNED TO PROCESS INSIGHTS UPON REQUEST AND IN ANY EVENT UPON COMPLETION OF THE USE FOR WHICH THIS DOCUMENT WAS LOANED.
DRAWING NUMBER: CAL.01.M.9801
REV: A.0
SHEET: 2/4


REVISIONS
REV | ECN | DESCRIPTION | DATE | CHK | APPD
A.0 | - | INITIAL RELEASE | 01/03/25 | DP | DP
N4 - ZERO AIR TUBE FITTING, 1/8"OD
N3 - HI CAL GAS TUBE FITTING, 1/8"OD
N2 - LO CAL GAS TUBE FITTING, 1/8"OD
N1 - SAMPLE IN TUBE FITTING, 1/4"OD
N7 - RETURN GAS (FAST LOOP) TUBE FITTING, 1/4"OD
N11 - SAMPLE VENT TO FLARE TUBE FITTING, 1/8"OD
N8 - ATM REF. / VENT TUBE FITTING, 1/8"OD
N9 - SG SAMPLE VENT TO FLARE TUBE FITTING, 1/8"OD (OPTIONAL)
N5 -AIR PRESS. REGULATOR INSTRUMENT AIR SUPPLY TUBE FITTING,1/4"OD PURGE/COOLER (OPTIONAL)
N20 -AIR PRESS. REGULATOR INSTRUMENT AIR SUPPLY TUBE FITTING,1/4"OD AIR AMPLIFIER
N6 -AIR PRESS. REGULATOR INSTRUMENT AIR SUPPLY TUBE FITTING,1/4"OD PNEUMATIC
N20 -AIR AMPLIFIER OUTLET TUBE FITTING,1/4"OD
PURGE BACK UP EXHAUST VENT (WITH PURGE OPTION)
42.50[1079.5] MOUNTING HOLES
40[1013] LIFTING EYEBOLTS
31.25[793.8] MOUNTING HOLES
CAUTION HOT SURFACE LABEL
LABEL
HMI DISPLAY
WARNING ARC FLASH AND SHOCK HAZARD LABEL
N12 - ATM VENT FLAME ARRESTER
53[1349] OVERALL WIDTH
15.5[393]
6.1[156]
LIFTING EYEBOLT 3/8"-16, 1" ID
COOLER (OPTIONAL)
X - PURGE (OPTIONAL)
36[906]
POWER CORD ENTRY EX CABLE GLAND CABLE SEALING RANGE .11-.22[2.8-5.5]
EARTH BOLT 1/4"-20 SS
N10 - ZERO AIR VENT TO ATM
CUSTOMER ACCESS HOLE, Ø7/8" (- COVERED WITH A HOLE PLUG - USE A CABLE GLAND ACCORDING TO THE HAZ LOC CLASSIFICATION)
NOTES:
- UNLESS OTHERWISE SPECIFIED -
- TUBING WALL THICKNESS
1/16"OD : 0.016"
1/8"OD : 0.028"
1/4"OD : 0.035"
1/2"OD : 0.065"
- FITTINGS : SWAGELOK
- THREAD : NPT
- THREAD SEALS : PTFE TAPE
- TUBING/FITTINGS : SS-316
DIMENSIONS ARE IN INCHES
[ ] ARE IN MILLIMETERS
DIM | INCH | mm
X [N/A] | ±1 | [N/A]
X.X [x] | ±.1 | [3]
X.XX [x.x] | ±.01 | [0.3]
X.XXX [x.xx] | ±.005 | [0.13]
X.XXXX[x.xxx] | ±.0005 | [0.013]
ANGLE | ±0.5° | ±0.5°
FRACTION | ±1/64 | [N/A]
DESCRIPTION:
9800 CXI MID TEMP OUTLINE
X PURGE, COOLER, SG
SCALE: 1:5
SIZE: D
WEIGHT: 400 LBS
PRODUCT: CAL
DRAWN BY: D.PHUNG
DATE: 01/03/25
Process Insights
14400 HOLLISTER STREET, SUITE 800B, TX 77066
NOTICE: THIS DOCUMENT CONTAINS PROPRIETARY AND CONFIDENTIAL INFORMATION WHICH BELONGS TO PROCESS INSIGHTS. IT IS LOANED FOR LIMITED PURPOSES ONLY AND REMAINS A PROPERTY OF PROCESS INSIGHTS. REPRODUCTION, IN WHOLE OR IN PART, OR USE OF THIS DESIGN OR DISTRIBUTION OF THE INFORMATION TO OTHERS IS NOT PERMITTED WITHOUT THE EXPRESS WRITTEN CONSENT OF PROCESS INSIGHTS. THIS DOCUMENT IS TO BE RETURNED TO PROCESS INSIGHTS UPON REQUEST AND IN ANY EVENT UPON COMPLETION OF THE USE FOR WHICH THIS DOCUMENT WAS LOANED.
DRAWING NUMBER: CAL.01.M.9801
REV: A.0
SHEET: 3/4



NOTES:
- UNLESS OTHERWISE SPECIFIED -
- TUBING WALL THICKNESS
  1/16 OD : 0.016"
  1/8 OD : 0.028"
  1/4 OD : 0.035"
  1/2 OD : 0.065"
- FITTINGS : SWAGELOK
- THREAD : NPT
- THREAD SEALS : PTFE TAPE
- TUBING/FITTINGS : SS-316

DIMENSIONS ARE IN INCHES		
[ ] ARE IN MILLIMETERS		
DIM	INCH	mm
X [N/A]	±1	[N/A]
X.X [x]	±.1	[3]
X.XX [x.x]	±.01	[0.3]
X.XXX [x.xx]	±.005	[0.13]
X.XXXX[x.xxx]	±.0005	[0.013]
ANGLE	±0.5°	±0.5°
FRACTION	±1/64	[N/A]

DESCRIPTION:
9800 CXI MID TEMP OUTLINE STAND, PUMP

SCALE: 1:5 | SIZE: D | WEIGHT: 400 LBS

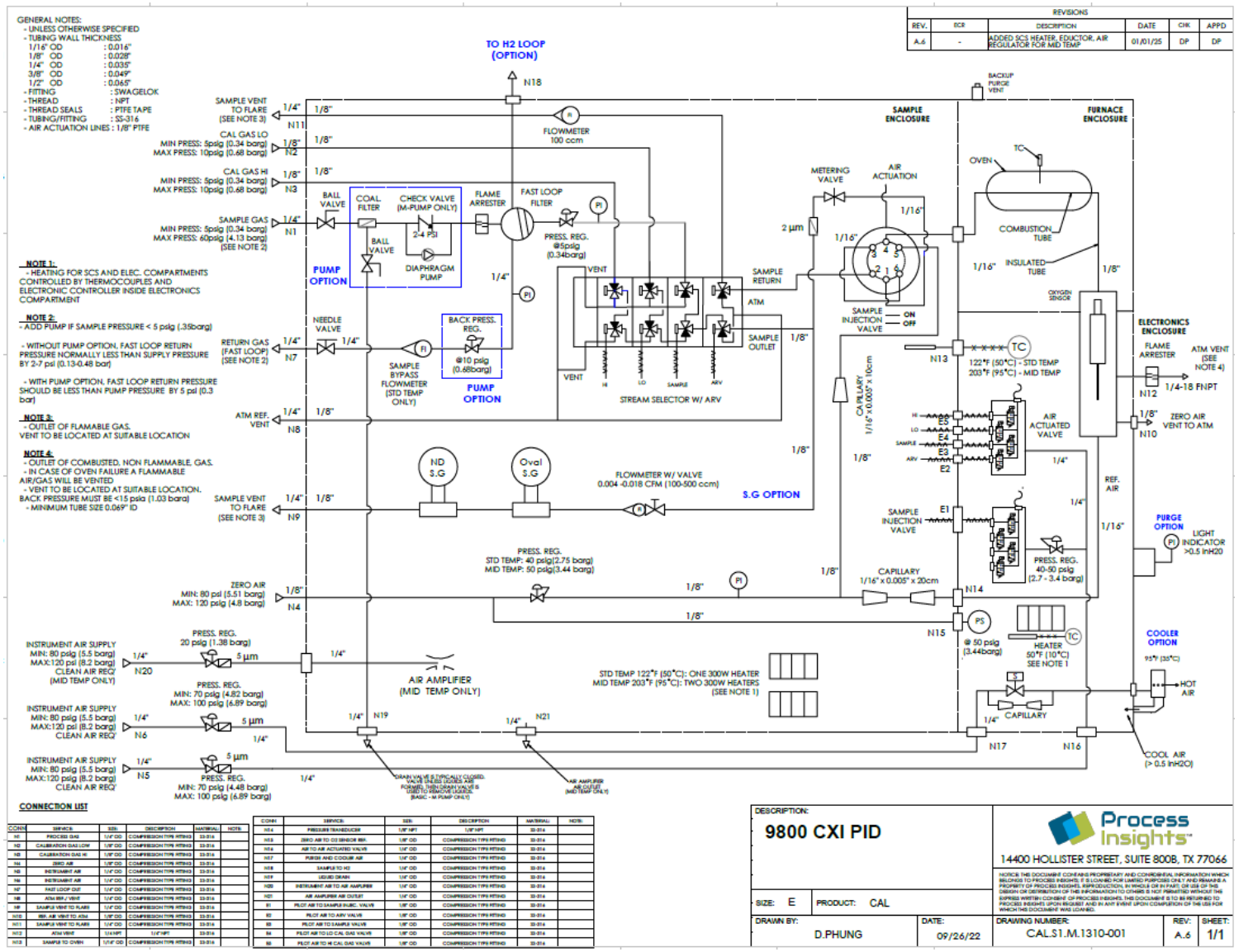
PRODUCT: CAL

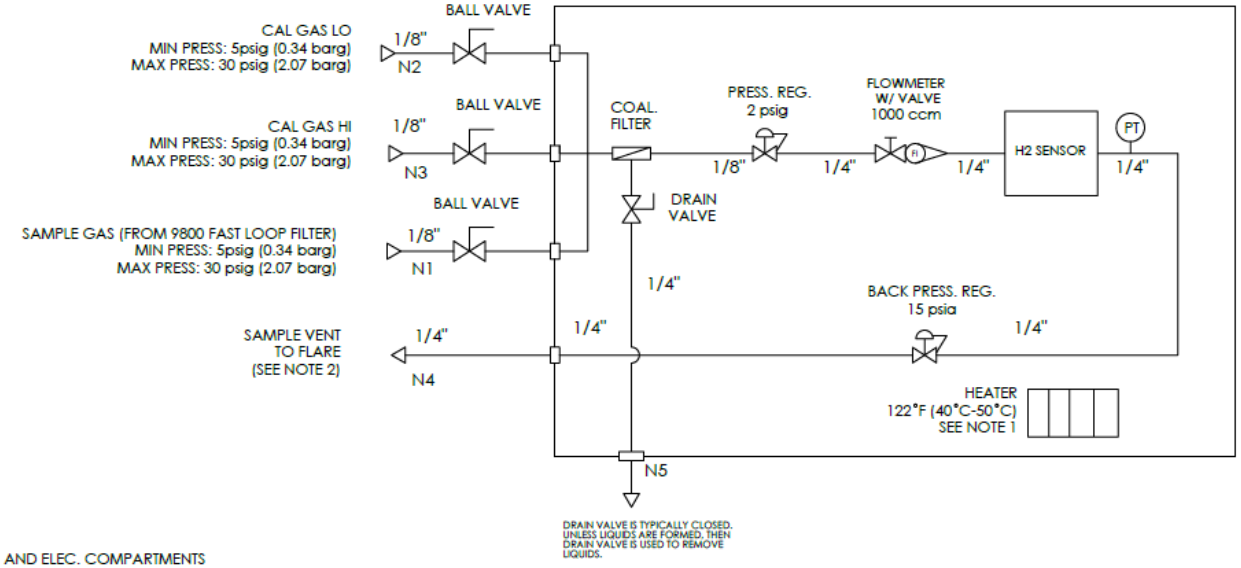
DRAWN BY: D.PHUNG | DATE: 01/03/25

Process Insights™
14400 HOLLISTER STREET, SUITE 800B, TX 77066

DRAWING NUMBER:	REV:	SHEET:
CAL.D1.M.9801	A	4/4

Section 2.5.2 - Process Flow Diagram (Generic)





NOTE 1:
- HEATING FOR SCS AND ELEC. COMPARTMENTS CONTROLLED BY THERMOCOUPLES AND ELECTRONIC CONTROLLER INSIDE ELECTRONICS COMPARTMENT

NOTE 2:
- OUTLET OF FLAMABLE GAS.
VENT TO BE LOCATED AT SUITABLE LOCATION

CONNECTION LIST

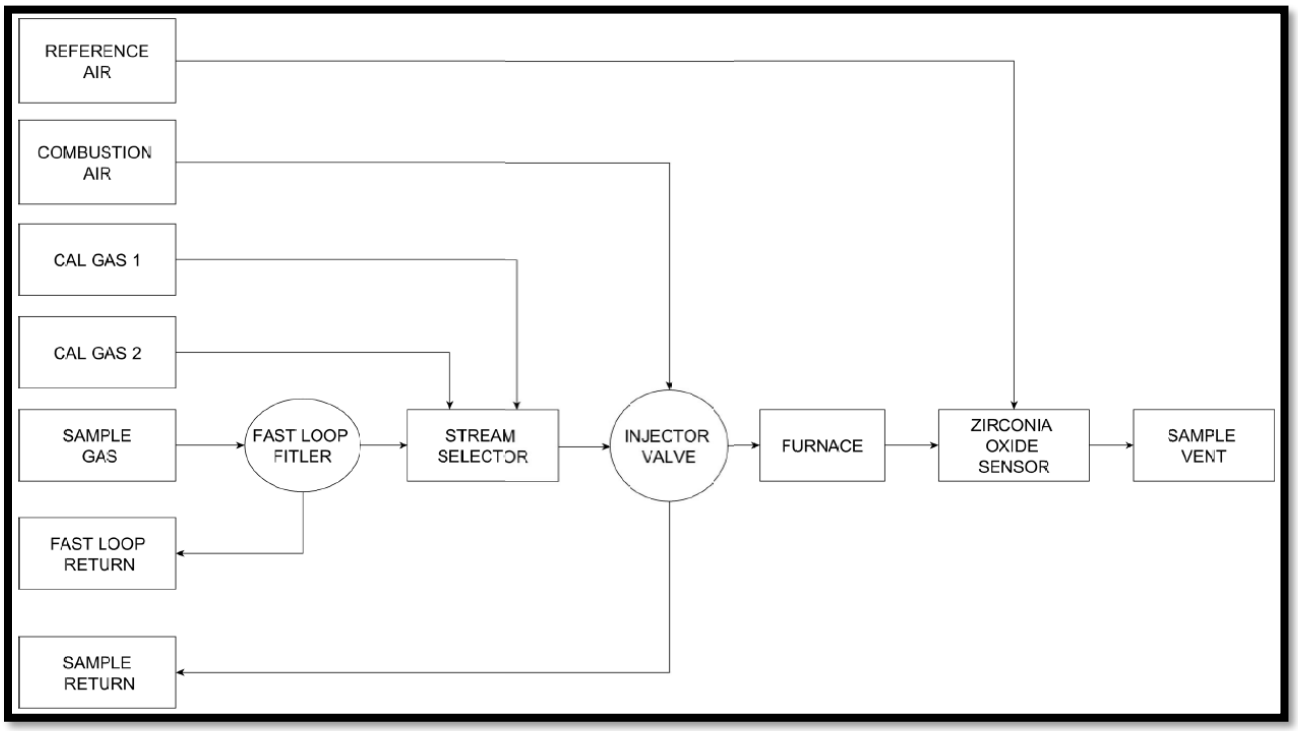
CONN	SERVICE:	SIZE:	DESCRIPTION	MATERIAL:	NOTE:
N1	PROCESS GAS	1/8" OD	COMPRESSION TYPE FITTING	SS-316	
N2	CALIBRATION GAS LOW	1/8" OD	COMPRESSION TYPE FITTING	SS-316	
N3	CALIBRATION GAS HI	1/8" OD	COMPRESSION TYPE FITTING	SS-316	
N4	SAMPLE VENT TO FLARE	1/4" OD	COMPRESSION TYPE FITTING	SS-316	

DESCRIPTION:
H2 OPTION

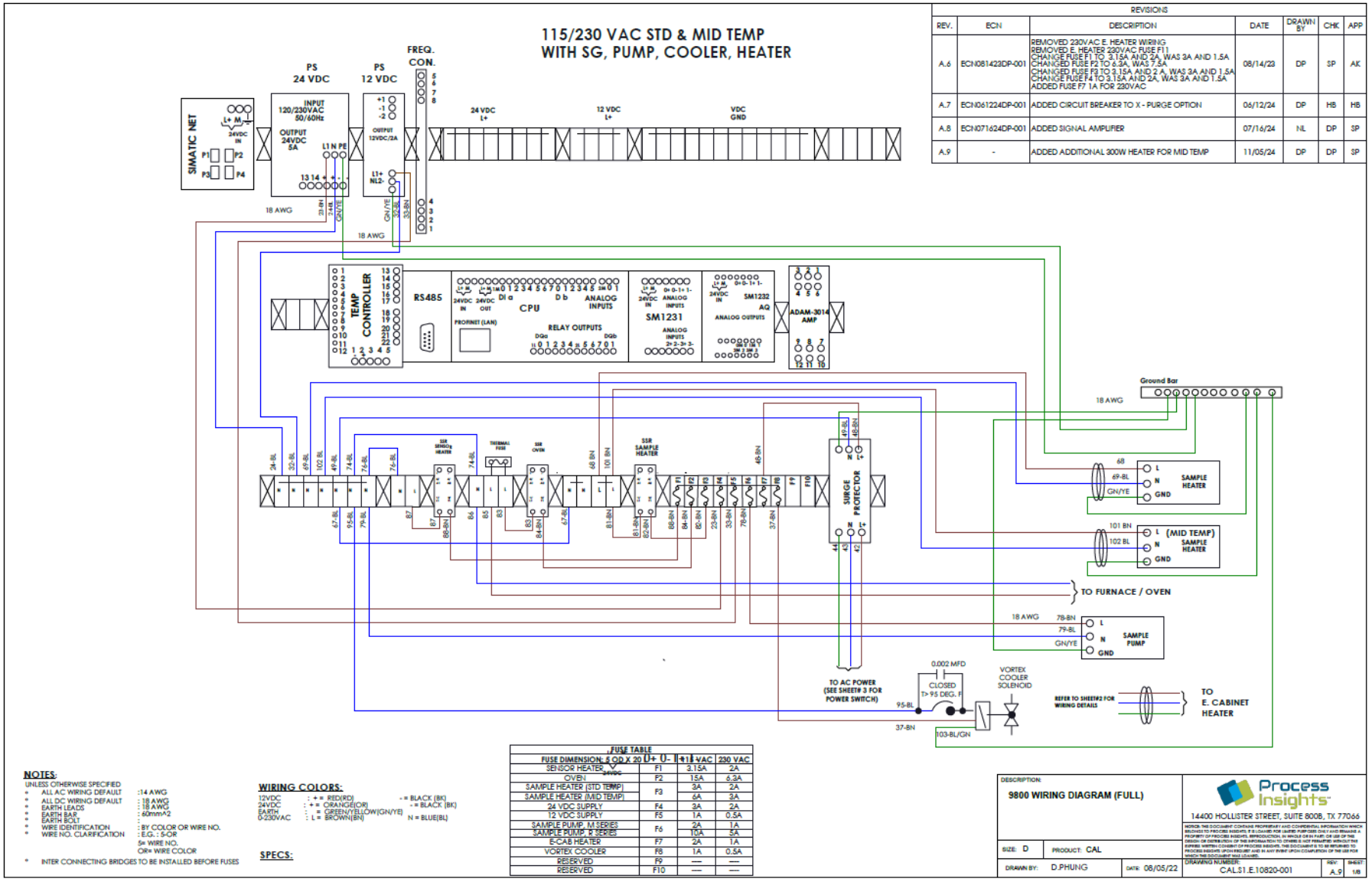
Process Insights
14400 HOLLISTER STREET, SUITE 800B, TX 77066

SIZE: D | PRODUCT: CAL
DRAWN BY: D.PHUNG | DATE: 09/26/22
DRAWING NUMBER: CAL.S1.M.1310-001 | REV: A.6 | SHEET: 2/2

Section 2.5.3 - Process Flow Chart (Generic)

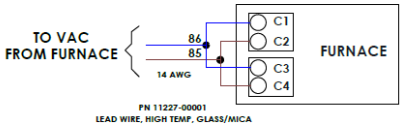


Section 2.5.4 - Total System Wiring (Generic)



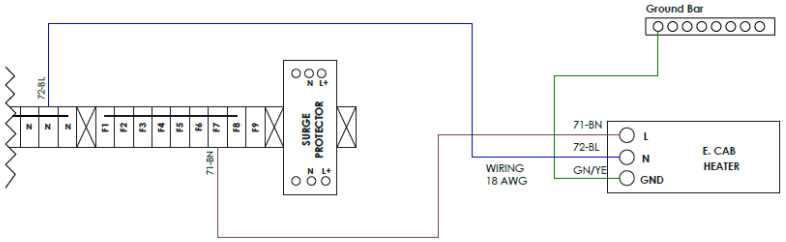
FURNACE / OVEN

115 VAC



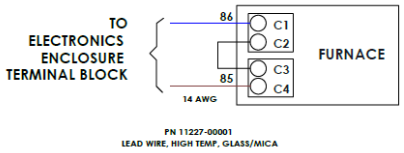
ELECTRONICS CABINET HEATER

115 VAC



FURNACE / OVEN

230 VAC



INTENTIONALLY LEFT BLANK

NOTES:

UNLESS OTHERWISE SPECIFIED

- ALL AC WIRING DEFAULT : 14 AWG
- ALL DC WIRING DEFAULT : 18 AWG
- EARTH LEADS : 18 AWG
- EARTH BAR : 60mm^2
- EARTH BOLT :
- WIRE IDENTIFICATION : BY COLOR OR WIRE NO.
- WIRE NO. CLARIFICATION : E.G. : 5=OR
  5= WIRE NO.
  OR= WIRE COLOR
- INTER CONNECTING BRIDGES TO BE INSTALLED BEFORE FUSES

WIRING COLORS:

12VDC : + = RED(RD) - = BLACK (BK)
24VDC : + = ORANGE(OR) - = BLACK (BK)
EARTH : = GREEN/YELLOW(GN/YE)
0-230VAC : L = BROWN(BN) N = BLUE(BL)

SPECS:

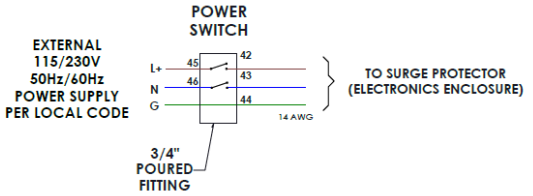
DESCRIPTION: 9800 WIRING DIAGRAM (FULL)

Process Insights
14400 HOLLISTER STREET, SUITE 800B, TX 77066

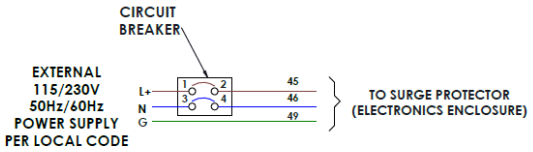
SIZE: D	PRODUCT: CAL		
DRAWN BY: D.PHUNG	DATE: 08/05/22	DRAWING NUMBER: CAL.S1.E.10820-001	REV: A.9 / SHEET: 2/8

POWER SUPPLY AND PURGE

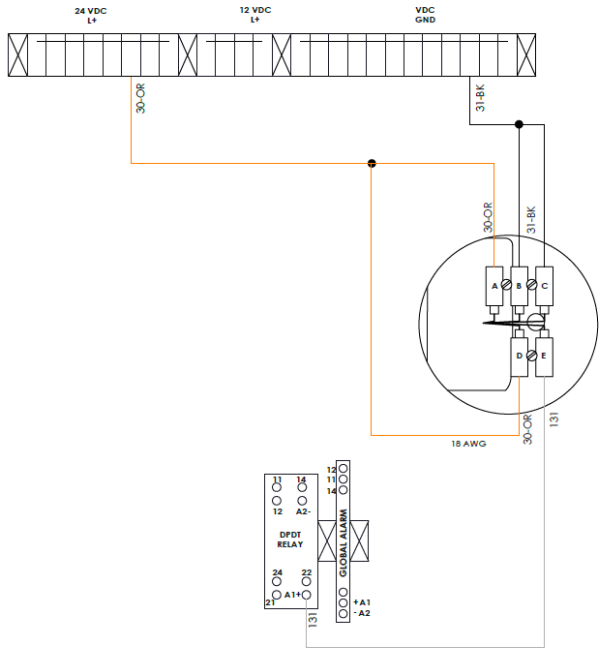
NO PURGE
C1D1 Z PURGE



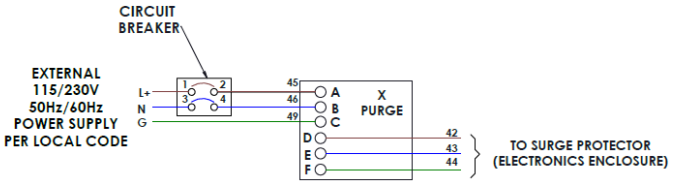
ATEX/ IECEx
Z PURGE



Z PURGE



X PURGE



NOTES:
UNLESS OTHERWISE SPECIFIED

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- EARTH LEADS : 18 AWG
- EARTH BAR : 60mm^2
- EARTH BOLT :
- WIRE IDENTIFICATION : BY COLOR OR WIRE NO.
- WIRE NO. CLARIFICATION : E.G.: 5-OR
  5= WIRE NO.
  OR= WIRE COLOR
- INTER CONNECTING BRIDGES TO BE INSTALLED BEFORE FUSES

WIRING COLORS:

12VDC : + = RED(RD) - = BLACK (BK)
24VDC : + = ORANGE(OR) - = BLACK (BK)
EARTH : = GREEN/YELLOW(GN/YE)
0-230VAC : L = BROWN(BN) N = BLUE(BL)

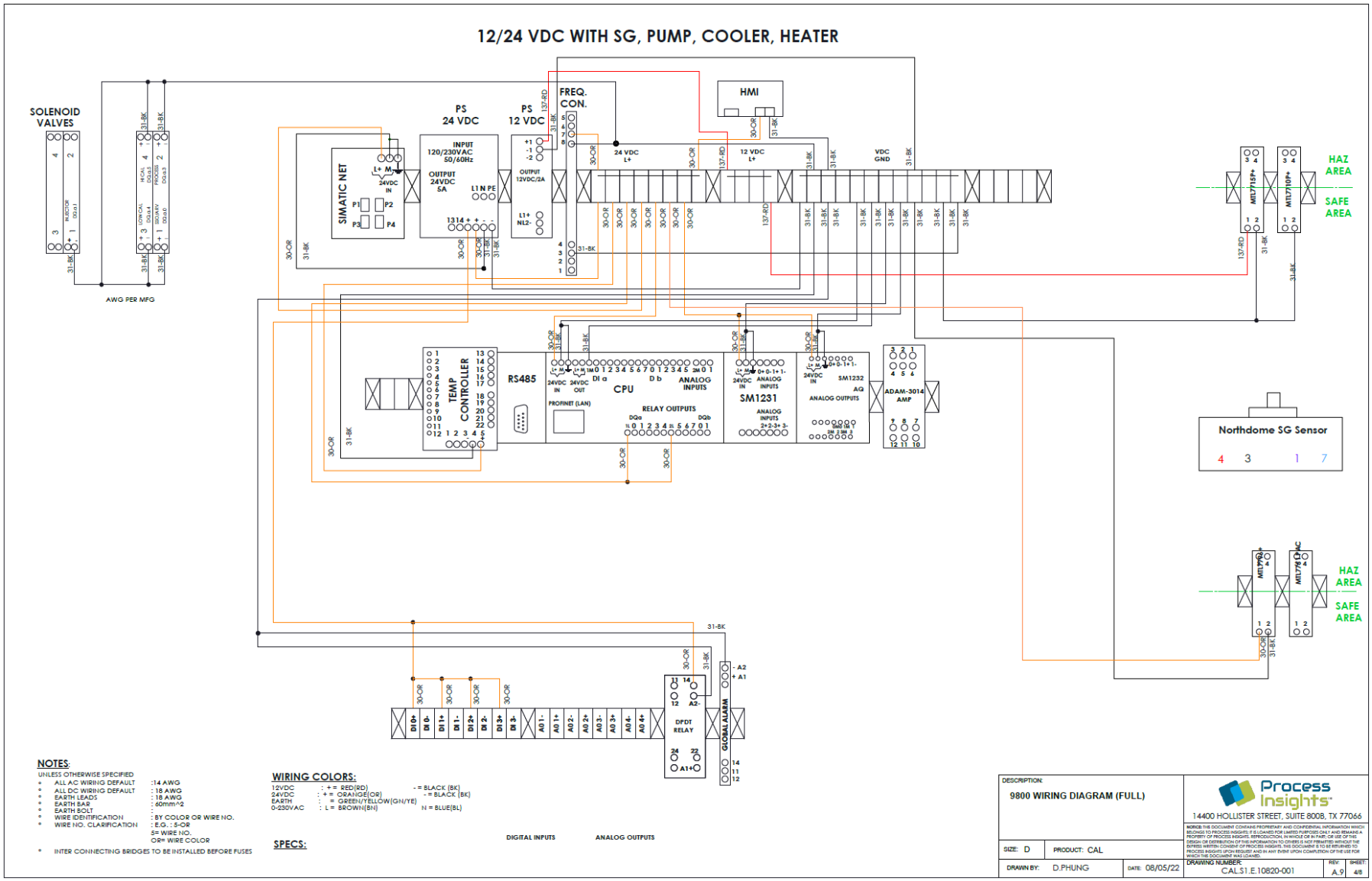
SPECS:

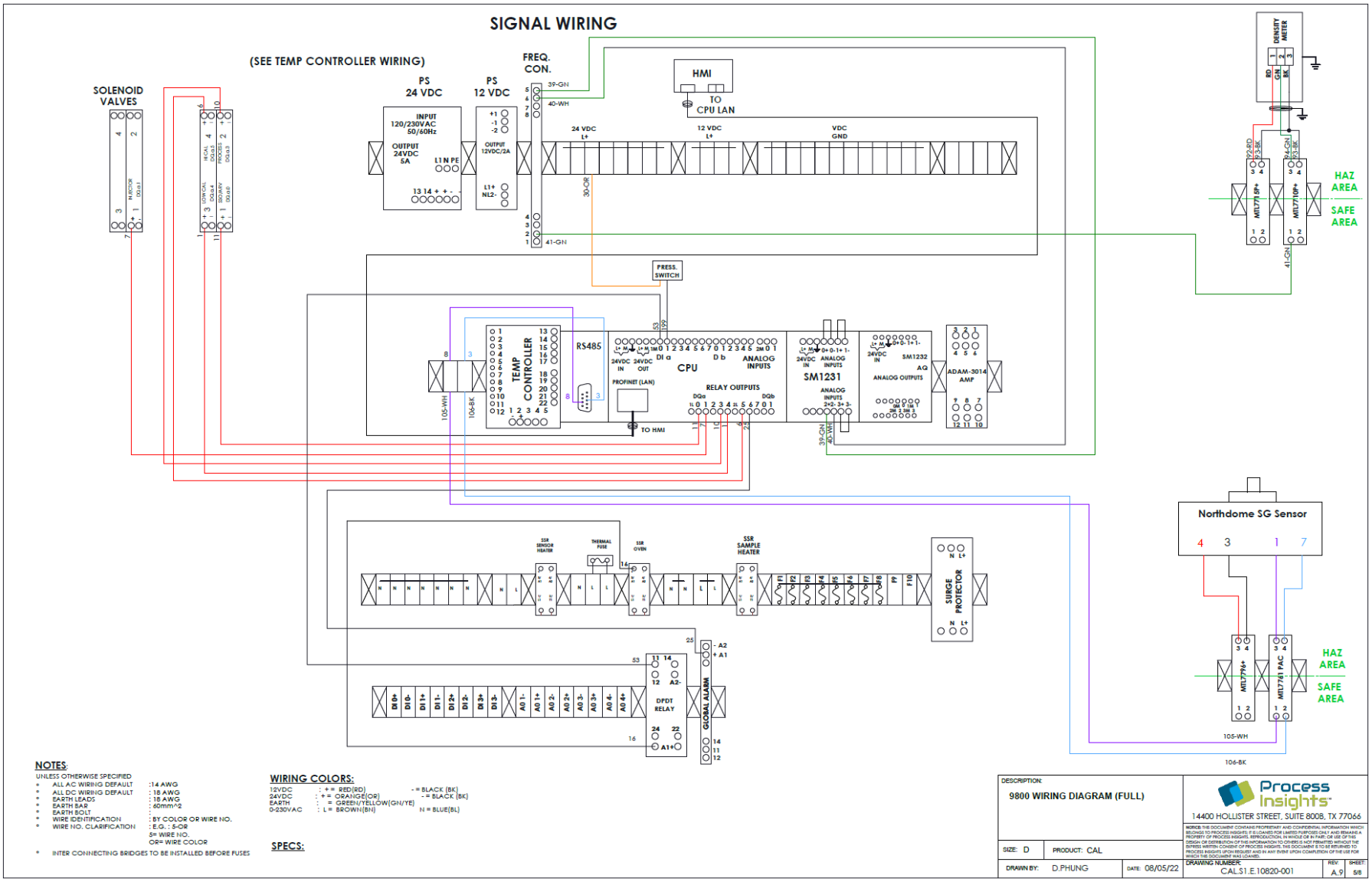
DESCRIPTION:
9800 WIRING DIAGRAM (FULL)

Process Insights
14400 HOLLISTER STREET, SUITE 800B, TX 77066

SIZE: D	PRODUCT: CAL		
DRAWN BY: D.PHUNG	DATE: 08/05/22	DRAWING NUMBER: CAL.S1.E.10820-001	REV: A.9

SHEET: 3/8


12/24 VDC WITH SG, PUMP, COOLER, HEATER
SOLENOID VALVES
AWG PER MFG
SIMATIC NET
PS 24 VDC
INPUT 120/230VAC 50/60Hz
OUTPUT 24VDC 5A
PS 12 VDC
OUTPUT 12VDC/2A
FREQ. CON.
HMI
24 VDC L+
12 VDC L+
VDC GND
HAZ AREA
SAFE AREA
TEMP CONTROLLER
RS485
CPU
PROFINET (LAN)
RELAY OUTPUTS
ANALOG INPUTS
SM1231
SM1232
ANALOG OUTPUTS
ADAM-3014 AMF
Northdome SG Sensor
4 3 1 7
DPDT RELAY
GLOBAL ALARM
DIGITAL INPUTS
ANALOG OUTPUTS
NOTES:
UNLESS OTHERWISE SPECIFIED
ALL AC WIRING DEFAULT :14 AWG
ALL DC WIRING DEFAULT : 18 AWG
EARTH LEADS : 18 AWG
EARTH BAR : 60mm^2
EARTH BOLT :
WIRE IDENTIFICATION : BY COLOR OR WIRE NO.
WIRE NO. CLARIFICATION : E.G. : 5-OR 5= WIRE NO. OR= WIRE COLOR
INTER CONNECTING BRIDGES TO BE INSTALLED BEFORE FUSES
WIRING COLORS:
12VDC : + = RED(RD) - = BLACK (BK)
24VDC : + = ORANGE(OR) - = BLACK (BK)
EARTH : = GREEN/YELLOW(GN/YE)
0-230VAC : L = BROWN(BN) N = BLUE(BL)
SPECS:
DESCRIPTION:
9800 WIRING DIAGRAM (FULL)
Process Insights
14400 HOLLISTER STREET, SUITE 800B, TX 77066
SIZE: D
PRODUCT: CAL
DRAWN BY: D.PHUNG
DATE: 08/05/22
DRAWING NUMBER: CAL.S1.E.10820-001
REV: A.9
SHEET: 4/8



NOTES:

UNLESS OTHERWISE SPECIFIED

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WIRING COLORS:

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24VDC : + = ORANGE(OR) - = BLACK (BK)
EARTH : = GREEN/YELLOW(GN/YE)
0-230VAC : L = BROWN(BN) N = BLUE(BL)

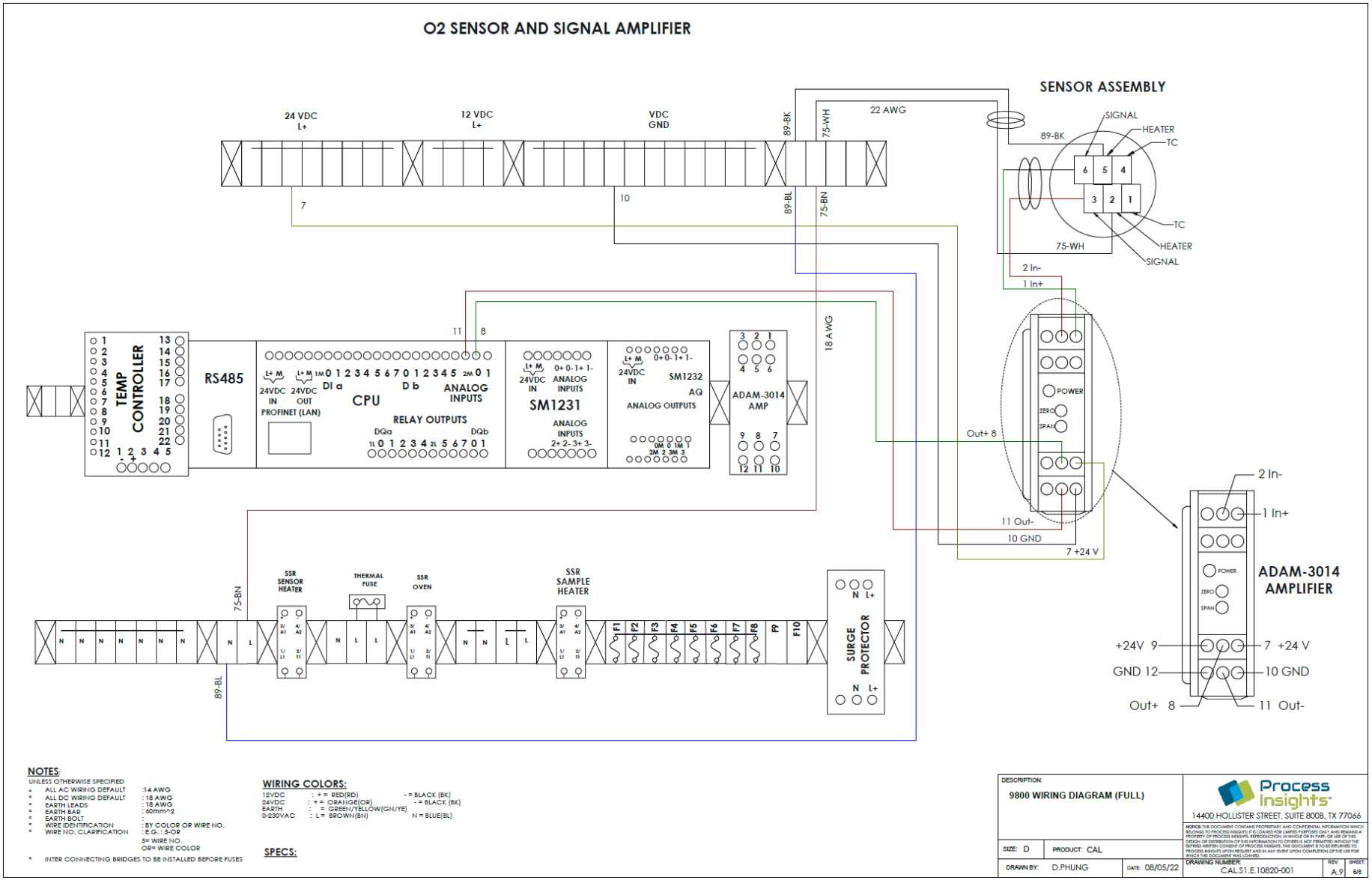
SPECS:

DESCRIPTION: 9800 WIRING DIAGRAM (FULL)

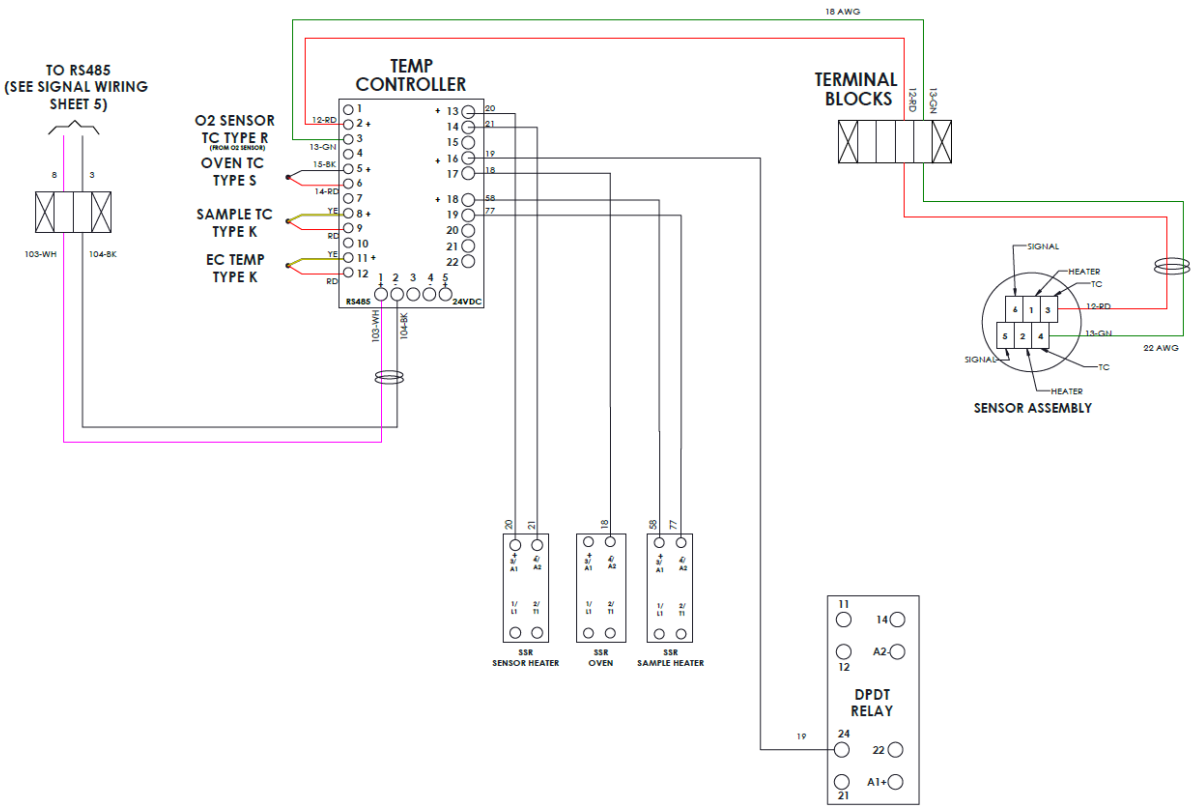
Process Insights™
14400 HOLLISTER STREET, SUITE 800B, TX 77066

SIZE: D | PRODUCT: CAL | DRAWN BY: D.PHUNG | DATE: 08/05/22

DRAWING NUMBER: CAL.S1.E.10820-001 | REV: A.9 | SHEET: 5/8


O2 SENSOR AND SIGNAL AMPLIFIER
SENSOR ASSEMBLY
24 VDC L+
12 VDC L+
VDC GND
89-BK
75-WH
22 AWG
SIGNAL
HEATER
TC
89-BL
75-BN
7
10
2 In-
1 In+
11
8
18 AWG
TEMP CONTROLLER
RS485
24VDC IN
24VDC OUT
PROFINET (LAN)
DI a
CPU
Db
ANALOG INPUTS
RELAY OUTPUTS
DQa
DQb
SM1231
ANALOG INPUTS
SM1232
AQ
ANALOG OUTPUTS
ADAM-3014 AMP
POWER
ZERO
SPAN
Out+ 8
11 Out-
10 GND
7 +24 V
SSR SENSOR HEATER
THERMAL FUSE
SSR OVEN
SSR SAMPLE HEATER
SURGE PROTECTOR
ADAM-3014 AMPLIFIER
+24V 9
GND 12
Out+ 8
NOTES:
UNLESS OTHERWISE SPECIFIED
ALL AC WIRING DEFAULT :14 AWG
ALL DC WIRING DEFAULT : 18 AWG
EARTH LEADS : 18 AWG
EARTH BAR : 60mm^2
EARTH BOLT :
WIRE IDENTIFICATION : BY COLOR OR WIRE NO.
WIRE NO. CLARIFICATION : E.G. : 5-OR
5= WIRE NO.
OR= WIRE COLOR
INTER CONNECTING BRIDGES TO BE INSTALLED BEFORE FUSES
WIRING COLORS:
12VDC : + = RED(RD) - = BLACK (BK)
24VDC : + = ORANGE(OR) - = BLACK (BK)
EARTH : = GREEN/YELLOW(GN/YE)
0-230VAC : L = BROWN(BN) N = BLUE(BL)
SPECS:
DESCRIPTION:
9800 WIRING DIAGRAM (FULL)
Process Insights
14400 HOLLISTER STREET, SUITE 800B, TX 77066
SIZE: D
PRODUCT: CAL
DRAWN BY: D.PHUNG
DATE: 08/05/22
DRAWING NUMBER: CAL.S1.E.10820-001
REV: A.9
SHEET: 6/8

TEMP CONTROLLER WIRING



NOTES:

UNLESS OTHERWISE SPECIFIED

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- EARTH LEADS : 18 AWG
- EARTH BAR : 60mm^2
- EARTH BOLT :
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- WIRE NO. CLARIFICATION : E.G. : 5-OR
  5= WIRE NO.
  OR= WIRE COLOR
- INTER CONNECTING BRIDGES TO BE INSTALLED BEFORE FUSES

WIRING COLORS:

12VDC	: + = RED(RD)	- = BLACK (BK)
24VDC	: + = ORANGE(OR)	- = BLACK (BK)
EARTH	: = GREEN/YELLOW(GN/YE)	
0-230VAC	: L = BROWN(BN)	N = BLUE(BL)

SPECS:

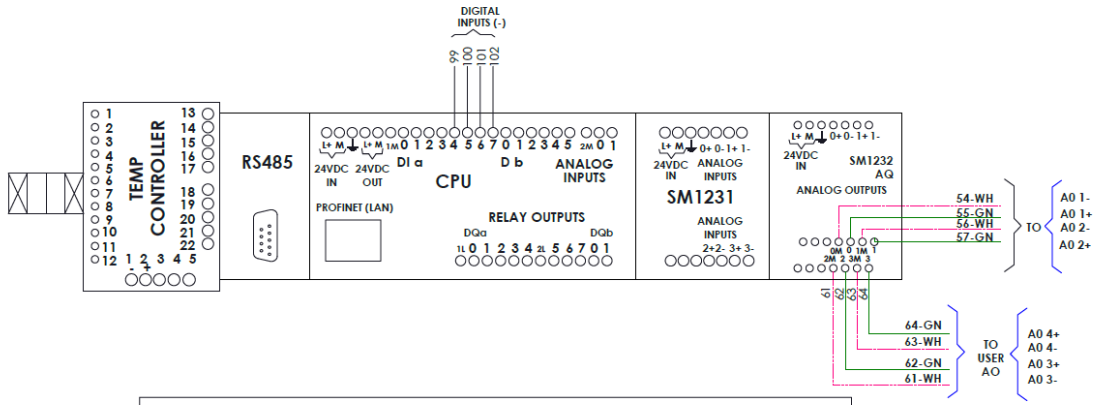
DESCRIPTION:
9800 WIRING DIAGRAM (FULL)

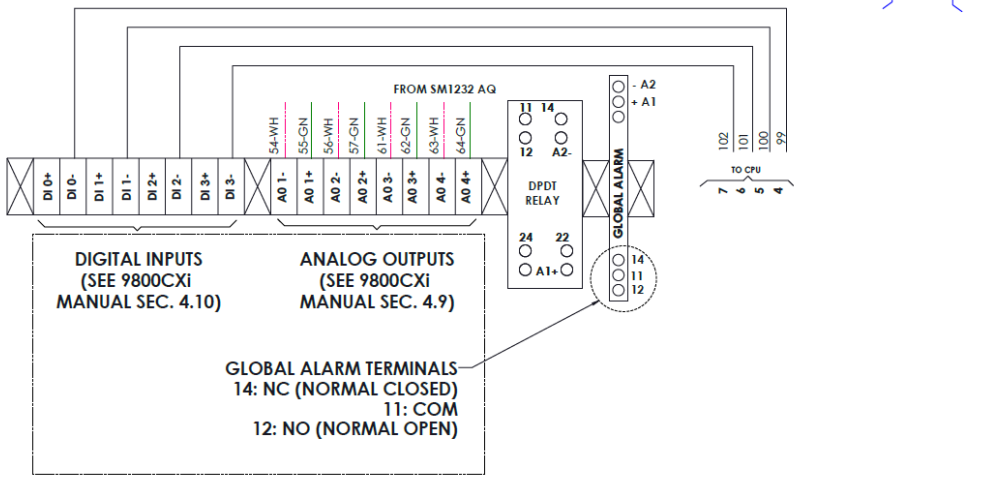
Process Insights
14400 HOLLISTER STREET, SUITE 800B, TX 77066

SIZE: D	PRODUCT: CAL		
DRAWN BY: D.PHUNG	DATE: 08/05/22	DRAWING NUMBER: CAL.S1.E.10820-001	REV: A.9

SHEET: 7/8

DIGITAL INPUTS / ANALOG OUTPUTS





CUSTOMER SUPPLIED WIRING

NOTES:

UNLESS OTHERWISE SPECIFIED

- ALL AC WIRING DEFAULT : 14 AWG
- ALL DC WIRING DEFAULT : 18 AWG
- EARTH LEADS : 18 AWG
- EARTH BAR : 60mm^2
- EARTH BOLT :
- WIRE IDENTIFICATION : BY COLOR OR WIRE NO.
- WIRE NO. CLARIFICATION : E.G. : 5-OR
  5= WIRE NO.
  OR= WIRE COLOR
- INTER CONNECTING BRIDGES TO BE INSTALLED BEFORE FUSES

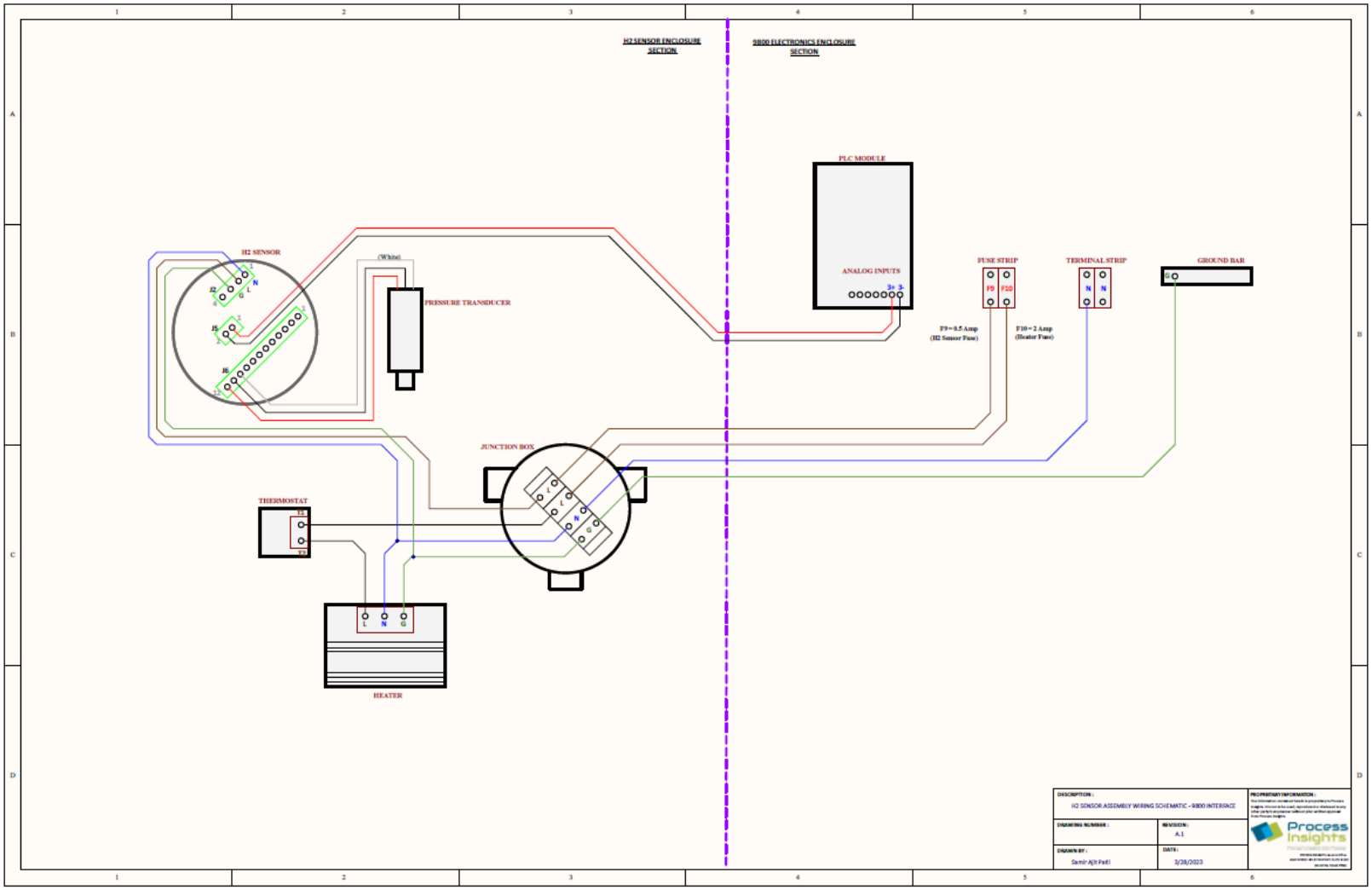
WIRING COLORS:

12VDC	: + = RED(RD)	- = BLACK (BK)
24VDC	: + = ORANGE(OR)	- = BLACK (BK)
EARTH	: = GREEN/YELLOW(GN/YE)	
0-230VAC	: L = BROWN(BN)	N = BLUE(BL)

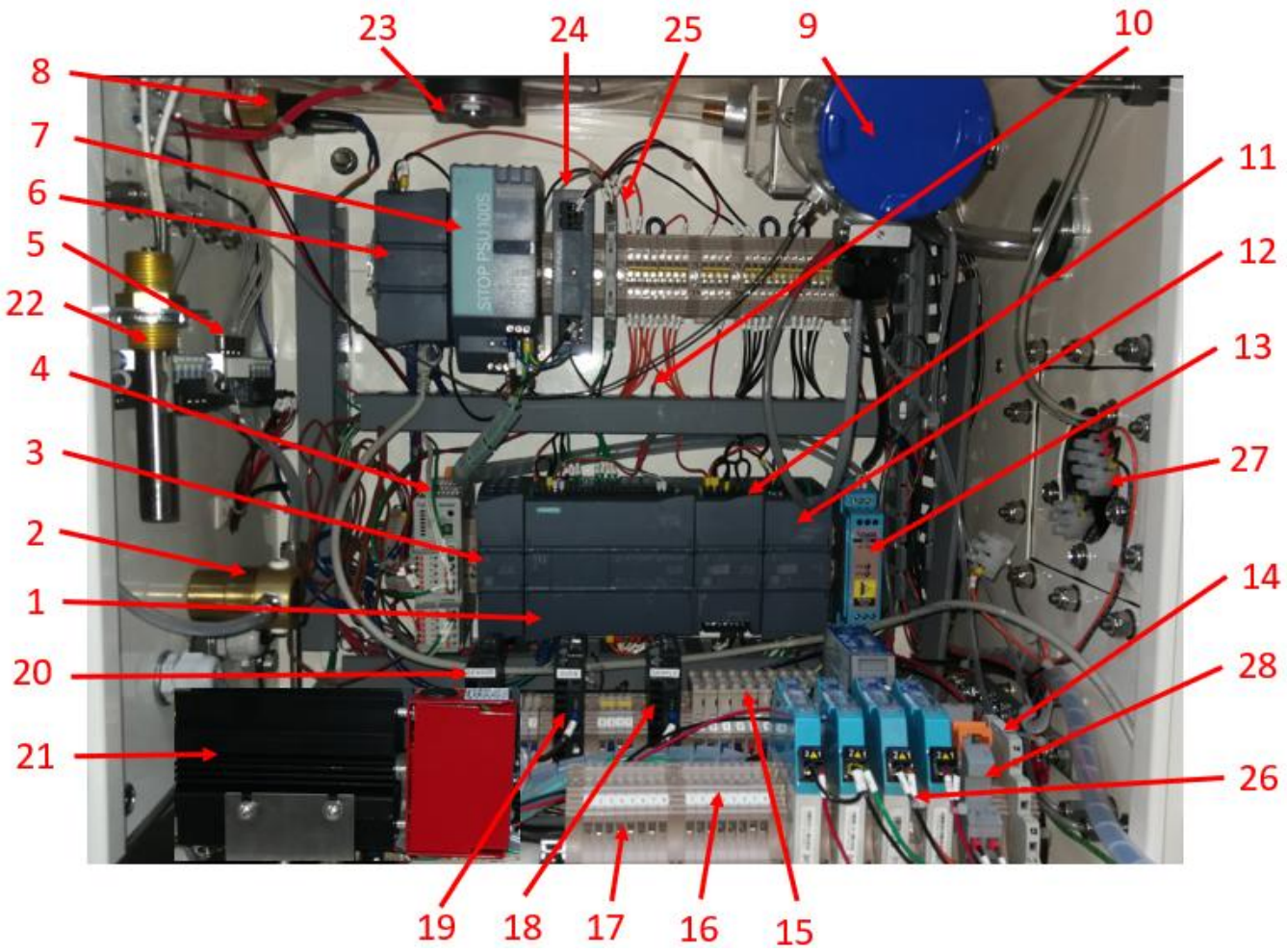
SPECS:

DESCRIPTION:	9800 WIRING DIAGRAM (FULL)
SIZE: D	PRODUCT: CAL
DRAWN BY: D.PHUNG	DATE: 08/05/22
DRAWING NUMBER:	CAL.S1.E.10820-001
REV:	A.9
SHEET:	8/8

Process Insights
14400 HOLLISTER STREET, SUITE 800B, TX 77066

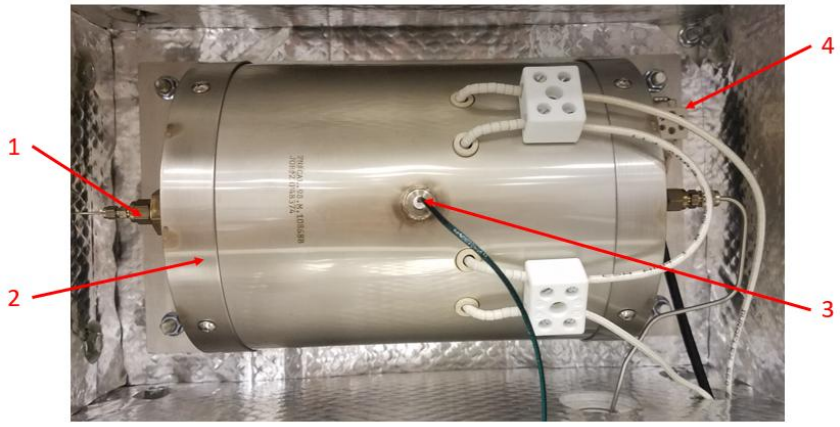

H2 SENSOR ENCLOSURE SECTION
9800 ELECTRONICS ENCLOSURE SECTION
PLC MODULE
ANALOG INPUTS
FUSE STRIP
F9
F10
TERMINAL STRIP
N
N
GROUND BAR
F9 = 0.5 Amp (H2 Sensor Fuse)
F10 = 2 Amp (Heater Fuse)
H2 SENSOR
(White)
PRESSURE TRANSDUCER
JUNCTION BOX
THERMOSTAT
HEATER
L
N
G
DESCRIPTION :
H2 SENSOR ASSEMBLY WIRING SCHEMATIC - 9800 INTERFACE
DRAWING NUMBER :
REVISION :
A.1
DRAWN BY :
Samir Ajit Patil
DATE :
3/28/2023
PROPRIETARY INFORMATION :
Process Insights

Section 2.5.4 - Electronics Enclosure



1. PLC
2. Fixed Pressure Regulator
3. Communication Module
4. Temperature Controller
5. Electronic Manifold Valve Actuators
6. Network Switch
7. 24VDC Power Supply
8. Pressure Switch
9. Zirconia Oxide O2 Sensor.
10. Thermocouple
11. Analog Input module.
12. Analog Output module.
13. Signal Amplifier
14. Global Alarm Relay
15. Fuses
16. AO Terminals
17. DI Terminals
18. Sample Heater SSR
19. Oven SSR
20. O2 Sensor Heater SSR
21. Electronics Cabinet Heater (option)
22. Thermostat (w/ Hi Temp option)
23. 2-Way Solenoid (w/ Hi Temp option)
24. 12VDC Power Supply (w/ Density Meter option)
25. Frequency Converter (w/ Density Meter option)
26. Power and Signal Barriers (w/ Density Meter option)
27. Purge (option)
28. DPDT Relay (w/ Purge option)

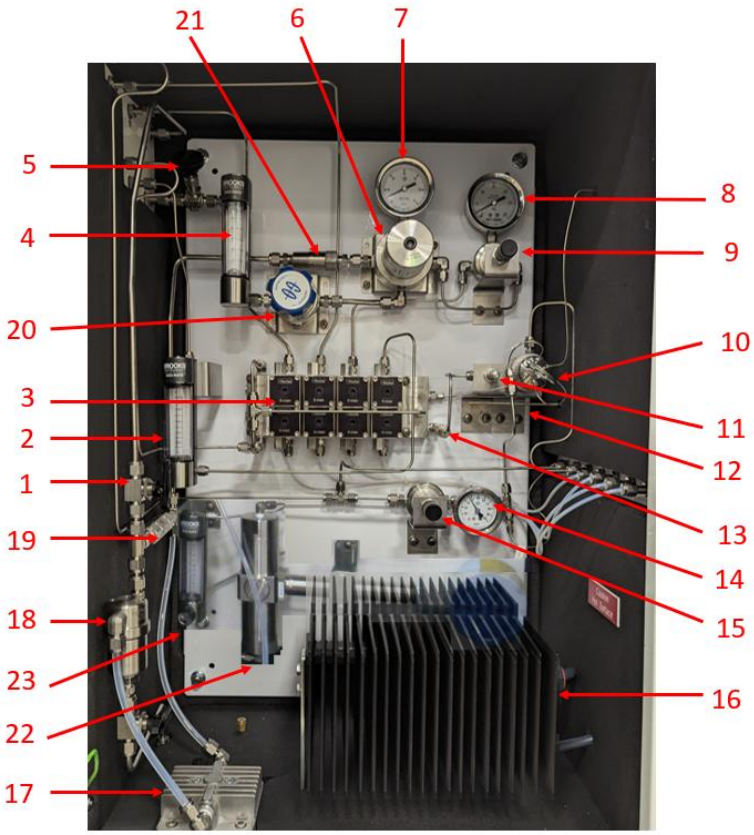
Section 2.5.5 - Furnace Enclosure

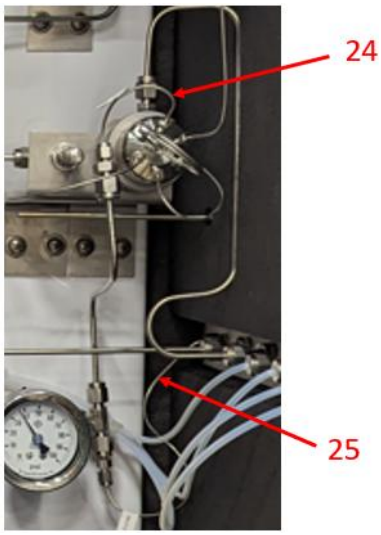


1. Combustion tube/chamber.
2. Furnace.
3. Type-S thermocouples.
4. Thermal Fuse.

Section 2.5.6 - Sample Enclosure

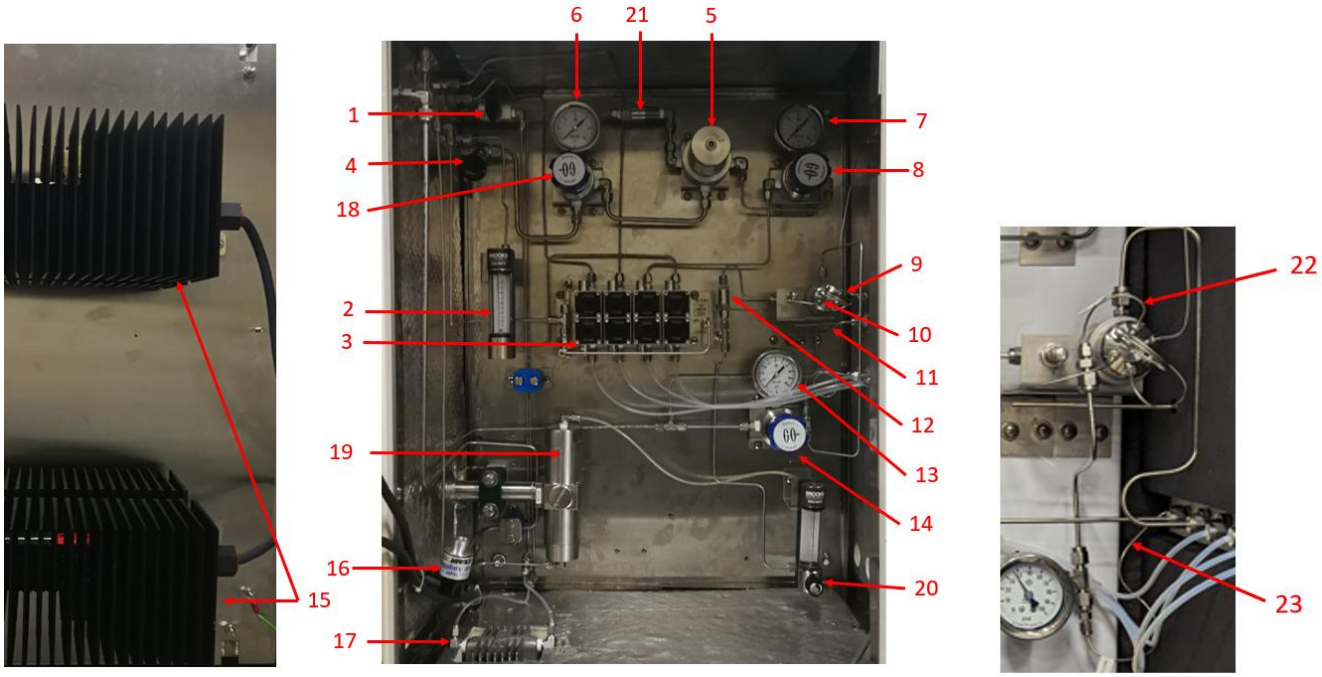
2.5.6.1 - Standard Temperature Model





1. Sample Shut-off Valve
2. Sample Flowmeter
3. Sample/Calibration gas selection manifold.
4. Fast Loop Flowmeter
5. Fast Loop Valve (Needle Valve)
6. Fast Loop Filter
7. Fast Loop Pressure Gauge
8. Sample Pressure Gauge
9. Sample Pressure Regulator
10. Sample Injection Valve
11. Sample Flow Control Valve (Metering Valve)
12. Sample Enclosure Thermocouple
13. Sample Filter.
14. Zero Air Pressure Gauge
15. Zero Air Pressure Regulator
16. Sample Cabinet Heater
17. Sample pump (optional).
18. Coalescing filter (w/ a basic sample pump)
19. Check valve (optional w/ a basic sample pump)
20. Back Pressure Regulator (w/ a sample pump option)
21. Flame Arrestor (w/ a purge option)
22. Density Meter (option)
23. Density Meter Flowmeter (option)
24. Capillary Tubing, 1/16" OD x 10 cm L
25. Capillary Tubing, 1/16" OD x 20 cm L

2.5.6.2 - Mid Temperature Model



1. Sample Shut-off Valve
2. Sample Flowmeter
3. Sample/Calibration gas selection manifold.
4. Fast Loop Valve (Needle Valve)
5. Fast Loop Filter
6. Fast Loop Pressure Gauge
7. Sample Pressure Gauge
8. Sample Pressure Regulator
9. Sample Injection Valve
10. Sample Flow Control Valve (Metering Valve)
11. Sample Enclosure Thermocouple
12. Sample Filter
13. Zero Air Pressure Gauge
14. Zero Air Pressure Regulator
15. Sample Cabinet Heater
16. Air Amplifier
17. Sample pump (optional).
18. Back Pressure Regulator (with a sample pump option)
19. Density Meter (Option)
20. Density Meter Flowmeter (Option)
21. Flame Arrestor (with a purge option)
22. Capillary Tubing, 1/16" OD x 10 cm L
23. Capillary Tubing, 1/16" OD x 20 cm L

Section 3 – Purge (If applicable)

Section 3.1 - Z-Purge

Section 3.1.1 – Description

Failure to maintain minimum overpressure within the protected enclosure shall be detected and communicated by an indicator and / or alarm. The purge cycle time is a manual operation and once the panel has been purged of explosive concentrations, only a minimum overpressure setting is required to be maintained within the enclosure and it is not necessary to remove power from the protected equipment upon the loss of minimum overpressure within the protected panel.

The CYCLOPS Z – Purge Indicator is used to provide safe monitoring of electrical equipment in Division 2, Zone 2 hazardous locations, which can be used to prevent the possibility of fire or explosion inside the panel of energized electrical equipment. A protective gas supply is used to purge potentially flammable materials to an acceptable level, creating a safe area for the electrical equipment within the pressurized enclosure. Maintaining a positive pressure prevents the ingress of potentially hazardous materials in the surrounding atmosphere from entering into the enclosure. After the enclosure is purged, power may be manually connected to the electrical equipment within the pressurized protected panel.

Section 3.1.2 – Purge and Pressurization System Installation

1) Make sure that area surrounding the Calorimeter to be monitored is known to be non-hazardous.

2) Make sure that all power is removed from the electrical equipment located in the enclosure where the CYCLOPS Z – Purge Indicator will be installed.

3) Before mounting the CYCLOPS Z – Purge Indicator install the O-ring provided into its appropriate groove. Next, line up CYCLOPS Z – Purge Indicator on the outside of enclosure, aligning the CYCLOPS Z – Purge Indicator to the mounting holes.

4) Using the five (5) each stainless steel, 1/4–20 UNC x 1/2 long screws, flat and split lock washers provided, mount the CYCLOPS Z – Purge Indicator to enclosure. Tighten bolts until the O-ring seal is completely compressed against the surface of the enclosure to a minimum torque setting of 5 lbf-ft (6.7 N-m) using a #3 Phillips head tool.

NOTE: Refer Calorimeter wiring diagram for wire connecting to Z Purge

Section 3.1.3 – Back-Up Exhaust Vent Installation Procedures

1) Make sure that area surrounding the Calorimeter is known to be non-hazardous.

2) Make sure that all power is disconnected from the electrical equipment located in the panel that Back – Up Exhaust Vent will be installed.

3) **Back – Up Exhaust Vents are orientation sensitive and can only be mounted vertically on top of enclosure.**

4) Before mounting the Back – Up Exhaust Vent; install the O-ring provided into its appropriate mounting fitting groove. Next, insert the Back – Up Exhaust Vent into the mounting hole.

5) Use mounting fitting nut to mount the Back – Up Exhaust Vent to enclosure. Tighten mounting fitting nut until seals against the surface of the enclosure, which will be 25 – 30 in lbs. (2.8 – 3.4 Nm).

Section 3.1.4 - Startup Procedures

1) Make sure that area surrounding analyzer to be purged and pressurized is non-hazardous.

2) Power up the analyzer.

3) Close and latch enclosure door.

4) Increase the flow rate of the protective gas supplying until the Purge Indicator Green LED illuminates.

Section 3.2 - X-Purge

Section 3.2.1 – Description

The CYCLOPS X – Purge Controller is used to provide safe control and monitoring of electrical equipment in Zone 1 hazardous areas. To prevent the possibility of fire or explosion inside the enclosure of energized electrical equipment, a protective gas supply is used to dilute potentially flammable materials to an acceptable level, creating a safe area for the electrical equipment within the enclosure. Positive pressure prevents the ingress of flammable materials in the surrounding atmosphere from entering into the enclosure, as long as positive pressure is maintained. After the electronics enclosure is purged, power may be automatically applied to the protected electrical equipment.

Section 3.2.2 – Start Up Procedures

1) With power applied to the CYCLOPS X – Purge Controller and the purge protective gas on the CYCLOPS X – Purge Controller green light begins to blink.

2) With purge protective gas being supplied to electronics and furnace enclosure and CYCLOPS X – Purge Controller green indicator light blinking, the automatic dilution purge time cycle will start. The dilution time cycle is factory set, before power can be automatically applied to the electrical equipment inside the purged enclosure by the CYCLOPS X – Purge Controller.

3) After the dilution purge time cycle has elapsed the green indicator will stop blinking, provided minimum overpressure setting is met.

4) and go into a steady state. Power will then be automatically applied by the CYCLOPS X – Purge Controller to the electrical equipment within the protected purged enclosure.

Section 4 – Software Operation

This section of the manual aims to provide a comprehensive overview of the 9800CXi software and a fundamental understanding of the operation of the standard and mid-temperature models of the analyzer.

The 9800CXi is a PLC-based system that is coupled with analog and digital I/O modules along with a HMI. This helps reduce hardware footprint and at the same time providing a seamless hardware integration.

The following section explains the HMI screens layout and functionality of each screen. Although this manual provides a substantial amount of information about the entire system and operation, users are also welcome to attend in-house training sessions conducted by PROCESS INSIGHTS that provide in-depth hardware, software and hands-on training.

The 9800CXi is an online analyzer, designed to provide continuous process measurement. The analyzer is programmed with two system-critical digital inputs – combustion air and purge. In addition, the analyzer does not begin operation unless the furnace and sample temperatures have reached their set points. This ensures that sample injection will not result in coking.

Section 4.1 - Start Up

The following are the steps in the analyzer power-up sequence.

- Turn “ON” the power breaker mounted on the right side of the Analyzer’s Electronics enclosure.

Note: *If the analyzer is installed in a classified location (Class 1, Div 1) and has the X-purge option installed, then the analyzer has to be purged for **30 minutes** while the furnace and electronics enclosures are closed, after which the X-purge will automatically turn ON the power to the analyzer.*

Even if the analyzer comes with the Z-purge option installed (Class 1, Div 2 area classification), the analyzer should be purged for the stipulated amount of time while the furnace and electronics enclosures are closed, before powering ON the analyzer.

- The PLC (mounted on the back wall inside the analyzer’s electronics enclosure) and the HMI (Display) will start their power-up sequences which will take a few minutes. During this time, you may see the status lights on the PLC change between Red and Green, which is normal during the power-up sequence.

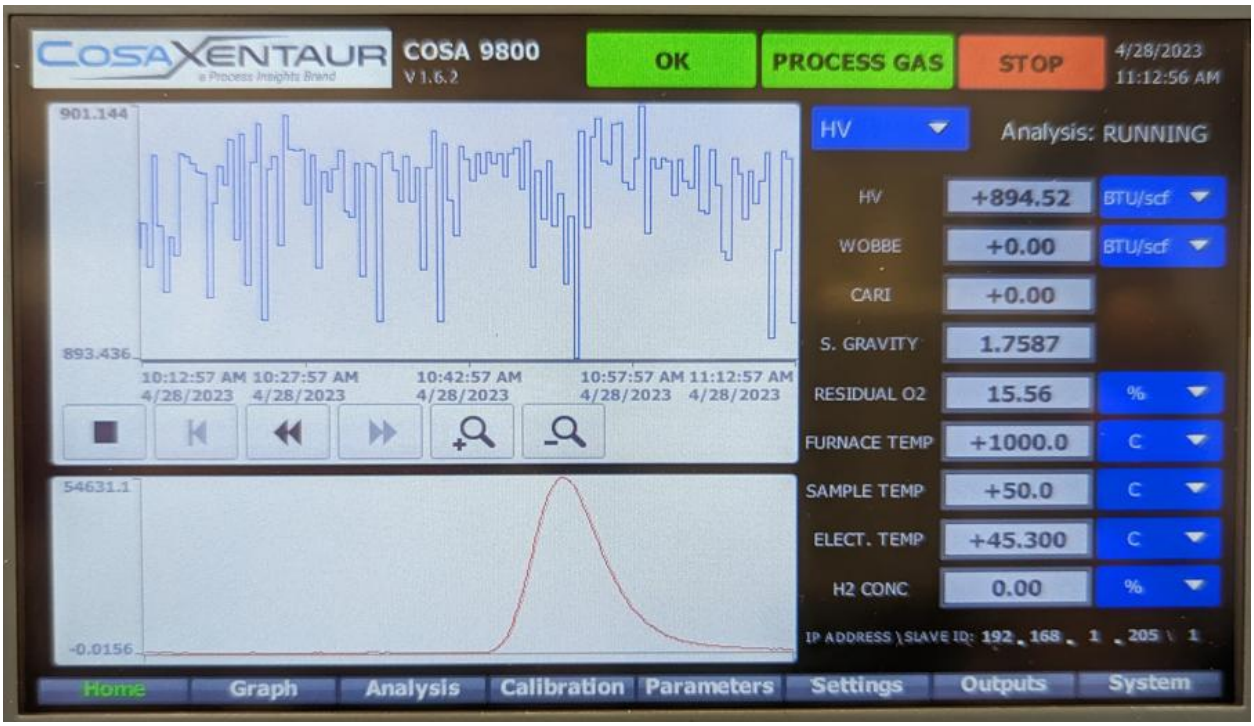
PLC module initializing

HMI initializing

When the Start menu comes up, you have the option to press the “Start” button to bring up the HMI, otherwise, the HMI will automatically start up after a preset delay of 30 seconds.

HMI Start Up screen

Once the PLC and HMI have initialized, and as long as no alarms are triggered, the status of the analyzer will be “OK”. The Analyzer will actuate the process stream and after a purge delay of the preset amount of time, the analyzer will automatically start running analyses, and the graph and parameter values will be updated every second in the respective screens.



HMI Start Up screen

Section 4.2 - Status bar on HMI

This indicates the current status of the analyzer. This bar is visible on the very top of the HMI and is common across all HMI screens.

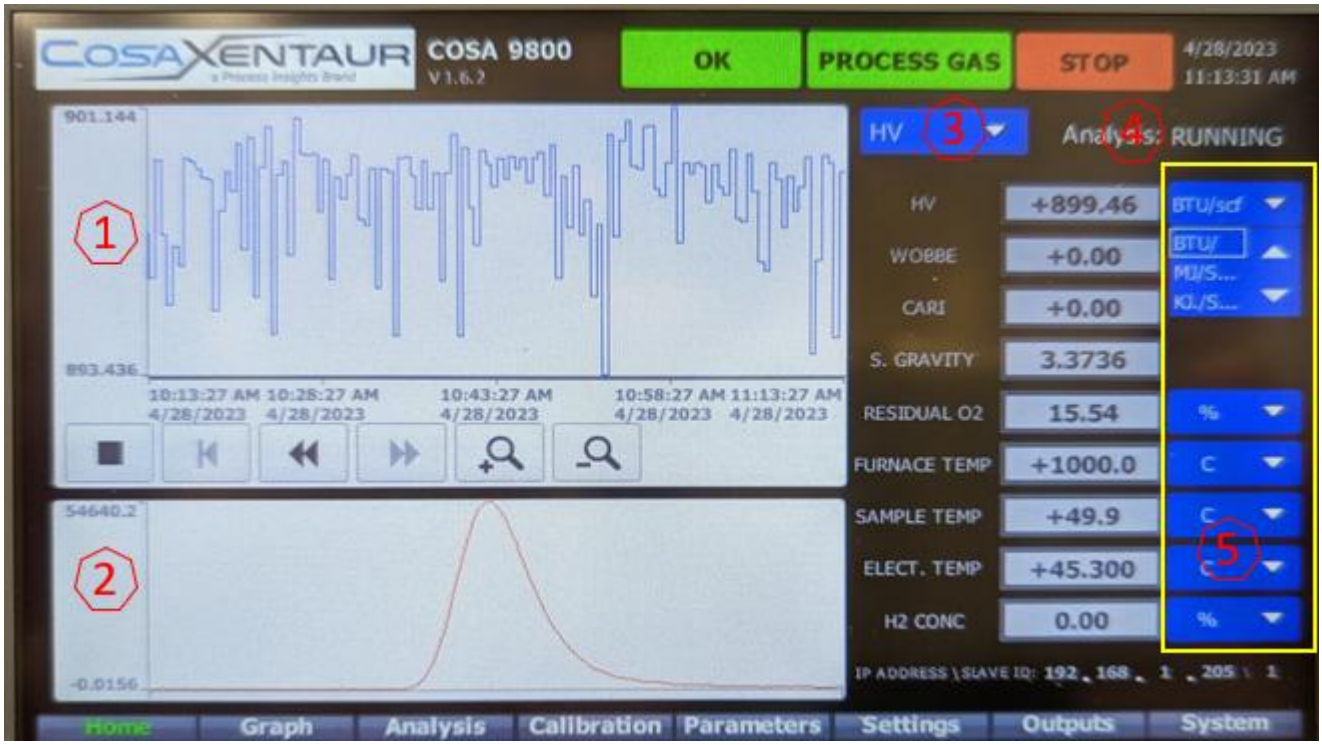
1 Shows one of three states: OK, WARNING or ALARM.

2 Shows whether current gas being analyzed is Process, Low Cal Gas, or High Cal Gas.

3 Button to START or STOP the analyses.

Section 4.3 - HOME Screen

This screen shows the latest results of the analysis cycle on the lower section of the screen, device parameters as well as the trend graph on the upper section of the screen.



The analysis values for HV (Heating Value), WOBBE, CARI, S. Gravity (Specific Gravity), and Residual O2 are updated at the end of every 30-second cycle. The temperature values are updated every second.

1 This displays a maximum of a 30-minute trend of the selected value.

2 This shows the current 30-second analysis cycle.

3 This drop-down list allows users to select one parameter: HV, WOBBE, SG, H2, or O2 for the trend plot.

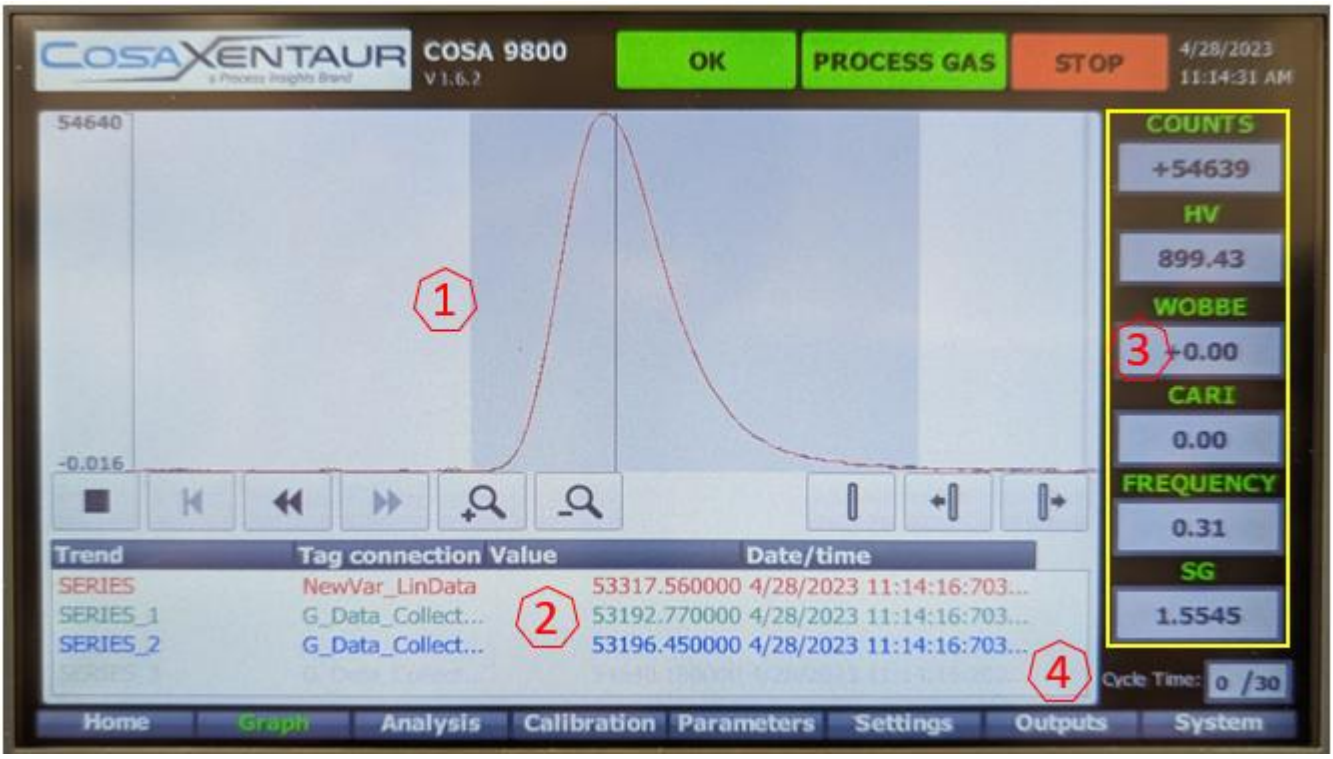
4 This status indicator lets users know whether the analyzer is running/holding.

5 These are drop-down lists of units of measurement that can be selected for each parameter.

	Units				
CV	BTU/scf	MJ/Sm3	MJ/Nm3	KJ/Sm3	KCAL/Sm3
WOBBE	BTU/scf	MJ/Sm3	MJ/Nm3	KJ/Sm3	
Temp	C	F			

Section 4.4 - GRAPH Screen

This screen shows the magnified graph that is also shown on the bottom section of the HOME screen.



This graph displays the 3 latest analysis cycles with the “red” plot being the current cycle. This screen also provides the actual measured response in terms of COUNTS and FREQUENCY values that are used to calculate the HV, WOBBE, SG, etc. for the current gas being analyzed.

1 Magnified image of the analysis cycles.

2 Last 3 analyses cycles - labels.

3 Process parameters are updated for every analysis cycle.

4 Current analysis cycle time progress in seconds.

Section 4.5 - ANALYSIS Screen

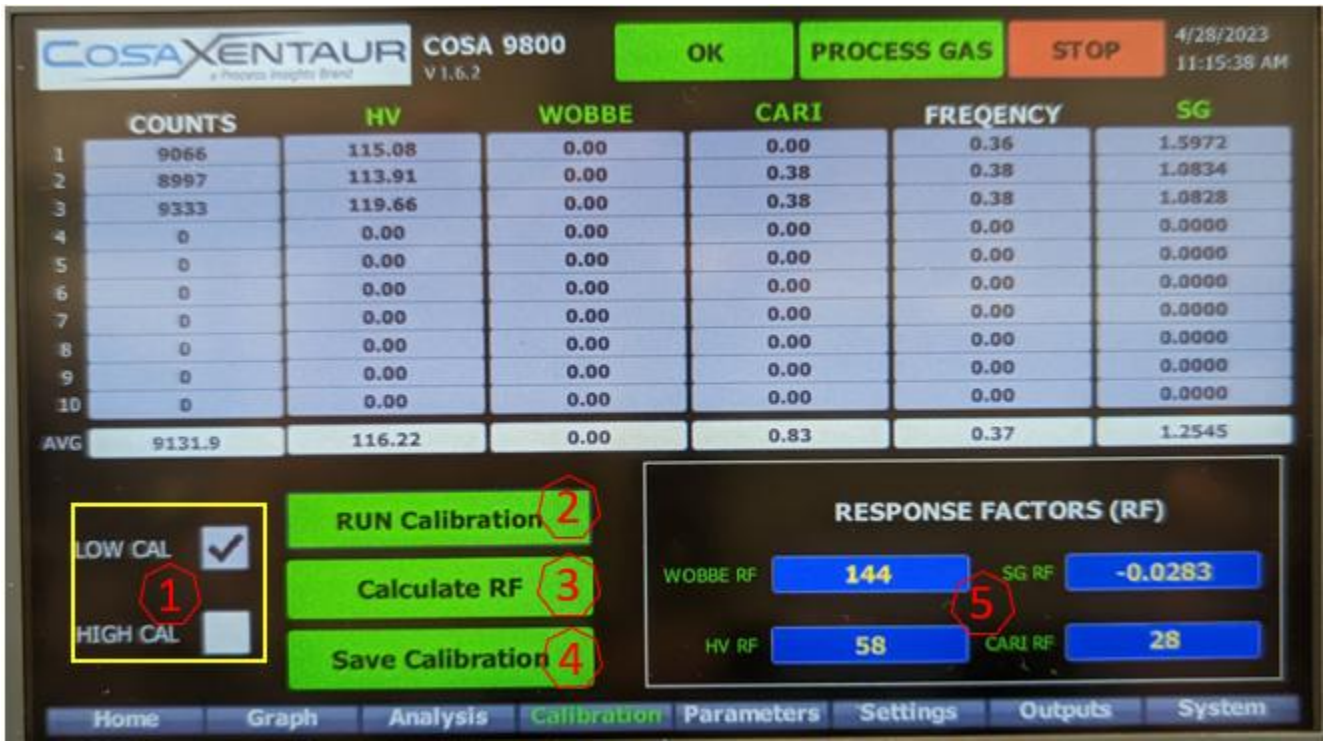
The ANALYSIS screen shows the results of the 10 latest analysis cycles.

1 Each of the shown columns displays the latest 10 process values. The user can enter an averaging factor value between 1 and 10 as shown in the above image. The analyzer then displays the average of the selected number of values and displays them in the row labeled “AVG”.

2 For example, if “AVG FACTOR = 5”, then the value displayed in the “AVG” row will be an average of the 5 latest values in that column.

Section 4.6 - CALIBRATION Screen

This screen contains the manual calibration controls as well as information about the last run calibration and the generated response factors (RF).



The user can run up to a maximum of 10 calibration cycles. The average of the results of the set number of calibration cycles is then used to calculate the individual response factors used in the HV, WOBBE, CARI, and SG values.

1. These check boxes are used to select the calibration gas that the user intends to run.

2. This button actuates the selected calibration gas and runs the set number of calibration cycles.

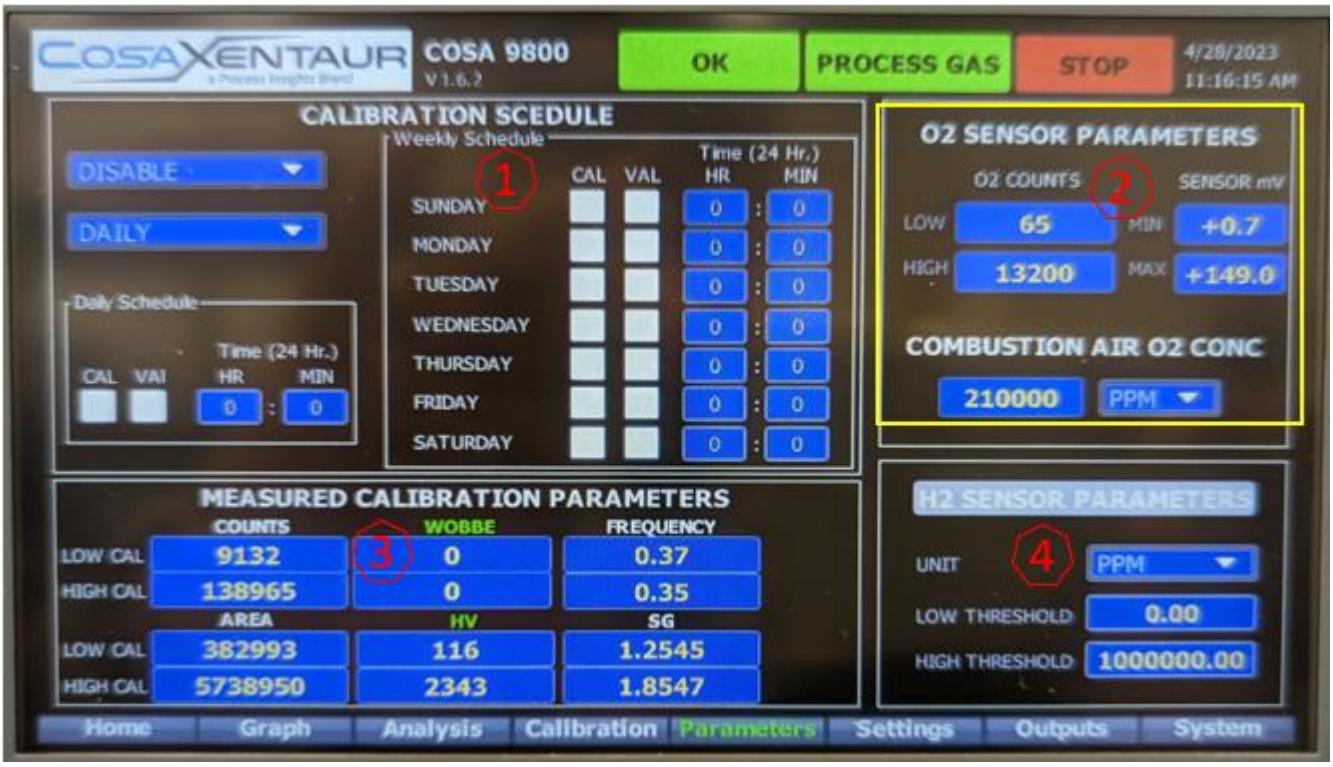
3. After the set number of calibration cycles have been run, clicking on this button will calculate the individual response factors for HV, WOBBE, and SG.

4. If the calibration is acceptable to the user, clicking on the “Save Calibration” button will accept this as a new calibration and all previous Response Factors will be overwritten.

5. The Response Factors for HV, WOBBE, SG, and CARI are calculated and saved in this section. These are the latest calculated Response Factors and are used for calculations until a new calibration is run and new Response Factors are calculated and saved.

Section 4.7 - PARAMETERS Screen

The PARAMETERS screen allows user to enter settings for auto-calibration/auto-validation as well as operating parameters for the Oxygen Sensor.



1. These Calibration Schedule is described in detail in a later section of this manual.

2. O2 sensor parameters are factory-set and crucial for calculating residual oxygen, HV, and WOBBE values. To ensure accuracy, these values should remain unchanged.

3. These are measured values during Calibration. These values are used to generate the required Response Factors- (RF).

4. The H2 Sensor parameters used for H2 measurement in units when available.

Section 4.8 - SETTINGS Screen

The SETTINGS screen provides details about the analysis cycle settings and calibration gas settings.

1 The settings for the analysis cycle include the start and stop times for SSO, injection time, baseline and peak signal integration windows, and the overall cycle window. Users can edit these settings to improve the analyses. However, please note that the maximum allowable cycle time is fixed at 30 seconds. It is recommended to use the preset times displayed on the screen above.

2 These are the physical properties of calibration gases. These values are used to generate the calibration curves (Response Factors) for HV, WOBBE, CARI, and SG.

3 The user can enter a value from 1 to 10 for the set number of Calibration Cycles. The Purge Time is the "wait" duration when the analyzer switches from one gas to another and allows the set time to purge out the previous gas to eliminate contamination.

Section 4.9 - OUTPUTS Screen

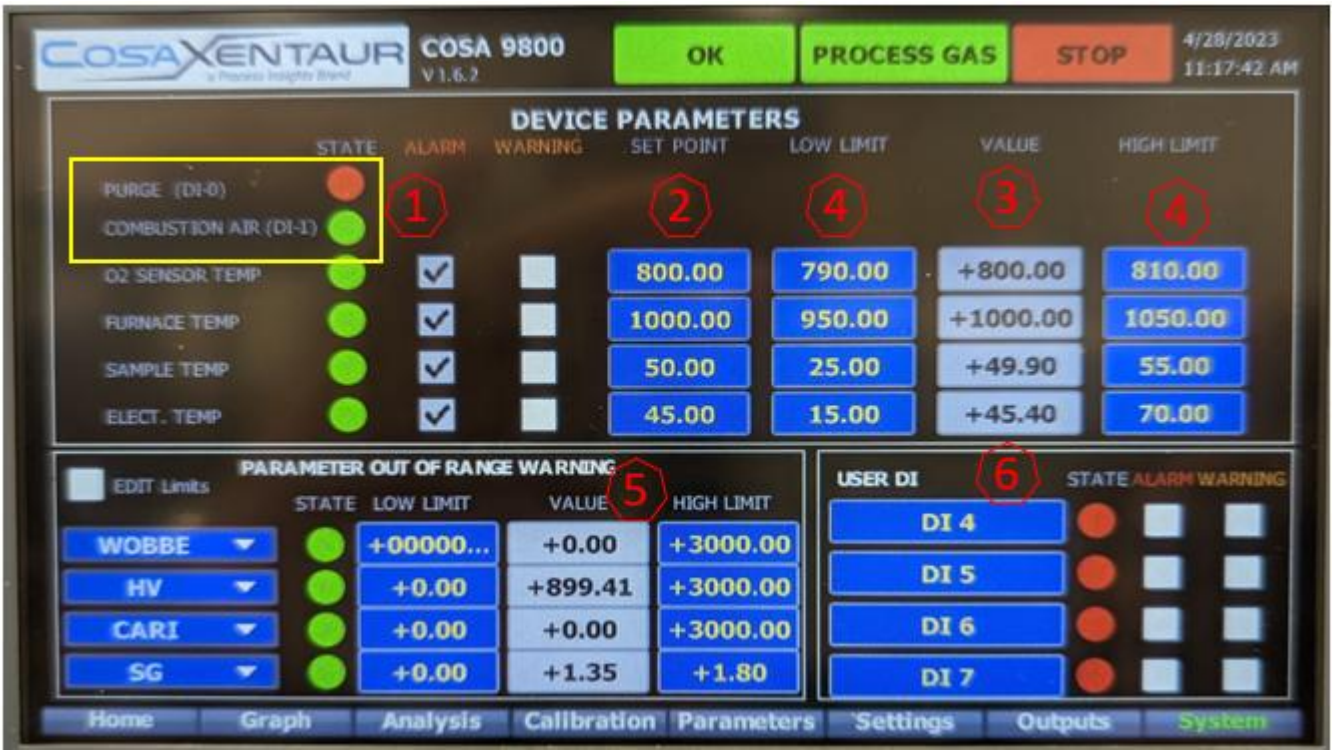
The Outputs screen shows information about the Analog and Digital Outputs of the analyzer.

1 The “Digital Outputs Status” section displays the current operating status of all Digital Outputs. These outputs control the analyzer manifold valves, which select between process gas, calibration gas, and the atmospheric reference valve. Additionally, these Digital Outputs also control the Sample (Inject) valve. A “GREEN” status indicates that the output is ON, while a “RED” status indicates that the output is OFF.

2 The analyzer features two Analog Output channels, with the option to add two additional channels. Each channel includes a drop-down menu of available parameters that the user can select for the analog output. The user can specify a low value, which corresponds to the 4 mA signal, and a high value, which corresponds to the 20 mA signal. This setup establishes the range for the Analog Output

Section 4.10 - SYSTEM Screen

The SYSTEM screen contains all the Alarm and Warning information of the analyzer. This provides the details about a particular Alarm/Warning generated during analyzer operation.



1 The Device Parameters screen provides the ability to monitor all the system temperatures and system-critical digital inputs. The "Purge DI-0" and "Combustion Air DI-1" are system-critical Digital Inputs. The Analyzer will not start analyses if either of these two Digital Inputs are in alarm (RED).

2 User can set the temperature set point for the O2 sensor temperature, furnace temperature, sample cabinet temperature, and electronics cabinet temperature. The analyzer temperature controller will control the temperature of each corresponding to the set point. The factory default setting is in the specification section.

However, the analyzer temperature controller **doesn't control the electronics cabinet temperature.**

3 Measured temperature values.

4 Users can set the alarm and warning limits. The checkboxes for "Alarm" and "Warning" determine how the system reacts when a parameter value falls outside the acceptable range. For example, if the "Alarm" box is checked for the Furnace Temp parameter, and if the actual value falls out of either set limit, the analyzer status will change from "OK" to "ALARM", and analyses will be stopped. However, if the "Warning" box is checked, the

analyzer status will change from “OK” to “WARNING”, but the analysis will not be suspended.

5 The Parameters Out Of Range Warning, as the name suggests, will change the analyzer status from “OK” to “WARNING”, if the value falls out of the lower or upper limit. The analysis will not be suspended.

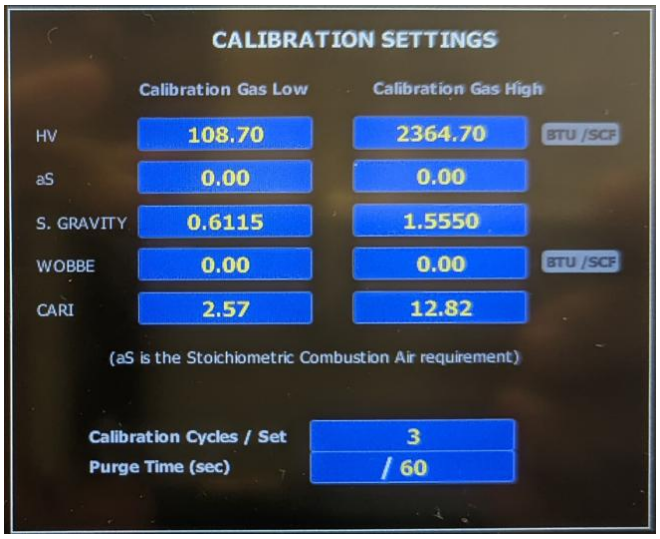
6 The User Configurable DIs are 4 Digital Inputs that the user can wire into the analyzer to be monitored. The analyzer can be programmed to either “Alarm” or just provide a “Warning”. The Alarm/Warning behavior is the same as described above for the Device Parameters.

Section 5 – Calibration and Validation Procedures

The analyzer requires two calibration gases, a low and high gas, to generate response factors used for calculating HV, WOBBE, CARI, and SG values.

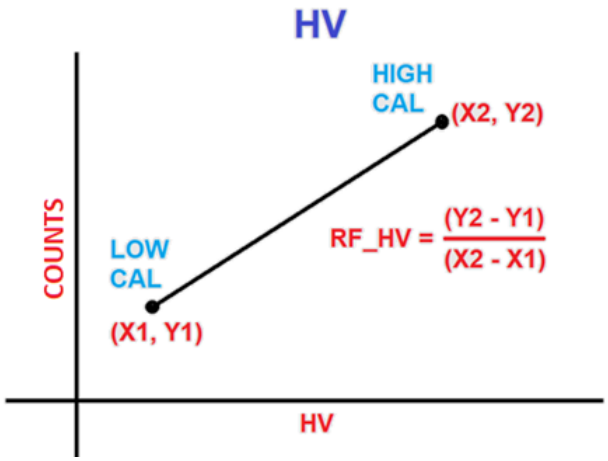
The calibration or validation can be run either manually, or automatically. Both these methods will be described in detail in the next sub-sections.

The calibration settings (located in the SETTINGS screen) provide information about the parameters for the low and high calibration gases. These known parameters are used to generate the calibration curve.



The calibration curve is actually a linear regression. As an example, the Response Factor calculation for HV is as shown below.

As shown, the two Calibration gases are run to generate the known Calibration parameters (Counts), which are then used to generate the linear regression. The slope of this regression corresponds to the Response Factor (RF) that is then used to calculate the process HV.

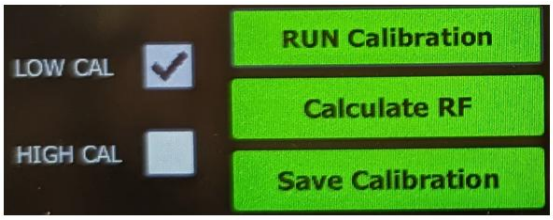


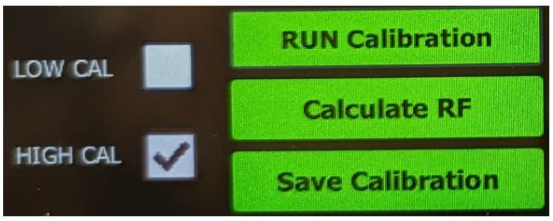
Section 5.1 - Manual Calibration/Validation

The manual calibration controls are located on the CALIBRATION screen. Before starting a calibration cycle, verify that the calibration settings for the calibration standards in the SETTINGS screen are set correctly.

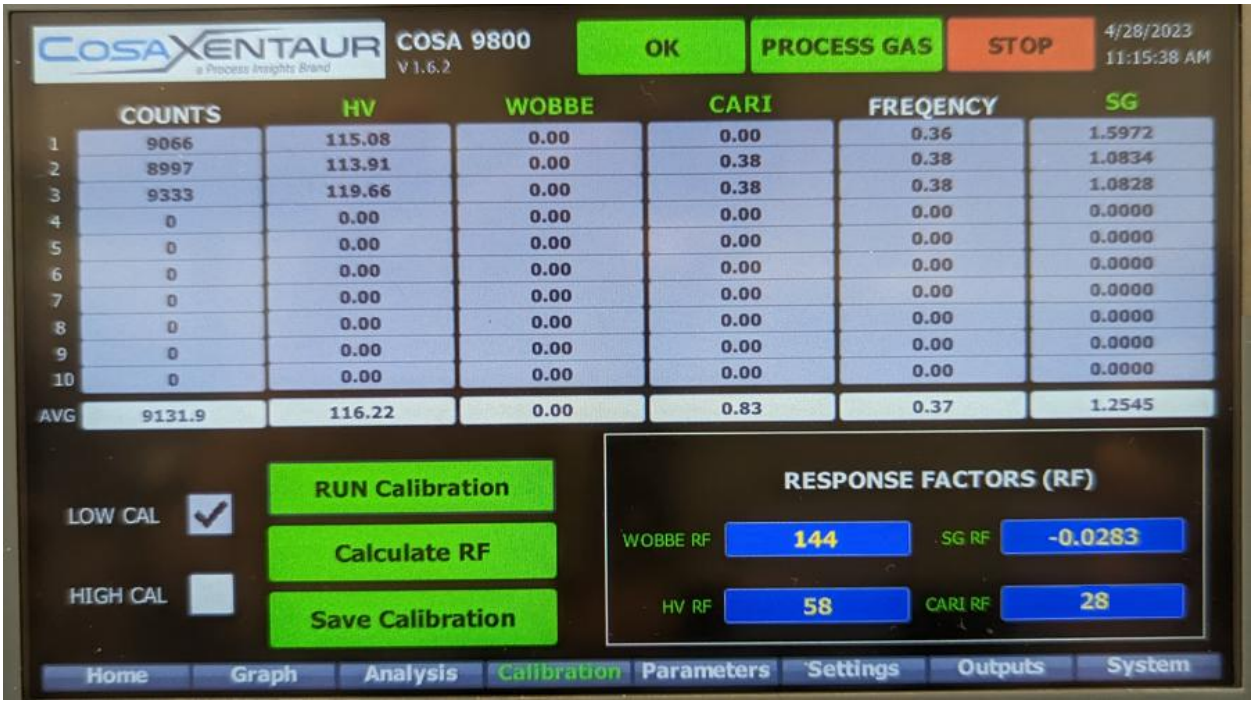
Also, in the SETTINGS screen, enter the number of calibration cycles you wish to run (Calibration Cycles / Set), as well as the "Purge Time (sec)", which is the duration for which the analyzer will purge the sample system and detector path with the new gas sample before beginning analyses. This ensures that the previous sample gas is completely purged out of the system to prevent sample contamination and thereby erroneous results.

Then navigate to the CALIBRATION screen, select the checkbox for "LOW CAL" and then click on "Run Calibration". The analyzer will switch to the low calibration standard and purge for the set amount of purge time before running the preset number of calibration cycles.





The results of the analyses are updated in the table located on the CALIBRATION screen.



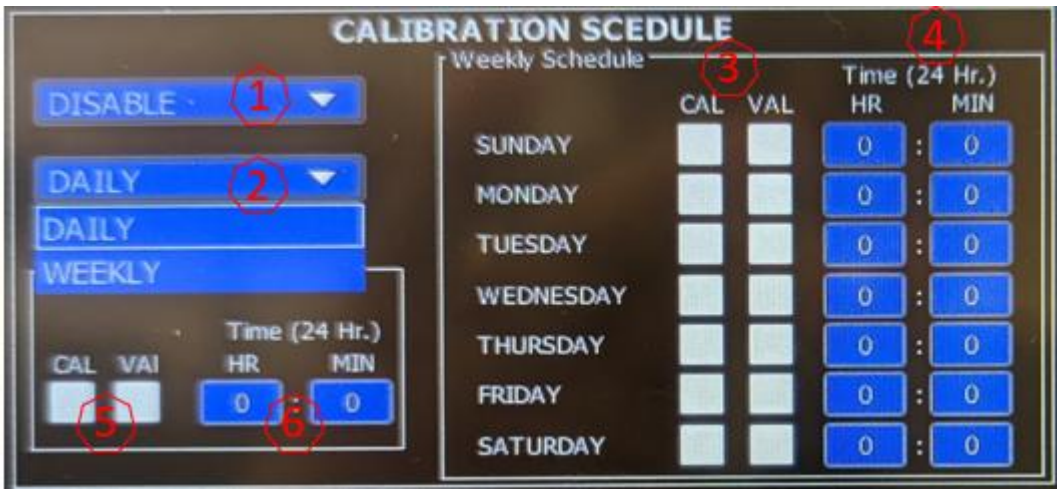
After the lower calibration is completed, follow the same procedure to run the high cal gas. The user can also select both checkboxes for “LOW CAL” and “HIGH CAL”. In that case, when “RUN CALIBRATION” is selected, the analyzer will run the high calibration standard first, and then the low calibration standard.

Once both calibration standard runs are completed, click on “Calculate RF”, which will generate new response factors for HV, WOBBE and SG. Click on “Save Calibration” to accept the new calibration. The new RF values will now be used to calculate the HV, WOBBE and SG for the process stream.

Section 5.2 - Calibration/Validation Schedules

The calibration/validation can also be set to run automatically on a preset schedule. The analyzer allows users to select either a Daily, or a Weekly schedule.

CAUTION: When using the Auto-Calibration option it should be noted that the new calibration is accepted irrespective of the response. This can potentially save incorrect Response Factors thereby reporting erroneous results that can adversely affect process.



1 In order to activate the scheduled calibration / validation, the “Calibration Schedule” has to be “Enabled”. By default it is “Disabled”.

2 Select either the “Daily” or “Weekly” schedule.

3 For the weekly schedule, select CAL (Calibration), VAL (Validation), or check both boxes to run both Calibration, and then Validation cycle.

4 For the weekly schedule, set the schedule run time in hours (24HR) and minutes.

5 For the daily schedule, select CAL (Calibration), VAL (Validation), or check both boxes to run both Calibration, and then Validation cycle.

6 For the daily schedule, set the schedule run time in hours (24HR) and minutes.

Section 5.2.1 - Daily Calibration/Validation Schedules

For the Daily schedule, select the appropriate checkbox for “Cal” or “Val”, and enter the calibration/validation time in hours and minutes (24-hour format).

The analyzer will then run the calibration/validation as selected at the pre-set time every day. If the Calibration box is checked, the analyzer will run both the low and high calibration gases, then calculate the new RF values and automatically save and start using the new Response Factors.

If the Validation box is checked, the analyzer will run both the low and high calibration gases, however the new RF values will not be automatically calculated and saved. The measured calibration parameters will be updated in the PARAMETERS screen, and the user will have the option to calculate the new RF values and save them.

Section 5.2.2 - Weekly Calibration/Validation Schedules

The weekly schedule is flexible, and the user has the freedom to set either auto-calibration or auto-validation as well as choose a different start time for each day.

The user can also choose to run both, the calibration and validation one after the other.

To activate this schedule, “Enable” the Calibration Schedule, select the “Weekly” option. Select the appropriate checkboxes for Cal or Val for each day, and enter the time (24-hour clock) in hours and minutes.

The analyzer will run the set number of calibration and/or validation cycles at the set day and time and either calculate and save the RF values for calibration, or just report the end results of the validation runs.

Section 6 – MODBUS Digital Communications

The 9800CXi Calorimeter is a PLC-based system and can be programmed for Modbus TCP/IP communication. The detailed Modbus map is available in the next section.

The MODBUS data is typically a near-continuous stream of data packets from the Client. The 9800CXi software is self-aligning regardless of where it starts listening to packets. This is accomplished by starting with an index of zero. The byte read must equal the Station ID if the index is zero. If not, the alignment procedure begins again without incrementing the index. Alignment is achieved within 8 characters of a packet for the 9800CXi. When a character read does equal the ID, the index is advanced from 0 to 1. The next character read must equal an allowable function code (1-6). If there is no match the index is reset to 0. Under this scenario, the reception of packets will self-synchronize. If we have a match on the first and second byte, read the next 6 bytes. At this point we have 8 bytes in a receive register. Perform a CRC on the first six characters and compare with the 7th and 8th characters. There must be a CRC match to process the received packet. If there is no match, the index is again reset to 0 and the process of data capture and qualification repeats. Upon detection of a complete and valid packet the received 8-byte packet is transferred to private processing area. The "Save Packet" function is called which executes a function (1-6) as defined by the function code byte in the 2nd byte of the saved packet. The 9800CXi software creates a reply message for the Client and transmits it back to the client. A message stream resembles the image below showing the command on the left and the response on the right.

Response time is approximately 10ms after the packet is decoded before a reply message is sent.

Example of reading a single unsigned 32-bit register

In the example below, registers pair R30169 and R30170 are the ppm value. Use function code 4 with an offset of 68 in the MODBUS message to read it.

Example MODBUS query: **02 04 00 44 00 02 31 ED**
Where:
02 = ID
04 = Function Code
00 44 = address offset = 68
00 02 = number of registers requested
31 ED = CRC

Example of MODBUS response, returns 4 bytes from offset 68: **02 04 04 00 07 B1 84 0D 76**
Where:
02 = ID
04 = Function Code
04 = Byte Count
00 07 B1 84 = 504,196 ppm
0D 76 = CRC

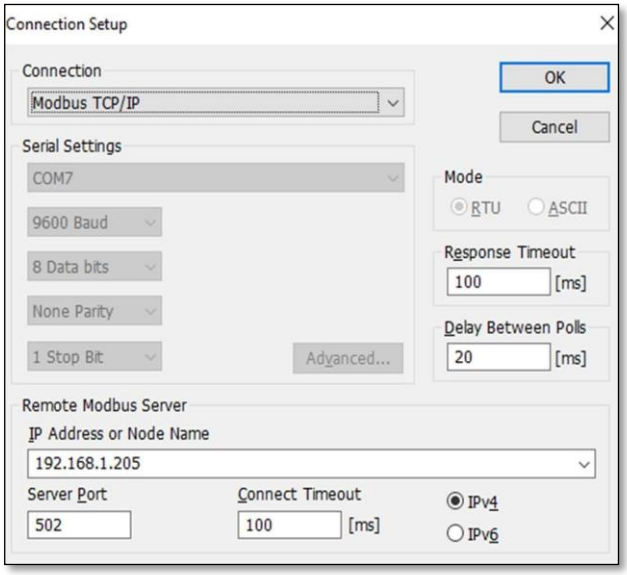
Section 6.1 - Communication Settings

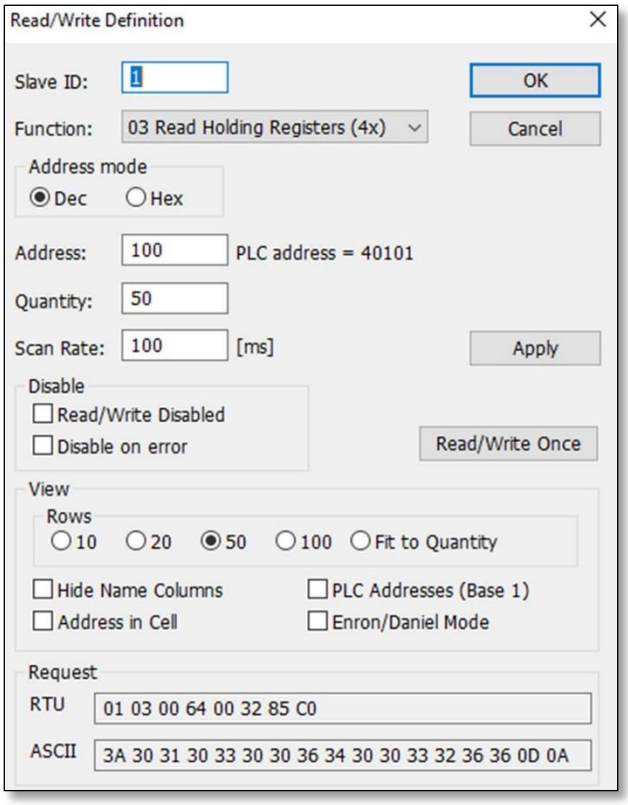
The communication setup is a part of the start-up and is addressed as a part of the Analyzer commissioning.

Section 6.2 - MODBUS Map

Address	Variable	Tag	Data Type	Updated every
40100	Cycle Counter	Process analysis cycle# every 30s	DINT	30s
40102	Peak	Max Counts during peak analysis	REAL	30 s
40104	Area	Area during peak analysis	REAL	30 s
40106	WOBBE	Calculated WOBBE	REAL	30 s
40108	HV	Calculated HV	REAL	30 s
40110	CARI	Calculated CARI	REAL	30 s
40112	ResidualO2	Calculated Residual O2	REAL	30 s
40114	Frequency	Measured Frequency from Densitometer	REAL	30s
40116	Specific Gravity	Calculated Specific Gravity	REAL	30s
40122	MFC	Calculated MFC	REAL	1 s
40124	FTemp	Furnace Temperature	REAL	1 s
40126	ECTemp	Electronics Cabinet Temperature	REAL	1 s
40128	SCTemp	Sample Cabinet Temperature	REAL	1 s
40130	O2Temp	Oxygen Sensor Temperature	REAL	1 s
40140	100ms Counter	Linearization sequence# every 100ms	UINT	100 ms
40142	Freq-100ms	Raw Freq – 100ms	REAL-4dp	100 ms
40144	Lin_Counts	Linearized Counts, updated 100ms	REAL-2dp	100 ms
40146	C_L	Low O2 Count	UNIT	100 ms
40148	C_H	High O2 Count	UINT	100 ms

40150	V_L	Low mV	REAL	100 ms
40152	V_H	High mV	REAL	100 ms
40154	S_CV	Count/ Voltage Ratio	REAL	100 ms
40156	#A	Residual O2%	REAL	100 ms
40158	C_BA	Baseline Average	REAL – 2dp	100ms
40160	RefO2	%Reference O2	REAL	HMI input
40164	Time msec	Time in msec	REAL	100 ms
40168	Cum mms	Cumulative msec from PLC reset	REAL	100 ms





Tx = 1825777: Err = 41326: ID = 1: F = 03: SR = 100ms

	Name	00100	Name	00120	Name	00140	Name	00160
0	Cycle Counter	19		--	100ms Counter	275	Ref O2	20.9499
1		--		--		--		--
2	Peak	209391	MFC	0	Raw_Counts	368		0
3		--		--		--		--
4	Area	1.242e+07	FTemp	24	Lin_Counts	-0.015625	Msec	792
5		--		--		--		--
6	WOBBE	865.188	ECTemp	0	C_L	10550		0
7		--		--		--		--
8	HV	36568.2	SCTemp	0	C_H	39100	Cumulative ms	797500
9		--		--		--		--
10	CARI	0	O2Temp	30.5	V_L	-0.001		
11		--		--		--		
12	ResidualO2	0.0108031		0	V_H	0.181		
13		--		--		--		
14	Freq	1		0	S_CV	156868		
15		--		--		--		
16	SG	0.819231		--	#A_Percentage	20.9499		
17		--		--		--		
18		0		0	Baseline Avg	10550		
19		--		--		--		

Section 7 – Basic Maintenance Guide

To ensure proper operation of your analyzer, it is recommended that user have regular visual checks using the guidelines listed below.

Wear PPE before performing any maintenance or inspection and follow the Warnings and Cautions stated in the manual.

The analyzer requires standard tools, the most common of which are listed below:

- Wrenches – 5/16, 1/4, 7/16, 1/2, 9/16
- Allen wrenches set - 1/16 - 3/8in
- #1 and #2 Flat head and Phillips head screw drivers
- Small flat head screwdriver set (electrical wiring)

Interval	Visual inspection	Actions
3 months	Leak check	Tighten or replace the fitting with new one
1 month	Plastic tubing	Replace if cracked, pinched, or degraded
1 month	Pressure regulator	Drain if water is collected in the filter bowl
6 months	Sample heater	Replace if not working
6 months	Main enclosure heater	Replace if not working
6 months	Pressure regulator	Replace if gauge is broken
6 months	Sample valve	Replace if it makes croaking sound
12 months	Wire & cables	Replace if cracked, pinched, or degraded
12 months	Purge monitor	Replace if Green/Red light is not working
12 months	Labels outside	Replace if worn out or illegible
12 months	Labels inside	Replace if worn out or illegible
12 months	Ground lugs nut	Tighten if loosened
12 months	Enclosures	If water and dust leakage found, then replace the seals
12 months	Mounting bolts	Tighten if loose and replace if corroded
12 months	Furnace vent	Replace if air flow is restricted

After performing any maintenance make sure following has been done:

1. Leak check.
2. Visual inspection of any loose wires that may have not been re-connected or accidentally pulled from the device.
3. Purge the instrument according to the purge time specs.

Section 7.1 - Safe Service Instructions

This section covers some basic maintenance procedures that can be performed regularly to keep the instrumentation running efficiently.
However, it is important to follow safe work measures to avoid any personal injuries and/or loss of life and/or property.
Please follow the safety guidelines in this manual very carefully. The most common maintenance tasks and the associated hazards are identified in this section. However, this manual also includes detailed information about identified risks and safe operation of the analyzer and its peripheral modules.

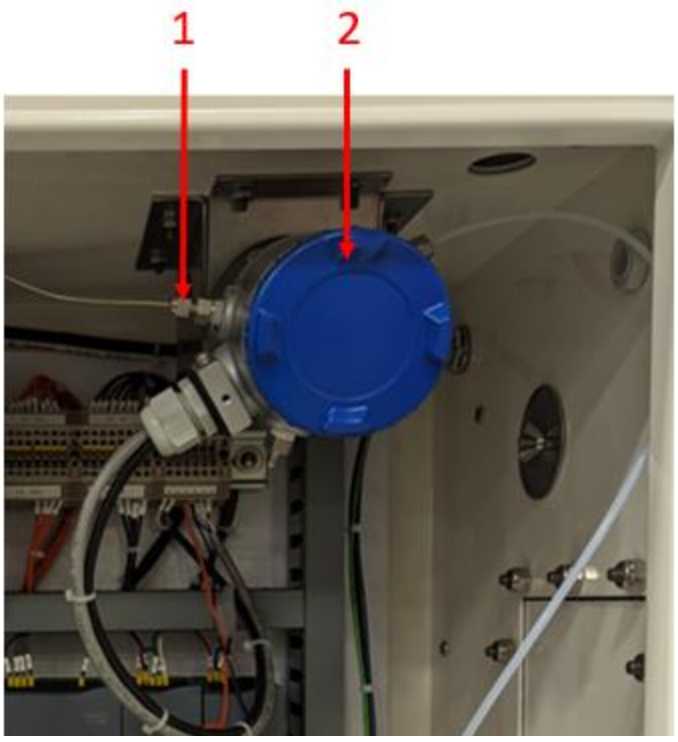
WARNING: 	**A SEVERE TO POTENTIONALLY LETHAL ELECTRIC SHOCK HAZARD MAY EXIST ON 110-240 VAC LINE COMPONENTS WHILE POWER IS APPLIED TO INTERNAL COMPONENTS.** Ensure that power is disconnected from the power source before working on the instrument.
WARNING: 	**HIGH-PRESSURE GASES SHOULD BE HANDLED WITH EXTREME CARE.** Ensure that all gas lines, regulators, gas purifiers, etc. are specified for the intended use. Verify that all tubing is depressurized, and sample drained before beginning work on any of the modules. Verify that lines are properly purged before opening lines or disconnecting sample.
WARNING: 	**HIGH-PRESSURE GAS BOTTLES SHOULD BE HANDLED WITH EXTREME CARE.** Typically, most sample and gas bottles are under pressures in the hundreds or thousands of PSI. Ensure that the bottle regulators are closed OFF before disconnecting lines.
WARNING: 	**IMPROPER/INCORRECT TOOLS CAN CAUSE INJURY AND/OR PROPERTY DAMAGE.** Using incorrect tools can cause slippage leading to injury from loss of balance, or cuts or trauma.
WARNING: 	**SEVERE BURNS CAN RESULT WHEN WORKING AROUND A HOT FURNACE.** The combustion chamber is extremely hot. Allow the furnace to cool down for at least 4 hours before performing any maintenance on it.
CAUTION: 	Carefully ensure the analytical system is free from leaks. Failure to do so may cause inconsistent analytical performance and/or system component damage.

WARNING: 	**COMPONENT DAMAGE MAY OCCUR WHEN USING A LIQUID LEAK DETECTOR.** Even though the solution in an approved liquid leak detector "Snoop" solution is non-conductive, care should be taken not to wet any electrical or electronic components to avoid damage to sensitive equipment. Many liquid leak detectors contain sulfur compounds that can contaminate the gas supply line and instrument flow path components. Care should be taken not to wet or contaminate the analytical flow system when using a liquid leak detector.
CAUTION: 	**Do not over-tighten fittings.** Fittings should be tightened according to manufacturer's specified recommendations to prevent leaks.
CAUTION: 	**Ensure all inlet and outlet openings are kept clean and free from contaminants.** It is recommended that the inlet and outlet openings be plugged when not connected to lines.
CAUTION: 	**Potentially hot surfaces are identified using this warning label. Caution is required when touching hot surfaces to avoid burns and other injuries.**
PROHIBITED: 	THE ANALYZER SHOULD NOT BE MODIFIED IN ANY WAY. ANY MODIFICATIONS TO THE ANALYZER HARDWARE, ESPECIALLY TO AND FROM THE FURNACE, CAN POTENTIALLY MAKE THE SYSTEM UNSTABLE. MODIFICATIONS TO THE FLOW PATH ARE PROHIBITED AS IT CAN COMPROMISE ANALYZER INTEGRITY AND POSSIBLY CAUSE CATASTROPHIC FAILURE.

Section 7.2 - Oxygen Sensor replacement

The Oxygen Sensor assembly is mounted between the furnace and electronics enclosures such that it's electrical wiring section is accessible through the electronics enclosure. The sample delivery section of the sensor inlet is located in the furnace section so that the ambient heat inside the enclosure helps maintain the gas phase of the sample during transfer from the furnace to the sensor. The sensor is maintained hot by it's internal heater.

It is recommended that the sensor be replaced every two to three years. This replacement schedule is also dependent upon the kind of process environment and there may be some applications where the sensor may need to be replaced more frequently.



The sensor housing has a built-in heater which in turn heats up the sensor housing. Hence, before you begin replacing the sensor, turn **OFF** the power to the analyzer and wait until the sensor housing is cool enough to touch.

1 Turn OFF the zero/combustion/reference air to the analyzer and then undo both these fittings.

2 Unscrew this cap to access the sensor.

3 Remove the two screws holding the cover plate (wiring connections template) and take the plate off.

4 Next, remove the screws that attach the sensor to the housing and then pull the sensor out.

5 Replace the sensor and follow the steps in reverse to install the new sensor.

6 Re-connect the zero/combustion/reference air fittings.

7 Power ON the analyzer.

It takes a few minutes for the sensor temperature to reach its set point after which the analyzer will automatically start running analyses.

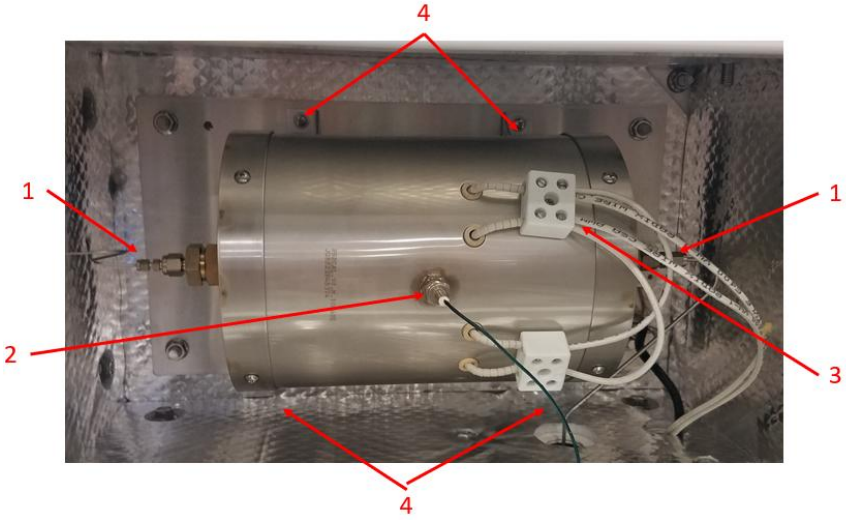
Section 7.3 - Furnace replacement

The 9800CXi furnace is always powered ON. The high temperature is required to get complete sample combustion encompassing varying process compositions, especially any Sulfur compounds. The extended high operating temperature and any power cycling can stress the furnace coils leading to furnace failure.

It is recommended to replace the furnace and combustion tube assembly every three years as a part of Preventive Maintenance.

WARNING

Since the furnace operates at a high temperature, the exterior of the furnace can reach a temperature > 100 °C. Hence, before you begin replacing the furnace, turn **OFF** the power to the analyzer and wait until the furnace exterior is cool enough to touch. This can typically take up to four hours.



Removal:

1. Disconnect the ⅛" tubing fittings
2. Disconnect the ¼" tubing fitting and remove the thermocouple from the furnace.
3. Remove the two AC power wires and cap them.
4. Remove four screws that attach the furnace to the back plate.
5. Remove the old furnace and combustion chamber together.

Installation:

5. Install the new furnace and combustion tube assembly to the back plate
4. Install fours screws
1. Connect the 1/8" tubing fittings
2. Install the thermocouple
3. Connect the AC power wires

Power ON the analyzer. It takes about 20-30 minutes for the furnace temperature to reach its set point after which the analyzer will automatically start running analyses.

Section 7.5 - Replacing Fuses

The fuses for the 9800CXi Calorimeter are located on the DIN rail mounted on the floor of the Electronics enclosure as shown below. To replace a fuse, simply lift up the fuse holder from one end as shown to access and replace the fuse.

The correct ratings for all fuses can be found on the Electrical Wiring Diagram.

Section 7.6 - Updating Software

The 9800CXi is a PLC-based system and requires special tools to update the system software/firmware. Please contact the PROCESS INSIGHTS Service department for more information.

Section 7.7 – Z-Purge Maintenance or Service Procedure (If applicable)

1) Properly disconnect power from all pressurized panel electronics, which requires maintenance or servicing.

2) Turn off the Protective Gas by turning the Pressure Regulator counterclockwise until the pressure reaches 0 psi.

3) Enclosure door may now be opened for maintenance or service can begin.

4) After maintenance or servicing is completed, properly close and seal enclosure door.

5) Supply purge gas to panel by turning the Protective Gas Inlet Kit manifold valve to the ON position. The Protective Gas Inlet Kit pressure regulator should remain the same to keep the purge gas CFM (LPM) flow rate the same as what was established during the initial Purge Cycle Time set up.

6) Power up the analyzer and the Green LED on the purge indicator should illuminate.

7) With Purge Indicator Green LED illuminated; let the purge run for the set time.

8) After the manual Purge Cycle Time is completed and Green LED is still illuminated; this indicates that the enclosure is maintaining a minimum overpressure.

NOTE: For more information, refer to CYCLOPS Z-Purge Indicator _ IOM Manual.

Section 7.8 – X-Purge Maintenance or Service Procedure (If applicable)

1) If maintenance or service must be performed with power applied to the electrical equipment mounted within the purged enclosure the CYCLOPS X – Purge Controller is monitoring, first make sure that area-surrounding the electronics enclosure, which the CYCLOPS X – Purge Controller is monitoring and controlling is known to be non-hazardous.

2) After it has been established that the area surrounding the electronics enclosure is non-hazardous, unscrew the cover over the CYCLOPS X – Purge Controller maintenance switch. Insert key and turn switch to the Maintenance position. **Maintenance switch key can only be removed from maintenance switch in Normal Operation position and cover cannot be screwed back on until key is removed from switch.** This means, that the maintenance switch key must remain in the switch while maintenance or service is being performed. When the CYCLOPS X – Purge Controller is in maintenance mode the indicator light will begin blinking red and, if connected, a remote alarm will be sent.

3) With the CYCLOPS X – Purge Controller in maintenance mode, turn off purge supply gas at the shut off valve on Continuous Dilution Purge Gas Inlet Kit manifold block. **Not at the Continuous Dilution Purge Gas Inlet Kit pressure regulator. The Continuous Dilution Purge Gas Inlet Kit pressure regulator setting should remain the same to keep the purge gas CFM (LPM) the same as what was established during the initial dilution time set up.**

4) With protective gas supply off at the shut off valve, open electronics enclosure door.

5) With electronics enclosure door opened and the CYCLOPS X – Purge Controller in maintenance mode applying power to the electronics, perform required maintenance or service.

6) After maintenance or service has been performed and completed, properly close and latch electronics enclosure door.

7) After enclosure door has been properly closed and latched, turn on purge supply gas at the shut off valve on Continuous Dilution Purge Gas Inlet Kit manifold block. **Not at the Continuous Dilution Purge Gas Inlet Kit pressure regulator. The Continuous Dilution Purge Gas Inlet Kit pressure regulator setting should remain the same to keep the purge gas CFM (LPM) the same as what was established during the initial dilution time set up**

8) With electronics and furnace enclosure door latched, purge supply gas turned on at the shut off valve and CYCLOPS X – Purge Controller maintenance switch to the Normal Operation position. It will go from a light blinking red to a steady state of green and power will remain connected through the CYCLOPS X – Purge Controller to the electrical equipment within the purged enclosure provided minimum overpressure setting is met.

9) After CYCLOPS X – Purge Controller maintenance switch has been returned to Normal Operations position, remove key and screw maintenance switch cover back on as before.

NOTE: for more information, refer to CYCLOPS X-Purge Controller_ SM Version _ IOM Manual

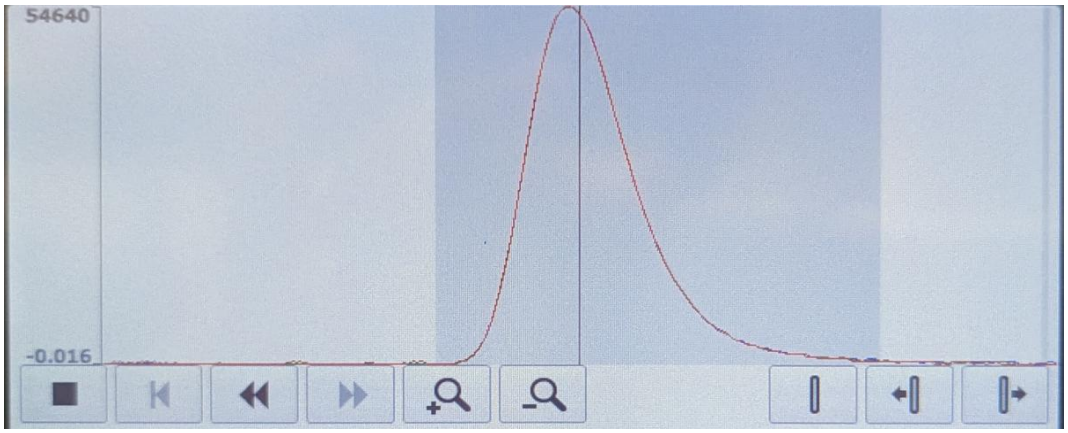
Section 8 – Troubleshooting

The 9800CXi is a continuous analyzer that reports Calorific, WOBBE, Specific Gravity values from the process gas. The analyzer will only work if certain operating conditions are met. These include critical digital inputs and temperatures for furnace, sample, and electronics enclosures.

This section describes some common failure modes and basic procedures to troubleshoot these failures. If these steps fail to resolve the issue it is recommended that you reach out to PROCESS INSIGHTS Customer Service for further support.

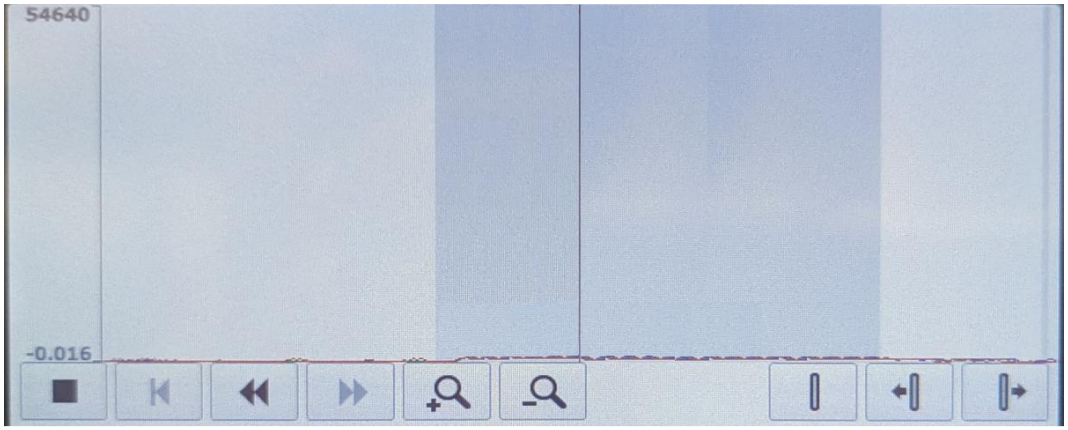
Section 8.1 - Reported Calorific value is “zero”

A typical sample analysis shows this peak response:



The Peak height corresponds to the O2 concentration that is used to calculate the process values such as Calorific, WOBBE, etc.

If for any reason the response looks like a flat line as shown below in Figure, follow these steps to troubleshoot the issue:



1) Verify that sample is injected – check sample pressure and flow.

2) Verify that the sample valve actuates at the preset time as set in the Timetable settings.

3) Verify that RF values in the Calibration tab are not “zero”.

4) Check all the sample and detector vents and make sure they are not plugged/clogged creating back-pressure on the sample flow path.

5) Measure the mV signal from the O2 sensor. If the sensor mV value remains unresponsive, or if the sensor loses the reference Zero Air, the result would be a flat-line response.
    a. This could also possibly be a result of a bad O2 sensor
    b. Make sure that the Reference Zero Air bottle is not empty

6) If all these items check out and the issue is not resolved, please contact PROCESS INSIGHTS Service department.

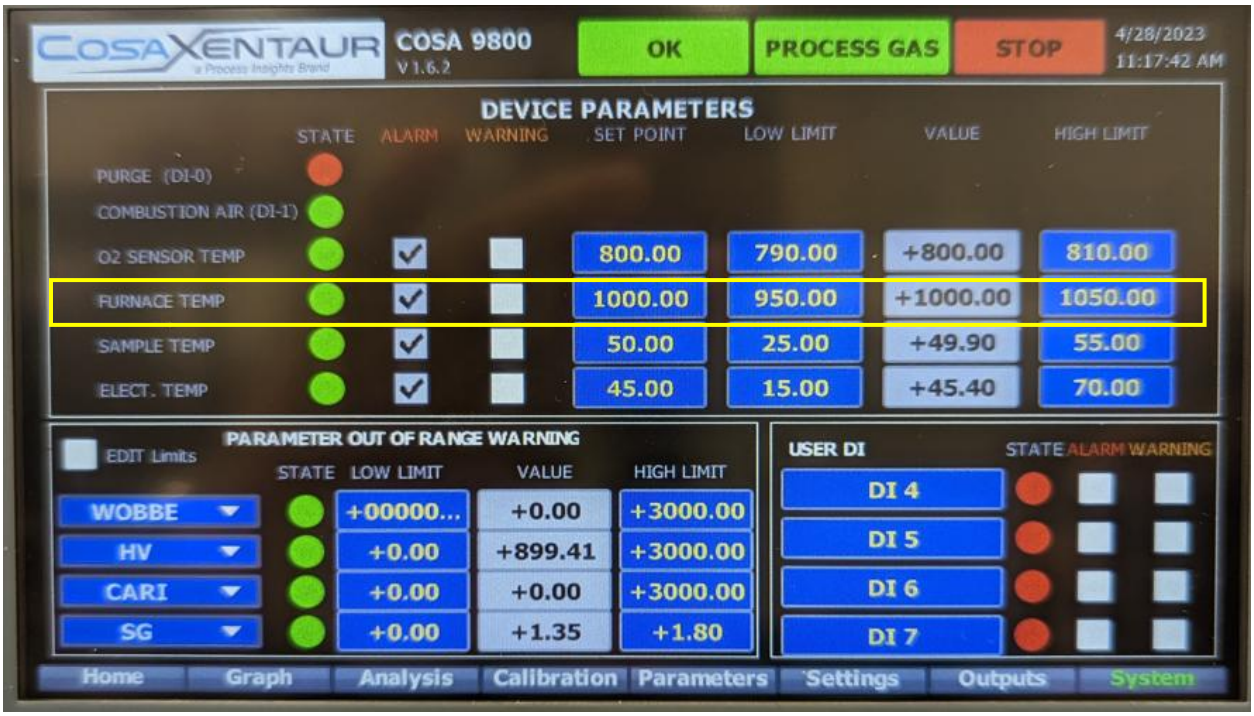
Section 8.2 – Furnace not at set temperature and will not heat up

The 9800CXi furnace operates at a factory-set temperature to ensure complete combustion of samples, with precise control managed by the Temperature Controller. The software is designed to trigger the global alarm, and analyses will not commence until the furnace reaches the set point.

When the analyzer is powered up and the preset conditions are met, the furnace should begin heating to the set point. If it does not, follow these steps to troubleshoot the Furnace Temperature Alarm:

1) Check the fuse F2 for the Furnace heater.

2) Verify that the Furnace Temperature set point is set correctly and not set at “zero” on the System tab on the HMI screen.



3) Verify that the Temperature Controller has power.

4) Verify that the correct AC voltage is present on the furnace coils.

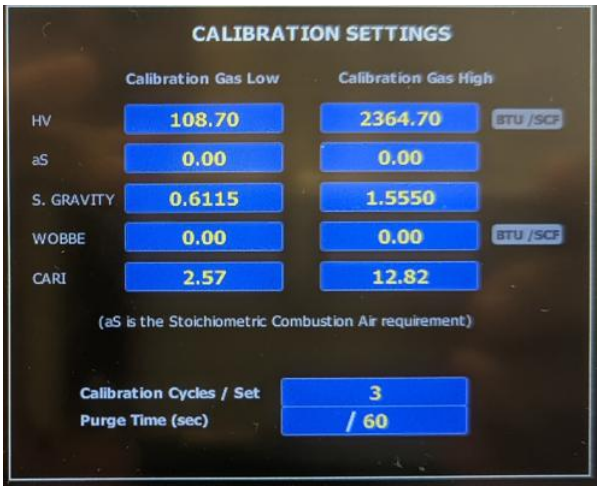
5) Measure the coil resistance and verify the coils are not open.

If these items are verified and the issue persists, please contact the PROCESS INSIGHTS Service Department.

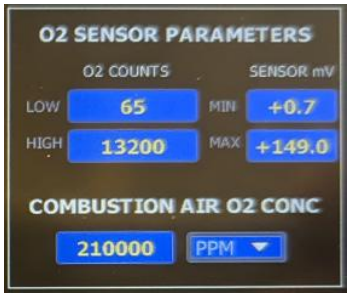
Section 8.3 – Analyzer will not calibrate correctly

1) Verify that the calibration parameters, sensor parameters, and calibration gas specifications have been entered correctly in the appropriate settings screens.

   Calibration Settings from the SETTINGS tab:

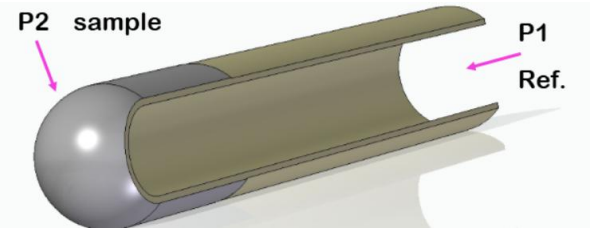


   O2 Sensor Parameter values from the PARAMETERS tab:



2) Verify that the sample pressure and flow are adequate and meet the minimum requirements of the analyzer.

3) Verify that the Reference Gas has correct flow. The reference Zero Air continuously purges the reference side of the Zirconia Oxide sensor, while the sample flows on the outside. This generates a potential difference due to O2 ion migration that is measured and converted to process readings.



4) Verify that the sample valve actuates at the correct preset time as set in the Timetable settings and that the sample does get injected.

5) Check the system for leaks or plugging.

6) If all these items check out and the issue is not resolved, please contact PROCESS INSIGHTS Service department.

Section 9 – Devices

Section 9.1 - Autonics 4-Channel Temperature Controller

TM Series

Multi-channel(4 channel / 2 channel) modular type PID control

▣ Features

Line-up

- Multi-channel(4 channel/ 2 channel) simultaneous controlling possible
- High-speed sampling cycle(4 channel: 100ms, 2 channel: 50ms)
- **No communication and power supply for expansion modules required by using side connectors: Max. 31 units (124 channels / 62 channels)**
- Input channel isolated design(Dielectric strength 1,000 VAC)
- Heating/Cooling simultaneous controlling
- Allows parameter setting by USB port of PC
  : Free download the integrated device management program(DAQMaster)
  ※Communication converter, sold separately
  : SCM-WF48(Wi-Fi to RS485/USB communication converter(availabe soon), SCM-US(USB to Serial converter), SCM-38I(RS-232C to RS485 converter), SCM-US48I(USB to RS485 converter)
- Parameter setting by SCM-US without power/wiring
- Easy maintenance via connector type connection
  : Sensor input connector, control output connector, power/communication connector
- Multi input / Multi range
- Heater disconnection function(CT input) ※ CT, sold separately: CSTC-E80LN, CSTC-E200LN

⚠ Please read "Caution for your safety" in operation manual before using.

Section 9.1.1 - Device Specifications

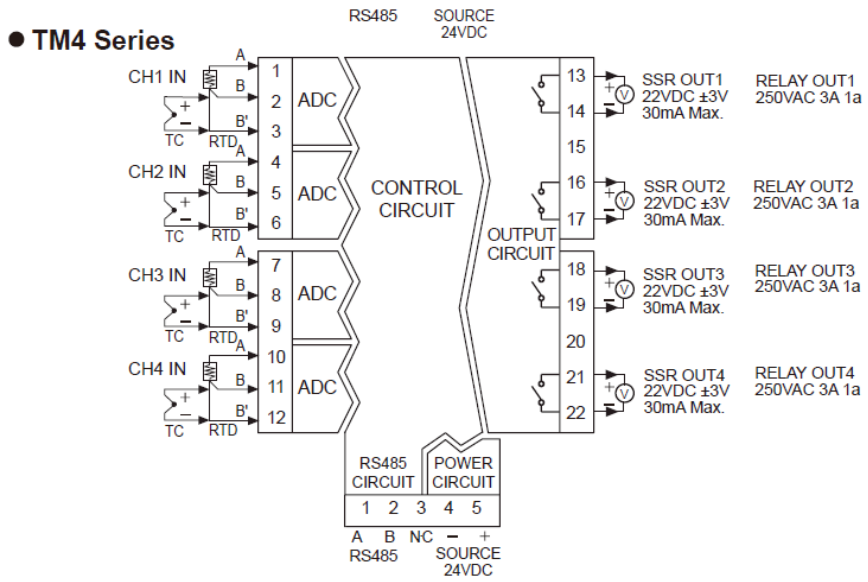
Multi-Channel Module type PID Control

▣ Specifications

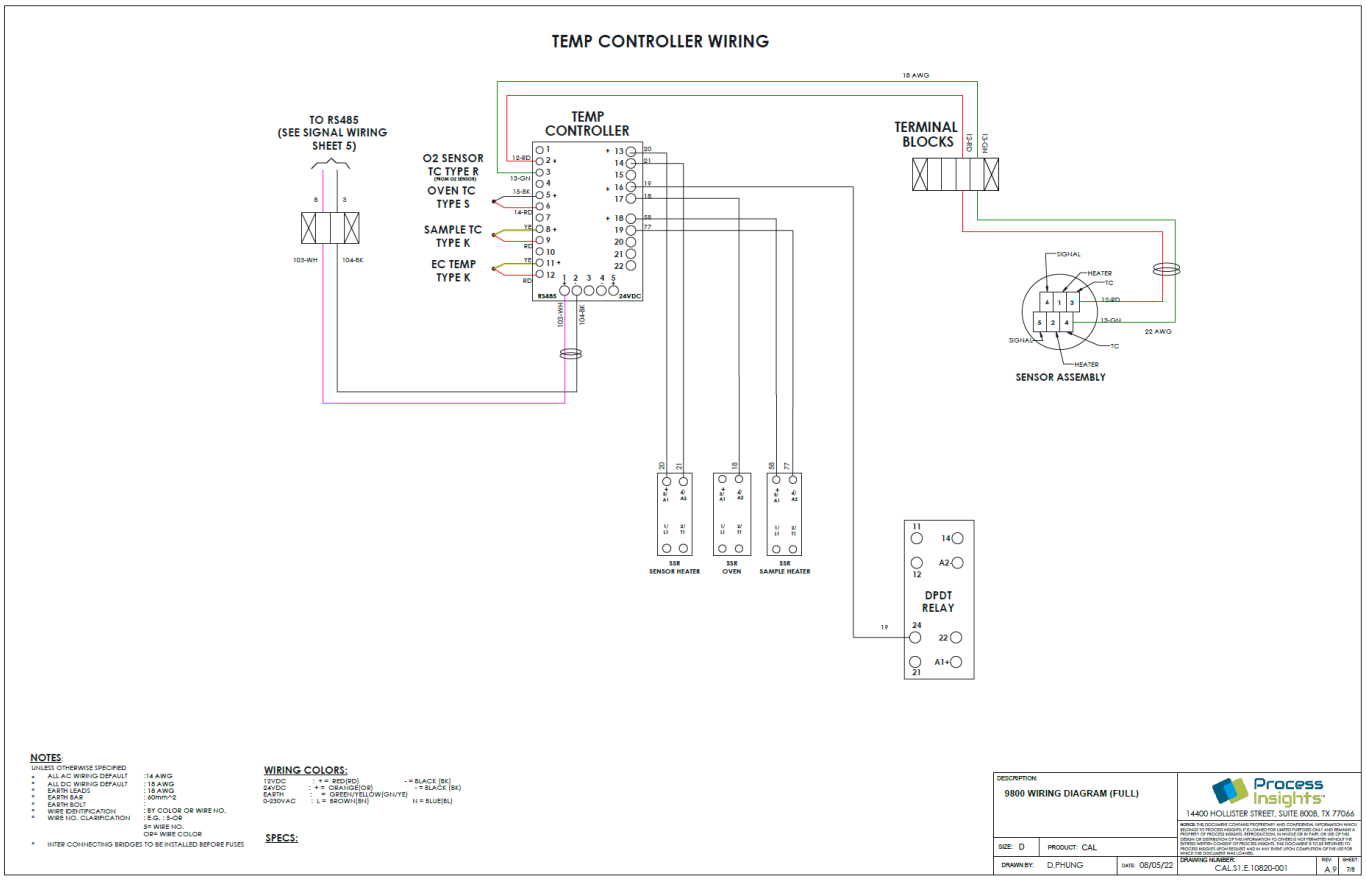
Series		TM2-22RB	TM2-42RB	TM2-22RE	TM2-42RE	TM2-22CB	TM2-42CB	TM2-22CE	TM2-42CE	TM4-N2RB	TM4-N2RE	TM4-N2SB	TM4-N2SE
Channel		2 Channel (Each channel insulated-Dielectric strength 1,000VAC)								4 Channel (Each channel insulated-Dielectric strength 1,000VAC)			
Power Supply		24VDC											
Allowable voltage range		90 to 110% of rated voltage											
Power consumption		Max. 5W											
Display type		Non-display type Parameter setting & monitoring with external devices (PC or PLC)											
Input type	RTD	DPt100Ω, JPt100Ω 3 wire (allowable line resistance max. 5Ω per a wire)											
	Thermocouple	K, J, E, T, L, N, U, R, S, B, C, G, PLII (13types)											
Display accuracy	RTD / Thermocouple※1	(PV ±0.5% or ±1℃, select the higher one) ±1digit Max.											
	CT input	±5% F.S. ±1digit Max.								—			
	Current output	±1.5% F.S. ±1digit Max.								—			
Influence of temperature※2	RTD / Thermocouple	(PV ±0.5% or ±2℃, select the higher one) ±1digit Max.(In case of thermocouple input, it is ±5℃ at -100℃ below.) • Thermocouples L, U, C, G, R, S, B: (PV ±0.5% or ±5℃, select the higher one) ±1digit Max.											
Control output	Relay	250VAC 3A 1a				—				250VAC 3A 1a		—	
	SSR	—				12VDC ±3V 30mA Max.				—		22VDC ±3V30mA Max.	
	Current	—				DC 4-20mA or DC 0-20mA selectable(load 500Ω Max.)				—			
Option output	Relay	250VAC 3A 1a								—			
	Communication	RS485 Communication output (Modbus RTU)											
Option input	CT input	0.0-50.0A(Primary current meaurement range) ※CT ratio = 1/1000								—			
	Digital input	• Contact input: ON Max. 1kΩ, OFF Min. 100kΩ • Non-contact input: ON Max. 1.5V residual voltage, OFF Max. 0.1mA leakage current • Outflow current: Approx. 0.5mA								—			
Control method	Heating, cooling / Heating&cooling	ON/OFF control mode, P, PI, PD, PID control mode											
Hysteresis		1 to 100℃/℉ (0.1 to 100℃/℉) variable								1 to 100 digit			
Proportional band (P)		0.1 to 999.9℃/℉											
Integral time (I)		0 to 9999 sec.											
Derivative time (D)		0 to 9999 sec.											
Control period (T)		0.1 to 120.0 sec. (only relay output and SSR drive voltage output type)											
Manual reset value		0.0 to 100.0%											
Sampling period		50ms (2 channel synchronous sampling)								100ms (4 channel synchronous sampling)			
Dielectric strength		1,000VAC 50/60Hz for 1 min. (between power source terminal and input terminal)											
Vibration		0.75mm amplitude at frequency of 5 to 55Hz(for 1 min.) in each of X, Y, Z directions for 2 hours											
Relay life cycle	Mechanical	Min. 10,000,000 operations											
	Electrical	Min. 100,000 operations (250VAC 3A resistance load)											
Insulation resistance		100MΩ(at 500VDC megger)											
Noise resistance		±0.5kV the square wave noise (pulse width: 1us) by the noise simulator											
Environment	Ambient temperature	-10 to 50℃, storage: -20 to 60℃											
	Ambient humidity	35 to 85%RH, storage: 35 to 85%RH											
Accessory		Expansion connector											
		Power / communication connector (※Basic module only)											
Insulation type		Double insulation or reinforced insulation (Mark: ⊡, Dielectric strength between the measuring input part and the power part: 1kV)											
Approval		CE c UL us											
Unit weight		Approx. 144g	Approx. 152g	Approx. 135g	Approx. 143g	Approx. 139g	Approx. 148g	Approx. 130g	Approx. 139g	Approx. 174g	Approx. 166g	Approx. 160g	Approx. 152g

※1: In case of thermocouple K, T, N, J, E at -100℃ below and L, U, PlatinelII, it is ±2℃ ±1digit Max.
In case of thermocouple B, display accuracy cannot be ensured under 400℃.
In case of thermocouple R, S at 200℃ below and thermocouple C, G, it is 3℃ ±1digit Max.
※2: Applied when used out of range 23 ±5℃.
※Environment resistance is rated at no freezing or condensation.

Section 9.1.2 – Autonics Temperature Controller Schematic



Section 9.1.3 - Temperature Controller Wiring for the 9800CXi



Section 9.2 - Control circuit for X purge

Alarm Signal Installation:

NOTE: ***The CYCLOPS X – Purge Controller, SM Version provides dry alarm contact(s) for use by the customer. For hook-up and use the alarm contact(s) provided by the purge controller, consult the following Alarm Source Specifications, Alarm Connection table, and Wiring Diagram drawing numbers DO-50007-A, page 75 for 115VAC unit and DO-50008-A, page 76 for 230VAC unit.***

Alarm Source Specifications
Alarm Contact is rated for 265Volts AC/DC, 150mA max.
Use up to 20 AWG two conductor copper or tin-plated copper power wire rated for at least 300 V at the required length.

Alarm Connections	
ALARM TERMINAL	**TERMINAL NUMBER**
Loss of Purge Pressure: Open on Alarm (Standard). Closed on Alarm (Optional). Closed (Standard) Open (Optional) when pressure in enclosure being monitored is at or above 0.50 inch H2O (1.25 mbar) Standard, 0.30 inch H2O (0.75 mbar) Optional	Terminal Block – 2 Position –1
Return for position one	Terminal Block – 2 Position – 2
Loss of Exhaust Flow: Open on Alarm (Standard). Closed on Alarm (Optional). Closed (Standard) Open (Optional) when flow of exhaust for enclosure being monitored has fallen below a safe level.	Terminal Block – 2 Position – 3
Return for position three	Terminal Block – 2 Position – 4
Maintenance Alarm and By-Pass Mode: Open on Alarm (Standard). Closed on Alarm (Optional). Open (Standard) Closed (Optional) when maintenance switch or by-pass switch is operated.	Terminal Block – 2 Position – 5
Return for position five	Terminal Block – 2 Position – 6

(*Normal Operation Mode*) Alarm Matrix			
ALARM	**VISUAL INDICATION**	**REMOTE INDICATION**	**POWER DISCONNECTED**
Purge pressure goes below 0.50 inch H2O (1.25 mbar) Standard, 0.30 inch H2O (0.75 mbar) Optional	Steady State, Red LED	Yes, when installed	Yes
Exhaust vent flow drops below safe level	Steady State, Red LED	Yes, when installed	Yes
Maintenance Switch turned to Over-Ride	Blinking, Red LED	Yes, when installed	No
During Purge Dilution Cycle Time	Blinking, Green LED	No	Yes
Normal Operation	Steady State, Green LED	No	No

(*Power Disconnect By-Pass Switch Mode*) Alarm Matrix			
ALARM	**VISUAL INDICATION**	**REMOTE INDICATION**	**POWER DISCONNECTED**
Purge pressure goes below 0.50 inch H2O (1.25 mbar) Standard, 0.30 inch H2O (0.75 mbar) Optional	Steady State, Red LED	Yes, when installed	No
Exhaust vent flow drops below safe level	Steady State, Red LED	Yes, when installed	No
Maintenance Switch turned to Over-Ride	Blinking, Red LED	Yes, when installed	No
During Purge Dilution Cycle Time	Blinking, Green LED	No	Yes
Normal Operation	Steady State, Green and Blinking Red LED.	Yes, when installed	No

Section 9.3 - Control circuit for Z purge

Z PURGE (Normal Operation Mode) Alarm Matrix			
ALARM	**VISUAL INDICATION**	**REMOTE INDICATION**	**POWER DISCONNECTED TO FURNACE**
Purge pressure goes below 0.50 inch H2O (1.25 mbar) Standard, 0.30 inch H2O (0.75mbar) Optional	Steady State, Red LED	Yes, when installed	Yes
Exhaust vent flow drops below safe level	Steady State, Red LED	Yes, when installed	Yes
During Purge Dilution Cycle Time	Steady State, Green LED	No	No
Normal Operation	Steady State, Green LED	No	No