

GASS™-2040
Sample
Conditioning
System
User's Manual

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Caution Statement

Thank you for purchasing sample gas conditioning equipment from Perma Pure LLC. We want your new sample gas conditioning equipment to operate safely. Anyone who installs or uses this equipment should read this publication before installing or operating this equipment.

To minimize the risk of potential safety problems, you should follow all applicable local and national codes that regulate the installation and operation of your equipment. These codes vary from area to area and usually change with time. It is your responsibility to determine which codes should be followed and to verify the equipment, installation and operation is in compliance with the latest revision of these codes.

At a minimum, you should follow all applicable sections of the National Fire Code, National Electrical Code, and the codes of the National Electrical Manufacturer's Association (NEMA). There may be local regulatory or government offices that can also help determine which codes and standards are necessary for safe installation and operation.

Equipment damage or serious personal injury can result from the failure to follow all applicable codes and standards. We do not guarantee the products described in this publication are suitable for your particular application, nor do we assume any responsibility for your system design, installation or operation. This product should not be operated in any manner that is inconsistent with its intended use.

If you have any questions concerning the installation or operation of this equipment, or you need additional information, please call us at 1-800-337-3762.

This publication is based on information that was available at the time it was printed. At Perma Pure we constantly strive to improve our products and services, so we reserve the right to make changes to the products and/or publications at any time without notice and without any obligation. This publication may also discuss features that may not be available in certain revisions of the product.

This equipment is to be installed and operated by trained personnel, with sufficient command of the English language to clearly understand the instructions and safety warnings.

Trademarks

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WARRANTY INFORMATION

Seller warrants that product supplied hereunder shall, at the time of delivery to Buyer, conform to the published specifications of Seller and be free from defects in material and workmanship under normal use and service. Seller's sole obligation and liability under this warranty is limited to the repair or replacement at its factory, at Seller's option, of any such product which proves defective within one year after the date of original shipment from seller's factory (or for a normal usable lifetime if the product is a disposable or expendable item) and is found to be defective in material or workmanship by Seller's inspection.

Buyer agrees that (1) any technical advice, information, suggestions, or recommendations given to Buyer by Seller or any representative of Seller with respect to the product or the suitability or desirability of the product for any particular use or application are based solely on the general knowledge of Seller, are intended for information guidance only, and do not constitute any representation or warranty by Seller that the product shall in fact be suitable or desirable for any particular use or application; (2) Buyer takes sole responsibility for the use and applications to which the product is put and Buyer shall conduct all testing and analysis necessary to validate the use and application to which Buyer puts the product for which Buyer may recommend the use or application of the product by others; and (3) the characteristics, specifications, and/or properties of the product may be affected by the processing, treatment, handling, and/or manufacturing of the product by Buyer or others and Seller takes no responsibility for the nature or consequence of such operations or as to the suitability of the product for the purposes intended to be used by Buyer or others after being subjected to such operations.

SELLER MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, OF THE PRODUCT SUPPLIED HEREUNDER, INCLUDING, WITHOUT LIMITATIONS, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE, AND ALL SUCH WARRANTIES ARE HEREBY EXPRESSLY EXCLUDED. SELLER SHALL HAVE NO LIABILITY FOR LOSS OF PROFITS, OR SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES UNDER ANY CIRCUMSTANCES OR LEGAL THEORY, WHETHER BASED ON NEGLIGENCE, BREACH OF WARRANTY, STRICT LIABILITY, TORT, CONTRACT, OR OTHERWISE. SELLER SHALL IN NO EVENT BE LIABLE IN RESPECT OF THIS ORDER AND OR PRODUCT DELIVERED ON ACCOUNT OF THIS ORDER FOR ANY AMOUNT GREATER THAN THAT PAID TO SELLER ON ACCOUNT OF THIS ORDER.

INTRODUCTION

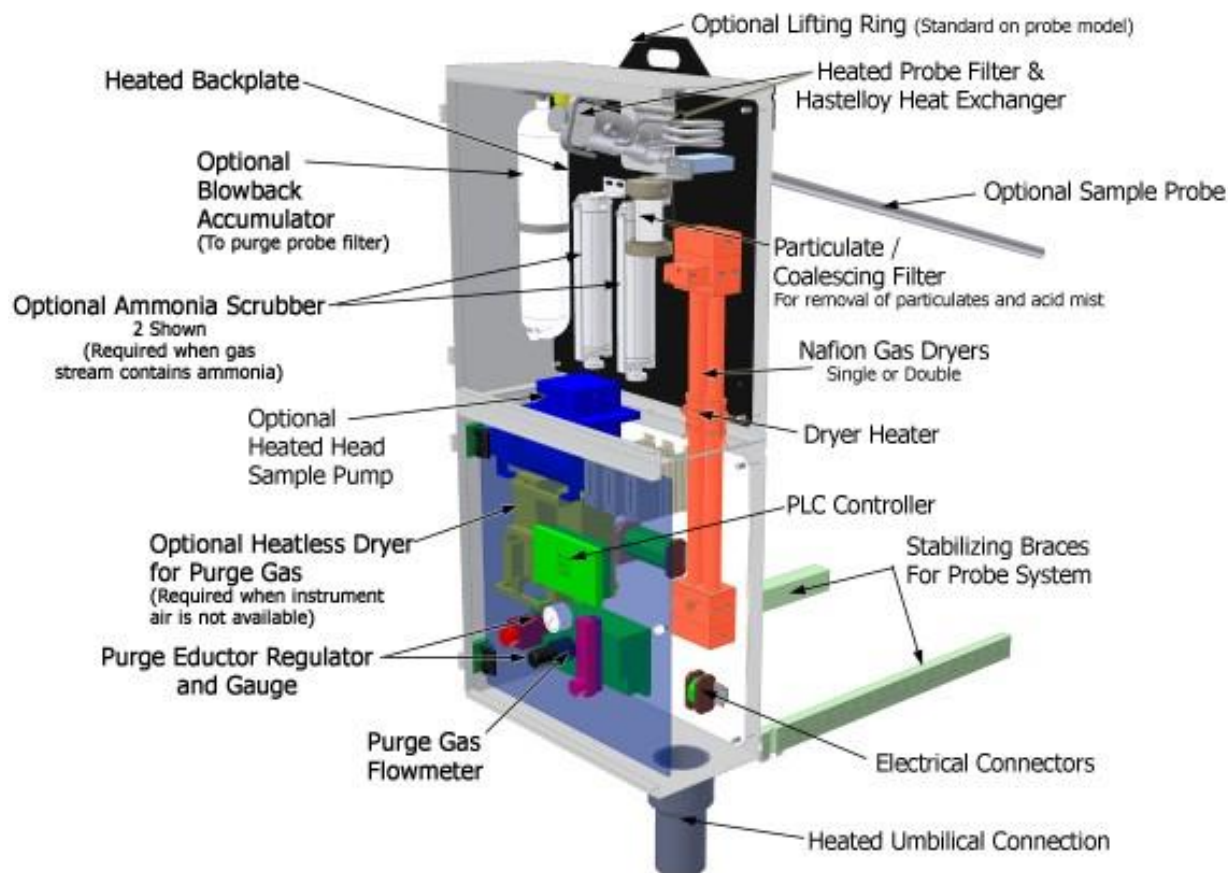
Perma Pure GASS-2040 sample pre-conditioning systems are designed to prepare gas samples for analysis. The GASS-2040 system will condition high-flow, high-moisture sample, eliminating acid mists or ammonia if present without removing the compounds being monitored. Figure 1 below gives a general overview of a GASS-2040 system.

Standard Features

- Heated Enclosure
- Filter(s) – Particulate and/or Coalescing
- Perma Pure Nafion™ Gas Dryer(s)
- Temperature Controller
- Dryer Purge Flow Controls

Options

- Purge Air Heatless Dryer
- Heated Head Sample Pump
- Filter Drain
- Ammonia Scrubber(s)
- Purge Air Eductor
- Z-Purge
- Probe and Automatic Blowback
- Probe Filter and Hastelloy Heat Exchanger



GASS-2040 COMPONENTS

Probe, Probe Filter and Automatic Blowback (optional)

The GASS-2040 system with integral probe filter eliminates the need for a high temperature heated line by conditioning the gas sample at the sample gas extraction point on the stack. When sample gas is drawn from the stack, it is passed through a 2 micron ceramic filter to remove oil and acid aerosols. The sample gas is dried and cooled immediately after removal from stack to minimize changes in sample composition (Refer to Appendix D for Installation Instructions).

The optional blowback assembly minimizes maintenance of the probe filter by periodically passing compressed air back through the element. This action dislodges captured particles and forces them back into the stack. Included with the blowback system is a calibration gas flow sensor which prevents blowback from occurring while calibration gas is flowing

Filtration

The sample is passed through a 1 μ filter to remove particulates and aerosols. The standard filter in the GASS-2040 system has a borosilicate glass filter element with a fluorocarbon binder. This element is disposable and will withstand high sample temperatures. In addition to removing particulates, it coalesces liquid aerosols and droplets.

Two flow patterns are possible with this filter:

1. **Particulate Filter:**
Filter installed with gas flowing from outside to the inside of the element. With this installation, collected particulates will build up on outside surface of the element allowing visual inspection of its condition.
2. **Coalescing and Particulate Filter (See Figure 2):**
Filter is installed with flow passing from inside of element to the outside. An automatic drain is usually installed to remove the condensate.

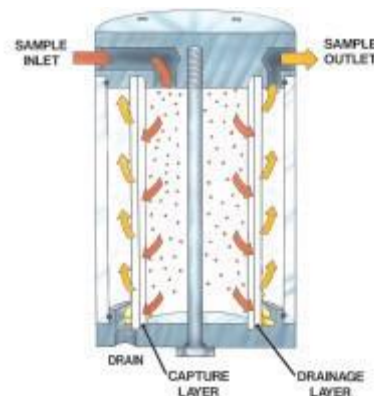


Figure 2

Automatic Filter Drain (optional)

If coalescing is anticipated, the system should be fitted with automatic filter drain to periodically remove collected liquid condensate.

In many cases, this condensate will be highly acidic. The filter drain needs to be permanently connected to a drainage system designed for this type of effluent!

Automatic drain is available in vacuum or pressurized style.

- **Vacuum Configuration:**
Collected liquid is withdrawn from filter drain port by a vacuum created by an eductor expanding compressed air through a venturi. This is done in cycles and controlled by adjustable digital timer that switches a solenoid valve controlling compressed air supply.
- **Pressurized Configuration:**
An eductor is not required since a vacuum is not needed to withdraw the sample. Therefore, condensate withdraw is directly controlled by the solenoid valve. Cycle times can be varied and will be dependent on the amount of liquid present in sample.

Sample Pump (optional)

The sample pump draws the sample gas and supplies it to the analyzer. It supplies up to 10 liters per minute of sample gas flow. The pump is typically plumbed between the coalescing filter and membrane dryer or between the coalescing filter and the ammonia scrubber (if present). The head of the pump is located in the heated section of the system while the motor is located in the control section. This configuration keeps pump head at a temperature above dew point of the sample preventing condensation from forming. Included with the optional sample pump is a vortex cooling tube that helps keep the control enclosure at an acceptable temperature. The PLC controls the valve that supplies air to the vortex tube. Compressed air requirements are approximately 4 scfm @ 80psi.

Nafion™ Dryer

The Perma Pure Nafion™ membrane dryer is installed downstream of the filter. As sample enters the dryer, flow splits into a number of small diameter Nafion™ tubes arranged in a parallel bundle as shown in Figure 3 below. After sample enters one of these tubes it comes in contact with the Nafion™ membrane walls. The membrane selectively removes water vapor from the sample by a process of permeation distillation. Water vapor travels through the tubing walls driven by the difference in partial water vapor pressure on the opposing sides of the membrane. As the sample flows from inlet to outlet water is continually removed, reducing the sample dew point as it travels through the dryer.

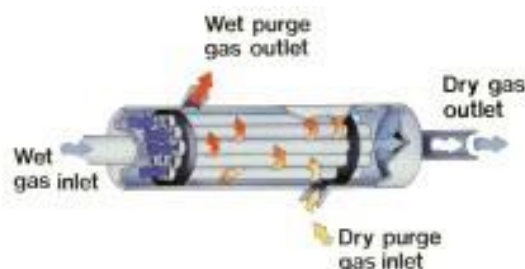


Figure 3

Dry purge gas enters the dryer at the sample outlet end and performs two functions:

1. Provides a medium for water vapor from the sample to be carried away.
2. Creates a temperature gradient along length of dryer.

Ambient purge air enters the dryer at sample outlet, keeping that portion of dryer cooled. This counter current flow is required to produce a temperature gradient along the length of the dryer. To effectively maintain the gradient, the temperature of purge gas exhaust is monitored and controlled by an electronic temperature controller. As purge gas passes through the dryer it is heated to the desired sample inlet temperature. This gradient allows for both rapid vapor removal and decreased final dew point. If the purge gas temperature begins to fall below the programmed temperature, the system's back plate will heat. An aluminum heating block will conduct energy from the back plate to the dryer's shell tube. Purge gas traveling through the dryer's shell acquires heat from the shell. This process allows final temperature of the purge gas to be closely controlled and a consistent temperature gradient will be maintained. It is important that the dryer removes water in vapor state only. If liquid water is introduced into the dryer, efficiency will decline and the dryer could fail to perform altogether. Tubing elongates approximately 10% over its dry length when saturated with liquid water causing tubing to kink inside housing. Nafion™ dryers will operate most efficiently when a portion of the dryer is heated to prevent sample from condensing.

Ammonia Scrubber (optional)

The optional ammonia scrubbing canister must be used when ammonia or urea is used for the purpose of lowering NOx levels or any time ammonia is present in sample stream. Ammonia salts can deposit in dryer tubes and cause permanent loss of drying efficiency if not removed from the sample stream. An ammonia scrubber consists of a polysulfone plastic and 316 SS housing filled with a phosphoric acid based media and inert ceramic saddles. This media will require periodic replacement. See section 6.3 for replacement instructions.

Purge Heatless Air Dryer (optional)

If -40°C dew point purge air is not available, a heatless air dryer can be installed in the GASS-2040 to dry the compressed air supply. Outlet of heatless dryer will be connected to standard purge gas flow controls. Operation of heatless dryer is fully automatic and continuous, and should not require any maintenance as long as oil free compressed air is used.

Purge Air Eductor (optional)

When the sample is under more than five inches of water vacuum, a purge air eductor is required. Eductor generates a vacuum to drop pressure of purge gas to prevent collapsing of Nafion™ tubing.

Z-Purge (optional):

For hazardous environments to meet Class I, Division II specifications (Refer to Appendix E).

INSTALLATION

(Refer to Figure 4 for reference)

Mounting

Unit should be shielded from direct rain and snow. Do not install outdoors if temperature will fall below -10°C.

Probe - refer to Appendix D

Automatic Blowback -refer to Appendix D

Z-Purge - refer to Appendix E

General flow schematic - refer to Figure 4

1. Install GASS-2040 system on vertical surface with dryer/filter compartment on top and control compartment on bottom.
2. Attach and tighten to sturdy surface.

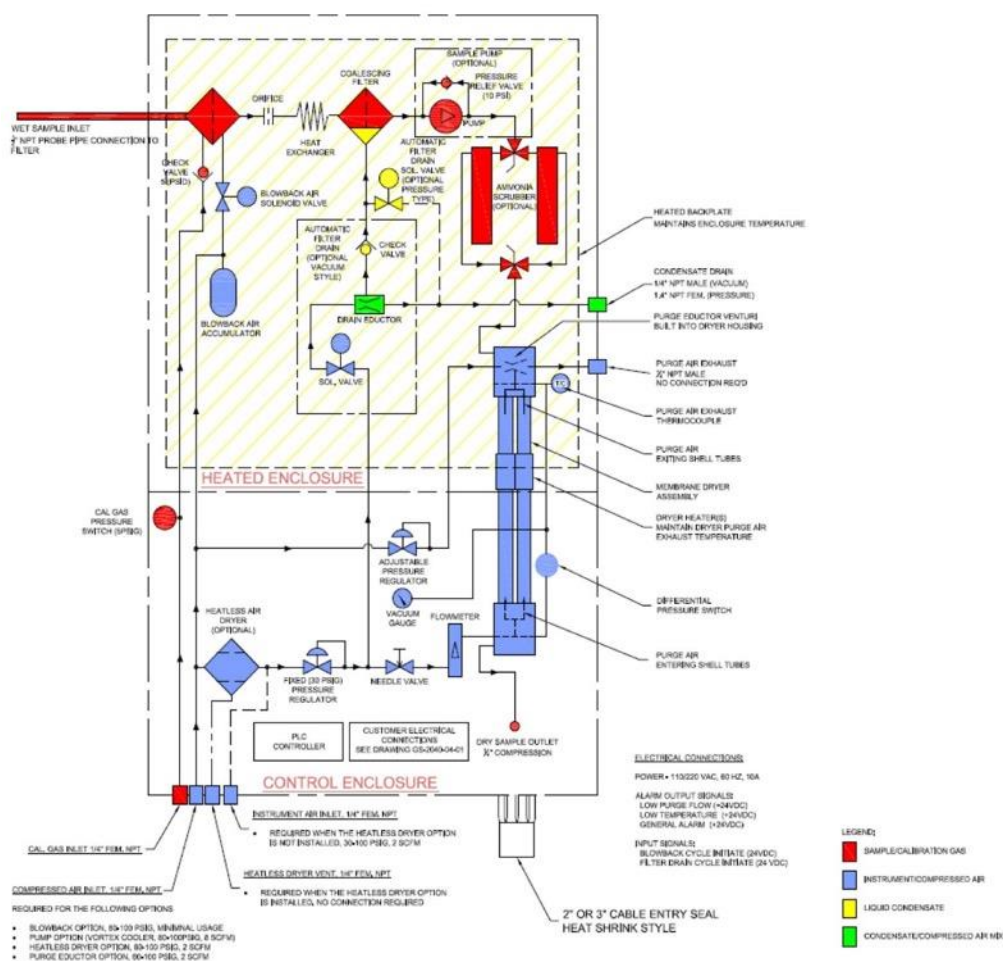


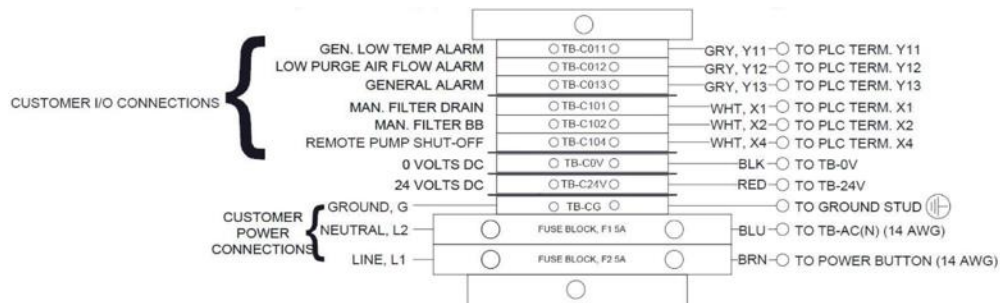
Figure 4

Electrical Connection

Power Wiring

The GASS-2040 system is intended to be hard wired via a customer supplied disconnect switch and wire capable of supplying 5A/10A at 115/230/VAC. The external disconnect switch must meet IEC 60947-1 & 60947-3 stds. and must be installed in close proximity to the equipment, within easy reach of the operator and shall be clearly marked as the disconnecting device for the GS-2040.

Connect the system to an appropriate earth ground. Adhere to all electrical code requirements in effect at the installation site.



Connect the power wiring as shown in Figure 4 below. The fuse block is supplied with 1.25" x 0.25" glass fuses and if necessary should be replaced with one of similar rating. A fuse block for PLC power, located in the upper terminal strip, is supplied with a 5mm x 20mm, 1.0A, fast-blow fuse and should be re-placed with one of a similar rating.

I/O Wiring

The PLC outputs operate at 24 VDC and are "sourcing" (See Figure 5). This means that when commanded to turn on by the PLC logic, the output terminal goes from 0 VDC to +24 VDC and supplies current to the device being signaled or powered. The device must pull no more than 0.5A and must have a minimum load of 10 mA at 24 VDC. A 0 VDC terminal connection is supplied as a current sink to complete the output circuit.

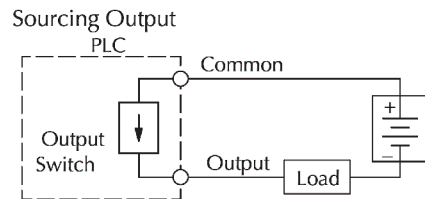


Figure 5

The PLC inputs operate at 24 VDC and are "sinking" (See Figure 6). This means that the input is to turn on and signal the PLC logic that an event has occurred or is desired, +24 VDC must be applied to the input terminal. A +24 VDC terminal is supplied as a current source to complete the input circuit.

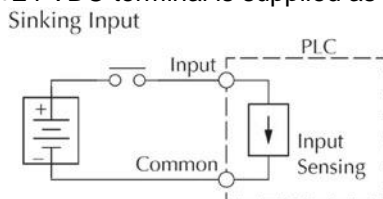


Figure 6

Plumbing Connection

Sample Gas Connection - GASS-2040 Probe version refer to Appendix D

With Optional Heated Line

1. Install heated line sealing fitting by threading hub into sleeve.
2. Ensure o-ring seal is installed on outside of enclosure (between sleeve and enclosure wall).
3. Run heated sample line through entry seal and into enclosure.
4. Connect sample line to compression fitting (labeled "Wet Sample In").
5. Shrink entry seal tubing around heated sample line with heat gun.
6. Connect sample outlet port of system to sample line running to analyzers. High temperature heated line is not necessary for this connection. If sample line will be exposed to freezing temperatures, freeze protected line is suggested.

Purge Air Supply

Instrument Air

Purge gas must be of instrument grade with dew point no higher than –40OC.

1. Connect regulated purge gas supply line to 1/4" female NPT purge inlet port of membrane dryer (labeled "Instrument Air"). Pressure maximum is 100 psig.

Heatless Dryer (Optional)

1. Connect oil free compressed air line to port (labeled "Purge Gas Inlet"). An oil coalescing pre-filter is recommended.
2. A 1/4" female NPT bulkhead fitting on bottom of enclosure is provided for heatless dryer purge air exhaust. Humid air can be vented to atmosphere or piped to remote location.

Filter Drain Connection

Failure to connect the drain properly may result in personal injury and/or property damage!

The condensate and sample gas exhausted during draining of the coalescing filter can be hazardous and must be permanently routed to a drainage system designed to accept the type of discharge that is expected based on the composition of the gas sampled at the particular installation.

Connect tubing or pipe of an appropriate material from the drain outlet to a permanent drainage system designed for this type of discharge.

1. For vacuum style drains:
1/4" I.D. tubing can be used for runs up to 10 feet. Use larger I.D. tubing for longer exhaust lines. Too small of an ID and/or too long of a piping run will cause inadequate drain performance.
2. For pressure style drains:
Tubing with an ID of at least 1/8" is adequate.
Connect line from eductor outlet to designated collection/exhaust basin containing acid absorption media to prevent release of exhaust to surrounding. 1/4" I.D. tubing can be used for runs up to 10 feet, or larger I.D. tubing for longer exhaust lines. Line should not restrict purge flow.

Purge Exhaust

Failure to properly vent the system may result in personal injury and/or property damage!

The gas exhausted from the purge exhaust port under normal operation is humid air. However, in the event of an internal failure of the sample gas dryer installed in the system, the exhaust may contain sample gas that may be hazardous. The purge exhaust must be permanently routed to a vent system or directly outdoors. Do not allow the purge to vent into a structure or confined space.

Connect tubing or pipe of an appropriate material from the purge exhaust outlet to a permanent vent designed for this type of discharge. 1/4" I.D. tubing can be used for runs up to 10 feet. Use larger I.D. tubing for longer exhaust lines. Too small of an ID and/or too long of a piping run will cause inadequate purge vacuum performance or collapse of the dryer membrane tubes resulting in poor drying performance and/or high sample gas flow restriction.

Purge Eductor Compressed Air (Optional)

Connect air supply line to compression fitting (labeled "Compressed Air").

CONTROL SYSTEM OPERATION

General Information

The GASS-2040 system consists of an operator interface panel and a Koyo DL06 PLC which serves a number of purposes. The PLC controls two or three PID temperature control loops. Two PID loops are standard on the wall mounted version. Three PID loops are standard on the stack mounted version which contains an additional PID loop for control of the probe filter.

In addition to controlling the temperature of the system, the PLC continually monitors the system temperatures and will initiate an alarm if any of the temperatures deviate too far from their respective set point temperatures. More about this can be found in the System Operation Monitor section on page 15.

The PLC also controls timing of the optional heated probe filter blow back air and the coalescing filter drain.

Clean display panel with soft cloth and mild detergent. Do not use chlorinate cleaners on stainless steel housing.

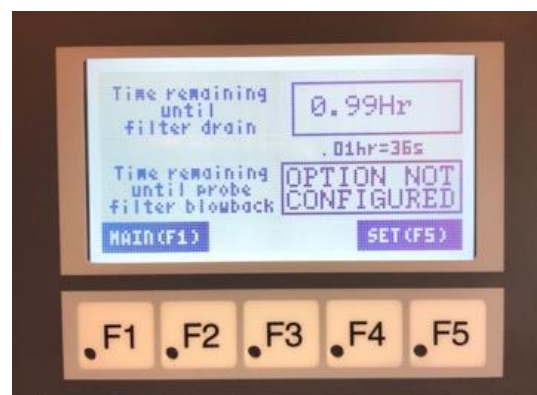
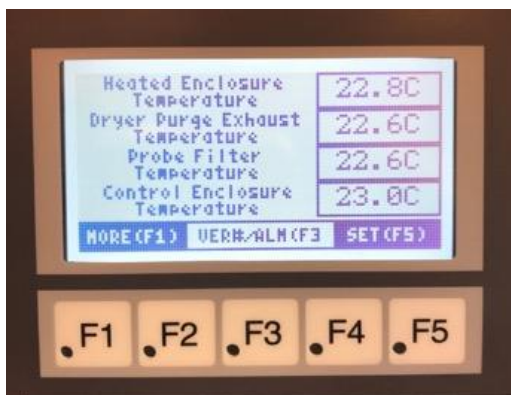
Operator Interface

The operator interface panel shown below serves both as a temperature / timer display, alarm status display and a set point entry device for the various temperature and timing parameters. There are four types of screens.

1. Startup screen displays the firmware revision levels and allows access to the Alarm Status screen. On initial power up of the system, the Startup screen that shows the PLC and HMI version information will appear for 5 seconds at which point the display will automatically switch to the Main screen. Pressing the "VER#/ALM", F3 button on the Main screen will also display the Startup screen.



2. Two data screens, Temperature Data and Timer Data, show the current temperature and timer values respectively. The "MORE(F1)" button will appear if either of the timers, Filter Drain, or Probe Filter Blowback, are configured. Pressing "MORE(F1)" on the Main screen will display the Timer Data screen and pressing "MAIN(F1)" on the Timer Data screen will revert the display to the Temperature Data screen. Pressing the "VER#/ALM(F3)" button on the Temperature Data screen will display the Startup screen.
 - *Enclosure Temperature* – Current enclosure air temperature in °C
 - *Dryer Purge Exhaust Temperature* – Current dryer purge air exhaust temperature in °C
 - *Probe Filter Temperature (GS2040-P models only)* - Current probe filter temperature in °C
 - *Control Enclosure Temperature (models with sample pump or vortex cooler option only)* – Current enclosure air temperature in °C
 - *Filter Drain Time remaining (models with filter drain option only)* – Time remaining until next filter drain, in hours.
 - *Probe Filter Blowback Time remaining (GS2040-P models only)* – Time remaining until next probe filter blowback, in hours.



3. Six setting screens allow the operator to view and adjust the various system operating parameters. The Setting screens are accessible by pressing the "Set" button, F5 shown on either the Main or Main2 screen. The available parameters can be cycled through by pressing the "Next" button, F5. To change a value, press the "Edit" button, F3. An overlay that describes the editing button functions will appear on the screen.

ESC | SHF | UP | DWN | ENT

ESC – Escape cancels the change and closes the editing overlay.

SHF – Shift moves the cursor to the next digit to the right or back to the beginning

UP – Up adds one to the parameter value at the current cursor position.

DWN – Down subtracts adds one from the parameter value at the current cursor position.

ENT – Enters the value into memory and closes the editing overlay.

The Main screen is accessible by pressing the "Main" button, on any one of the setting screens.

Heated Enclosure Temperature Set – Enclosure air temperature setpoint in °C

Range: 0 to 100°C, Default: 70°C. Note: If this setpoint is set to a value above the current dryer temperature setpoint, the dryer temperature setpoint will be automatically changed to match.



Dryer Purge Exh. Temperature Set – Dryer temperature set-point in °C.

Range: 0 to 110°C, Default: 80°C. Note: The lower limit of the dryer setpoint will be the current Heated Enclosure temperature setpoint.



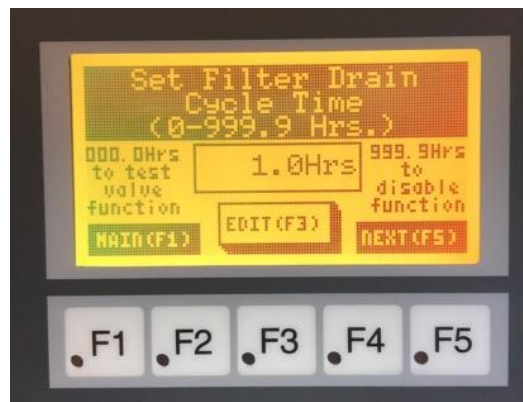
Probe Filter Temperature Set (Optional feature) - Probe filter temperature setpoint in °C. Range: 0 to 100°C, Default: 190°C. GS2040-P models only. "Option Not Configured" will appear on GS2040-P models.



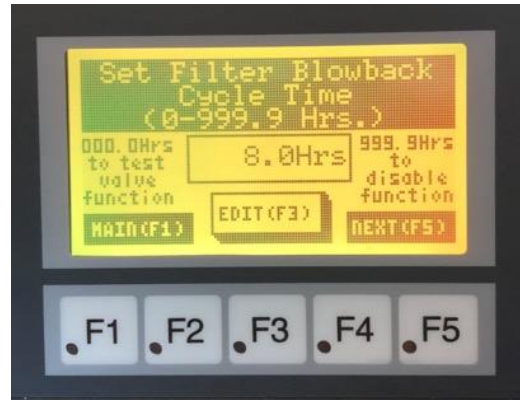
Control Enclosure Temperature Set (Optional feature, GS2040 models with integrated sample pump or vortex cooler options only) - Enclosure air temperature setpoint in °C. Range: 25-45°C, Default: 45°C. "Option Not Configured" will appear if the option is not installed in the unit.



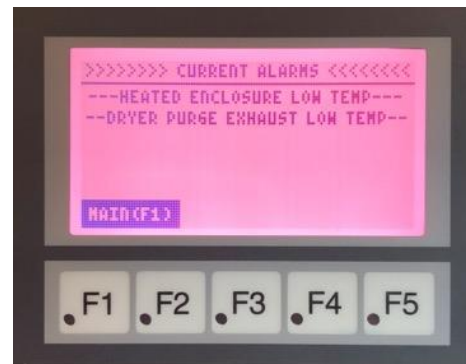
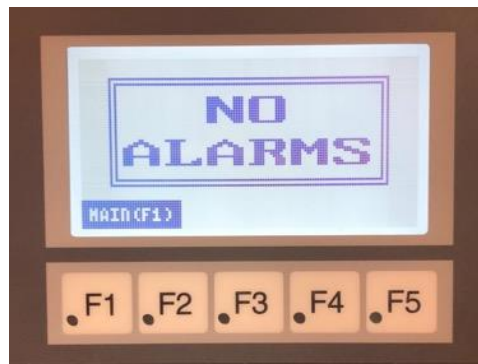
Coalescing Filter Drain Cycle Interval Time Set (Optional feature) - Probe filter blowback cycle interval time setpoint in hours. Default: 8.0 hrs. (Drain "ON" time fixed at 6 sec)
Range 000.0 hrs.(Always on, for testing purposes) to 999.9 hrs.(Disabled). "Option Not Configured" will appear if the option is not installed in the unit



Blow Back Cycle Interval Time Set (Optional feature GS2040-P models only) - Probe filter blowback cycle interval time setpoint in hours. Default: 8.0 hrs. (Blowback "ON" fixed at 2 sec) Range 000.0 hrs. (Always on, for testing purposes) to 999.9 hrs. (Disabled). "Option Not Configured" will appear if the option is not installed in the unit



4. Alarm Status shows current active alarms or "NO ALARM" if the system is operating normally. The Alarm Status screen is displayed by first pressing the "VER#/ALM(F3)" button on the Main screen and then pressing the "ALARM STATUS(F5)" button on the Startup screen.



Systems Operation and Alarm Monitoring

The PLC monitors the system parameters for proper operation and can alert personnel of potential problems via an indicator light, or signal an external control system via digital outputs.

System user interface, HMI – At any time power is on to the system and the system's General Alarm is active, the HMI backlight color will be pink on all screens. All screens will operate normally.

Alarm Output Operation – The system has three digital alarm outputs that can be used to signal an external control system that a problem has been detected. Refer to the I/O Wiring section for connection details on page 11. The definition of an active alarm is that the related output will be OFF. During normal operation, (i.e. no active alarms), all alarm outputs will be ON. In the event of a power failure to the system, all alarms will be in the active or OFF state.

- *Low Dryer Purge Air Flow alarm* - This alarm is initiated when the airflow that is used to purge the dryer is too low. The airflow is sensed by a differential pressure switch located in the lower enclosure and connected to the dryer purge gas inlet and outlet. At any time while the dryer purge air is too low, this alarm will be active.
- *Low Temperature alarm* – This alarm is initiated when any of the system temperatures fall below the respective setpoint by 10°C as sensed by the thermocouples. Anytime the system temperatures is too low, this alarm will be active.
- *General alarm* – This is an alarm that is initiated by either of the two alarms above. At any time while the system power is on and either of the two alarms above is active, this alarm will also be active.

System Status Indicator Operation – The system power pushbutton/light serves as a basic system status indicator and is located at the lower left hand side of the control panel. Based on the status of the alarm outputs and whether the system has reached operating temperature or not, the indicator light will either remain lit or flash at one of two different rates. There are three modes of operation:

- *Start-up/Heat-up mode* – In this mode the indicator lamp will flash slowly at approximately 1Hz. The system will stay in this mode until all of the system temperatures achieve their respective setpoints.
- *Normal Operation mode* – In this mode the indicator lamp will remain lit and will not flash.
- *Alarm mode* – In this mode the indicator lamp will flash quickly at approximately 4Hz. Two different system conditions can initiate this mode:
 1. The system detects a low purge flow condition at any time. For example, power to dryer heaters is interrupted to prevent damage due to overheating.
 2. The system temperatures have all reached their respective setpoints (Normal Operation mode attained) and one or more of the temperatures then falls below the setpoint by more than 10°C.

Note:

The actual *Low Temperature* alarm output is not affected by the system status mode and will be active during any low temperature condition including Start-up/Heat-up.

Preheating the System

1. Turn on AC power to the system.

DO NOT BEGIN SAMPLE FLOW AT THIS TIME! Check for purge air flowing from the exhaust port immediately after turning on AC power. If, for any reason, there is no purge air or flow is inadequate, turn off AC power before attempting to locate the problem. **OPERATING THE SYSTEM WITH LITTLE OR NO PURGE AIR CAN CAUSE DAMAGE TO MEMBRANE DRYER ASSEMBLY.**

2. Adjust purge air flow to the 1 or 2 dryer range depending on the configuration of the system.
3. Set purge air eductor vacuum level to 5 in-Hg (This is necessary only if the sample gas pressure upstream of the GASS2040 is below atmosphere and more than 10 in-H₂O vacuum)
4. Allow 15 - 30 minutes of additional heating time after system has come to set- point temperature.
5. Sample flow may now be started. For GASS-2040 systems that include a sample pump, the pump will turn on if the pump switch is in the "AUTO" position. The sample pump can be turned off externally via the *Remote Pump Shut-off* input to the PLC. Refer to the I/O Wiring section for connection details on page 11 and the electrical wiring diagram in the appendix.

Automatic Filter Drain Operation (Optional)

Adjust the drain cycle time as described in the *Operator interface* section on page 14.

When the sample gas is under a vacuum, an eductor is used to generate enough vacuum to remove condensate in the filter (See Figure 8). This is the most common configuration as the sample pump is most typically located downstream of the sample conditioning system. Since the sample gas is being pulled through the system, some amount of vacuum will be present in the filter and a higher vacuum will be required to expel condensate from the filter. When the drain timer in the PLC times out, a solenoid valve energizes and allows compressed air to flow to the drain eductor for 6 seconds. In turn, the eductor generates vacuum to expel condensate.

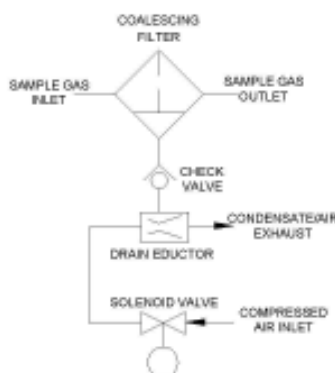


Figure 8

When the sample gas is under positive pressure, it allows condensate to be directly expelled through a solenoid valve (See Figure 9). When the drain timer in the PLC times out, a solenoid valve energizes and allows the pressure in the filter to push the condensate out of the filter.

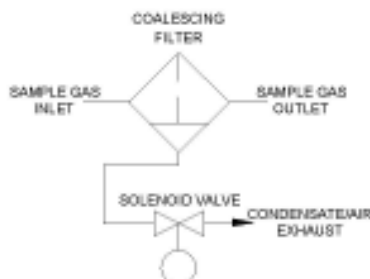


Figure 9

The filter drain event can be triggered externally via the *Manual Filter Drain* input to the PLC. Refer to the I/O Wiring section for connection details on page 11.

Automatic Probe and Filter Blowback Operation (Optional)

Adjust the *Blowback Time* as described in the *Operator interface* section on page 14.

Dust in the probe filter needs to be removed periodically to extend the life of the element. This is accomplished by passing compressed air backwards through the filter (See Figure 10). The blowback system consists of an accumulator tank and solenoid valve to accomplish this task.

When the blowback timer in the PLC expires, a solenoid valve is energized for two seconds. This allows compressed air to flow from the accumulator tank directly into the probe filter causing collected dust on the filter element to be forced back into the stack through the probe pipe. The timer then resets to the user selected cycle time and begins counting down to the next blowback. The cycle repeats indefinitely unless the timer is turned off. When calibration gas flow is detected, the blowback timer is temporarily paused. This prevents the blowback valve from activating while a system calibration cycle is in process.

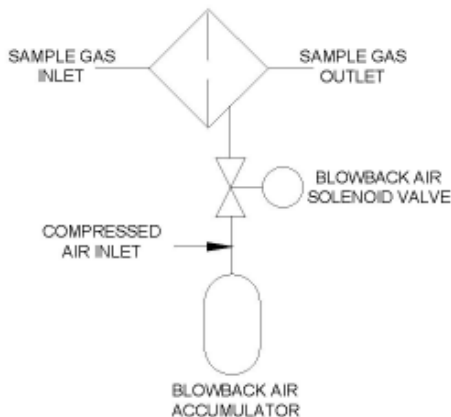


Figure 10

The filter blowback event can be triggered externally via the *Manual Filter Blowback* input to the PLC. Refer to the I/O Wiring section for connection details on page 11 and the electrical wiring diagram in the appendix.

Electrically Heated Systems

1. Check that no condensate is present in sample line between filter and dryer.
2. If water droplets are visible, increase temperature of filter/dryer compartment by 5°C.
3. Allow about ½ hour for system to stabilize and then check again for condensate.
4. If necessary, continue to increase temperature at 5°C intervals until condensate is no longer visible. Do not exceed 100°C! Maximum system temperature is 100°C. Operation above this temperature can cause damage to Nafion™ dryer.

It is essential that purge gas flows continuously and setpoint temperature is not above 100°C to prevent damage to dryer.

MAINTENANCE

Filters

If system is fitted with a pre-filter, it should be checked regularly to ensure that the element is in good condition. If element appears to be dirty or begins to cause flow restriction in system, it should be replaced.

Filter element replacement (Refer to Figure 11)

1. Loosen bolt on bottom of filter.
2. Gently pull apart assembly and remove old element.
3. Place new element into grooves in top and bottom of housing.
4. When re-assembling, inspect for o-rings on top and bottom caps and on center bolt.
5. Install glass shell onto bottom piece.
6. Place new element in groove in bottom piece. Be sure that element is seated correctly and parallel to glass shell.
7. Carefully mate bottom assembly onto top piece. Slight twisting motion may be required to allow shell to slip over o-ring seal.
8. Visually make sure element is seated correctly in top groove.
9. Replace bolt through hole in bottom piece and screw clockwise into top piece. Do not over-tighten center bolt. It should be just tight enough so it does not vibrate loose. Over-tightening will not help the filter to seal.

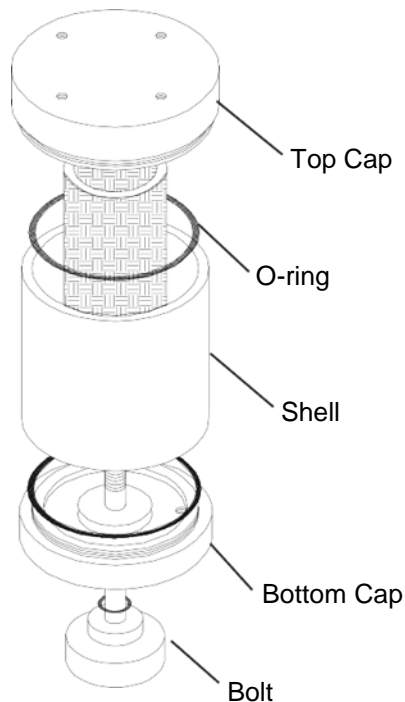


Figure 11

Dryers

Under normal conditions, Perma Pure dryers require little maintenance and can last for several years. However, if there is no pre-filter and the tubing becomes clogged or saturated with water, the dryer may require cleaning or repair.

Refer to Appendix B for PD dryer element replacement.

Ammonia Scrubber

Media Replacement:

When deposits are visible on 75% of the scrubber, scrubbing media needs to be replaced.

1. Unscrew thumbscrew on bottom of housing.
2. Swing yoke to one side.
3. Separate housing and bottom cap as an assembly from top cap.
4. Remove spring and top screen.
5. Remove old media and dispose of properly (rinse housing with soapy water to clean).
6. Fill housing with 135cc of Berl Saddles (tap housing to allow material to settle).
7. Pour 65cc of Scrubbing Media (tap housing to allow material to settle).
8. Replace stainless steel screen on top of media.
9. Replace spring on top of screen.
10. Clean o-rings on shell and inside top manifold (replace if necessary).
11. Place center tube into o-ring seal in top cap.
12. Push and twist to seal housing around o-ring.
13. Replace yoke and finger tighten thumbscrew (**do not overtighten**).

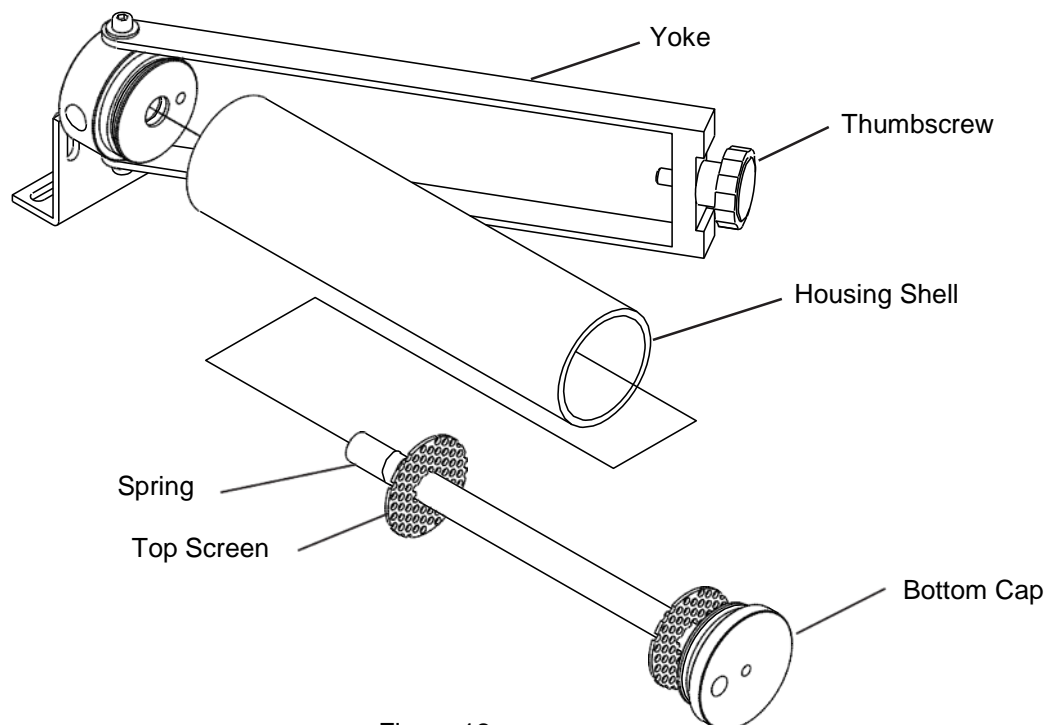


Figure 12

APPENDIX A

Specifications

| | |
|---|---|
| MAXIMUM SAMPLE FLOW RATE: | 0 TO 10 LITER/MIN |
| MAXIMUM INLET SAMPLE TEMPERATURE: | 250°F W/SST FILTER 230°F W/KYNAR FILTER |
| MAXIMUM GAS SAMPLE WATER VAPOR CONTENT: | 70% |
| OUTLET SAMPLE DEW POINT: | 26°F (-4°C) at 10 L/MIN |
| (With GS2040-PD200KA dryer) | 12°F (-12°C) at 5 L/MIN -12°F (-25°C) at 2 L/MIN |
| (With GS2040-PD100KA dryer) | 36°F (2°C) at 10 L/MIN 26°F (-4°C) at 5 L/MIN 6°F (-15°C) at 2 L/MIN |
| (With GS2040-50KA dryer) | 42°F(5°C) at 10 L/MIN |
| SOLUBLE GAS REMOVAL RATES: | NO, NO ₂ , SO ₂ 0% loss CO, CO ₂ 0% loss H ₂ S, HCl 0% loss |
| MAXIMUM GAS SAMPLE INLET PRESSURE: | 10 PSIG |
| MINIMUM GAS SAMPLE INLET PRESSURE: | |
| - WITHOUT PURGE EDUCTOR OPTION: | 5" H ₂ O VACUUM |
| - WITH PURGE EDUCTOR OPTION: | 10" H ₂ O VACUUM |
| GAS SAMPLE INLET FITTINGS: | 1/4" or 3/8" TUBING FITTINGS |
| GAS SAMPLE OUTLET FITTINGS: | 1/4" or 3/8" TUBING FITTINGS |
| AIR REQUIREMENTS: | PURGE AIR -40°C DEW POINT MAXIMUM ONE (1) CFM MAXIMUM THREE (3) CFM |
| -OPTIONAL PURGE EDUCTOR | |
| ELECTRICAL REQUIREMENTS: | 950 Watts @ 115V ±10% or 230V ±10%, 50/60Hz, 10A/5A |
| FUSE: | |
| - FUSE BLOCK | 1.25" X 0.25" GLASS FUSE, 5A or10A (DEPENDING ON SYSTEM VOLTAGE) |
| - INLINE FUSE HOLDER (PLC) | 5mm X 20mm 1.0A FAST-BLOW FUSE |
| ENCLOSURE: | NEMA 4X, STAINLESS STEEL |
| DIMENSIONS: | 20"W x 40"H x 10"DEEP |
| OPERATING ENVIRONMENT: | -20°C TO 40°C AMBIENT TEMP. 0 TO 95% R.H. Altitude - up to 2000m |

APPENDIX B

PD Dryer Disassembly

Special tool needed for Assembly/Disassembly (included) - for item numbers, refer to the dryer assembly drawing on page 25.

1. Begin by loosening the four set screws (item 11).
2. Remove the four 1/4" NPT plugs (item 10) in the end faces of the coupling fittings (item 1). See Figure 10.
3. Disconnect the differential pressure switch tubing from the compression fitting.
4. Using the special dryer disassembly tool begin removing the coupling fittings by performing the following steps:

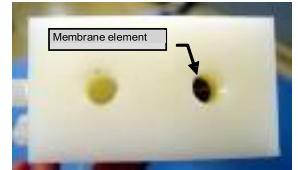


Figure 10

Single element dryer (only one shell tube contains a membrane tube element)

- a. Look into the ports from which the plugs were just removed and determine which one contains the dryer element. The membrane tube ends will be visible (See Figure 11).
- b. Thread the tool into this port and tighten by hand. Turn the handle until resistance is felt.
- c. Then slowly turn the handle until the coupling fitting is free of the shell tubes. Some manual adjustment of the assembly will be required to keep the coupling fittings parallel with each other while pressing (See Figure 12).
- d. Repeat steps a-c for the other coupling fitting.
- e. At this point, the dryer element/shells should be free of the coupling fittings and the header plugs (item 5) on the unused shell tube side should still be in the coupling fitting bore.
- f. Remove an o-ring (item 8) from one of the element headers (See Figure 13).
- g. Slip the element from the opposite end of the shell tube (See Figure 14).



Figure 11

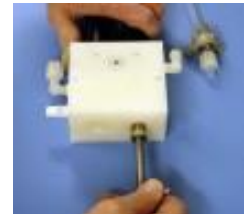


Figure 12



Figure 13



Figure 14

Dual element dryer

- a. Thread the tool into one of the ports from which the plugs were just removed and tighten by hand. Turn the handle until resistance is felt. Then slowly turn the handle 2-3 turns. The coupling fitting will begin to move away from the shell tubes.
- b. Remove the tool and thread it into the other port on the same coupling fitting and tighten by hand. Slowly turn the handle 2-3 turns.
- c. Repeat steps a-b until the coupling fitting is free of the shell tubes.
- d. Repeat steps a-c for the other coupling fitting.
- e. At this point, the dryer element/shells should be free of the coupling.
- f. Remove an o-ring (item 8) from one of the membrane element headers and slip the element from the opposite end of the shell tube.
- g. Repeat step f for the other membrane element/shell tube assembly.

PD Dryer Reassembly

Special tool needed for Assembly/Disassembly (included) - for item numbers, refer to the dryer assembly drawing on page 25.

1. Insert a membrane element into the **heated** shell tube and install o-rings (item 8) into the grooves on each header (See Figure 15). The membrane element should now be constrained to the shell by the o-rings.
2. If this is a dual membrane element dryer, repeat step 1 for the other membrane element/shell tube assembly.
3. Perform the following steps to complete the reassembly:
 - h. Locate one of the coupling fittings and place it on a hard surface with the shell tube bores facing up. Install o-rings (item 6) in the grooves (See Figure 16).
 - i. Skip this step for dual element dryers. For a single element dryer: Insert the end of the empty shell into the bore of the coupling fitting that has the header plug residing in it. (**Important! - Position the purge air holes as shown on the drawing**). Press the assembly into place in the coupling fitting. (See Figure 17)
 - j. Insert the shell/element assembly into the other bore and press into place. (**Important! - Position the purge air holes as shown on the drawing**). Repeat for the second shell/element assembly (See Figure 18-19).

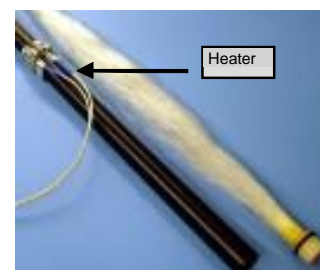


Figure 15

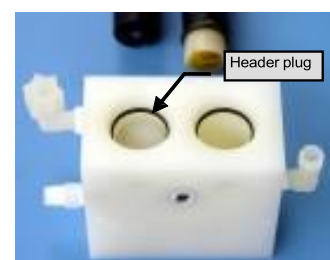


Figure 16

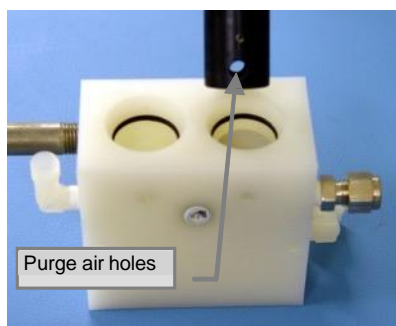


Figure 17



Figure 18



Figure 19

- a. Insert the free shell tube ends of the partially completed assembly into the bores of the other coupling fitting. **(Important! – Be sure to have the set screw holes in each coupling fitting facing in the same direction)**. See Figure 20.
- b. Press the tubes into the coupling. This step can be done by hand with some rocking of the coupling fitting while pressing. Rocking the fitting helps get the shell tube ends past the o-rings. **Light** tapping with a rubber mallet or pressing **lightly** in an arbor press will facilitate the assembly (See Figure 21).
- c. Lay the dryer assembly on a flat surface with the set screw holes facing up. Check that both coupling fittings are flat against the surface and there is no twist in the dryer assembly. Gently tighten all four shell set screws (item 11) by turning until resistance is felt and turning an additional ¼ turn. **Do not over-tighten**. See Figure 22.
- d. Reinstall all four pipe plugs, (item 10)
- e. Reconnect the purge pressure switch tubing to the compression fittings in each coupling fitting.

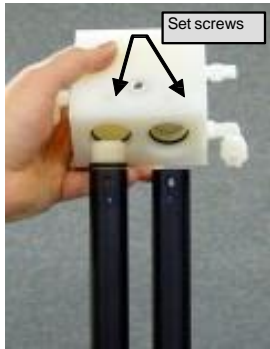


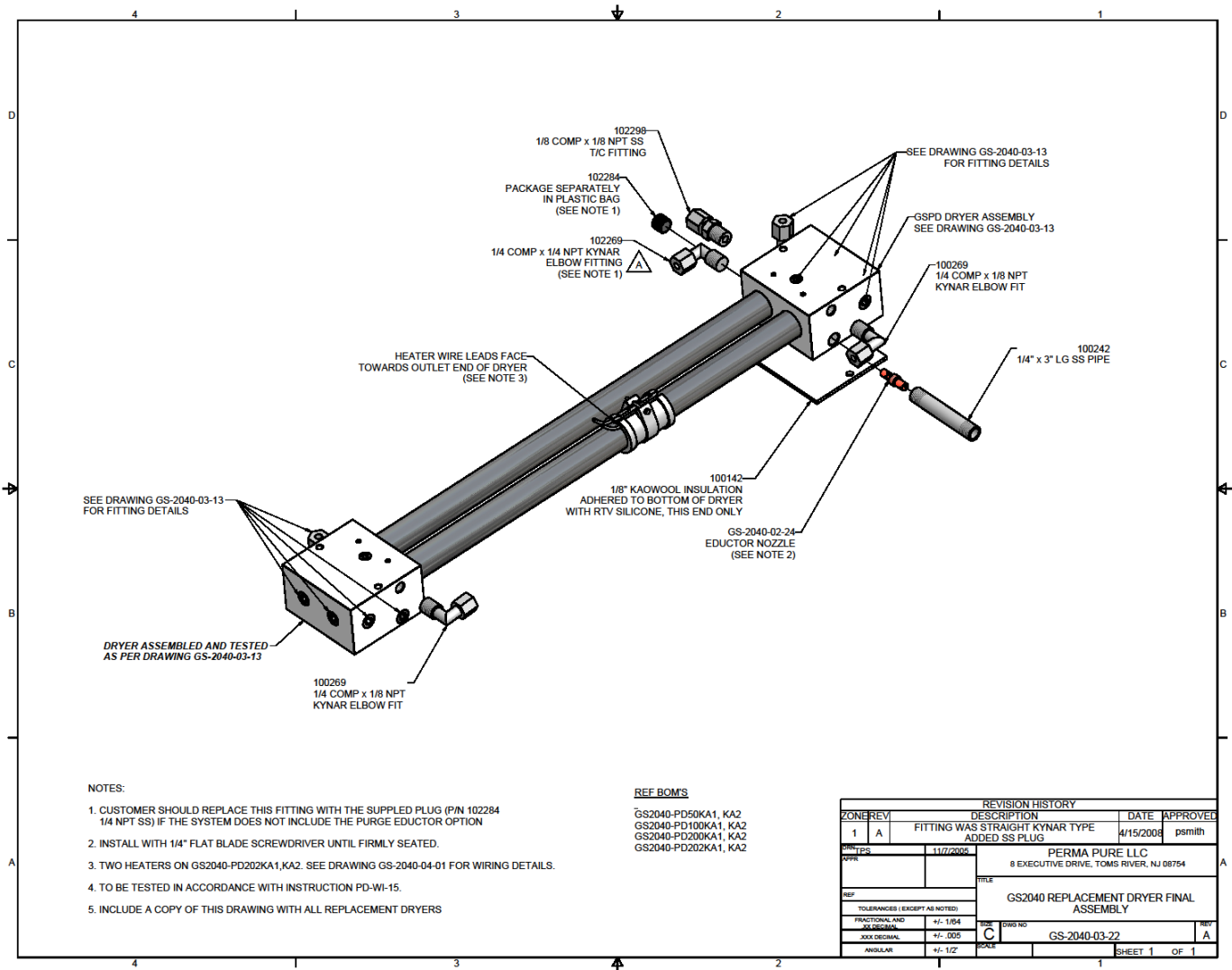
Figure 20



Figure 21



Figure 22



APPENDIX C

Replacement Parts List for GASS-2040

| <u>Part #</u> | <u>Description</u> |
|----------------|---|
| GS2040-PLC | Control Module |
| GS2040-DTC | J-Type Thermocouple for dryer and enclosure, or probe filter temperature GS2040-DPS Differential Pressure Switch |
| GS2040-FM | Flow Meter, purge gas (0-50 L/min) GS2040-PR Pressure Regulator, 30 psi |
| GS-VG-0-30 | Vacuum Gage, purge eductor (0-30" Hg) |
| GS-SV-K24 | Safety Interlock Solenoid Valve, Kynar, 24V |
| GS-SV-S24 | Safety Interlock Solenoid Valve, Stainless Steel, 24V |
| FF-DCV | Drain Check Valve, Polypropylene, for vacuum drain |
| DVP-S24 | Drain Solenoid Valve, Stainless Steel, for vacuum drain 24V |
| DVP-K24 | Drain Solenoid Valve, Kynar, for vacuum drain 24V |
| MG-DVT | Drain Valve Timer |
| MG-DC | Mounting Clamps for Dryer (specify dryer model) |
| MG-1412-HB | Backplate with Heater for Enclosure 1412 |
| MG-2112-HB | Backplate with Heater for Enclosure 2112 |
| GS2040-PD-50E | 50 Tube dryer replacement element, 24" long, includes o-rings |
| GS2040-PD-100E | 100 Tube dryer replacement element, 24" long, includes o-rings |
| GS2040-PD-200E | 200 Tube dryer replacement element, 24" long, includes o-rings |
| FF-250-E-2.5G | Replacement filter element, particulate/coalescer |
| FF-250-G | Replacement glass shell |
| FF-250-3 | Replacement O-ring set, set of 3 |
| AS-200-08-EB | Media replacement for ammonia scrubber, bulk supply, 5 fillings |
| GS2040P-FE | Replacement 10 micron, ceramic filter element for probe filter, includes gasket |

APPENDIX D

Stack Mount System

The GASS-2040 stack mount system is intended to be mounted on a 2" to 4" flanged nozzle has been welded directly to the stack. It will accommodate a nozzle flange angle of 0 to 10 degrees. Mounting of the system is relatively simple but will require a three person team as the system weighs approximately 110 pounds and will need to be supported temporarily during installation (See Figure 23).

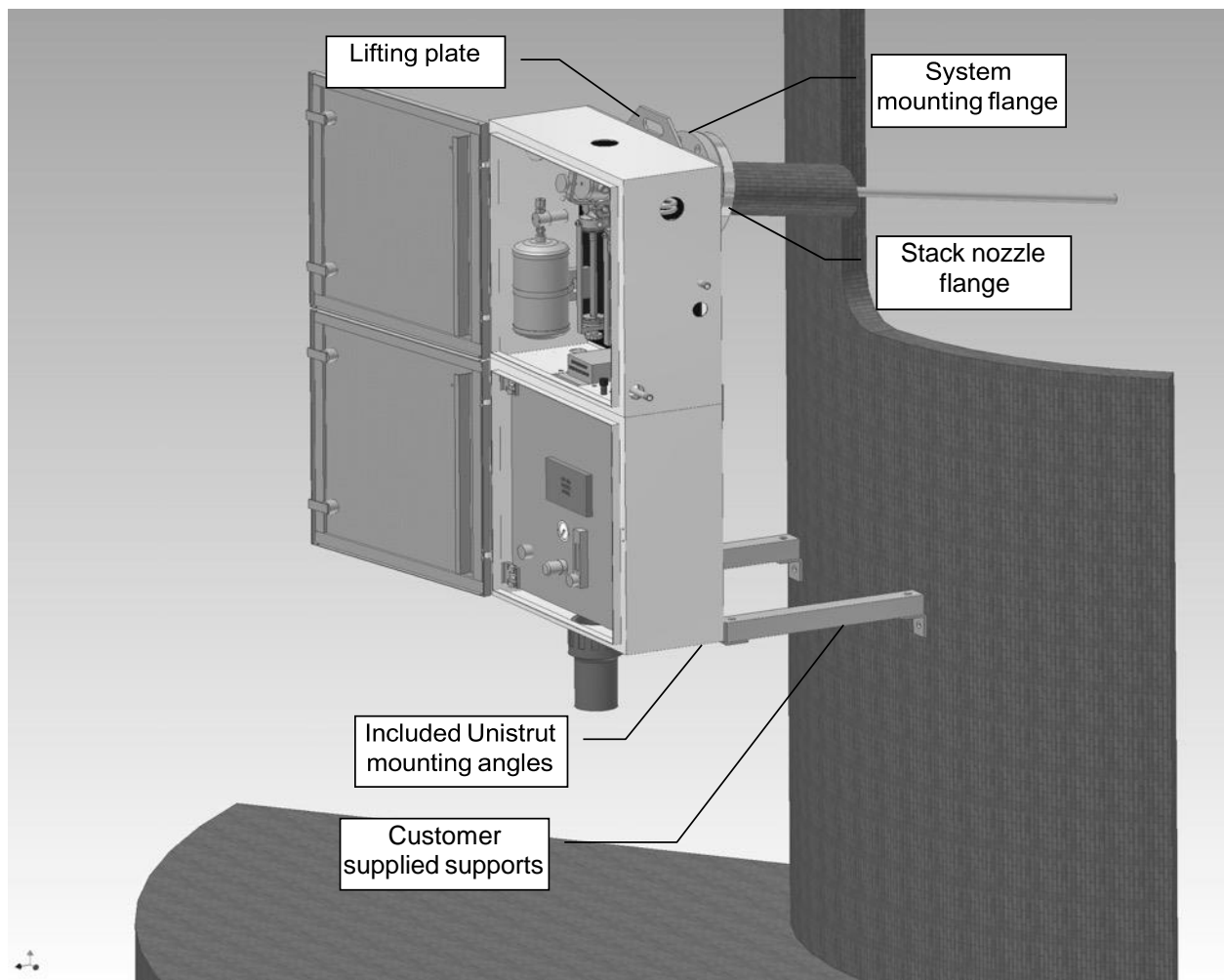


Figure 23

Flange Mounting

- a. Once the system has been lifted up to the platform, set the system down on blocks (Short lengths of 2x4 studs or equivalent). The blocks will protect the utility connections from damage and allow the system to be positioned upright on the platform deck.
- b. Install the mounting flange on the system by threading it on to the protruding nipple that exits the back of the system and tighten. Be sure to align the bolt hole pattern with that of the mating flange on the stack nozzle.
- c. If the probe pipe is less than two feet in length, it can be installed and tightened.
- d. If the probe is longer than two feet, it may be necessary to slide the probe pipe into the stack nozzle first. This depends on how wide the platform is or if there is physically enough space to be able to back the system away from the stack with the probe pipe attached.
- e. At this point, an appropriately sized flange gasket should be installed on the system flange. Attaching the gasket to the flange with a small amount of tape at the edge of the gasket will hold it in place temporarily.
- f. If space is limited, slide the probe pipe into the stack nozzle and hold on tightly.
- g. Lift the system up to the nozzle and install the probe pipe on the system and tighten.
- h. Mate the two flanges, install the mounting bolts and tighten.

Support Installation

Once the system has been mounted on the flange, supports must be installed to prevent it from swinging on the hinged flange mount. Two Unistrut compatible angle brackets are mounted to the lower corners of the enclosure to allow attachment. Due to the wide variety of possible support configurations, this is left up to the customer. The supports can be placed vertically to the deck or horizontally to the stack wall or any other convenient angle as long as they are rigidly attached by welding or mechanical fastening.

APPENDIX E

Z-Purge Operation

With the inert gas supply connected, enclosure power de-energized and alarm system (if utilized). Follow steps to purge system:

1. Carefully read Start-Up Instruction Nameplate on system.
2. Check operation of the Enclosure Protection Vent (EPV-1, if utilized), opening it manually several times (see helpful hints below)
3. Seal protected enclosures.
4. Open Enclosure Pressure Control Regulator, but turning CW, to set Enclosure Pressure Indicator at "Safe" pressure.
5. Ensure the Protection System Enclosure Pressure Indicator maintains a "Safe" pressure for one minute.
6. Standby for exchange time as specified on the Instruction Nameplate, then energize the protected enclosure power.
7. Ensure the Enclosure Pressure Indicator maintains a "Safe" pressure before leaving system unattended.

Troubleshooting

| Problem or Fault | Possible Causes | Corrective Action |
|---|--|--|
| Enclosure pressure control valve will not hold a "safe" .25 inch pressure. | Leakage around gasketing, covers, seams, piping and tubing connections, conduit connections and electrical conduit seals of the enclosure. | Tighten enclosure latches: Where tightening is not feasible, and gasketing materials are not practical, holes or gaps can be closed with silicone sealant applied from inside the protected enclosure. |
| Enclosure pressure gauge reading is difficult to stabilize. | Insufficient enclosure leakage or opening of the venturi orifice is crimped to small. | Remove the orifice, cut off the crimped end and ream the tube, then recrimp and reinstall the tube to note effect. As tube is shortened, reamed, and recrimped, sensitivity decreases, allowing easier adjustment of setpoint on the enclosure pressure gauge. |
| Enclosure pressure loss alarm switch does not appear to be operating. | Pressure switch is out of calibration. Pressure switch has not been energized (WPSA style systems only) | Calibrate by slowly adjusting counterclockwise to decrease the setpoint, and clockwise to raise the setpoint. (Do not attempt to calibrate the switch until all efforts to make the switch respond properly have failed.) Verify 120 VAC has been applied to power contacts of WPSA style system. |
| Problems persists, or if the system does not appear to be operating properly. | Persisting problems. | Contact Pepper+Fuchs applications/customer service department at 330-486-0002 |

Helpful Hints

- The term "Safe" pressure for purposes of this manual is defined as follows:
 - Class I = a minimum 0.25 inch of water column pressure.
 - Class II = a minimum 1.0 inch of water column pressure.
- Regulator may be in the locked position upon arrival. To adjust regulator, pull handle to outward position.
- To test the vent's operation, gently prod the vent flapper open with a soft pointed object (i.e. eraser end of pencil) ensuring that the vent works freely.

For further assistance, please contact us at:

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Lakewood, NJ 08701
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Tel: 732-244-0010
Tel: 800-337-3762 (Toll Free USA)
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