Installation / Operation / Maintenance Manual

GASGUARD®

Source System AP11

Manual Part Number: 410254

Edition: Rev- 16

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Printed in the U.S.A.

The content of this Installation/Operation/Maintenance manual is intended to be used by trained equipment owners and Versum Materials technical personnel who understand the functions and hazards of the system.

WARRANTY

Versum Materials, Inc. (hereinafter referred to as "Versum Materials") warrants that:

(A) Each new GASGUARD® system is free from defects in material and workmanship under normal use and service for a period of one year from the date of delivery by Versum Materials to the first purchaser.

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Revision Control Summary

Chapter	Revision	File Name
Cover • Updated Revisions	Rev-14	MNL000126.doc
Chapter 1 – Safety Warnings • Label updates	Rev-8	MNL000127.doc
Chapter 2 – Dimensions & Mounting • Added eV option, updated seismic	Rev-5	MNL000128.doc
Chapter 3 – Tubing Connections • Added purge info for GASGUARD® eV	Rev-6	MNL000129.doc
Chapter 4 – Electrical Connections • Revised GASGUARD® eV Power for 700W Blankets	Rev-13	MNL000130.doc
Chapter 5 – Helium Leak Check • Updated company name and logo	Rev-3	MNL000131.doc
Chapter 6 – Functional Checklist • Added Pneumatic Regulator Check	Rev-8	MNL000132.doc
Chapter 7 – System Description • Updated with Active Control and new features	Rev-6	MNL000133.doc
Chapter 8 – Operating Procedures • Updated with eV details	Rev-5	MNL000134.doc
Chapter 9 – Troubleshooting • Updated with Active Control alarms	Rev-6	MNL000135.doc
Chapter 10 – Maintenance • Updated with eV details	Rev-8	MNL000136.doc
Chapter 11 – System Specific Information • Added low pressure pneumatic reg	Rev-14	MNL000137.doc

Chapter 12 – Installation Drawings • Not included. Ships with system	N/A	N/A
Chapter 13 – Pigtail and Cylinder Support Adjustments • Updated company name and logo	Rev-2	MNL000078.doc
Chapter 14 – Active Control Features and Operation • Added pressure boost and LVP features	Rev-2	MNL000607.doc
Appendix A – UHP Tubing & Fitting Specification • Updated company name and logo	Rev-2	MNL000138.doc
Appendix B – N2 MSDS • Updated company name and logo	Rev-3	MNL000139.doc
Appendix C – PED Assessment • Updated company name and logo	Rev-2	MNL000140.doc
Appendix D – Acetylene • Added active control notes	Rev-4	MNL000306.doc
Appendix E – Remote eV Heater Controller • First incorporation into this manual	Rev-2	MNL000570.doc
Addendum C – Heat trace installation • First incorporation into this manual	Rev-2	MNL000063.doc

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ADDENDUM C HEAT TRACE INSTALLATION AND OPERATION

Chapter 1

Safety Warnings

Please read the following safety warnings carefully before installing the equipment.

1.1 Introduction

This section is meant to communicate to the user any hazards involved with the equipment.

The following paragraphs will define the hazard warnings used and describe the icons found in various sections of the manual and on the equipment. The hazard warning labels used in the manual will correlate with those used on the equipment.

1.1.1 Level or Intensity of Hazard

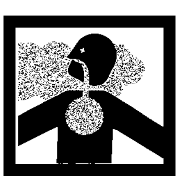
Indicates an immediate hazard, which if not avoided, <u>will</u> result in death or serious injury.

Indicates a potentially hazardous situation, which if not avoided, <u>could</u> result in death or serious injury.

Indicates a potentially hazardous situation, which if not avoided, <u>may</u> result in a minor or moderate injury. It may also be use to alert against unsafe practices.

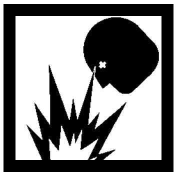
1.1.2 Hazard Types (Symbols)

This symbol is a safety alert symbol.



This symbol represents asphyxiant, toxic or corrosive gases. Gases used with the GASGUARD® can cause personal injury or death.

This symbol can represent one or more of the following conditions:

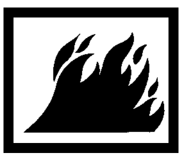


Explosive gases! Gases used with the GASGUARD® can cause an explosion when combined with air.

The formation for explosive gas mixtures of flammable gas and air when exposed to an ignition source.

Pyrophoric gases which will ignite spontaneously without the presence of an ignition source when exposed to air.

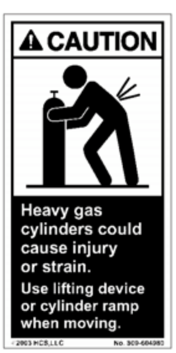
Energy release which may result from pneumatic or hydraulic pressure rapidly escaping from a portion of the equipment.



This symbol represents flammable gases. Gases used with the GASGUARD® can cause flammable atmospheres.

This symbol represents PPE (Personal Protective Equipment). Proper PPE shall be worn when working with this system.

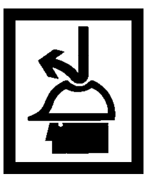
This symbol represents electrical shock hazard.



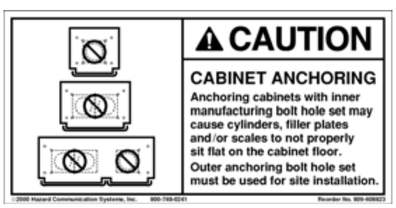
This symbol warns of potential strain or injury when lifting cylinders.

This symbol warns of a pinch hazard. This hazard exists on cabinet doors equipped with automatic closers.

This symbol warns of the possibility of the source system tipping over if it is not installed properly. Personal injury could result.



This symbol indicates the need for head protection.



This symbol cautions against the improper anchoring of cabinets.

1.2 Important Safety Warnings

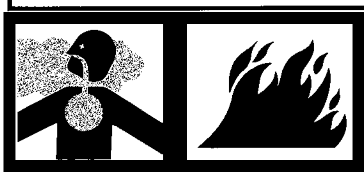
⚠WARNING

Failure to read, understand and follow the safety information found in this section could result in personal injury and death.

⚠CAUTION

The operator must read and understand this safety section before operating the system. All operating and maintenance personnel must receive training and instruction by Versum Materials, Inc.

⚠WARNING

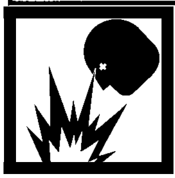


All cylinder storage areas must be continually monitored with an air quality monitor to prevent the danger of a hazardous atmosphere.

⚠CAUTION

Before using the system, review your company's requirements for use of toxic, corrosive, flammable, pyrophoric, oxidizers and inert gas cylinders and electrically powered equipment. You must be thoroughly trained in your company's safety procedures and safety equipment (self-contained breathing apparatus, emergency shutdown systems, plant alarm locations, etc.)

⚠WARNING

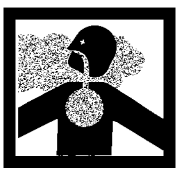


Do not use this device in any manner other than specified in this manual.

Do not make any changes to the equipment independently. INJURY or DEATH may result from unauthorized modifications. All modifications to equipment MUST be approved in writing by an Versum Materials, Inc.' Representative.

1.3 Inert Gas Hazards

⚠WARNING



High concentrations of nitrogen, helium, or other inert gases can cause an oxygen deficient atmosphere in a confined area which can cause DEATH. All personnel must read and understand the material safety data sheet(s) (MSDS) for the specific gas(es) being used.

Oxygen concentrations of 19.5% or less can greatly increase the hazard of asphyxiation to personnel. Before working in an area where nitrogen, helium or other inert gases could be present, check the area with an oxygen monitor to be sure the oxygen concentration is between 19.5% and 23%. While working in the area, the oxygen concentration needs to be monitored with a continuous oxygen monitor. Always provide adequate ventilation in the work area to decrease the risk of an oxygen deficient atmosphere.

Personnel in an oxygen deficient atmosphere will not realize they are being asphyxiated. Breathing of pure inert gases will cause immediate unconsciousness. Symptoms of asphyxia include:

- Rapid breathing
- Nausea
- Vomiting
- Inability to move
- Convulsive movements
- Collapse
- Abnormal pulse
- Rapid fatigue

- Faulty judgment
- Insensitivity to pain
- Abnormal emotions

Remove any personnel in an oxygen deficient atmosphere to fresh air. ***Get medical attention immediately. Positive pressure breathing apparatus must be worn by any rescuers entering a suspected oxygen deficient atmosphere.***

Nitrogen gas may accumulate in low or confined areas. All requirements of OSHA 1910.146 (Confined Space Guidelines) must be met when inert gases may be present in confined spaces. Self contained breathing apparatus is required (cartridge or filter type gas masks cannot be used). See the information on personal protective equipment in this section for details.

When entering a confined area or area which may contain high inert gas concentrations, a **"Buddy System"** must be used. One person should remain outside the suspect area, but within view of the other person. This method ensures that the other person can respond in the event of an emergency.

1.4 Pressurized Fluids / Gases

⚠CAUTION

Pressurized gas and water sprinkler lines can injure personnel and damage equipment. Never tighten or loosen a fitting when it is under pressure.

The house nitrogen supply lines can contain pressures of 100+ psig (6.9+ barg). The water sprinkler lines contain pressures of 30 psig (2.1 barg). Exercise care when working around these lines. Ensure that pressure has been vented before breaking any connection. Tag out and lock out the line before doing any work. ***Follow Typical Minimal Lockout or Tagout System Procedures described by Occupational Safety and Health Admin., Labor Para. 1910.147.***

1.5 Electrical Hazard

Electric shock can cause personal injury or death.

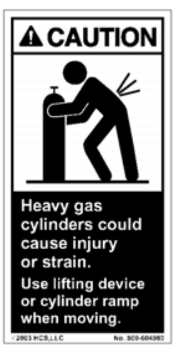
The control circuits for the system use 115/220 VAC, 50/60 Hz. Do not attempt to work on the system without first turning the power off and tagging out and locking out the electrical supply disconnect switch per plant lock out procedures. ***Follow the Typical Minimal Lockout or Tagout System Procedures described by Occupational Safety and Health Admin., Labor Para. 1910.147.***

1.6 Falling Equipment Hazard

This system is a top heavy device. If it is not properly installed, it could fall and injure, crush or kill personnel working in the area.

When moving and installing the system, extreme care needs to be taken to support it properly. Due to the top heavy nature of the system, when moving or if not installed properly, it could tip over, injuring, crushing or possibly killing personnel in the area. Moving and setting equipment shall be done only by those persons having proper training and qualification in lifting and rigging.

1.7 Gas Cylinder Handling Hazard



Improper handling and storage of compressed and liquefied gas cylinders could cause injury or death.

Restrain gas cylinders during storage and use. Keep protective cap on cylinder when not dispensing gas. Lifting gas cylinders could cause strain or injury. See Safetygrams found in the Safety section of the Operation Manual.

1.8 Pinch Hazard

A pinch hazard exists on cabinet doors equipped with automatic closers.

1.9 Personal Protective Equipment

Personal protective equipment, as defined in this section, must be worn when working with this system.

Personal protective equipment is designed to protect personnel from inadvertent risk. The listed personal protective equipment must be worn regardless of operator or technician level of training and qualifications.

The minimum personal protective equipment required for operating and maintaining the GASGUARD® system is dependent on the hazard category of the gas(es) being used. When a gas meets more than one hazard category, the PPE for the most hazardous category ***must*** be used. Refer to the hazard warnings in Section 1.10 for the hazards of the gas(es) being used.

In addition to the personal protective equipment, the following safety equipment is highly recommended and is required when VERSUM MATERIALS, INC. personnel operate this equipment. This equipment should be supplied by the customer prior to operating the GASGUARD® system.

- Safety shower
- Emergency phones
- Eye wash
- Gas leak detection system for gases to be used (ex: MDA)

  The gas leak detection system must warn personnel (through visible and audible alarms located near the gas cabinet) of a hazardous atmosphere. The gas sensor(s) need to be set up to alarm at the lowest level of hazard of exposure. Upon activation of an alarm, follow the established shutdown procedures for your system.

- Scrubber with a pollution abatement system sized for maximum potential upset flow of hazardous gas.
- Adequate ventilation as described in section 3.7.

If you are unsure what personal protective equipment list to follow for the gases being used, <u>DO NOT</u> continue. Failure to understand the hazards and use the proper personal protective equipment may cause INJURY or DEATH. Contact Versum Materials, Inc. for the gas category.

Personal Protective Equipment for the gas categories follows:

Personal Protective Equipment for Toxics

- Toxic gas leak detection (ex. MDA)
- Self contained positive pressure breathing apparatus
- Long sleeved Nomex suit
- Safety glasses with side shields
- Leather gloves
- Safety shoes

NOTE: Most highly toxics (diborane, germane phosphine) are also flammable. Nomex suit is not required for non-flammable toxics (ex: nitrogen dioxide, boron trifluoride). All gases in Chapter 1 Section 12 using the warning sign with POISON GAS on the left and FLAMMABLE GAS on the right <u>REQUIRE</u> the Nomex suit.

Personal Protective Equipment for Corrosives

- Corrosive gas leak detector (ex. MDA)
- Self contained positive pressure breathing apparatus
- Level C acid suit (jacket with bib overalls)

- Safety glasses with side shields
- Leather gloves
- Safety shoes

NOTE: Either air quality monitoring or self contained breathing apparatus is required for corrosive gases. Versum Materials, Inc. recommends the use of both. It is not required to use both, however at least one MUST be used at all times.

Personal Protective Equipment for Pyrophorics

- Pyrophoric gas leak detection (ex: MDA)
- Hard hat (fire hat with brim recommended)
- Long sleeved Nomex suit
- Face shield
- Safety glasses with side shields
- Leather gloves
- Safety shoes

Personal Protective Equipment for Flammables

- Hard hat (fire hat with brim recommended)
- Long sleeved Nomex suit
- Face shield
- Safety glasses with side shields
- Leather gloves
- Safety shoes

Personal Protective Equipment for Inerts

- Oxygen depletion monitor
- Safety glasses with side shields
- Leather gloves
- Safety shoes

1.10 Hazard Warnings

The following hazard warnings detail system hazards. Follow the warnings to avoid personal ***injury or death. Do not work on the system before reading and understanding the following warnings.*** The hazard warnings include:

- Toxic Gases Hazards
- Corrosive Gases Hazards
- Flammable and Pyrophoric Gases Hazards
- Oxidizer Hazards
- Inert Gas Hazards
- Pressurized Gases
- Cylinder Handling Hazards
- Electrical Hazards

Not all of the gas related hazards may apply to your system. For example, you may not be using any gases in the oxidizer class.

⚠WARNING

Some gases have more than one hazard. For example, fluorine is toxic, corrosive and also an oxidizer.

The Pressurized Gases Cylinder Handling Hazards and Electrical Hazard warnings apply to all GASGUARD® systems.

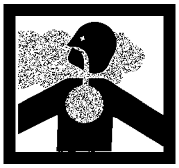
⚠WARNING

The following is general information on typical gas hazards. It is not a substitute for training and use of Material Safety Data Sheets by all operators.

1.10.1 Toxic Gas Hazards

WARNING

Many of the gases used in the GASGUARD® system could cause personal INJURY OR DEATH at very low concentrations.



Many of these gases provide no physical warning signs (i.e. coughing, throat irritation, burning sensations, and shortness of breath) to alert personnel of exposure to toxic levels.

Personal protective equipment required for use with toxic gases is detailed in Chapter 1 Section 9 of this manual.

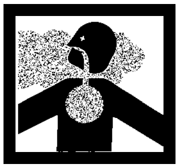
A list of most of the toxic gases used in the GASGUARD® system follows:

Ammonia
Arsine
Boron trichloride
Boron trifluoride
Carbon monoxide
Chlorine
Chlorine trifluoride
Diborane
Diborane mixtures
Dichlorosilane
Disilane
Fluorine
Germane
Hydrogen bromide
Hydrogen chloride
Hydrogen fluoride
Hydrogen sulfide
Methyl chloride
Nitrogen dioxide
Nitrogen trifluoride
Phosphine
Phosphine mixtures
Phosphorous pentafluoride
Silane
Silicon tetrachloride
Silicon tetrafluoride
Sulfur tetrafluoride
Trichlorosilane
Tungsten hexafluoride

1.10.2 Corrosive Gas Hazards

DANGER

Corrosives such as chlorine, fluorine and ammonia will irritate and burn human tissue. They can cause personal INJURY and DEATH.



Exposure to very small concentrations of corrosive gases can cause severe irritation of the eyes and respiratory system. At higher concentrations, they can cause ***severe personal injury or death***.

Chapter 1 Section 9 of this manual lists the personal protective equipment required for use with corrosive gases.

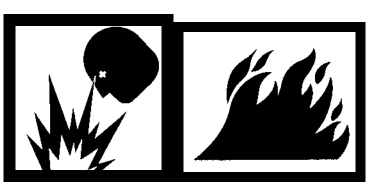
A list of most of the corrosive gases used in the GASGUARD® system follows:

Ammonia	**Hydrogen chloride**
Boron trichloride	**Hydrogen fluoride**
Boron trifluoride	**Hydrogen sulfide**
Chlorine	**Nitrogen dioxide**
Chlorine trifluoride	**Phosphorous pentafluoride**
Dichlorosilane	**Silicon tetrachloride**
Fluorine	**Silicon tetrafluoride**
Hydrogen bromide	**Tungsten hexafluoride**

1.10.3 Flammable and Pyrophoric Gas Hazards

WARNING

Flammable and pyrophoric gases could cause fire, explosions, personal injury or death.



Pyrophoric gases will spontaneously ignite in air

Pyrophoric gases do not need a source of ignition to burn. However, low concentrations may accumulate without pyrophoric ignition (i.e. silane can accumulate up to a concentration of 2 molar percent [number of moles of silane per fixed volume of air] before spontaneous ignition occurs). Pyrophoric gases will ignite in the presence of oxygen.

Flammable mixtures can burn or explode

Fire and explosion hazards can be controlled by preventing the formation of combustible fuel-oxidant mixtures and by eliminating sources of ignition such as sparks, open flames or other heat sources.

Flammable mixtures will burn when ignited and can explode when the concentration is above the lower explosive limit (LEL) and below the upper explosive limit (UEL) for that specific gas. Some flammable gases may accumulate as pockets in enclosed areas and subsequently explode if an ignition source is present. A flammable gas also presents an asphyxiating hazard in sufficient quantities to reduce oxygen concentration below 19.5%, however fire/explosion is typically the primary hazard.

Adequate ventilation is necessary

Adequate ventilation helps reduce the possible formation of flammable mixtures in the event of a flammable gas leak. See tables in Chapter 3 Section 7 which list the exhaust requirements per enclosure size for all gases.

> ***NOTE: To avoid any possible hazardous reactions (i.e. fire, explosion, extremely corrosive or toxic mixtures) never vent incompatible gases out the same duct!***

Continually monitor the atmosphere

Continually monitoring the atmosphere with a gas leak detector will alert the operator to a flammable or explosive atmosphere in the area.

> ***NOTE: The installation of a hydride detector is strongly recommended for silane and other pyrophoric gases to detect leaks or pockets of gas that may not spontaneously ignite!***

Versum Materials, Inc. strongly recommend installation of a hydride detector to detect gas pocketing of pyrophoric gases.

Guidelines to avoid forming combustible mixtures

Avoid forming combustible mixtures by adhering to the following:

- Do not admit flammable gases into an area that contains oxygen/air. Do not admit oxygen/air into an area that contains flammable gases.
- Maintain a small positive pressure in systems to prevent air from leaking into them when the equipment is shut down.
- Avoid venting of flammable gases through vents that do not contain an inert atmosphere.

Personal protective equipment required for use with pyrophoric and flammable gases is listed in Chapter 1 Section 9. ***Note that the personal protective equipment (PPE) for pyrophorics differs from the flammables. Be sure to use the proper PPE.***

A list of most of the pyrophoric gases used in the GASGUARD® system follows:

Diborane	**Phosphine**
Disilane	**Silane**

A list of most of the flammable gases used in the GASGUARD® system follows:

Acetylene	**Germane**
Ammonia	**Hydrogen**
Arsine	**Hydrogen mixtures**
Carbon monoxide	**Hydrogen sulfide**
Diborane	**Methane**
Diborane mixtures	**Methyl chloride**
Dichlorosilane	**Methyl fluoride**
Disilane	**Trichlorosilane**

1.10.4 Oxygen and Other Oxidizer Hazards

⚠WARNING

Systems using oxygen or other oxidizers (i.e. nitrous oxide, fluorine) have specific guidelines for specifying equipment, materials of construction and system cleanliness. Failure to comply with materials of construction and system cleanliness could result in injury or death.

Follow safe practices when using oxygen or oxidizers (chlorine and fluorine)

Oxygen concentrations in excess of 23% significantly increase the hazard exposure to personnel and equipment. Those materials which burn in air will burn more violently and explosively in oxygen/oxidizer enriched atmospheres. Guidelines for oxygen systems are found in CGA Pamphlet G-4.4. (Contact your gas supplier or the Compressed Gas Association to order CGA Pamphlets.) Only those personnel who have read and understand the hazards of oxygen or oxidizers and safe practices for these systems should be permitted to operate and maintain the system.

Use only equipment specifically designed for oxygen or oxidizer service.

Inappropriate materials of construction increase the danger of ignition of pipelines and controls. Pipe sizing is just as important to ensure all velocity restrictions for oxygen or oxidizers are met. Do not substitute components or equipment without considering these hazards. Refer to CGA Pamphlet G-4.4 for guidelines and specifications of oxygen systems. (Contact your gas supplier or the Compressed Gas Association to order CGA Pamphlets.)

Maintain oxygen cleanliness at all times.

All equipment and piping in contact with oxygen or oxidizers must be cleaned to specifications outlined in CGA Pamphlet G-4.1. (Contact your gas supplier or the Compressed Gas Association to order CGA Pamphlets.) Failure to clean components and piping increases the danger of ignition and fire. Note that the cleaning solvent must be thoroughly removed before the equipment can be placed into service. Maintain cleanliness during assembly, installation, and repair.

No open flames, smoking, or sparks permitted near oxygen equipment.

Since many materials will burn in oxygen/oxidizer enriched atmospheres, the best method in preventing fires is to eliminate sources of ignition. Where this control equipment is being used or where concentrations of oxygen are greater than 23%, avoid open flames, sparks, or sources of heat. Never weld on a pressurized line flowing oxygen or an oxidizer. Make sure signs are posted warning personnel that oxygen or oxidizers are in use.

Do not substitute oxygen for compressed air.

Substituting oxygen for compressed air is dangerous. ***Explosions can occur when oxygen is substituted for air.*** Chances are the instrument air equipment is not compatible or cleaned for oxygen service. Oxygen used to clean off equipment or clothing could come in contact with a source of ignition (spark, flame, or other) and ignite. In some cases, the elevated oxygen levels could linger even after the source has been shut off. Never tie into an oxygen system for personal breathing purposes.

A list of most of the oxidizers used in the GASGUARD® system follows:

Chlorine	**Nitrogen trifluoride**
Chlorine trifluoride	**Nitrous oxide**
Fluorine	**Oxygen**

1.10.5 Inert Gas Hazards

High concentrations of nitrogen, helium, or other inert gases will cause an oxygen deficient atmosphere in a confined area which can cause DEATH. All personnel must read and understand the Material Safety Data Sheet(s) (MSDS) for the specific gas(es) being used.

Oxygen concentrations of 19.5% or less can greatly increase the hazard of asphyxiation to personnel. Before working in an area where nitrogen, helium or other inert gases could be present, check the area with an oxygen monitor to be sure the oxygen concentration is between 19.5% and 23%. While working in the area, the oxygen concentration needs to be monitored with a continuous oxygen monitor. Always provide adequate ventilation in the work area to decrease the risk of an oxygen deficient atmosphere. **Read VERSUM MATERIALS, INC. Safetygram 17 "Dangers of Oxygen Deficient Atmospheres" included in the safety literature in Section 1.14 of this manual.**

Any time an oxygen deficient atmosphere is suspected, the proper personal protective equipment must be used. See the information on personal protective equipment in Chapter 1 Section 9 for details.

Personnel in an oxygen deficient atmosphere will not realize they are being asphyxiated. Breathing of pure inert gases will cause immediate unconsciousness.

Symptoms of asphyxia include:

- Rapid breathing
- Nausea
- Vomiting
- Inability to move
- Convulsive movements
- Collapse
- Abnormal pulse

- Rapid fatigue
- Faulty judgment
- Insensitivity to pain
- Abnormal emotions

Remove any personnel in an oxygen deficient atmosphere to fresh air. ***Get medical attention immediately. Use cardiopulmonary resuscitation if the victim is not breathing. Positive pressure breathing apparatus must be worn by any rescuers entering a suspected oxygen deficient atmosphere.***

Nitrogen gas may accumulate in low or confined areas. All requirements of OSHA 1910.146 (Confined Space Guidelines.) must be met when working with inert gases in confined spaces. Self contained breathing apparatus is required (cartridge or filter type gas masks cannot be used). See the information on personal protective equipment in this section for details.

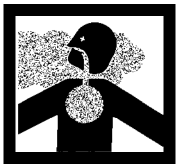
When entering a confined area or area which may contain high inert gas concentrations, a **"Buddy System"** must be used. One person should remain outside the suspect area, but within view of the other person. This method ensures that the other person can respond in the event of an emergency.

Personal protective equipment required for use with inerts is listed in Chapter 1 Section 9.

A list of inert gases used in the GASGUARD® system follows:

Argon	**Halocarbon 115**
Carbon Dioxide	**Halocarbon 116**
Halocarbon 11	**Helium**
Halocarbon 12	**Krypton**
Halocarbon 13	**Neon**
Halocarbon 14	**Nitrogen**
Halocarbon 22	**Perfluoropropane**
Halocarbon 23	**Sulfur Hexafluoride**
Halocarbon 113	**Xenon**

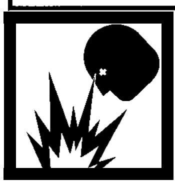
⚠WARNING



Any gas, in addition to those listed above, used in the GASGUARD® system could potentially displace the oxygen in the air and cause asphyxiation.

1.10.6 Pressurized Gases

⚠WARNING



Pressurized gas lines could injure personnel and damage equipment. Never tighten or loosen a fitting when it is under pressure.

The process and purge gas cylinders can contain pressures up to 2650 psig in the USA. In Europe, cylinders can contain pressures up to 200 barg. A leak from a loose mechanical fitting, component or a ruptured/failed component can expose the operator to a high pressure gas stream or projectile. ***Read the cylinder handling warnings in Chapter 1 Section 1.10.7 and the safety literature on cylinder handling in Chapter 1 Section 13***.

The house nitrogen supply lines can contain pressures of 100+ psig (7+ barg). Exercise care when working around these lines. Insure that pressure has been vented before breaking any connection. Tag out and lock out the line before doing any work. ***Follow Typical Minimal Lockout or Tagout System Procedures described by Occupational Safety and Health Admin., Labor Para. 1910.147 found in Section 1.11.***

1.10.7 Cylinder Handling Hazards

⚠WARNING

High pressure gas cylinders could be extremely hazardous when not handled properly.

Proper training, maintenance, leak testing and mechanical connection procedures can prevent operators from being exposed to high pressure gas streams. ***Use the cylinder change out procedures in Chapter 8 Section 8.3.2, "Process Cylinder Procedures."***

- Do not use a wrench or other device to close diaphragm type cylinder valves. This could cause diaphragm rupture and valve failure which ***could result in personal injury or death.*** Contact your gas supplier for the maximum torque (ft./lbs. or N/m) allowed on diaphragm type cylinder valves. Certain gases are supplied with cylinder valves without handwheels. Use ***only*** the tool specified by your gas supplier to open and close diaphragm type cylinder valves to avoid over torquing these valves.
- If a cylinder valve protection cap is extremely difficult to remove, do not apply excessive force or pry the cap loose. Attach a label to the cylinder identifying the problem and notify the personnel responsible for returning cylinders about the defective cylinder. Obtain another cylinder. Do not attempt to open a frozen cap as this would damage the cylinder valve and ***could result in personal injury or death.***
- Do not rotate the cylinder using the cylinder valve handle. This may open the cylinder valve and cause a high pressure gas leak.
- ***NEVER*** replace the gas specified for use in the source system with another type of gas cylinder. Incompatible gases could cause fires, explosions or extremely corrosive or toxic mixtures which can ***cause personal injury or death.*** If another type of gas is required for use in the gas source system, contact Versum Materials, Inc. immediately.
- A valve outlet sealing cap ***must*** be supplied on all toxic, corrosive and pyrophoric gases. Consult your gas supplier if there is no sealing cap on any of the above types of gas cylinders.
- Cylinder valves are available with removable flow restrictor orifices in the valve outlet for use with gas cylinders. This flow restrictor orifice significantly limits the rate of release of gas from the valve outlet during transportation, storage and use, due to a valve or system failure. Verify that your gases are supplied in cylinders with valves that have the appropriate flow restrictor orifice. Note that there are different size flow restrictor orifices available. Verify that the correct size is being used for your specific situation. A quality control program should be established to assure that your supplier has installed the correct flow restrictor orifice in the valve outlet after the filling operation has been completed.

1.10.8 Electrical Hazards

WARNING

Electric shock could cause personal injury or death.

The control circuits for the system use 115/220 VAC, 50/60 Hz. Do not attempt to work on the system without first turning the power off and tagging out and locking out the electrical supply disconnect switch per plant lock out procedures. ***Follow the Typical Minimal Lockout or Tagout System Procedures described by Occupational Safety and Health Admin., Labor Para. 1910.147 found in Chapter 1 Section 11 of this manual.***

1.10.9 Purge Gas Backstream Hazard

WARNING

Avoid low pressure condition in purge gas cylinder to prevent a backstream hazard.

The purge gas system incorporates a pressure indicating gage which will provide the means of displaying a low purge gas cylinder pressure condition (usually 200 psig [14 barg] minimum). The cylinder should be changed out at this point to prevent process gas from backstreaming into the purge gas cylinder.

1.11 Typical Minimal Lockout or Tagout System Procedures

NOTE: The following OSHA document is included to help you develop a lockout/tagout procedure for the GASGUARD® System. A written procedure is required for any work performed under lockout/tagout. It must be reviewed, approved and understood by all participants who are trained to perform the work. (Occupational Safety and Health Admin., Labor Para. 1910.147)

Although OSHA does not have jurisdiction outside the United States of America, it is Versum Materials, Inc. recommendation that Lockout, or Tagout procedures be followed, except where local laws are more stringent.

General

Lockout is the preferred method of isolating machines or equipment from energy sources. To assist employers in developing a procedure which meets the requirements of the standard, the following simple procedure is provided for use in both lockout and tagout programs. This procedure may be used when there are a limited number of types of machines or equipment or there is a single power source. For a more complex system, a more comprehensive procedure will need to be developed, documented and utilized.

Lockout (or Tagout) Procedure for (Name of Company)

Purpose

This procedure establishes the minimum requirements for the lockout or tagout of energy isolating devices. It shall be used to ensure that the machine or equipment is isolated from all potentially dangerous energy, and locked out or tagged out before employees perform any servicing or maintenance activities where the unexpected energization, start-up or release of stored energy could cause injury (Type(s) and Magnitude(s) of Energy Hazards).

Responsibility

Appropriate employees shall be instructed in the safety significance of the lockout (or tagout) procedure (Name(s)/Job title(s) of employees authorized to lockout or tagout). Each new or transferred affected employee and other employees whose work operations are or may be in the area shall be instructed in the purpose and use of the lockout or tagout procedure (Name(s)/Job title(s) of affected employees and how to notify).

Preparation for Lockout or Tagout

Make a survey to locate and identify all isolating devices to be certain which switch(s), valve(s) or other energy isolating devices apply to the equipment to be locked or tagged out. More than one energy source (electrical, mechanical, or others) may be involved. (Type(s) of energy isolating means).

Sequence of Lockout or Tagout System Procedure

1. Notify all affected employees that a lockout or tagout system is going to be utilized and the reason therefore. The authorized employee shall know the type and magnitude of energy that the machine or equipment utilizes and shall understand the hazards thereof.
2. If the machine or equipment is operating, shut it down by the normal stopping procedure (depress stop button, open toggle switch, etc.).
3. Operate the switch, valve, or other energy isolating device(s) so that the equipment is isolated from its energy source(s). Stored energy (such as that in springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam or water pressure, etc.) must be dissipated or restrained by methods such as repositioning, blocking, bleeding down, etc. (Type(s) of stored energy methods to dissipate or restrain).
4. Lockout and/or tagout the energy isolating devices with assigned individual lock(s) or tag(s) (Method(s) selected, i.e., locks, tags, additional safety measures, etc.)
5. After ensuring that no personnel are exposed, and as a check on having disconnected the energy sources, operate the push button or other normal operating controls to make certain the equipment will not operate (Type(s) of equipment checked to ensure disconnections).

CAUTION ***Return operating control(s) to neutral or off position after the test.***

6. The equipment is now locked or tagged out.

Restoring Machines or Equipment to Normal Production Operations

1. After the servicing and/or maintenance are complete and equipment is ready for normal production operations, check the area around the machines or equipment to ensure that no one is exposed.
2. After all tools have been removed from the machine or equipment, guards have been reinstalled and employees are in the clear, remove all lockout or tagout devices. Operate the energy isolating devices to restore energy to the machine or equipment.

Procedure Involving More Than One Person

In the preceding steps, if more than one individual is required to lockout or tagout equipment, each shall place his/her own personal lockout device on the energy isolating devices(s). When an energy isolating device cannot accept multiple locks or tags, a multiple lockout or tagout device (HASP) may be used. If lockout is used, a single lock may be used to lockout the machine or equipment with the key being placed in a lockout box or cabinet which allows the use of multiple locks to secure it. Each employee will then use his/her own lock to secure the box or cabinet. As each person no longer needs to maintain his/her lockout protection, that person will remove his/her lock from the box or cabinet (Name(s)/Job title(s) of employees authorized for group lockout or tagout).

Basic Rules for Using Lockout or Tagout System Procedure

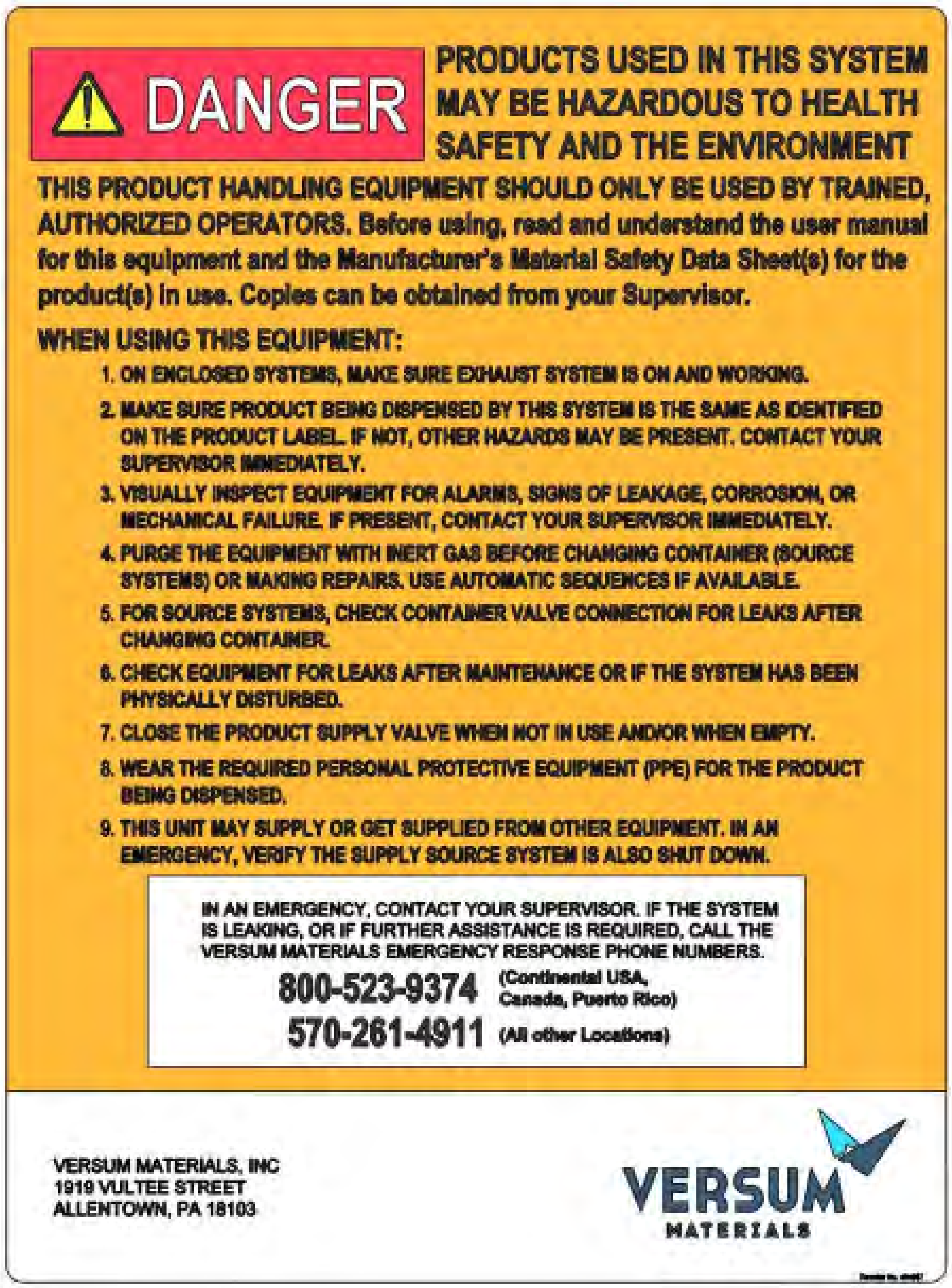
All equipment shall be locked or tagged out to protect against accidental or inadvertent operating when such operation could cause injury to personnel. Do not attempt to operate any switch, valve or other energy isolating device where it is locked or tagged.

Entry No.	Description
1.	Name of Company
2.	Type(s) and Magnitude(s) of energy and hazards
3.	Name(s)/Job title(s) of employees authorized to lockout or tagout
4.	Name(s)/Job title(s) of affected employees and how to notify
5.	Type(s) and Location of energy isolating means
6.	Type(s) of stored energy
7.	Method(s) selected, i.e. locks, tags, additional safety measure, etc.
8.	Type(s) of equipment checked to ensure disconnections
9.	Name(s)/Job title(s) of employees authorized for group lockout or tagout

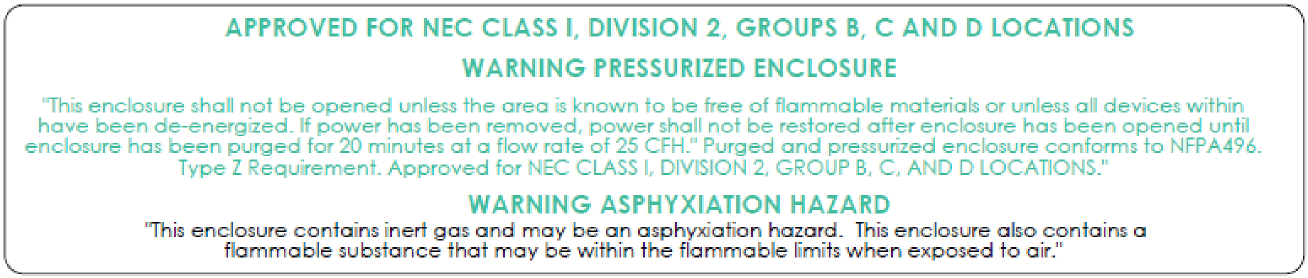
1910.147 29 CFR Ch.XVII (7-1-90)

1.12 Safety Signs and Labels

The following sign is located on the exterior door of the GASGUARD® cabinet.



The following sign is located on the GASGUARD® controller. This label is required if the GASGUARD® Source System is located in a Class I, Division II rated area (United States) or in a Group 2, Category 3 ATEX rated area (Europe). Acetylene systems will have the same label as shown below, but they will be approved for NEC Class I, Division 2, Groups A, B, C, and D Locations.


APPROVED FOR NEC CLASS I, DIVISION 2, GROUPS B, C AND D LOCATIONS

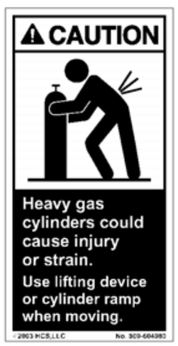
WARNING PRESSURIZED ENCLOSURE

"This enclosure shall not be opened unless the area is known to be free of flammable materials or unless all devices within have been de-energized. If power has been removed, power shall not be restored after enclosure has been opened until enclosure has been purged for 20 minutes at a flow rate of 25 CFH." Purged and pressurized enclosure conforms to NFPA496. Type Z Requirement. Approved for NEC CLASS I, DIVISION 2, GROUP B, C, AND D LOCATIONS."

WARNING ASPHYXIATION HAZARD

"This enclosure contains inert gas and may be an asphyxiation hazard. This enclosure also contains a flammable substance that may be within the flammable limits when exposed to air."

The following label appears inside cabinets containing cylinders. It is located on the inside door, approximately at eye level. It is also located on the cylinder strap on both cabinets and racks.



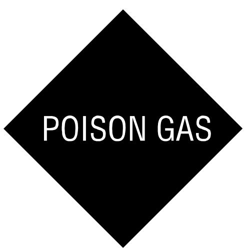
The following label appears inside doors of cabinets.

The following label appears on cabinets. It is located on the back of the cabinet, approximately 12” (305 mm) from the top.

The following eleven labels are specific to the gases being used. They are located on the door of the GASGUARD® cabinet. They are identical to the labels on the process gas cylinder in the GASGUARD® cabinet to provide verification that the correct process gas is being installed and used.

> ***NOTE: The signs shown below are United States DOT classifications. They are not to be used to classify gas hazards. Refer to the appropriate MSDS provided with the system documentation.***

The following label would be used with the gases listed below it:

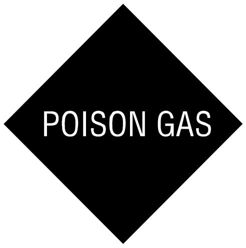


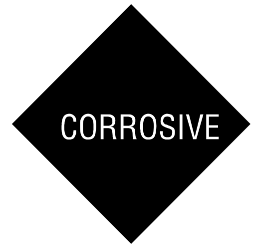
THIS EQUIPMENT IS DESIGNED FOR USE WITH:

Boron trifluoride	**Phosphorous pentafluoride**
Chlorine	**Sulfur dioxide**
Carbon tetrachloride	**Sulfur tetrafluoride**
Nitrogen dioxide	**Tungsten hexafluoride**
Nitric oxide	

The following label would be used with the gases listed below it:

THIS EQUIPMENT IS DESIGNED FOR USE WITH:





Boron trichloride

Hydrogen bromide

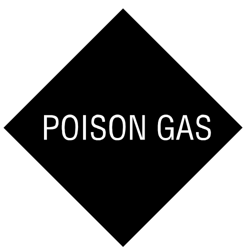
Hydrogen chloride

Hydrogen fluoride

Silicon tetrafluoride

The following label would be used with the gases listed below it:

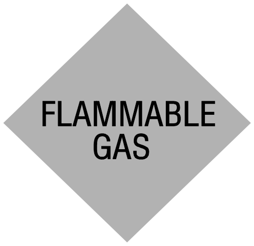
THIS EQUIPMENT IS DESIGNED FOR USE WITH:



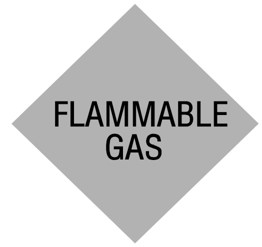
Fluorine

Fluorine mixtures

The following label would be used with the gases listed below it:



THIS EQUIPMENT IS DESIGNED FOR USE WITH:



Acetylene

Butane

Disilane

Deuterium

Ethane

Ethanol mixtures

Ethylene

Halocarbon 32

Halocarbon 41

Hydrogen

Hydrogen mixtures

Isobutane

Isobutylene

Methane

Methyl chloride

Methyl silane

Propane

Silane

Silane mixtures

The following label would be used with the gases listed below it:

THIS EQUIPMENT IS DESIGNED FOR USE WITH:

Arsine mixtures

Carbon monoxide

Diborane mixtures

Dichlorosilane

Diethyl telluride

Germane

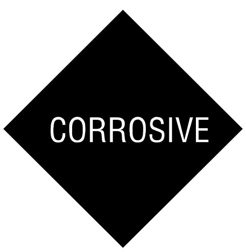
Hydrogen selenide

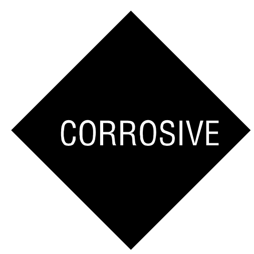
Hydrogen sulfide

Phosphine mixtures

The following label would be used with the gases listed below it:

THIS EQUIPMENT IS DESIGNED FOR USE WITH:





Silicon tetrachloride

The following label would be used with the gases listed below it:

Chlorine trifluoride

The following label would be used with the gases listed below it:

THIS EQUIPMENT IS DESIGNED FOR USE WITH:

Ammonia	**Halocarbon 125**
Argon	**Halocarbon 128**
Carbon dioxide	**Halocarbon C141B**
Halocarbon 11	**Halocarbon C318**
Halocarbon 12	**Helium**
Halocarbon 13	**Krypton**
Halocarbon 13B1	**Neon**
Halocarbon 14	**Nitrogen**
Halocarbon 21	**Nitrous oxide**
Halocarbon 22	**Perfluoropropane**
Halocarbon 23	**Sulfur hexafluoride**
Halocarbon 113	**Teteafluoroethane**
Halocarbon 115	**Xenon**
Halocarbon 116	

The following label would be used with the gases listed below it:

THIS EQUIPMENT IS DESIGNED FOR USE WITH:

NON FLAMMABLE GAS

OXIDIZER

Oxygen	**Nitrogen trifluoride**
Oxygen mixtures	**Nitrogen trifluoride mixtures**

1.13 Equipment Safety Features

Dependent on the design of your specific system, the following safety features may be incorporated into the GASGUARD® system:

- Warning labels and gas identification labels are placed on the outside door of each cabinet (see Chapter 1 Section 12).
- The gas cabinet has a self-closing cabinet door with locking mechanism.
- A sprinkler head is installed in HPM gas cabinets, unless water reactivity is a superseding hazard for the specific gas.
- Cabinet doors have self-closing 1/4" thick wire reinforced safety glass windows.
- Fault and Shutdown alarms notify the operator through the alarm horn, light and alarm label on the controller of a problem with the system. In addition, the Shutdown alarms close all pneumatic valves and abort the controller program.
- Excess flow sensors are installed, when required, to shut off the flow of gas in the event of downstream equipment failure.
- An exhaust monitor verifies ventilation through the cabinet.
- The system may utilize a positive shutoff regulator. This type of regulator is designed to close tightly if the pressure builds above the setpoint because the diaphragm is mechanically connected to the valve poppet. Be aware that the regulator may leak if the regulator seat is damaged, corroded or soiled.
- A flow restricting orifice may be installed in the cylinder valve. This flow restricting orifice significantly reduces the flow of gas in the event of a failure in the downstream equipment.
- An ultraviolet infrared (UV/IR) detector or temperature switch installed for pyrophoric gas systems.
- A UV/IR detector and delayed start feature is provided on source systems for SiH_4 and certain SiH_4 mixes.
- A temperature switch is recommended for flammable and strong oxidizer gas systems.
- Pressure relief valves may be incorporated into the design to prevent overpressurization of the process line and downstream equipment and to protect the inert purge system.
- Manual operation access is denied during the presence of a shutdown alarm.
- An "EMERGENCY STOP" pushbutton is located on the controller panel.

- A password security system prevents unauthorized personnel to operate or modify the GASGUARD® controller menu.
- Customer I/O capability to accept a remote shutdown or gas detection signal.

1.14 Safety Literature for Handling and Use of Gas Cylinders

The following safety literature ***must be read and understood.***

VERSUM MATERIALS, INC. Safetygram 10	Handling, Storage and Use of Compressed Gas Cylinders
VERSUM MATERIALS, INC. Safetygram 11	Emergency Action in Handling Leaking Compressed Gas Cylinders
VERSUM MATERIALS, INC. Safetygram 14	Don't Turn a Cylinder into a Rocket
VERSUM MATERIALS, INC. Safetygram 15	Cylinder Safety Devices
VERSUM MATERIALS, INC. Safetygram 23	Cylinder Valves

Material Safety Data Sheets for all gases used in system (Please contact your gas supplier to obtain the appropriate MSDS documents).

1.15 Safety Literature for Handling and Use of Instrument Nitrogen Supply

The safety literature listed below ***must be read and understood.***

VERSUM MATERIALS, INC. Safetygram 2	Gaseous Nitrogen
VERSUM MATERIALS, INC. Safetygram 17	Dangers of Oxygen Deficient Atmospheres

Nitrogen Material Safety Data Sheet (Included as Appendix B)

Chapter 2

Dimensions and Mounting

Note: The dimensions included in this section are intended for familiarization purposes. For system specific details, refer to the installation drawings supplied. An installation drawing (INS) will be provided upon request.

2.1 Outline Dimensions

For overall dimensions see the following Outline Dimension figures.

Section 2.1.1 contains the 1 Cylinder Source System figures
Section 2.1.2 contains the 2 Cylinder Source System figures
Section 2.1.3 contains the 3 Cylinder Source System figures
Section 2.1.4 contains the 1x1 Cylinder Source System figures
Section 2.1.5 contains the 1x2 Cylinder Source System figures

2.1.1 Outline Dimension Figures for 1 Cylinder Source Systems

2.1.1.1 - 1 Cylinder Enclosure

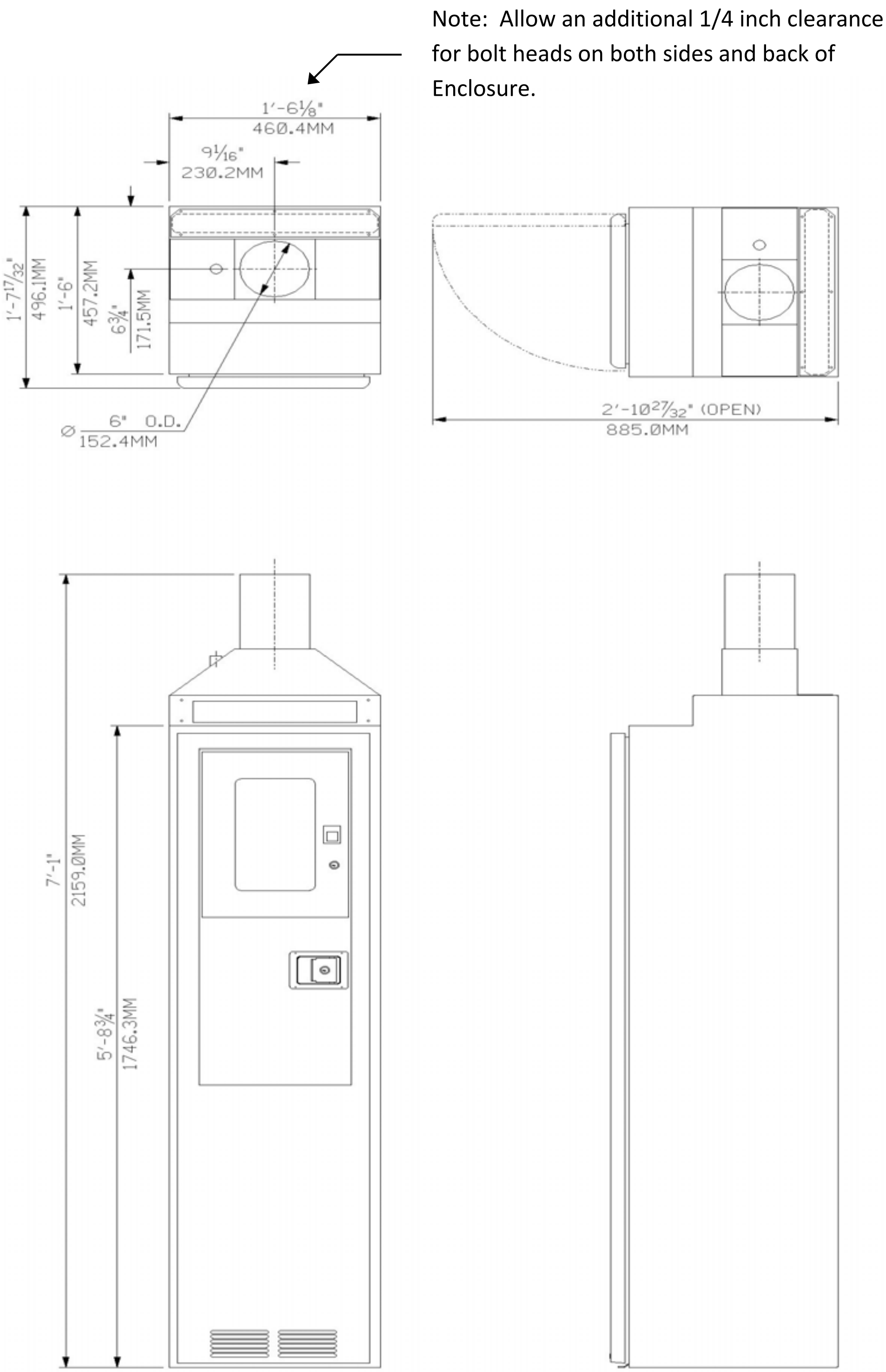
2.1.1.2 - 1 Cylinder Euro (XH-Extra High) Enclosure

2.1.1.3 - 1 Cylinder Rack

2.1.1.4 - 1 Cylinder Euro (XH-Extra High) Rack

2.1.1.5 - 1 Cylinder Wall Mount

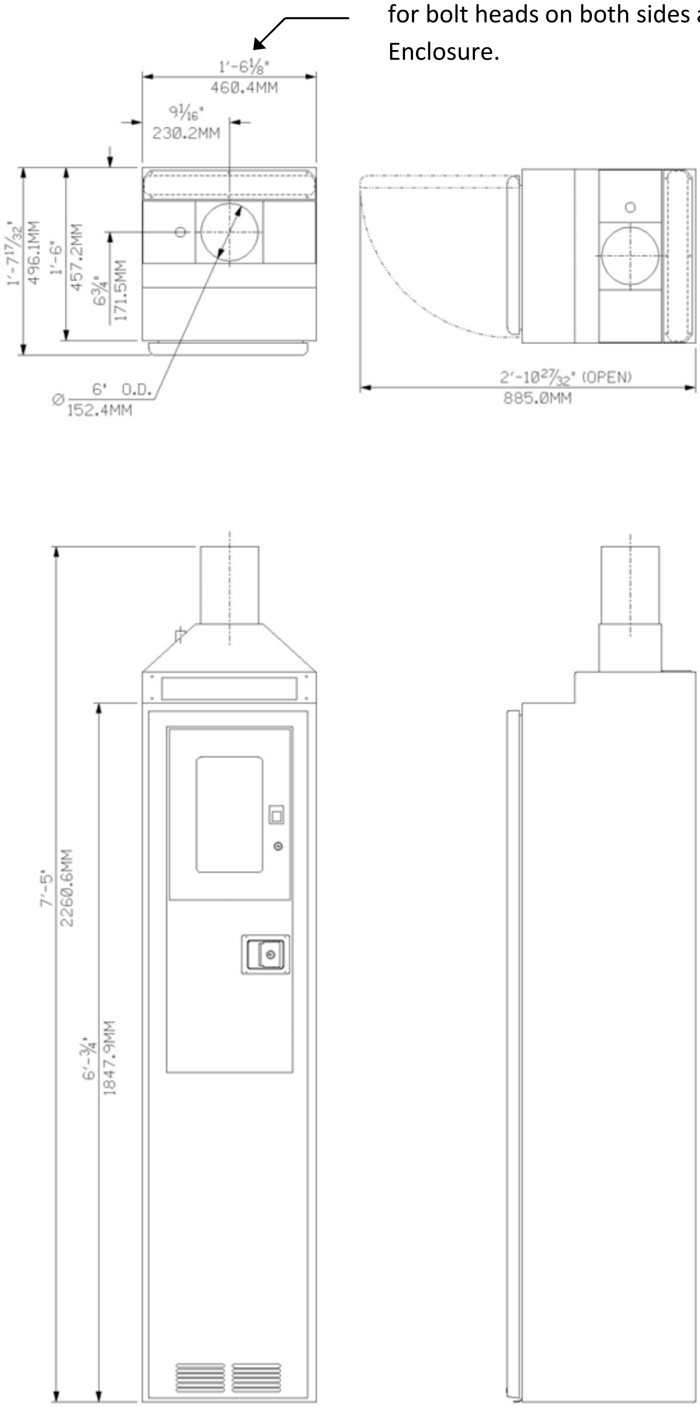
2.1.1.6 - 1 Cylinder Euro (XH-Extra High) Wall Mount



Approximate Weight = 350 pounds (158.76 Kilograms)

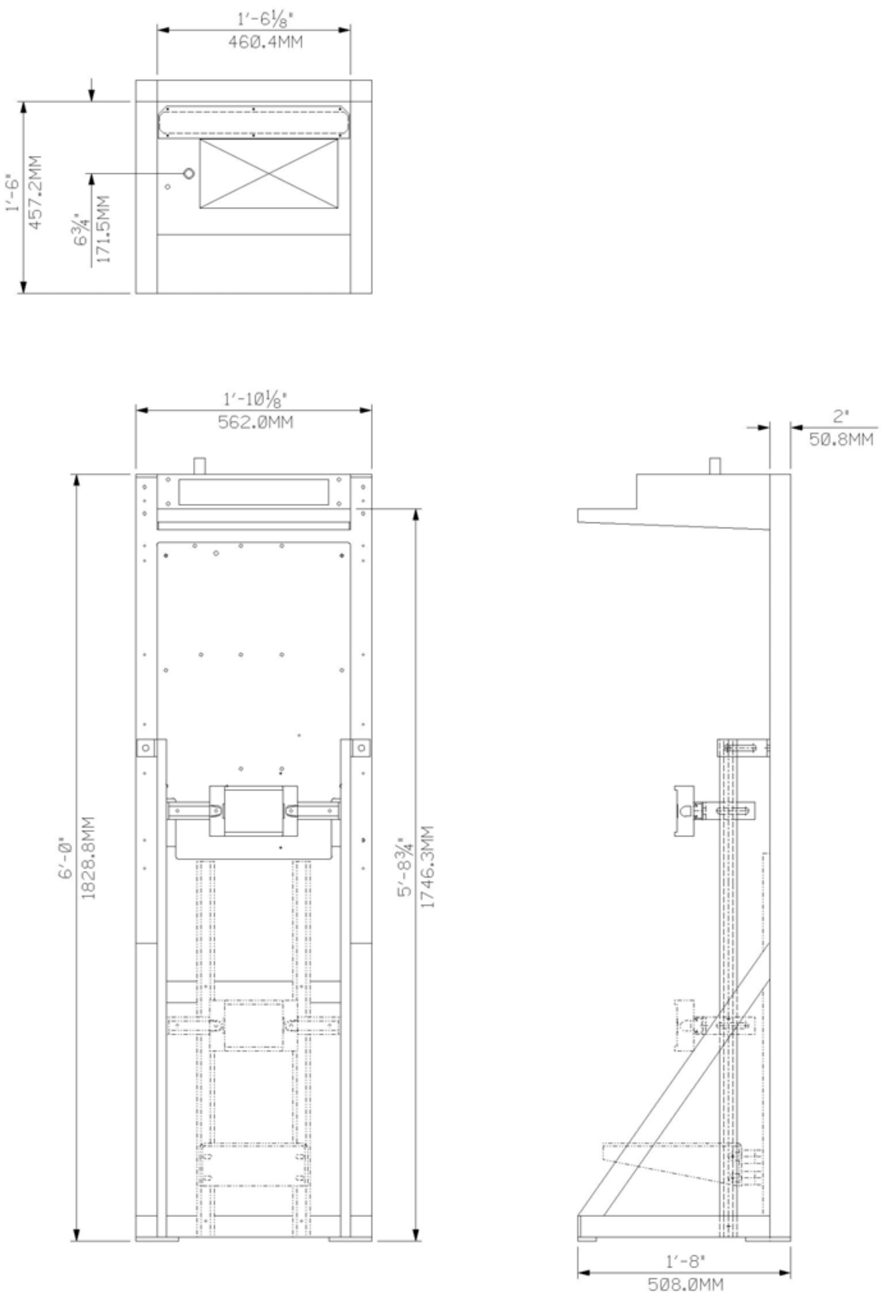
Figure 2.1.1.1: Outline Dimensions
1 Cylinder Enclosure

Note: Allow an additional 1/4 inch clearance for bolt heads on both sides and back of Enclosure.



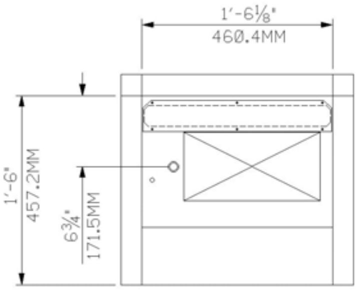
Approximate Weight = 350 pounds (158.76 Kilograms)

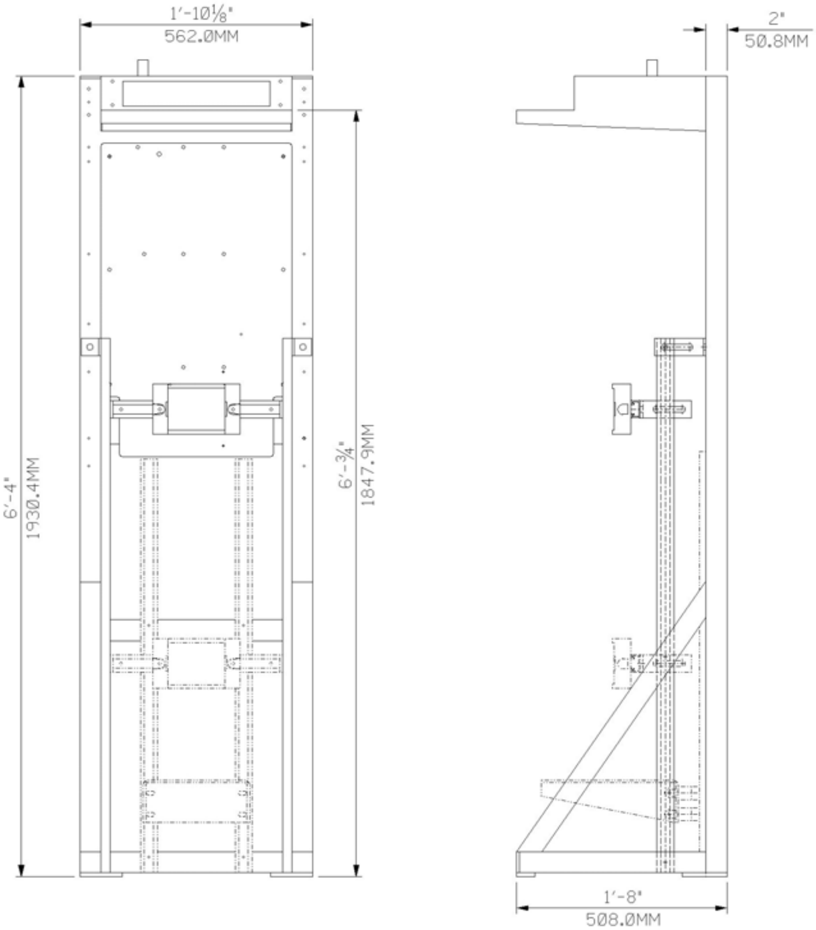
Figure 2.1.1.2: Outline Dimensions
1 Cylinder Euro (XH) Enclosure



Approximate Weight = 250 pounds (113.40 Kilograms)

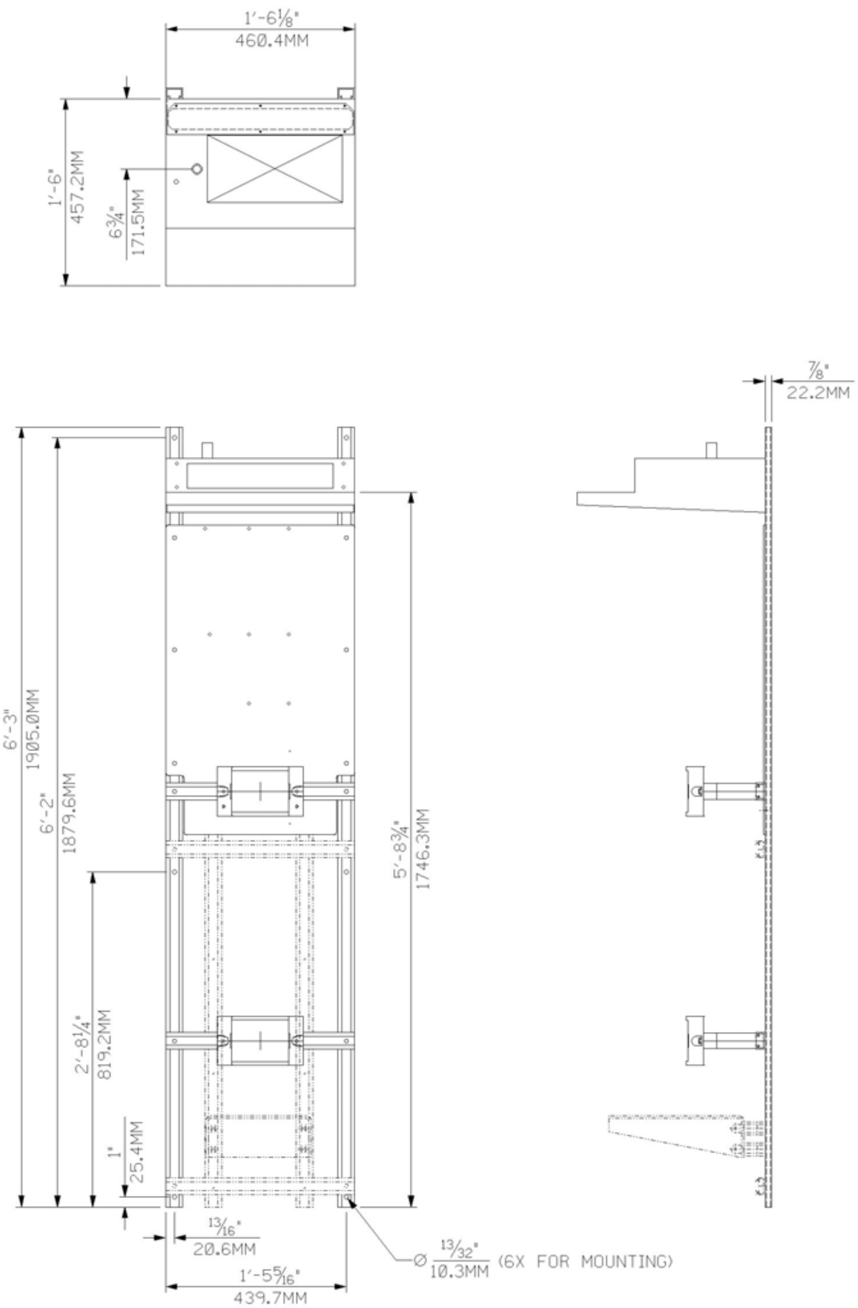
Figure 2.1.1.3: Outline Dimensions
1 Cylinder Rack





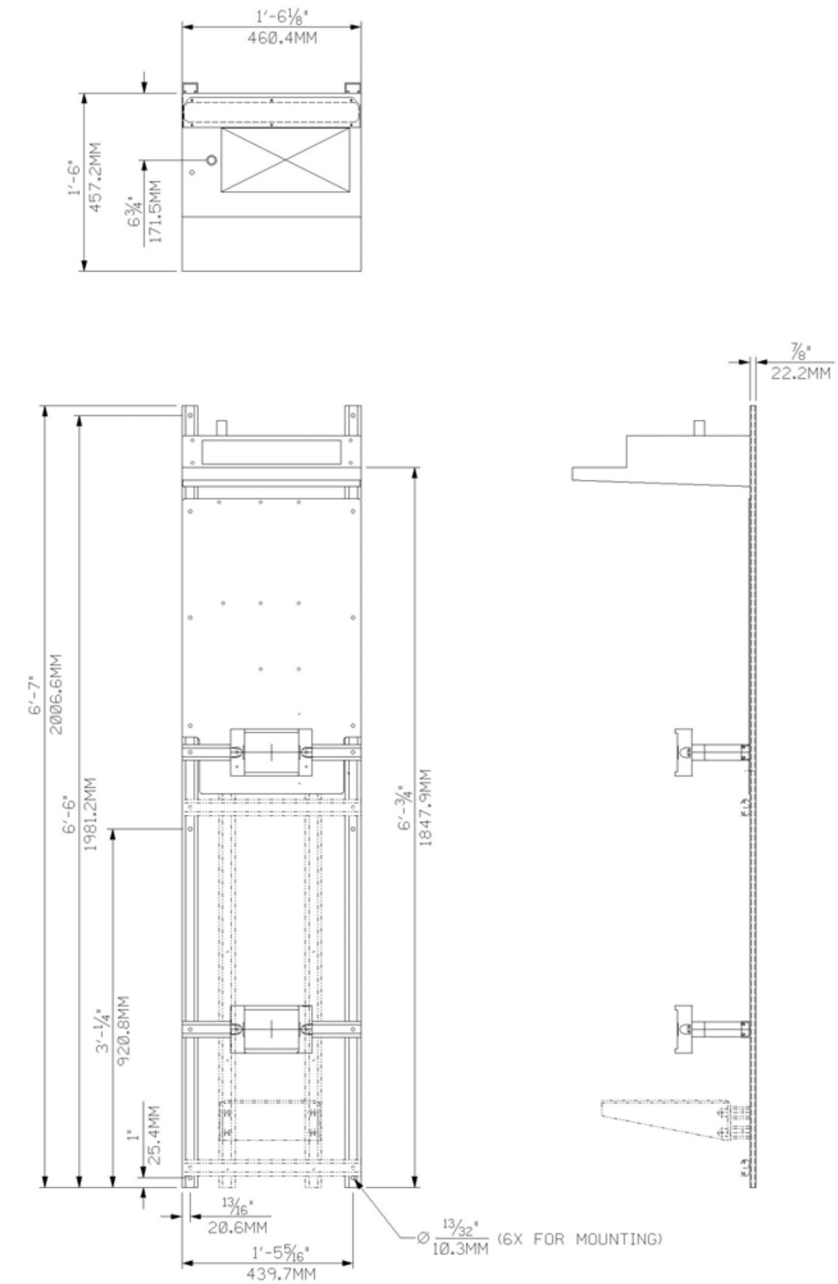
Approximate Weight = 250 pounds (113.40 Kilograms)

Figure 2.1.1.4: Outline Dimensions
1 Cylinder Euro (XH) Rack



Approximate Weight = 185 pounds (83.92 Kilograms)

Figure 2.1.1.5: Outline Dimensions
1 Cylinder Wall Mount



Approximate Weight = 185 pounds (83.92 Kilograms)

Figure 2.1.1.6: Outline Dimensions
1 Cylinder Euro (XH) Wall Mount

2.1.2 Outline Dimension Figures for 2 Cylinder Source Systems

2.1.2.1 - 2 Cylinder Enclosure

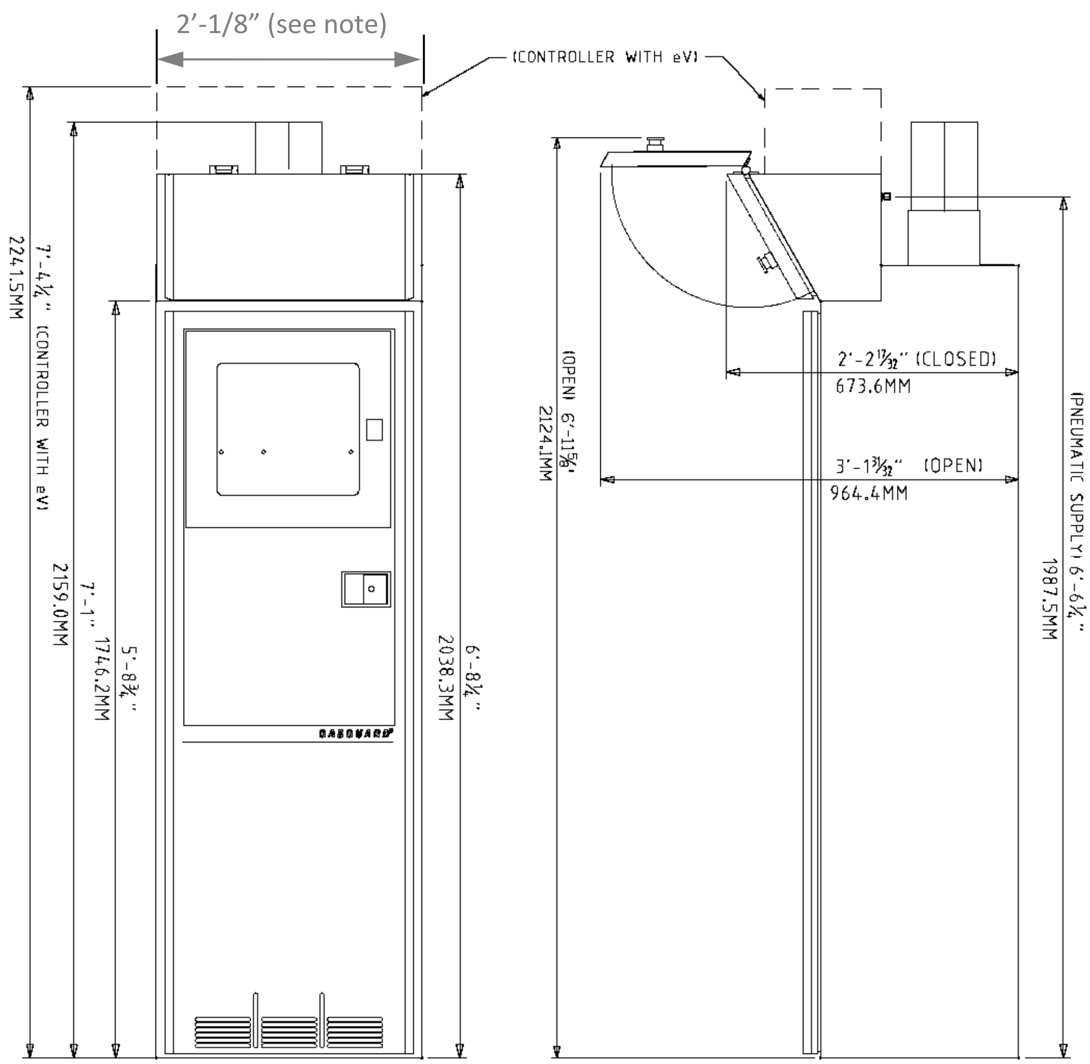
2.1.2.2 - 2 Cylinder Euro (XH-Extra High) Enclosure

2.1.2.3 - 2 Cylinder Rack

2.1.2.4 - 2 Cylinder Euro (XH-Extra High) Rack

2.1.2.5 - 2 Cylinder Wall Mount

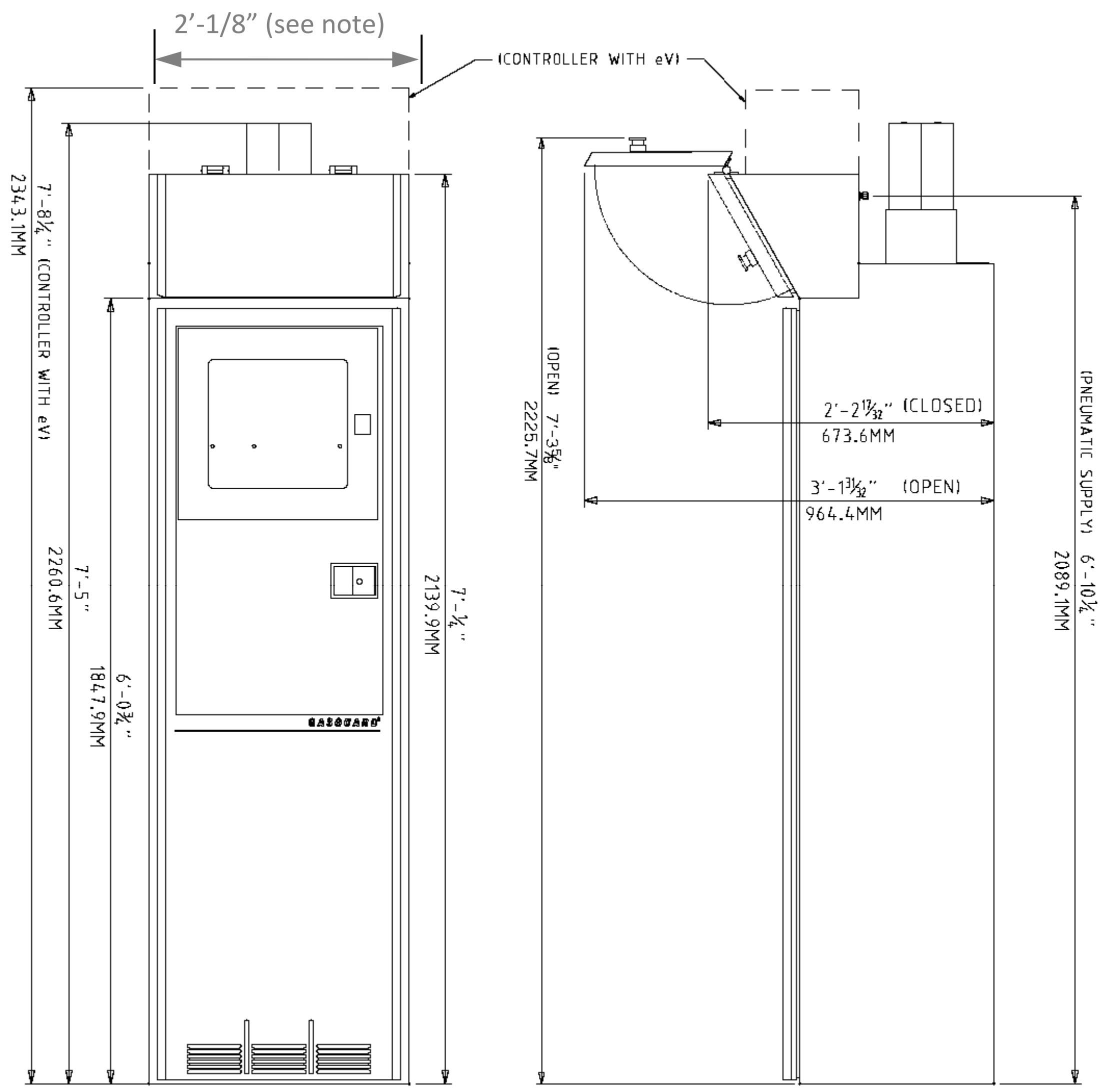
2.1.2.6 - 2 Cylinder Euro (XH-Extra High) Wall Mount



Approximate Weight = 500 pounds (226.24 Kilograms)

Figure 2.1.2.1: Outline Dimensions
2 Cylinder Enclosure

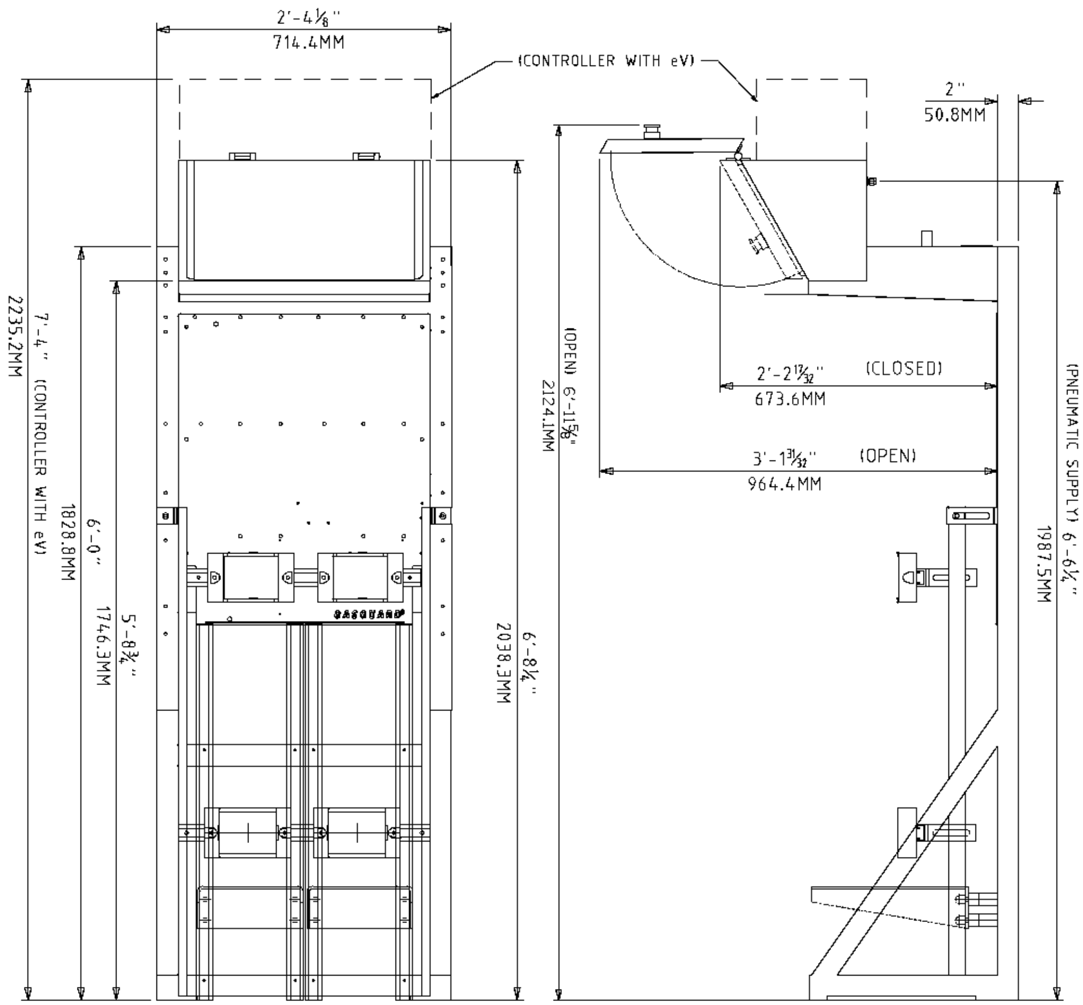
Note: Allow an additional ¼-inch clearance for bolt heads on both sides and back of cabinet.



Approximate Weight = 500 pounds (226.24 Kilograms)

Figure 2.1.2.2: Outline Dimensions
2 Cylinder Euro (XH) Enclosure

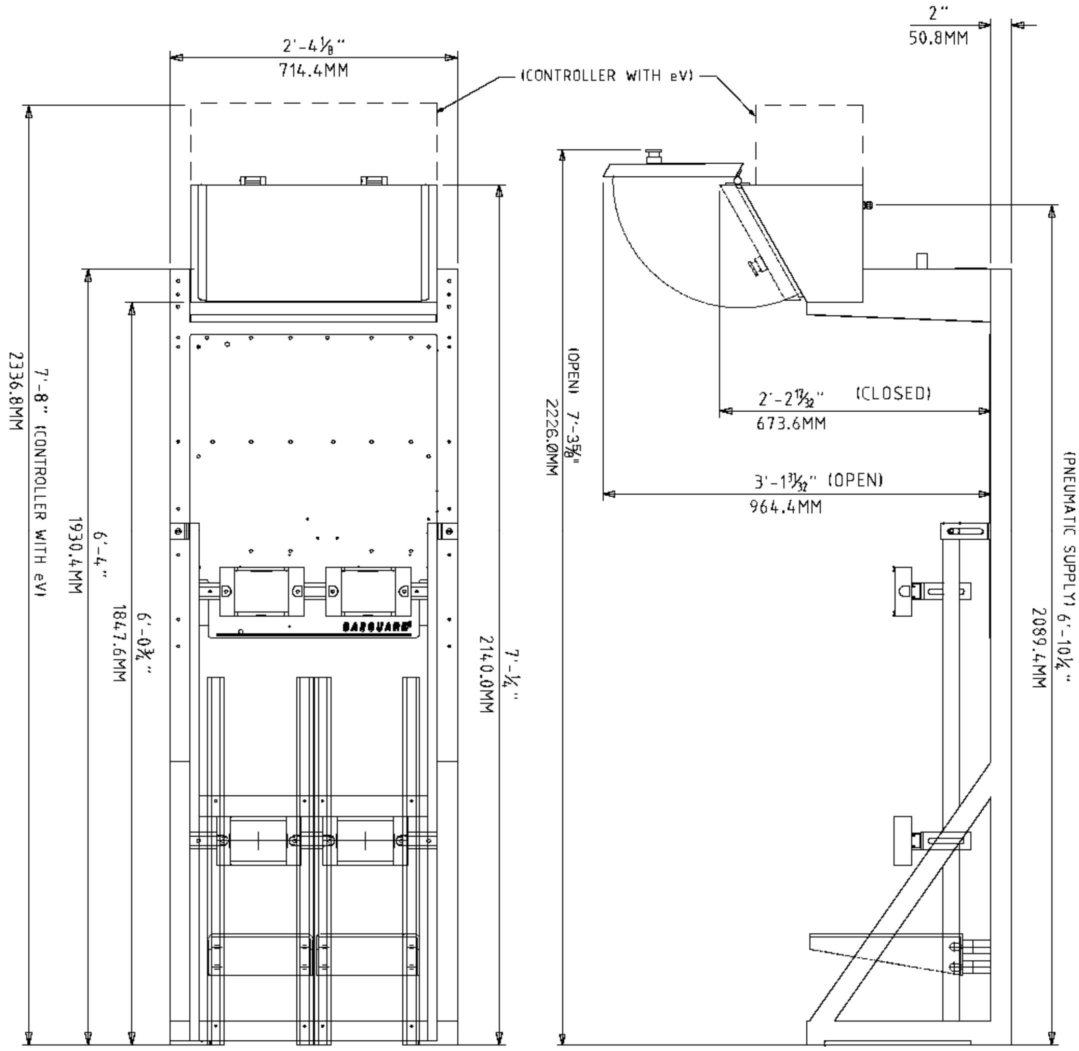
Note: Allow an additional ¼-inch clearance for bolt heads on both sides and back of cabinet.



Approximate Weight = 360 pounds (163.29 Kilograms)

Figure 2.1.2.3: Outline Dimensions
2 Cylinder Rack

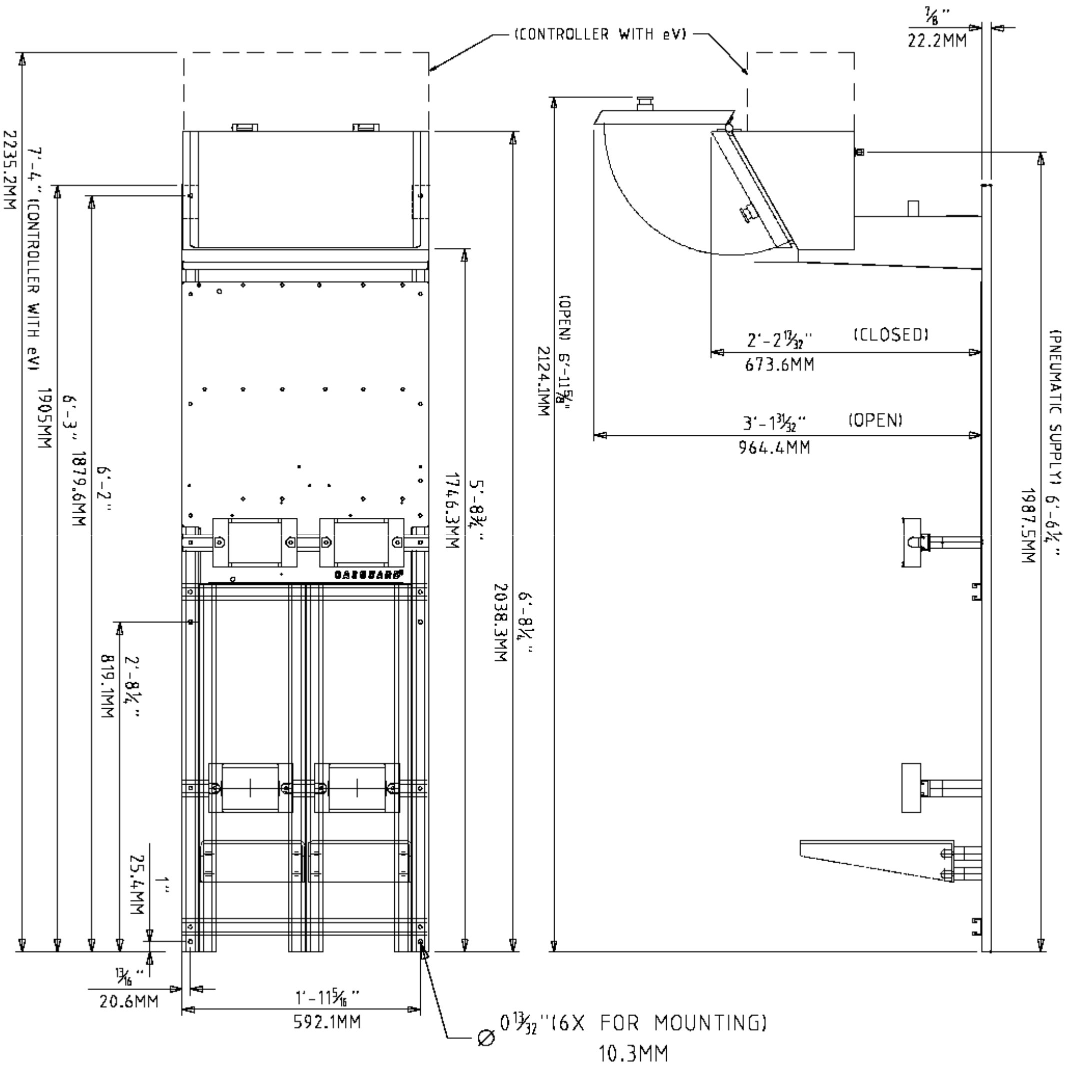
Note: Allow an additional 1/4 inch clearance for bolt heads on both sides and back of rack.



Approximate Weight = 360 pounds (163.29 Kilograms)

Figure 2.1.2.4: Outline Dimensions
2 Cylinder Euro (XH) Rack

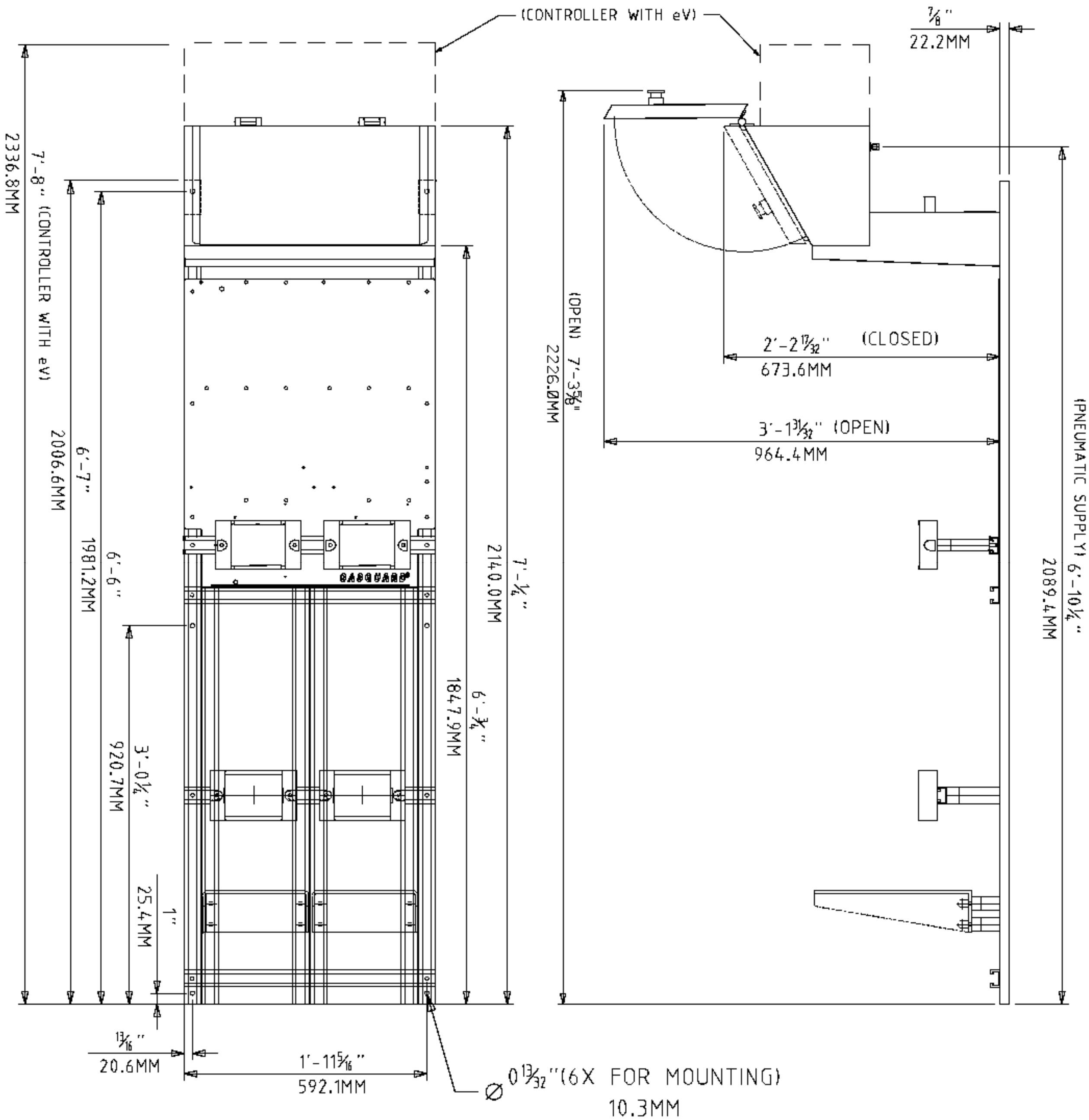
Note: Allow an additional 1/4 inch clearance for bolt heads on both sides and back of rack.



Approximate Weight = 275 pounds (124.73 Kilograms)

Figure 2.1.2.5: Outline Dimensions
2 Cylinder Wall Mount

Note: Allow an additional 1/4 inch clearance for bolt heads on both sides and back of wallmount.



Approximate Weight = 275 pounds (124.73 Kilograms)

Figure 2.1.2.6: Outline Dimensions
2 Cylinder Euro (XH) Wall Mount

Note: Allow an additional 1/4 inch clearance for bolt heads on both sides and back of wallmount.

2.1.3 Outline Dimension Figures for 3 Cylinder Source Systems

2.1.3.1 - 3 Cylinder Enclosure

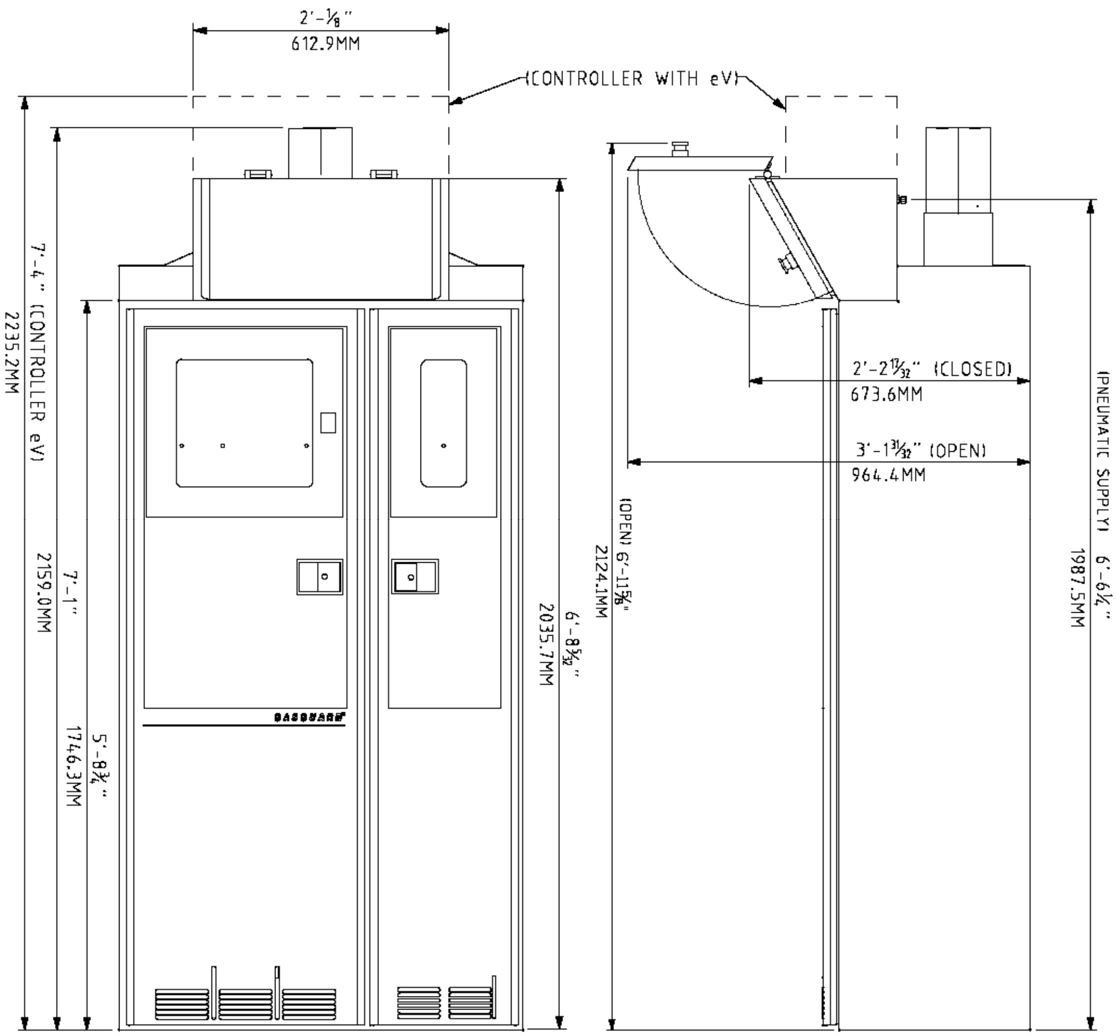
2.1.3.2 - 3 Cylinder Euro (XH-Extra High) Enclosure

2.1.3.3 - 3 Cylinder Rack

2.1.3.4 - 3 Cylinder Euro (XH-Extra High) Rack

2.1.3.5 - 3 Cylinder Wall Mount

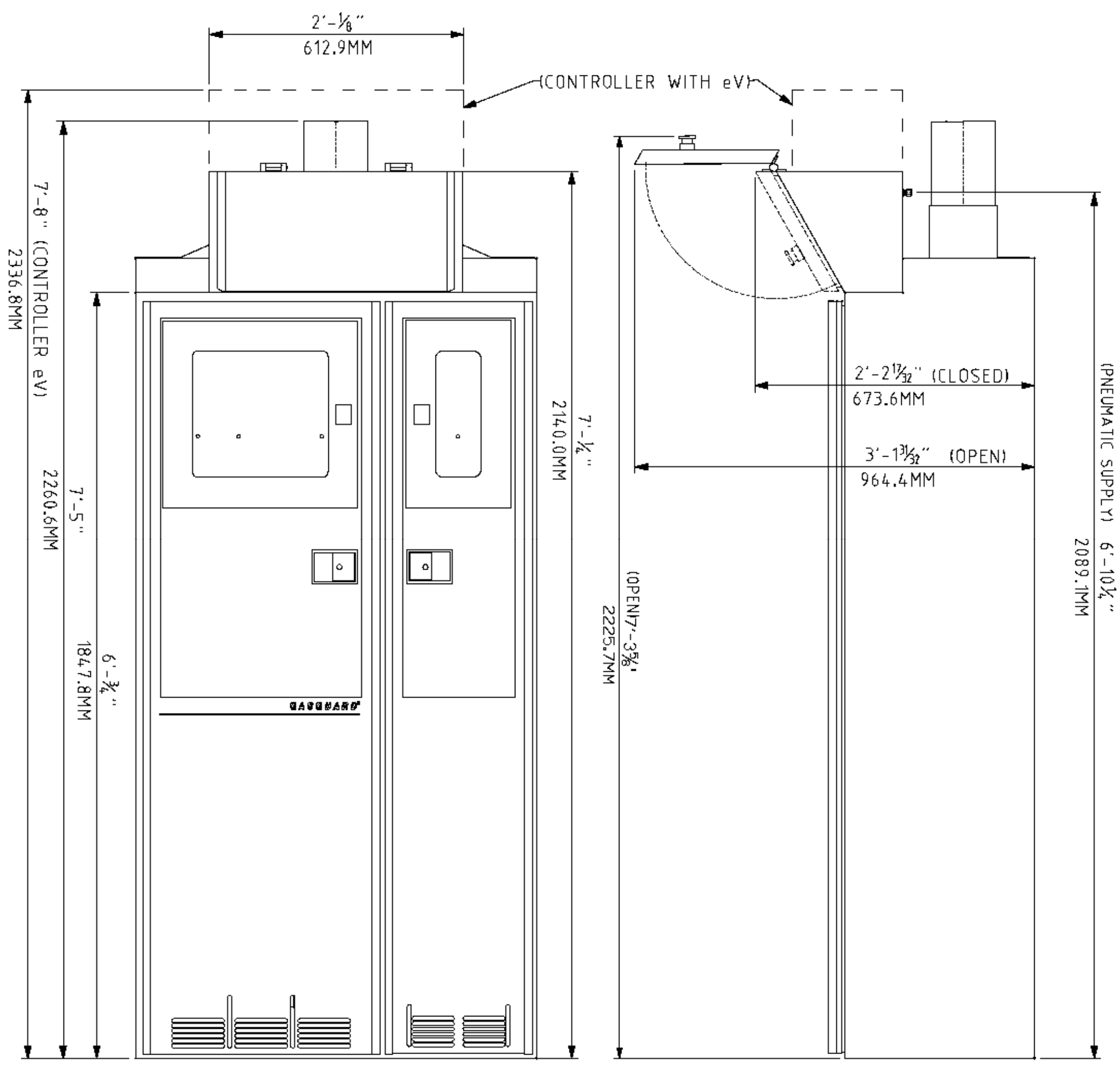
2.1.3.6 - 3 Cylinder Euro (XH-Extra High) Wall Mount



Approximate Weight = 600 pounds (271.49 Kilograms)

Figure 2.1.3.1: Outline Dimensions
3 Cylinder Enclosure

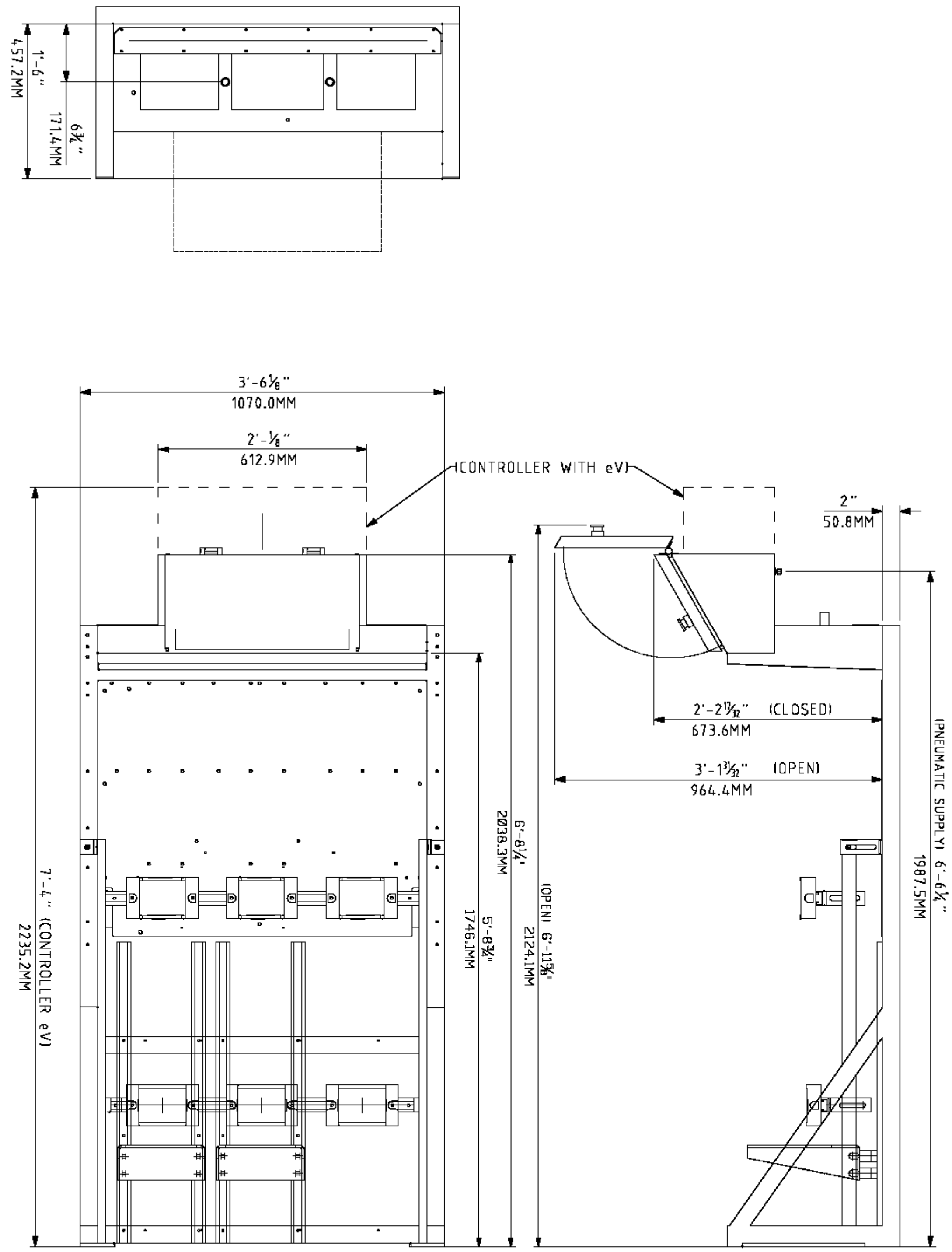
Note: Allow an additional 1/4 inch clearance for bolt heads on both sides and back of cabinet.



Approximate Weight = 600 pounds (271.49 Kilograms)

Figure 2.1.3.2: Outline Dimensions
3 Cylinder Euro (XH) Enclosure

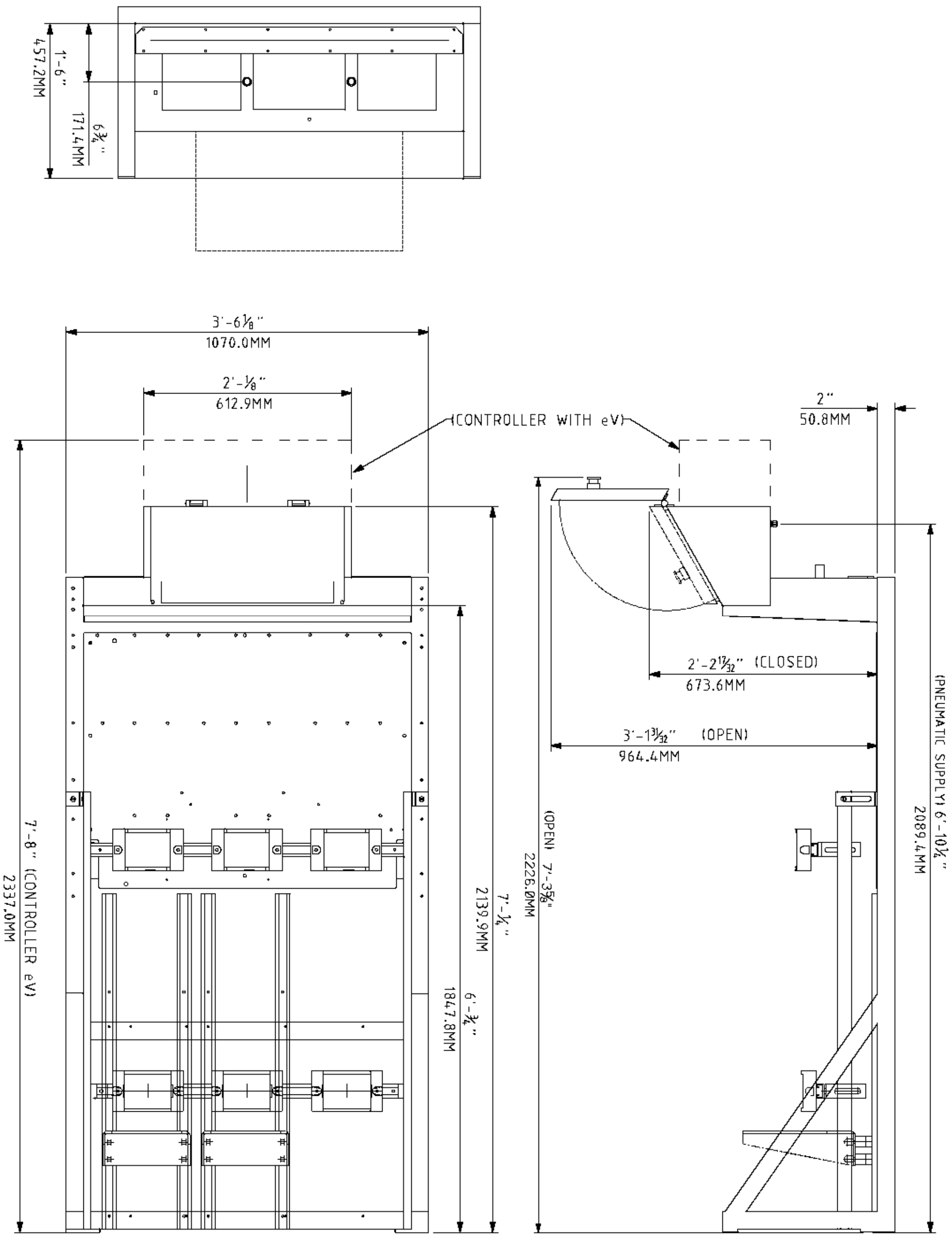
Note: Allow an additional 1/4 inch clearance for bolt heads on both sides and back of cabinet.



Approximate Weight = 425 pounds (192.77 Kilograms)

Figure 2.1.3.3: Outline Dimensions
3 Cylinder Rack

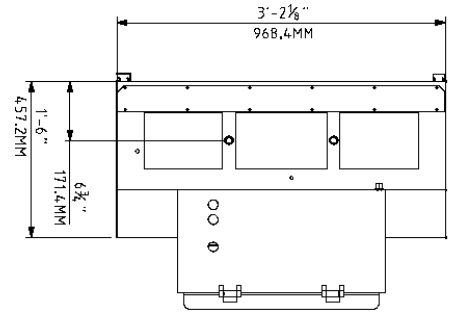
Note: Allow an additional 1/4 inch clearance for bolt heads on both sides and back of rack.

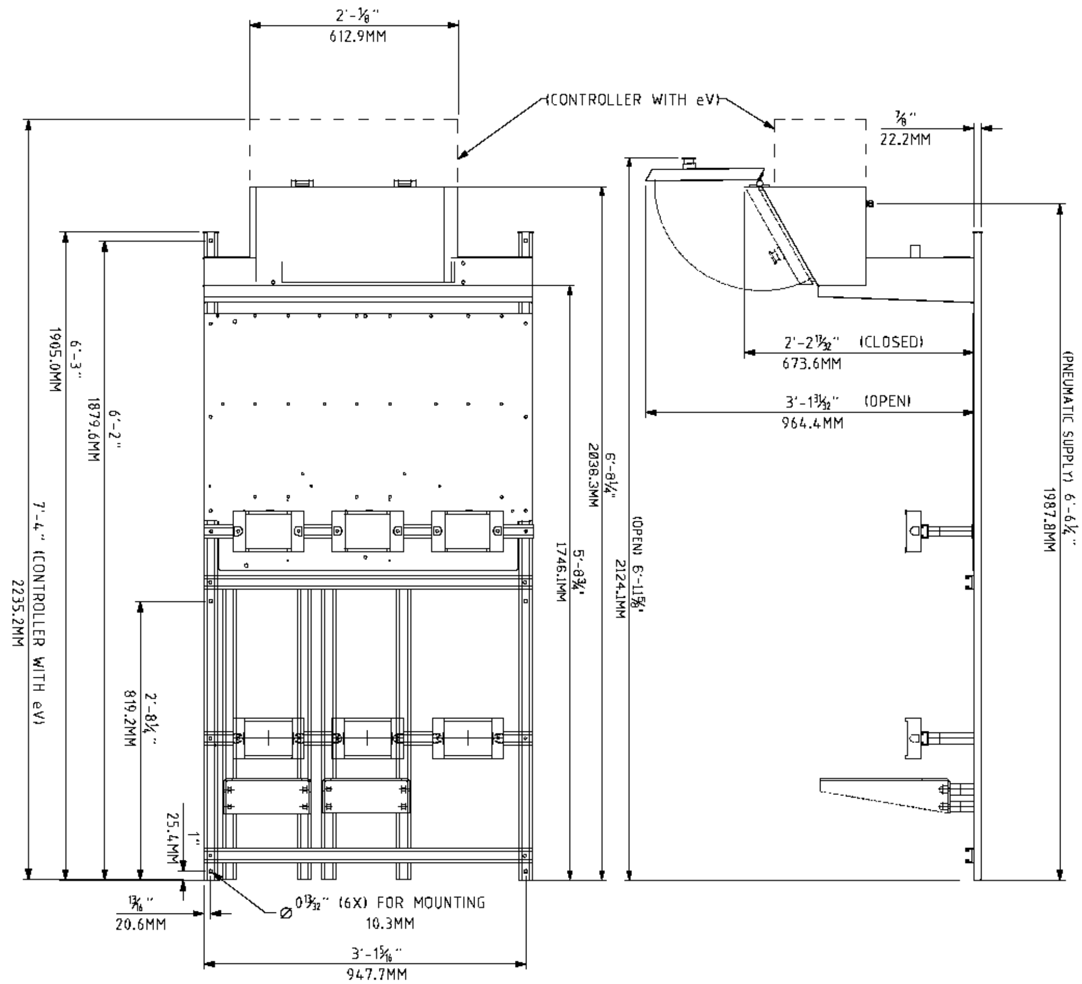


Approximate Weight = 425 pounds (192.77 Kilograms)

Figure 2.1.3.4: Outline Dimensions
3 Cylinder Euro (XH) Rack

Note: Allow an additional 1/4 inch clearance for bolt heads on both sides and back of rack.

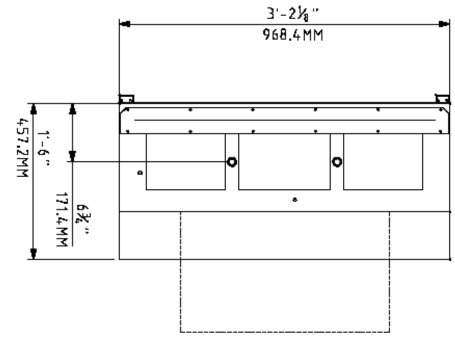


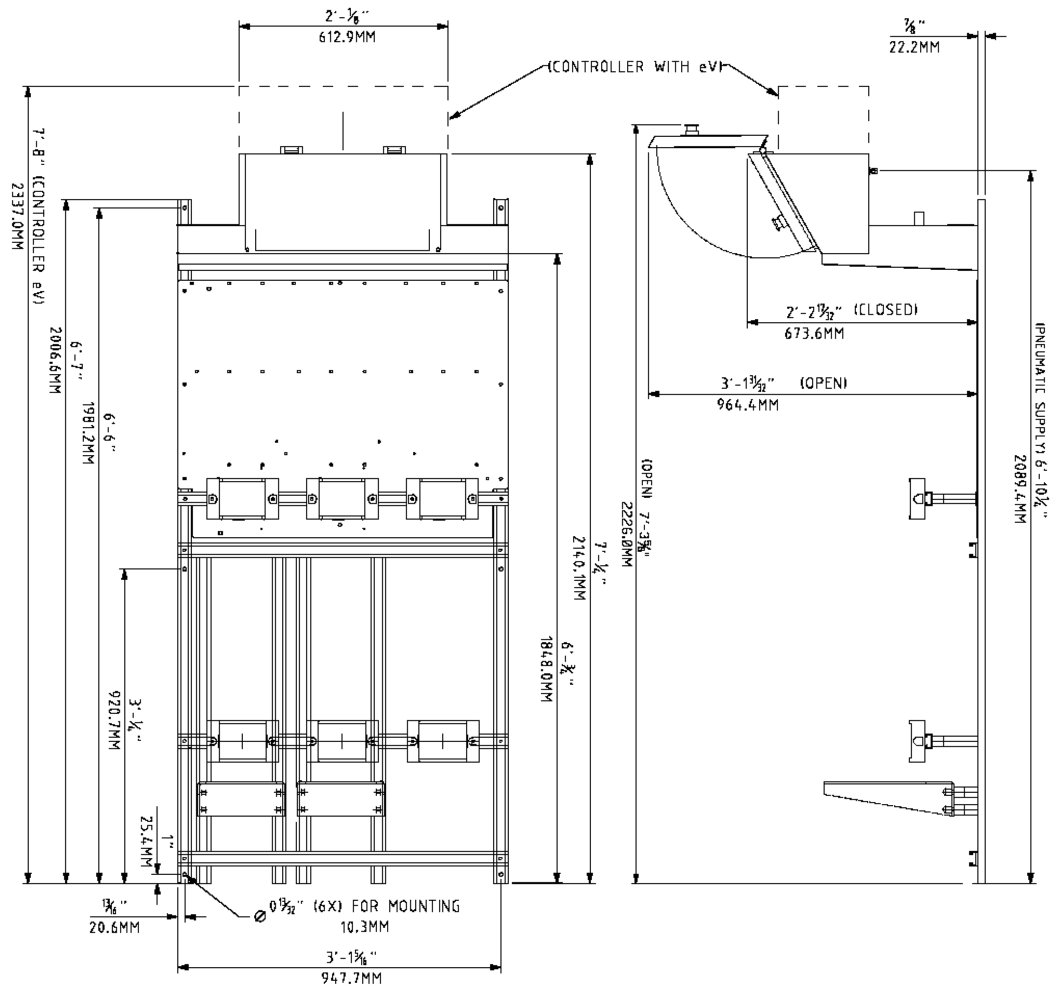


Approximate Weight = 300 pounds (136.07 Kilograms)

Figure 2.1.3.5: Outline Dimensions
3 Cylinder Wall Mount

Note: Allow an additional 1/4 inch clearance for bolt heads on both sides and back of wallmount.





Approximate Weight = 300 pounds (136.07 Kilograms)

Figure 2.1.3.6: Outline Dimensions
3 Cylinder Euro (XH) Wall Mount

Note: Allow an additional 1/4 inch clearance for bolt heads on both sides and back of wallmount.

2.1.4 Outline Dimension Figures for 1x1 Cylinder Source Systems

2.1.4.1 - 1x1 Cylinder Enclosure

2.1.4.2 - 1x1 Cylinder Euro (XH-Extra High) Enclosure

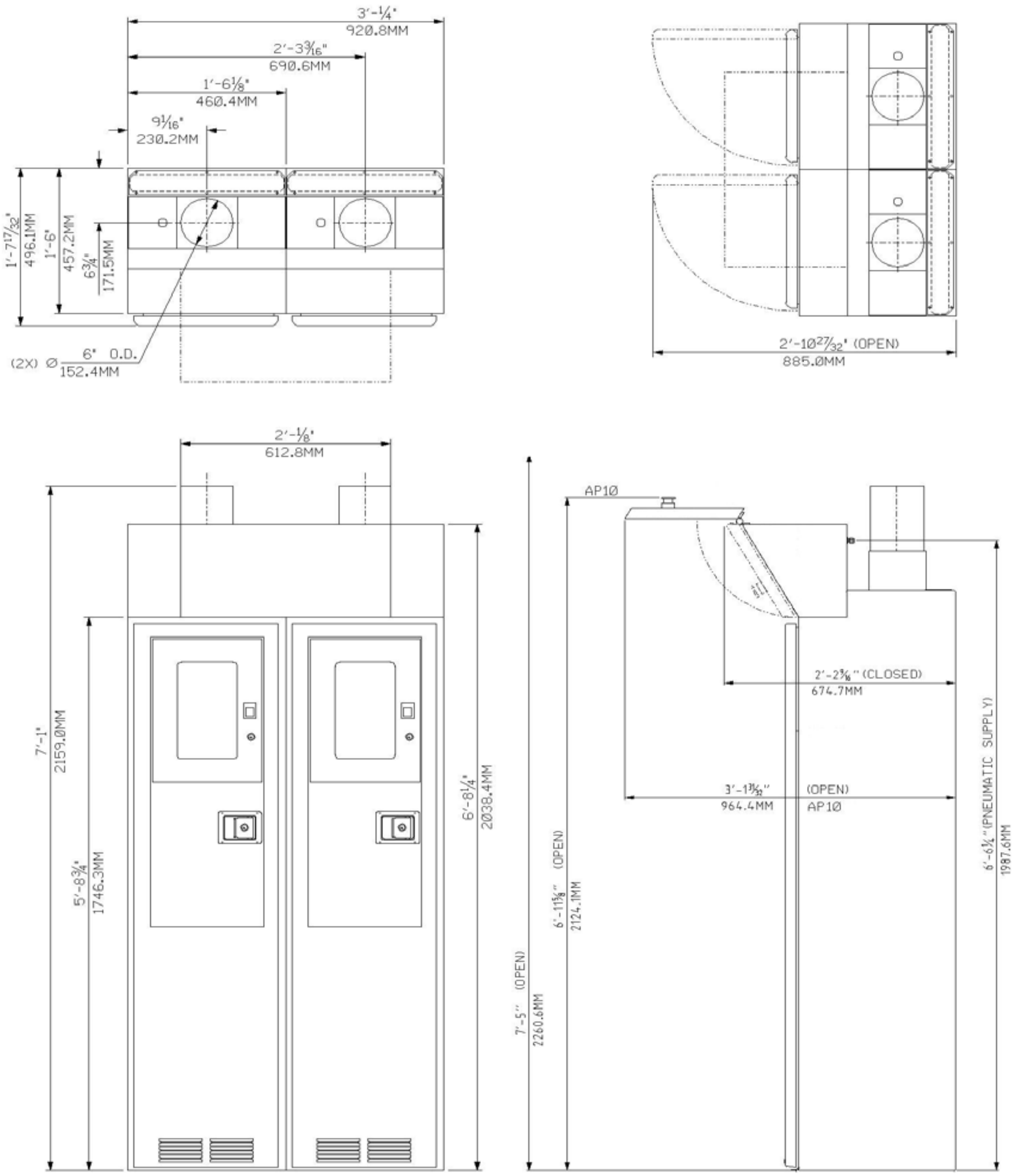
2.1.4.3 - 1x1 Cylinder Rack

2.1.4.4 - 1x1 Cylinder Euro (XH-Extra High) Rack

2.1.4.5 - 1x1 Cylinder Wall Mount

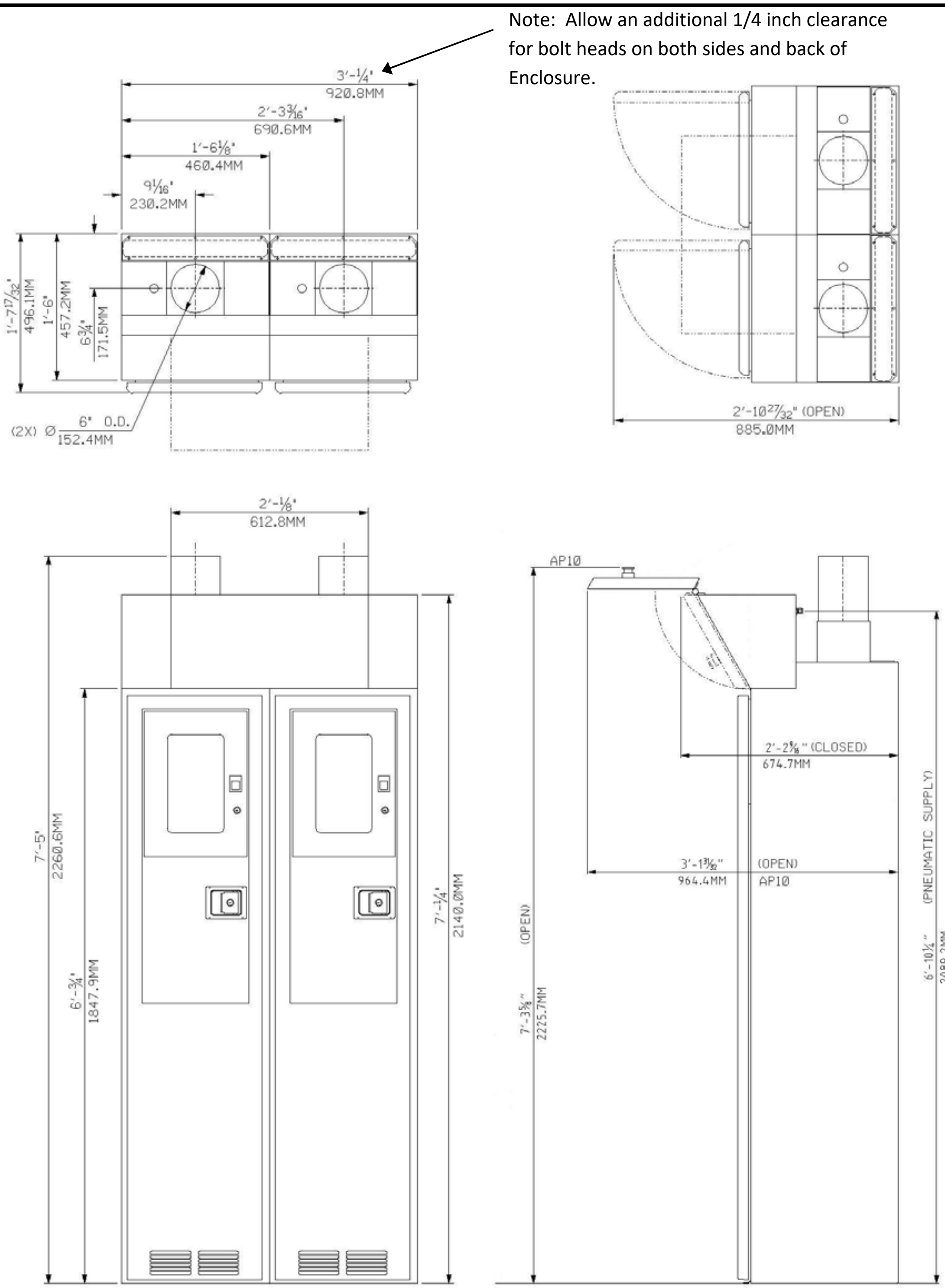
2.1.4.6 - 1x1 Cylinder Euro (XH-Extra High) Wall Mount

Note: Allow an additional 1/4 inch clearance for bolt heads on both sides and back of Enclosure.



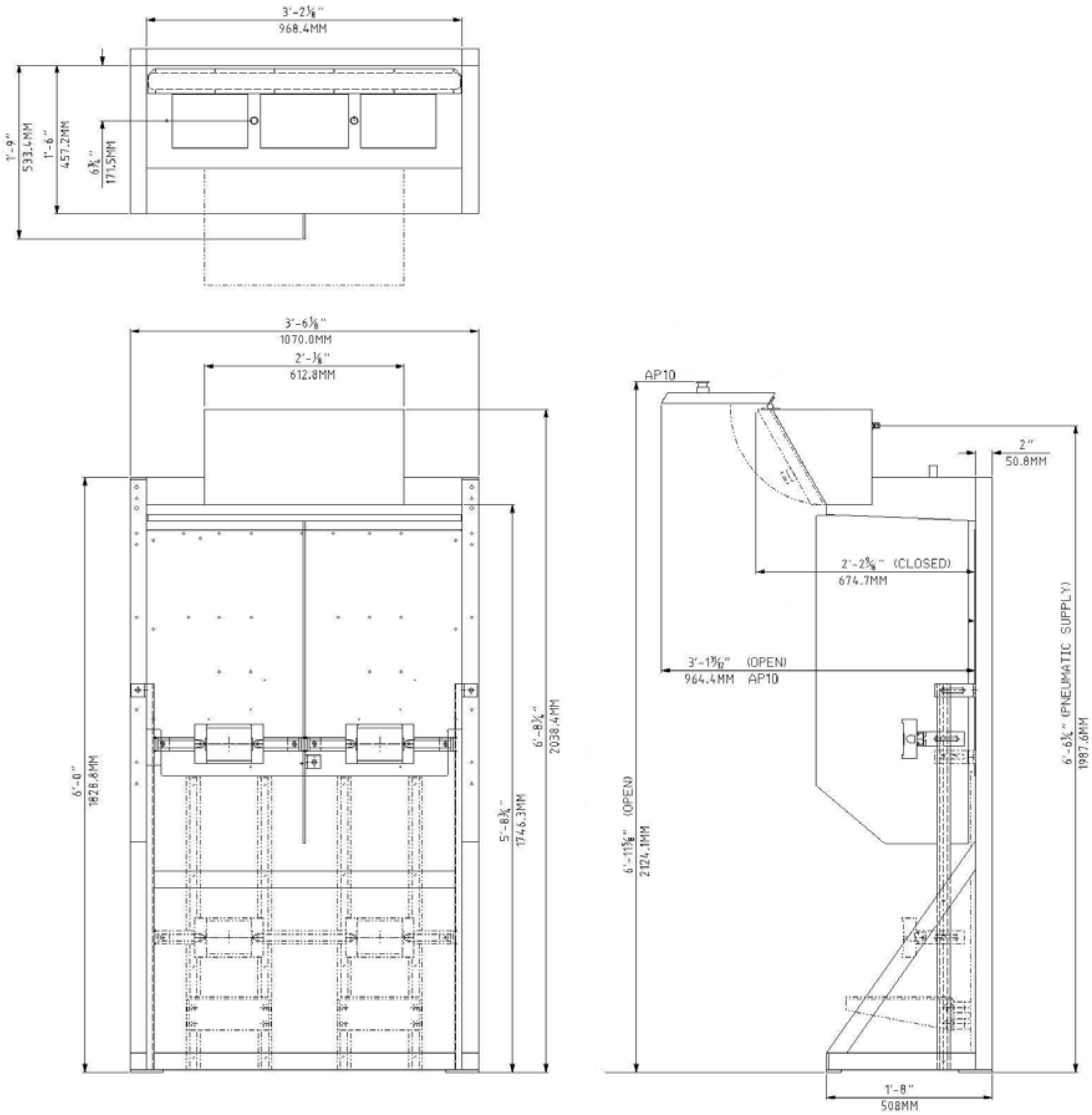
Approximate Weight = 600 pounds (271.49 Kilograms)

Figure 2.1.4.1: Outline Dimensions
1x1 Cylinder Enclosure



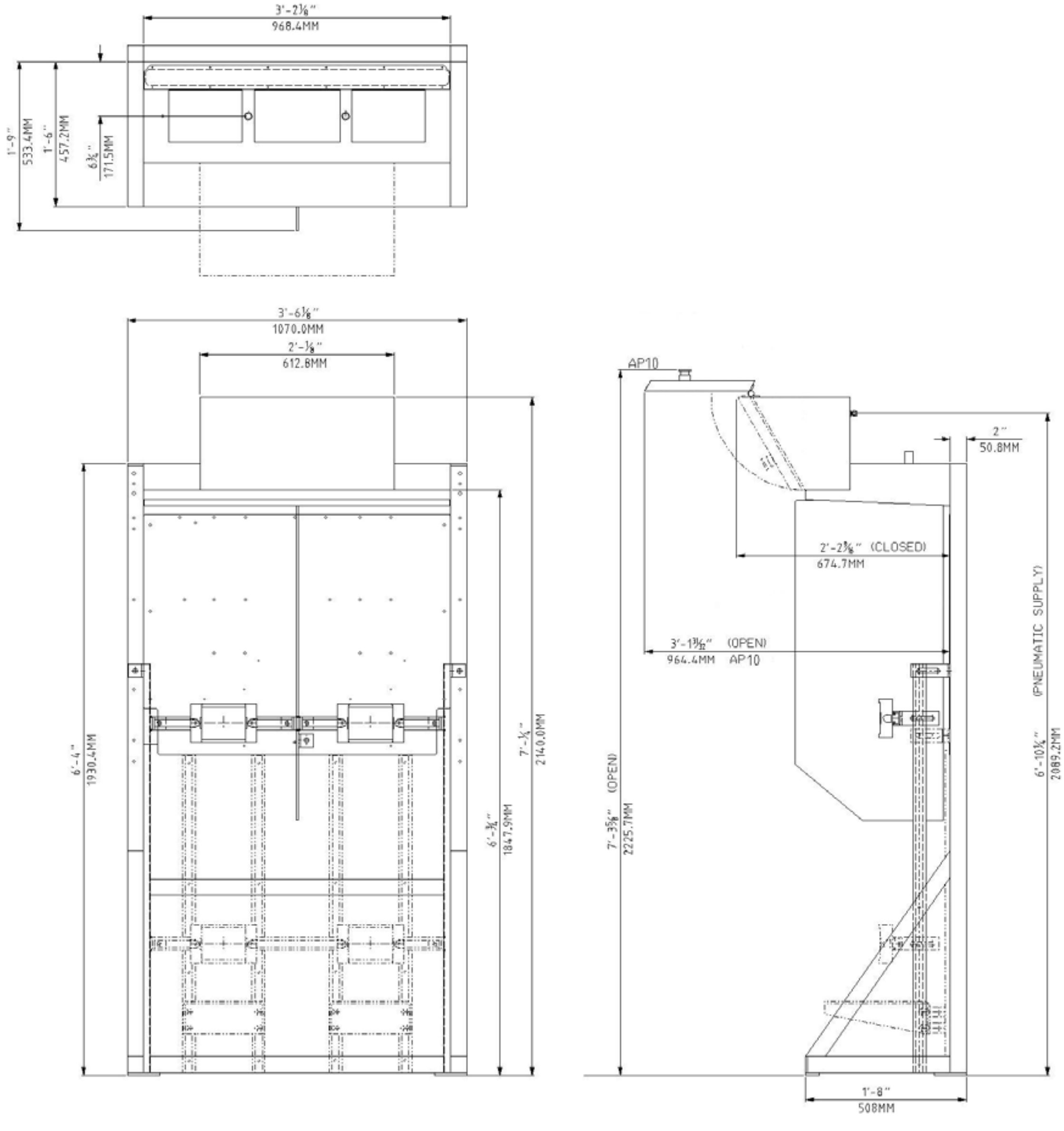
Approximate Weight = 600 pounds (271.49 Kilograms)

Figure 2.1.4.2: Outline Dimensions
1x1 Cylinder Euro (XH) Enclosure



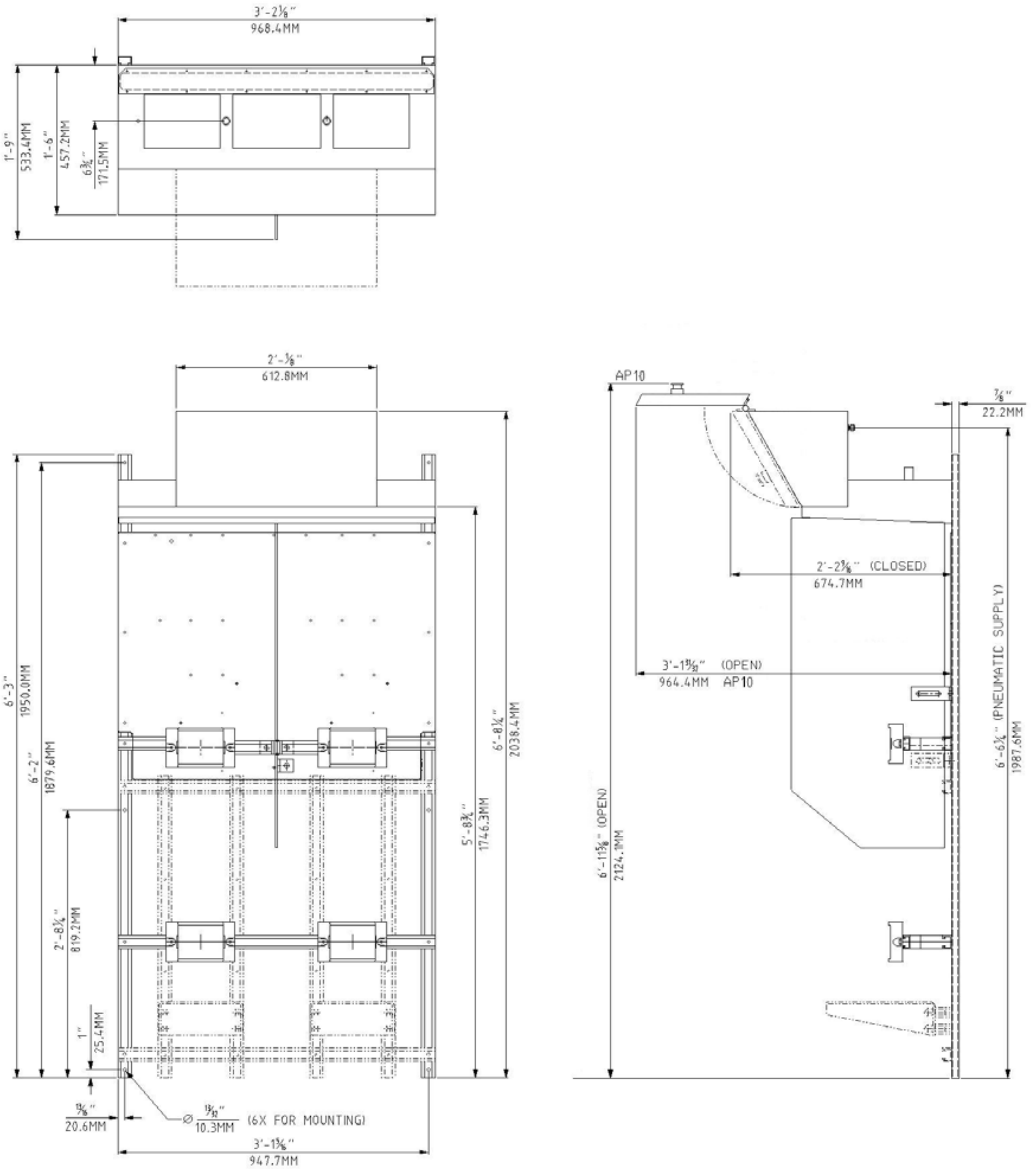
Approximate Weight = 425 pounds (192.77 Kilograms)

Figure 2.1.4.3: Outline Dimensions
1x1 Cylinder Rack



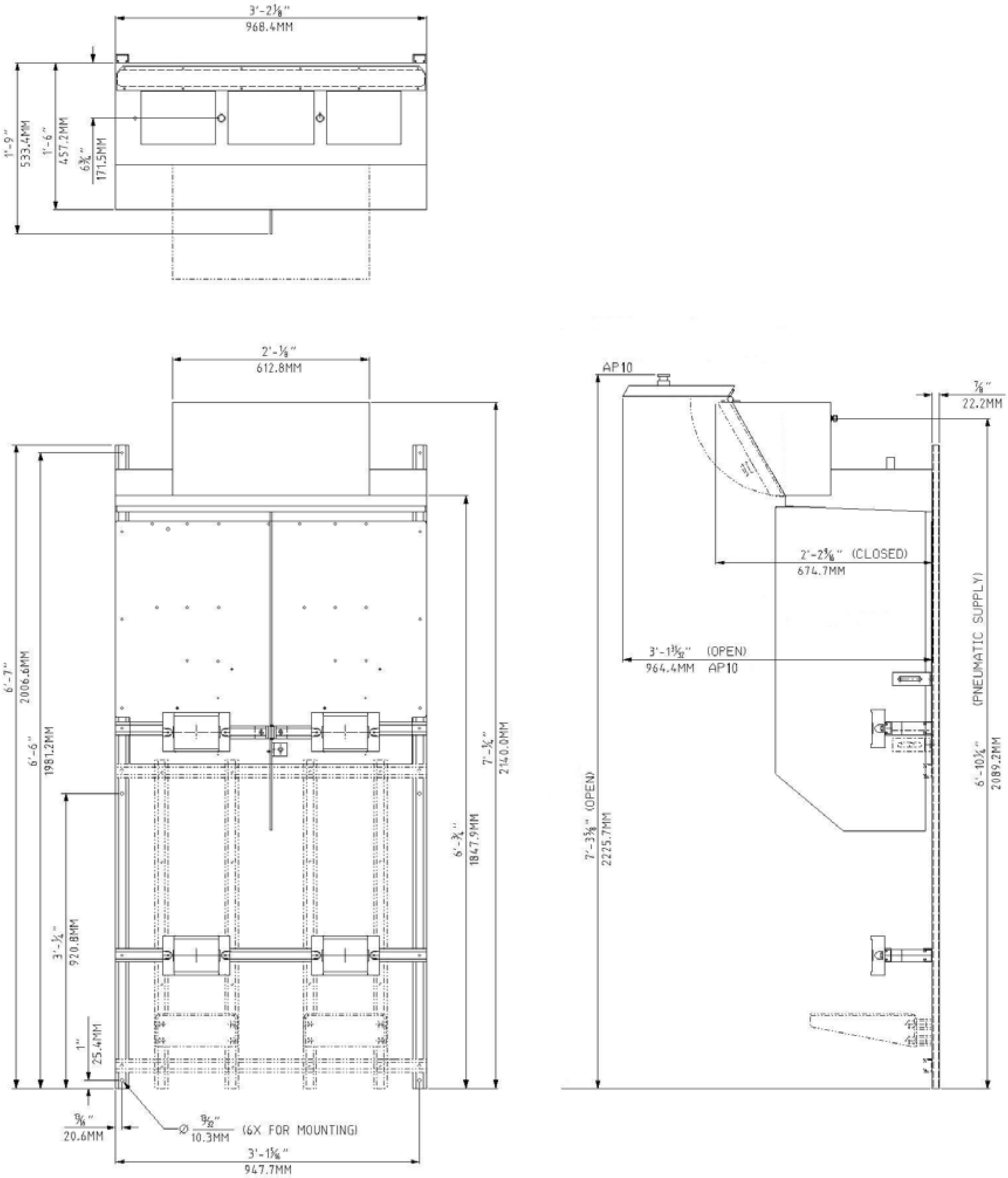
Approximate Weight = 425 pounds (192.77 Kilograms)

Figure 2.1.4.4: Outline Dimensions
1x1 Cylinder Euro (XH) Rack



Approximate Weight = 300 pounds (136.07 Kilograms)

Figure 2.1.4.5: Outline Dimensions
1x1 Cylinder Wall Mount



Approximate Weight = 300 pounds (136.07 Kilograms)

Figure 2.1.4.6: Outline Dimensions
1x1 Cylinder Euro (XH) Wall Mount

2.1.5 Outline Dimension Figures for 1x2 Cylinder Source Systems

2.1.5.1 - 1x2 Cylinder Enclosure

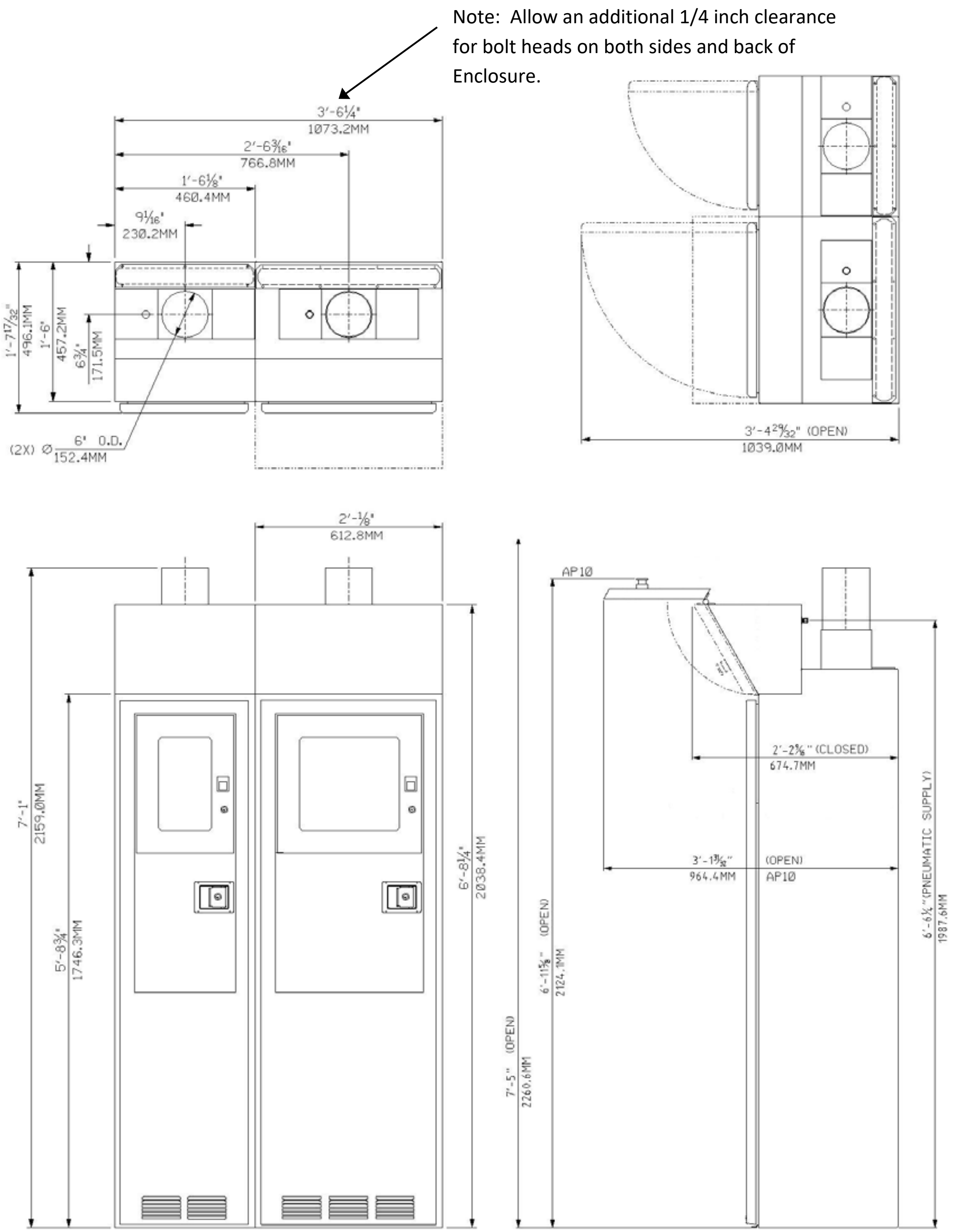
2.1.5.2 - 1x2 Cylinder Euro (XH-Extra High) Enclosure

2.1.5.3 - 1x2 Cylinder Rack

2.1.5.4 - 1x2 Cylinder Euro (XH-Extra High) Rack

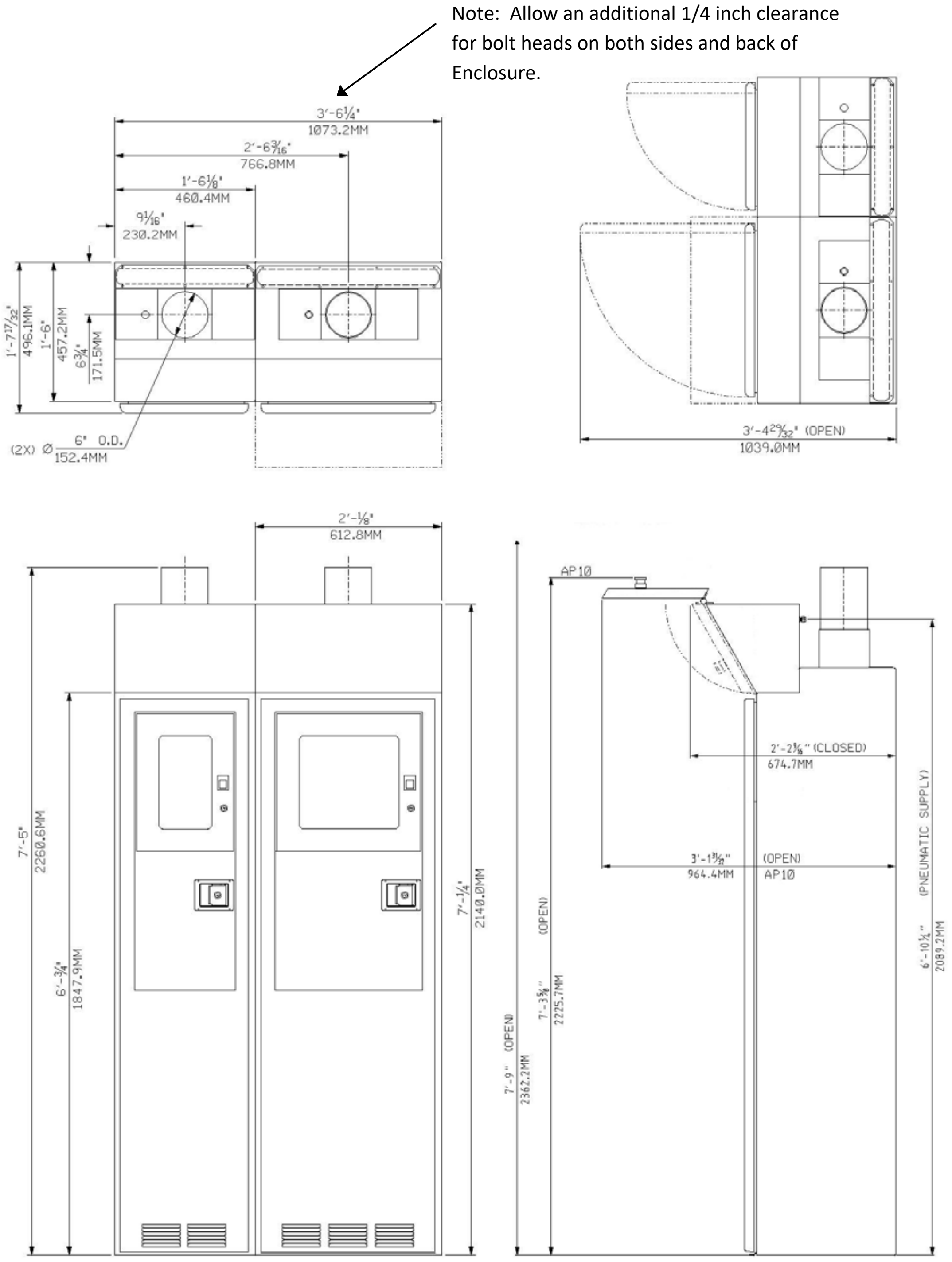
2.1.5.5 - 1x2 Cylinder Wall Mount

2.1.5.6 - 1x2 Cylinder Euro (XH-Extra High) Wall Mount



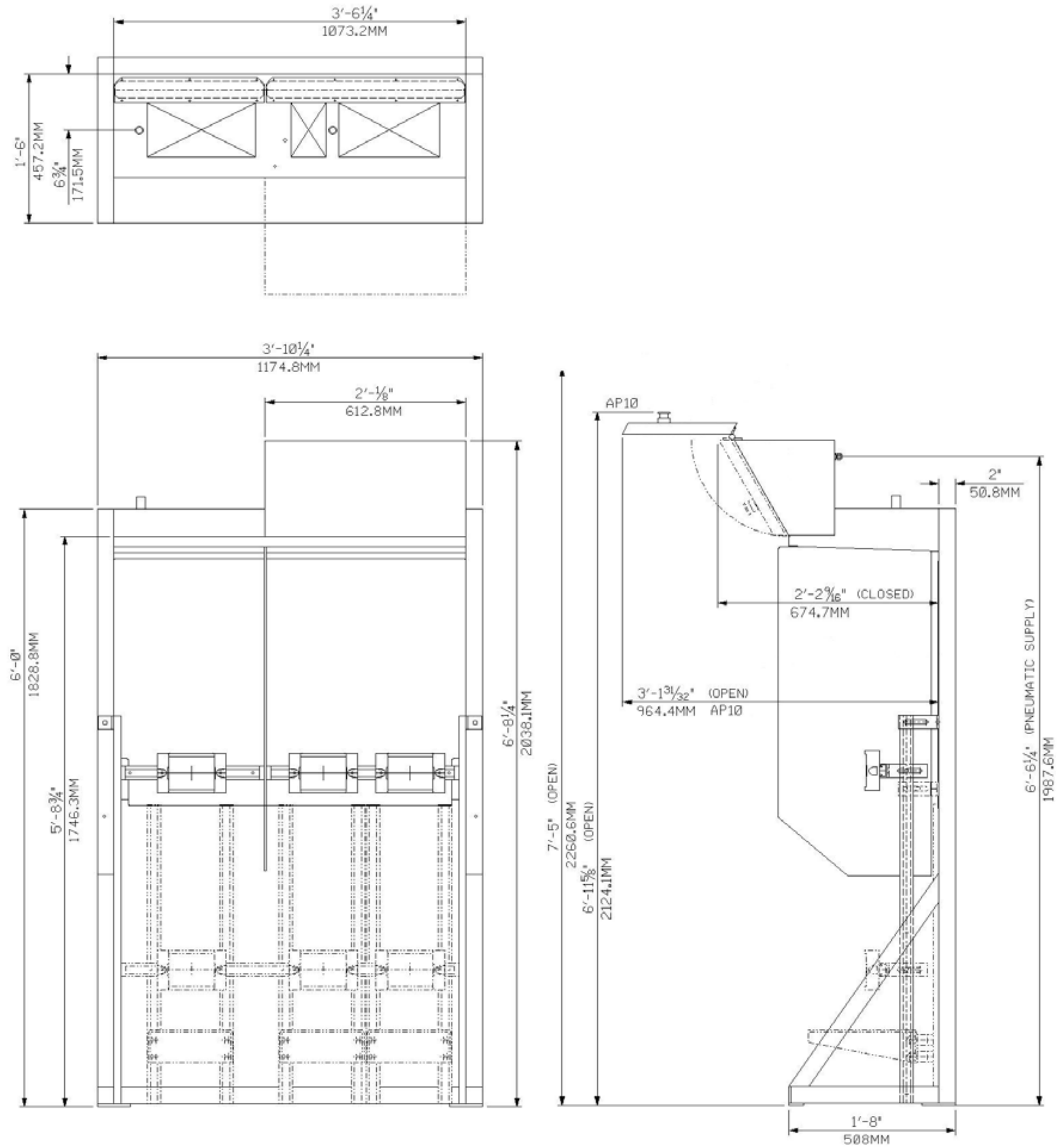
Approximate Weight = 650 pounds (294.84 Kilograms)

Figure 2.1.5.1: Outline Dimensions
1x2 Cylinder Enclosure



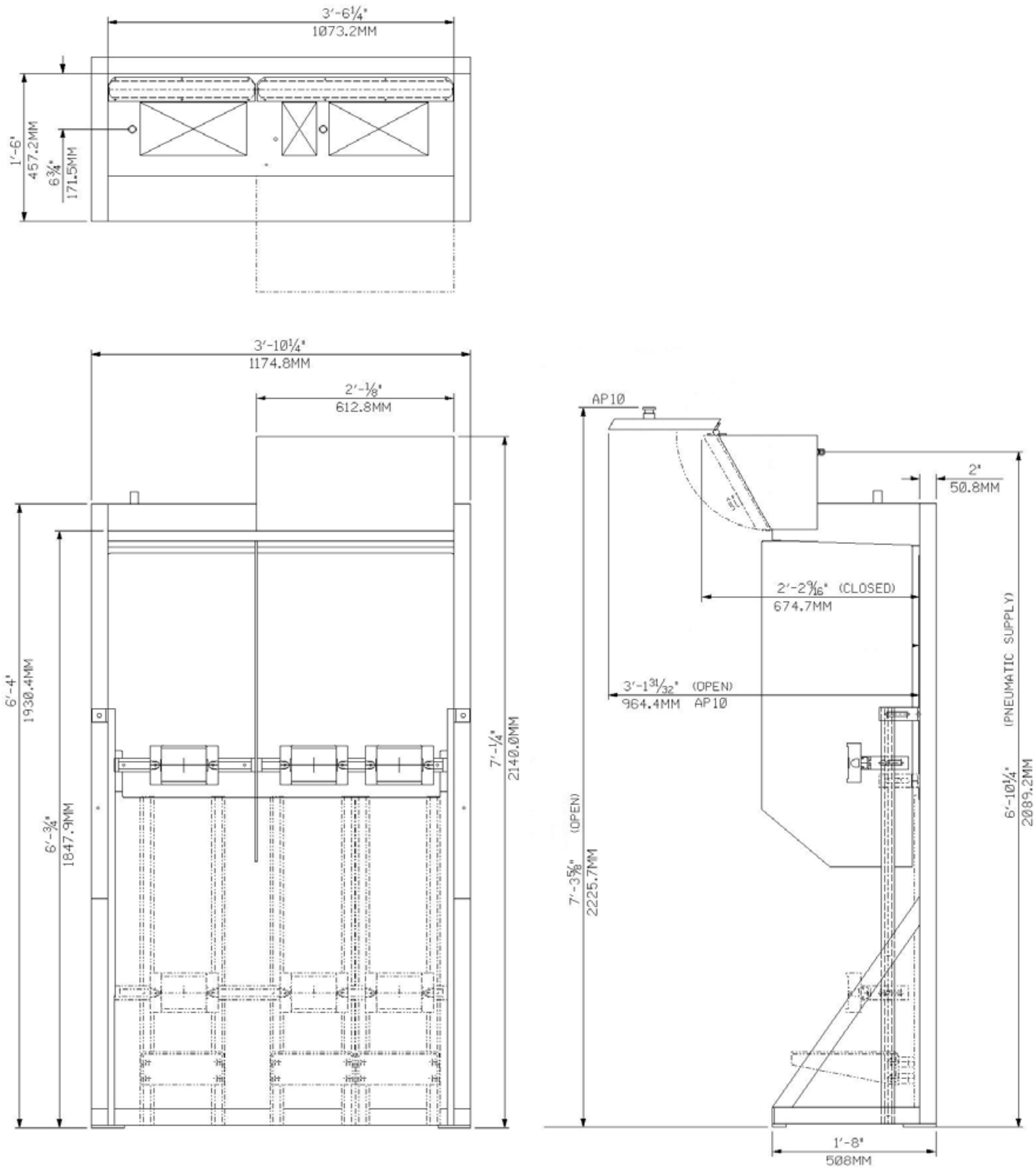
Approximate Weight = 650 pounds (294.84 Kilograms)

Figure 2.1.5.2: Outline Dimensions
1x2 Cylinder Euro (XH) Enclosure



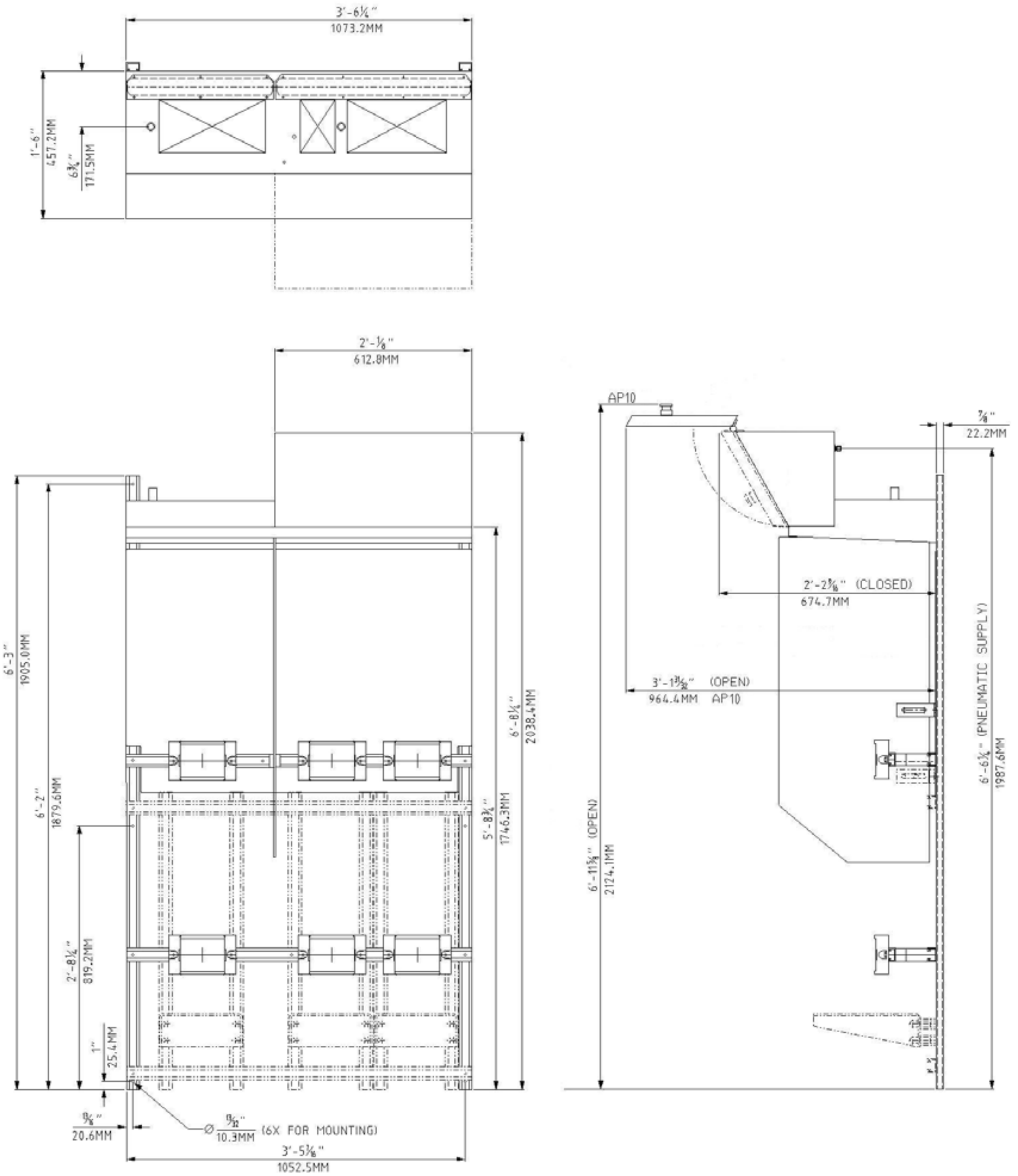
Approximate Weight = 450 pounds (204.12 Kilograms)

Figure 2.1.5.3: Outline Dimensions
1x2 Cylinder Rack



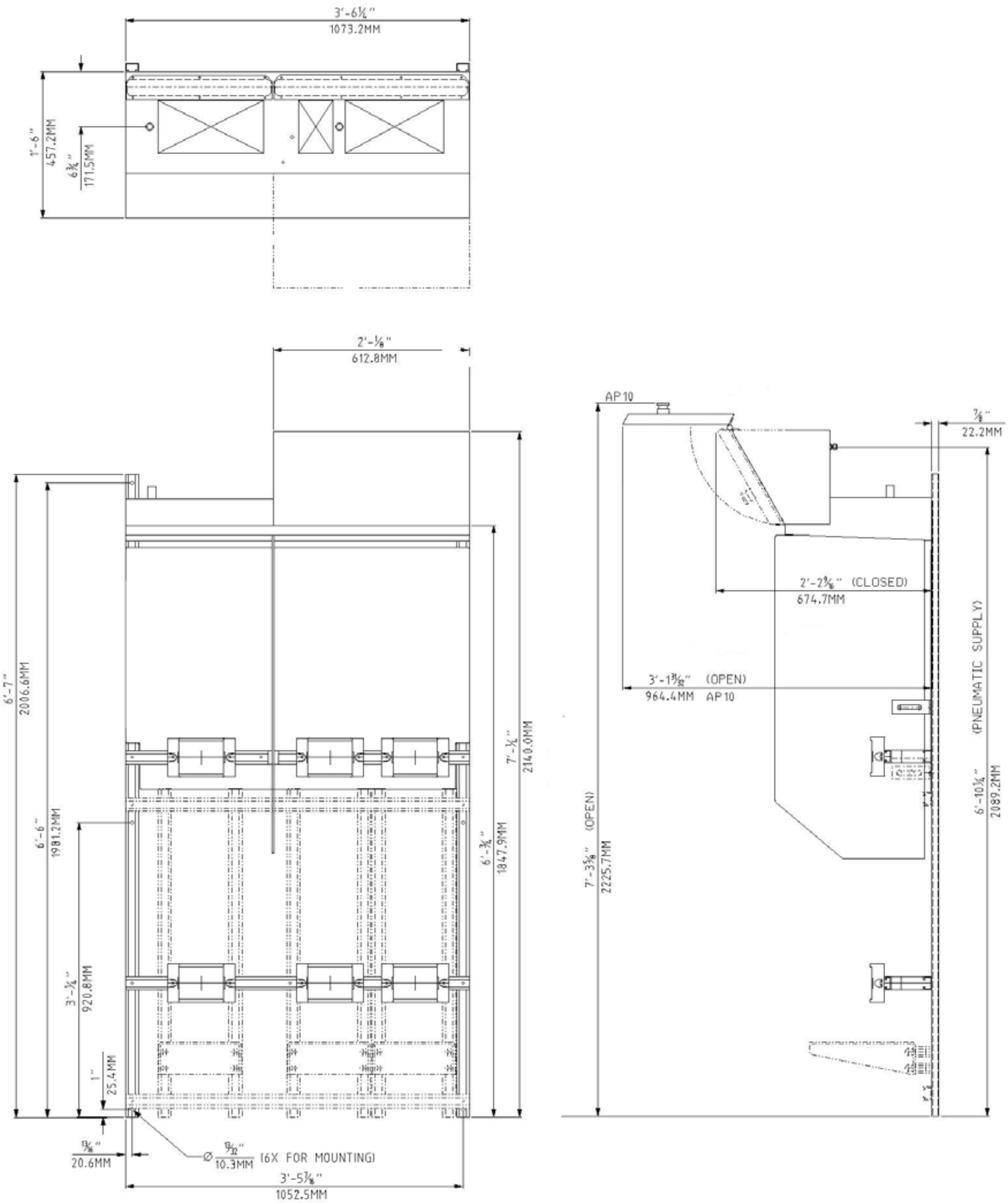
Approximate Weight = 450 pounds (204.12 Kilograms)

Figure 2.1.5.4: Outline Dimensions
1x2 Cylinder Euro (XH) Rack



Approximate Weight = 325 pounds (147.19 Kilograms)

Figure 2.1.5.5: Outline Dimensions
1x2 Cylinder Wall Mount



Approximate Weight = 325 pounds (147.19 Kilograms)

Figure 2.1.5.6: Outline Dimensions
1x2 Cylinder Euro (XH) Wall Mount

2.2 Mounting Hole Locations

The GASGUARD® Source System Enclosures or Racks are mounted to the facility floor using four (4) anchors, one in each corner of base.

The recommended mounting hardware is four (4) ½ inch stainless steel anchors. The necessary strength can be achieved with minimum 4-inch embedment or with minimum 2.75-inch embedment using certified epoxy anchors. The cabinets are pre-drilled at the factory with four (4) 9/16-inch clearance holes to accommodate these. The mounting locations are shown on the following pages. The facility floor mounting location should be clean and must be level. Each anchor should provide a minimum of 1600 lbf tensile strength (i.e. ½ anchor 3000lb concrete with special inspection.) This applies to each of the 4 fasteners (4 x 1600 lbf, 6400 lbf total).

The GASGUARD® Source System Wall Mounts are mounted to vertical walls or supporting structure using six (6) 13/32” (10.3 mm) diameter holes, three (3 ea) in the vertical Unistrut® channels on the back of the system assemblies. There is no floor bolting for these systems.

For cabinet anchoring figures see Section 2.2.1. For rack anchoring figures see section 2.2.2. For Wallmount locations, reference the figures in Section 2.1.

2.2.1 Cabinet Anchoring

For Enclosure anchoring, see the following Mounting Hole Location Figures for proper floor location of the concrete anchors using the four (4) 9/16 inch holes to secure the enclosure to the floor. *Do not use inner manufacturing bolt hole set in cabinet base*. Using the inner manufacturing bolt hole set may interfere with gas cylinder and/or cylinder weight scale placement within the Enclosure and may not meet seismic requirements.

2.2.1.1 - 1 Cylinder Enclosure or 1 Cylinder Euro (XH-Extra High) Enclosure

2.2.1.2 - 2 Cylinder Enclosure or 2 Cylinder Euro (XH-Extra High) Enclosure

2.2.1.3 - 3 Cylinder Enclosure or 3 Cylinder Euro (XH-Extra High) Enclosure

2.2.1.4 - 1x1 Cylinder Enclosure or 1x1 Cylinder Euro (XH-Extra High) Enclosure

2.2.1.5 - 1x2 Cylinder Enclosure or 1x2 Cylinder Euro (XH-Extra High) Enclosure

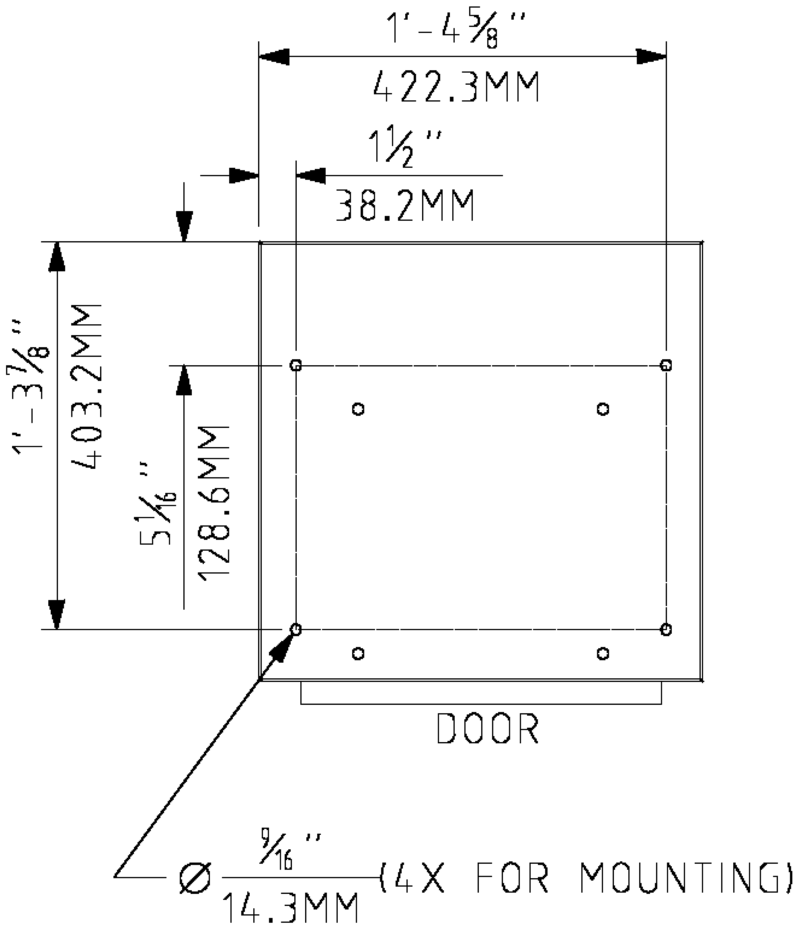


Figure 2.2.1.1: Mounting Hole Locations
1 Cylinder Enclosure or 1 Cylinder Euro (XH) Enclosure

Use only the mounting holes indicated. Do not use inner manufacturing holes.

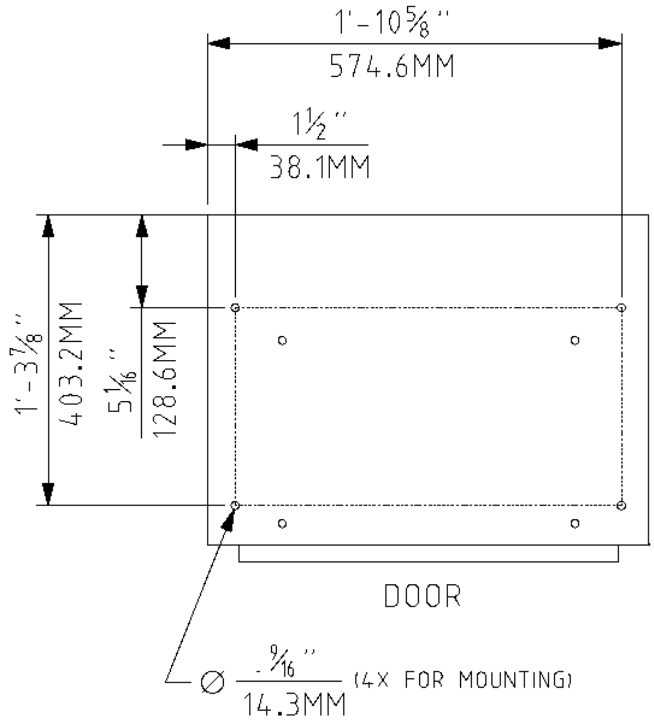


Figure 2.2.1.2: Mounting Hole Locations
2 Cylinder Enclosure or 2 Cylinder Euro (XH) Enclosure

Use only the mounting holes indicated. Do not use inner manufacturing holes.

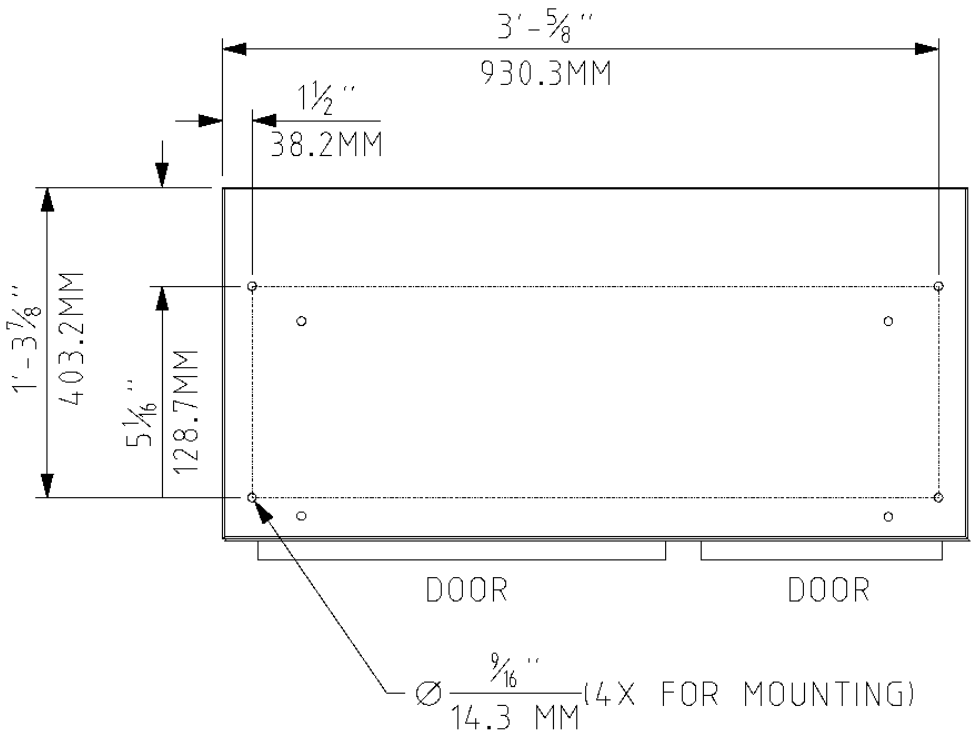


Figure 2.2.1.3: Mounting Hole Locations
3 Cylinder Enclosure or 3 Cylinder Euro (XH) Enclosure

Use only the mounting holes indicated. Do not use inner manufacturing holes.

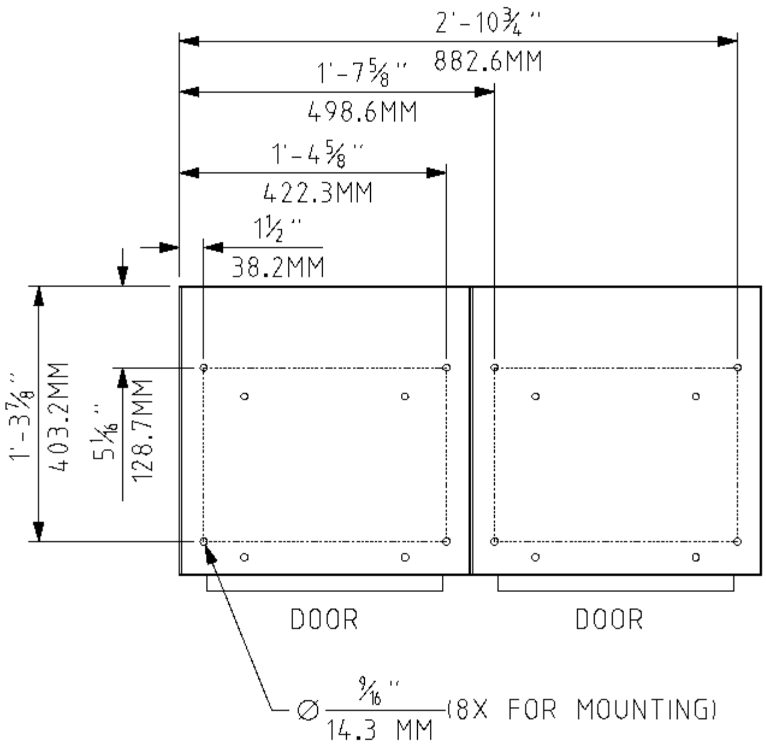


Figure 2.2.1.4: Mounting Hole Locations
1x1 Cylinder Enclosure or 1x1 Cylinder Euro (XH) Enclosure

Use only the mounting holes indicated. Do not use inner manufacturing holes.

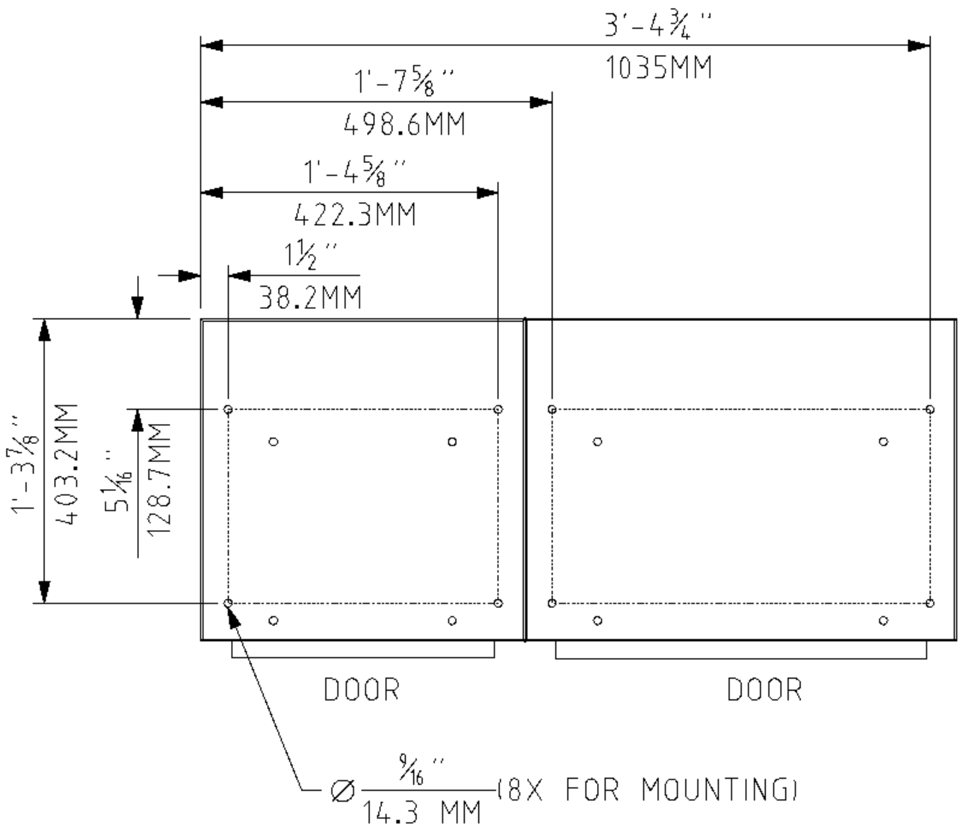


Figure 2.2.1.5: Mounting Hole Locations
1x2 Cylinder Enclosure or 1x2 Cylinder Euro (XH) Enclosure

Use only the mounting holes indicated. Do not use inner manufacturing holes.

2.2.2 Rack Anchoring

For Rack anchoring see the following Mounting Hole Location Figures for proper floor location of four (4) 9/16” (14.3 mm) diameter holes in the frame base.

2.2.2.1 - 1 Cylinder Rack or 1 Cylinder Euro (XH-Extra High) Rack

2.2.2.2 - 2 Cylinder Rack or 2 Cylinder Euro (XH-Extra High) Rack

2.2.2.3 - 3 Cylinder Rack or 3 Cylinder Euro (XH-Extra High) Rack

2.2.2.4 - 1x1 Cylinder Rack or 1x1 Cylinder Euro (XH-Extra High) Rack

2.2.2.5 - 1x2 Cylinder Rack or 1x2 Cylinder Euro (XH-Extra High) Rack

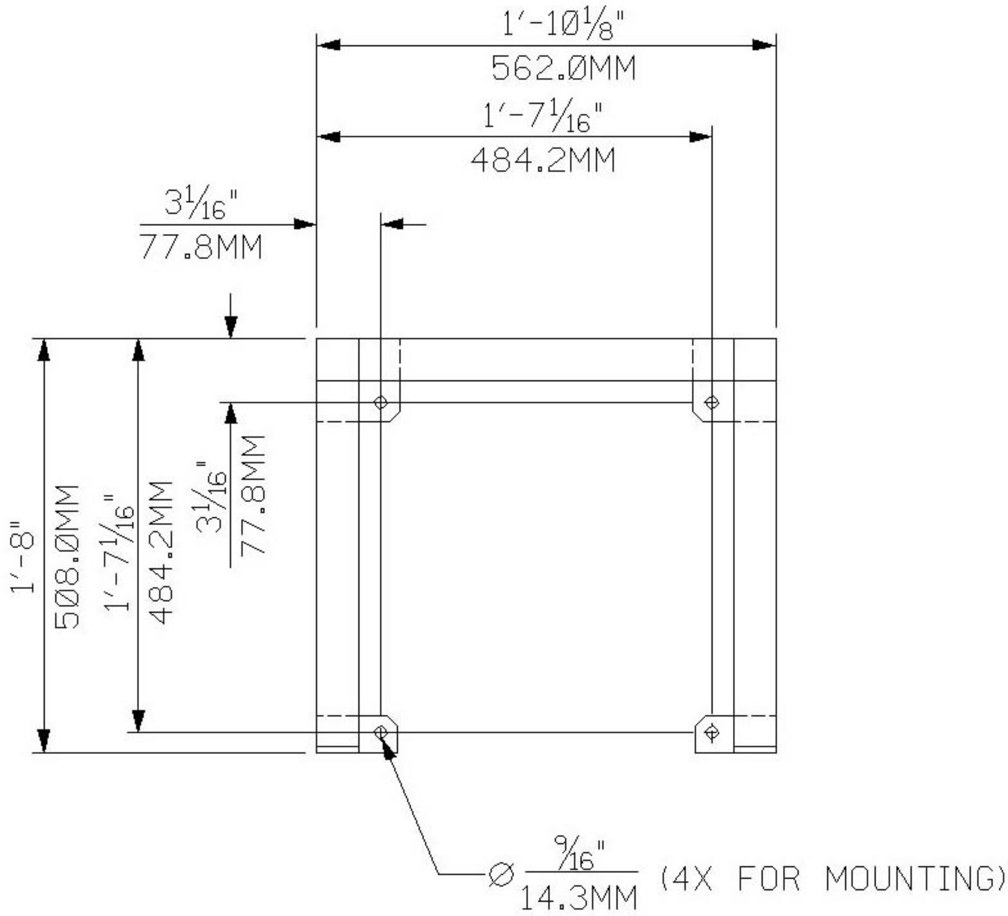


Figure 2.2.2.1: Mounting Hole Locations
1 Cylinder Rack or 1 Cylinder Euro (XH) Rack

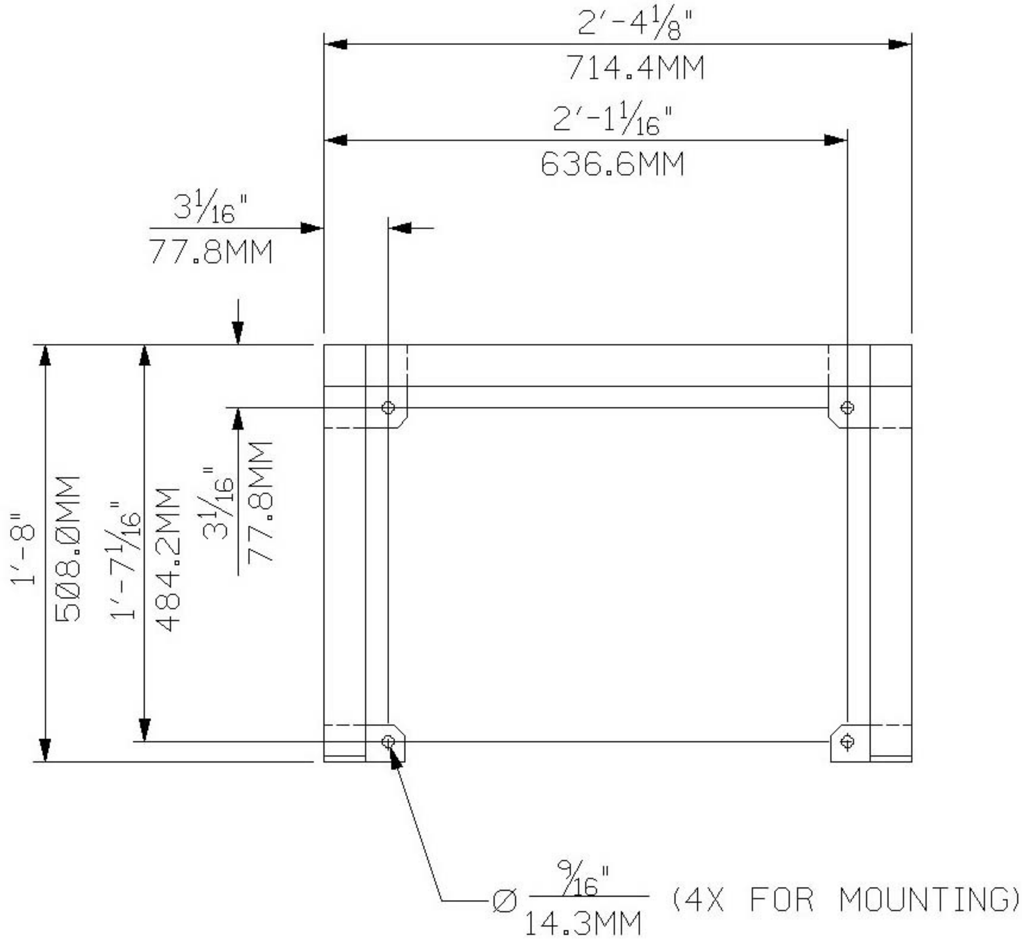


Figure 2.2.2.2: Mounting Hole Locations
2 Cylinder Rack or 2 Cylinder Euro (XH) Rack

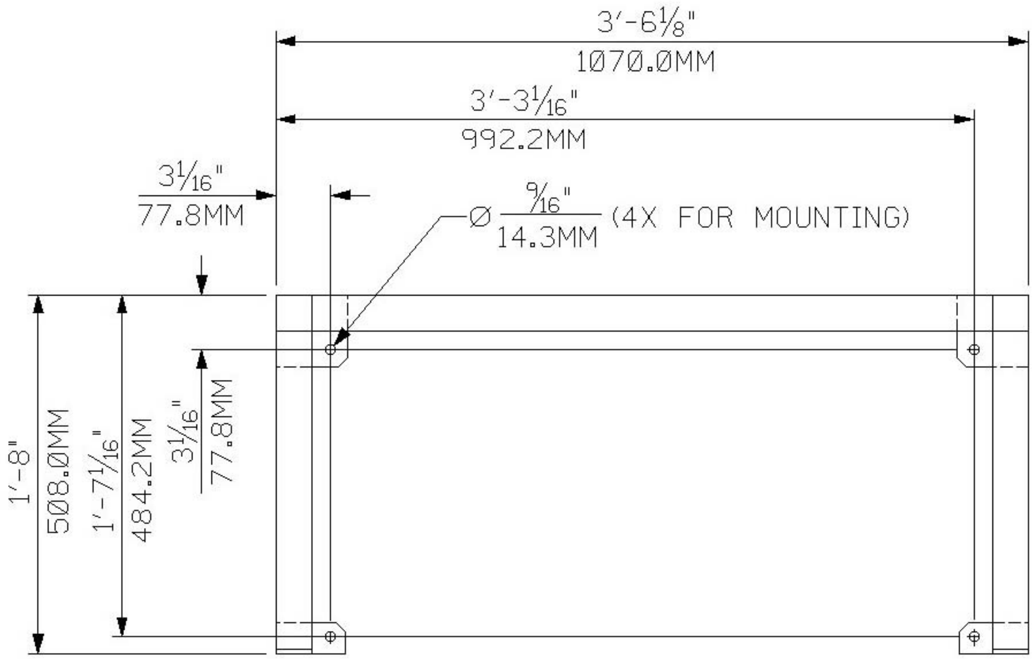


Figure 2.2.2.3: Mounting Hole Locations
3 Cylinder Rack or 3 Cylinder Euro (XH) Rack

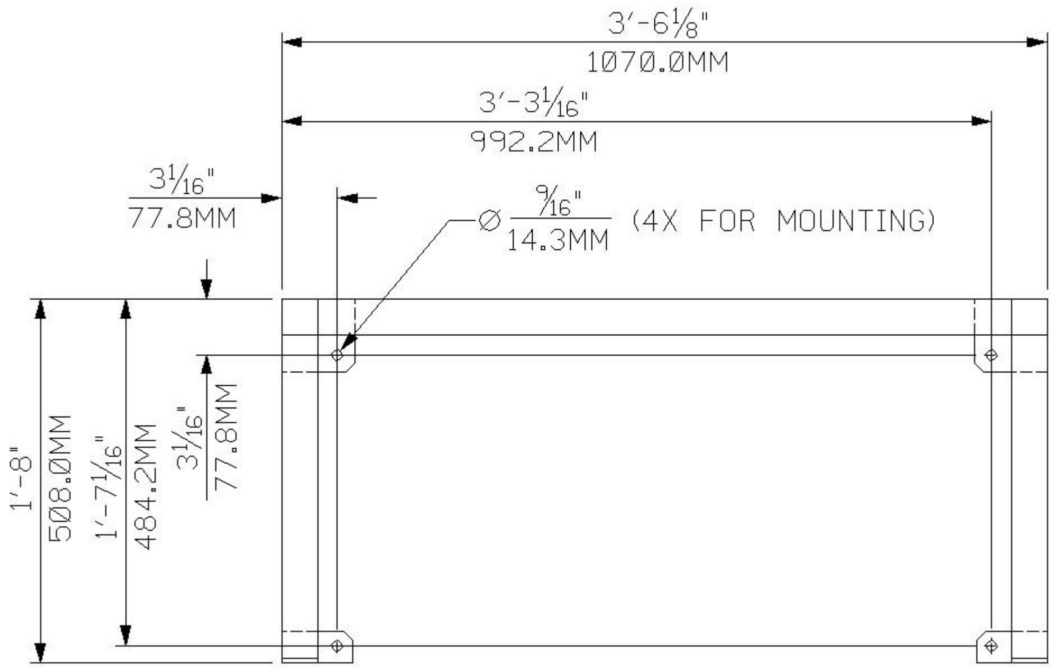


Figure 2.2.2.4: Mounting Hole Locations
1x1 Cylinder Rack or 1x1 Cylinder Euro (XH) Rack

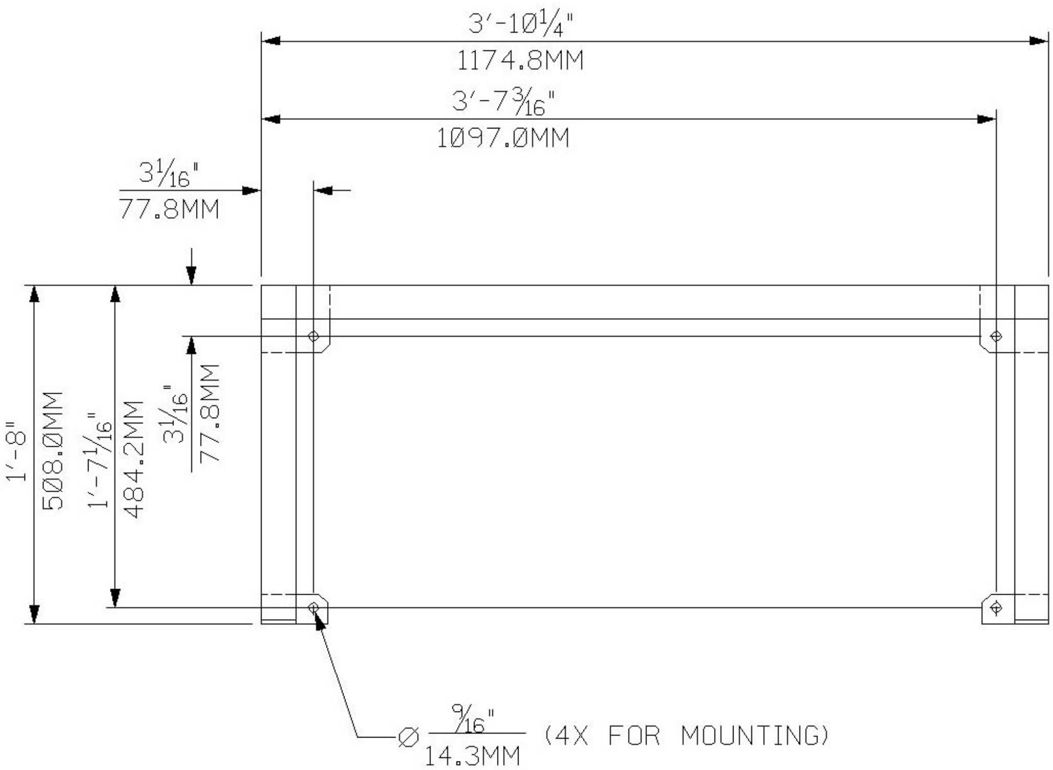


Figure 2.2.2.5: Mounting Hole Locations
1x2 Cylinder Rack or 1x2 Cylinder Euro (XH) Rack

Chapter 3

Tubing Connections

Section 13 Cylinder Cooling (Diborane Mixes)

Section 14 Hazardous Area / Potentially Flammable Atmosphere Requirements for Racks and Wallmounts

All tubing connections to the GASGUARD® Source System should be designed and installed following the local piping codes and should comply with the intent of ASME B31.3 "Chemical Plant and Petroleum Refinery Piping." Tubing must be sized to flow the maximum amount of gas required by the process system. Tubing is normally constructed of 316L stainless steel. Hastelloy C22 (Nickel-Chromium-Molybdenum Alloy) is sometimes specified by the customer for corrosive gases. Verify the tubing material type on the Specification Sheet that is supplied with the order.

All tubing connections are made at the top rear of the source system. Connections that terminate with a VCR fitting are either capped or plugged at the factory and are ready for connection to the facility piping. Connections that terminate with open tube ends are bagged for shipping purposes. Process and purge lines are double bagged and taped for shipment. Vent and venturi supply lines are single bagged and taped. All tube ends have been faced and are ready for welding to facility piping. Welding should be performed using established high purity welding techniques. Verify all tubing connections with the flow schematic, or Installation drawing (INS drawing) prior to welding.

Note: When internal terminations are specified, specific inlet/outlets typically end with VCRs inside of this enclosure. Field installation is made at this point. Refer to Specification Sheet or INS drawing to verify if the internal termination option applies.

3.1 Tubing Interconnections

Process outlet:	1/4" (6.4 mm) diameter, 0.035" (0.9 mm) wall thickness
Optional coax	1/2" (12.7 mm) diameter, 0.049" (1.2 mm) wall thickness
Optional process outlet:	3/8" (9.5 mm) diameter 0.035" (0.9 mm) wall thickness
Optional coax	5/8" (15.8 mm) diameter 0.049" (1.2 mm) wall thickness
Optional process outlet:	1/2" (12.7 mm) diameter 0.049" (1.2 mm) wall thickness
Optional coax	3/4" (19.05 mm) diameter 0.065" (1.7 mm) wall thickness
Venturi inlet:	1/4" (6.4 mm) diameter, 0.035" (0.9 mm) wall thickness
Purge inlet:	1/4" (6.4 mm) diameter, 0.035" (0.9 mm) wall thickness
Vent outlet:	3/8" (9.5 mm) diameter, 0.035" (0.9 mm) wall thickness
Optional vent:	1/4" (6.4 mm) diameter, 0.035" (0.9 mm) wall thickness
SRV outlet:	3/8" (9.5 mm) diameter, 0.035" (0.9 mm) wall thickness
Bonnet Vent Outlet:	1/4" (6.4 mm) diameter, 0.035" (0.9 mm) wall thickness
HPLT Option:	
High Pressure Inlet:	1/4" (6.4 mm) diameter, 0.035" (0.9 mm) wall thickness

Specific piping connections for this system can be found on the Installation Drawing (INS). An INS drawing is provided only when it is specifically requested by the customer. Please contact your GASGUARD® commercial representative for assistance.

3.2 Process Line Connection

The process line connection can be furnished in one of two configurations: Standard Bulkhead or Coaxial Bulkhead.
The standard bulkhead permits a single process out line to penetrate the enclosure, while providing an acceptable seal for enclosure ventilation purposes. Figure 3.1 shows a standard bulkhead.

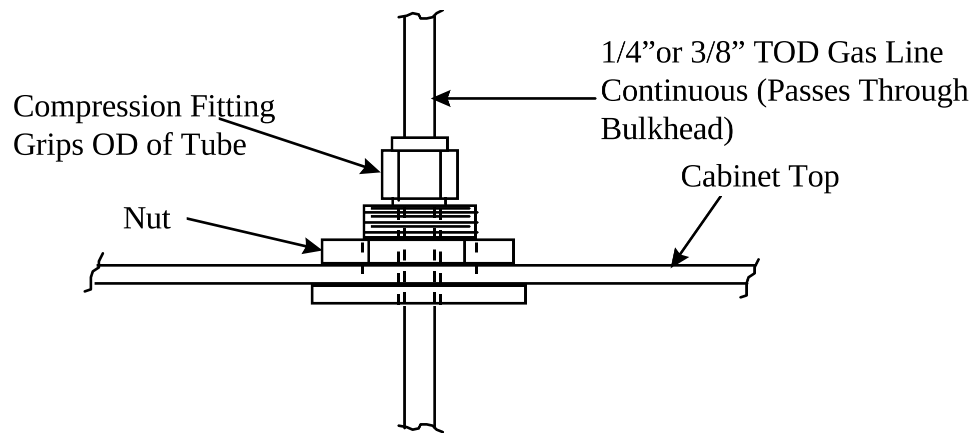


Figure 3.1: Standard Bulkhead

The coaxial bulkhead permits a single process out line to penetrate the enclosure, while providing an acceptable seal for enclosure ventilation purposes. In addition, the coaxial bulkhead provides a termination point for an outer secondary containment tube. The outer secondary containment tube, or jacket, is connected directly to the coaxial bulkhead. The outer secondary containment continues through the coaxial bulkhead and terminates as a branch on the coaxial bulkhead inside the enclosure. This branch on the outer secondary containment may remain open, be dead ended, or be pressurized with inert gas, depending on the method chosen to monitor the secondary containment tube for leaks.

Two methods of monitoring are typically used: gas detection or pressure decay of the annular space. An open or vented annular space is monitored at the open end with a toxic gas detection system (customer supplied), and vented to a scrubbed exhaust system. The pressure decay technique requires the annular space to be pressurized with inert gas (typically nitrogen) above the process gas delivery pressure (typically 100 psig/6.9 barg) and monitored for decay with a pressure switch. Pressure decay indicates either a process gas leak or jacket leak. The alarm may be configured as a fault or shutdown, per customer specification.

Note: The method of monitoring the outer secondary containment for leaks may be dictated by local codes, such as the Toxic Gas Ordinance.

CAUTION ***For coax tubing on silane lines, the pressure decay method with an inert gas (not air) must be used.***

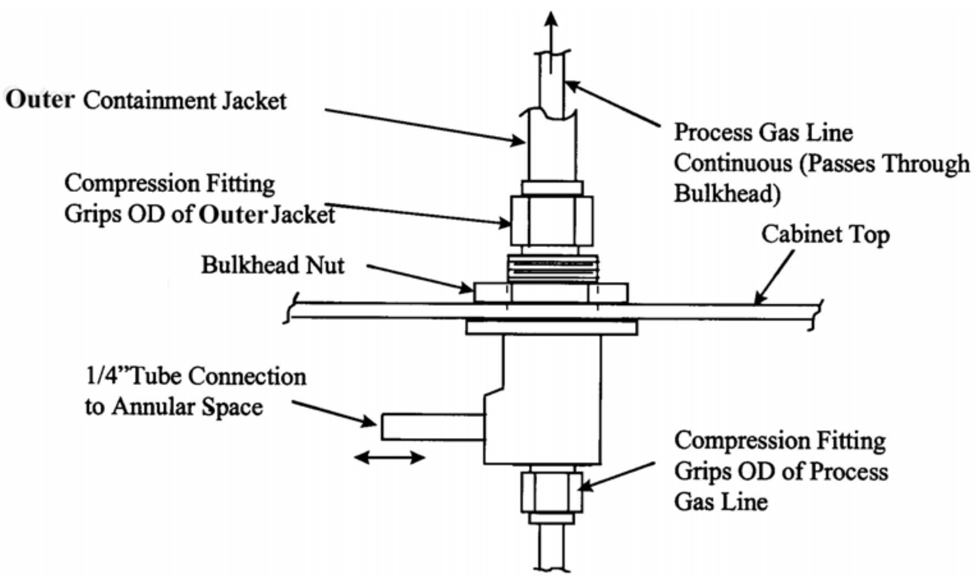


Figure 3.2: Coax Bulkhead

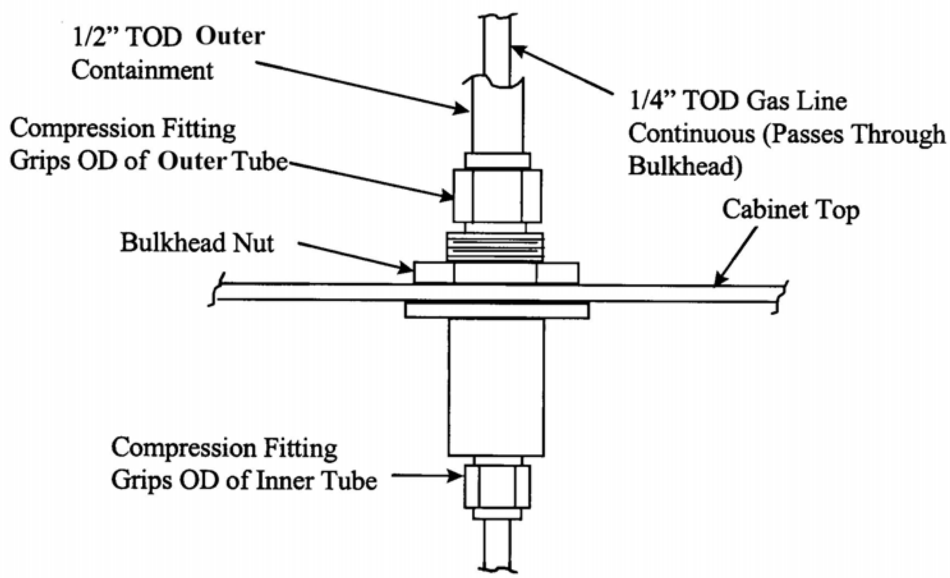


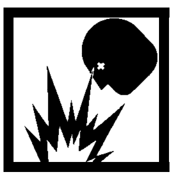
Figure 3.3: Dead End Coax Bulkhead

3.3 Vent Lines and Sizing

3.3a Process Vent Line

The vent line must be piped directly to an acceptable pollution abatement system designed for the specific gas being vented. Process gas will be introduced into the vent line during the "Pre-Purge" purging cycle, when the process gas panel is being purged prior to process gas cylinder removal. At this time, 50-60 LPM (106-127 CFH) of nitrogen is also being sent into the line through the vacuum venturi loop. The purging sequences run approximately 30-45 minutes.

WARNING



Process gas can be introduced to the vent system at any time in the event of certain multiple component failures, therefore the vent line and pollution abatement system should be capable of handling a full process gas cylinder release in the event of catastrophic failure.

When multiple gases are to be vented, ensure compatibility before plumbing vents together. Contact your GASGUARD® Representative for this information. A nitrogen trickle purge is constantly bled into the vent line to maintain an inert atmosphere when hazardous gases are being used. For this reason, a trickle purge valve, V7, is furnished with an approximately 0.009” (0.25 mm) orifice. The flow rate of this trickle purge is approximately 2-5 LPM (4-10 CFH). Figure 3.4 depicts a typical trickle purge assembly.

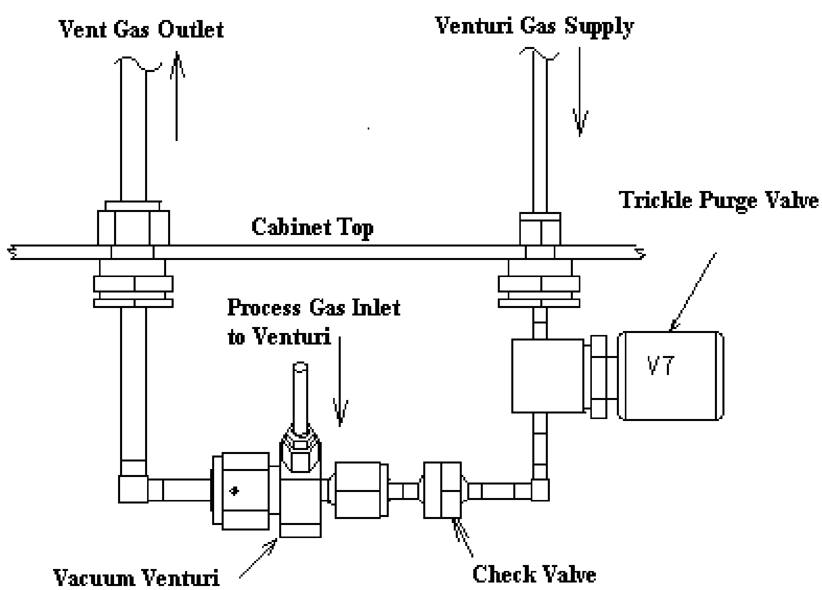


Figure 3.4: Typical Trickle Purge Assembly

Vacuum Venturi Vent Line Sizing

The vacuum venturi is extremely susceptible to vent line back pressure, and cannot tolerate more than 0.5 psi back pressure. If back pressure exceeds 0.5 psi, the AP10 controller will fail and abort the purge sequence on insufficient vacuum. It will be impossible to continue until the restriction is eliminated. The recommended vent line sizes below should be used when installing the vacuum venturi vent line. Transitions to larger tubing should be made within 1 ft. of the piping enclosure.

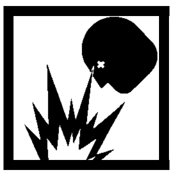
Recommended Vent Line Sizes:
Line Length Minimum Recommended Tube Diameter
1 ft. through 5 ft. 1/2" tube
5 ft. through 100 ft. 3/4" tube
100 ft. through 400 ft. 1" tube
Over 400 ft. 1-1/2" tube

The venturi vent line must be piped to a safe location away from personnel exposure. It is recommended that the customer consult and design the vent system to all applicable codes. The emergency vent discharge opening should be constructed to prevent blockage from weather and animals. Vent gases will be introduced into the emergency vent lines whenever a purge or conditioning sequence is run. Do not combine vent lines, instead, route individual vent lines to an appropriately sized vent header.

3.3b SRV (Safety Relief Valve) Line

For hazardous gases, the SRV line must be piped directly to an acceptable pollution abatement system designed for the specific gas being vented. Purge gas and non-hazardous process gases should be vented to a safe location. The SRV line must be designed to have minimum pressure drop. It should limit the maximum backpressure to less than 5% of the SRV set pressure.

WARNING



Process gas can be introduced to the vent system at any time in the event of certain multiple component failures, therefore the vent line and pollution abatement system should be capable of handling a full process gas cylinder release in the event of catastrophic failure.

When multiple gases are to be vented, ensure compatibility before plumbing vents together. Contact your GASGUARD® Representative for this information.

3.3c Bonnet Vent Relief Outlet Line

For Open systems (Racks, Wallmounts, VMPs, etc.) containing silane: The Bonnet Vent Outlet must be kept open to allow gas to escape. It must not be sealed or routed into other vent lines. It may be covered with a loose fitting cap to prevent water intrusion provided that it does not prevent gas from escaping. If the standard outlet location is directed in an unsafe manner (i.e. towards flammable construction materials, personnel walkways, etc.) or presents another potentially unsafe situation the outlet must be rerouted to a safe location during installation. Gas detectors and/or UV/IR detectors should be used in the surrounding area to monitor for a potential leak.

For Enclosed systems (Cabinets, VMBs, etc.) containing silane: The Bonnet Vent Outlet must be kept open to allow gas to escape into the exhaust system. It must not be sealed or routed into other vent lines. Downstream ventilation dampers must not be designed to fail closed or close on gas detection. The bonnet vent outlet should be located upstream of the exhaust gas monitor to detect a potential leak.

Reference PTB 2002-02," Silane Regulator Bonnet Vent Routing", Rev B. for detailed assessment and recommendation

3.4 Venturi Line

Most process cylinder pressures are significantly higher than houseline operating pressures. In the event of multiple failures of certain process panel components, there is a remote possibility of back contamination of the houseline source connected to the vacuum venturi.
Contact your GASGUARD® representative for design details.

The venturi line requires 75-95 psig (5.2-6.6 barg) of nitrogen to adequately produce the vacuum needed during purge cycles. The supply is usually taken from a bulk liquid source, but it can also originate from a cylinder manifold system. The vacuum generator will demand a flow of 50-60 LPM (106-127 CFH) of nitrogen during purge cycles.

3.5a Purge Line

A purge line may be provided when the nitrogen purge cylinder is not included in the source system. This purge line must be connected to a designated purge source for the source system. The pressure required during cylinder purging is typically 80-90 psig (5.5-6.2 barg) for most gases, 70-80psig for very low vapor pressure gases. Purge pressure for Acetylene systems must not exceed 10psig (see Appendix D). If an external purge source is used, sufficient over pressure protection must be provided. Unless otherwise noted on the installation drawing, operating manual or specification sheet, the recommended safety relief valve setpoint is 125 psig (maximum) for the purge supply. Do not exceed the source system component maximum allowable working pressure (MAWP) in the event of purge source regulator failure. If an internal purge cylinder is included in the source system the purge line connection does not apply.

⚠CAUTION

The purge gas source for the GASGUARD Source System should be used only to purge other gas source systems or VMBs handling the same process gas. It must not be used to purge systems handling incompatible process gases. It is recommended that the purge gas cylinders be placed in an exhausted enclosure. Purge gas must not be supplied from a low pressure bulk gas source.

3.5b HPLT (High Pressure Leak Test) Inlet – Optional

A high pressure leak test (HPLT) inlet line may be provided at the customer's request. This line must be connected to a designated leak test panel and cylinder for the source system. Typical leak test gases are He, He/N2 mixes, or He/Ar mixes. The maximum pressure allowed during leak test varies by the gas type. Sufficient over pressure protection must be provided on the leak source panel. The overpressure protection must be designed so that the source system component maximum allowable working pressure (MAWP) cannot be exceeded in the event of purge source regulator failure. If the appropriate GASGUARD® HPLT source panel is used, the overpressure protection is provided on that panel.

The following table lists the recommended leak test pressures and the maximum test pressures allowed. Verify actual transducer pressure before performing leak test. Systems may vary.

CAUTION

Do NOT exceed the maximum leak test pressure. Higher Leak test pressure may result in an invalid leak test or damage to source system components. Verify actual transducer pressure before performing leak test, systems may vary.

Gas Type	Chemical Formula	Recommended Test Pressure	Typical Maximum Test Pressure (Verify transducer range and Do NOT exceed)
1,3 Hexafluorobutadiene	C4F6	75	80
Ammonia	NH3	220	233
Argon	Ar	950	2980
Arsine	AsH3	950	980
Boron Trichloride	BCl3	75	80
Boron Trifluoride	BF3	950	2980
Carbon Dioxide	CO2	950	2980
Carbon Monoxide	CO	950	2980
Chlorine	Cl2	220	233
Deuterated Ammonia	ND3	220	233
Deuterium	D2	950	2980
Dichlorosilane (DCS)	SiH2Cl2	75	80
Difluoromethane	CH2F2	950	980
Disilane	Si2H6	75	80
Ethane	C2H6	950	2980
Ethyl Chloride	C2H5Cl	75	80

Ethylene	**C2H4**	**950**	**2980**
High Pressure gas mixtures	**Mix**	**950**	**2980**
Helium	**He**	**950**	**2980**
Hexafluoroethane	**C2F6**	**950**	**980**
Hydrogen	**H2**	**950**	**2980**
Hydrogen Bromide	**HBr**	**950**	**980**
Hydrogen Chloride	**HCl**	**950**	**980**
Hydrogen Fluoride	**HF**	**75**	**80**
Hydrogen Sulfide	**H2S**	**950**	**980**
Krypton	**Kr**	**950**	**2980**
Methane	**CH4**	**950**	**2980**
Methyl Chloride	**CH3Cl**	**220**	**233**
Methyl Fluoride	**CH3F**	**950**	**980**
Methylsilane	**CH6Si**	**950**	**980**
Neon	**Ne**	**950**	**2980**
Nitric Oxide	**NO**	**950**	**980**
Nitrogen	**N2**	**950**	**2980**
Nitrogen Trifluoride	**NF3**	**950**	**2980**
Nitrous Oxide	**N2O**	**950**	**2980**
Octafluorocyclobutane	**C4F8**	**75**	**80**
Octafluorocyclopentene	**C5F8**	**75**	**80**
Octafluoropropane	**C3F8**	**220**	**233**
Oxygen	**O2**	**950**	**2980**
Perfluorotetrahydrofuran	**C4F8O**	**75**	**80**
Phosphine	**PH3**	**950**	**980**
Propane	**C3H8**	**220**	**233**
Propylene	**C3H6-2**	**220**	**233**
Silicon Tetrachloride	**SiCl4**	**75**	**80**
Sulfur Dioxide	**SO2**	**75**	**80**

Sulfur Hexafluoride	**SF6**	**950**	**980**
Tetrafluoroethane (R-134a)	**C2H2F4**	**220**	**233**
Tetrafluoromethane	**CF4**	**950**	**2980**
Trifluoromethane	**CHF3**	**950**	**2980**
Trimethylsilane	**C3H10Si**	**75**	**80**
Tungsten Hexafluoride	**WF6**	**75**	**80**
Xenon	**Xe**	**950**	**980**

CAUTION

The leak test source for the GASGUARD Source System should be used only to test other gas source systems or VMBs handling the same process gas or compatible process gases. It must not be connected to systems handling incompatible process gases.

3.6 Pneumatic Supply

A pneumatic supply of inert gas without oxygen is recommended for our controllers. **It is strongly recommended to not use clean dry air for pneumatic supply.** The pneumatic supply may be shared in the controller between the pneumatic solenoids and the enclosure inerting/pressurizing service (Z-purge). Clean dry air may promote the corrosion of electrical connectors for interconnecting power cables. The presence of oxygen enhances the corrosion effect and may result in deterioration of controller performance.

This nitrogen supply needs to be regulated to 85-95 psig (5.9-6.6 barg). The flow rate required for pneumatic valve operation is negligible. If compressed air is used as the pneumatic source, the compressor shall be located in a non-classified area. If the air intake line for the compressor passes through a classified location, the line shall be made of a non-combustible material designed to prevent leakage and protect against mechanical damage. If electrical power for the purge air is required, this power shall be on a separate disconnect or before the gas ***source system*** disconnect.

In NEC Class I, Division 2 applications (in U.S.A.) and in ATEX Zone (Group) 2, Category 3 (in Europe) this supply is also used for Type Z purge of the electrical enclosure. The Type Z purge is required to maintain a positive pressure at or above 0.1" H_2O (24.9 Pa) as dictated by the National Fire Protection Agency (NFPA) and the European directives (ATEX). In applications where Type Z purge is required, the controller will be equipped with a pressure switch to monitor the pressure. The Type Z purge will require a flow rate of up to 12 LPM (25 CFH), and GASGUARD® eV will require a flow rate of up to 7 LPM (15 CFH). Do not exceed 12 LPM (25 CFH) during purge of the AP11 or 7 LPM (15 CFH) during purge of GASGUARD® eV.

Typically this supply is taken from a houseline nitrogen source. A 1/4" Swagelok® connection at the back of the controller is provided for the pneumatic supply inlet connection as shown in Figure 3.5. Piping for the pneumatic supply must be protected from mechanical damage. Maximum allowable working pressure is 100 psig (6.9 barg). Over-pressurization protection, such as a safety relief valve, must be provided for the internal solenoids.

⚠CAUTION

Solenoids may be damaged and system valves may fail to close if pneumatic pressure exceeds 100psig.

3.6.1 Z-purge Procedure

The Z purge pressure is controlled by a needle valve at rear of controller. After opening the controller in a suspected hazardous area it is necessary to use the following procedure to re-establish the Z-purge before operating the controller:

1. Close the controller front and tighten both latches completely.
2. Open the needle valve 4 to 5 turns (counter-clockwise). Allow the controller to purge for 20 minutes. For GASGUARD® eV, the purge time is 30 minutes.
3. Adjust needle valve to satisfy the "Z-Purge" alarm (approximately 2 total turns open).

Flow requirements to operate the solenoid valves are very small, less than 1 LPM (2 CFH). If Type Z purge is required, a flow rate of 12 LPM (25 CFH) will be needed, depending on the tightness of the individual controller and the installation. GASGUARD® eV will require 7 LPM (15CFH). Flow rates should be monitored during Type Z purge. Do not exceed 12 LPM (25 CFH) during purge of the AP11 or 7 LPM (15 CFH) during purge of GASGUARD® eV.

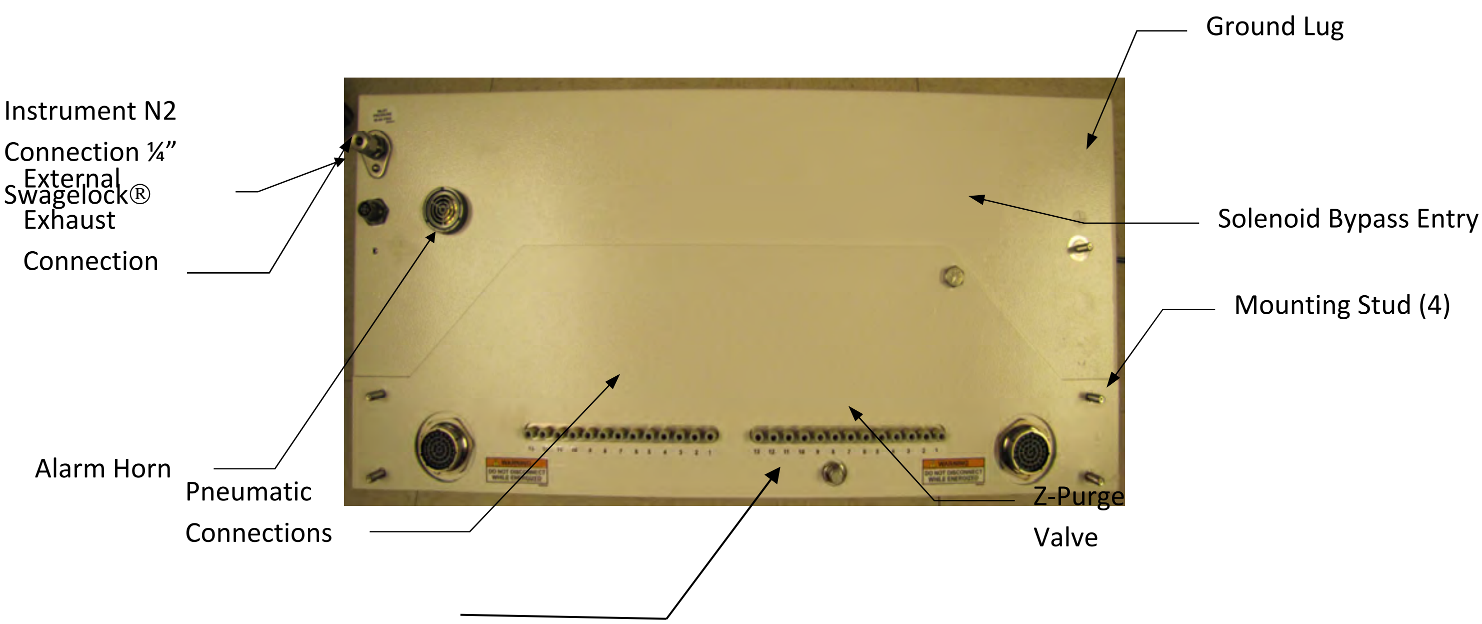


Figure 3.5: Rear View of GASGUARD® AP11 Controller

3.7 Enclosure Exhaust System Requirements

1. In order to meet SEMI S2 criteria in HPM (Hazardous Production Material) gas service, the enclosure should control emissions into the room to less than 25% TLV (Threshold Limit Value) of the HPM gas in the event of an internal leak.

2. In order to meet NFPA criteria (U.S.A. only) in HPM gas service, air velocity across the opened access hatch must meet the following velocity requirements to minimize potential operator exposure to hazardous gas: 200 feet per minute average, with 150 feet per minute minimum at any point (61 meters per minute average, with 46 meters per minute minimum).

3. In order to meet the minimum safety requirements for enclosed Silane gas service, the volumetric air flow through the cabinet must be at least 250 times the maximum potential leak rate. Reference NFPA, IFC (U.S.A. only), and CGA G-13.

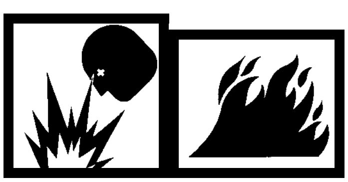
⚠WARNING

The values listed in the tables below should serve as a guideline for reference only. Cabinet ventilation systems must:

(1) Be designed, installed, and balanced to suit individual facility requirements.

(2) Comply with applicable local, state, and federal codes.

⚠WARNING



This exhaust system must be independent of any general plant exhaust system and must be designed for the types of gases being used. Ensure only compatible gases are fed into each exhaust system. Be certain the exhaust system power and shut down interlocks comply with IFC and NFPA code requirements (U.S.A. only).

The tables below list the exhaust requirement for the Gasguard enclosures to meet the above code requirements.

Table 1A

Minimum Exhaust Requirements for GASGUARD® High Flow Enclosures Containing Silane to meet NFPA and CGA Requirements of 250x Potential Leak Rate Dilution

	Access Port Closed			Access Port Open		
Enclosure Size [1]	exhaust flow (cfm)	static pressure (in H20)	velocity pressure (in H20)	exhaust flow (cfm)	static pressure (in H20)	velocity pressure (in H20)
1 CYLINDER High Flow	625	-0.7	0.63	625	-0.7	0.67
2 CYLINDER High Flow	625	-0.7	0.64	625	-0.7	0.64

Notes: [1] All vent stack duct sizes are 6 inch (154 mm) diameter.

[2] “Access Hatch Open” values produced average velocities greater than 200fpm the access hatch opening at all points.

[3] No Baffles were used on window or in interior.

Table 1B

Minimum Exhaust Requirements for GASGUARD® High Flow Enclosures Containing Disilane Si2H6 (Dilution of maximum potential leak to < ½ LFL and meet former UFC)

	Access Port Closed		Access Port Open	
Enclosure Size [1]	Exhaust flow (cfm)	Static pressure (in H20)	Exhaust flow (cfm)	Average Duct Velocity
1 CYLINDER, High Flow	325	-0.31	350	1783
2 CYLINDER, High Flow	475	-0.54	490	2496

Notes: [1] All vent stack duct sizes are 6 inch (154 mm) diameter.

[2] “Access Hatch Open” values produced average velocities greater than 200fpm through the access hatch opening at all points.

[3] No Baffles were used on window or in interior.

Table 2

Minimum Exhaust Requirements for Enclosures containing HPM gases with a TLV ≥ 0.20 ppm, except Silane, Disilane, and Monochlorosilane

	ACCESS HATCH CLOSED [2] (SEMI S2 criteria)						ACCESS HATCH OPEN [3] (UFC 80 criteria)			
enclosure size [1]	exhaust flow (cfm)	static press. (in H20)	velocity press. (in H20)	exhaust flow (m3/m)	static press. (Pa)	velocity press. (Pa)	exhaust flow (cfm)	velocity press. (in H20)	exhaust flow (m3/m)	velocity press. (Pa)
1 CYLINDER	75	-1.0	0.009	2.1	249	2.2	173	0.048	4.9	11.9
2 CYLINDER	75	-1.0 [4]	0.009	2.1	249	2.2	326	0.171	9.2	42.6
3 CYLINDER	75	-1.0 [4]	0.009	2.1	249	2.2	282	0.128	8.0	31.9

Notes: [1] Vent stack duct sizes are 6 inch (154 mm) diameter for the MC-1Cyl/2Cyl/3Cyl

[2] “Access Hatch Closed” values have been measured, or calculated at the exhaust stack duct.

[3] “Access Hatch Open” values have been calculated to achieve a velocity of 200 feet per minute (61 meters per minute) through the access hatch opening, and include 20% to account for flow through the air inlet diffuser, door gasketing, and latches.

[4] Static pressures less than -1.0 inches of water column may not meet UFC access port velocity requirements. An access port baffle is available which reduces access area by 50% to reduce exhaust flow requirements when the hatch is open.

Table 3

Minimum Exhaust Requirements for Enclosures containing HPM gases with a TLV between 0.050 and 0.20 ppm, except Silane, Disilane and monochlorosilane

[Includes the following pure (100%) gases: Chlorine Trifluoride, Diborane, Arsine, Hydrogen Selenide]

	ACCESS HATCH CLOSED [2] (SEMI S2 criteria)						ACCESS HATCH OPEN [3] (UFC 80 criteria)			
enclosure size [1]	Exhaust flow (cfm)	Static press. (in H20)	velocity press. (in H20)	exhaust flow (m3/m)	static press. (Pa)	velocity press. (Pa)	exhaust flow (cfm)	velocity press. (in H20)	exhaust flow (m3/m)	velocity press. (Pa)
1 CYLINDER	120	-1.0	0.020	3.4	249	5.0	173	0.048	4.9	11.9
2 CYLINDER	120	-1.0 [4]	0.009	3.4	249	5.0	326	0.171	9.2	42.6
3 CYLINDER	120	-1.0 [4]	0.009	3.4	249	5.0	282	0.128	8.0	31.9

Notes: [1] Vent stack duct sizes are 6 inch (154 mm) diameter for the MC-1Cyl/2Cyl/3Cyl

[2] “Access Hatch Closed” values have been measured, or calculated at the exhaust stack duct.

[3] “Access Hatch Open” values have been calculated to achieve a velocity of 200 feet per minute (61 meters per minute) through the access hatch opening, and include 20% to account for flow through the air inlet diffuser, door gasketing, and latches.

4] Static pressures less than -1.0 inches of water column may not meet UFC access port velocity requirements. An access port baffle is available which reduces access area by 50% to reduce exhaust flow requirements when the hatch is open.

Table 4

Monochlorosilane (SiH3Cl)

	Access Port Closed		Access Port Open	
enclosure size [1]	Exhaust flow (cfm)	Static pressure (in H20)	Exhaust flow (cfm)	Average Duct Velocity (fpm)
Standard Flow Doors, 1, 2 and 3 CYLINDER	225	-1.6	320	3100

3.7.1 Exhaust Flow Clarifications and Definitions

1. For 1 x 1 cylinder cabinet configurations, be sure to provide ventilation capacity and ventilation connections for two, 1 cylinder cabinets.

2. For 1 x 2 cylinder cabinet configurations, be sure to provide ventilation capacity and ventilation connections for one, 1 cylinder cabinet, and one 2 cylinder cabinet.

3. High-impact polycarbonate baffles are not supplied and are not available and not necessary for the access hatch of any 1 cylinder cabinet.

4. The throat diameter of all enclosures is six inches. The building ventilation system will likely require a larger duct size diameter. Building ventilation systems must (1) be designed, installed, and balanced to suit individual facility requirements, and (2) comply with applicable local, state, and federal codes.

5. Definitions:
   Static pressure - The suction pressure provided by the exhaust system measured near the entrance of the 6” (154 mm) round exhaust duct. Static pressure does not provide a verification of exhaust flow. See velocity pressure.
   Velocity pressure - Moving air creates a force, or pressure component, that can be measured by means of a pitot tube and differential pressure measuring device such as a pressure switch or pressure transmitter. These devices can be used to verify exhaust flow and provide a visual, digital, or analog signal; they only provide an approximation of the exhaust flow rate. They cannot provide an accurate measurement of exhaust flow due to their location and air flow characteristics in the round exhaust duct located on the enclosure.
   High-impact polycarbonate baffle - A clear high-impact polycarbonate window closing off 50% of the access hatch area when the window is opened. This baffle reduces air flow requirements through the hatch.

Figure 3.6 shows the typical exhaust hookup location. See the installation drawing, if requested, for the specific location and size of the cabinet exhaust duct. Also shown is the location where static, or velocity pressure is measured.

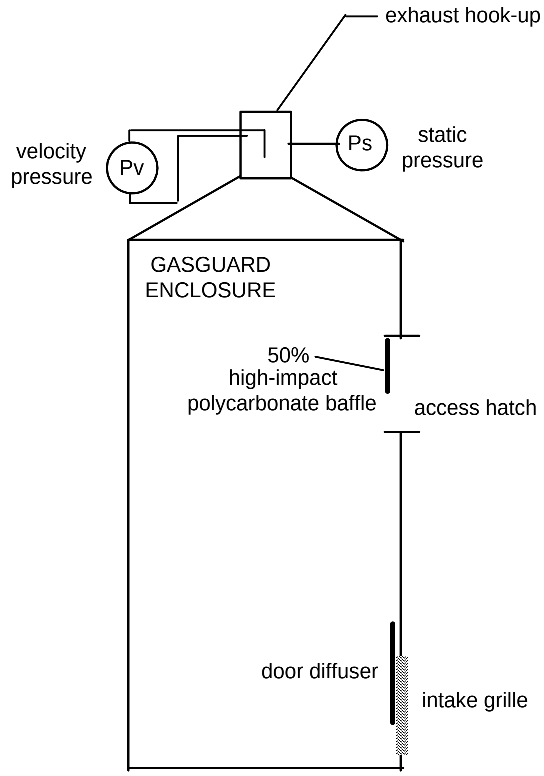


Figure 3.6: Exhaust Hook-up and Ventilation Measurement Location

3.8 Sprinkler Installation

GASGUARD® Source System Cabinets, Wall Mounts and Racks can contain optional coated sprinkler head(s) with a trip point of 165° F (74° C). The sprinkler head is capable of flowing 32 GPM @ 31 psig (145 LPM @ 2.1 barg). The connection is a ½" FNPT. It is located on the ceiling of cabinets and on wall mounts and racks the optional sprinkler is located on the controller shelf. Figure 3.7 shows the sprinkler connection location for a 2 cylinder cabinet.

Sprinklers may not be provided for racks or wallmounts. Area or room sprinklers are should be installed for these open systems where required for HPMs.

⚠CAUTION

Local code may require area or room sprinklers.

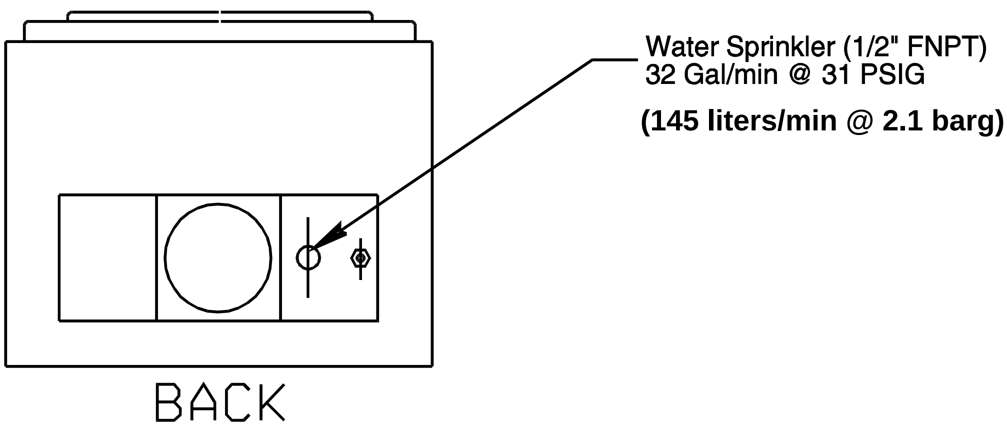
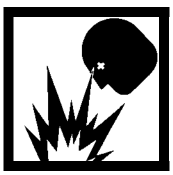


Figure 3.7: Sprinkler Connection Location

3.9 Helium Leak Test Port (Optional)

A helium leak test port may be provided on the vent header for connection to a helium mass spectrometer. A manual valve, MV22, isolates the downstream vent system in order to achieve vacuums required for in-board leak testing upstream. When leak testing is complete, the VCR port must be capped and manual valve
MV22 should be opened and left open during normal operation of the GASGUARD® Source System.

WARNING



The helium leak test port is for vacuum service only. Do not connect pressurized gas to this port.

3.10 Hazardous Gas Leak Detection System (Customer Requirement)

A gas leak detection system must be installed by the customer for all toxic gases used in the Gasguard cabinet. The detection points must include the interior of the gas cabinet. If a leak is detected, the system must provide signals that will shutdown the gas cabinet as required by local code. See specific I/O field wiring drawings provided in the document envelope.

A hydride leak detection system is highly recommended for Silane and other pyrophoric gases. Although these gases will normally ignite and burn immediately when they leak to atmosphere, under certain conditions they can pocket and detonate with devastating force. A hydride monitor can detect leaking Silane and shutdown the system eliminating or reducing the risk and size of explosion.

3.11 Restrictive Flow Orifice (RFO) for Cylinder Valve (Customer Requirement)

A restrictive flow orifice (RFO) must be installed in the outlet valve of any cylinder containing a highly toxic gas or gas mix.

An RFO with a maximum orifice diameter of 0.010 inch (.254mm) must be installed in the outlet valve of any cylinder containing pure silane or mixes containing 2% or more of silane.

In addition to the above requirements, systems that do not have an excess flow switch installed in the process piping line must have an RFO installed in the outlet valve of the cylinder, if the cylinder contains a toxic gas, flammable gas, toxic gas mix or flammable gas mix.

A restrictive flow orifice (RFO) may be used (at the customer's discretion) to reduce the hazardous exhaust treatment requirements, as an RFO will decrease the maximum potential leak rate from a full cylinder.

Finally, a maximum 0.02 inch RFO is required in the cylinder valve for F2 mixes of 5% or more. The RFO is required to reduce the potential for a reaction between the high percentage fluorine mix and internal soft goods.

WARNING

Do not operate equipment without a properly sized RFO installed in the cylinder valve.

3.12 Purifier Installation & Conditioning

When a hazardous purifier is purchased for use in a GASGUARD® Source System, it is not installed at the factory. It typically ships separately from the source system. It is important to match the purifier with the appropriate source system. The instructions for the proper installation and conditioning of each purifier are contained in the purifier manufacturer's operation and installation manual. These procedures vary by gas type, manufacturer, and model so it is important to completely read and understand the literature for every purifier. If necessary, please contact your GASGUARD® representative for assistance.

WARNING

Do not attempt to install purifier without completely reading and understanding the purifier installation manual. Failure to fully read and understand the purifier manual may result in a serious reaction when the purifier is exposed to atmosphere or process gas.

WARNING

Do not attempt to install purifier without proper conditioning. Failure to comply with the manufacturer's procedures may result in a serious reaction when the purifier is exposed to atmosphere or process gas.

3.13 Cylinder Cooling (Diborane Mixes)

Diborane (B2H6) is thermally unstable and decomposes at room temperature. It polymerizes to form higher-order boron hydrides, primarily B10H14, that are also nonvolatile and have a tendency to plug the regulator, valves, filters and other restrictions in the system. The following reaction describes the decomposition of diborane:

$$5B_2H_6 \rightarrow B_{10}H_{14} + 8H_2$$

Temperature is a key factor in the decomposition of diborane mixes. The colder the storage temperature of the cylinder, the less decomposition will occur. See Figure 3.13.a. A maximum storage and usage temperature of 4.4°C (40°F) is highly recommended.

The preferred method of cylinder cooling in a gas cabinet is through the use of a closed system recirculating chiller. Contact your GASGUARD(R) representative for details. Ice baths are not recommended.

> NOTE: Failure to maintain a cylinder temperature of 4.4°C (40°F) or less may result in reduced component and B2H6 product life.

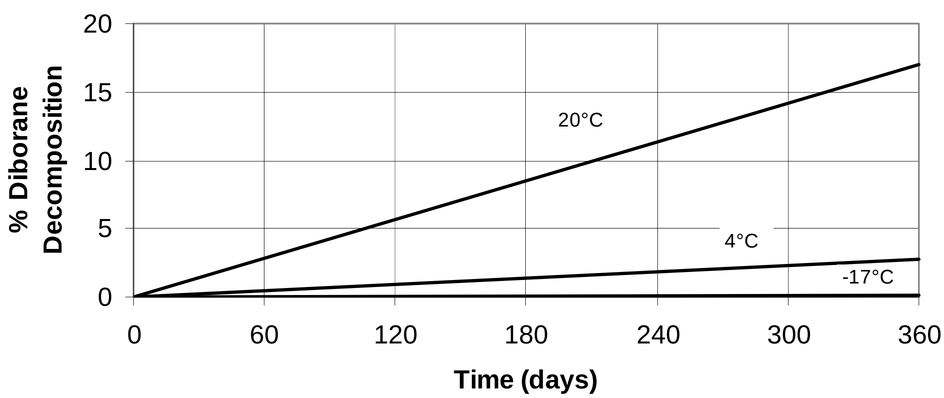


Figure 3.13.a: Percent of Initial Diborane Concentration Versus Time for a 5% B2H6 mix

The initial concentration of B_2H_6 mix is another key factor in the decomposition of diborane mixes. It is recommended to use the lowest workable concentration to prolong the equipment and product life. The higher the initial concentration in the cylinder, the more rapidly the decomposition will occur. See Figure 3.13.b. It is especially important to cool the cylinder when dealing with higher % B_2H_6 mixes.

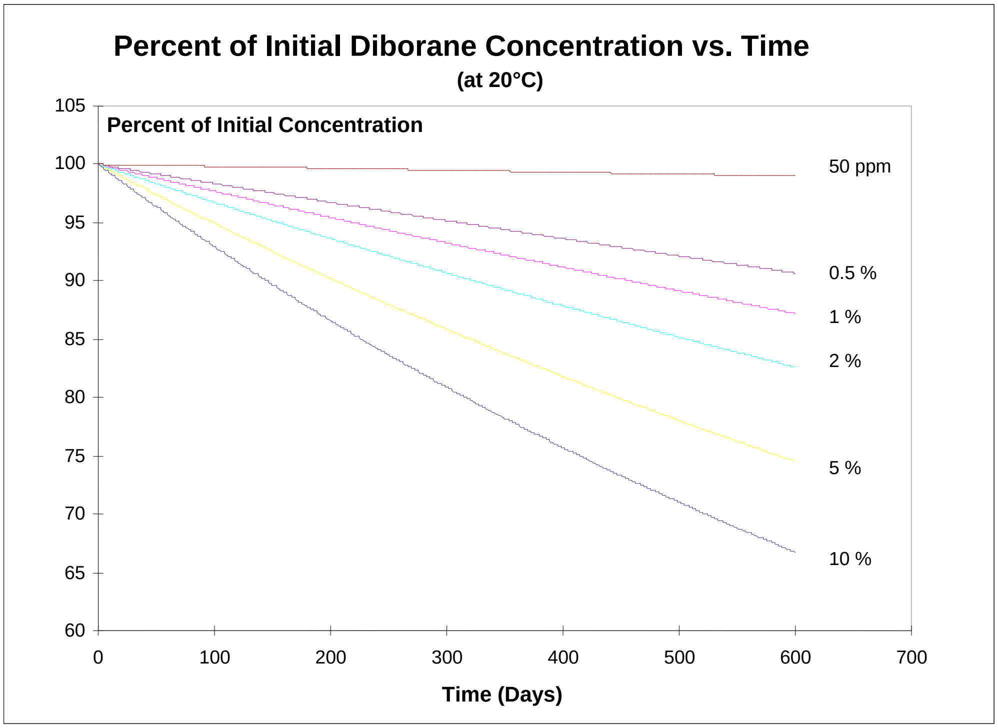


Figure 3.13.b: Percent of Initial Diborane Concentration Versus Time (at 20°C)

3.14 Hazardous Area / Potentially Flammable Atmosphere Requirements for Rack or Wallmount

For any open rack or wall mount dispensing a flammable gas, the surrounding area must be protected from potential ignition sources and comply with local requirements for Electrical Classification / Hazardous Area Protection, such as ATEX or Class 1 Div2 certification. Typically, the protected zone must extend a minimum of 10ft radius around the system.

Chapter 4

Electrical Connections

All electrical connections must comply with Article 300 - Wiring Methods and Article 500 - Hazardous (Classified) Locations of the National Electric Code (NEC), if installed in the United States.

All electrical connections must comply with Canadian Electrical Code (CEC), Part I, CSA C22.1, and CSA C22.2 No. 0, if installed in Canada.

Reference to the use of this equipment in Hazardous Locations only applies to installations located within the United States of America or Canada. These systems are also Explosive Atmosphere Directive approved for use in the European Community and have been reviewed by a third party test lab.

Range of Environmental Conditions:

- -20 to 60° C Operating Temperature Range
- 95% Maximum Relative Humidity
- 2000 Meters Above Sea Level, Maximum
- 100 to 240 VAC Nominal Voltage Range, 3 wire, 50 to 60 Hertz
- ± 10% Fluctuation of Nominal Voltage Range
- Short Circuit Current Rating (SCCR) is 10 kA

Range of Environmental Conditions and Conditions of Use (with GASGUARD® eV):

- -20 to 40° C Operating Temperature Range
- 95% Maximum Relative Humidity
- 2000 Meters Above Sea Level, Maximum
- 120VAC or 208-240VAC Nominal Voltage Ranges, 3 wire, 50 to 60 Hertz
- ± 10% Fluctuation of Nominal Voltage Range
- Short Circuit Current Rating (SCCR) is 5 kA
- Must be installed with appropriate protection from light to ensure that the resistance to light of the GASGUARD® eV or parts of the GASGUARD® eV is satisfactory.
- This equipment is intended for installation only in locations providing adequate protection against entry of solid foreign objects and water capable of impairing safety.
- Equipment is intended for indoor installation. It has been evaluated for installation in locations provided adequate protection against the entry of water. The equipment is intended to be afforded the equivalent of ingress protection IP54 by location.

- Upon installation, all conduit connections must be sealed appropriately for type protection "pzc".
- The GASGUARD® eV cabinet must remain locked during normal operation. Operating personnel shall only unlock and open the lower cabinet door while performing canister changes or prescribed preventative maintenance procedures and the area is known to be free of flammables.
- Year of construction for the GASGUARD® eV can be determined by contacting your Versum Materials representative. Equipment number and serial number will need to be provided, which can be found on the door of the GASGUARD® eV.

4.1. Grounding Method

The equipment must be grounded in accordance with Article 250 - Grounding in the National Electrical Code, if installed in the United States. The customer is responsible for connections to earth ground. A ground connection is supplied in the controller for this purpose.

On the plenum of the gas cabinet there is an additional split bolt terminal for connection hookup to the facilities grounding network. Figure 4.1 shows a suggested grounding method for a typical system. This drawing may not be applicable to your specific system.

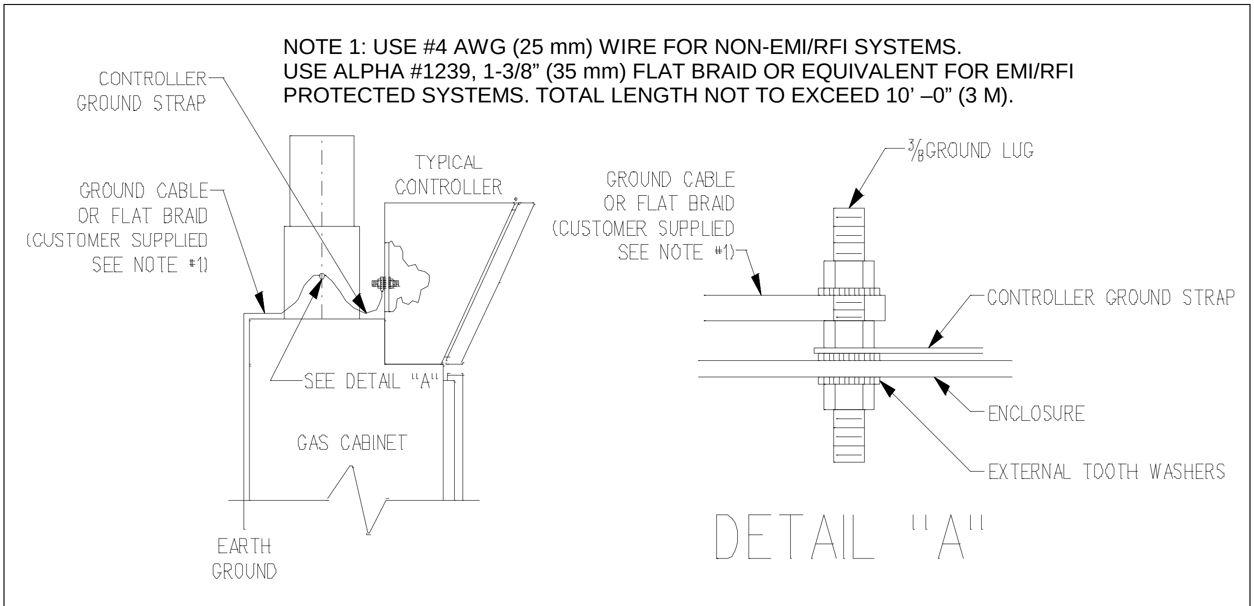


Figure 4.1: Suggested Grounding Method

Use of #4 AWG ground wire will not maintain CE marking. Use Alpha #1239, 1-3/8" flat braid or equivalent for CE marked systems (total length not to exceed 10 feet or 3 meters).

After grounding the overall resistance must be measured. This resistance for the equipment ground to the grounding electrode should not exceed one ohm (1Ω). Check the effectiveness of grounding by using a ground resistance meter (i.e., an AEMC clamp on ground resistance tester or equivalent).

For 1X1 and 1X2 cabinet configurations, each cabinet requires grounding to earth ground.

Reference: Worldwide Engineering Specification #4WEQ-9502 GASGUARD® Gas Cabinet Grounding Specification

4.2. Power Supply Connection – AP11 controller only

Each GASGUARD® System should be installed with an independent external circuit interrupting device to remove power from the unit when maintenance on the controller is required and should be Lockout/Tagout capable. This device should be rated as a minimum at 240 volts, 3 amps, 50/60 Hz and 10,000 rms symmetrical ampere interrupting capacity. The device should be accessible to the operators, marked as the disconnecting device for the gas cabinet, and must have the on/off position clearly marked for the operator, and should be near the gas cabinet.

Disconnect switches shall meet the requirements of IEC 60947-1 and IEC 60947-3 and the disconnect switch must not interrupt the protective earth conductor.

The power input must be wired to the terminals shown below. For additional detail on the power connection, see Figure 4.2a, 4.2b, depending on your configuration.

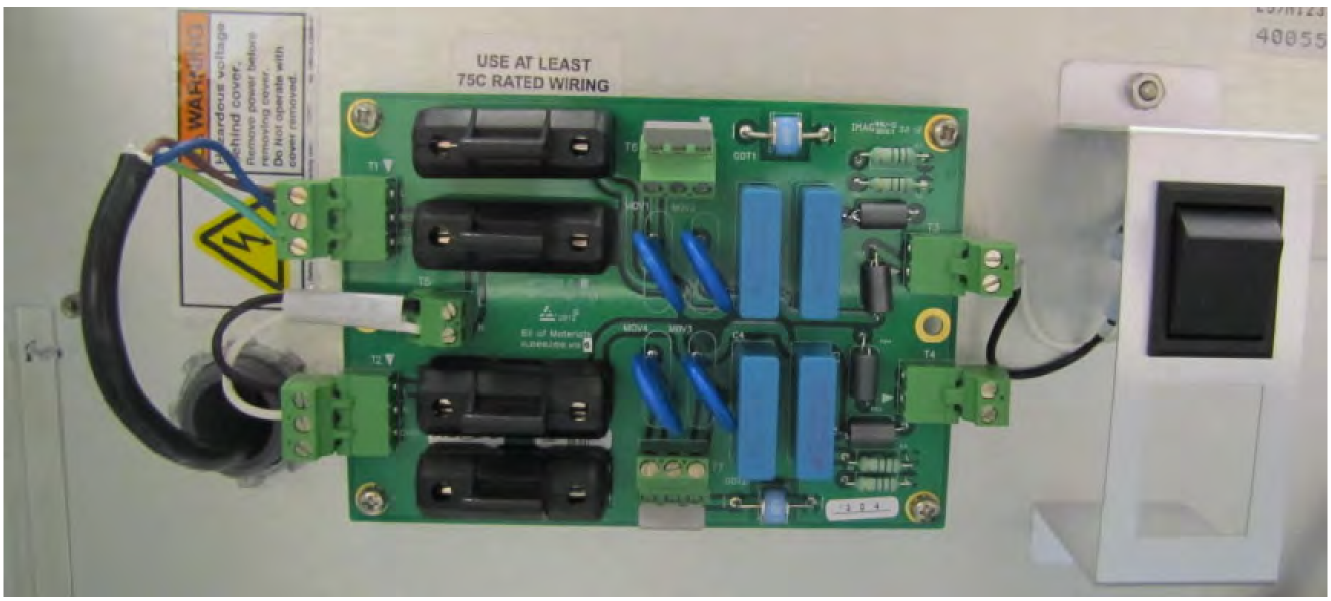


Figure 4.2a: Single Power Supply Terminal Connection

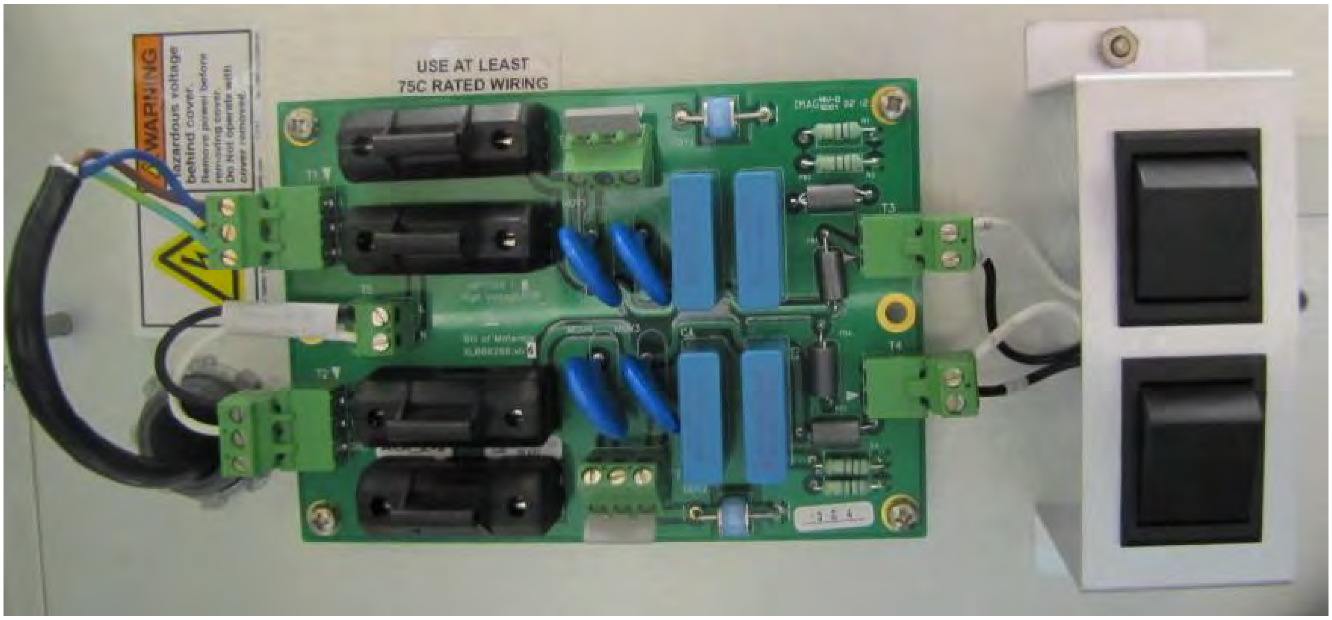


Figure 4.2b: Dual Power Supply Terminal Connection

The power requirements are as follows:

100-240 VAC @ 150 VA maximum, 3 wire

The controller power is the same for idle, average, and peak and is less than 0.125 KW.

NOTE: Power wiring must be sized to deliver the required voltage at the rated current. Voltages should be checked at each cabinet after installation to ensure proper levels. Wire size should not exceed 12AWG (3.3 mm^2). An optional kit is available to allow use of 10AWG (5.26 mm^2) wire.

Replaceable fuses - F1, F2, F3, and F4 located on the power board are 4A super quick acting fuses. See the Spare Parts List in Chapter 11 for Manufacturer and part number specifications.

Use at least 75C rated wiring for the mains supply.

4.3. Power Supply Connection – AP11 with GASGUARD® eV Heating.

Each GASGUARD® System should be installed with an independent external circuit interrupting device to remove power from the unit when maintenance on the controller is required and should be Lockout/Tagout capable. This device should be rated as a minimum at 240 volts, 15 amps, 50/60 Hz and 10,000 rms symmetrical ampere interrupting capacity. The device should be accessible to the operators, marked as the disconnecting device for the gas cabinet, and must have the on/off position clearly marked for the operator, and should be near the gas cabinet.

Disconnect switches shall meet the requirements of IEC 60947-1 and IEC 60947-3 and the disconnect switch must not interrupt the protective earth conductor.

See Appendix E for information specific to Remote eV Controller.

Power Requirements: Single Power Feed

120 VAC, 17A, 50/60Hz, 3 wire
OR
208-240 VAC, 9A, 50/60Hz, 3 wire

Power Requirements: Controller Powered Separate from Heaters

Heaters: 120 VAC, 17A, 50/60Hz, 3 wire
Controller: 100-240 VAC @ 150 VA maximum, 50/60Hz, 3 wire
OR
Heaters: 208-240 VAC, 6A, 50/60Hz, 3 wire
Controller: 100-240 VAC @ 150 VA maximum, 50/60Hz, 3 wire

Acceptable wire gauge:

Single power feed: 14-8 AWG
OR
Heater Power: 14-8 AWG
Controller Power: 14-10 AWG

Replaceable fuses:

F1, F2, F3, and F4, located on the power board in the top of the AP11 controller, are 4A super quick acting fuses.
FS-107, located the GASGUARD® eV power enclosure adjacent the DC power supply, is a 2A fast acting fuse.
See the Spare Parts List in Chapter 11 for Manufacturer and part numbers and specifications.

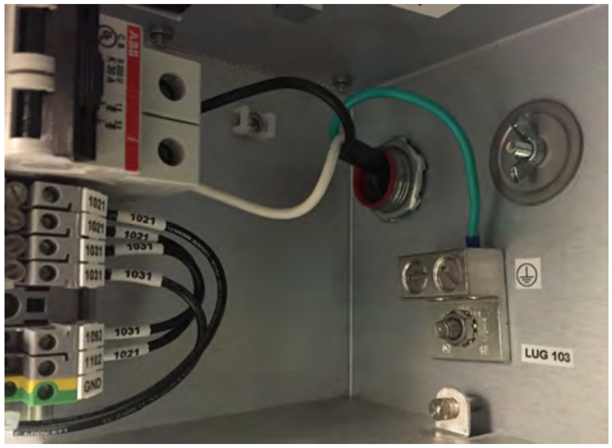


Figure 4.3a: Power Connections

Dual Power Supply Connection:

- To supply power for the AP11 controller separate from the heaters complete the following steps: Remove wires between terminal blocks 1031-1092 and 1021-1102 (Figure 4.3c).
- Wire heater power feed into the normal connection points (CB-102 and ground lug on rear wall.
- Wire controller power feed into terminal blocks 1092 (L1), 1102 (L2/N), and ground lug on rear wall.
- Apply "Danger – Hazardous Voltage Fed by Two Sources" label to controller door as shown (Figure 4.3b).

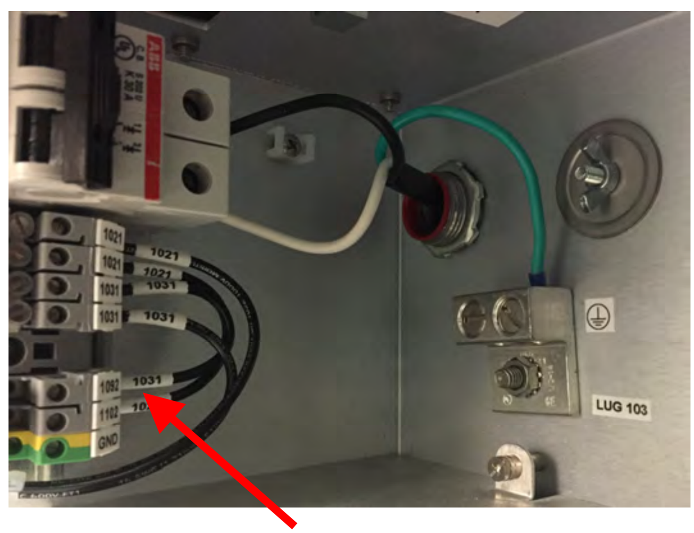


Figure 4.3b: Label Placement

Figure 4.3c: Wire Removal

4.4. Field Connections

⚠WARNING

In NEC Class I, Division 2 areas (only in the U.S.A.), a conduit seal ("pour fitting") or equivalent must be installed between each electrical connection point on the cabinet and the electrical source. Liquid tight flexible conduit can be installed between the GASGUARD® AP11 connectors and the conduit seals to facilitate these connections. A maximum length of 18" (457 mm) is allowed between the last pour fitting and the cabinet connector. All conduits shall be sealed in accordance to Sections 501-5, 502-5 or 504-70 of the National Electric Code. See Figures 4.4a, 4.4b, 4.4c and 4.4d for details.

NOTE: For Systems approved for installation and use in Explosive Atmospheres (Europe), refer to section 4.8 for additional instructions.

⚠WARNING

In classified hazardous areas – Do not separate electrical terminations or connectors while energized due to risk of electrical arc or spark which can ignite potentially flammable atmospheres.

A 1-1/8" (28.6 mm) diameter hole for 3/4" conduit is supplied for connecting the 120/240 VAC power supply to the system. The conduit hole is located on the top of the controller enclosure. Two additional holes are supplied for customer I/O and/or Ethernet Cable. Figure 4.4a and Figure 4.4b.

Figure 4.4a: Top View of GASGUARD® AP11 Controller

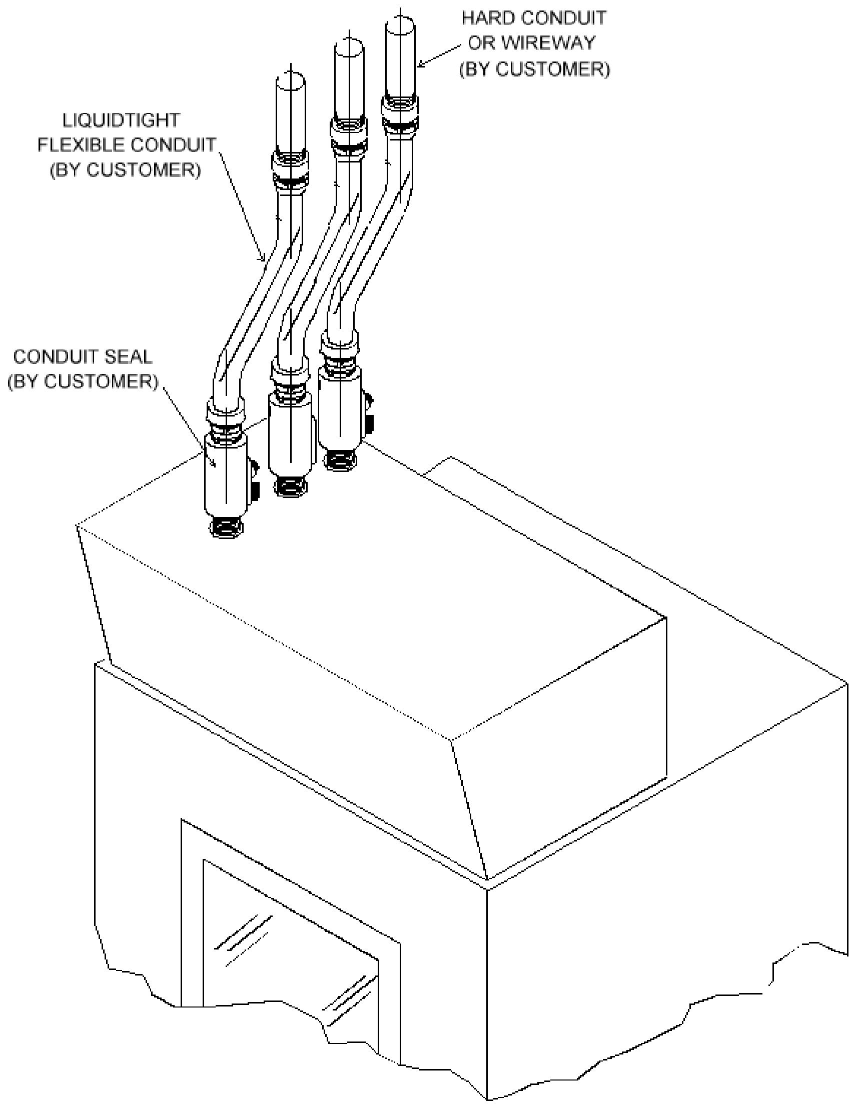


Figure 4.4b: Conduit and Conduit Seals

Controllers with GASGUARD® eV heating control have the conduit holes in the top of the AP11 covered. New conduit locations are shown in Figure 4.4c and Figure 4.4d.

All conduit holes are 1-1/8" (28.6 mm) in diameter for 3/4" conduit.

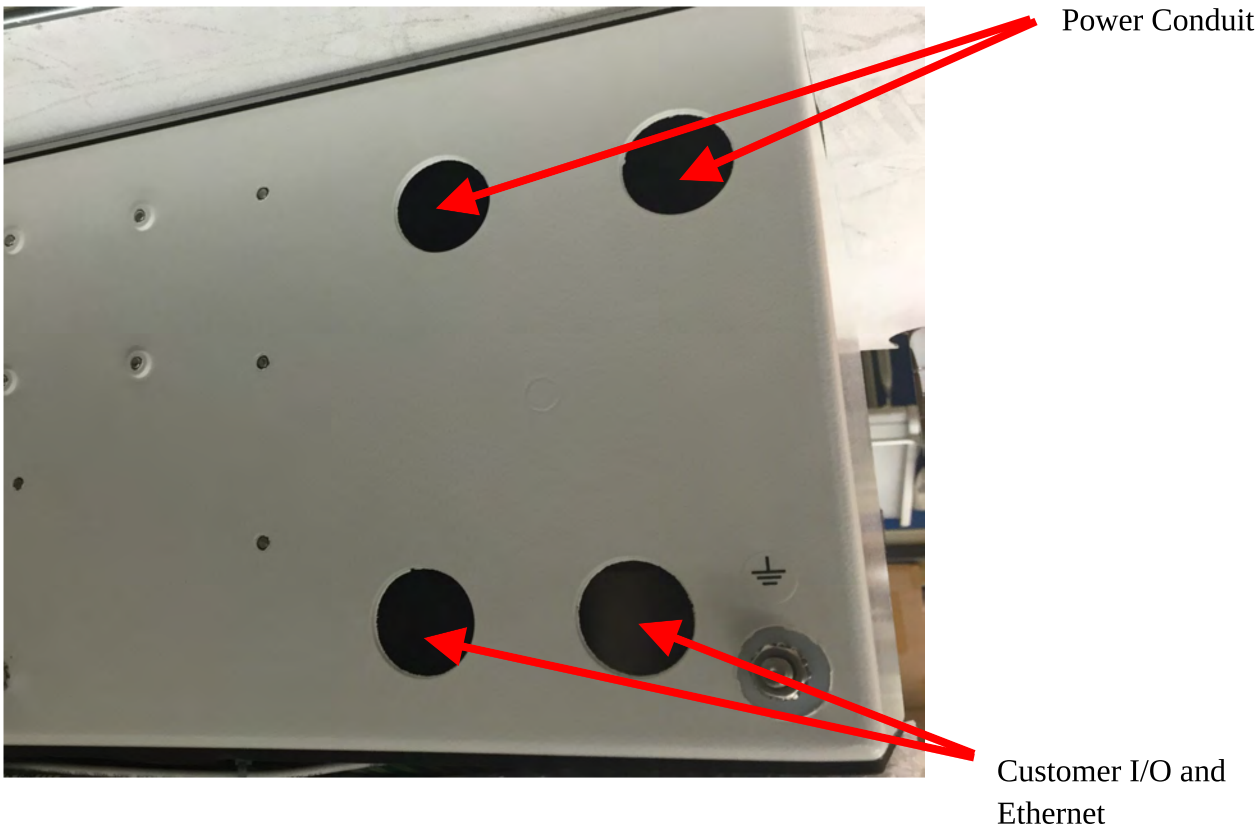


Figure 4.4c: Rear View of GASGUARD® eV AP11 Controller

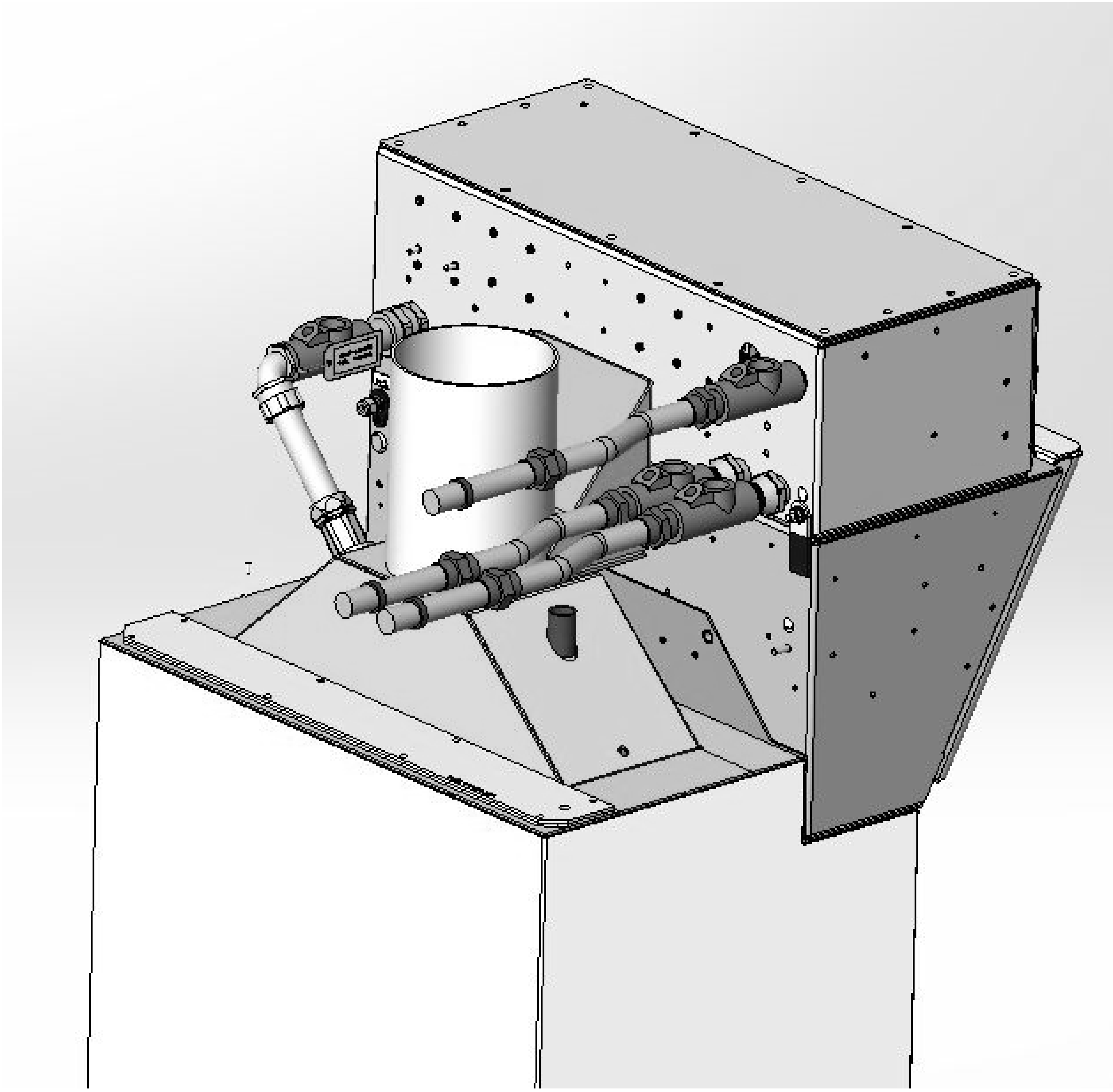


Figure 4.4d: GASGUARD® eV Conduit and Conduit Seals

4.5. External I/O Communication

(Optional Customer boards available upon request)

The GASGUARD® AP11 controller supports connections to external I/O devices through optional Customer I/O boards. There are four available boards, each with a different complement of I/O as shown below.

	I/O Type:						
Board Version:	Digital Inputs	Digital Outputs (Relay dry-contact)	Supervisory Inputs	Analog Inputs (4-20mA, 0-5v)	Setra Analog-Inputs (4-20mA)	Thermocouple-Inputs (J-, K-type)	Analog Outputs (4-20mA)
Customer I/O (**AP1563**)	12	12	2	6	2	-	-
Customer-Lite (**AP1573**)	6	4	-	-	-	-	-
Customer-Expansion (**AP1574**)	12	12	2	6	2	8	-
Customer Analog-Output (**AP1580**)	12	12	2	6	2	-	8

Connections between the AP11 controller and external I/O devices are made at the Customer Board terminals located inside the controller, on the left side wall. See Figures 4.5a, 4.5b, 4.5c, and 4.5d for details on the location of the connections.

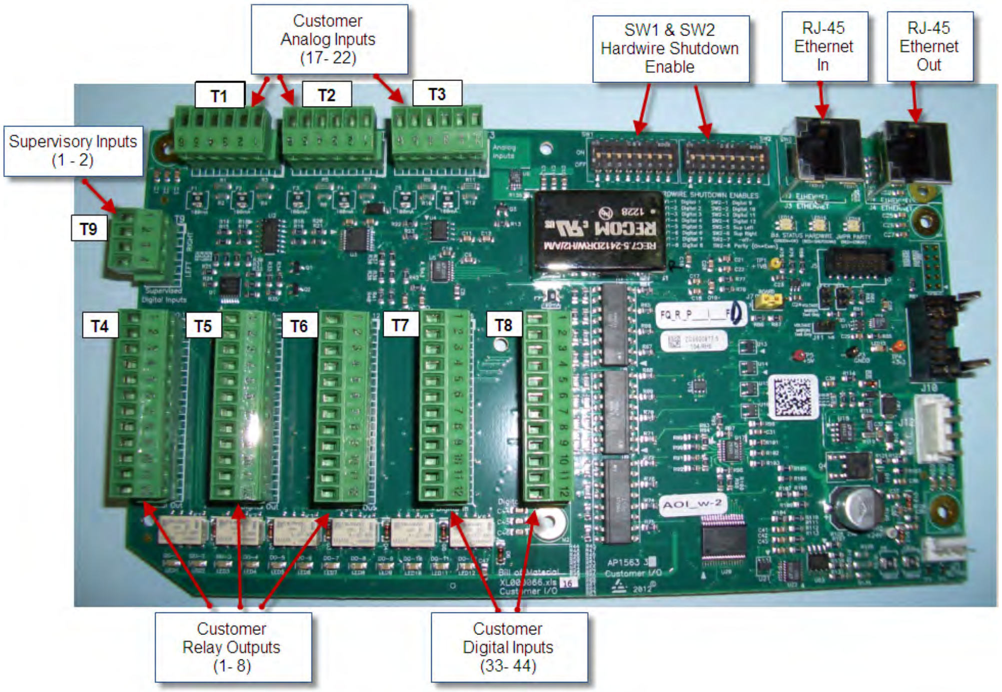


Figure 4.5a: AP1563 Customer I/O Terminal Blocks

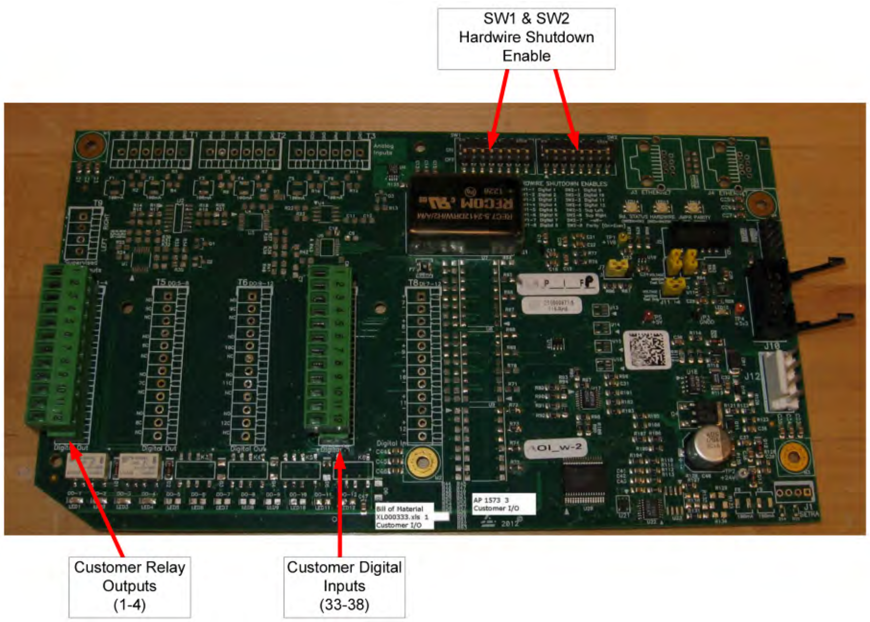


Figure 4.5b: AP1573 Customer-Lite Terminal Blocks

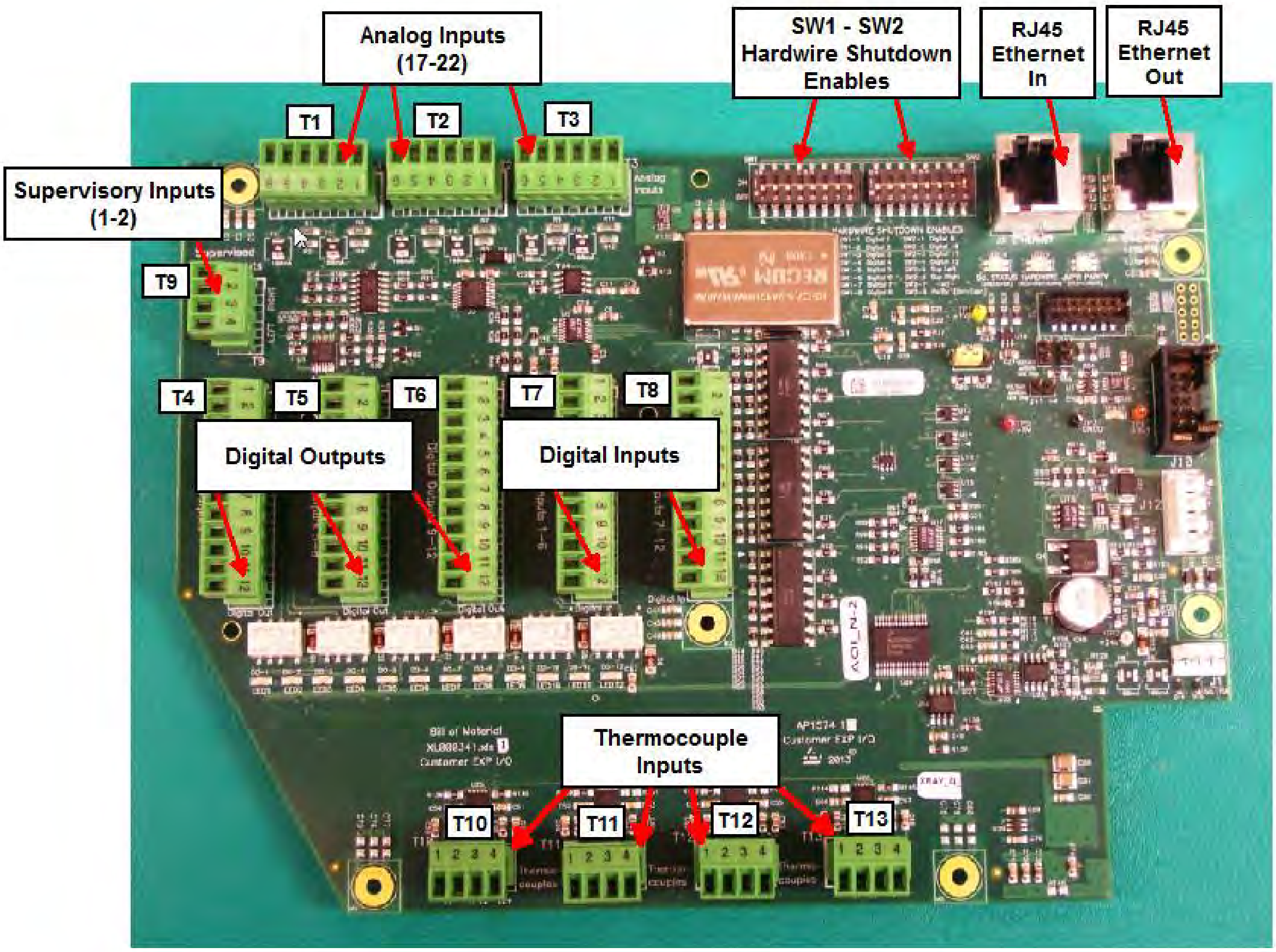


Figure 4.5c: AP1574 Customer-Expansion Terminal Blocks

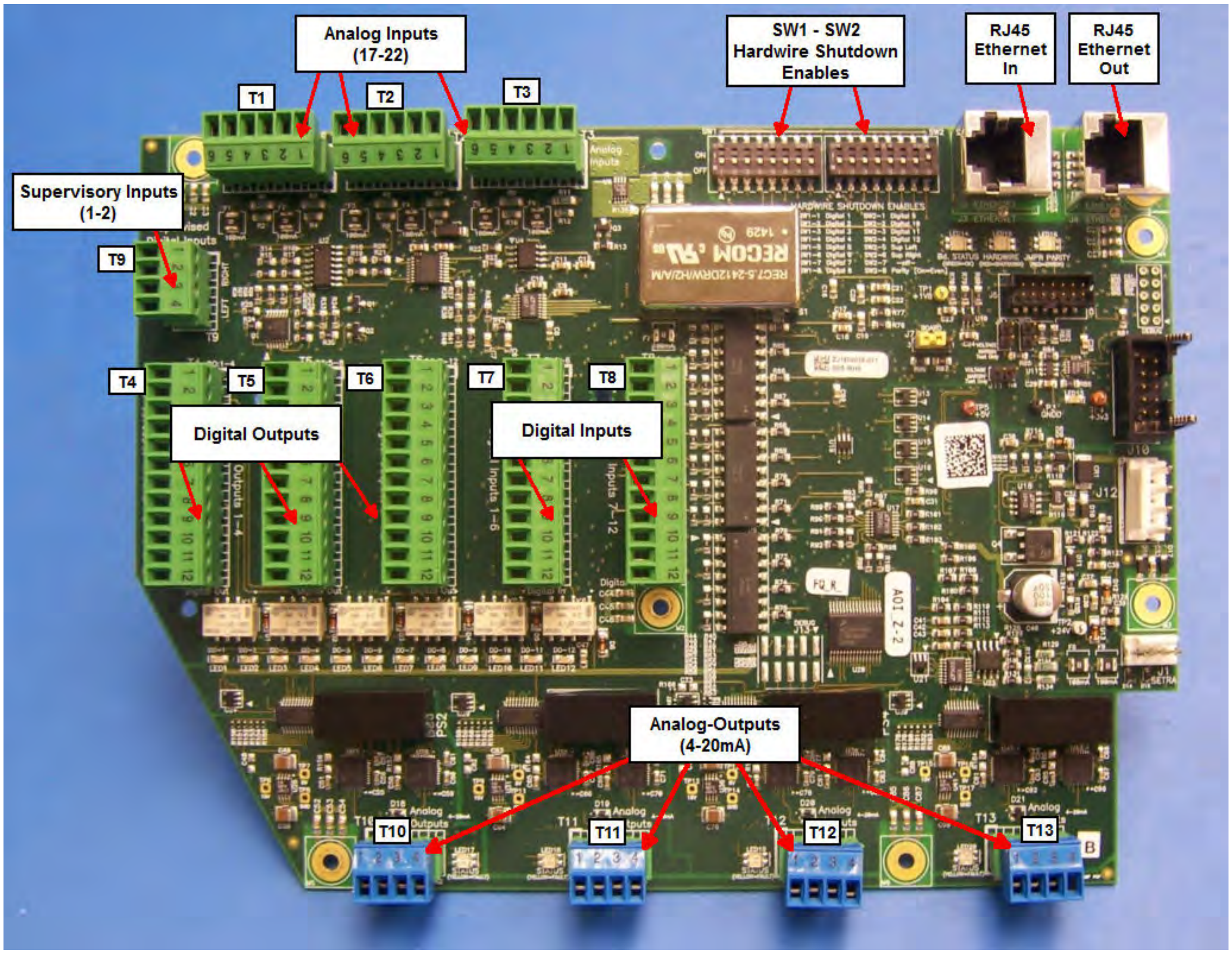


Figure 4.5d: AP1580 Customer Analog-Output Terminal Blocks

The tables on the following pages list recommended external I/O communications and detail digital output and digital input connections.

Specific I/O field wiring connections for this system are found on the drawings in the document envelope, supplied with each system.

Additional I/O circuit boards may have been purchased as an option with this specific system. If so equipped, termination for the additional points will be shown in the drawings located in the document envelope.

4.5.1. Supervised Inputs

(Requires optional AP1563, AP1574, or AP1580 Customer board)

The system supports two supervised inputs from the customer interface. Supervised inputs are digital inputs, which are monitored via a window comparator. These inputs are monitored for normal operation, alarm type, and fault conditions.

A normally open switch is to be used as an input device. This switch must have a 10 kilo-ohm resistor in parallel with the contacts. When the switch contacts are open the circuit will provide a signal, which represents a normal operating condition. When the switch contacts are closed, the circuit will provide a signal which indicates an alarm condition. An open wire in this circuit, or a short circuit, will produce an out of range signal, which indicates a circuit fault.

Switch contacts must be rated for 20mA @ 24VDC. Switch contacts must be dry contact and external wiring should not have any form of power applied to them.

Typically, supervised inputs are used with the life safety system. Figure 4.5e shows the supervisor input wiring for use with the life safety system.

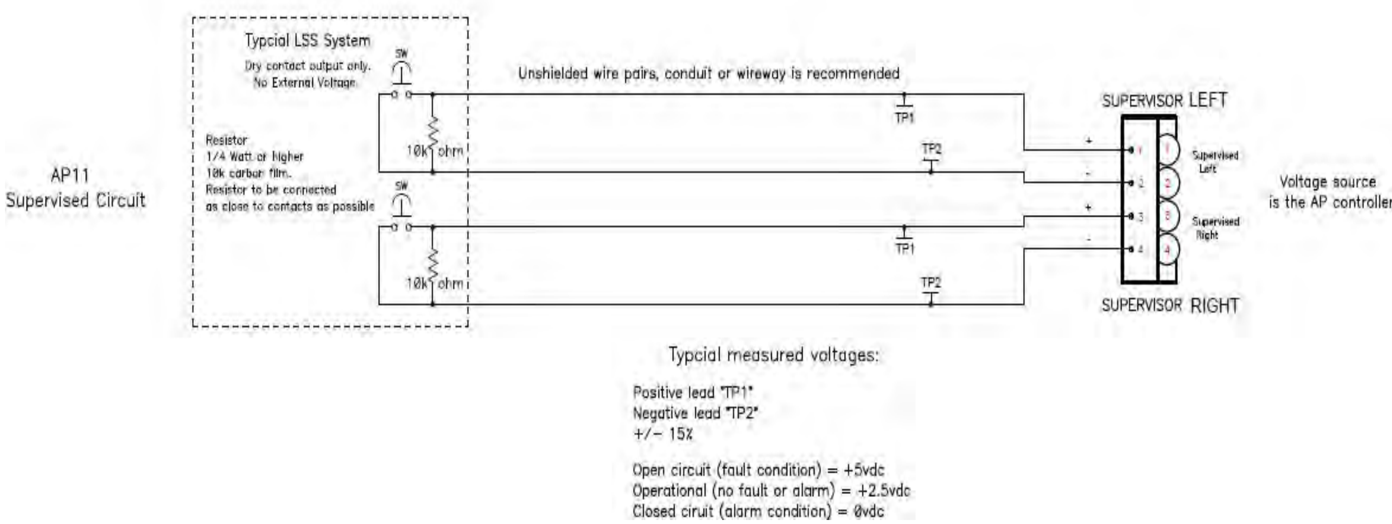


Figure 4.5e: Supervisory Input Wiring

NOTE: wire resistance between the Supervisory Inputs and switch must be less than 300 ohms.

- **Example 1**: typical 24 AWG wire has a resistance of 30-ohms/1000ft. The maximum total wire length is 10,000ft, which equates to a 5,000ft maximum cable-length.
- **Example 2**: typical 26 AWG wire has a resistance of 47-ohms/1000ft. The maximum total wire length is 6,300ft, which equates to a 3,150ft maximum cable-length.

4.5.2. Available External I/O Communications

(Requires optional Customer board)

*** Requires optional AP1563, AP1574, or AP1580**

Digital Outputs	Response
Fault Alarm	Notify when fault alarms occur
Shutdown Alarm	Notify when shutdown alarms occur
Gas unavailable	Notify process tool that gas is unavailable

Digital Inputs	Response
Remote Shutdown	Shutdown GASGUARD® System
Vent system unavailable	Prevents purge modes from starting

Supervised Inputs	Response
Life Safety Shutdown *	Shutdown GASGUARD® System

The GASGUARD® System is equipped with a "vent unavailable" feature which prevents process gas from being vented from the panel if the scrubber system is not operating. Use of this feature requires the installation of a hardwire between the controller and the scrubber. Failure to utilize this feature may result in the discharge of process gas to a non-functioning vent system.

Digital Outputs Dry (Customer)

(Requires optional Customer I/O board)

*** Requires optional AP1563, AP1574, or AP1580**

24 VDC @ 2 Amp maximum

Relay Output #	NO	Customer Brd COMMON	NC
1	T4-1	T4-2	T4-3
2	T4-4	T4-5	T4-6
3	T4-7	T4-8	T4-9
4	T4-10	T4-11	T4-12
5	T5-1	T5-2	T5- 3
6	T5-4	T5-5	T5-6
7*	T5-7	T5-8	T5-9
8*	T5-10	T5-11	T5-12
9*	T6-1	T6-2	T6-3
10*	T6-4	T6-5	T6-6
11*	T6-7	T6-8	T6- 9
12*	T6-10	T6-11	T6-12

Digital Inputs (Customer)

(Requires optional Customer I/O board)

 # Requires optional AP1563, AP1574, or AP1580

Digital Input #	Customer Brd Signal	Customer Brd Return	Hardwire Switch Position
5 / 6*#	T9-LEFT (+)	T9-LEFT (-)	SW2-5
7 / 8*#	T9-RIGHT (+)	T9-RIGHT (-)	SW2-6
33*	T7-1	T7-2	SW1-1
34*	T7-3	T7-4	SW1-2
35*	T7-5	T7-6	SW1-3
36*	T7-7	T7-8	SW1-4
37*	T7-9	T7-10	SW1-5
38*	T7-11	T7-12	SW1-6
39*#	T8-1	T8-2	SW1-7
40*#	T8-3	T8-4	SW1-8
41*#	T8-5	T8-6	SW2-1
42*#	T8-7	T8-8	SW2-2
43*#	T8-9	T8-10	SW2-3
44*#	T8-11	T8-12	SW2-4

* Each digital-input can be individually configured to provide a hardwire shutdown alarm function. Figures 4.5a, 4.5b, 4.5c, and 4.5d optional Customer I/O PCBs provide the location of SW1 & SW2 hardwire switches.

To configure an input as a hardwire, the corresponding switch shown in the above table must be set to the ON position.

SW2-8 Parity Switch setting:
- "On" if total number of active hardwire circuits is 0, 2, 4, 6, 8, 10, or 12.
- "Off" if total number of active hardwire circuits is 1, 3, 5, 7, 9, or 11.
(PCB parity LED will be green when switches are configured correctly)

A digital-input that is in the OPEN state and configured as a hardwire will have the same functional effect as pressing the EMO (Emergency Stop) switch.

Analog Inputs (Customer)

(Requires optional AP1563, AP1574, or AP1580 Customer I/O board)

Analog inputs supplied power at 24VDC fused @ 100 mA each w/ 100 Ω series resistor.

Analog Input #	Customer Brd Signal	Customer Brd 24 VDC+	Customer Brd GND
17	T1 - 5	T1 - 6	T1 - 4
18	T1 - 2	T1 - 3	T1 - 1
19	T2 - 5	T2 - 6	T2 - 4
20	T2 - 2	T2 - 3	T2 - 1
21	T3 - 5	T3 - 6	T3 - 4
22	T3 - 2	T3 - 3	T3 - 1
23 *	J1 - 4	J1 - 1	
24 *	J1 - 2	J1 - 3	

* Analog Input # 23 supports Setra Exhaust sensor #1 & Input #24 supports Setra Exhaust sensor #2

User Power (Customer)
(Requires optional AP1563, AP1574, or AP1580 Customer I/O board)

The AP11 customer board supports six Analog-Input (AI) channels, each of which can be independently configured for **0-5V** or **4-20mA** inputs. Three user-connections (per channel) are provided: +24V-power, +24V-gnd, and signal. A common isolated power-supply is used for all channels, however each channel's power is individually fused/current-limited. The combined power-supply loading of all channels must be less than **200mA**. In some configurations, it may be possible to exceed this limit. It is the users responsibility to ensure this constraint is not violated. The following sections provide detailed guidelines on how to connect and use the customer board.

There are 3 types of devices as shown in Figure 4.5f below. (AP11 connections are shown on the left)

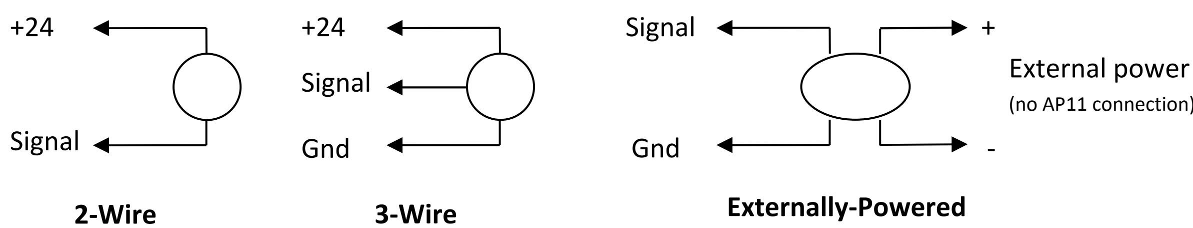


Figure 4.5f

2-Wire (4-20mA) Device: Device has 2 wires: power and signal. The device draws up to 20 mA.

3-Wire Device (Powered from AP11): Device has 3 wires: power, signal, and ground. The current draw should be included on the manufacturer's data sheet and should be plugged into the table below.

Externally-Powered: These devices receive power for their operation from another source and interface with the AP11 using 2 wires: signal and ground.

There are two calculations that must be performed when connecting Analog devices to an AP11.
1. The total current-consumption calculation of AP11-powered devices
2. The cable-resistance calculation for each device connection

The following sections provide detailed examples on how to perform these calculations.

Current-Consumption Calculations for AP11-powered devices:

The current-consumption calculation is necessary to ensure the total draw of all connected devices is less than the 200mA capacity of the Customer Board. If using all 2-wire devices, no calculation is required as the AP11's capacity is sufficient for this configuration. For all other cases, use the following table to determine the current-consumption.

Type	Number of Devices	Multiply by current draw per device	Total
2-Wire (4-20mA) Device		X 20 mA	= mA
3-Wire Device		X mA	= mA
Externally-Powered Device		X 0 mA	= 0 mA
TOTAL (Sum of Above) Can **NOT** exceed 200 mA			mA

Note: If the manufacturer specifies power consumption in watts instead of current in milliamps, assume that the device is receiving 15V and approximate the current draw as follows:

$$Milliamps = \frac{Watts}{15V * 1000}$$

EXAMPLE:
An AP11 needs to connect to three 2-wire devices and two 3-wire devices and one externally-powered device. The manufacturer of the 3-wire device specifies that it will draw no more than 50 mA.

Type	Number of Devices	Multiply by current draw per device	Total
2-Wire (4-20mA) Device	*3*	X 20 mA	= *60* mA
3-Wire Device	*2*	X *50* mA	= *100* mA
Externally-Powered Device	*1*	X 0 mA	= 0 mA
TOTAL (Sum of Above) Can **NOT** exceed 200 mA			*160* mA

In this example, the calculated current draw (160mA) is below the AP11's capacity (200mA) so the configuration is valid.

Cable-Resistance Calculation:

Resistance in the cables used to connect field-devices to an AP11 results in voltage-drops that must be considered. These voltage-drops directly subtract from the power-supply's output used to power a device. The resultant voltage (as seen by the device) must be sufficient to satisfy the minimum excitation voltage specification for a given device to operate properly. This specification is available from the manufacturer of the device.

To satisfy a devices excitation spec, the "actual" cable-resistance must be less than the "maximum" cable-resistance that can be supported. Example calculations are shown below. It should be noted that calculations differ for each of the device types.

2-Wire (4-20mA) **Device:** Device has 2 wires: power and signal. The device draws up to 20 mA.

The maximum cable resistance is equal to the minimum voltage seen at the power pin on the AP11 minus the minimum excitation voltage of the device (as provided by manufacturer) minus the voltage caused by the input resistance of the AP11 all divided by the maximum current of the device.

$$Max\ cable\ resistance = \frac{20.8V - \text{min. excitation voltage} - 5V}{0.02\ A}$$

Cable resistance is calculated as the resistance per meter times the number of meters that the signal travels. IMPORTANT: Both the wire going to and returning from the sensor must be included.

Cable resistance = Ohms per meter * meters of cable * 2 (this is for wire to and from sensor)

EXAMPLE:

A sensor with an excitation spec of 10v is at the end of a 100 meter 22/2 cable. The manufacturer specifies that the 22 AWG wire has a resistance of 0.0527 ohms/meter.

$$Max\ cable\ resistance = \frac{20.8V - 10V - 5V}{0.02\ A} = \frac{5.8V}{0.02A} = 290\ \text{ohms}$$

Cable resistance = 0.0527 ohms/meter * 100 meters * 2
(actual) = 10.54 ohms

The calculations confirm that the "actual" cable resistance (10.54 ohms) is less than the Max cable resistance (290 ohms) so the excitation specification is satisfied.

3-Wire Device (Powered from AP11): Device has 3 wires: power, signal, and ground.

The current draw and minimum operating voltage of the device should be included on the manufacturer's data sheet. The voltage seen by the device is reduced by the resistance of the cable going to the device and by a 100 ohm resistor within the AP11. Calculations to determine the maximum cable resistance are shown in Figure 4-5g below:

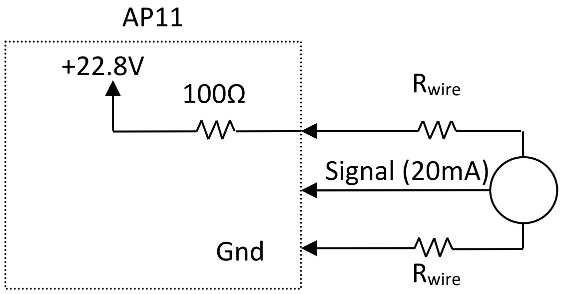


Figure 4-5g

Excitation Voltage (V_E): Minimum operating voltage of the device as specified by the manufacturer

Current Draw (I_L): The amount of current the sensor draws as specified by the manufacturer. This is measured in Amps.

> Note: If the manufacturer specifies power consumption in watts instead of current in milliamps, assume that the device is receiving its minimum voltage and approximate the current draw as follows:

$$Amps = \frac{Watts}{Minimum\ Voltage}$$

Max Cable Resistance: The maximum resistance of the wiring to and from the sensor.

$$Max\ Cable\ Resistance = \frac{22.8V - V_E - 100 * I_L}{I_L - .01}$$

Cable resistance is calculated as the resistance per meter times the number of meters that the signal travels. IMPORTANT: Both the wire going to and returning from the sensor must be included.

Cable resistance = Ohms per meter * meters of cable * 2 (this is for wire to and from sensor)

EXAMPLE:

A sensor that draws 50 mA and has a minimum excitation voltage of 15V is at the end of 100 meters of 22/3 cable. The manufacturer specifies that the 22 AWG wire has a resistance of 0.0527 ohms/meter.

$$Max\ Cable\ Resistance = \frac{22.8V - 15 - 100 * 0.05A}{0.05A - .01} = 70\ ohms$$

Cable resistance = 0.0527 ohms/meter * 100 meters * 2
(actual) = 10.54 ohms

The calculations confirm that the "actual" wire resistance (10.54 ohms) is less than the max wire resistance (70 ohms) so the excitation specification is satisfied.

4.5.3. Thermocouple Inputs
(Requires optional AP1574 Customer-Expansion board)

Thermocouple (Analog) Input #	Thermocouple Input -	Thermocouple Input +
33 (TC-1)	T10-1	T10-2
34 (TC-2)	T10-3	T10-4
35 (TC-3)	T11-1	T11-2
36 (TC-4)	T11-3	T11-4
37 (T-C5)	T12-1	T12-2
38 (TC-6)	T12-3	T12-4
39 (TC-7)	T13-1	T13-2
40 (TC-8)	T13-3	T13-4

****Color codes:** K-Type: Red-,Yellow+ J-Type: Red-,White+

The AP11 provides temperature measurement capability via 8 dedicated thermocouple-inputs on the Customer-Expansion board, AP1574. Each channel is independently configurable for K-type or J-type thermocouples. Only 3/16" diameter shielded un-grounded thermocouples should be used such as Omega part-numbers **TJ84CASS-316U-3-SB** (K-Type) and **TJ84ICSS-316U-3-SB** (J-Type).

4.5.4. Analog Outputs (4-20mA)
(Requires optional AP1580 Customer Analog-Output Board)

Isolated Power-supply	Analog Output #	Signal	Return
1	1	T10-1	T10-2
	2	T10-3	T10-4
2	3	T11-1	T11-2
	4	T11-3	T11-4
3	5	T12-1	T12-2
	6	T12-3	T12-4
4	7	T13-1	T13-2
	8	T13-3	T13-4

The AP11 optionally provides 4-20mA analog-output capability via 8 dedicated outputs on the Customer Analog-Output board, AP1580. Output channels are self-powered, and each pair of channels shares an isolated 15v (nominal) power-supply. After subtracting power-supply tolerance and compliance-voltage, a 12volt budget is available for acquisition-measurement and loss caused by wire resistance. This equates to a maximum permitted load resistance of 600 ohms on each output.

Return signals for each pair of outputs are internally connected. (see figure below) For example, T10-2&4 are connected. Similarly, T11-2&4 are connected, T12-2&4 are connected, and T13-2&4 are connected. This should be considered when connecting AP11 analog-outputs to remote analog-inputs and is discussed in the following paragraphs.

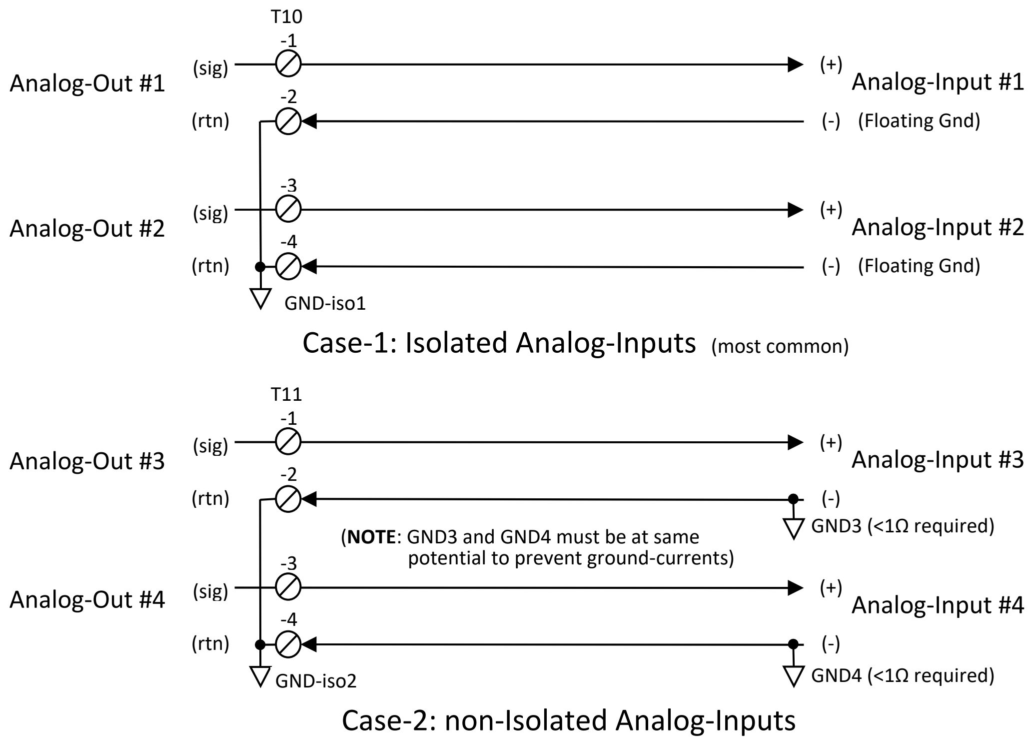


Figure 4.5h: Analog Input Topologies

In the figure above, case-1 shows a pair of analog-outputs connected to isolated analog-inputs, and case-2 shows a pair of analog-outputs connected to non-isolated analog-inputs.

Using differential-measurements and/or isolated measurement techniques will prevent undesirable ground-loops. (case-1) This is the most common analog-input topology.

If both outputs of a pair connect to devices having non-isolated single-ended inputs, the grounds of both target systems must be at the same potential to prevent ground-currents. (case-2) To ensure this, the resistance for the equipment ground to the grounding electrode should not exceed one ohm (1Ω). Check the effectiveness of grounding by using a ground resistance meter (i.e., an AEMC clamp on ground resistance tester or equivalent).

4.6. USB Connection Port

GASGUARD® AP11 controller USB port is located on the face of the controller. The USB port allows a USB connection to be made without having to open the controller door. Electrical devices should never be operated, connected to, or disconnected from the USB port unless the area surrounding the equipment is known to be free of flammable material. The USB port on the face of the controller will also have a warning label (Figure 4.6a) for operation in a flammable area.

Each USB connector type is 2.0 format. 4ea USB ports available inside the controller, with one of the ports extended externally to the AP11 controller door as shown in Figure 4.6b.

Safety standards require that the AP11 front-panel USB port be tool accessible. To meet the standard, a Lindy USB Port Blocker (see Figure 4.6c) will be factory installed on all AP11 controllers. In order to use the USB port, the USB Port Blocker plug must be removed using a Lindy key. Remember, electrical devices should never be operated, connected to, or disconnected from the USB port unless the area surrounding the equipment is known to be free of flammable material. When finished using the USB port, the USB Port Blocker plug must be reinstalled along with the USB cover.

Figure 4.6a: USB Port Warning Label

Figure 4.6b: AP11 Controller USB Port on the Face of the Controller

Figure 4.6c: Lindy USB Port Blocker and Key

4.7. GASGUARD® Networking

4.7.1. General Description

Remote monitoring of GASGUARD® systems can be attained using the GASGUARD® OPC Server software or SCADA system, GCS (Global Communications System). Either method can provide continuous on-line 24 hour per day monitoring of the status of all connected GASGUARD® Cabinets, VMBs and BSGS systems. The GASGUARD® AP11 communicates to GCS or OPC via Ethernet.

4.7.2. GCS Ethernet Network Wiring Configuration

A GCS is typically integrated into the site's Ethernet network. Figure 4.7a depicts the typical network architecture of a GCS. In most instances, the GCS is connected to two separate networks. One subnet will interconnect only the gas controller equipment, while the other subnet will be the connectivity to the overall site Local Area Network. Using this architecture, the gas controller network traffic will not be adversely affected by other nodes on the site LAN; furthermore, if the site needs to disconnect the GCS from their network -- for instance when a remote support person accesses the system via modem – the ability to monitor the gas controller network will not be affected. The connection to the site LAN allows for connectivity from office PC's to the GCS for WebView sessions as well as ODBC data downloads. The GCS may also be equipped with additional options which will require its connectivity to additional LAN's. Such will be the case if the GCS will need to supply gas availability data to a site's tool annunciation system. GCS uses standard TCP/IP network protocol to communicate over all networks.

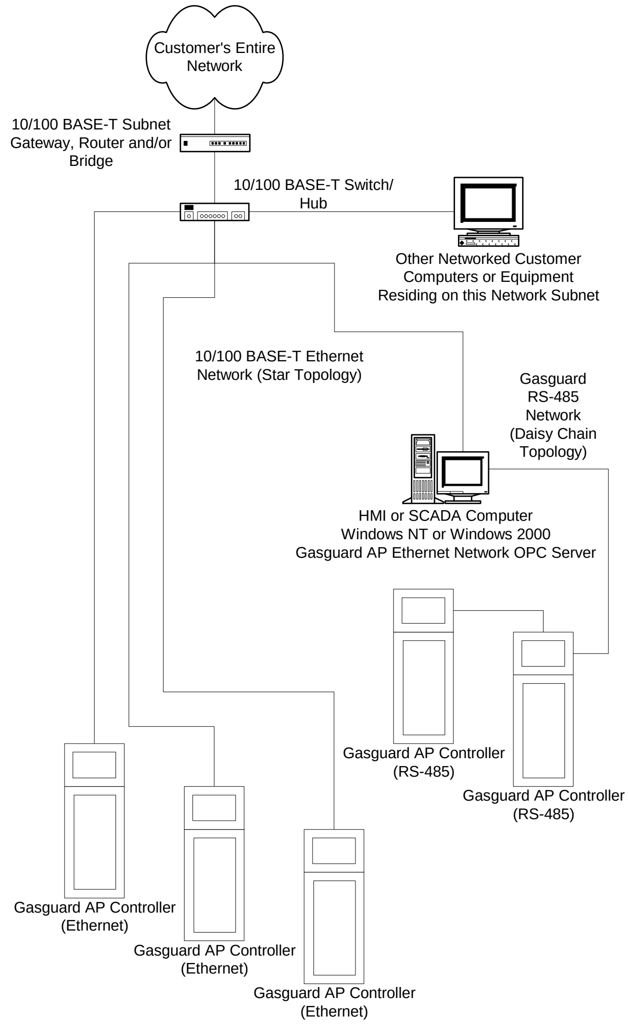


Figure 4.7a Typical GCS Network Architecture

4.7.3. GASGUARD® AP11 Controller Connections

The main network electrical connection is made on the Carrier board and is a standard RJ-45 connector.

Optional RJ-45 network connection is available on the Customer I/O board.
(If a Customer I/O board is present, the network connection is made to the Customer I/O board)

See Figures 4.7b and 4.7c for the location of the RJ-45 network connections.

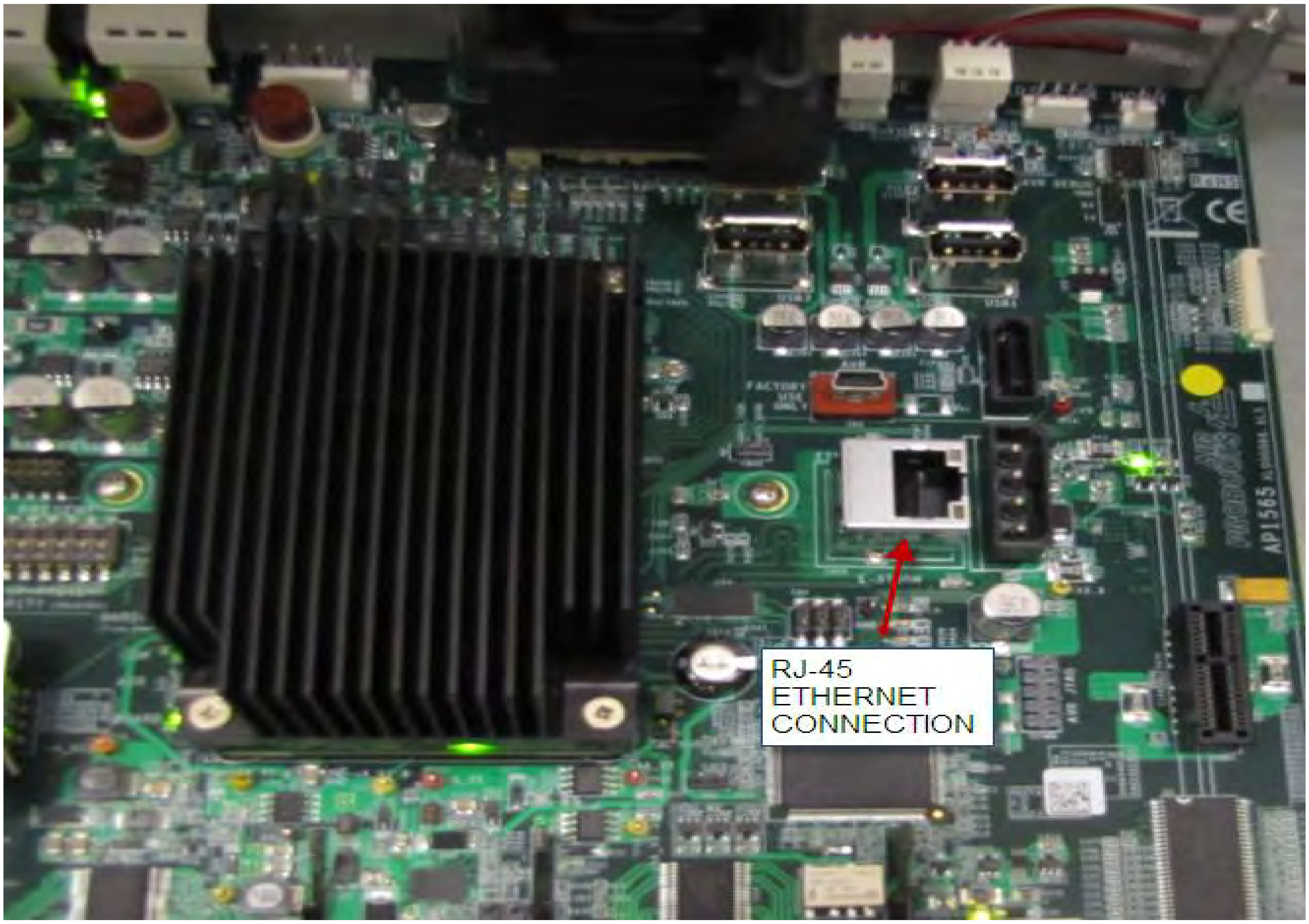


Figure 4.7b: GASGUARD® AP11 Carrier board Ethernet connection

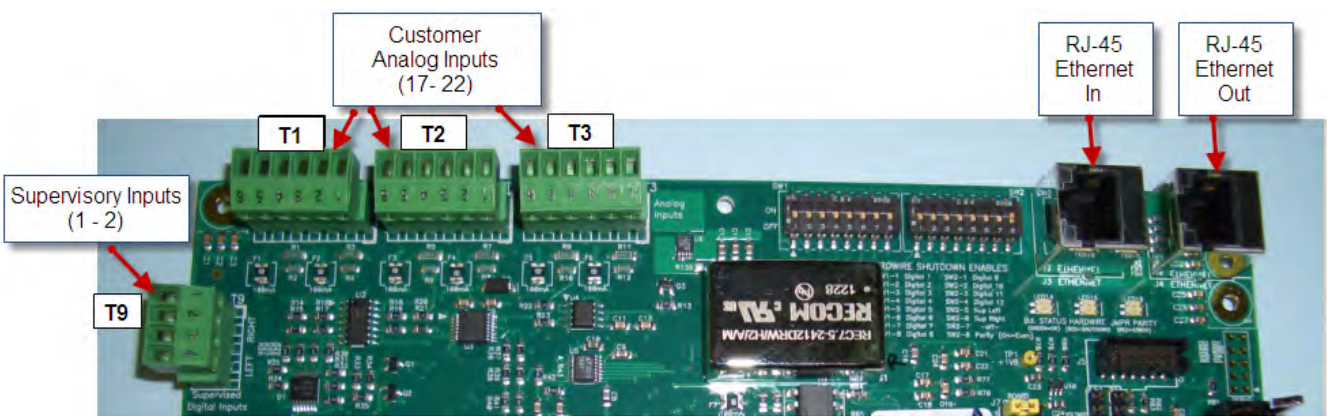


Figure 4.7c: GASGUARD® AP11 Customer board Ethernet connection (optional board)

Optional Customer I/O board capacity provides 12ea customer digital input alarm circuits, 12ea customer digital output circuits, and 6ea customer analog input circuits.

See Figure 4.7d for jumper configuration for Customer I/O board option.

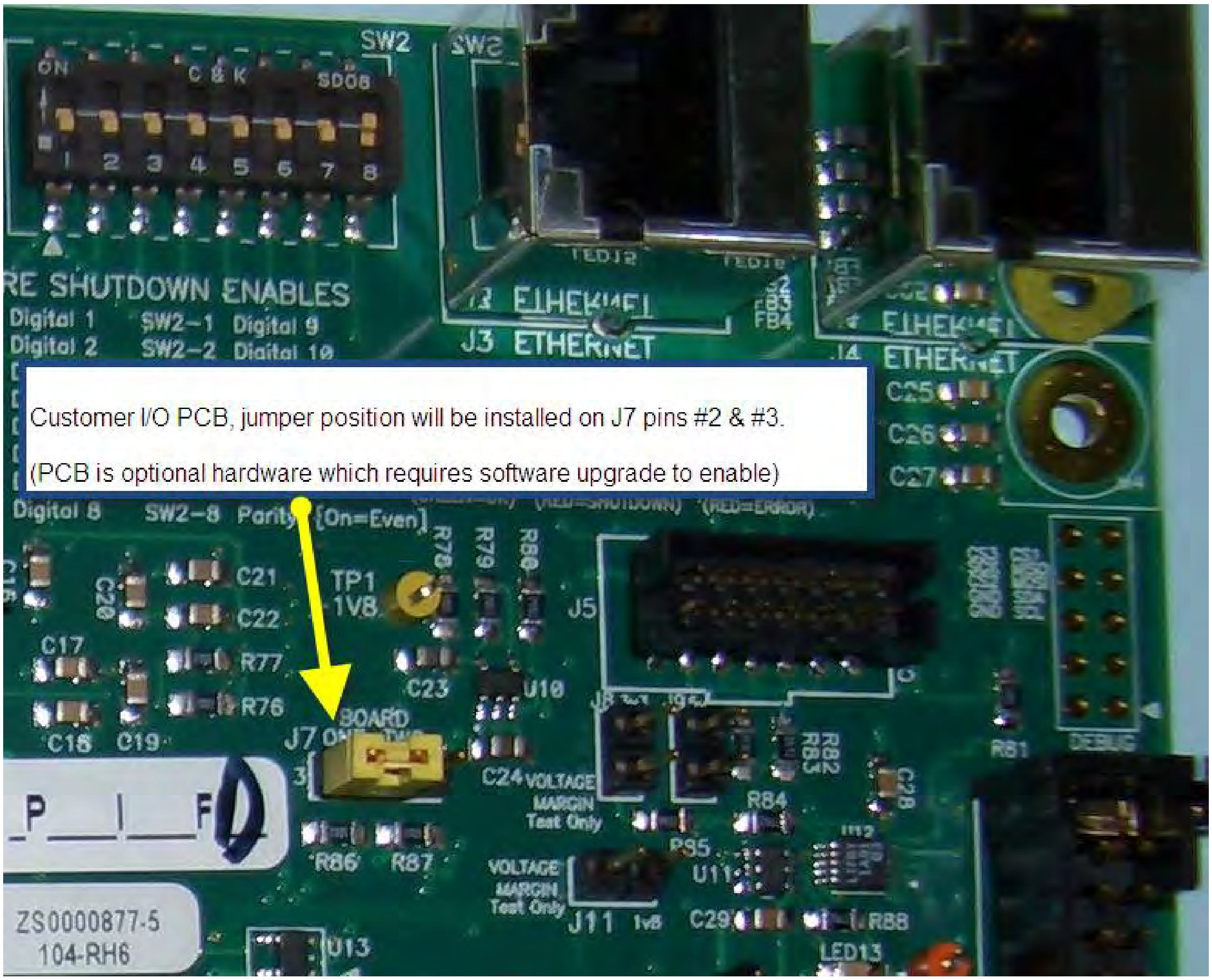
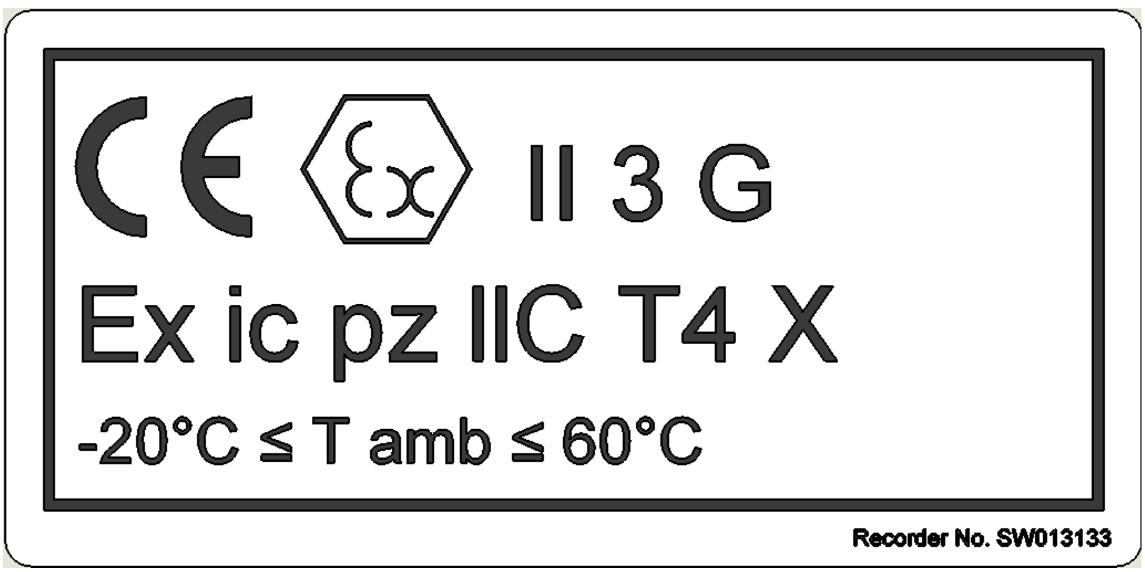


Figure 4.7d: GASGUARD® AP11 Customer board "J7" jumper configuration (Optional board)

4.8. Explosive Atmosphere (ATEX) Installations

GASGUARD® AP11 controllers that have the label shown in Figure 4.8a has been certified to comply with European Union ATEX Directive 94/9/EC of the European Parliament and Council when properly installed in accordance with the guidelines and instructions referenced in this section. The ATEX label for GASGUARD eV systems is similar to figure 4.8a but shows a -20 to 40deg temperature range.

GASGUARD® AP11 controllers with the following label attached for explosion protection are of Group II, Category 3; intended for use only in areas where explosive atmospheres of gas are unlikely to occur, or if they do occur are likely to do so infrequently or for a short period.



4.8.1. Label Markings

The ATEX label placed on the AP11 controller includes the following information (symbols follow in order starting at the upper left corner):

- The CE Symbol which reflects conformity with the European Directives
- The Hexagonal “Ex” Symbol for Explosive Atmosphere
- The equipment group symbol for the electrical apparatus which is II. All industry gases are classified as Group II gases.
- The equipment category number 3. The equipment category number 3 means the equipment is suitable for an environment where an explosive atmosphere is unlikely to occur, occurs infrequently, or occurs for only a short period of time.
- The atmosphere symbol “G”. “G” means that product is safe in an explosive GAS atmosphere.
- Symbol “Ex”. This symbol stands for the equipment has been tested under the latest European Harmonized Standard for use in Explosive Atmospheres.
- Symbol “ic” for intrinsic safety.
- Symbol “pz” for pressurization. Pressurization prevents the ingress of an explosive atmosphere to a space that may contain a source of ignition. This is used for the controller.
- Symbol “IIC’ for the apparatus gas group.
- The symbol indicating the maximum surface temperature, T6. T6 indicates that the maximum surface temperature does not exceed 85°C.
- The symbol “X” for special conditions of installation and relevant use for safety. The normal ambient temperature range in the ATEX standard is considered to be -20°C to 60°C. Since the temperature range for the AP11 varies from the normal range, an X is included on the label markings.
- The ambient temperature range, Ta.

4.8.2. Special Conditions for Safe Use (X)

- **Environmental Limits**
  - GASGUARD® AP11 controllers are intended for indoor installation. They have been evaluated for installation in locations providing adequate protection against the entry of water.
  - AP11 controllers are intended for use in ambient temperatures in the range of -20°C to +60°C and should not be used outside this range.
  - DO NOT rub the surface of the touch screen with a dry cloth. Electrostatic charge generated by the friction may result. When cleaning the face with a damp cloth, take the measures of an electrostatic discharge such as earth band, ionic shower, etc.
- **Installation Conditions**
  - When installing the equipment, appropriate precautions must be taken to ensure that the equipment has been connected to earth. Refer to Section 4.1 of this manual for more information.
  - Installation of this equipment shall be carried out in accordance with the installation standards for potentially explosive atmospheres. Installation, startup and maintenance must be carried out only by personnel trained in explosion protection.
- **Power Supply**
  - Input power supply specs must not exceed the maximum values as listed in Section 4.2 of this manual.
- **Maintenance**
  - Before opening the controller enclosure ensure that there is no danger of explosion in the atmosphere and wait at least 10 minutes after the power has been removed.
  - Before turning the power supply ON, be sure to close the enclosure cover tightly and securely fasten the latch. Ensure that z purge is operating and functional for at least 20 minutes prior to turning the power on.
  - Only qualified Versum Materials personnel should service the controller. Substitution of components (other than those recommended by Versum Materials) may impair its suitability for use in hazardous locations.

4.9. GASGUARD® eV Heater Board Connections

The GASGUARD® eV AP11 controller supports connection to a heater board for temperature monitoring, control and over-temperature protection. These connections are typically made at the factory, but may require on-site wiring for component replacement, trouble shooting, or retrofit. The I/O landing points will be defined on the customer EE-drawing and/or specification sheet found in the document envelope, supplied with each system. Figure 4.9a shows the AP1602 heater board layout.

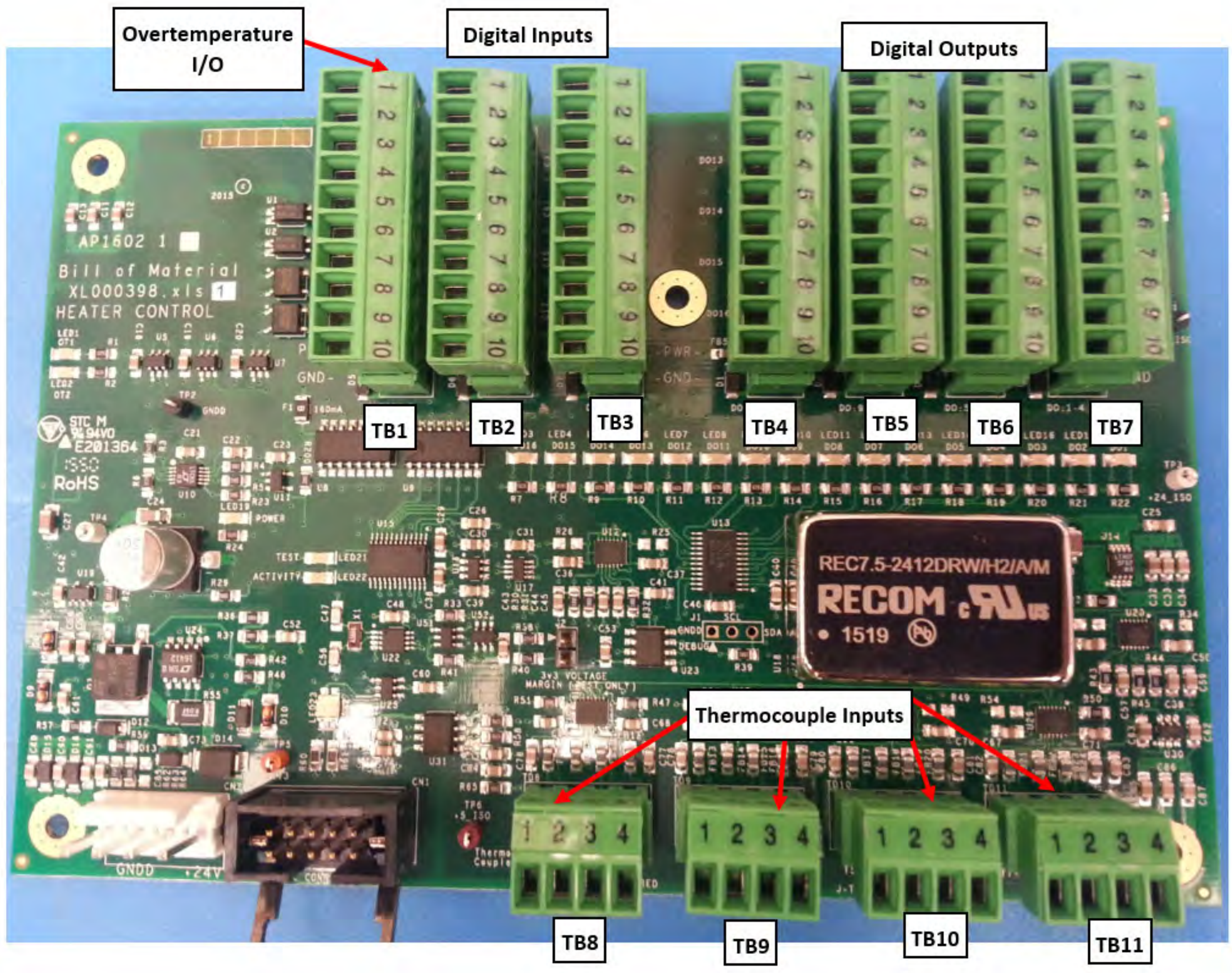


Figure 4.9a: AP1602 Heater Board Terminal Blocks

Chapter 5

Helium Leak Testing

All personnel **must** be trained in helium leak detector operations. Consult your leak detector manufacturer for leak detector operations training.

The customer is responsible for ensuring that all field piping to the GASGUARD® Source System be completely leak tight. Leak testing should be performed in accordance with the current industry standard, SEMI (Semiconductor Equipment and Materials International) #F1-90, Specification for Leak Integrity of Toxic Gas Piping Systems and all applicable codes. A suitable helium leak detector is required to attain the level of sensitivity required by the above standard.

There are several methods of helium leak testing. The two most often used are:

Inboard - The component being tested is evacuated to a negative pressure and sprayed externally with helium.

Outboard - The component is pressurized with helium and sniffed externally with the detector.

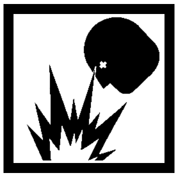
NOTE: It is recommended that the internal GASGUARD® Source System tubing, which was helium leak tested at the factory, be rechecked at this time to ensure no leaks have developed during installation or shipment. Consult your GASGUARD(R) representative for proper helium leak detection procedures.

In order to adequately leak test the GASGUARD® Source System internal and external piping, the pneumatic emergency shutoff and auto-crossover valves within the cabinet must be operated. These valves can be manually opened and closed through "Manual Mode" operation on the front keypad of the GASGUARD® controller. It is **strongly recommended** that all operators receive training by a GASGUARD® representative prior to operating the GASGUARD® Source System in "Manual Mode". Operations training is an additional service provided for a cost. The cost of this service may have been *pre-arranged* during the sale and scope review of the project. Contact your GASGUARD® representative to discuss this.

To operate these valves, the pneumatic supply hookup (Section 3.6 of this manual) and the electrical power connection (Section 4.2 of this manual) installation must be completed.

Section 5.1: How to Perform System Helium Leak Checking in Manual Mode

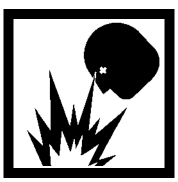
WARNING



Operating in Manual Mode can cause the following hazards which can result in PERSONAL INJURY OR DEATH.

- ***Process gas could be forced into the purge panel and/or purge gas cylinder.***
- ***Opening purge panel valves when high pressure process gas is present.***
- ***High pressure process gas could be unintentionally vented.***
- ***Opening vent valves when high pressure process gas is present.***

WARNING



No process gas cylinders should be connected at this time. If one is or was connected, do not continue, as personal injury or death can result. Contact your GASGUARD® representative for system verification.

NOTE: Due to the potential hazards listed above, Manual Mode operation requires a second or higher level security code.

NOTE: Prior to shipment, the GASGUARD® Source System panel has been certified to strict cleanliness specifications. Improper operation of the valves in "Manual Mode" could result in contamination of the gas panel

NOTE: A pneumatic supply connected to the controller with 85-95 psig (5.9-6.6 barg) of nitrogen must be available to actuate the valves.

NOTE: Shutdown alarms (indicated by the red SHUTDOWN LED being lit) will not allow you to access and open valves in manual mode, therefore making a leak test invalid. If a shutdown alarm is present, contact your GASGUARD® representative for system verification prior to leak testing.

1. Enter second level (or higher) security code (check with appropriate GASGUARD® representative for proper password) as follows:

Touch anywhere on the graphics portion of the screen.

You will see a pop-up window entitled: "Password"

Using the keypad, type in the password.

Press OK

If the password is correct, the Main Menu will be displayed. If the password is incorrect, "Invalid Password" will be displayed at the base of the pop-up window.

2. From the Main Menu screen, select which process line using the drop down menu or the left and right arrow keys.

3. Press the Manual Mode pushbutton.

   3.1. Another window will pop-up entitled: "Manual Mode"

   3.2. A legend, located on the graphics panel, indicates the valve status color scheme. The legend shows which color (red or green) is used to designate if a valve is open or closed.

4. Follow the procedures below to open and close valves. (Valves that can be controlled manually are shown highlighted with a yellow square box around them.)

To open a valve:

4.1. Select the valve by touching the screen.

4.2. The valve state menu will appear. Confirm that you want to open the valve by pressing "Open Valve" Open Valve . Pressing "CANCEL" Cancel will close the menu leaving the valve closed.

To close a valve:

4.1. Select the valve by touching the screen.

⚠CAUTION

Extreme care must be taken when operating valves manually. Only those valves required for adequate leak testing should be opened.

5. When leak testing is complete, press Cancel to return to the Main Menu.

NOTE: Any valves left in open position will be closed automatically.

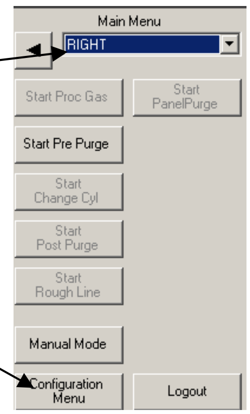
6. From the Main Menu screen, press Logout to return to normal display.

CAUTION

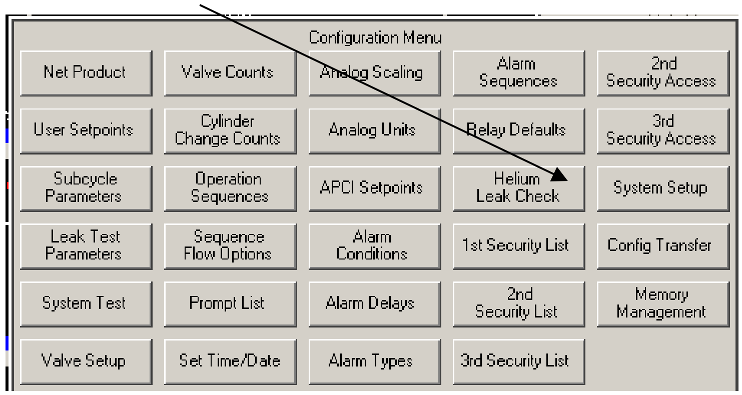
Source System must not be left unattended in Manual Mode, as access to the system in Manual Mode is open to anyone.

Section 5.2: How to select Inboard or Outboard leak test Mode for cylinder change routines

1. Log into controller menu (see Section 8).
2. Select “Right” or “Left” Panel.
3. Select “Configuration Menu” from Main Menu.

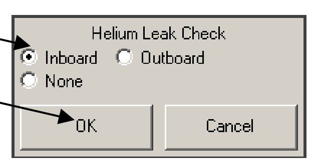


4. Select “Helium Leak Check” from Configuration Menu.



5.Select “Inboard” or “Outboard” from the Helium Leak Check Menu.

6.Select “OK”.



Chapter 6

Functional Checklist

After all connections have been made and installation of the gas source system is complete, the appropriate GASGUARD® Representative should be contacted to schedule the final on-site gas source system functional check. This functional check must be made prior to start-up. The functional check is an additional service provided for a cost. The cost of this service may have been *pre-arranged* during the sale and scope review of the project. Contact your GASGUARD® Representative to discuss this. The GASGUARD® Technical Representative and/or Megasys® Technician will ensure that all the mechanical and electrical components in the gas source systems are functioning properly and all programmed sequences are operational.

A copy of the completed source system functional checklist should be supplied to your GASGUARD® Representative for placement into the source system maintenance file. The Source System Utility Checklist is found on the following two pages.

6.1 Source System Utility Checklist

_____________ 1. Cabinet located and mounted to floor (see Section 2).

_____________ 2. Cabinet exhaust duct installed, functioning and monitored for loss of exhaust (see Section 3.7).

_____________ 3. Sprinkler line installed (if applicable) and pressurized (see Section 3.8).

_____________ 4. Grounding wire installed (cabinet and controller) and checked for less than 1 ohm resistance (see Section 4.1).

_____________ 5. Electrical power (120/240 VAC, 50/60 Hz) connected (see Section 4.2).

_____________ 6. Remote I/O wiring installed and checked (see Section 4.3).

_____________ 7. Gasguard Network wiring installed (if applicable) and configured on the host (see Section 4.5 and 4.6).

_____________ 8. Process line installed and helium leak tested (see Section 3.2).

_____________ 9. Vent line installed and helium leak tested (see Section 3.3).

_____________ 10. Venturi line installed, leak tested and 75-95 psig (5.2-6.6 barg) of nitrogen available (see Section 3.4).

_____________ 11. Purge line installed and helium leak tested (see Section 3.5). (If external purge cylinder utilized.)

_____________ 12. Pneumatic supply connected to controller and 85-95 psig max. (5.9-6.6 barg) of nitrogen available (see Section 3.6).

_____________ 13. AP11 source system internal piping helium leak tested (see Section 5).

_____________ 14. Purge cylinder available.

_____________ 15. Hazardous gas monitor installed and operating.

_____________ 16. Properly sized RFO installed in process cylinder valve (see Section 3.11).

____________ 17. Pigtail adjusted to proper height. (see Section 13)

____________ 18. Z-purge alarm enabled (Section 3.6.1). (applies to Class1 Div2 or ATEX locations)

____________ 19. Bypass Jumpers installed for unused customer I/O.

____________ 20. Valves on unused (unfacilitated) process outlets are locked out (see Section 3).

____________ 21. Helium Leak Test line installed (if applicable) and helium leak tested (see Section 3.5b). Overpressure protection installed.

Inspection Sign-Offs

____

Electrical

____

Mechanical

____

Quality

____

Safety

____

GASGUARD® / MegasSys® Technical Representative (Field Start-Up Checklist Complete)

6.2 GASGUARD® AP11 SOURCE SYSTEM FIELD START-UP CHECKLIST page 1 of 14

CUSTOMER ___________________SYSTEM # _____________ SERIAL #___________

DEVICE DESCRIPTION ______________________________MODEL# _____________

GAS TYPE ____________________START DATE ___________ FINISH DATE ________

TOOL NAME _____________________ TECH REP ___________________________________

CUSTOMER SYSTEM LABEL ____

VISUAL INSPECTION

PIPING/MECHANICAL	**Check off line item when completed** **Sign and date when section completed**	
	Left side or single	**Right side**
Perform visual inspection to verify all mechanical and electrical connections have been made.		
System labeled correctly per Specification Sheet.		
System information received: (circle) Specification Sheet, Flow Schematic, Customer I/O Drawing, Inspection and Test sheet (leak test and certification), Quality Inspection and Test sheet (functional test), Installation and Operation Manual		
All open connections sealed		
General appearance satisfactory		
Verify leak test from gas bottle to P.O.U. complete		
Verify corrosive or toxic scrubber and incinerator operational and running		
Pitot tube installed with correct 90° orientation		
Sprinkler line installed (except ClF_3)		
Tel tails installed		
Verify cabinet exhaust is functioning		
Panel under pressure 20 psig ≥ ≤ 25 psig (1.4 barg ≥ ≤ 1.7 barg)		
Correct process purifier installed per gas service		
Cylinder conn. seating surface condition acceptable		
Verify and record cylinder orifice size (see Section 3.11 and warnings Section 8.3)		

GASGUARD® AP11 SOURCE SYSTEM FIELD START-UP CHECKLIST page 2 of 14

PIPING/MECHANICAL (cont.)	**Check off line item when completed** **Sign and date when section completed**	
	Left side or single	**Right side**
Shelf kit installed and adjusted		
Cyl. Chains / Cyl. Straps (circle)		
Trickle purge gasket installed		
Correct venturi pressure present Minimum 80 psig (5.2 barg)		
Correct pneumatic pressure present 85 psig to 95 psig max. (5.9-6.6 barg)		
Purge cylinder installed		
Gas detection system operational		
Secondary containment installed		
Pneumatics for cylinder valve operator, Or CGA Cylinder Indicator installed		
Verify and record flow switch rating	See Quality Inspection and Test Sheet	
Valves locked out on unused process outlets		
High pressure flow switch rating		
Low pressure flow switch rating		

SECTION COMPLETED SIGNATURE_____________________ DATE _________

Notes: ____

GASGUARD® AP11 SOURCE SYSTEM FIELD START-UP CHECKLIST Page 3 of 14

ELECTRICAL	**Check off line item when completed** **Sign and date when section is completed**	
	Left side or single	**Right side**
Earth ground installed		
120v/220v/24v electrical complete (circle)		
Graphics panel condition satisfactory		
Elect. sealoffs poured		
I/O wired per DWG # EE-_______		
Non-GASGUARD eV Heating:		
3rd Party heating system (AGCS, UE, etc)		
Verify temperature control power		
Verify heat tape power		
	Blanket Set Point _____	Blanket Set Point _____
	Blanket Temp.______	Blanket Temp.______
	Heat Trace Set Point _____	Heat Trace Set Point _____
	Heat Trace Temp.______	Heat Trace Temp.______
GASGUARD eV Heating:		
Verify Supplied Voltage Matches Voltage on Label Voltage: _________		
	Blanket Set Point _____	Blanket Set Point _____
	Blanket Temp.______	Blanket Temp.______
	Heat Trace Set Point _____	Heat Trace Set Point _____
	Heat Trace Temp.______	Heat Trace Temp.______

SECTION COMPLETED **SIGNATURE**___________________ **DATE** ________

Notes: ____

GASGUARD® AP11 SOURCE SYSTEM FIELD START-UP CHECKLIST Page 4 of 14

CONTROLLER	**Left side or single**	**Right side**
Ensure all cable connections are seated properly		
Does the Graphic Insert match the Configuration		
E-stop guard in place		
Carrier Board LEDs all green		
Panel L Board LEDs all green		
Panel R Board LEDs all green		
Customer Board LEDs all green		
Door Board LEDs all green		
Caution: Ensure valves can be operated safely before addressing the next 3 steps.		
Do all valves operate		
Manual mode operation		
No audible solenoid leaks		
Firmware Versions:		
Controller EXE Version ___________		
DLL Version ______________________		
Startup EXE Version ____________		
Controller Memory Load ________		
OS Image Version ________________		
BIOS Version ________________		
I/O Processor Version ______________		
Configuration File Rev. ______________		
External Shutdown wired		
Gas Detection wired (if applicable)		
Supervisory circuit utilized		
Correct program loaded / version ____________		
Program name and date ____________________		
Life safety system utilized (yes / no)		
Verify port and loop # indicated on the controller		
Source system name		
Port number		
Channel number		
IP Address (Ethernet Only)		
IP Subnet Mask (Ethernet Only)		
Default Gateway (Ethernet Only)		
AP11 source system communicating with network		
Controller door adjustment		
Z – purge set @ $\geq$ 0.1" H20 (24.9 Pa)		
Adjust / Balance Power Supply(s)		

SECTION COMPLETED SIGNATURE____________________ DATE ________

Notes: ____

GASGUARD® AP11 SOURCE SYSTEM FIELD START-UP CHECKLIST Page 5 of 14

CALIBRATION **Verify analog scaling (psig) with program documentation**											
Transducers must be powered up a minimum of 15 minutes. Zero and span should be checked a minimum of 4 times to insure repeatability											
Check and record the pressure before and after calibration in psig											
Analog #	Label	**Left side or single**					**Right side**				
	(Left/right)	Zero	Zero	Span	Span	Completed	Zero	Zero	Span	Span	Complete
		before	after	before	after		before	After	before	after	
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											

SECTION COMPLETED SIGNATURE____________________ DATE ___________

Notes: ____

Thermocouple-Inputs (Functional test, open-circuit test)

Verify each channel displays the proper "type", and the expected "value" for current conditions.
Verify thermocouple wire-colors & polarity at Customer Brd connections T10-T13 or Heater Control Board TB8-TB11. (K: Yel+,Red- J: Wh+, Red-)
NOTE: a channel with an open-circuit will display a full-scale value of 1200degC.

Check and record the thermocouple value & type displayed for each channel

Analog #	Label	Value	Type	T+ wire	T- wire	Completed
	(TC-#)	(degC)	(K/J)	(Yel/Wh)	(Red)	
33*						
34*						
35*						
36*						
37*						
38*						
39*						
40*						
49**						
50**						
51**						
52**						
53**						
54**						
55**						
56**						

*** These inputs require optional Customer I/O hardware (AP1574) and software program with thermocouples enabled.**

**** These inputs require optional Heater Control hardware (AP1602) and software program with thermocouples enabled.**

SECTION COMPLETED SIGNATURE__________________ DATE __________

Notes: ____

GASGUARD® AP11 SOURCE SYSTEM FIELD START-UP CHECKLIST Page 7 of 14

Analog Outputs (Functional test)

Check and record analog output signal each channel

Analog #	Label	Completed
1*		
2*		
3*		
4*		
5*		
6*		
7*		
8*		

*** These inputs require optional Customer I/O hardware (AP1580) and software program with thermocouples enabled.**

SECTION COMPLETED SIGNATURE___________________ DATE __________

Notes: ____

GASGUARD® AP11 SOURCE SYSTEM FIELD START-UP CHECKLIST page 8 of 14

FUNCTIONAL TEST - DIGITAL ALARMS

Record label from software documentation. Record, verify and test the digital alarms and the hardwire shutdowns. Note: Appropriate Hardwire switch must be ON for hardwire shutdown to be activated.

Digital In #	Label	Hardwire SD loc.	Checked
1	Emergency Stop	---	
2	Z-purge	---	
3	Power Supply #1	---	
4	Power Supply #2	---	
5*	Supervised Input #1 FAULT	---	
6*	Supervised Input #1 ALARM	---	
7*	Supervised Input #2 FAULT	---	
8*	Supervised Input #2 ALARM	---	
9	Left Terminal Box Switch 1	---	
10	Left Terminal Box Switch 2	---	
11	Left Terminal Box Switch 3	---	
12	Left Terminal Box Switch 4	---	
13	Left Terminal Box Switch 5	---	
14	Left Terminal Box Switch 6	---	
15	Left Terminal Box Switch 7	---	
16	Left Terminal Box Switch 8	---	
17	Left Terminal Box Switch 9	---	
18	Left Terminal Box Switch 10	---	

*** These Digital input alarm circuits require optional Customer I/O PCB hardware (AP1563, AP1574, AP1580) and software program with alarm circuits enabled.**

GASGUARD® AP11 SOURCE SYSTEM FIELD START-UP CHECKLIST page 9 of 14

FUNCTIONAL TEST - DIGITAL ALARMS (cont.)			
19	Left Terminal Box Switch 11	---	
20	Left Terminal Box Switch 12	---	
21	Right Terminal Box Switch 1	---	
22	Right Terminal Box Switch 2	---	
23	Right Terminal Box Switch 3	---	
24	Right Terminal Box Switch 4	---	
25	Right Terminal Box Switch 5	---	
26	Right Terminal Box Switch 6	---	
27	Right Terminal Box Switch 7	---	
28	Right Terminal Box Switch 8	---	
29	Right Terminal Box Switch 9	---	
30	Right Terminal Box Switch 10	---	
31	Right Terminal Box Switch 11	---	
32	Right Terminal Box Switch 12	---	

GASGUARD® AP11 SOURCE SYSTEM FIELD START-UP CHECKLIST page 10 of 14

FUNCTIONAL TEST - DIGITAL ALARMS (cont.)			
33**	Customer Digital Input 1		
34**	Customer Digital Input 2		
35**	Customer Digital Input 3		
36**	Customer Digital Input 4		
37**	Customer Digital Input 5		
38**	Customer Digital Input 6		
39*	Customer Digital Input 7		
40*	Customer Digital Input 8		
41*	Customer Digital Input 9		
42*	Customer Digital Input 10		
43*	Customer Digital Input 11		
44*	Customer Digital Input 12		
53***	Cylinder Overtemperature – L		
54***	Cylinder Overtemperature – R		

*** These Digital input alarm circuits require optional Customer I/O PCB hardware (AP1563, AP1574, AP1580) and software program with alarm circuits enabled.**

**** These Digital input alarm circuits require optional Customer I/O PCB hardware (AP1563, AP1573, AP1574, AP1580) and software program with alarm circuits enabled.**

***** These Digital input alarm circuits require optional Heater Control PCB hardware (AP1602) and software program with alarm circuits enabled.**

SECTION COMPLETED SIGNATURE____________________ DATE ________

Notes: ____

GASGUARD® AP11 SOURCE SYSTEM FIELD START-UP CHECKLIST page 11 of 14

FUNCTIONAL TEST - RELAY OUTPUTS Check off line item when completed	**Sign and date when section is completed**
Customer Board #1	
Relay outputs (digital outputs) tested	
Relay # 1**	
Relay # 2**	
Relay # 3**	
Relay # 4**	
Relay # 5*	
Relay # 6*	
Relay # 7*	
Relay # 8*	
Relay # 9*	
Relay #10*	
Relay #11*	
Relay #12*	

*** These Relay output circuits require optional Customer I/O PCB hardware (AP1563, AP1574, AP1580) and software program with output circuits enabled.**

**** These Relay output circuits require optional Customer I/O PCB hardware (AP1563, AP1573, AP1574, AP1580) and software program with output circuits enabled.**

SECTION COMPLETED SIGNATURE____________________ DATE ________

NOTES: ____

GASGUARD® AP11 SOURCE SYSTEM FIELD START-UP CHECKLIST page 12 of 14

FUNCTIONAL TEST-USER SETPOINTS **Check off line item when completed**

Sign and date when section is completed

	Left side or single	**Right side**
User Alarm set points listed and verified		

	Left side or single			**Right side**		
List changes in this column	Alarm #	Label	Setpoint	Alarm #	Label	Setpoint

SECTION COMPLETED SIGNATURE____________________ DATE ________

NOTES: ____

GASGUARD® AP11 SOURCE SYSTEM FIELD START-UP CHECKLIST page 13 of 14

FUNCTIONAL TEST- PROGRAM MODES	Check off line item when completed Sign and date when section is completed	
	Left side or single	**Right side**
AP11 Source system programs		
Enable ARS Fault Alarms (ARS only)		
Process		
Pre-purge		
Change cylinder		
Post purge		
After post purge, verify low pressure portion of the panel is in vacuum state from the decay test.		
Aux purge		
Lamp test		
ARS Functional Test (ARS Crossover, Recovery)		
ARS Shutdown Test (EMO, LSS, Timeout, HW)		
Crossover signal tested		
Crossover line purge lockout tested		
Low process delivery		
Process response for very low purge		
Test shutdowns for process line and aux purge while other side is in gas to tool ________________		

SECTION COMPLETED SIGNATURE____________________ DATE ________

Notes: ____

GASGUARD® AP11 SOURCE SYSTEM FIELD START-UP CHECKLIST page 14 of 14

FUNCTIONAL TEST - FILE VERIFICATION **Check off line item when completed** **Sign and date when section is completed**		
	Left side or single	**Right side**
Verify purge parameters per software documentation		
Verify alarm conditions per software documentation		
Verify APCI set points per software documentation		
AP11 Source System cleaned inside and out		
Suggested Customer Signoff (Optional)	**Date**	**Signature**
Section: Required / Not required (Circle one)		
Exhaust signed off		
Electrical Signed off		
Safety signed off		
Environmental documentation submitted		
Plumbing signed off		
Environmental sign off		

SECTION COMPLETED SIGNATURE____________________ DATE ________

Comments____

____

____

____

I have received and understood training on the operation of this Source System on the date given below.

____ _____________

Name Date

Gas service to CGA and DISS fitting cross-reference			
Appendix A			
Gas	**Gas abbreviation**	**CGA fitting**	**DISS fitting**
AMMONIA	NH3	660	720
ARGON	AR	580	718
ARSINE	ASH3	350	632
BORON TRICHLORIDE	BCL3	660	634
BORON TRIFLUORIDE	B11F3	330	642
CARBON DIOXIDE	CO2	320	716
CHLORINE	CL2	660	634/724
DIBORANE MIXES	B2H6	350	632
DICHLOROSILANE	DCS	678	636
DISILANE	SI2H6	350	632
HEXAFLUOROETHANE (HALOCARBON-116)	C2F6	660	716
TETRAFLUOROMETHANE (HALOCARBON-14)	CF4	580	716
TRIFLUOROMETHANE (HALOCARBON-23)	CHF3	660	716
HELIUM	HE	580	718
HYDROGEN	H2	350	724
HYDROGEN BROMIDE	HBR	330	634
HYDROGEN CHLORIDE	HCL	330	634
HYDROGEN SULFIDE	H2S	330	722
NITROGEN	N2	580	718

NITROGEN TRIFLUORIDE	NF3	330	640
NITROUS OXIDE	N20	326	712
OXYGEN	O2	540	714
OCTAFLUOROPROPANE (PERFLUOROPROPANE)	C3F8	660	716
PHOSPHINE	PH3	350	632
SILANE	SIH4	350	632
SILICON TETRACHLORIDE	SICL4		636
SILICON TETRAFLUORIDE	SIF4	330	642
SULFUR HEXAFLUORIDE	SF6	580	716
TUNGSTEN HEXAFLUORIDE	WF6	670	638

Chapter 7

System Description

The GASGUARD® Source Systems typically consist of a gas cabinet (except for wall-mounted or rack-mounted systems), a controller, a process gas panel, and an inert purge gas panel.

Some GASGUARD® systems can be configured to provide continuous gas service, without interruption from a depleted cylinder. These systems are called auto switch-over, because process gas is automatically switched from a panel supplying gas from a depleted cylinder, to a panel that can supply gas from a full cylinder. The minimum hardware requirements to operate in auto switchover mode are:

- One dual controller, and
- Two process gas panels sharing process outlet piping

GASGUARD® Systems are designed and built for the safe storage and handling of high purity toxic, flammable, pyrophoric, corrosive, oxidizing, and reactive cylinder gases. GASGUARD® Systems have been designed in accordance with the applicable requirements of the National Fire Protection Agency (NFPA), Uniform Fire Code (UFC), Toxic Gas Ordinance (TGO), and Semiconductor and Equipment and Materials International (SEMI).

7.1 Gas Cabinet

The function of the GASGUARD® Cabinet is to ensure a safe environment for personnel during cylinder changes or in the unlikely event of a hazardous gas leak. The cabinet must be connected to a properly designed exhaust system that is continuously operated in order to provide a safe environment.

The cabinet provides the secondary containment for any leak from the hazardous gas cylinder, cylinder connection and pigtail, and the process panel. The exhaust system continuously removes any leaking hazardous gas from the cabinet to a safe disposal system.

The GASGUARD® MC (Mass Customized) Cabinet is constructed of 12 gage (0.004 mm) steel with fully welded seams and protected with corrosion resistant polyurethane paint. Cabinet sizes are available to hold from one to three cylinders. One or more exhaust stacks are provided for connection to the customer's exhaust system.

The Cabinet has 12 gage (0.004 mm) steel doors with windows constructed of 1/4" thick (6.4 mm) wire reinforced safety glass. A temperature activated (165°F / 74°C) sprinkler head is provided, in accordance with Article 51 of the UFC. Formed brackets are mounted inside of the cabinet to securely hold each cylinder. There is a weight scale option for use with cylinders containing liquefied gases.

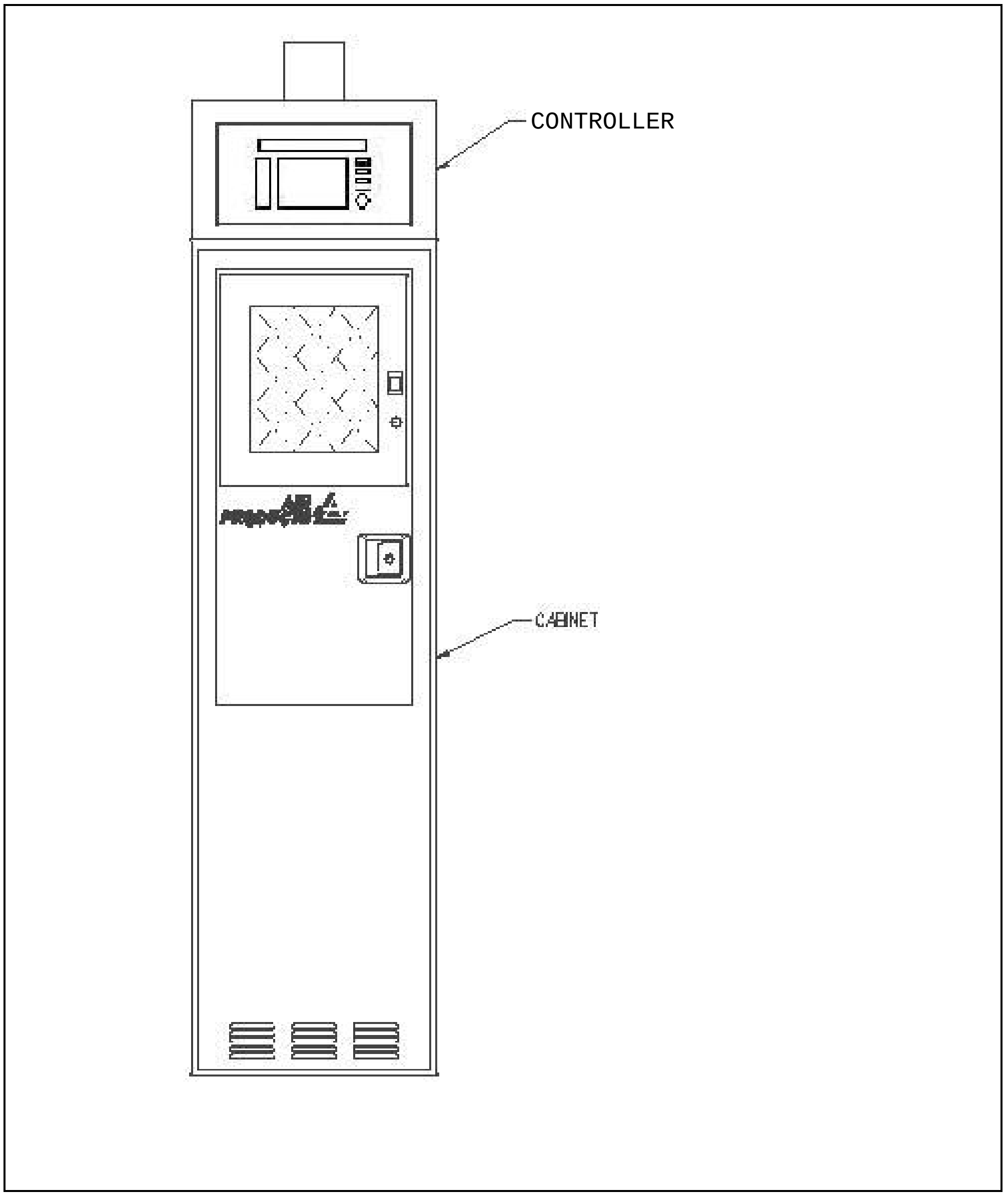


Figure 7.1: GASGUARD® cabinet

7.2 Rack System

A Rack System is a free-standing open platform for inert and silane gas handling systems. Its design will accommodate process and purge panels, gas cylinders and a controller. No exhaust hook-up is required.

The use of a rack system for silane distribution is the preferred alternative to gas cabinets that minimizes the potential for silane pocketing and subsequent explosion.

NFPA 318 and UFC 80-1 lend insight into open rack design. In addition any local building codes need to be followed when considering the use of a rack system.

A typical rack system is shown in Figure 7.2.

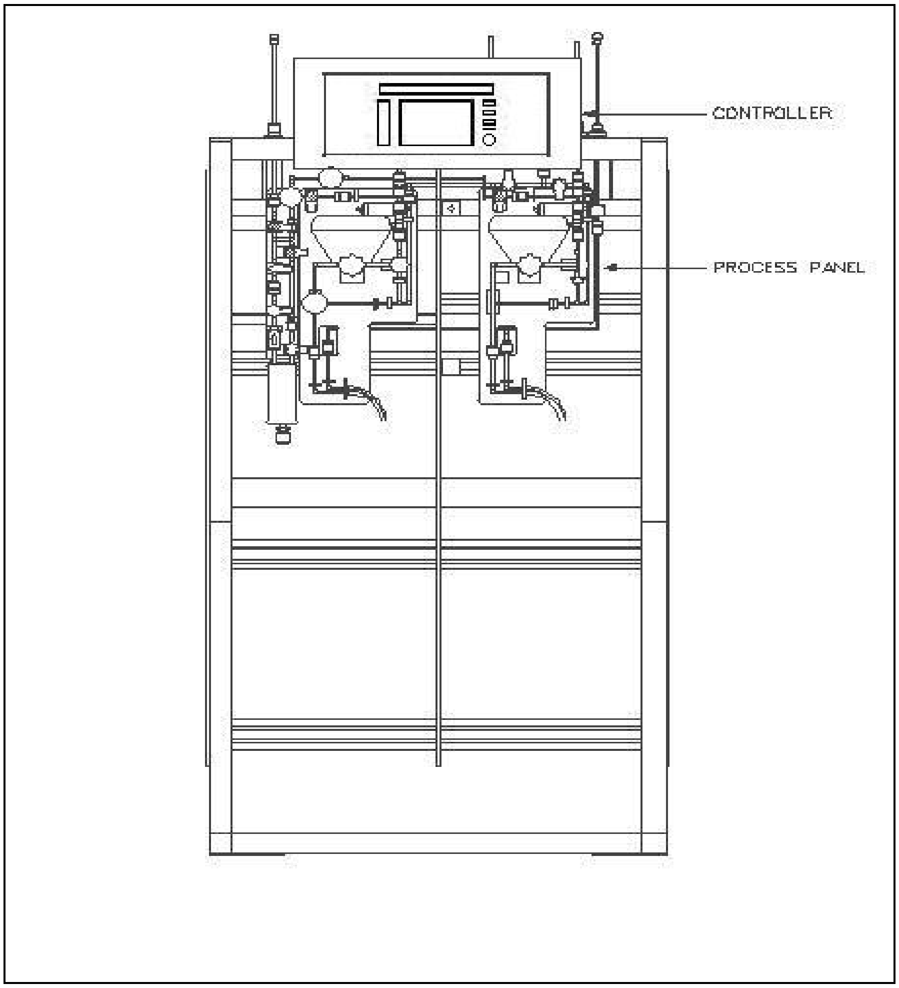


Figure 7.2: Typical Rack System

7.3 Auto Switchover System

For automatic switchover to occur, both cylinders must be placed into a "PROCESS GAS FLOW" mode. Whichever cylinder is started first will begin flow, the other cylinder will wait in a "standby" state until the cylinder flowing gas is stopped by a “VERY LOW DELIVERY PRESSURE”, “VERY LOW CYLINDER PRESSURE”, or “VERY LOW CYLINDER WEIGHT” alarm. If a global related shutdown alarm arises, both cylinders will return to the "IDLE" mode and all pneumatic valves will close.

Minimum hardware requirements for the automatic switchover system is one dual GASGUARD® AP11 controller, and two process gas panels sharing the process out piping. Figure 7.2 on page 7-3 depicts a two cylinder low pressure auto switchover system. Process gas switchover between right and left cylinders is initiated by either a very low delivery pressure, a very low process gas cylinder pressure or weight (on liquid cylinders). This switchover setpoint is set and entered by the customer.

After an automatic switchover has occurred, the low process cylinder can be purged for a cylinder change while the other cylinder is flowing gas. This cycle is called "PRE-PURGE". When the automated pre-purge cycles are completed, the "CHANGE CYLINDER" mode must be selected. The cylinder can physically be removed and replaced during this time. During a cylinder change-out procedure, sufficient Personal Protective Equipment (PPE) must be worn assuming hazardous process gas is still present in the pigtail line. See Section 1.9 for details on PPE.

With a new cylinder in place, the next step would be "POST-PURGE". Any air which may have entered the pigtail and valve connection during changeout is removed during these purging cycles. When post-purge is complete, the cylinder can be put into the "PROCESS GAS FLOW" mode again, which will now place it into standby until the other cylinder is stopped.

7.4 Hazardous Gas Panel

The Gas Panel consists of pneumatic valves, *manual valves, pressure transducers, pressure regulators, check valves, relief valves and various safety/purity components that perform the following functions:

- Regulate cylinder pressure to the process tool working pressure.
- Remove hazardous material, if present, from the panel prior to changing the process cylinder.
- Provide immediate shut-off in a hazardous situation using fail-safe pneumatic valves.
- Maintain process tubing purity during process cylinder change.

Pneumatic valves are used to shut off process gas flow, to control purge gas flow into the process panel, to vent process gas and purge gas from the panel and to feed inert gas to the vacuum venturi system. Check valves are used as backup to prevent process gas flow into the inert gas panel and to prevent contamination of the panel from the exhaust system.

All components and tubing are type 316L stainless steel. Hastelloy C-22 trim is used in corrosive gas regulators. All components handling the process gas or purge gas are welded into the system or use Cajon VCR fittings or equivalent. The panels are connected to the gas cylinder by a stainless steel pigtail and a CGA, DISS, or keyed VCR fitting, in the United States, (BS, DIN, AFNOR, INI in Europe, JIS in Asia) that is defined specifically for each type of gas. A flow restricting orifice is sometimes installed in the cylinder valve to minimize hazardous gas flow. Excess flow sensors may be installed on certain systems.

There are several overpressure alarms used in the AP11 software to prevent over-pressurizing the system in case of a failed regulator or other upset condition. The factory setting is designed to conservatively protect the internal gas cabinet components (typically 130 psig setpoint for high vapor pressure gases and 75 psig for low vapor pressure designs). These factory setpoints are only adjustable by special order, however there is user adjustable alarm “V Hi Proc Del User” that is user configurable. This alarm can be set by the customer to a lower overpressure setpoint to shutdown the gas cabinet and prevent high pressure gas from being sent downstream during process modes. If the user alarm is set higher than the factory alarm, it will be superseded by the factory alarm. Reference Chapter 14 for the user alarm details.

WARNING

The outlet of a typical gas cabinet may reach 130 psig under an upset condition. Ensure downstream components are appropriately rated for pressure.

Note: Asterisk (*) indicates manual valve type supplied is not equipped with optional Lock-Out/Tag-Out hardware, but maybe available. Contact your GASGUARD® representative for more information related to this optional manual valve hardware.

7.5 Inert Gas Purge Panel

This panel controls the pressure and flow of purge gas to the hazardous gas panel during the purge sequence and cylinder change-out procedure. The panel is constructed using similar materials and techniques as the hazardous gas panel. In addition, a safety relief valve located on the purge panel is used to prevent overpressure of the inert gas purge system, and the process panel.

7.6 Panel Schematic and Component Descriptions

Figure 7.3 is a flow schematic of a typical GASGUARD® AP11 Process/Process/Purge Auto Crossover Source System.

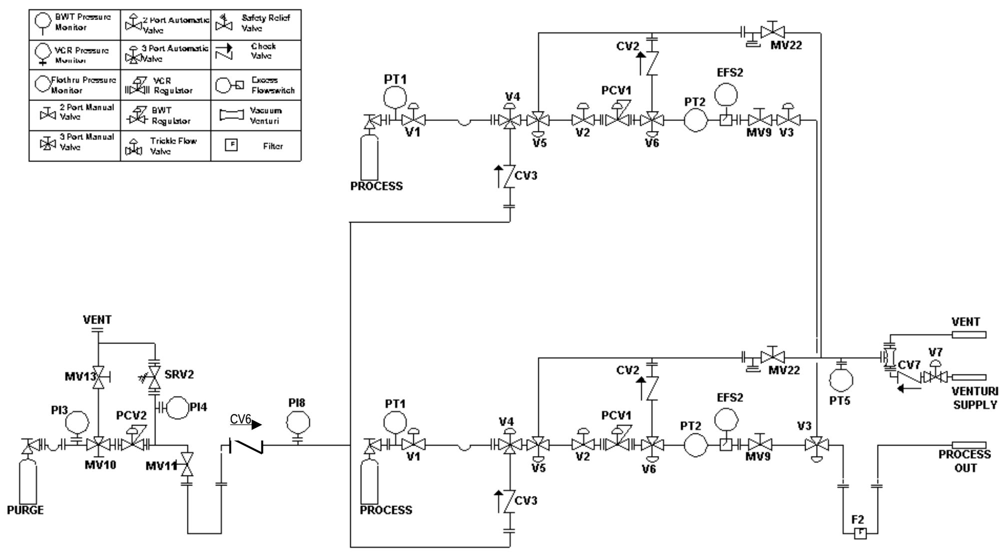


Figure 7.3: Process/Process/Purge Auto Crossover Source System Schematic

The function of each component is described in the table.

V0 Process Cylinder Valve (Customer Supplied)

This valve located on the process cylinder controls process gas flow from the cylinder to the pigtail. If the valve is pneumatically operated, it will automatically close on shutdown alarms. Solenoid valve, V8, in the controller is used to supply the pneumatic cylinder valve (if present).

V1 Automatic Shutoff Valve (On Pigtail)

This pneumatic valve is located on the pigtail, close to the process gas cylinder. Its primary function is to stop the flow of process gas when a shutdown alarm occurs or the E-Stop button is pressed.

V2 High-Pressure Process Isolation Valve

This pneumatic valve isolates the pressure regulator and downstream components from the high pressure process gas.

V3 Low-Pressure Process Isolation Valve

This pneumatic valve isolates the gas cabinet piping from the facility process piping.

V4 Purge Gas Inlet Valve

This pneumatic valve controls the on/off flow of purge gas to the high pressure side of the process panel and pigtail.

V5 High-Pressure Vent Valve

This pneumatic valve controls flow from the high pressure side of the panel to vent/vacuum system.

V6 Low-Pressure Vent Valve

This pneumatic valve controls flow from the low pressure side of the panel to vent/vacuum system.

V7 Vacuum Venturi Supply Valve

This pneumatic valve controls house nitrogen flow to the vacuum venturi, where vacuum is created and used to evacuate the process piping during purge sequences.

V9/V44 Trickle Purge Valve (Optional)

This pneumatic valve is used in series with V4 to provide a trickle purge from an open pigtail connection during cylinder change. The valve has a small orifice which allows a continuous flow of purge gas when it is closed and V4 is open.

PT1 Process Cylinder Pressure Transducer

This transducer monitors process gas pressure at the cylinder outlet. It is also used to check pressures during purge cycles.

PT2 **Process Delivery Pressure Transducer**

This transducer monitors process gas delivery pressure at the outlet side of the process regulator.

PT3 **Purge Cylinder Pressure Transducer**

This transducer monitors pressure of the purge gas at the cylinder outlet.

PT4 **Purge Delivery Pressure Transducer**

This transducer monitors purge gas delivery pressure at the outlet side of the purge regulator.

PT5 **Vent Line Pressure Transducer**

This transducer monitors vacuum pressure in the vent piping created by the vacuum venturi.

PT8 **Purge Line Pressure Transducer (Optional)**

This transducer monitors pressure in the purge header downstream of the purge purifier.

PIS36 **Fill Port Monitor (Optional)**

This pressure indicating switch is used to monitor process piping coax.

MV9 **Process Line Isolation Valve (Optional)**

This manual valve isolates the facility process piping and downstream equipment from the low pressure process gas supply. When closed, along with V3, it provides double block isolation of the process panel from the facility process piping.

MV10 **High Pressure Purge Gas Isolation Valve (Optional)**

This manual valve isolates the purge regulator from the high pressure purge supply.

MV11 Low Pressure Purge Gas Isolation Valve (Optional)

This manual valve isolates the purge gas pressure regulator from components.

MV12 Purge Gas Purifier Isolation Valve (Optional)

This manual valve isolates the purge gas purifier from the process panel piping.

MV13 Purge Gas Vent Valve

This manual valve is used to remove air from the high pressure purge piping after purge cylinder installation.

MV14 Process Purifier Isolation Valve (Optional)

This manual valve isolates the process purifier inlet from process gas.

MV15 Process Purifier Bypass Valve (Optional)

This manual valve allows process, purge or test gases to bypass the process purifier when open. It is used in conjunction with MV14 and MV16. It should be closed during normal process gas flow.

MV16 Process Purifier Isolation Valve (Optional)

This manual valve isolates the process purifier outlet from process gas.

MV17 Process Purifier Inlet Valve (Optional)

This manual valve isolates the process purifier when removed from the system.

MV18 Process Purifier Outlet Valve (Optional)

This manual valve isolates the process purifier when removed from the system.

MV19 Purge Purifier Inlet Valve (Optional)

This manual valve isolates the purge gas purifier when removed from the system.

MV20 Purge Purifier Outlet Valve (Optional)

This manual valve isolates the purge gas purifier when removed from the system.

MV21 Purge Gas Isolation Valve (Optional)

This manual valve is only used when the nitrogen purge panel is external to the cabinet.

MV22 Vent Isolation Valve

This manual valve isolates the vacuum venturi piping from the vent piping on each process panel, in a dual process panel system. It is also used to isolate the vacuum venturi piping from an optional helium leak test port in the high pressure vent downstream of V5. The valve should be left open except when performing a helium leak test.

MV23 Purge Gas Outlet Isolation Valve (Optional)

This manual valve isolates the gas cabinet purge panel from the downstream purge gas line exiting the cabinet to supply other cabinets or valve manifold boxes.

MV29 Process Outlet Isolation Valve (Optional)

When a system has more than one process outlet, this manual valve(s) isolates the process outlet gas line from the facility process piping.

CAUTION ***Prior to initiating a Main Menu sequence, ensure these valves are in the proper configuration for the task to be performed.***

MV31 Leak Test Isolation Valve (Optional)

This manual valve isolates a leak test port (typically a VCR connection) from the process panel.

MV33 Weld Gas Inlet Valve (Optional)

This manual valve is used to supply weld gas to the process line during installation.

MV34 Process Purifier Purge Valve (Optional)

This manual valve is used to supply purge gas to the process purifier during purifier installation and removal.

MV35 Process Purifier Vent Valve (Optional)

This manual valve is used to vent purge gas from the process purifier during purifier installation and removal.

MV36 Fill Port Isolation (Optional)

This manual valve isolates the coax fill port from the coaxial process line.

MV39 Process Crossover Isolation Valve (Optional)

This manual valve is installed in the crossover piping, between process out piping, on a dual outlet system.

PCV1 Process Gas Pressure Regulator

This regulator controls process gas delivery pressure.

PCV2 Purge Gas Pressure Regulator

This regulator controls purge gas delivery pressure.

CV1 High Pressure Process Vent Check Valve

This check valve prevents back-flow of vent gases is V5 is improperly opened.

CV2 Low Pressure Process Vent Check Valve

This check valve prevents bypass of high pressure process gas around PCV1. CV2 also prevents back-flow of vent gases if V6 is improperly opened.

CV3 Purge Gas Supply Check Valve

This check valve prevents back-flow of process gas into the purge gas line.

CV4 Purge Gas Supply Check Valve (Optional)

This check valve is installed to protect the purge gas purifier. It must also be installed in conjunction with PT8.

CV5 Vacuum Venturi Check Valve

This check valve prevents back-flow of process gas from the vent piping into the house nitrogen system. CV5 provides redundancy to CV7.

CV6 Purge Panel Vent Check Valve

This check valve prevents back-flow of purge gas from SRV2.

CV7 Vacuum Venturi Check Valve

This check valve prevents back-flow of process gas from the vent piping into the house nitrogen system.

SRV2 Purge Gas Delivery Pressure Safety Valve

This pressure safety valve prevents overpressurization of the purge gas delivery piping.

7.7 GASGUARD® AP11 Controller

The GASGUARD® AP11 controller is a microprocessor-based unit housed in a custom designed metal enclosure. It continuously monitors system inputs and automatically performs purging operations by sequencing valve actuation. Adequate purging is ensured by checking pressure and vacuum at each step within the purge cycles. The controller also has the capability of shutting down the system if an unsafe condition arises.

The controller screen allows the operator to easily understand the operation and to quickly identify operating problems. The color scheme for open and closed valves can be found on the legend of the controller face. The path of gas flow is indicated by an animated dashed line and controller status is displayed in the middle of the top of the screen. Any shutdown alarms are displayed in the SHUTDOWN ALARM box in the top left hand corner of the screen. Fault alarms are displayed in the FAULT ALARM box in the top right hand corner of the screen.

Figure 7.4: GASGUARD® AP11 Controller

7.7.1 Controller Components

The Display Screen

Located on the front face of the controller, the display screen is an LCD that contains a graphical display of the process gas panel, shutdown and fault alarm boxes, a controller status box and the selection window. The screen that is displayed when the system is powered up for a single controller is shown below.

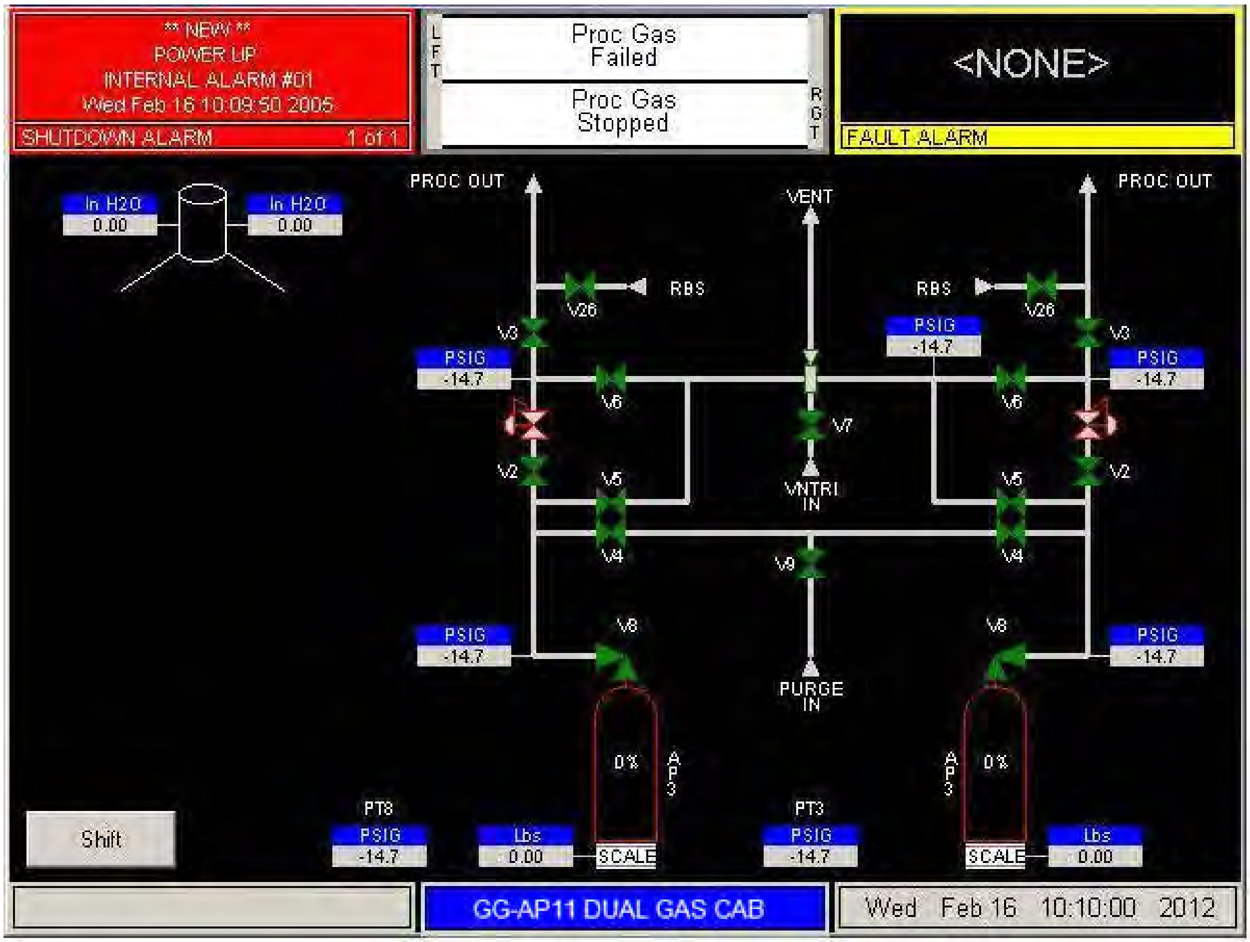


Figure 7.5: GASGUARD® AP11 Power Up Screen

The Main Menu and Cabinet Configuration Selection Window

The selection window is located to either the left or right side of the screen after successfully entering the password. It presents prompts and menu selections. The Main Menu is shown in Figure 7.6. The Main Menu will remain displayed for a configurable amount of time or until the Logout key is pressed.

Figure 7.6: GASGUARD® AP11 Controller Main Menu

It is possible to resize the Main Menu to get a full screen view. To resize the Main Menu, touch the words, "Main Menu," at the top of the window.

The Main Menu will appear like the illustration to the right.

To return the Main Menu to its full size, simply touch the words, "Main Menu," at the top of the window again.

Alarm and Controller Status Boxes

Shutdown alarms will appear on the SHUTDOWN ALARM box, located in the top left hand corner of the screen. Fault alarms will appear on the FAULT ALARM box, located in the top right hand corner of the screen. If <NONE> is displayed, no alarm conditions are present. A time stamp of when the alarm occurred will be displayed with each alarm. Touch either box to acknowledge alarms and touch again to reset alarms.

The CONTROLLER STATUS box is located in the top center of the screen and displays the current status of the process panel. Refer to Figure 7.7.

Figure 7.7: Alarm and Controller Status Boxes

Source System Information

The source system information window can be reached by touching the blue title button at the bottom of the screen. This window displays the firmware, network, and configuration information. The user also has the option of testing the shutdown and/or fault alarms as well as cleaning the screen.

VGA LCD Display

The VGA LCD display, located on front of the cabinet controller, provides, through a lighted display, visual indication of pneumatic valve positions. The color scheme for open and closed valves can be found on the legend of the controller face.

Controller LEDs

Additionally, LEDs which display cabinet functions, are located to the right of the LCD display. The table below describes these LEDs and their functions.

LED	Function
SHUTDOWN ALARM	This LED flashes red on power up and for an un-acknowledged shutdown alarm. Once acknowledged, the LED stops flashing but remains red until it is reset.
FAULT ALARM	This LED flashes yellow on power-up and for a fault alarm. Once acknowledged, the LED stops flashing but remains yellow until it is reset.
PROCESS	This LED lights green when process gas is flowing.
ARS	This LED lights blue; steady on when ARS is enabled, flashing when ARS is active.
POWER	This LED indicates that there is +5 VDC power to the unit.

Emergency Stop

The red, mushroom head push-pull emergency stop button, located on the right side of the cabinet controller, shuts off power to the pilot solenoids, closing all of the pneumatic valves. Power is maintained to the controller, but it cannot open the valves until the button is pulled out to its normal position. Refer to Figure 8.1 for details on the Emergency Stop pushbutton.

Screen Saver

For all display types, the screen saver will blank the screen and a randomly moving mode indicator box will appear on the screen. The screen saver function will become active when the programmed amount of time has elapsed since the last operator touch screen action. If the operator presses the touch screen, a new alarm appears, or a sequence prompt appears while the screen saver is active, the screen saver function will become inactive and the key pressed will be ignored.

USB Devices

The GASGUARD® AP11 Controller is furnished with four USB ports; 3 available on the Carrier board, 1 available at the front of the controller.

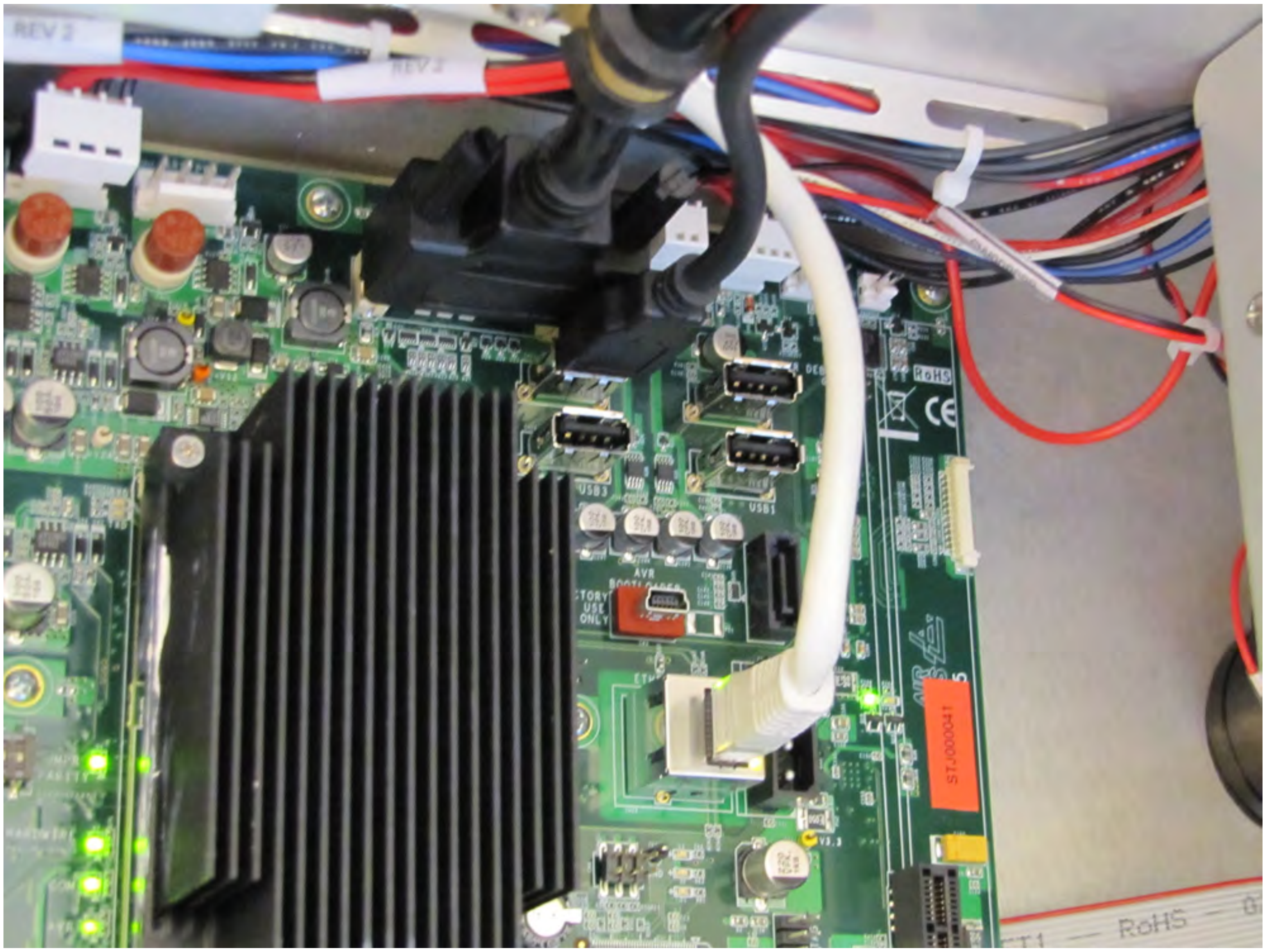


Figure 7.8: USB Ports

Any USB compatible device may be connected to either of the USB ports. For instance, a memory device may be used to transfer Firmware from the device to the Controller. Likewise, information can also be transferred from the Controller to the memory device. As another example, a USB compatible mouse can be used to navigate the Controller screens rather than using the touch screen capabilities.

An option available for the GASGUARD® controller is a USB port that is located on the face of the controller, just to the right of the fault alarm light. Refer to Section 4 for further information about this USB port and proper operation.

Mouse Usage

The GASGUARD® AP11 Controller is setup for mouse usage. All actions performed using the touch screen can also be achieved using a mouse. This may become necessary in the event of a touch screen failure. For the mouse icon to appear, move the mouse at a 45 degree angle to the upper left-hand corner and right click. This will enable the cursor.

Notes On Highlighting Text

In the Controller Configuration menu, it is possible modify setpoint, password, and other numerical data. Rather than hitting the BACKSPACE key to eliminate the exiting data, it is possible to highlight the data by simply dragging your finger across the field and then entering the new data using the on-screen keypad.

Flow Valve (Z-Purge)

The flow valve is located on the right rear of the controller and can be adjusted via the penetration into the gas cabinet between the pneumatic control bulkheads.

> The flow valve controls the flow of the house nitrogen to the controller interior. Its use may be required in certain areas (i.e. Class I, Division II designated areas in the U.S.A. or Group II, Category 3 areas in the European Community.)

A pressure switch is installed inside the controller to ensure adequate pressure (≥ 0.1" H_2O) during the Z-purging. A "low Z-purge" alarm will be triggered if pressure falls below the setpoint. The nitrogen flow must be increased until the alarm can be reset.

7.8 Main Menu Options

> ***Note: The following descriptions of system sequences are not intended as a guide to operation. Use specific operating procedures, provided in Section 8, to operate the system.***

The main menu provides access to the controllers' sequences. It is password-protected. Contact your GASGUARD® representative for your system password. Section 8.2 explains how to enter a password. Some options are only available after completing another sequence. For example, a cylinder change must be preceded by pre purge.

The following options are available from the main menu:

Process Gas Flow

This option starts and stops the process gas flow.

The start sequence tests the process panel for adequate process pressures.

If problems are found, process gas flow is not started and an alarm is displayed. Details of these alarms are located in Section 11 (System Specific Information) of this manual.

If no problems are found, the process gas flow is started. Flow continues until a process stop, or until an alarm condition causes a shutdown.

Pre Purge

This option starts the pre purge sequence prior to cylinder change.

It tests for a gross leak at the cylinder valve. The primary purpose of this test is to provide operator safety and protect purity of the system.

The pre purge sequence tests for adequate vacuum, then initiates a series of purges of the process piping to remove all process gas before changing the process gas cylinder.

The number of purge cycles depends on the type of process gas. Minimum values are built into the sequence. Cycles may be increased (see AP11 Source System Configuration in Section 8.6 of this manual), but not reduced below the minimum.

Change Cylinder

This option only appears on the Main Menu after a Pre Purge has been completed.

This option is used when changing the process cylinder. It must be preceded by a pre purge sequence.

This sequence tests for high pressure, which is an indication of a process cylinder valve leak, and then establishes a trickle purge flow through the pigtail for cylinder removal and replacement.

If a safe condition is detected, you are prompted to remove the spent cylinder and replace it.

CAUTION

Cylinder change procedures are located in Section 8.3. Do not attempt to change a cylinder without following appropriate procedures.

Post Purge

This option only appears on the Main Menu after a Change Cylinder has been completed.

This option starts the post cylinder change purge sequence.

The post cylinder change purge sequence purges the process panel after a process cylinder change. It tests for gross leaks at the pigtail cylinder connection.

As with the pre purge, the number of purge cycles is determined by the process gas type. Cycles may be increased (See AP11 Source System Configuration in Section 8.6 of this manual), but not reduced below the minimum.

Rough Line Evac (Optional)

This option starts the rough line evacuation sequence.

The rough line evacuation sequence purges the process line between the gas cabinet and the tool. It is used to remove process gas before maintenance on a component, such as a mass flowmeter, located between the cabinet and the tool. It is also used to remove contaminants after maintenance is complete.

This sequence alone does not remove the process gas from the process line to an acceptable threshold limit value (TLV).

It is recommended to follow the Rough Line Evac sequence with an inert flow (flush) from the gas cabinet to the tool.

This can be established with the use of Manual Mode operation as described in Section 8.5.

Panel Purge (Optional)

This option starts the panel purge sequence. The panel purge sequence evacuates the entire process panel, including both the high pressure and low pressure sides, then purges the low pressure side of the panel up to V3. It is used to remove process gas before any maintenance is performed on the panel or if the entire panel is to be removed.

7.9 Remote Backup System (RBS)

RBS, *also referred to as Automated Backup System (ABS),* is an optional piping configuration. The following section describes functionality of RBS for systems designed with the RBS piping configuration.

7.9.1 Description

A Remote Backup System (RBS) is a configuration of multiple interconnected GASGUARD® Source System systems. An RBS configuration consists of one or more Dual Process Out (Primary) systems and an Autocrossover (Backup) system, and is designed to reduce the number of individual GASGUARD® systems required to supply a given number of tools.

RBS implementation requires both piping (process gas) and electrical (alarm / status signal) interconnections between the Backup and Primary GASGUARD® systems. The following material documents the general principals, interconnections and other considerations related to implementing Remote Backup Systems.

7.9.2 Definitions

Primary system - the system that supplies gas to the tool (through a VMB if applicable). It is essentially a dual outlet system equipped with the RBS piping assembly allowing for automatic crossover function between each side (independently) and the backup system.

Backup system - this is the system that supplies gas to one or more primary systems. It is configured as a typical 2 cylinder automatic crossover system.

RBS - Remote Backup System - *also referred to as ABS - Automated Backup System*. This is the combined system consisting of one backup system and one or more primary systems.

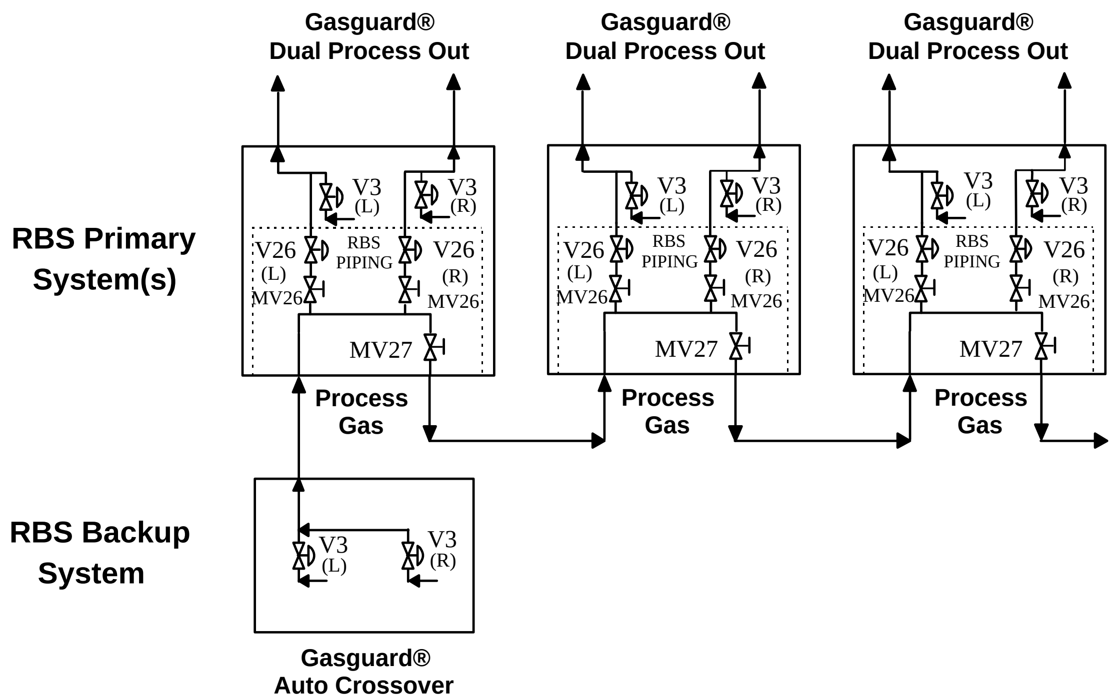


Figure 7.9: RBS - Simplified Piping Interconnections

7.9.3 Valve Numbers and Nomenclature

The RBS requires the use of 5 additional valves on the primary system;

MV26 = “PROCESS BACKUP SOURCE” (manual). One each for left and right side.

V26 = “PROCESS BACKUP SOURCE” (pneumatic). One each for left and right side.

MV27 = “PROCESS BACKUP OUTLET” (manual). Quantity one.

Since the backup system is a typical automatic crossover system, no additional valves are required.

7.9.4 Description of Operation

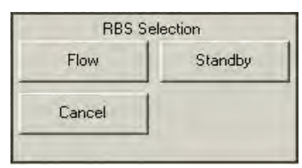
RBS is a special firmware controlled operation designed to reduce the number of systems required for a given number of tools while still maintaining crossover functionality. The Configuration Software file must be set up defining the system as RBS. There is an input on the primary systems used to accept a ‘gas unavailable’ signal from the backup system. This signal indicates that the backup system is off line and, hence, crossover would not be functional. If this signal is present, the system automatically reverts to a standard dual outlet configuration with no crossover functionality.

If the Configuration Software file has been setup defining the system as RBS, the Main Menu will have an RBS pushbutton.

The RBS selection on the Main Menu will always be available even if a local mode is currently running.

RBS Selection Pushbutton

Selecting “Start RBS” will initiate an operator prompt for “Flow” “Standby”. Pressing Cancel will close the operator prompt perform no action.



The prompt will inhibit the “Flow” option if:

- “Process Flow” is running
- A ‘V3 open’ command is detected in a sequence that is running.
- Gas Unavailable signal from the backup system is detected.

Selecting “Stop RBS” will take RBS out of standby mode or immediately close the valve V26 if RBS is currently flowing.

The controller will always display the current status of RBS if running or in standby. The controller will display “<current local mode>/ RBS Flowing” or “<current local mode>/RBS Standby”.

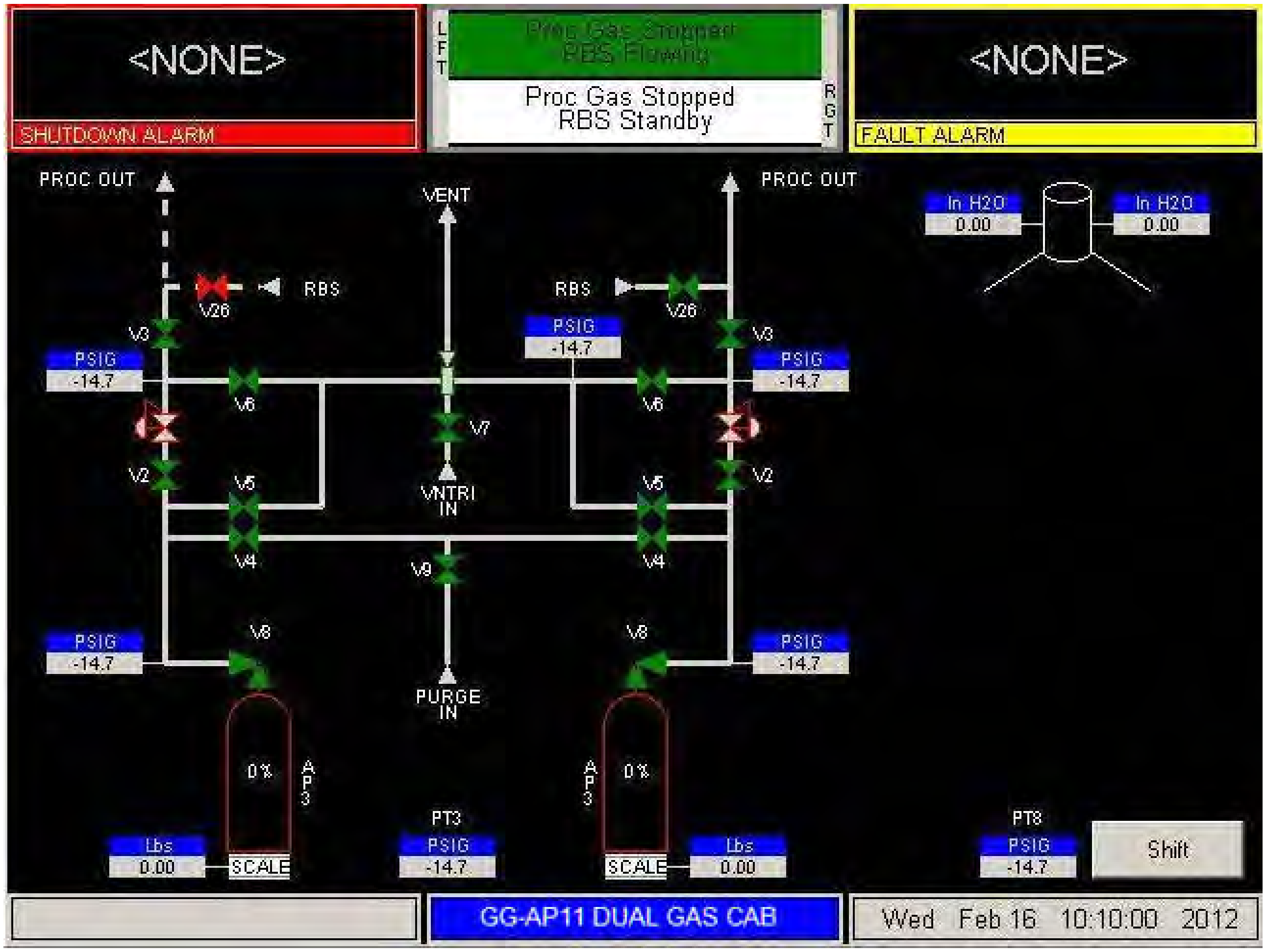


Figure 7.10: RBS Controller Display

No RBS label status will be displayed if RBS is stopped (via the main menu).

While RBS is in standby:

- If an RBS shutdown alarm (identified in the Configuration Software file) occurs, RBS will remain in standby;
- If Gas Unavailable signal from the backup system is detected, a Fault alarm will appear; RBS will remain in standby;
- If start process gas flow is selected, RBS will remain in standby.

While RBS is flowing gas:

- If a local mode is selected, the mode will run normally with the following exceptions.
  - If an “Open V3” command is detected in the local mode sequence, the local mode sequence will abort with the alarm “V3 Inop During RBS”. RBS continues to flow. If no “Open V3” command is found, the local mode will run normally.
  - A Process Gas mode is selected: The Process Gas mode will run normally. When V3 opens, the RBS valve closes (via the config sequence) and RBS remains enabled and in standby.
- If RBS shutdown alarm occurs: RBS valve closes and RBS is placed in standby mode. Operator can restart RBS directly from the main menu after clearing alarm.
- If Backup system cabinet shutdown occurs (gas unavailable): RBS valve closes and alarms, and RBS is placed in standby mode. Local modes are not affected.

Crossover from primary to backup will occur for either of the following two scenarios:

- On any of the following three alarm conditions; very low cylinder weight, very low process cylinder pressure, or very low process delivery pressure: Crossover immediately. If, however, backup system cabinet is not available, “Process Flow” will stop but crossover will not occur.
- On stopping a Process Gas mode, the crossover window will display with the options of “Crossover”, “Stop”, or “Cancel”. If the backup system cabinet is not available at this time, the prompt will not appear.

When crossover occurs, V3 (process outlet on primary) is closed and V26 is opened on the side that has alarmed. For gas to flow after crossover has taken place, MV26 on each primary side must be open.

The function of MV27 is to provide dual isolation between the RBS gas and atmosphere. When more than one primary system is connected to one backup system, MV27 on all systems except the last one in line must be open in order for each downstream system to be able to crossover. MV27 on the last (farthest downstream) system must remain closed in order to provide the dual isolation (dual isolation is achieved by MV27 and capped port).

The backup source is not intended for extended periods of use and the primary panel should be brought back on line as soon as possible after crossover. The first step in accomplishing this is to perform the normal pre-purge, cylinder change, and post-purge procedures (refer to appropriate sections in operation manual). When the primary panel is ready to flow gas again, selecting ‘START PROCESS GAS’ from the main menu will automatically close V26 (thereby stopping the backup source for this panel) and open V3, so that process gas is being supplied by the primary panel.

7.9.5 Limitations

Note that there is a limit to the number of primary system panels that may function off of a single backup system. The main factor influencing this limit is obviously the process flow rate required at each primary system. A secondary factor is the number of primary systems that are connected (the backup gas must pass through one MV27 for each primary system except the last one, and experiences a pressure drop at each MV27). Theoretically, there could be a large number of primary systems functioning off of one backup system if there would be a practical way to limit the number of primary panels that could crossover with and use the backup gas at any given time.

7.9.6 Alarm Conditions And Responses

As mentioned previously, crossover is caused by either a very low process cylinder weight, very low process cylinder pressure, or very low process delivery pressure. The following table summarizes alarms which describe the interaction of the primary and backup systems. Other alarms exist (not listed in the table) which control the operation of the individual systems.

INPUT ALARM	SYSTEM	PRIMARY RESPONSE	BACKUP RESPONSE	CROSSOVER
B/U Unavailable	P	Shutdown RBS mode, Local modes unaffected.	None	NO
B/U System Disable	B	None	Shutdown	NO
UVIR flame detect	P	Shutdown	Shutdown	NO
UVIR flame detect	B	None	Shutdown	NO
High temperature	P	Shutdown	Shutdown	NO
INPUT ALARM	**SYSTEM**	**PRIMARY RESPONSE**	**BACKUP RESPONSE**	**CROSSOVER**
High temperature	B	None	Shutdown	NO
V. low process del.	P	Shutdown	None	YES
V. low process del.	B	None	Local crossover	NO
V. low process cylinder press.	P	Shutdown	None	YES
V. low process cylinder press.	B	None	Local crossover	NO
V. low process cylinder weight	P	Shutdown	None	YES
V. low process cylinder weight	B	None	Local crossover	NO

RBS - Alarm Conditions & Responses

NOTES: Shutdown alarms on the backup system that do not directly shutdown the primary system will indirectly shut down the primary system IF the primary system has crossed over with the backup and is supplying gas from the backup system.

Example; crossover has occurred and the primary system was not put back on line. The backup system, not the primary system, is now supplying gas to that particular VMB/tool. The backup system experiences a very high process delivery pressure alarm and shuts itself down. The 'gas unavailable' signal would then be sent to the primary system causing it to revert to the standard dual outlet configuration (see section 3). Since the primary panel is not on line, the flow of gas to the VMB / tool would be interrupted.

7.10 High Pressure Leak Test (HPLT)

HPLT is an optional piping configuration. The following section describes functionality of HPLT for systems designed with the HPLT piping configuration.

7.10.1 Definitions

HPLT - high pressure leak test. This is the term used to describe the leak test function performed at an elevated pressure on the CGA connection between a pigtail and cylinder. The control system utilizes a pressure transducer to monitor for pressure decay and will indicate the presence of a leak.

Standard leak test - this is the leak test function supplied with standard cabinets. It can be configured as either inboard or outboard. Inboard is done with a helium spray at the CGA connection and a leak detector pulling a vacuum through the leak test port. Outboard is done with a sniffer probe sensing at the pressurized CGA connection.

RFO - restrictive flow orifice. Installed in a line to limit flow rate or provide surge suppression. There is an RFO on the HPLT supply line to provide surge suppression (0.007 inch).

7.10.2 Valve And Transducer Numbers And Nomenclature

V44 (old V9) = trickle purge valve (pneumatic). On systems with HPLT, this is a high pressure valve with a 0.010 inch orifice bypass.

V10 = HPLT supply valve (pneumatic).

V11 = low pressure purge inlet valve (pneumatic). This is also a high pressure valve, and is installed opposite to the purge flow direction allowing HPLT gas pressure to seat against the inlet side of the valve body.

MV4 = “PURGE IN GAS” (manual). The purpose of this valve is to provide dual isolation between HPLT gas and process gas when one side is being tested and the other side is flowing gas.

PT1 = cylinder pressure transducer.

PT8 = purge back pressure transducer. Not required on all systems. Senses process gas back flow and contamination of purge line/cylinder. PT8 is supplied for certain hazardous gases where the cylinder pressure is high enough to back contaminate the purge gas. PT8 is typically a 250 PSI transducer, however 1000 PSI transducers are supplied on HPLT systems where PT8 is needed (so a higher leak test pressure can be used without damaging the transducer).

7.10.3 Description Of Operation

HPLT is supplied in order to more effectively verify the leak integrity of the pigtail-to-cylinder CGA connection after a cylinder is changed. It is an improvement on the standard leak testing. Leak testing done at a higher pressure will indicate leaks faster and of a lesser magnitude than leak testing done at a lower pressure.

The maximum value of the leak test pressure is dependent upon several factors;

- the service pressure of the fittings and valves that will be exposed to it.
- the pressure rating of PT1
- the pressure rating of PT8
- the pressure available from the leak test gas supply.

If PT1 is a 1000 psi transducer, the recommended HPLT supply pressure is 950 psig, but shall not exceed 970 psig. If PT1 is a 250 psi transducer, the recommended HPLT supply pressure is 220 psig, but shall not exceed 230 psig.

HPLT is automatically initiated as part of the cylinder change sequence following cylinder changeout. Upon initiation of the cylinder change sequence, a prompt will appear to close MV4 on the opposite side. Upon completion of the cylinder changeout portion of the cylinder change sequence, the HPLT will open V10 and V4 allowing the system to pressurize with leak test gas between V10 and V2. When the HPLT is initiated, the high purge back pressure alarm associated with PT8 is disabled. A period of 3 minutes is allowed for the system to stabilize, after which time V10 and V4 are closed. After stabilization, the pressure is monitored by PT1 for 10 minutes. During the test, the message “HP LEAK L (or R)” is displayed~~,~~ and the 10 minute period is counted down on the screen.

If the actual pressure decay was less than the preset limit, the system has passed. Post purge can now be initiated (refer to appropriate section in operation manual). If the pressure decay was equal to or greater than the limit, the test will abort and the system will alarm indicating that the test has failed. The connection must be remade and the cylinder change sequence performed again. Note, prior to re-running the cylinder change sequence, the operator must ensure a vacuum condition at PT1 and PT2. If not at a vacuum, the operator must manually achieve vacuum at PT1 and PT2 before change cylinder mode can be started. If the HPLT fails, the controller will not allow post purge and process gas sequences to start. HPLT must be successfully completed before any further operations are permitted.

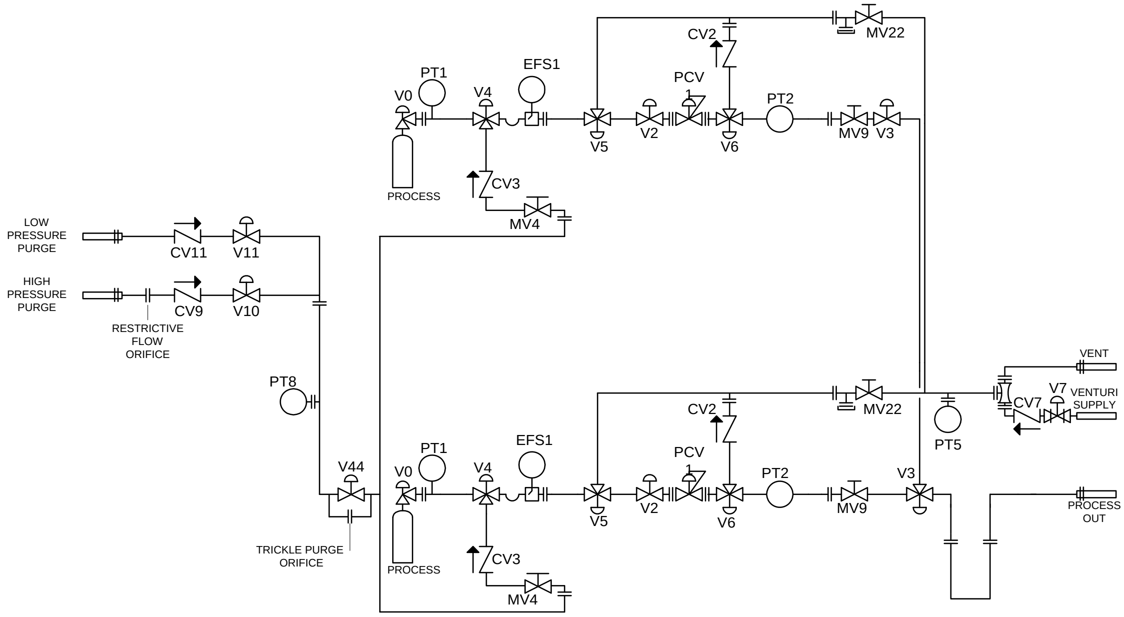


Figure 7.12: Example HPLT Piping Schematic

7.10.4 Alarm Conditions And Responses

The following table summarizes the typical alarms associated with HPLT. Setpoints and alarm conditions may vary according to customer specification. Other alarms exist (not listed in the table) which control the operation of the system.

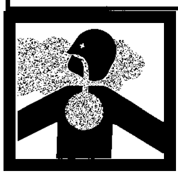
INPUT ALARM	RESPONSE	CONDITION	DELAY	SETPOINT (950 psig supply pressure)	SETPOINT (220 psig supply pressure)
HIGH HP PURGE PT1	Fault	HI	0	980	233
LOW HP PURGE PT1	Fault	LO	0	900	200
LOW HP PURGE PT8	Fault	LO	0	900	200

HPLT - Alarm Conditions & Responses

7.11 Multiple Process Outlets

Multiple Process Outlets are optional piping configurations available for auto crossover configurations that can extend the flexibility and application of a single GASGUARD® Source System. Each additional process outlet is furnished with a manual isolation valve and a process line connection with the option of either a standard bulkhead or a coaxial bulkhead. The VCR connection downstream of the valve is terminated and capped with a VCR plug at the factory. The additional outlet piping spools are faced, ready for welding and are shipped loose with the cabinet. Verify all tubing connections with the flow schematic, or INS drawing (if requested), prior to welding.

⚠CAUTION



Additional process outlet piping spools shall not be installed until the facility delivery line is complete and ready to be terminated.

Multiple process outlets offer a convenient method for providing gas to multiple use points:

- to another source cabinet(s) for emergency manual supply.
- to valve manifold box(es) or process tool(s).
- for future expansion.

⚠CAUTION

Prior to initiating a Main Menu sequence, ensure these valves are in the proper configuration for the task to be performed.

⚠CAUTION

Before attempting to service a Multiple Process Out system, tag out and lock out (see section 1.11) all Process Outlet Isolation Valves (MV-29) to prevent opening while service is being performed.

7.12 GASGUARD® eV Heating

GASGUARD® eV provides heating control for 2 cylinder blankets and 2 zones of heat trace. Heating is monitored and controlled from the AP11. Each heater can be individually controlled with separate alarm and control setpoints. The control thermocouple temperature for each heater is displayed on the screen of the AP11 controller. Heating control logic is integrated into the AP11 software and is automatically switched on and off as necessary to facilitate cylinder changes.

If it becomes necessary to turn off heat trace or cylinder heaters outside of the normal operating routines, the control setpoint must be set well below the lowest ambient temperature. It is recommended to use the minimum setpoint of -15 degC. **Note: For intrusive maintenance, it is strongly recommended to disconnect power to those areas.**

NOTE: During ARS events, the system will not heat.

7.13 New GASGUARD® Features

7.13.1 LED Interior Lighting

High quality service LED lights are available in the GASGUARD® product line to facilitate system maintenance and visual inspections. The lights are installed in both controller and piping enclosures. See Chapter 14 for operational details.

7.13.2 Active Pressure Control

Pre-tuned, pneumatically actuated regulators are available in the GASGUARD® product line. This control platform is used to reduce set-up time, offset the pressure supply effect and the flow related droop associated with traditional spring-loaded regulators. See Chapter 14 for operational details.

7.13.3 Premium Controller Options

Premium software and controller options are available in the GASGUARD® product line by license. For example, the local analog trending package allows the user to view real time and historical analog data directly from the local controller interface. See Chapter 14 for operational details.

Chapter 8

Operating Procedures

This section will describe the operating procedures. The following procedures are included.

CAUTION

Be sure you have read and understood the safety information located in Section 1 of this manual before operating the system. You should also be familiar with the location and function of all components.

CAUTION

Prior to operating the system, the proper installation procedures need to be completed. This information is found in the Sections 1 through 7.

CAUTION

The gases being used in this equipment may be extremely hazardous. It is the customer's responsibility to assure that only experienced, trained operators, thoroughly familiar with this manual, the equipment and operating procedures, the hazards and the safety procedures are permitted to operate this system.

CAUTION

The handling of any toxic gas cylinders must be performed by two trained operators utilizing self-contained breathing apparatus.

8.1 Emergency Shutdown Procedures

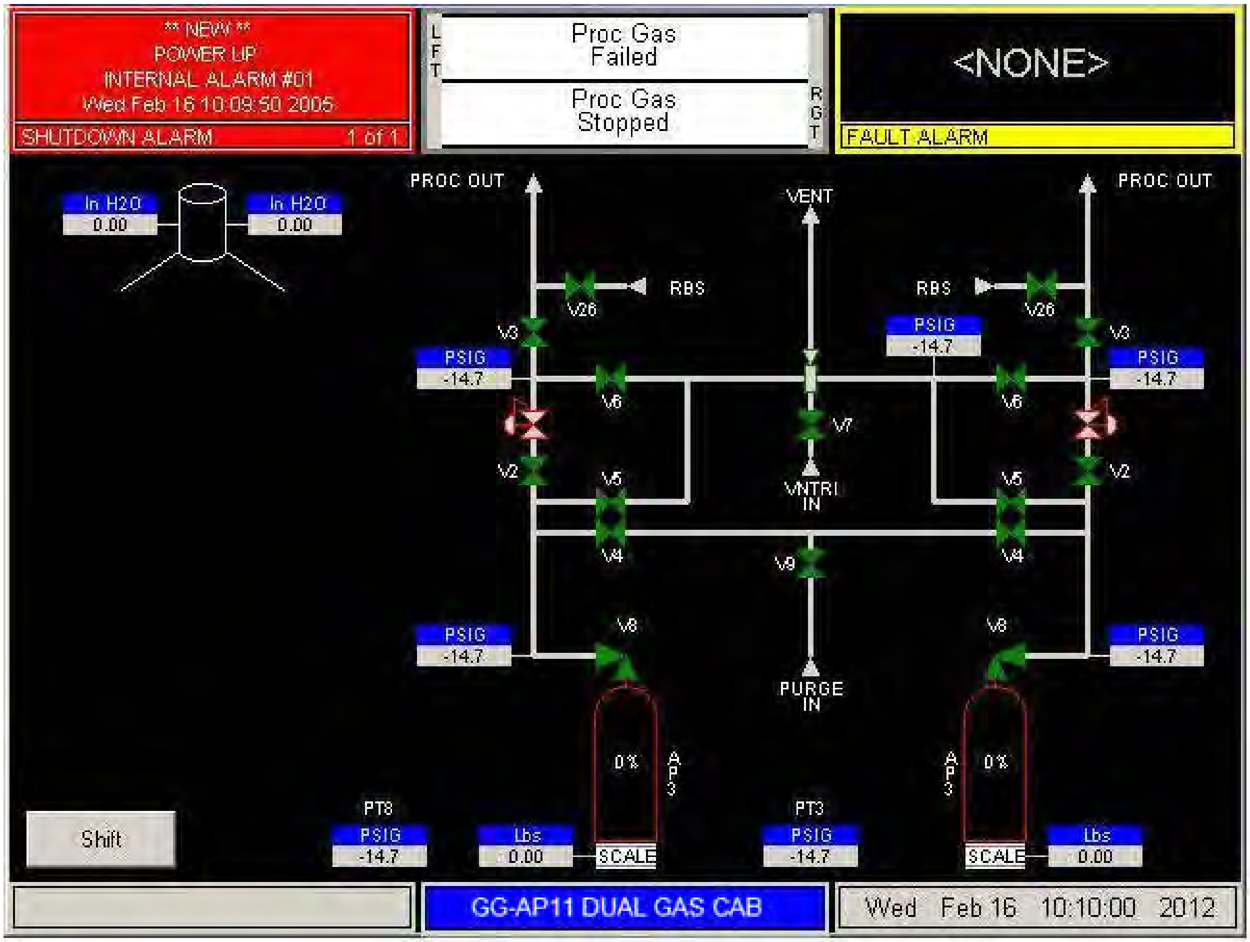
In the event of an emergency, press the "EMERGENCY STOP" pushbutton on the controller panel. See Figure 8.1 below. This will close all valves, any process or purge program is aborted, the alarm horn will sound and the shutdown alarm light will flash. ***Evacuate the area***.

Figure 8.1: Emergency Stop Pushbutton Location

Pressing the "Emergency Stop" button does not disconnect power to the controller. The 120 VAC/240 VAC power is still active within the controller. Do not perform maintenance on the controller without disconnecting or switching of power externally and following the required Lockout or Tagout procedures.

If it is necessary to reenter the area while a hazardous atmosphere is suspected, the proper Personal Protective Equipment (PPE) must be worn. See Section 1.9 of this manual for the proper PPE.

8.2 Operation of the Source System Controller



This is the screen that is displayed upon power up.

To begin operation, press the Shutdown Alarm Status window once to acknowledge any alarms. Press the Shutdown Alarm Status window again to reset any alarms.

Touch anywhere on the graphics portion of the screen.

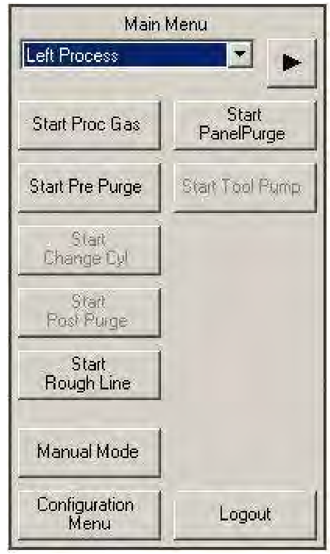
A window like the one on the right will open on the screen.

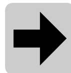
Enter the password using the numbers on the keypad.

Example:
To enter the password "11234": where the level of access precedes the password.
Press 

If an improper password is entered, the password window will look like the one to the right.

“Invalid Password” will appear at the bottom of window.



Use the  and  keys or the drop down menu to select the left or right process line.

The main menu screen for the selected panel will appear on the screen.

To select a menu choice, simply press the corresponding button.

> ***Note: Selections that appear dimmed are not selectable at this point of the controller sequence. All sequences require the operator to follow an executable order.***

8.3 Process and Purge Cylinder Procedures

⚠CAUTION

Only operators trained in the following procedures and the hazardous gas system are allowed to change cylinders.

⚠WARNING

High pressure gas cylinders can be extremely hazardous when not handled properly. Follow the procedures in this section to prevent personal injury or death.

⚠CAUTION

The procedures listed in this section are intended to be used in conjunction with the purge and cylinder change functions of the cabinet controller. Do not use these procedures independently.

⚠WARNING

All high pressure gas cylinders containing highly toxic or pyrophoric gases must have an RFO installed in the cylinder. Do not operate equipment without a properly sized RFO in place

⚠WARNING

Any HPM container > 15psig must have an RFO installed in the cylinder valve if there is no Excess Flow Switch installed in the system. Do not operate equipment without a properly sized RFO in place

⚠WARNING

All silane cylinders and silane mix cylinders containing 2% or more silane must have an RFO installed in the cylinder valve with a maximum orifice diameter of 0.010 inch. Do not operate equipment without a properly sized RFO in place.

8.3.1 Inert Purge Gas Cylinder Change Procedure

This procedure will normally be done after "PRE-PURGE CYCLES" in conjunction with a process gas cylinder change.

WARNING

Before approaching a hazardous gas cabinet for a cylinder change, verify that there are no alarm labels displayed on the screen and that the exhaust system is functioning correctly. Only operators trained in these procedures and the hazardous gas system are allowed to change cylinders.

CAUTION

Process gas back-stream hazard can exist if the purge cylinder pressure drops below 200 psig (13.78 barg).

8.3.1.1 Empty Purge Gas Cylinder Removal

1. Check and record the required information on the Process Gas Cylinder Change Checklist (found at the end of Section 8.3) each time a cylinder is changed.

WARNING

Do not proceed if there are any alarm labels displayed on the screen, the exhaust system is not working or pressures appear abnormal.

2. Open access window.

3. Close purge gas cylinder valve (fully clockwise).

4. Close manual valve MV10.

5. Slowly open manual valve MV13, to vent purge gas within pigtail. Close MV13.

6. Through the access window, loosen the pigtail cylinder connection from the cylinder valve using the proper wrench. Be sure to support the connection and pigtail tubing.

7. Close access window.

8. Don the required Personal Protective Equipment (PPE) prior to opening cabinet door.

9. Re-verify that exhaust system is working.

10. Open gas cabinet door.

11. Recheck that cylinder valve and manual valve MV10 are closed.

12. Fully remove pigtail cylinder connection from cylinder valve.

13. Install cylinder valve protection cap.

14. Install pigtail cylinder cap/plug onto pigtail connection.

15. Unbuckle cylinder strap and remove cylinder from source system.

16. Place cylinder in appropriate cart and strap in place. Place "EMPTY" tag on cylinder and return cylinder to the appropriate cylinder storage area.**8.3.1.2 Full Purge Gas Cylinder Installation**

1. Verify that the replacement cylinder is identical to the purge gas cylinder that was removed.

Never attempt to replace specified gas with another gas without consulting equipment supplier. Incompatible gases could cause fires, explosions or extremely corrosive or toxic compounds.

2. Position full cylinder in gas cabinet, and strap loosely. Remove valve protection cap.

If a valve protection cap is extremely difficult to remove, do not apply excessive force or pry the cap loose. Attach a label to the cylinder identifying the problem. Obtain another cylinder. Do not attempt to open a frozen cap as this would damage the cylinder valve and could result in personal injury or death.

3. Check that the cylinder valve is tightly closed.

4. Check valve outlet area for contamination or damage. Do not attempt to use gas cylinder with damaged or contaminated valve outlet. Replace the cylinder and tag the defective cylinder indicating the problem.

5. Position valve outlet so that it lines up properly with the pigtail cylinder connection and tighten cylinder strap.

Do not rotate cylinder by holding cylinder valve handle. This may open the cylinder valve and cause a high pressure gas leak which could result in personal injury or death.

6. Remove pigtail cap/plug from pigtail cylinder connection.
7. Thread cylinder nut hand tight into/onto clean undamaged cylinder valve outlet. Be careful not to cross thread connections.

8. Tighten nut using appropriate tools to support pigtail. Do not apply excessive torque. Refer to CGA Pamphlets in Appendix for recommended torque of cylinder connection.

9. Close cabinet door.

8.3.1.3 Cylinder Connection Leak Check (Purge Cylinder)

1. Open access window.

2. Slowly open purge cylinder valve to fill pigtail panel with purge gas.

3. Close cylinder valve.

4. Slowly open MV13 to vent purge gas from pigtail.

5. Close MV13.

6. Repeat steps 3-5 a minimum of 10 times to purge the pigtail of any contaminants that may have entered during purge gas cylinder installation.

7. Open MV10.

8. Slowly open purge cylinder valve to fill pigtail and purge panel with purge gas. PI3 should indicate full cylinder pressure.

9. Close cylinder valve.

10. Observe PI3 for any pressure decay for five (5) minutes.

11. If there is no decay, the cylinder connection is not leaking at a detectable level. Proceed to step 13.

12. If there is a pressure drop, a leak is indicated.
    a. Slowly open manual valve MV13 to completely vent purge gas pressure in pigtail.
    b. Close valve, MV13.
    c. Close valve, MV10.
    d. Remove purge cylinder from the pigtail.
    e. Reinstall the purge cylinder (reference Section 8.3.1.2 "Full Purge Gas Cylinder Installation.)

f. Retest following steps 1 through 11 in Section 8.3.1.3.
g. If leak persists, remove cylinder (reference Section 8.3.1.1 "Empty Purge Gas Cylinder Removal Procedure".)
h. Remember to mark the cylinder "FAULTY, BAD CYLINDER CONNECTION."

13. With suitable means (helium mass spectrometer, thermal conductivity detector, or liquid leak detector - as specified for area), inspect the cylinder connection and pigtail connection for leakage. Pay particular attention to the point where the nipple passes through the nut.

8.3.1.4 Putting Purge Gas Cylinder On-Stream

1. Open access window and open purge cylinder valve.

2. Slowly open manual valve MV13 for approximately 15 seconds to remove air from pigtail, then close.

3. Slowly open manual isolation valve, MV10, to regulator.

4. Adjust the purge gas regulator, PCV2, to 80-90 psig (5.51-6.20 barg) delivery pressure.

5. Close access window.

6. The inert purge gas system is now ready for use.

8.3.2 Process Gas Cylinder Procedures

8.3.2.1 Empty Process Gas Cylinder Removal (Prior to Removal)

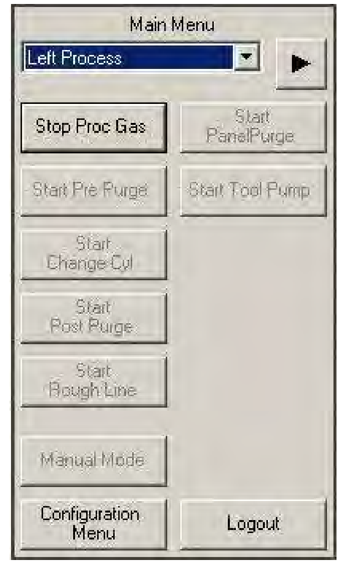
This procedure assumes that a process gas cylinder and an inert purge gas cylinder are in place and operating.

Before approaching a hazardous gas cabinet for a cylinder change, verify that there are no alarm labels displayed on the screen and that the exhaust system is functioning correctly   Only operators trained in these procedures and the GASGUARD® hazardous gas system are permitted to change cylinders. The appropriate Personal Protective Equipment (PPE) must be worn when performing any Process Cylinder Procedures. See Section 1.9 of this manual for the appropriate PPE.

1. Confirm with operating personnel that the process gas can be shut off before initiating stop process gas.
2. On the Main Menu window, press the "STOP PROCESS GAS" pushbutton
3. Check and record the following information on the Process Gas Cylinder Change Checklist (found at the end of Section 8.3.2.5) each time a cylinder is changed.

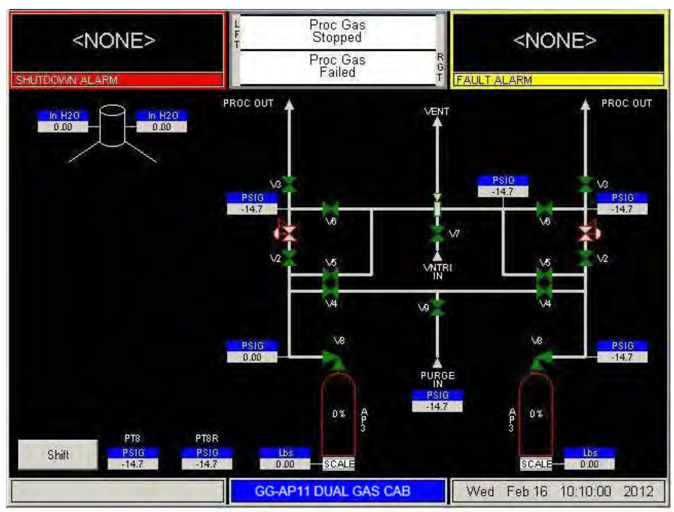
   Pressure readings on:
   "PROCESS CYL PRESS" and
   "PROCESS DEL PRESS"

   Process cylinder weight (if scale is present)



4. Note the valve color coding key on the graphics panel.

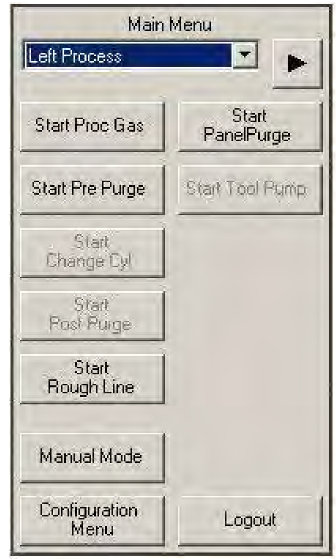
Observe that all valves are closed (color for closed indicated on legend), and no shutdown or warning labels are displayed. Note any other comments about the condition of system.



Proceed to the troubleshooting section for corrective action if any shutdown or warning conditions occur. Notify your supervisor immediately or contact your GASGUARD® representative for assistance.

5. On the Main Menu window, press the "START PRE PURGE" pushbutton.

6. Follow prompted manual steps on the screen.



NOTE: If a purge sequence fails and/or stops and you would like to resume the purge sequence after the last completed sub-cycle, the prompt shown in the Figure at right will appear after "Start PrePurge" has been selected. Selecting "Restart" on the prompt will allow the entire purge routine to start again from the beginning. Selecting "Continue" on the prompt will allow the purge routine to resume from the last completed sub-cycle. Selecting "Cancel" on the prompt will cause the system to return to Idle mode. The prompt will continue to appear after "Start Pre-Purge" has been selected until a decision has been made to restart or continue the purge sequence.

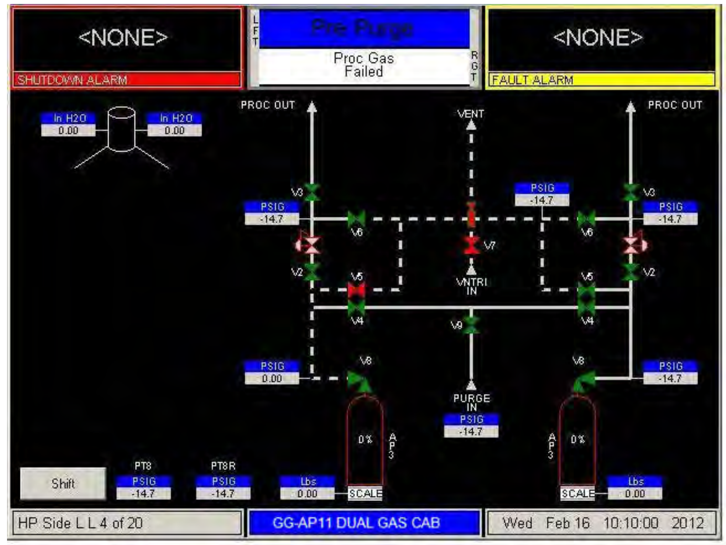
When "Continue" is selected on the prompt, all purge and vacuum sequences prior to the subcycle and in between the subcycles will be repeated along with all prompting and actions (such as leak tests and acknowledging prompts).

It is important to redo the prompts and the leak tests prior to the purge routine resuming after the last completed sub-cycle in the event that manual mode needed to be entered to correct the issue that caused the purge to fail. The initial steps in the purge also set the panel up for the cycles that with follow, and will also be repeated prior to resuming the purge. In pre-purge, the initial steps evacuate process gas, but in the case of restart, the steps may need to remove purge gas before panel cycles.

The following valves will sequence on the display during the high pressure purge cycles.

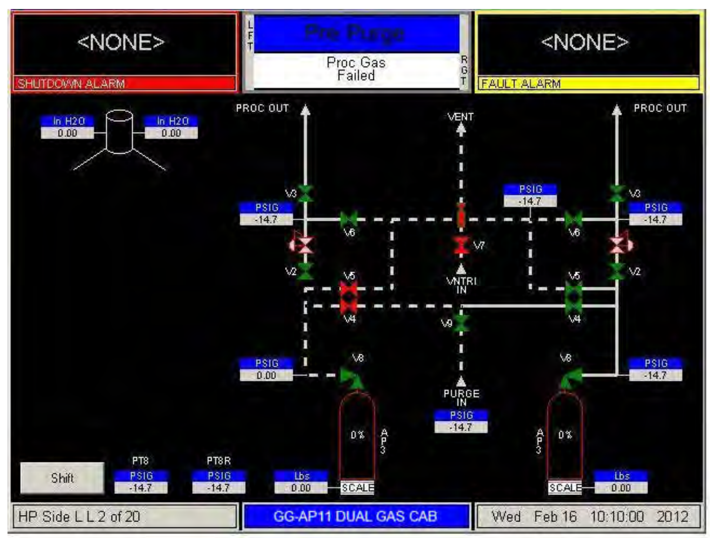
First, the tubing between the high pressure valve (V2) and the process cylinder valve is evacuated.

If the valve color scheme is green for valve closed and red for valve open, the valves will look like the illustration on the right. If the valve color scheme is red for valve closed and green for valve open, the valve colors will be opposite of those in the illustration.



The high pressure tubing will then be "flush" purged.

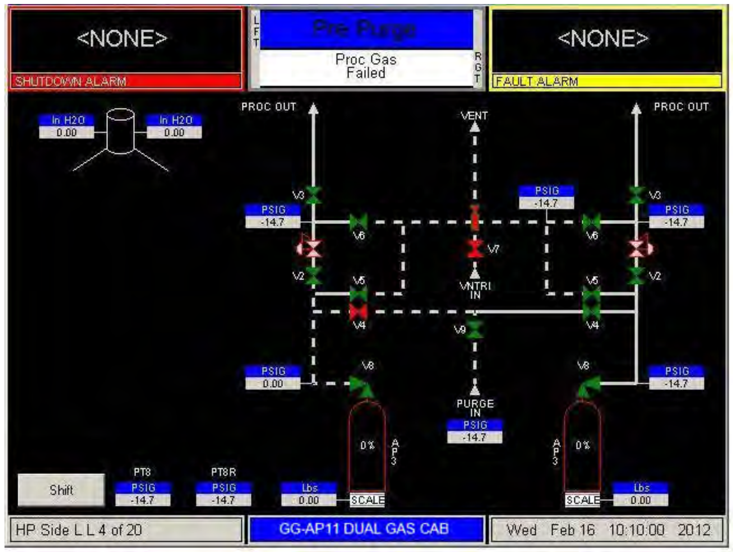
If the valve color scheme is green for valve closed and red for valve open, the valves will appear as illustrated to the right. If the valve color scheme is red for valve closed and green for valve open, the valve colors will be opposite of those in the illustration.



The tubing will then be pressurized with purge gas.

If the valve color scheme is green for valve closed and red for valve open, the valves will appear as illustrated to the right. If the valve color scheme is red for valve closed and green for valve open, the valve colors will be opposite of those in the illustration.

This sequence of evacuation and pressurization will be repeated until the configured number of cycles is completed.



8.3.2.1a Optional: Dynamic Source Valves (DSV)

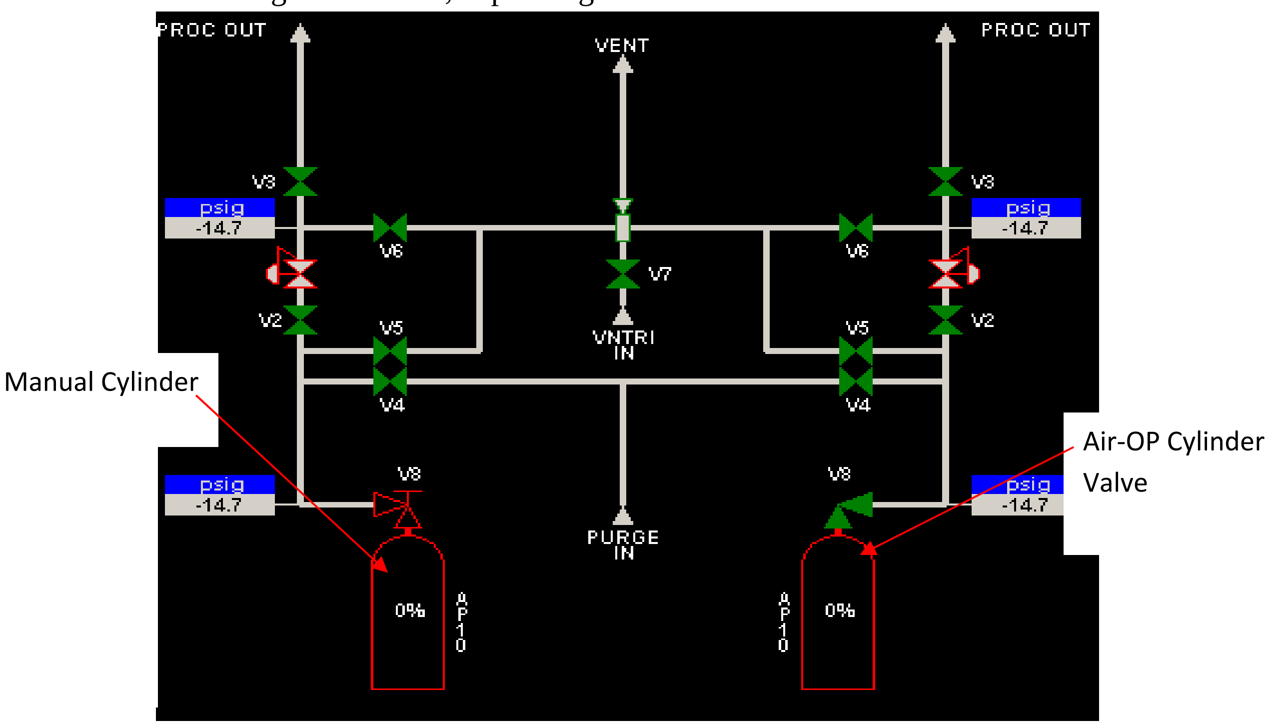
Configuring the Process Cylinder Valve Type; Manual or Pneumatic (Air-op)

If the AP11 system is programmed with the Dynamic source valve feature, it can accommodate either a manual or pneumatic (air-op) type cylinder valve. The operator must select the type of valve prior to starting any automatic process modes. It is strongly recommended to use a cylinder with a pneumatic valve whenever available.

The valve types are displayed as follows:

1) A Manual valve is shown on the left side cylinder below. It is designated by a red outline only. It is not filled in with color and there is a handle on top. It does not change color.

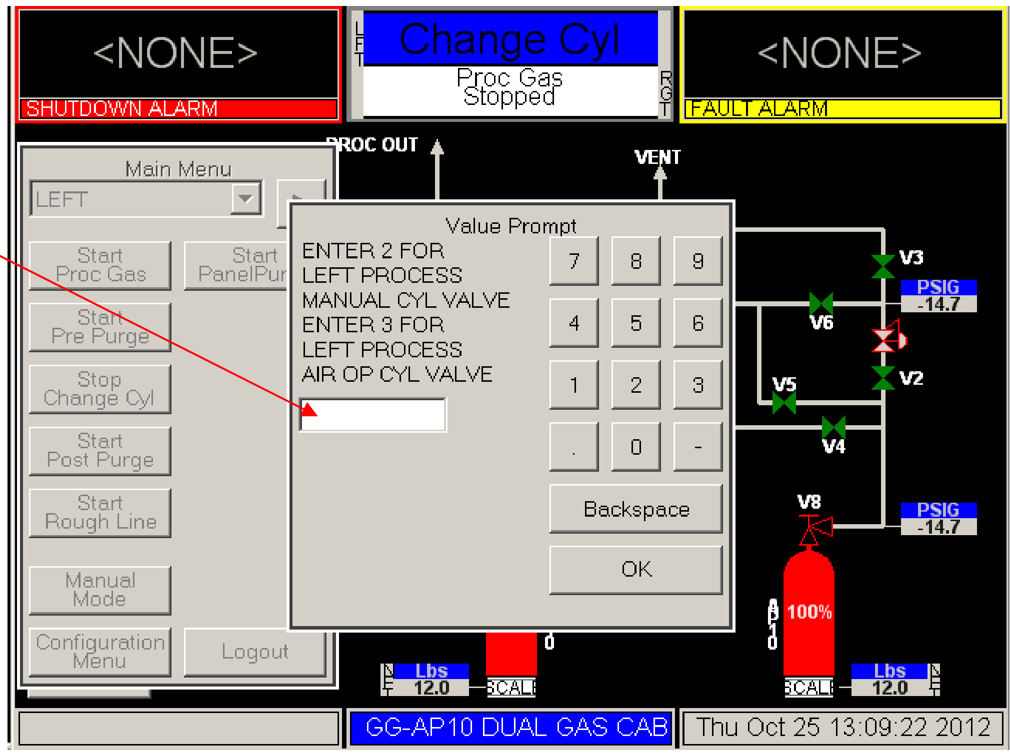
2) A Pneumatic or Air-Operated cylinder valve is shown on the right side cylinder below. The valve outline is completely filled in and there is no handle on top. The color will change between green and red, depending on the status of the valve.



The operator will be prompted during the Cylinder Change Mode to define the type of valve on the **NEW** cylinder which has just been installed. This prompt appears after the operator has been instructed to 'remove and replace process cylinder'.

a) Enter 2 for manual cylinder valve OR Enter 3 for pneumatic cylinder valve

b) Enter OK to continue.



8.3.2.1b Barcode Setup (Optional)

The AP11 system can be configured with a barcode verification feature. When used properly, this feature ensures that only designated product is installed during the cylinder change process. The feature requires use of cylinders that have been systematically labeled with a code that identifies the product contents. See example label below. If the controller was purchased with the external barcode scanner option, the information may be entered automatically by scanning the barcode. Otherwise, the information may be entered manually thru a pop-up keypad on the controller screen.

A00187602125324

If the barcode verification feature is not used, skip this section.

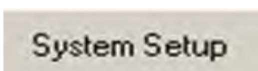
How to enable barcode feature:

1) From the Configuration Menu:

   a. Log-in to controller (See Section 8.1)

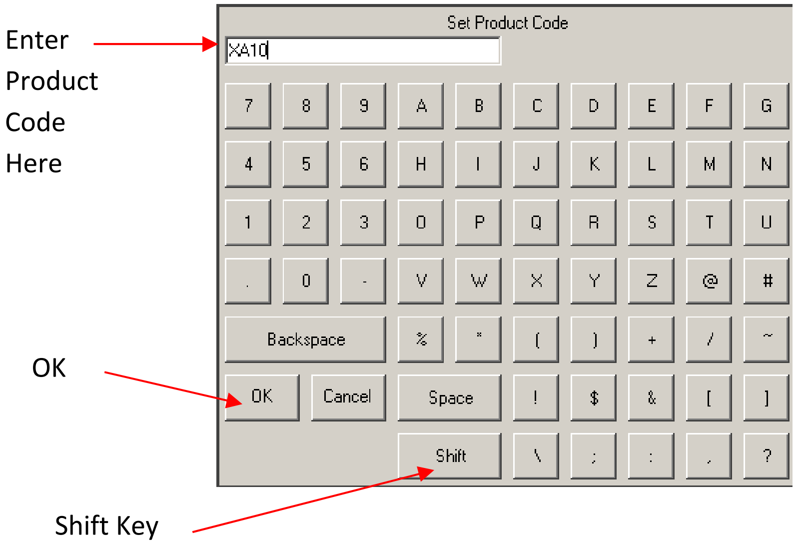
   b. Select “Configuration Menu”

   c. Select “System Setup”.



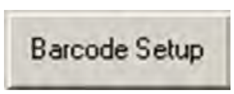
   d. Select “Set Product Code” from the System Setup menu.

   e. Enter the Product Code for the gas type to be used in this cabinet. The product code is the portion of the code within the barcode string that identifies the product type. It is the piece of information that will be compared to confirm that the correct cylinder has been installed. Press “OK” when complete.

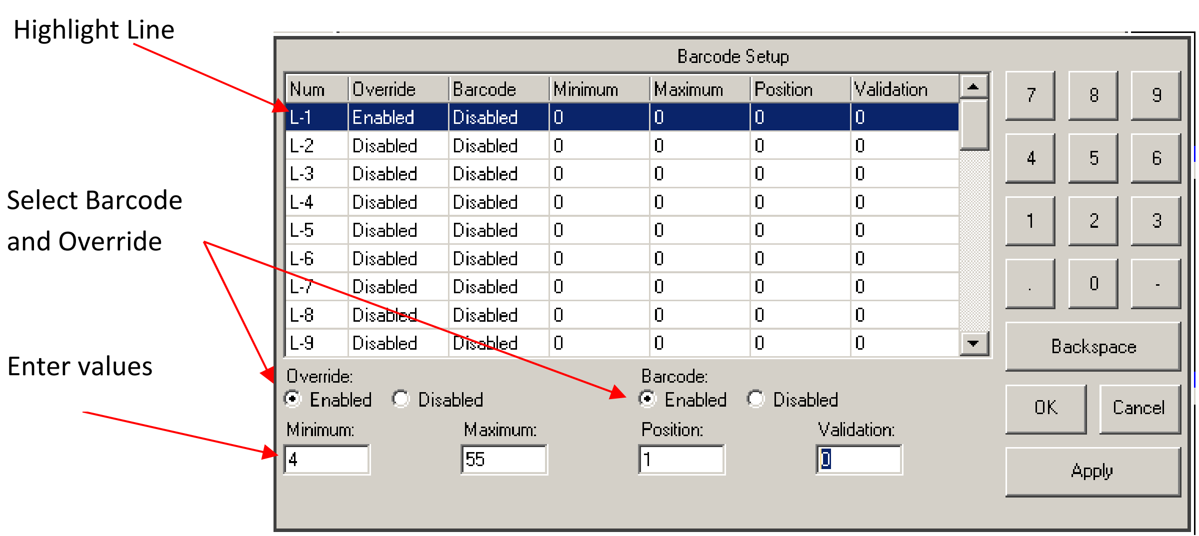


Note: Barcode strings are case sensitive. Be sure to use the proper case when entering letters. The case can be toggled between uppercase and lowercase by pressing the shift key.

f) Select "Barcode Setup" from the System Setup menu.



g) Select/highlight the first line for the left or right side. Lines L1 thru L20 are reserved for the left side process cylinders. Lines R1 thru R20 are reserved for the right side process cylinders.



h) Change the Barcode field to “Enabled”.

i) Change the Override field to “Enabled”.

j) Enter the minimum allowable number of characters in the barcode string.

Note: The minimum number must be at equal to or greater than the number of characters in the Product Code plus the number of the starting position for the product code. Otherwise, the system will produce an error message.

k) Enter the maximum allowable number of characters in the barcode string.

Note: The maximum number cannot exceed 55.

l) Enter the starting position of the product code.

Example: For product code XA10 in the following:

ABC346XA10ZZ123 starting position is 7.

XA10ABC346ZZ123 starting position is 1.

m) Enter the validation code:

i) “0” – No other restrictions. The only check is to verify that barcode contains the product code.

ii) “1” – In addition to verifying the product code, this validation method verifies that the Barcode is not the same any previously installed cylinder.

iii) “2” – In addition to verifying the product code, this validation method verifies that the Barcode is not the same as the most recently installed cylinder on that process side.

iv) “3” – This selection should not be used. This option causes the system to ignore the barcode command. It is only used in development testing.

n) Enter “Apply” if editing multiple barcode lines and return to step g).

o) Enter “Ok” when complete.

How to disable the barcode feature:

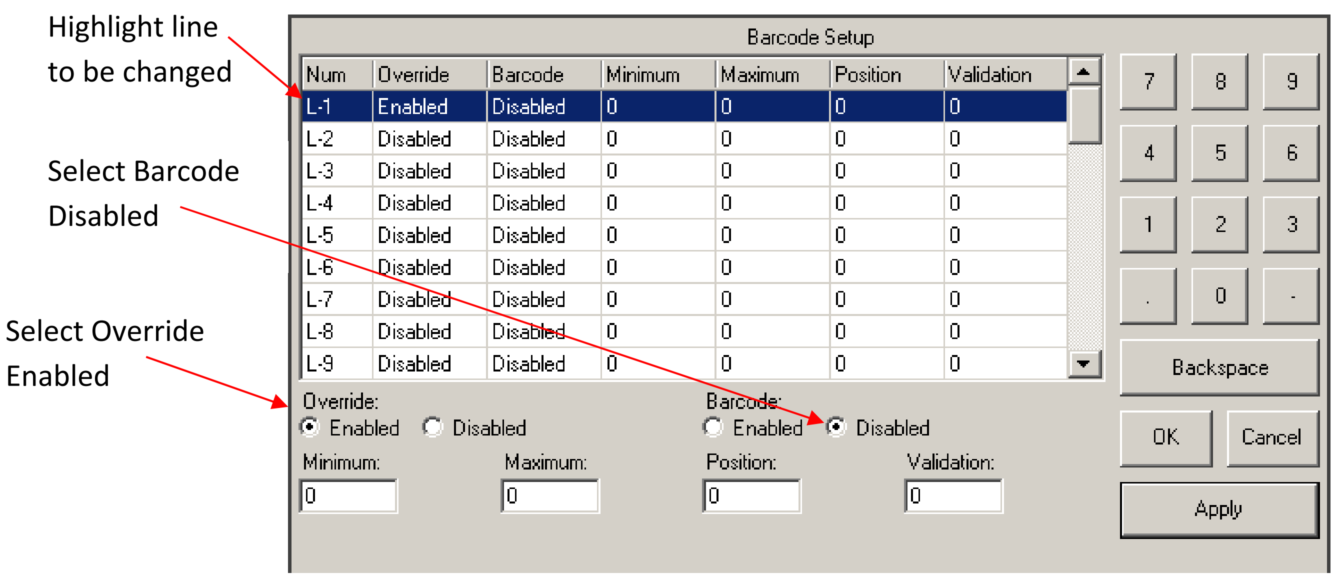
a. Highlight the input line.

b. Select Override: Enabled.

c. Select Barcode: Disabled.

d. Select “Apply” if editing multiply lines and return to step a).

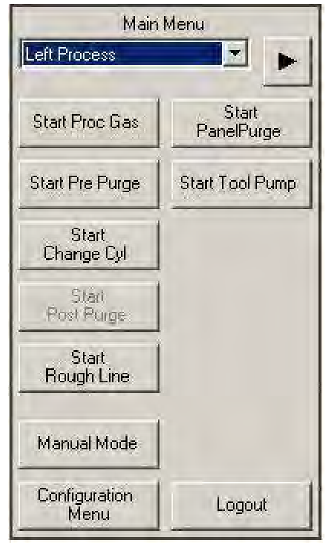
e. Select “OK” when complete



8.3.2.2 Empty Process Gas Cylinder Removal

1. Verify that "PRE-PURGE COMPLETE" is displayed in the controller status box.

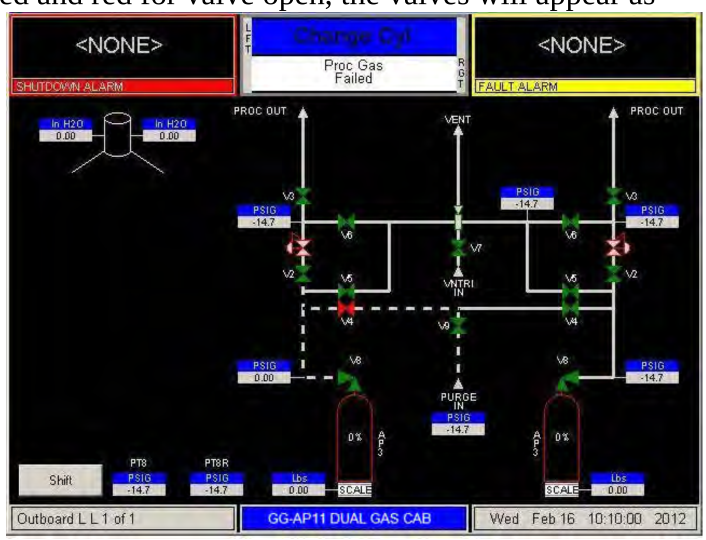
2. On the Main Menu screen, press the "START CYL CHANGE" pushbutton.



3. Follow prompted information on the screen.

As an optional feature, a trickle purge of the high pressure tubing may begin and continue until you press OK, acknowledging the prompt "Remove and Replace Cylinder", indicating the cylinder change is complete.

If the valve color scheme is green for valve closed and red for valve open, the valves will appear as illustrated to the right. If the valve color scheme is red for valve closed and green for valve open, the valve colors will be opposite of those in the illustration.



4. ***Don the self-contained breathing apparatus and all other Personal Protective Equipment (PPE) if required, if not done already. See Section 1.9 for details on the required PPE.***

5. Verify that exhaust system is working.

6. Open access window.

7. Recheck that process cylinder valve is closed.

CAUTION

Do not use a wrench or other devices to close diaphragm type cylinder valves. This could cause valve failure. The maximum torque on diaphragm type cylinder valves is 12 foot/pounds (16.3 Nm). Certain gases are supplied with cylinder valves without handwheels. Use the proper tool from your gas supplier to operate these valves.

8. (Optional) The system may contain a CGA collar. This pneumatically-operated device covers the cylinder connection when it is unsafe to disconnect and uncovers the cylinder connection when it is safe to disconnect. DO NOT attempt to disconnect the cylinder if the device is still covering the connection. Contact your GASGUARD® representative for assistance.

9. Loosen and remove the pigtail cylinder connection from the gas cylinder using appropriate tools to support the connection and pigtail tubing. Note proper direction of rotation. Fittings with left-hand threads have notched hex corners. Observe and listen for any sound of gas leakage. Close door immediately if the process gas cylinder valve is leaking and evacuate the area.

10. Install cylinder valve outlet plug/cap securely into/onto process cylinder valve outlet.

CAUTION

This valve outlet cap must be used on all toxic, corrosive and pyrophoric gases. Consult your supplier if there is no cap on these gas cylinders.

11. Install pigtail cap/plug onto pigtail cylinder connection.

12. Open gas cabinet door.

13. Loosen cylinder holding strap but do not unbuckle.

14. Install cylinder valve protection cap. If necessary, tilt cylinder toward door slightly.

15. Unbuckle cylinder strap and remove cylinder from cabinet.

16. Place cylinder in appropriate cart and strap in place. Place "EMPTY" tag on cylinder and return cylinder to the appropriate cylinder storage area.

8.3.2.3 Full Process Gas Cylinder Installation

The required Personal Protective Equipment (PPE) must be worn when performing any process cylinder procedures. Refer to Section 1.9 of this manual for the required PPE.

1. Verify that the cylinder contains the same gas as the label on the gas cabinet and process panel.

Never attempt to replace a specified gas with another gas without consulting equipment supplier. Incompatible gases could cause fires, explosions or extremely corrosive or toxic compounds.

2. Position full cylinder in gas cabinet, and strap loosely. Remove valve protection cap.

⚠WARNING

If a valve protection cap is extremely difficult to remove, do not apply excessive force or pry the cap loose. Attach a label to the cylinder identifying the problem. Obtain another cylinder. Do not attempt to open a frozen cap as this would damage the cylinder valve and could result in personal injury or death.

3. Check that the cylinder valve is tightly closed.

4. Slowly remove valve outlet plug/cap on the cylinder. Listen and observe for any sign of leakage. If you notice leakage, immediately retighten cap, close the cabinet door and evacuate the area.

Follow established emergency response procedures. Cylinders with valve leaks are defective and should be returned to supplier.

5. Check valve outlet area for contamination and damage. Do not attempt to use a gas cylinder with a damaged or contaminated valve outlet. Tag the cylinder as "FAULTY", and obtain another cylinder.

6. Position cylinder so that the valve outlet lines up with the pigtail cylinder connection and tighten cylinder strap.

⚠WARNING

Do not rotate cylinder by holding cylinder valve handle. This may open the cylinder valve and cause a high pressure gas leak which could result in personal injury or death.

7. Remove pigtail cap/plug from pigtail connection.

8. Install new washer on those cylinder connections that require washers.

9. Thread pigtail cylinder nut hand tight into/onto clean undamaged cylinder valve outlet noting proper direction of rotation. Be careful not to cross thread connections.

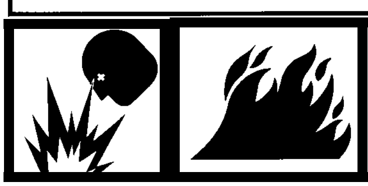
10. Tighten nut using proper wrench. Be sure to support pigtail. Do not apply excessive torque. Refer to CGA Technical Bulletins located in Appendix for recommended torque of cylinder connection.

11. (Optional with Cylinder Collar) When the program continues, the cylinder collar will automatically activate to cover the connection.

12. Close cabinet door.

13. The system is now ready for post purge cycles.

⚠WARNING



Do not open the process cylinder at this time. The post purge procedure must be completed first.

8.3.2.4 Full Process Cylinder Purge (After Installation)

1. On the Main Menu window, press the "START POST PURGE" pushbutton.

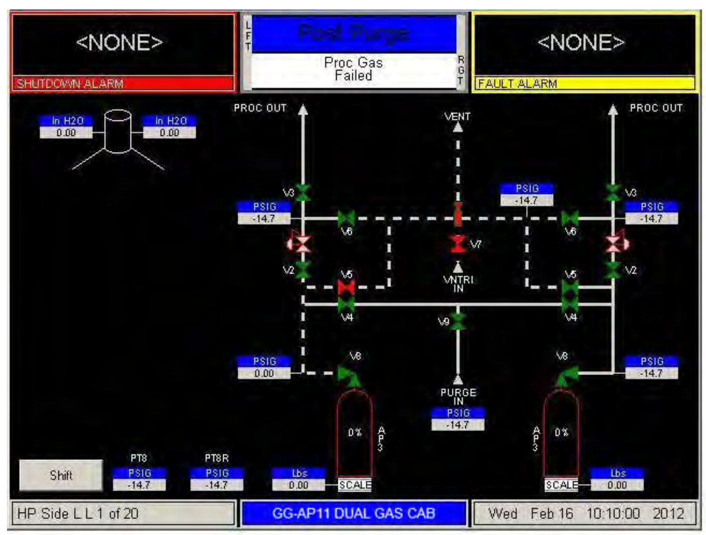
2. Follow any steps that may be prompted on the screen.

The following valves will sequence on the display during the high pressure purge cycles.

First, the tubing between the high pressure valve (V2) and the process cylinder valve is evacuated.

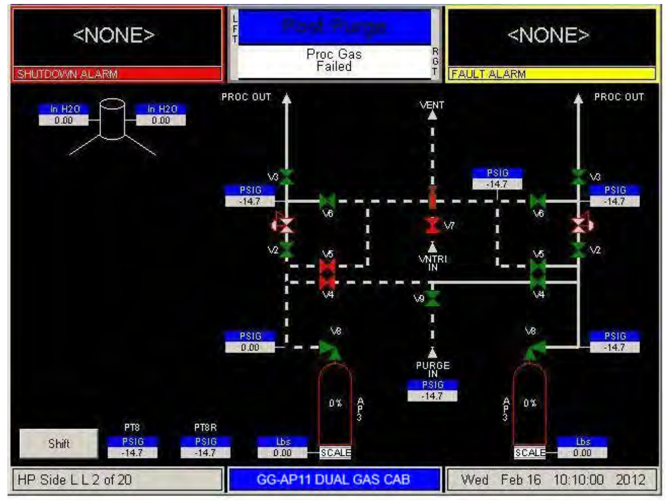
If the valve color scheme is green for valve closed and red for valve open, the valves will look like the illustration on the right.

If the valve color scheme is red for valve closed and green for valve open, the valve colors will be opposite of those in the illustration.



The high pressure tubing will then be "flush" purged.

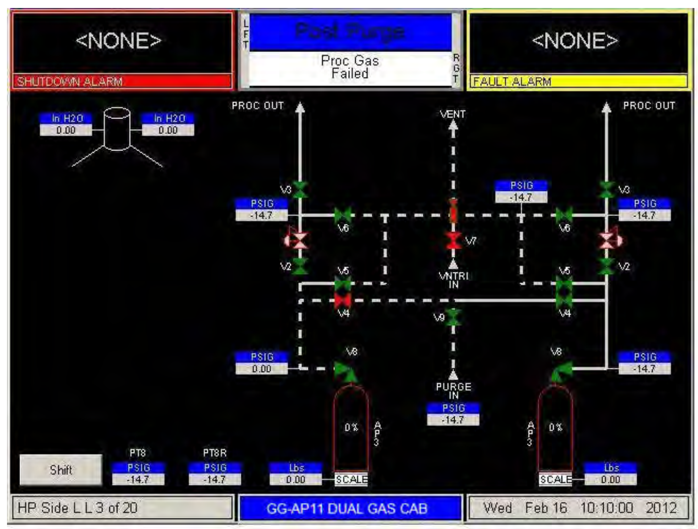
If the valve color scheme is green for valve closed and red for valve open, the valves will appear as illustrated to the right. If the valve color scheme is red for valve closed and green for valve open, the valve colors will be opposite of those in the illustration.



The tubing will then be pressurized with purge gas.

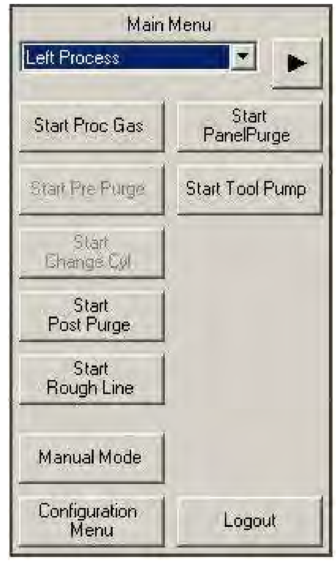
If the valve color scheme is green for valve closed and red for valve open, the valves will appear as illustrated to the right. If the valve color scheme is red for valve closed and green for valve open, the valve colors will be opposite of those in the illustration.

This sequence of evacuation and pressurization will be repeated until the configured number of cycles is completed.

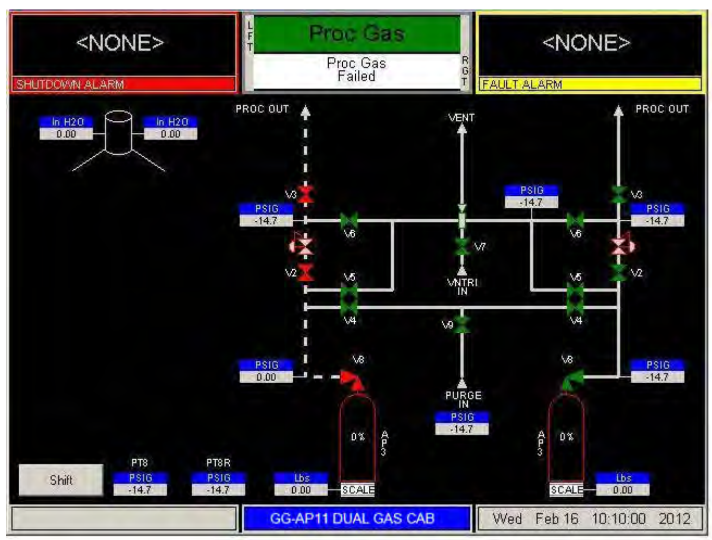


8.3.2.5 Process Gas Flow

1. On the Main Menu window, press the "START PROCESS GAS" pushbutton
2. Follow the steps prompted on the screen.



3. Process gas is now flowing to the process equipment.



If the valve color scheme is green for valve closed and red for valve open, the valves will look like the illustration on the right.

If the valve color scheme is red for valve closed and green for valve open, the valve colors will be opposite of those in the illustration.

In addition, the "PROCESS" LED will illuminate.

PROCESS GAS CYLINDER CHANGE CHECKLIST

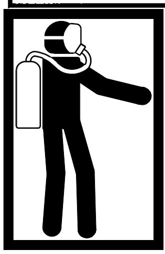
Customer Cabinet No. ____

Gas Service ____

⚠CAUTION

CLOSE CYLINDER VALVE BEFORE STARTING PURGE SEQUENCE.

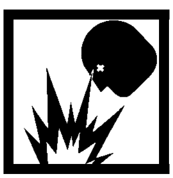
⚠WARNING



WEAR APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT AS DETAILED IN SECTION 1.9 OF THIS MANUAL WHEN CHANGING OR INSTALLING A TOXIC GAS CYLINDER.

⚠WARNING

RECHECK THAT CYLINDER VALVE IS TIGHTLY CLOSED BEFORE LOOSENING CGA CONNECTION FROM CYLINDER VALVE.

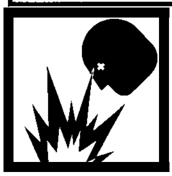


Date	Time	Cabinet Interior OK (Leakage Corrosion)	Cabinet Exhaust Working	Cylinder Valve Closed	Proper RFO Installed		Process Gas Pressure		Purge Gas Pressure		Cylinder Weight	Operator Initials
							PI1	PI2	PI3	PI4		
						Start						
						Finish						
						Start						
						Finish						
						Start						

						Finish						

8.4 New System Startup Procedure

WARNING



In NEC Class I, Division II hazardous locations (applies only in the U.S.A.) or Explosive Atmospheres (applies only in the European Community), do not apply power to the cabinet controller until the controller enclosure has been purged for at least 20 minutes at a pressure at or above 0.1" H_2O (.025 milli-barg) as monitored by the internal Z purge pressure switch (hazardous locations only). Refer to steps 3 and 4 below. This complies with NFPA 496 and ATEX regulations regarding electrical equipment enclosures. Failure to do so could result in the ignition of any flammable gas which may be present.

1. Verify that the system is ready for startup by completing the startup checklist in the installation manual. Check, to be sure, that the GASGUARD® system and all plant piping have been leak checked with a helium mass spectrometer in accordance with the customer's specified procedure. Check that the GASGUARD® system has been functionally checked after installation.

2. Check that the cabinet exhaust system and hazardous gas disposal system (pollution abatement) are operating.

3. Verify that house nitrogen pressure is between 85-95 psig (5.9-6.6 barg).

4. In Class I, Division II (US) or Group II, Category 3 (Europe) hazardous locations, turn on and adjust Z-purge gas flow to the cabinet controller. The controller is equipped with a Z-purge pressure switch. The absence of this alarm during Z-purging indicates that the Z-purge is adequate. If a "Low Z-purge" alarm is present, increase the flow rate until the alarm can be reset (hazardous locations only).

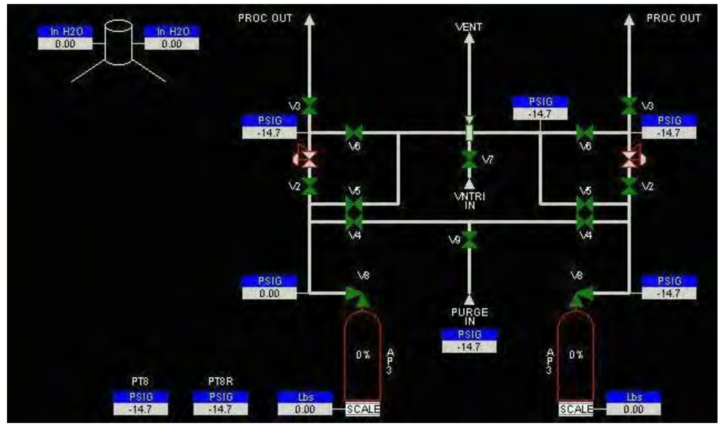
5. After purging the controller for at least 20 minutes, turn on electrical power to the controller.

   NOTE: The GASGUARD® AP11 system is supplied with an internal controller purging means that meets NFPA 496, Type Z purging requirements for use in NEC Class I, Division II hazardous location (applicable only in the U.S.A). The internal Z-purge also meets the requirements of the Explosive Atmospheres Directive (ATEX)

(applicable in the European Community). Type Z purge <u>does not</u> meet Class I, Division I NEC requirements.

6. Press the shutdown alarm status window to initialize the controller on power up. No alarms should be present. If alarms are present, ***do not continue***. Follow the troubleshooting procedures found in Section 9. If needed, contact your GASGUARD® representative for assistance.

7. Check that all automatic valves indicate closed position (Green). They should appear as illustrated to the right.



8. Check that regulators are closed (knob rotated fully counterclockwise).

9. Ensure the process pigtail connection cap/plug is installed and tight.

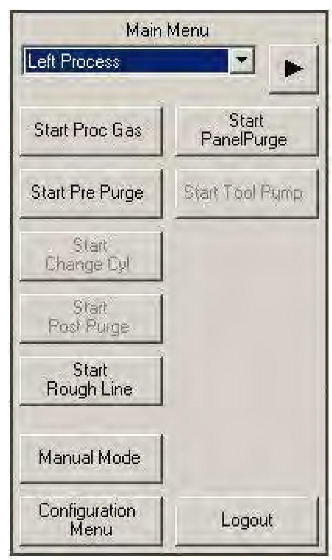
10. Install an inert purge gas cylinder in the cabinet. Refer to Section 8.3.1.2 Full Purge Gas Cylinder Installation.

11. Select anywhere on the graphics portion of the screen and enter the password.

12. Press 

13. On the Main Menu screen, press the "START PRE PURGE" pushbutton

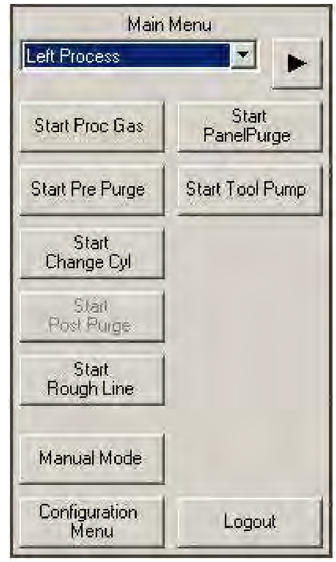
14. Follow the prompts on the screen.



15. When the controller status box indicates "PRE PURGE COMPLETE", press the "START CYL CHANGE" pushbutton.

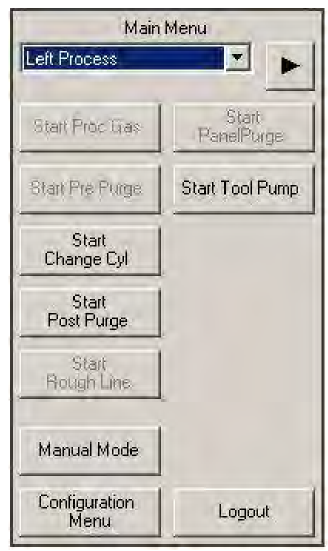
16. Follow the prompts on the screen.

17. Refer to Section 8.3.2.3 Full Process Gas Cylinder Installation.



18. When the controller status box indicates "CYL CHANGE COMPLETE," press the "START POST PURGE" pushbutton.

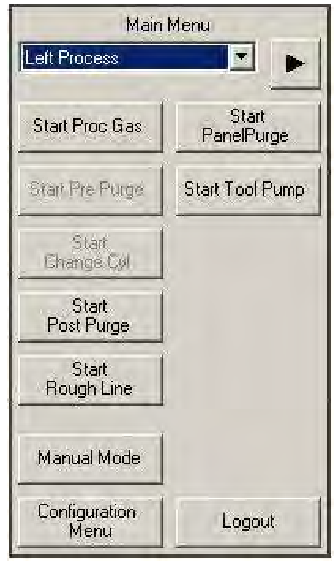
19. Follow any prompts that may be on the screen.



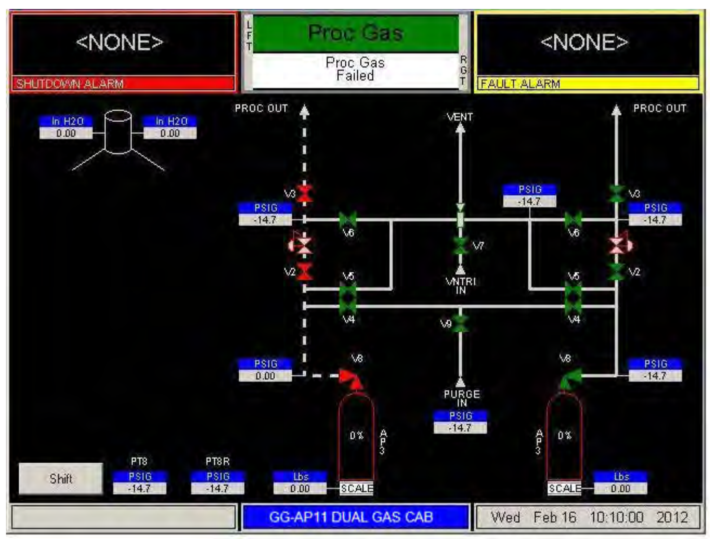
CAUTION

Before proceeding further, verify that process equipment and facility piping is ready to receive process gas.

20. When the controller status box indicates "POST PURGE COMPLETE", press the "START PROCESS GAS" pushbutton.
21. Adjust the process gas regulator, through the access window, to the desired delivery pressure.
22. Process gas is now flowing to the process equipment.



With process gas flowing, the valves on the graphic display will appear as illustrated to the right.



In addition, the "PROCESS" LED will illuminate.

8.5 Manual Mode Operation

⚠CAUTION

Only experienced operators should operate the cabinet in manual mode. Operating valves out of their proper sequence could potentially cause damage to the product by interrupting or providing insufficient gas flow. Manual operation should not be used for normal, daily operation.

NOTE: Opening high pressure vent valves when high pressure gas is present could cause damage to the vent line pressure transducer, if installed.

Manual mode provides a means of flowing purge gas through the purge and process gas panels during cabinet installation and pre-start-up procedures. It also provides a means of flowing purge gas while maintenance or repairs are being performed.

8.5.1 How to Operate in Manual Mode

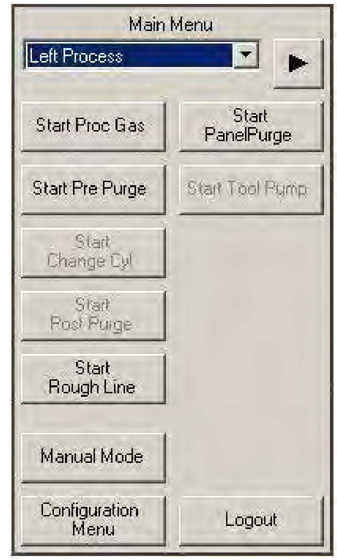
⚠WARNING

Operating in Manual Mode could cause the following hazards which can result in PERSONAL INJURY OR DEATH.

- ***Process gas could be forced into the purge panel and/or purge gas cylinder.***
- ***Opening purge panel valves when high pressure process gas is present.***
- ***High pressure gas could be vented.***
- ***Opening vent valves when high pressure process gas is present.***

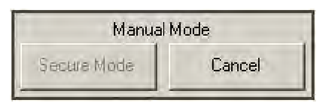
NOTE: Due to the potential hazards listed above, Manual Mode operation requires a second level security code.

1. Select anywhere on the graphics portion of the screen and enter the password.
2. Press OK
3. From the Main Menu screen, press the "MANUAL MODE" pushbutton.



The MANUAL MODE window will display

4. Operate valves referring to Section 8.5.2 below.
5. To exit MANUAL MODE, press Cancel.



NOTE: Pressing Cancel will automatically close any valves which were left open unless the secure mode feature is used as seen below in section 8.5.2.

8.5.2 How to Open and Close Valves

To open a valve:

1. Select the valve by touching the screen. The valves that can be operated from the screen will be highlighted with a yellow box.

2. The valve confirmation window will appear, asking you to confirm that you want to open the valve by pressing Open Valve .

   Pressing Cancel will close the window, leaving the valve closed.

To close a valve:

1. Simply select the valve by touching the screen.

To SECURE Manual Mode:

1. The Secure option will allow an operator to exit the Manual Mode menu while remaining in manual mode with valves open. The Secure option will not be selectable if no valves are open. When the operator chooses Secure Mode from the Manual Mode window, the controller will leave the bank in manual and allow the operator to go to other screens. Any open valves will remain open, and the Mode Status Box will continue to indicate manual mode. Manual mode will remain active or ‘secured’ until an operator reenters the Manual Mode window. While manual mode is ‘secured’, Manual Mode will be the only selectable option on the Main Menu.

8.5.3 How to Operate Cylinder Collar (optional) in Manual Mode

After enabling, a collar icon will appear on the main display and can be used to operate the device in Manual mode.

⚠CAUTION

Cabinet must not be left unattended in Manual Mode, as access to the system in Manual Mode is open to anyone.

8.5.4 General Principles of Manual Operation

Open valves in sequence from cylinder to outlet for pressure or from vacuum to cylinder or line for vacuum.

Close valves in reverse order.

Monitor pressures on the screen frequently.

Consider all possible results before opening or closing a valve.

8.6 Source System Configuration

Certain GASGUARD® AP controller files may be modified using a second or third level security code. These modifications are referred to as the source system configuration.
The source system configuration may be accessed from the CONFIGURATION MENU option on the Main Menu. From the CONFIGURATION MENU, you may display some configurable parameters and change user configurable parameters. The CONFIGURATION MENU will appear as illustrated below.

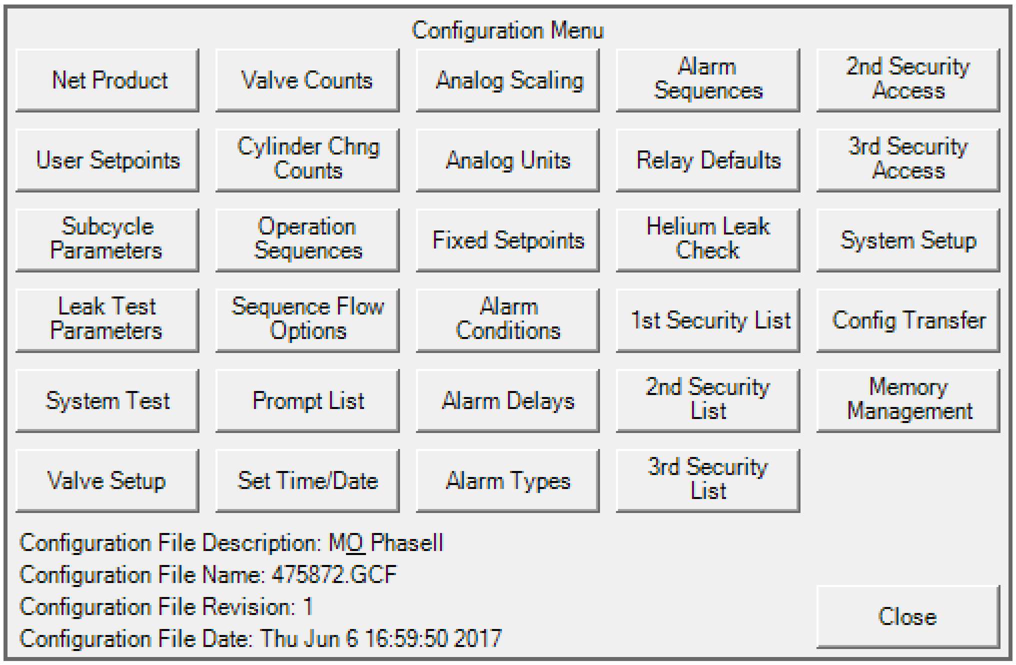


Figure 8.2: Configuration Menu

To select a menu option, simply press the corresponding menu option button.

Table 8.3 defines the preset permissions assigned to each security level and configuration parameter. In the table, “W” defines a Write access level of security and “R” defines Read access level. A blank means no access is allowed for the user. For safety considerations, most configuration parameters may be changed only by the GASGUARD® technical representative.

Table 8.3 - Source System Permissions

Section	Configuration Menu Options	Sub-Menu Options	Level 2	Level 3
8.6.1	Net Product		W	W
8.6.2	User Analog Setpoints		R	W
8.6.3	Subcycle Parameters		R	W
8.6.4	Leak Test Parameters		R	W
8.6.5	System Test		W	W
8.6.5.1		Test Digital In	W	W
8.6.5.2		Test Digital Out	W	W
8.6.5.3		Test Analog In	W	W
8.6.5.4		Test Internal Flag	W	W
8.6.5.5		Test Remote In	W	W
8.6.6	Valve Setup			R
8.6.7	Valve Counts		R	W
8.6.8	Operation Sequences			R
8.6.9	Cylinder Change Counts		R	W
8.6.10	Sequence Flow Options			R
8.6.11	Prompt List			R
8.6.12	Set Time/Date		R	W
8.6.13	Analog Scaling		R	R
8.6.14	Analog Units		R	W
8.6.15	Fixed Analog Setpoints		R	R
8.6.16	Alarm Conditions		R	R
8.6.17	Alarm Delays		R	W
8.6.18	Alarm Types			R

Section	Configuration Menu Options	Sub-Menu Options	Level 2	Level 3
8.6.19	Alarm Sequences			R
8.6.20	Relay Defaults			R
8.6.21	Helium Leak Check			W
8.6.22	1st Security List			W
8.6.23	2nd Security List			W
8.6.24	3rd Security List			R
8.6.25	2nd Security Access		R	W
8.6.26	3rd Security Access		R	W
8.6.27	System Setup			W
8.6.27.1		Local Setup		W
		Change Exhaust Stack Size		W
		Password Protected Reset		W
		Screen Saver		W
8.6.27.2		Network Setup		W
		Enable/Disable Network Control		W
		RS-485 Channel Number		W
		Ethernet Channel Number		W
		Network Comm Type		W
8.6.27.3		IP Settings		W
8.6.27.4		Peer-to-Peer IP Settings		W
8.6.27.5		Set Product Code		W
8.6.28	Config Transfer			W
8.6.28.1		Controller to USB Transfer		W
8.6.28.2		USB to Controller Transfer		W
8.6.29	Memory Management			
8.6.29.1		USB to Controller Firmware		
8.6.29.2		Controller to USB Memory Contents		
8.6.29.3		Delete Nonvolatile Date File and Reboot		
8.6.29.4		Other Options		

The following paragraphs describe the parameters that you may view and/or change.

8.6.1 Net Product

This option allows the operator to display either a gross or net value on any analog. The gross value will display the normal analog reading with no adjustment. The net value will display a “net” reading based on the value input by the operator. If a value other than zero is entered in this window, the “net” value will be calculated and displayed for this analog. A “net” tag will also appear at the analog display box. If zero is entered, the gross or unadjusted value will display with no additional tag.

This window is also used to enter the full cylinder pressure of the process and purge cylinders installed in the system. The analogs configured for displaying cylinder pressures will prompt for the “max cyl press” instead of a “net product”. This will not occur however if a process cylinder scale is utilized, in which case the process cylinder analogs will function as standard analogs.

8.6.2 User Analog Setpoints (User Setpoints)

This option allows the operator to choose an analog input device from a drop down menu or exit the window. When the operator chooses an analog input device, the corresponding setpoints will be displayed. The operator has the ability to select and change any of the setpoints. The User Analog Setpoints window displays the customer/user defined analog alarm data. The window will display the alarm number, alarm label, and current alarm setpoint for each user defined alarm. A total of ten setpoints will exist per analog input. The number of user setpoints will be equal to ten minus the number of factory controlled (FIXED) setpoints. This window will allow the operator to enter a new setpoint value for one or more chosen alarms or exit the window without changes. These setpoints may include one or more of the following:

- Low Process Cyl.
- Very Low Process Cyl
- Regulator Creeping (may also serve as a high pressure delivery alarm)
- Low Process Del.
- Low Cyl. Weight
- Very Low Cyl. Weight

To change a setpoint, first select the analog input device from the drop down menu. Then highlight the setpoint of your choice, by touching the screen. Type in a numeric value using the keypad.
Press Apply to accept the changes. Press the OK pushbutton to exit the window.

8.6.3 Subcycle Parameters

This option displays the current values for the purge parameters. You may increase these values, but may not decrease them below their pre-programmed minimum. The purge parameters and their pre-programmed minimum values follow:

- High Pressure Cycles = 20
- Low Pressure Cycles = 20
- Helium Leak Inboard = 1
- Helium Leak Outboard = 1

To change a value, select the parameter of your choice by touching the screen. Use the keypad to type in a numeric value. Press Apply to accept the changes. Press the OK pushbutton to exit the window.

8.6.4 Leak Test Parameters

This option displays the current values for the leak parameters. You may increase these values, but may not decrease them below their pre-programmed minimum. The leak parameters and their fixed pre-programmed minimum values follow:

- Cylinder Leak Test Min. of Testing = 5 Press. Differ. = 5psi (.344 barg)
- Decay Test Min. of Testing = 5 Press. Differ. = -5psi (-.344 barg)
- V-3 Leak Test Min. of Testing = 5 Press. Differ.= 5 psi (.344 barg)
- HP Leak Test Min. of Testing = 10 Press. Differ. = 5 psi (.344 barg)

To change a value, select the parameter of your choice by touching the screen. Then select either the Delta or the Duration by again touching the screen. Use the key pad to type in a numeric value. Press Apply to accept the changes. Press the OK pushbutton to exit the window.

CAUTION

All Decay Test parameters must have a negative value for the pressure difference in order to detect a leak and alarm.

8.6.5 System Test

8.6.5.1 Test Digital In

This option displays a list of the digital inputs and their current state. The state may be used to determine if the digital device is operating properly.

Use the scroll bar to view all the digital input values.

8.6.5.2 Test Digital Out

This option displays a list of the digital outputs and their current values. Outputs may be forced "on" (energized) or "off" (de-energized) to determine if the output is operating properly.

This file operates in a similar manner to manual operation as described in Section 8.5. It is the customer's responsibility to adhere to all operational warnings in Section 8.5 when performing the Digital Out Test.

Use the scroll bar to view all the digital output values.

CAUTION

Extreme care must be taken when forcing a digital output either on or off as there is no confirmation in Digital Out Test, as a reminder, like that which is used in manual operation for critical valve operation.

8.6.5.3 Test Analog In

This option displays a list of the analog inputs, their current values (net or gross), and the raw signal input. The current value may be used to determine if the analog device is providing accurate output (controller input).
Use the scroll bar to view all the analog input values.

8.6.5.4 Test Internal Flag

The Test Internal Flags window will display the internal flag number, label, and state (Set or Clear) for all internal flags in the system. This window will allow the operator to exit the window or change one or more internal flag states to SET or CLEAR. To change an internal flag state, highlight the desired internal flag to change and select SET or CLEAR at the bottom of the window. Then press the APPLY pushbutton. Upon exiting the Test Internal Flags window, any changes made to internal flag states will be ignored and the internal flag states will return to their original state.

CAUTION

Extreme care must be taken when changing the state of an internal flag. The operator must fully understand the use of the flag prior to any edits.

8.6.5.5 Test Remote In

The Test Remote In window will display the controller number, controller name, controller input, controller input type, controller input value, and controller comm status for different controllers on the network. Changes to parameters in the Test Remote In window are not allowed.

8.6.6 Valve Setup

The Valve Setup window will display the solenoid number, valve label, and valve confirmation for each valve in the system. This window will allow the operator to change the valve confirmation mode for one or more valves or exit the window without changes. The valve confirmation mode will be set to CONFIRM or NO CONFIRM.

8.6.7 Valve Counts

The Valve Counts window will display each valve in the system and the count for each valve. The valve count will represent the number of times a pneumatic valve has cycled (opened and closed). This window will allow the operator to change the valve count for one or more valves or exit the window. New valve counts will be written to the NV Data File upon exiting and saving the Configuration Menu. To change the valve counts, select the solenoid of your choice by touching the screen. Use the keypad to type in a numeric value. Press Apply to accept the changes. Press the pushbutton to exit the window. OK

8.6.8 Cylinder Change Counts

The Cylinder Counts window will display the number of times a cylinder has been changed. This will be listed for both cylinders in a dual cabinet system. The count can be reset if desired and if write access security password is used.

8.6.9 Operation Sequences

The Operation Sequences window will display a menu, listing the following for each operational sequence defined in the Configuration File: process line number, an indication of whether the sequence is a main menu sequence, sequence type, sequence number, and sequence label. This menu will allow the operator to exit the window or view an operational sequence by choosing the desired sequence. Changes to operational sequences will not be allowed.

8.6.10 Sequence Flow Options

The Sequence Flow Options window will display a list of all Main Menu Sequences in the system. The operator will be allowed to choose one of these sequences. When the operator chooses a sequence, a window will appear with the sequence label as the title. The window will display the end, stop, and fail options lists defined in the Configuration File for the chosen sequence. The end, stop, and fail options lists will contain the sequence label of each main menu sequence that is permitted to be selected from the main menu after an end, stop, or fail of the chosen sequence. Changes to sequence flow options will not be allowed.

8.6.11 Prompt List

The Prompt List window will display the prompt number and prompt label for each of the prompts in the system. The window will allow the operator to view the prompt list or exit the window. Changes to the prompt list will not be allowed.

8.6.12 Set Time/Date

The Set Time/Date window will display the current time and date for the system. The window will allow the operator to exit the window or enter a new time and/or date by selecting to the appropriate prompt.

8.6.13 Analog Scaling

The Analog Scaling window will display all the analogs used in the system. The operator will be allowed to choose an analog or exit the window. After selecting an analog, the operator can change the maximum and minimum scaling values using the keypad. The Analog Scaling window will display the analog number, analog label, device type (milliamps or volts), minimum analog value, and maximum analog value for each analog point. This window will allow the operator to exit the window or enter a new analog range minimum and/or analog range maximum for one or more analog points. To change the analog scaling values, select the input of your choice by touching the screen. Select either the minimum or maximum. Use the keypad to type in a numeric value. Press Apply to accept the changes. Press the OK pushbutton to exit the window.

8.6.14 Analog Units

The Analog Units window will display all the analogs used in the system. The operator can choose an analog to change its engineering units. When a change is applied all setpoints associated with that analog will be converted to the new units.

8.6.15 FIXED Analog Setpoints (FIXED Setpoints)

The FIXED Setpoints window will display all analogs used in the system. The operator will be allowed to choose an analog from the drop down menu or exit the window. When the operator chooses an analog, the corresponding setpoints for that analog will be displayed. The FIXED Setpoints window will display the FIXED defined analog alarm data. The window will display the alarm number, alarm label, and current alarm setpoint for each FIXED alarm. A total of ten setpoints will exist per analog input. The number of FIXED setpoints will be equal to ten minus the number of user setpoints. This window will allow the operator to enter a new setpoint value for one or more chosen alarms or exit the window without changes. The FIXED Setpoints window is not available to customers.

8.6.16 Alarm Conditions

The Alarm Conditions window will display the alarm input type, alarm number, alarm label, and alarm condition for each system alarm. This window will allow the operator to change the alarm condition for digital alarms to closed, open, or not used and the alarm condition for analog alarms to high, low, or not used. The window will allow the operator to change one or more alarms or to exit the window without changes.

8.6.17 Alarm Delays

The Alarm Delays window will display the alarm input type, alarm number, alarm label, and current alarm time delay (in seconds) for each alarm in the system. The window will allow the operator to enter a new time delay value for one or more alarms or exit the window. A delay entry of ‘ 0’ equates to no delay. The range of values is from 0 to 255 seconds.

8.6.18 Alarm Types

The Alarm Types window will display the alarm input, alarm number, alarm label, and alarm type for each alarm in the system. The possible alarm types are Fault, Shutdown, Sequence Controlled, and Non-Latching. The window will allow the operator to exit the window or change the alarm type of one or more alarms. An alarm having an alarm type of Sequence Controlled cannot be changed to a different type. All other alarm types can be changed; however, the alarm type cannot be changed to Sequence Controlled.

8.6.19 Alarm Sequences

The Alarm Sequences window will display the alarm number and alarm label for each alarm in the system. The window will also display the alarm response sequence and alarm response sequence label for those alarms that have an alarm response associated with them. The window will allow the operator to exit the window or select one or more alarms to view the alarm response sequence. Changes to alarm response sequences will not be allowed.

8.6.20 Relay Defaults

The Relay Defaults window will display the relay number, relay label, and relay default state for each relay in the system. The window will allow the operator to exit the window or change the relay default state of one or more relays. Each relay default state will be set to No Default, Energize, or Deenergize.

8.6.21 Helium Leak Check

The Helium Leak Check Menu window will display the leak check options and will indicate the currently selected leak check option. The options will be Inboard He Leak Check, Outboard He Leak Check, and None. The operator will be allowed to exit the window or change the leak check option.

8.6.22 1st Security List

The 1st Security List window will display the password number and password for each first level password. The 1st level security list will be accessible to 2nd level security users and higher. This window will allow the operator to exit the window or change, add, or delete one or more 1st level passwords. To change a password, 1) select the password by touching the screen, 2) highlight the entire password by dragging your finger across the password field at the bottom of the window, and 3) use the keypad to enter the new password. Only numeric characters are permitted in 1st level passwords and the first character will always be the number one.

8.6.23 2nd Security List

The 2nd Security List window will display the password number and password for each second level password. The 2nd level security list will be accessible to 3rd level security users and higher. This window will allow the operator to change, add, or delete one or more 2nd level passwords or exit the window without changes. To change a password, 1) select the password by touching the screen, 2) highlight the entire password by dragging your finger across the password field at the bottom of the window, and 3) use the keypad to enter the new password. Only numeric characters are permitted in 2nd level passwords and the first character will always be the number two.

8.6.24 3rd Security List

The 3rd Security List window will display the password number and password for each third level password. The third level security list will be accessible to 3rd level security users and higher. This window will allow the operator to exit the window or change, add, or delete one or more third level passwords. To change a password, 1) select the password by touching the screen, 2) highlight the entire password by dragging your finger across the password field at the bottom of the window, and 3) use the keypad to enter the new password. Only numeric characters are permitted in 3rd level passwords and the first character will always be the number three.

8.6.25 2nd Security Access

The 2nd Security Access window will display all available user functions. For each function, the window will display the current operator's degree of access at the 2nd level of security. The degrees of access will be No Access, Read Only, or Write. The operator will be allowed to view the access list or exit the window. Operators at 3rd level of security and higher that have Write access to the 2nd Security Access window will be allowed to change one or more degrees of access. Changes to the degree of access cannot allow a 2nd level operator greater access than a higher level operator.

8.6.26 3rd Security Access

The 3rd Security Access window will display all available user functions. For each function, the window will display the current operator's degree of access at the 3rd level of security. The degrees of access will be No Access, Read Only, or Write. The operator will be allowed to view the access list or exit the window.

8.6.27 System Setup

The System Setup window will display the option to change either local or network options. It also allows the change of the IP settings.

8.6.27.1 Local Setup

The Local Setup selection will display the Local Setup window. This window will display the menu timeout values. The window will allow the operator to exit the window or change one of the following:

Change Exhaust Stack Size

The Change Exhaust Stack Size option will allow the operator to enter the exhaust diameter in inches.

Password Protected Reset

The Password Protected Reset option will allow the operator to toggle the password protected reset feature between ENABLED and DISABLED. When this feature is enabled, the operator will be required to enter a valid password when resetting alarms.

Screen Saver

The Screen Saver option will allow the operator to change the screen saver time delay. The box will accept the values 0 or 31–99. A time delay of zero will disable the screen saver.

Key Press Feedback
Key Press Feedback enables or disables the "beep" noise associated with pressing a touch screen key or button.

Simulation
Permits the user to enable or disable simulation capabilities.

8.6.27.2 Network Setup

The Network Setup option will display the Network Setup window. The Network Setup window will display the network port number, the network device type, the Network Control state, the RS-485 channel numbers, the Ethernet channel numbers, and the network comm. type. The window will allow the operator to exit the window or change one or more of the network parameters.

Enable/Disable Network Control

The Enable/Disable option will allow the operator to change the Network Control state to either Enable or Disable.

RS-485 Channel Number

The RS-485 change channel option will allow the operator to change the left and right RS-485 channel numbers. The numbers may be changed within the range of 0 to 63. Changes to the channel number will be written to the NV data file.

Ethernet Channel Number

The Ethernet change channel option will allow the operator to change the left and right channel numbers. The numbers may be changed within the range of 0 to 63. Changes to the channel number will be written to the NV data file.

Network Comm. Type

The network comm. type can be set to either RS-485 or Ethernet.

8.6.27.3 IP Settings

The IP settings option allows the user to modify the IP address, subnet mask, and default gateway.

8.6.27.4 Peer-to-Peer IP Settings

The Peer-to-Peer IP Settings option displays the controller number, controller name, controller IP address, controller port, and controller comm. information for different controllers on the network. It also displays the peer-to-peer communication status as well as the network communication timeout values. The user has the ability to modify the controller IP address and controller port.

8.6.27.5 Set Product Code

The set product code option allows the user to modify the product code.

8.6.28 Config Transfer

The Configuration Transfer window will display the Configuration File transfer options listed below. The operator will be allowed to choose an option or exit the window.

8.6.28.1 Controller to USB

The controller to USB transfer option will begin the file transfer of the Configuration File from the controller to the target device connected to the controller USB port.

8.6.28.2 USB to Controller Transfer

The USB to controller transfer option will begin the file transfer of the configuration file from the source device connected to the controller USB port.

8.6.29 Memory Management

The Memory Management window is not accessible to the customer. Only authorized personnel have access.

8.7 GASGUARD® eV Heating Configuration

8.7.1 GASGUARD ® eV Overview

GASGUARD® eV provides heating control for 2 cylinder blankets and 2 zones of heat trace. Heating is monitored and controlled from the AP11. Each heater can be individually controlled with separate alarm and control setpoints. The control thermocouple temperature for each heater is displayed on the screen of the AP11 controller. Heating control logic is integrated into the AP11 software and is automatically switched on and off as necessary to facilitate cylinder changes.

8.7.2 Changing Cylinder Heater and Heat Trace Setpoints

The heat trace ships from the factory with a standard setpoint of 35°C (95°F), unless otherwise specified by the customer. This setpoint should be adjusted in the field to meet the system requirements. Reference the following guidelines:

- The setpoint should be between 0°C and 60°C.
- The process piping (heat trace) temperature inside the gas cabinet should be set at least 8°C (15°F) higher than the heated process gas container to prevent the formation of liquid in the process piping upstream of the regulator, if a cylinder heater is used.
- The process piping (heat trace) temperature should be set at least 5°C (10°F) higher than the ambient temperature.

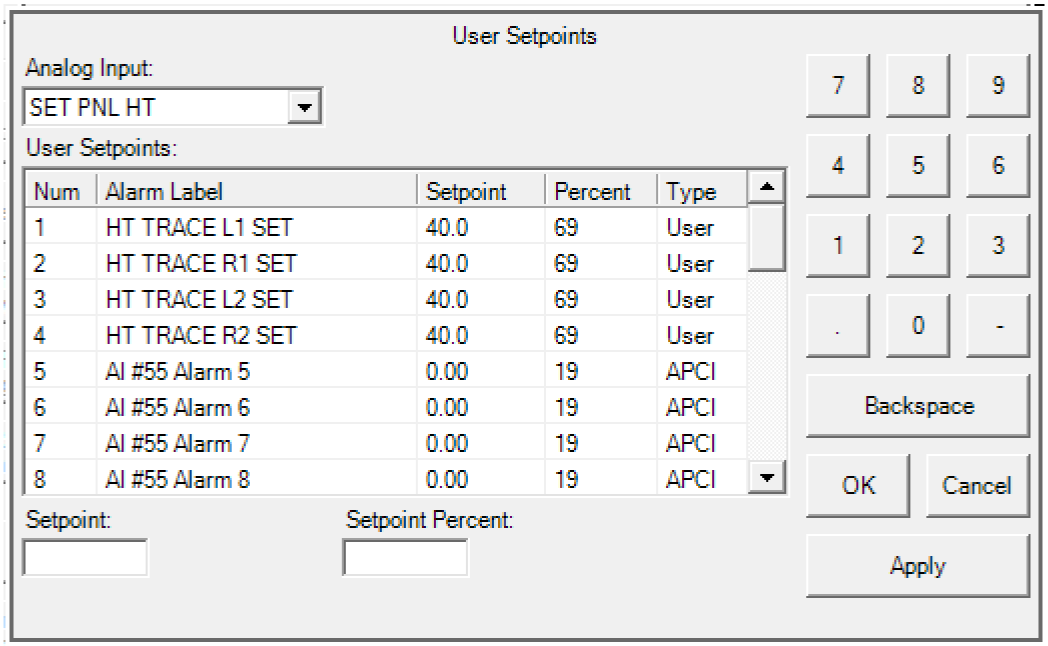
Note: Once the process gas is throttled to houseline delivery pressure, the saturation temperature (point at which liquid begins to form inside the piping) changes. Heat trace on the houseline should be set at least 5°C (10°F) higher than the saturation temperature at the maximum delivery pressure.

The heating control setpoints may be accessed as follows: From the MAIN MENU click on CONFIGURATION MENU, then click USER SETPOINTS.

In the upper left there is a drop down menu labeled Analog Input.

Select SET PNL HT to adjust heat trace temperature.

Select SET CYL HTR to adjust cylinder heater temperature.



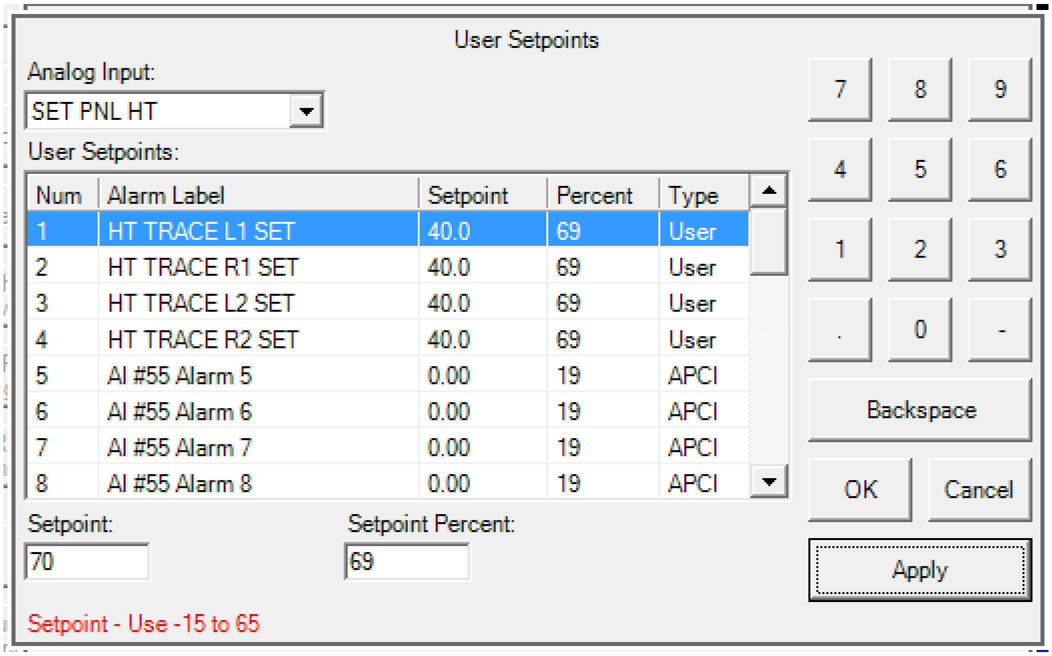
Select which heat trace or cylinder you would like to adjust.

Enter new value in SETPOINT box. All setpoints are in degC. Press APPLY.

Heat trace may be set from -15 to 65 degC.

Cylinder heaters may be set from -15 to 41 degC.

If a value outside of the allowable range is entered, the message as shown below will appear and the value won’t change.



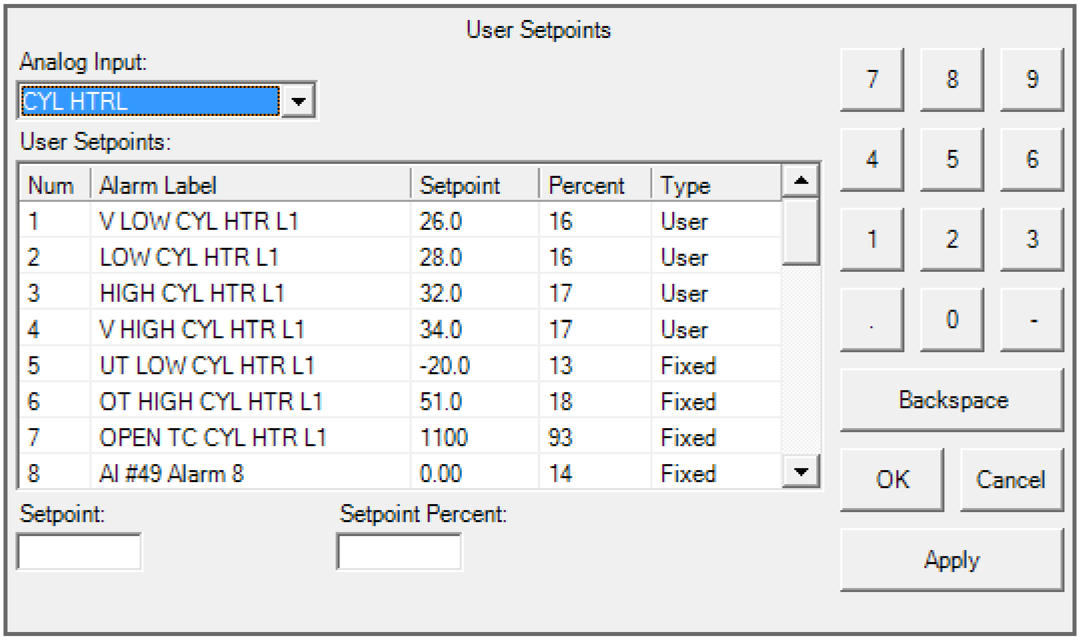
8.7.3 Changing Cylinder Blanket and Heat Trace Alarm Setpoints

Whenever you change the temperature setpoint for the cylinder heater or heat trace the associated alarms will also need to be adjusted.

The heating control alarm setpoints may be accessed as follows: From the MAIN MENU click on CONFIGURATION MENU, then click USER SETPOINTS.

In the upper left there is a drop down menu labeled Analog Input.

Select CYL HTRL for left cylinder heater alarms.
Select CYL HTRR for right cylinder heater alarms.
Select HEATTRACE L1 for left heat trace alarms.
Select HEATTRACE R1 for right heat trace alarms.



VLOW CYL HTR: Very low panel heat trace temperature.
The recommended setpoint is at least 5 degC below the heat trace temperature setpoint.

LOW CYL HTR: Low panel heat trace temperature.
The recommended setpoint is at least 3 degC below the heat trace temperature setpoint.

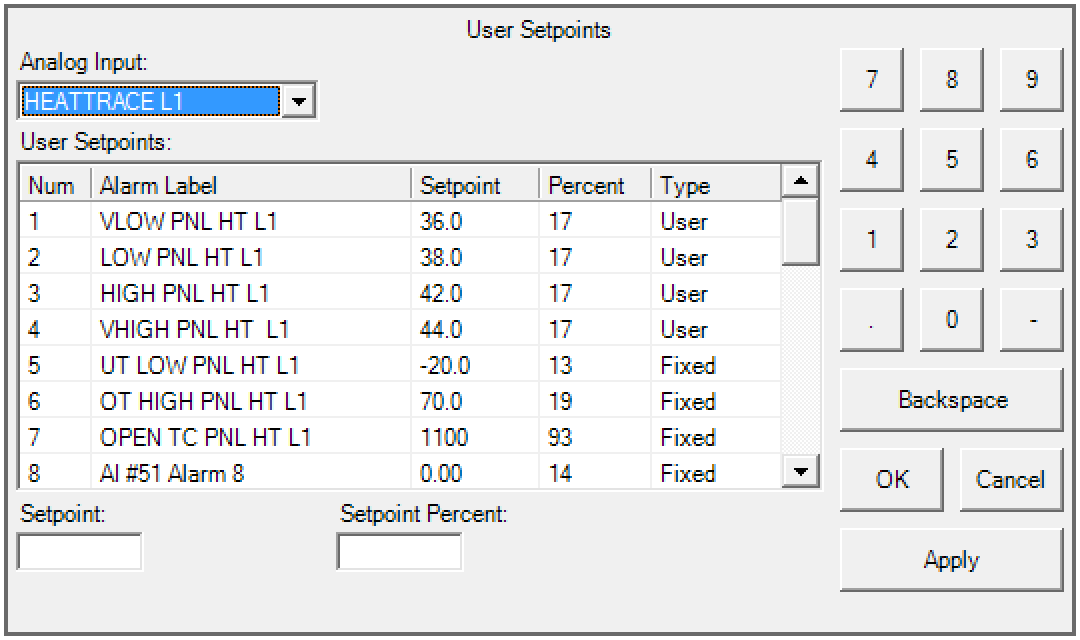
HIGH CYL HTR: Very high panel heat trace temperature.
The recommended setpoint is at least 3 degC above the heat trace temperature setpoint.

VHIGH CYL HTR: High panel heat trace temperature.
The recommended setpoint is at least 5 degC above the heat trace temperature setpoint.

UT LOW CYL HTR: Undertemp low panel heat trace temperature. Not user configurable.

OT HIGH CYL HTR: Overtemp high panel heat trace temperature. Not user configurable.

OPEN TC CYL HTR: Open thermocouple panel heat trace. Not user configurable.



VLOW PNL HT: Very low panel heat trace temperature.
The recommended setpoint is at least 5 degC below the heat trace temperature setpoint.

LOW PNL HT: Low panel heat trace temperature.
The recommended setpoint is at least 3 degC below the heat trace temperature setpoint.

HIGH PNL HT: Very high panel heat trace temperature.
The recommended setpoint is at least 3 degC above the heat trace temperature setpoint.

VHIGH PNL HT: High panel heat trace temperature.
The recommended setpoint is at least 5 degC above the heat trace temperature setpoint.

UT LOW PNL HT: Undertemp low panel heat trace temperature. Not user configurable.

OT HIGH PNL HT: Overtemp high panel heat trace temperature. Not user configurable.

OPEN TC PNL HT: Open thermocouple panel heat trace. Not user configurable.

Chapter 9

Troubleshooting

This section explains how you can identify malfunctions present in the system.

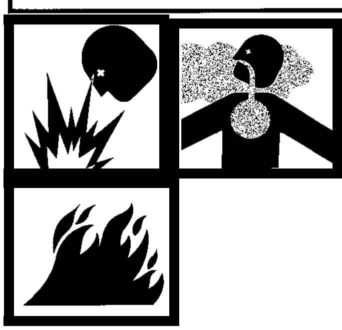
CAUTION

Troubleshooting is only to be performed by trained people who understand the hazards of the system.

WARNING

Personal injury or death may result if proper personal protective equipment (PPE) is not worn when performing troubleshooting. See Section 1.9 for the proper PPE.

WARNING



Before attempting to service the system components, close the cylinder valve(s), vent all pressure in the system, and purge all lines that have contained process gas. Tag out and lock out the cylinder valve(s) following the procedure in Safety Section 1.11 of this manual to prevent opening while service is being performed. Once the repairs have been made, follow the start-up procedure, in Section 8.4 of this manual.

WARNING

Turn off electrical power to the system before performing service.

This section explains how you can identify malfunctions present in the system. The format of this section is the presentation of a problem, possible cause and possible solutions.

CAUTION

Before performing troubleshooting, review the Safety section and read the warnings in following section. If at any time during troubleshooting, you are unsure what to do next, DO NOT CONTINUE. Contact your GASGUARD® representative.

9.1 System Shut Down, No Lights on Controller

Electrical power failure	Check the power being supplied to the system.	Restore specified power to electrical control panel.
	Verify internal circuit breaker is in the "ON" position.	Place in "ON" position.

9.2 No or Low Purge Gas Pressure

Closed purge gas cylinder valve	Check position of cylinder valve.	Open cylinder valve, pressure should indicate the current purge cylinder pressure.
Low purge gas cylinder pressure	Check cylinder pressure.	Change cylinder following Cylinder Change Out Procedures found in Section 8.3.1 of this manual.
Instrument nitrogen supply not adequate	Check instrument nitrogen pressure.	Adjust instrument nitrogen to 85-95 psig (5.9-6.6 barg).

Purge gas pressure regulator set incorrectly	Check setting on pressure regulator.	Set pressure regulator to correct delivery pressure 80-90 psig (5.5-6.2 barg).
Purge gas pressure transducer(s) malfunctioning	Check input to controller, Check connections and signal from pressure transducers.	Repair connections, repair or replace transducer(s) as necessary.

9.3 No or Low Purge Gas Flow

No or low purge gas pressure	See Section 9.2 above.	
Purge gas manual isolation valve(s) closed or partially closed	Check position of purge gas manual isolation valve(s).	Open fully.
Are any purge vent valves open?	Check position of all purge vent valves.	Close any purge vent valves if open.
Are purge gas pneumatic valves receiving sufficient pressure to open?	Check if instrument supply is adequate.	Adjust to 85-95 psig (5.9-6.6 barg) if necessary.

9.4 No or Low Process Gas Pressure

Closed process gas cylinder valve	Check position of process gas cylinder valve.	Open cylinder valve, pressure should indicate process cylinder pressure.
Low process gas cylinder pressure	Check process gas cylinder pressure.	Change cylinder following Cylinder Change Out Procedures found in Section 8.3.2 of this manual.

Instrument nitrogen supply not adequate	Check instrument nitrogen pressure.	Adjust instrument nitrogen to 85-95 psig (5.9-6.6 barg).
Process gas pressure regulator set incorrectly	Check setting on pressure regulator.	Set pressure regulator to correct metering pressure.
Process gas pressure transducer(s) malfunctioning	Check input to controller, Check connections and signal from pressure transducers.	Repair connections, repair or replace transducer(s) as necessary.
Cylinder heater too low	Verify temperature on screen	Adjust control setting
Blankets not tightly secured against cylinder	Check cylinder blanket installation	Adjust as straps necessary
Condensation in lines	Check that heat trace temperature is above cylinder heater and ambient Check that Heat trace temperature is set higher than cylinder heater and ambient temperatures	Adjust heat trace temp to minimum 15degF above cylinder heater and 10degF above ambient Adjust heat trace setpoints to minimum 15degF above cylinder heater and 10degF above ambient

9.5 No or Low Process Gas Flow

No or low process gas pressure	See Section 9.4 above.	
Process gas manual isolation valve(s) closed or partially closed	Check position of process gas isolation valve(s).	Open fully.
Are any vent valves open?	Check position of all vent valves.	Close any vent valves if open.
Are process gas pneumatic valves receiving sufficient pressure to open?	Check if instrument supply is adequate.	Adjust to 85-95 psig (5.9-6.6 barg) if necessary.
Cylinder heater too low	Verify temperature on screen	Adjust control setting

Blankets not tightly secured against cylinder	Check cylinder blanket installation	Adjust straps as necessary

9.6 Typical Alarms

This section assumes that all devices are calibrated and functioning according to the manufacturer's specification. Contact your GASGUARD® Technical Representative or the manufacturer should you need to obtain this information.

CAUTION

Before performing troubleshooting, review the Safety section and read the warnings in section 9.1. If at any time during troubleshooting, you are unsure what to do next, DO NOT CONTINUE. Contact your GASGUARD® technical representative.

NOTE: Contact your GASGUARD® technical representative if the alarm displayed on the screen does not appear in this section.

NOTE: Contact your GASGUARD® technical representative for the procedure for calibrating the transducers.

9.6.1 Excess Flow

Probable Cause	Corrective Action
High process gas flow due to mechanical failure or product surge.	Examine process gas system to locate cause of signal.

9.6.2 Low Pneumatic Pressure

Probable Cause	Corrective Action
Pneumatic supply to the controller is less than 65 psig (4.5 barg).	Adjust pneumatic pressure to the controller to 85-95 psig (5.9-6.6 barg).

PT1 (Process Cylinder Transducer) Alarms

The following are possible process cylinder transducer alarms.

9.6.3 Low Process Cylinder Pressure or Very Low Process Cylinder Pressure

Probable Cause	Corrective Action
Process cylinder is below the low and/or very low setpoint.	Follow the process cylinder change-out procedure found in Section 8.3.2 of this manual.
OR Cylinder valve is not open.	Ensure cylinder valve is open.

9.6.4 Low Vacuum at PT1

Probable Cause	Corrective Action
Vacuum at PT1 < -5 psig (0.67 barg) due to Vacuum Venturi supply pressure or flow requirement is insufficient.	Verify Venturi supply is 75-95 psig (5.2-6.6 barg) and that a flow rate of 50-60 slpm (105-127 cfh) can be achieved.
OR PT1 path to vent is isolated either from a closed manual valve or an air operated valve in this path not actuating.	Visually inspect the panel for a closed manual valve in the path to vent and verify 85-95 psig (5.9-6.6 barg) of pneumatic supply pressure is being supplied to the controller.

9.6.5 Low Purge Pressure at PT1

Probable Cause	Corrective Action
Purge pressure at PT1 is less than 70 psig (4.8 barg) due to low purge delivery pressure.	Increase purge delivery to 80-90 psig (5.5-6.2 barg).

9.6.6 High Pressure at Cylinder Connection (Diss, CGA, Keyed VCR, etc.)

Probable Cause	Corrective Action
Process cylinder valve was accidentally opened prior to starting the change cylinder sequence or the post purge sequence.	Ensure the process cylinder valve is closed and enter the Manual Mode (according to the steps in Section 8 of this manual) and evacuate by opening V7, V5 and V1 until PT1 is less than -5 psig (0.67 barg), reinitiate the sequence.

9.6.7 Standby Leak Detected

Probable Cause	Corrective Action
Used on Auto Crossover Systems Only. This alarm monitors process gas retention while a panel is on "Stand-by." Probable causes are V3, V5 or V6 are leaking across the seat.	Remove pneumatic line hoses from these valves and verify absence of pressure. If pressure is present, this indicates a solenoid failure. Contact your GASGUARD® Technical Representative. Perform a pre-purge sequence with the purpose of removing any debris that may be on the seat of the valves.

9.6.8 Cylinder Connection Leaking

Probable Cause	Corrective Action
Process gas cylinder connection not properly tightened.	***Personal protective equipment (PPE) MUST be worn when a leak is suspected.*** Appropriate PPE is detailed in Section 1.9 of this manual. Tighten pigtail cylinder connection to the value specified in the CGA Bulletins found in the Appendix. If leak persists, advise supervisor or contact your GASGUARD® Technical Representative.

9.6.9 Cylinder Leaking

Probable Cause	Corrective Action
Process cylinder valve not completely closed.	Close cylinder valve. (Do not overtorque.) Reinitiate program sequence. If failed, assume cylinder valve is leaking and take appropriate emergency response.

PT2 (Process Delivery Transducer) Alarms

The following are possible process delivery transducer alarms.

9.6.10 Low Vacuum at PT2

Probable Cause	Corrective Action
Vacuum at PT2 is < -10 psig (0.7 barg) due to Vacuum Venturi supply pressure or flow requirement is insufficient. OR An air operated valve in the PT2 path to vent is not actuating.	Verify Venturi supply is 70-90 psig (4.8-6.2 barg) at a deliverable flow rate of 50-60 slpm (105-127 cfh). Ensure that 85-95 psig (5.9-6.6 barg) of pneumatic supply pressure is being supplied to the controller.

9.6.11 Low Purge Pressure at PT2

Probable Cause	Corrective Action
Purge pressure at PT2 is < 10 psig (0.7 barg) due to low purge delivery pressure. OR Process regulator set to deliver less than 10 psig (0.7 barg).	Increase purge delivery to 80-90 psig (5.5-6.2 barg). Increase process regulator to deliver more than 10 psig (0.7 barg).

9.6.12 Low Process Delivery or Very Low Process Delivery

Probable Cause	Corrective Action
Process delivery pressure is below the low and/or very low setpoint.	Adjust process pressure regulator to the desired delivery pressure.

9.6.13 High Process Delivery Pressure or Very High Pressure

Probable Cause	Corrective Action
Process delivery pressure exceeded the high and very high setpoints	Decrease the process pressure regulator. Observe regulator for proper operation. If regulator will not maintain the setpoint, it may be "creeping". Contact your GASGUARD® Technical Representative.

PT3 (Purge Cylinder Transducer) Alarms

The following is a possible purge cylinder transducer alarm.

9.6.14 Low Purge Cylinder Pressure or Very Low Purge Cylinder Pressure

Probable Cause	Corrective Action
Purge cylinder pressure is below user setpoint.	Change purge cylinder following purge gas cylinder procedures in Section 8.3.1 of this manual.

PT4 (Purge Delivery Transducer) Alarms

The following are possible purge delivery transducer alarms.

9.6.15 Low Purge Delivery Pressure

Probable Cause	Corrective Action
Purge delivery pressure is below user setpoint.	Adjust purge gas pressure regulator to the desired pressure. Change purge cylinder as required following procedures in Section 8.3.1

9.6.16 High Purge Delivery Pressure

Probable Cause	Corrective Action
Purge gas delivery pressure is too high.	Adjust purge pressure regulator to the desired pressure. Observe regulator for proper operation. Advise supervisor or contact your GASGUARD® technical representative if regulator will not maintain setpoint.

PT5 (Vent Line Transducer) Alarms

The following are possible vent line transducer alarms.

9.6.17 High Vent Pressure

Probable Cause	Corrective Action
Vent line pressure is above user setpoint.	Check pollution abatement equipment for obstruction.

9.6.18 Low Vacuum Generated PT5

Probable Cause	Corrective Action
Vacuum Venturi supply pressure or flow requirement is insufficient.	Verify a Venturi supply of 75-95 psig (5.2-6.6 barg) at 50-60 slpm (106-127 cfh) is obtainable.
OR	
Vent isolation valve, MV22, is closed.	Open manual valve, MV22.

PT8 (Purge Header Transducer) Alarms

The following are possible purge header transducer alarms. This transducer is located downstream of the purge panel and purge purifier (if installed).

9.6.19 High Purge Delivery PT8 or Very High Purge Delivery PT8

Probable Cause	Corrective Action
V4 (Purge Gas Inlet Valve) and check valve failure resulting in process gas entering the common purge header.	Verify alarm was not caused by high purge gas delivery pressure. If not, assume V4 is leaking and purge panel, purge purifier and purge cylinder are contaminated with process gas. Take appropriate action. Contact your GASGUARD® Technical Representative for assistance.

If V4 is leaking and purge panel, purge purifier and purge cylinder are contaminated with process gas. Take appropriate action. Contact your GASGUARD® Technical Representative for assistance.

9.6.20 Low Purge Delivery Pressure

Probable Cause	Corrective Action
Purge delivery pressure is below user setpoint.	Adjust purge gas pressure regulator to the desired pressure. Change purge cylinder as required following procedures in Section 8.3.1

9.6.21 High Purge Delivery Pressure

Probable Cause	Corrective Action
Purge gas delivery pressure is too high.	Adjust purge pressure regulator to the desired pressure. Observe regulator for proper operation. Advise supervisor or contact your GASGUARD® technical representative if regulator will not maintain setpoint.

Scale Alarms

The following is a possible scale alarm.

9.6.22 Low Cylinder Weight or Very Low Cylinder Weight

Probable Cause	Corrective Action
Process cylinder weight is below setpoint.	Change cylinder following procedure found in process cylinder change procedures in Section 8.3.2.

Heating Alarms – *GASGUARD® eV*

The following are possible cylinder heater and heat trace related alarms for GASGUARD® eV equipped systems.

9.6.23 Low and Very Low Cylinder or Heat Trace Temperature

Control setting too close to alarm setpoint	Adjust alarm setpoint to be are at least 2degC below the control setting.
OR	
Loss of power (Dual power source only)	Turn on all power sources.
OR	
Tripped circuit breaker or GFCI breaker	Visually inspect circuit breakers inside GASGUARD® eV cabinet then close tripped breaker.
OR	
Incorrect Wiring	Review for new components or wiring change, then correct wiring per documentation.
OR	
Failed relays or other control components	Check voltage at input and output of control relays, then replace failed components.

9.6.24 High and Very High Cylinder or Heat Trace Temperature

Control setting too close to alarm setpoint OR	Adjust alarm setpoint to be are at least 2degC above the control setting.
Ambient Temperature higher than setpoint OR	Adjust alarm setpoints or control ambient temperature.
Incorrect Wiring OR	Review for new components or wiring change, then correct wiring per documentation.
Failed relays or other control components	Check voltage at input and output of control relays, then replace failed components.

9.6.25 Open Thermocouple

Broken or disconnected wires in thermocouple circuit	Inspect and repair TC wiring.

9.6.26 Active Control Alarms: See Chapter 14

9.7 SYSTEM FAULTS

If any system/board faults occur, they will be displayed as a "System Fault" fault alarm using the following format:

System Fault BN, DN, DEN, DEP1, DEP2

Where

BN = Board Number
DN = Device Number
DEN = Device error number (Internal for authorized GASGUARD® Technician Use)
DEP1 = Device error parameter 2 (Internal for authorized GASGUARD® Technician Use)
DEP2 = Device error parameter 2 (Internal for authorized GASGUARD® Technician Use)

The board numbers are as follows:

1. Carrier Board
2. Door Board
3. I/O Board 1 - 1st Customer Board (optional hardware)
4. I/O Board 2 - Left Panel Board
5. I/O Board 3 - Right Panel Board (optional hardware)
6. I/O Board 4 – Heater Control Board (optional hardware)

Chapter 10

Maintenance

10.1 Warranty

Seller warrants the Equipment manufactured by it to be free from defects in material and workmanship at the time of shipment from Seller's factory for a period of twelve (12) months from the date of shipment, (herein referred to as the "warranty period"). If, during the warranty period, any part of such Equipment is found to have been defective or damaged at the time it was shipped, at Seller's option it will either be repaired at Seller's factory, or it will be replaced by a similar part provided that Buyer gives Seller immediate written notice upon the discovery of any defective or damaged items, whereupon Seller shall have the option of requiring the return of the defective material to establish the claim. This warranty is expressly conditioned upon installation of the Equipment in accordance with the Equipment drawings and instructions of the Seller, and upon Buyer availing itself of the services of Seller's installation and startup advisors, to ensure the correct installation and successful operation of the equipment.

As to all apparatus and products not manufactured by Seller which are component parts of the Equipment, furnished by Seller, Seller's only obligation shall be to obtain for Buyer such warranties or guarantees are obtainable from the manufacturers. Such warranties or guarantees shall extend over the longest period of time obtainable in this instance without payment by Seller of additional consideration therefore, and Seller shall use reasonable efforts to require its vendors to fulfill obligations of their warranties of guarantees on such apparatus or products furnished in connection with this quotation or any contract resulting therefore.

The replacement or repair of defective parts, as aforesaid, shall be Buyer's only remedy for breach of the material and workmanship warranties of Seller. As to the Equipment of other manufacturers, resort shall be had against such manufacturers only. No allowance will be made for repairs or alterations made without the written consent of Seller, in which event all Sellers' warranties hereunder shall be void and of no effect. Buyer agrees to assume responsibility and pay for such defects which are attributable to it and for damages which may occur to the Equipment after delivery to it. Seller shall not be responsible for any defects due to or caused by normal wear and tear, corrosion, erosion or disregard of Seller's operating and maintenance instructions, or improper use of equipment.

10.2 Routine Maintenance

The following maintenance needs to be done at the indicated times.

Maintenance is only to be performed by trained personnel who understand the hazards of the system.

Before attempting to service the system components, all pressure in the system should be relieved and electrical power to the system turned off. Close the cylinder valve(s) and then vent all pressure in the system. Purge out all process gas lines and seal them. The process gas cylinder must be removed from the gas source system following the process cylinder procedures in Section 8.3.2 of this manual. Tag out and lock out the cylinder valve(s) (see Section 1.11) to prevent opening while service is being performed. Once the maintenance is complete, helium leak test the system using a mass spectrometer. Follow the start-up procedure, in Section 8.4.

Personal injury or death may result if proper personal protective equipment (PPE) is not worn when performing troubleshooting. See Section 1.9 of this manual for the proper PPE.

When piping is added, proper labels must be affixed to critical components. Failure to label correctly could result in inadvertent operation of system, possible resulting in personal injury or death.

When performing maintenance on a Gas Guard system where piping is replaced or added assure mounting supports and brackets are installed. Failure to attach this hardware could result in leaks and personal injury or death.

Preventative Maintenance – Mechanical Components

NOTE: Asterisk (*) indicates that Preventative Maintenance task requires a shutdown.

Component	Task	Minimum Frequency
Process Piping & Components	Purge with clean, dry, inert gas to achieve recommended purity levels. Refer to Gasguard™ Position Paper on Gas Panel Purging 3EQ95018. Minimum recommended purity level for purge gas is 99.999% and <1ppmv H20 to maintain mechanical integrity. A higher level of purge gas purity may be required to meet customer process specifications.	Corrosives: Every cylinder change and at the start of an extended shutdown. It is recommended that panels in corrosive service (including standby side) be purged at least once every 3 months.
		All other process gases: Every cylinder change
Cylinder Connection Gasket/Filter	Replace gasket each time the cylinder connection is broken. Do not reuse.	As required
Process/Purge Pigtail	Examine cylinder connection face seal for scratches, plugging, or corrosion. Replace the pigtail if there is evidence of damage.	Every cylinder change
	Check flexhoses for signs of wear.	Every cylinder change or every 3 months (whichever comes first)
	Replace as recommended.	See Section 10.3
Cylinder Connection Gasket/Filter	Replace gasket each time the cylinder connection is broken. Do not reuse.	As required
Process/Purge Panel	Visually inspect for damage, leaks, or malfunctioning components. Check process and purge pressures for readings that are outside of the specification range (found in Section 11 of operating manual) or dramatic changes from previous values. Observe the interior of the gas cabinet for any signs of corrosion or gas leakage. Verify that pneumatic tubing is securely connected to valve actuators.	Every cylinder change or Every 3 months (whichever comes first)
Cabinets and Frames	Sweep enclosures and racks. Clean all external surfaces with a clean damp cloth. Clean the interior cabinet enclosures and rack frames. **Caution:** Use a damp cloth only on the outside of the controller. Do not clean controller interior. Especially in hazardous areas, DO NOT rub the surface of the screen with a dry cloth. This could generate an electrostatic charge. When cleaning the controller face, take measures to prevent an electrostatic discharge such as earth band, ionic shower, etc. **Caution:** Do not use pressurized water to clean inside or outside of source systems as serious damage could occur to the electronic components.	Every 3 months unless the equipment is located in a cleanroom environment. Cleanroom units should be cleaned as necessary.

CONTINUED NEXT PAGE

Preventative Maintenance – Mechanical Components (Continued)

NOTE: Asterisk (*) indicates that Preventative Maintenance task requires a shutdown.

Component	Task	Minimum Frequency
Cabinet Door/Window	Verify that self-closing mechanism functions properly. Inspect hinges and gaskets for damage or excessive wear. Look for aging, cracks, and peeling of the gaskets. Also check the surface onto which the gaskets seal. Look for oxidation, corrosion, and foreign material that would prevent proper sealing.	Yearly
Cylinder Restraints	Visually inspect for wear. Verify cylinder is properly secured.	Every cylinder change or every year (whichever comes first)
Pressure Monitors (Transducer, Switch, Transmitter, Gauge)	Check pressure readings against the cylinder change checklist pressure readings. If process gas pressure must be adjusted, monitor the delivery pressure for a smooth increase or decrease.	Every cylinder change
	Verify zero.	Yearly
	*Function Test Pressure Switches for safety critical alarms. Where applicable, verify: • High pressure cylinder shutdown • High pressure delivery shutdown • Co-axial high/low pressure shutdown • Low pressure excess flow alarm	Every 2 years
Regulator	Check downstream pressure.	Daily
	Toxics, Corrosives and Pyrophorics only: Visually examine exterior of the regulator and connections for signs of external leakage.	Annually
Regulator Bonnet Vent Piping	Pyrophorics only: Visually examine exterior of bonnet piping for signs of blockage, silane dusting, leakage, etc. Verify vent is routed to safe location. Caution: Do not attempt to clean blockage until verifying that there is no gas present.	Yearly
Excess Flow Switch	* Test Excess Flow Switch.	Every 2 years
Safety Relief Valves	* Test safety relief valves (or replace with new) to ensure they relieve at manufacturer's specified pressure setting. Replace any defective safety relief valves. Caution: Shut down piping circuit and remove SRV before performing test. Never intentionally overpressurize the system components.	Corrosives: Every 3 years or as dictated by local code (whichever comes first)
		All others: Every 4 years or as dictated by local code (whichever comes first)

CONTINUED NEXT PAGE

Preventative Maintenance – Mechanical Components (Continued)

NOTE: Asterisk (*) indicates that Preventative Maintenance task requires a shutdown.

Purifiers	Replace as recommended.	Consult purifier manufacturer's specification
Vacuum Venturi	Verify vacuum readings.	Every cylinder change
Exhaust Ventilation Inlet Filter	Check for clogging.	Monthly
	Replace or clean as required.	As necessary
Analog Exhaust Monitor (i.e., Setra)	Verify zero.	Yearly
Exhaust Switch	Replace as recommended.	See Section 10.3
Exhaust Switch Pitot Tube	Visually inspect for damage.	Yearly
Pneumatic Bulkhead	Visually inspect for fatigue, cracking, or other damage.	Yearly
Pneumatic Tubing	Examine for cracking or signs of wear. Replace as required or recommended.	Indoor: Yearly
		Outdoor: Every 6 months
UV/IR Detector	Clean housing glass. Verify that the detector is aimed in the proper direction.	Indoor: Every 6 months
		Outdoor: Monthly
	* Test UV/IR detector.	Yearly
UV Source for auto self-check	Replace as recommended.	See Section 10.3
Temperature Switch	* Test temperature switch.	Every 2 years
Scales	Verify zero or calibrate to known weight.	Yearly or at every cylinder change if cylinder life exceeds 1 year.
Sprinklers	Inspect for corrosion or damage. Verify that wax coating is intact. Verify that discharge path to cylinder is clear.	Yearly
VCR Gaskets	Replace each time a connection is broken. Do not reuse.	As required
Cylinder Heaters (TCU, Temperature Control Units)	Test over-temperature interlocks.	2 years
Heating Blankets	Inspect blankets for wear	Every Cylinder Change

Preventative Maintenance – Electrical Components

NOTE: Asterisk (*) indicates that Preventative Maintenance task requires a shutdown.

Component	Task	Minimum Frequency
Power Supply	Replace as recommended.	See Section 10.3
	Verify power supply voltage is between 23.8 and 24.2vdc. Contact your GASGUARD® representative for a copy of the AP11 Power Supply Adjust procedure.	Yearly
Power Board	Replace fuses as necessary.	As required
Instrument Air Pressure Transmitter	Check that pressure transmitter is in working condition.	Yearly
LCD Screen	Check for readability and brightness. Replace backlight as necessary.	Yearly
E-Stop	* Test E-Stop.	Every 2 years
EMI/RFI Gasket	Look for aging, cracks, and peeling of the gaskets. Also check the surface onto which the gaskets seal. Look for oxidation, corrosion, and foreign material that would prevent proper sealing.	Yearly
Door Hinges	Check resistive hinges and replace as necessary.	Yearly
Solenoids	Verify that LED on solenoid lights when component is activated. Gas should flow through the solenoid. Verify that the pressure is off within the required response time. Listen for leaks inside the controller. Check that the pneumatic supply does not exceed the maximum recommended pressure.	Yearly
Z-Purge Switch	* Test switch.	Yearly
Power and signal wiring	Visually inspect for insulation damage, corrosion, shortages.	Yearly
Grounding Connections	Verify that there is minimum resistance in ground line as specified in Section 4.1 of the Gasguard Operations manual. Tighten connections as needed.	Yearly

10.3 Component Expected Life

This section provides the expected life of several system components. The listed expected life is the length of time during which the component, with proper care and handling as outlined in Section 10.2, is expected to function properly. At the end of the expected life, the component should be replaced to ensure the safe and proper functioning of the system.

Mechanical Components Expected Life

Component	Expected Life / Recommended Minimum Changeout Frequency
Cylinder Connection Gasket	Every cylinder change
Process Pigtail	Corrosives/Diborane/Pyrophorics: 3 years
	SST tubing for Noncorrosives: 5 years
	Flexhose for inert service: 6 years
	Flexhose for flammable service: 3 years
Conical Filter (downstream of pigtail)	Corrosives/Diborane/Pyrophorics: 3 years
	Noncorrosives: 5 years
Pressure Transducers	10 years
Electronic Pneumatic Control Regulator (installed in AP11 for Active Control)	6 years
Process Regulator	Diborane: 1 year for single stage regulators 2 years for dual stage regulators
	Corrosives: 5 years
	All others: 10 years
Purge Regulator	10 years
Excess Flow Switch	10 years
Valves	10 years
Purifiers	See purifier manufacturer's specification
Purge Pigtail	SST Tubing: 10 years
	Flexhose: 6 years
Vacuum Venturi	10 years
Exhaust Ventilation Inlet Filter	10 years
Analog Exhaust Monitor	10 years
Exhaust Switch	2 years

CONTINUED NEXT PAGE

Component	Expected Life / Recommended Minimum Changeout Frequency
Pneumatic Connectors & Tubing	Outdoor: 2 years
	Indoor: 10 years
UV/IR Detector	10 years
UV source for auto self-check	3 years
Temperature Switch	10 years
Pressure Switch (Coaxial Tubing)	10 years
Scales	10 years
Interior LED lights	10 years

Electrical Components Expected Life

Component	Expected Life / Recommended Minimum Changeout Frequency
Power Supply	5 years
Power Board	Changeout as necessary. Expected Life is 10 years with no power surge.
LCD Backlight	Changeout as necessary. Expected Life is 5–10 years
EMI/RFI Gasket	Indoor: 10 years
	Outdoor: 10 years
System Controller	10 years

10.4 Decommissioning

Decommissioning is the process by which the equipment is taken out of service. The safe isolation and securing of the process gas lines to and from the equipment is the sole responsibility of the System Owner requiring adequate coordination between gas technicians and the Fab Owner. This section is to provide general guideless for decommissioning of gas distribution equipment. All Fab Tools process lines must be disconnected prior to using this procedure. Before decommissioning the system, ensure the all pressure in the system has been relieved.

CAUTION

Procedures are only to be performed by trained personnel who understand the hazards of the system.

Personal injury or death may result if proper personal protective equipment (PPE) is not worn when performing troubleshooting. See Section 1.9 of this manual for the proper PPE.

Before attempting to decommission the service the system components, all pressure in the system should be relieved and electrical power to the system turned off. Close the cylinder valve(s) and then vent all pressure in the system. Purge out all process gas lines and seal them. The process gas cylinder must be removed from the gas source system following the process cylinder procedures in Section 8.3.2 of this manual. Tag out and lock out the cylinder valve(s) (see Section 1.11) to prevent opening while service is being performed. Once the maintenance is complete, helium leak test the system using a mass spectrometer. Follow the start-up procedure, in Section 8.4.

Decommissioning Checklist

______________ 1. Verify all site paperwork has been completed for Gas Distribution Equipment Shut Off request.

______________ 2. Ensure that proper PPE has been obtained and donned. Refer to site documentation for the gas being decommissioned.

______________ 3. Gather all required tools. Refer to site documentation.

______________ 4. Ensure all electrical power to the system has been turned off (see Section 4.2).

______________ 5. Ensure process cylinder valve is closed and purge gas is available.

______________ 6. Ensure all pressure in the system has been relieved.

______________ 7. Perform required number of manual purges based on the gas. Contact your GASGUARD® representative for more information.

______________ 8. Start system flow through purge on all components in cabinet and all panels of the system. Refer to Section 4.0

______________ 9. After ensuring complete flow through purge for required number of minutes (contact your GASGUARD® representative for more information). Remove purge cylinder and gas cylinder(s).

______________ 10. In conjunction with site coordinators, cut process lines or isolate system from house lines as needed. If it has been longer than 12 hours since the Process Line Purge repeat the manual purge.

______________ 11. Remove any Fab Tool ID and Status Tags (such as On-line) from the Gas Cabinet and Process Line and hang a “Prior Use” Tag on the Gas Panel(s) with the Date and Fab Tool Name.

______________ 12. Verify the valve positions are correct (all Pneumatic and Manual Valves Closed) and the Controller is in Idle.

______________ 13. Notify LSS to stop monitoring for equipment demolition

14. All equipment associated utilities (except exhaust and fire sprinklers) should be isolated and disconnected from the equipment and OK to DEMO Tag attached

15. Decommission and decontaminate any support equipment associated with this gas system (cylinder heaters, heat trace, exhaust scrubbers, chillers, etc.) per site protocols. Contact your GASGUARD® representative for more information.

Chapter 11

System Specific Information

This section is provided as a placeholder for information specific to the system. Some information is supplied with the equipment separate from the manual or may be supplied upon request.

11.1 System Specifications

The specifications for the system follow this page.

11.2 AP11 Recommended Spare Parts

11.2.1 AP11 Controller Spare Parts

Item	Category	Critical Spare Part (Qty)	Recommended Spare Part (Qty)	Manufacturer	GASGUARD® Part #	Description
1	Carrier Board	1	0	VERSUM MATERIALS	**407410**	Carrier Board w/SOM, Heat sink, & firmware. Part # AP1565
2	Panel Board	1	0	VERSUM MATERIALS	**407356**	Panel Board, part # AP1564
3	Customer Board	1	0	VERSUM MATERIALS	**440969**	Customer Board **STD**, part # AP1563 (replacement board only, see item 6 for complete kit)
4	Customer Board	0	1	VERSUM MATERIALS	**440776**	Customer Board **STD** Kit (includes AP1563 board & cables to add customer input/output alarm function)
5	Customer Board	1	0	VERSUM MATERIALS	**424112**	Customer Board **Lite**, part # AP1573 (replacement board only, see item 8 for complete kit)
6	Customer Board	0	1	VERSUM MATERIALS	**424072**	Customer Board **Lite** Kit (includes AP1573 board & cables to add customer input/output alarm function)
7	Customer Board	1	0	VERSUM MATERIALS	**426430**	Customer Board **Expansion**, part # AP1574 (replacement board only, see item 10 for complete kit)
8	Customer Board	0	1	VERSUM MATERIALS	**426406**	Customer Board **Expansion** Kit (includes AP1574 board & cables to add customer input/output alarm function)
9	Door Board	1	0	VERSUM MATERIALS	**407726**	Door Board, part # AP1562
11	Display	1	0	NEC	**436466**	Display (LED BACKLIGHT TYPE)
14	Display	1	0	Quadrangle	**439367**	Display Cable
15	Fuse	5	0	Littelfuse	**409610**	Fuse 250MA radial, (37002500410)
16	Fuse	5	0	Littelfuse	**409611**	Fuse 500MA radial,

Item	Category	Critical Spare Part (Qty)	Recommended Spare Part (Qty)	Manufacturer	GASGUARD® Part #	Description
						(37005000410)
17	Fuse	5	0	Littelfuse	**409608**	Fuse 1A radial, (37011000410)
18	Fuse	5	0	Littelfuse	**418758**	Fuse 4A radial, (37014000410)
19	Fuse	5	0	Littelfuse	**2301022**	Fuse 1.6A radial, (37011600410)
20	Fuse	5	0	Littelfuse	**2301023**	Fuse 6.3A radial, (37016300410)
21	Graphics	1	0	VERSUM MATERIALS	**415647**	Graphic Overlay/Touch Screen Assembly (one piece, legacy used thru ~2017)
22	Graphics	1	0	VERSUM MATERIALS	**462078**	Touchscreen Graphic Overlay (part of 2-piece overlay)
23	Graphics	1	0	VERSUM MATERIALS	**456049**	LED Graphic Overlay (part of 2-piece overlay)
24	Pressure Switch	1	0	Micro Pneumatic Logic	**809-418802**	Differential Pressure Switch, For Z-Purge, 0.1" H2O, N.O., 1/16" Barbed Special.
25	Solenoid	1	0	SMC	**409865**	AP11 10V Solenoid Bank (SW008631)
26	Solenoid	1	0	SMC	**409864**	AP11 13V Solenoid Bank (SW008369)
27	Solenoid	1	0	SMC	**420179**	Master Solenoid Valve (L Style, 24V, w/base)
28	Power Supply	1	0	Phoenix Contact	**409506**	Power Supply, 24 VDC, 4A
29	Power Supply	1	0	VERSUM MATERIALS	**414764**	AP11 Power Cooling Fan (SW008286.SLDDRW)
30	Power Supply	1	0	VERSUM MATERIALS	**414762**	PCB High Voltage AP11, AP1568
31	Power Supply	1	0	VERSUM MATERIALS	**436467**	10Awg Power Wire Modification Kit
32	Misc.	0	1	VERSUM MATERIALS	**400509**	SETRA Exhaust sensor cable (SW008106.SLDDRW)
33	Misc.	0	1	Allen Bradley	**409501**	Push Button - Mushroom Head - Red - Maintained Push/Pull Twist to Release.
34	Misc.	0	1	Mallory / Sonalert	**171538**	Mallory Sonalert Horn

Item	Category	Critical Spare Part (Qty)	Recommended Spare Part (Qty)	Manufacturer	GASGUARD® Part #	Description
35	Graphics	0	1	VERSUM MATERIALS	**199117**	AP11 Logo w/ Z Purge Warning
36	Graphics	0	1	VERSUM MATERIALS	**199116**	AP11 Graphic Overlay Optional Valve Legend
37	Fuse	4	0	Schurter or SIBA	**416974**	Fuse 4A, super quick acting (Schurter 7022.0660 or SIBA 189020.4)
38	Misc.	0	1	VERSUM MATERIALS	**415646**	Weather Protection Kit
39	Misc.	0	1	Honeywell	**418571**	Pressure-sensor, 150psi, 2%
40	Misc.	0	1	Lindy	**435058**	USB Type-A Port Blocker
41	Customer Board	1	0	VERSUM MATERIALS	**469624**	Customer Board with **Analog-Out**, part # AP1580 (replacement board only, see item 40 for complete kit)
42	Customer Board	0	1	VERSUM MATERIALS	**468487**	Customer Board with **Analog-Out** Kit (includes AP1580 board & cables to add customer input/output alarm function)
43	Heater Board	1	0	VERSUM MATERIALS	**467662**	Heater Control Board, part # AP1602 (replacement board only, see item 42 for complete kit)
44	Heater Board	0	1	VERSUM MATERIALS	**459769**	Heater Control Board Kit (includes AP1602 board & cables to add customer input/output alarm function)
45	Fuse	2	0	Cooper Bussman	**466814**	Fuse 2A (GMA-2-R)
46	Power Supply	1	0	Phoenix Contact	**9-688-79-2761**	Power Supply, 24VDC, 2A (2938730)
47	Relay	1	0	Potter Brumfield	**466815**	Relay, 30A, 24VDC Coil (T92S7D22-24)
48	SSR	1	0	Crydom	**466996**	Solid State Relay, 10A, 3-32VDC input. (CL240D10C)
49	Heat Trace	1	0	Omega Engineering	**183573**	Thermocouple, (for heat trace monitoring)
50	Heater Blanket	1	0	Versum Materials	**482567**	700W Cylinder Heater Blanket Size A/B cylinder (D=9”, H=51-55”) for GASGUARD ® eV

Item	Category	Critical Spare Part (Qty)	Recommended Spare Part (Qty)	Manufacturer	GASGUARD® Part #	Description
51	Heater Blanket	1	0	Versum Materials	Order by Cylinder size & description	700W Cylinder Heater Blanket (other sizes) for GASGUARD ® eV
52	Heater Blanket	1	0	Versum Materials	**2300418**	700W Cylinder Heater Blanket Size B-Ni cylinder (D=7”, H=47”) for GASGUARD ® eV
53	Heater Blanket	1	0	Versum Materials	**2300531**	700W Cylinder Heater Blanket (D=7”, H=33” cylinder) for GASGUARD ® eV
54	Heater Blanket	1	0	Versum Materials	Order by Cylinder size & description	700W Cylinder Heater Blanket Size D-Stl (D=7”, H=19”) for GASGUARD ® eV
55	Heater Blanket	1	0	Versum Materials	**2300530**	700W Cylinder Heater Blanket Size (9x45 and 9x47) for GASGUARD ® eV
56	Heater Blanket	1	0	Versum Materials	**2301024**	700W Cylinder Heater Blanket Size (9x30) for GASGUARD ® eV
57	Display	0	1	VERSUM MATERIALS	**2304444**	LED Backlight kit for controller display
58	Misc	1	0	Proportion Air	**485924**	Electronic Pneumatic regulator for dome loading process regulator 0-110psig High Pressure gases
59	Misc	1	0	Proportion Air	**2304361**	Electronic Pneumatic regulator for dome loading process regulator 0-30psig Low Pressure gases
60	Power Board	1	0	VERSUM MATERIALS	**2300312**	AP1620 24V Power Distribution Board
61	Misc	0	1	VERSUM MATERIALS	**2300492**	LED light bar for cabinet interior

Note: Only spares that meet the manufacturer’s specifications should be used.

11.2.2 Source Recommended Mechanical Spare Parts

Process Panel

Process Pigtail

Purge Pigtail

Purge Panel

Purge Purifier (if used)

Process Purifier (if used)

Process Out Spool

Process Crossover Spool (if used)

Purge Crossover Spool

Vacuum Venturi Spool

Contact your GASGUARD® representative when ordering spare parts. Your equipment commodity code number will be required when placing your order. The commodity code number can be found on the enclosure door, cylinder rack frame or cylinder wall mount frame.

Figure 1: Equipment Commodity Code Number on an AP11 Gas Cabinet

Figure 2: Equipment Commodity Code Number on an AP11 Gas Rack

Figure 3: The AP11 Gas Cabinet equipment commodity code number (circled above) can be found on the enclosure door.

Chapter 13

Pigtail and Cylinder Support Adjustments

Section 13 Pigtail and Cylinder Support Adjustments

The GASGUARD® Source System with cross-purge pigtails has been designed to accommodate a variety of cylinder sizes and customer options. Before starting up the cabinet, it may be necessary to make adjustments.

Note that deep purge pigtails are not field adjustable. If cylinder size has changed, contact your GASGUARD® representative to place order for new pigtail size.

13.1 How to adjust pigtail height:

1. This process should be completed prior to the start of change cylinder mode.

2. If installing cylinder shelves or dual cylinder brackets, be sure to install and adjust these items before beginning this step (See Sections 13.2 and 13.3).

3. If performing this procedure with a charged HPM cylinder or a system that process gas flowing on the opposite side, be sure to put on the appropriate PPE before beginning this process.

WARNING

Personal injury or death may result if proper personal protective equipment (PPE) is not worn when performing intrusive maintenance. See Section 1.9 for the proper PPE.

Never try to adjust the pigtail when filled with process gas. Always ensure that pigtail has been properly purged and evacuated before adjusting pigtail.

4. Place the process cylinder into the cabinet and strap the cylinder into place. (cylinder cap should remain on)

5. Grasp pigtail with both hands positioned as shown in Figure 13.1. One hand must support the back part of the pigtail loop. The second hand should grasp the front part of the loop. Do not pull on the cylinder connection itself.

6. While holding the back part of the pigtail in place, pull the front hand slowly downward or upward until the center of the cylinder connection is in line with the center of the cylinder valve (Cylinder valve is about 3 inches above the base of the cylinder cap).

   Note: Be careful to keep the cylinder connection in the same orientation while bending the pigtail by pulling straight up or down. Do not push forward or pull backwards on the pigtail. If the cylinder connection is allowed to rotate, the keyed cylinder fittings will not properly align.

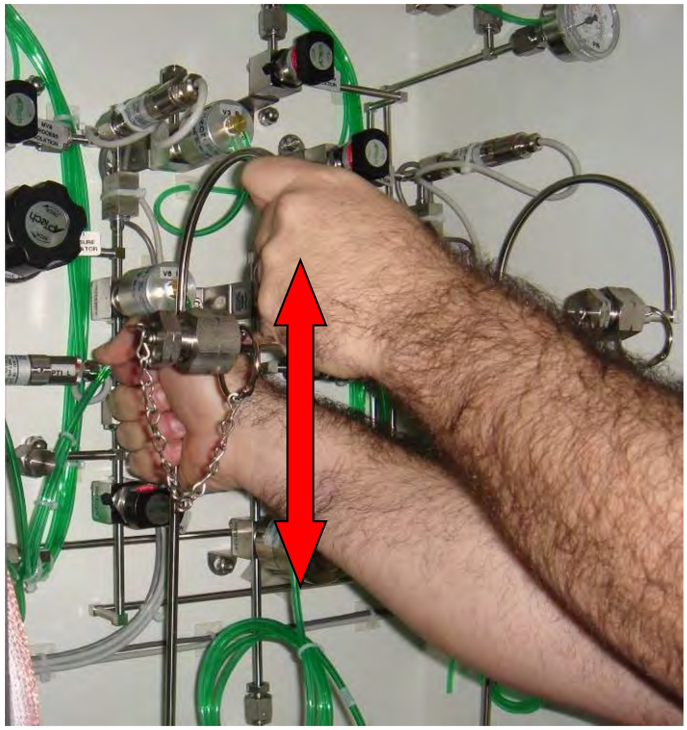


Figure 13.1 Adjusting the pigtail height

7. After completing change cylinder mode and ready to connect cylinder, remove the cap and make any final adjustments to the pigtail height.

13.2 How to install or adjust cylinder shelves (optional):

Cylinder shelves are required for small bottle sizes. The shelf allows the operator to access the cylinder valve and connection through the window opening. The shelf also raises a shorter cylinder near the standard height of the pigtail connection so that only minor adjustments are required.

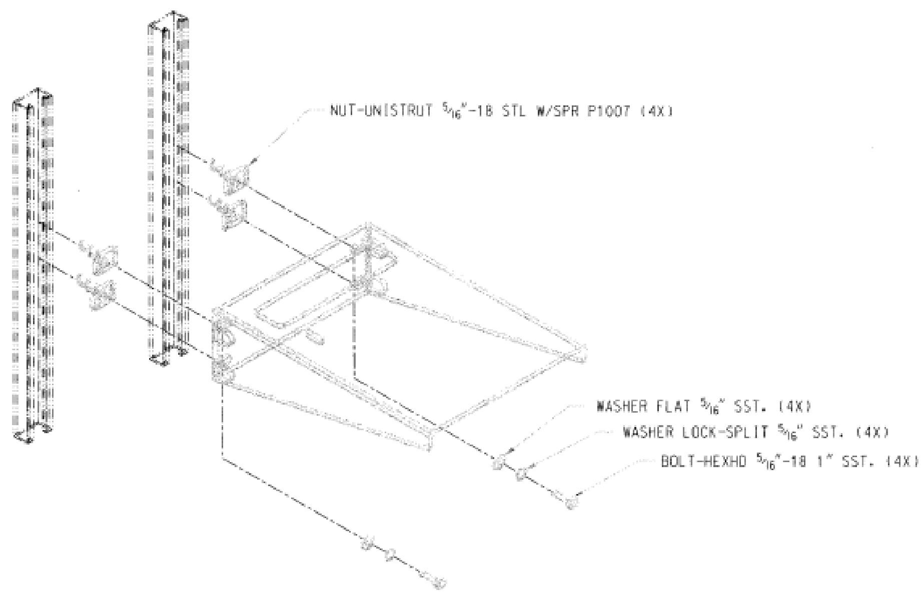


Figure 13.2.1 Exploded view of cylinder shelf assembly

1. If cylinder shelf is not already installed, gather materials and necessary tools.
    a. For each cylinder shelf, the shelf kit will include:
        i. Qty(1) Cylinder shelf
        ii. Qty(4) 5/16-18 UNC hex head bolts
        iii. Qty(4) 5/16 inch flat washers
        iv. Qty(4) 5/16 inch split washers
        v. Qty(4) Unistrut-Nuts with springs
    b. You will also need the following tools:
        i. ½ inch socket wrench or adjustable wrench
        ii. Tape measure (inches)
        iii. Pencil

2. Measure the vertical distance (in inches) from the Cylinder valve connection to the floor. Record here______________.

3. If scales are used, add 1-3/8 inches to this measurement. Otherwise, add nothing. Record here_______________.

4. Subtract the “value from step 3” from 58-1/2 inches and record below. This is the target height of the cylinder shelf platform:

    58-1/2 inches – “value from step 3” = _____________ inches

5. Mark the target height from step 4 inside the vertical Unistrut pieces welded to the back wall of the cabinet.

    NOTE: If the measured distance is higher than the top of the Unistrut, place shelf at highest possible position.

6. Install the upper pair of Unistrut nuts about 1-1/4 inch below this mark, placing one nut in each piece vertical Unistrut.

7. Install the lower pair of Unistrut nuts about 2-1/4 inches below the first.

Figure 13.2.2 Unistrut nuts installed in back wall of cabinet.

8. Loosely install the cylinder shelf using the flat washer, split washer and hex bolt as shown in figure 13.2.

    NOTE: If the cylinder shelf interferes with piping, lower the shelf to the highest acceptable position.

9. Confirm that the shelf height is correct by measuring the vertical distance from the center of the pigtail connection to top of the cylinder shelf platform. This distance should be the same as the distance measured in step 2.

10. Tighten all the bolts.

13.3 How to Install Dual Cylinder Brackets

All Gasguard 2000 systems are equipped with one set of cylinder brackets and straps to secure the cylinders. (Shown with optional cylinder chains below). In addition, customers have the option to purchase a 2nd set of dual cylinder brackets for field installation.

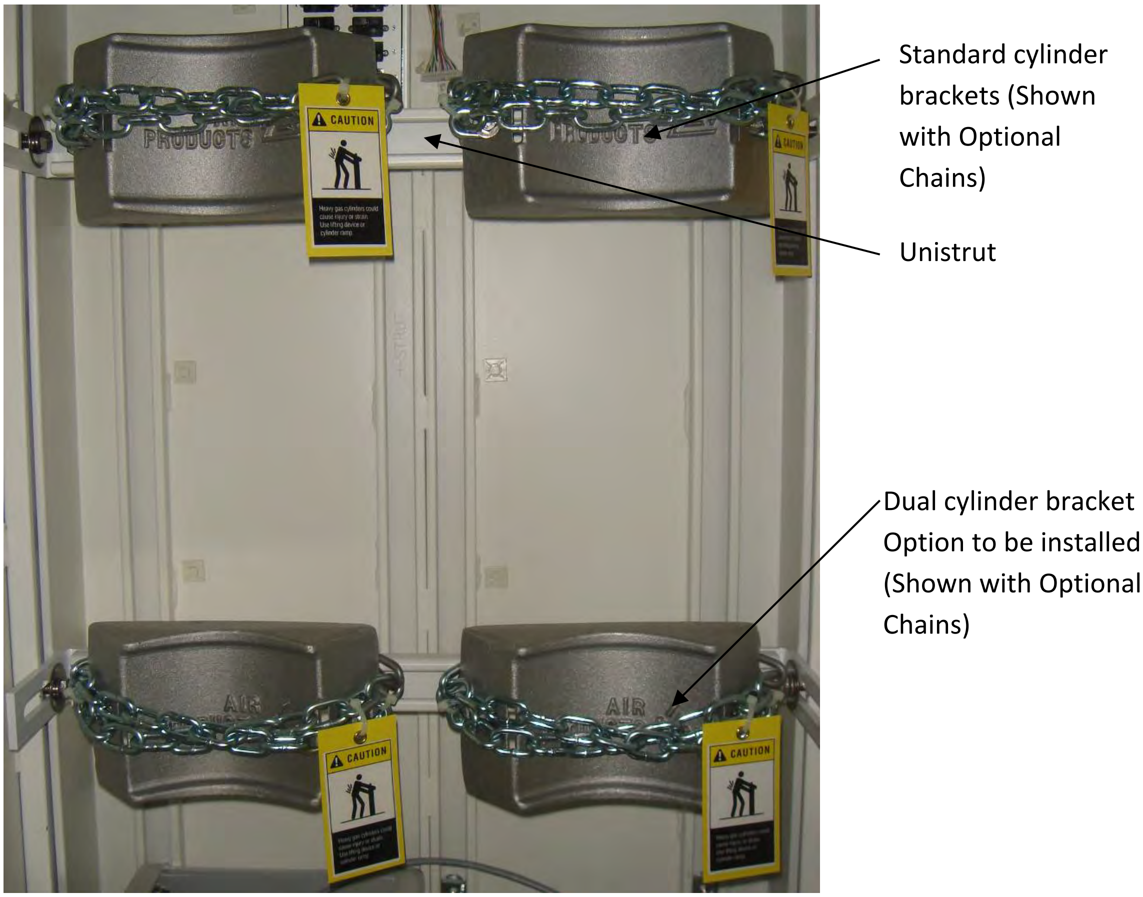


Figure 13.3.1 Overview of Installed Cylinder Brackets (with optional Dual Cylinder Brackets and Chains)

1. Gather materials and necessary tools.
   a. For each cylinder bracket, the kit will include:
      i. Qty(1) Cylinder bracket
      ii. Qty(2) 5/16-18 UNC hex head bolts
      iii. Qty(2) Unistrut-Nuts with springs
      iv. Qty(2) 5/16 inch split washers
   b. For each cabinet, the cylinder bracket kit will include:
      i. Qty(2) 90 degree mounting brackets
      ii. Qty(1) Unistrut piece, cut to length
      iii. Qty(4) 5/16-18 UNC hex head bolts

iv. Qty(2) 5/16-18 UNC hex nut
v. Qty(2) Unistrut-Nuts with springs
vi. Qty(4) 3/8 x 1-1/2 inch fender washers
vii. Qty(4) 5/16 inch split washers
viii. You will also need the following tools:
ix. Qty(2) ½ inch socket wrenches or adjustable wrenches
x. Tape Measure
xi. Pencil

2. Align the new cylinder brackets with the existing cylinder brackets by doing the following:

3. Measure the horizontal position of the existing cylinder brackets. Measure from the end of the Unistrut to each of the cylinder bracket bolts. (See Figure 13.3.1 and 13.3.2)

4. Mark the new Unistrut with the cylinder bracket bolt locations.

5. Install the Unistrut nuts (Qty (2) for each cylinder bracket) into the new Unistrut piece where marked.

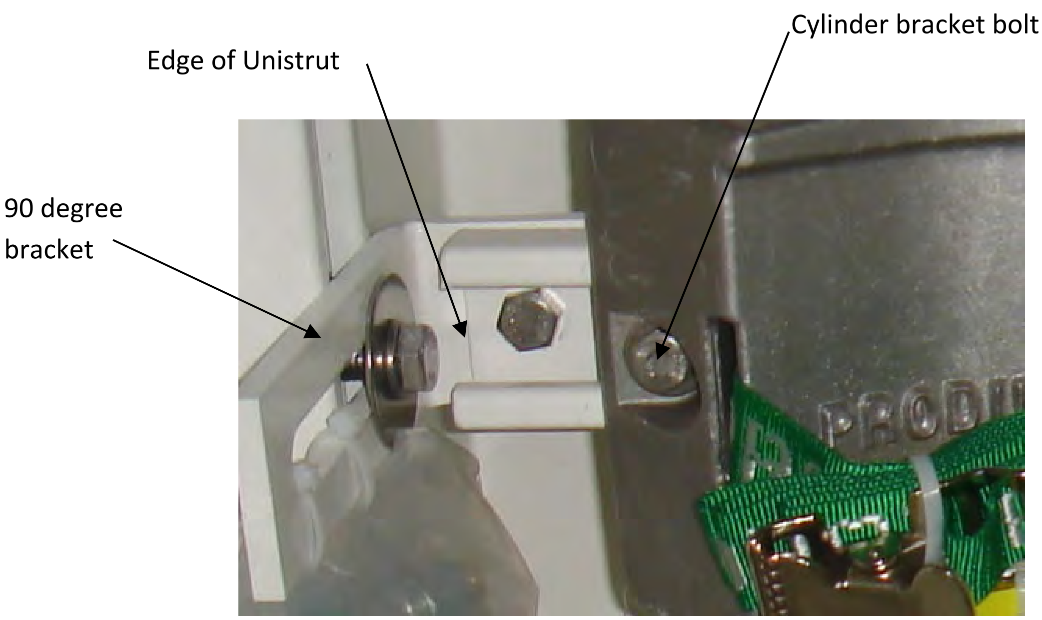


Figure 13.3.2 Detailed view of left side cylinder bracket assembly

6. Attach the 90 degree brackets to the new piece of Unistrut by doing the following:
    a. Place the short end of the 90 degree bracket behind Unistrut with the long end facing forward.
    b. Align the pre-drilled holes
    c. Install the 5/16 hex head bolt through the holes. Fasten with 1-1/2 inch fender washer, 5/16 split washer, and 5/16 inch hex nut.
    d. Repeat for the other side.
    e. Tighten assembly.

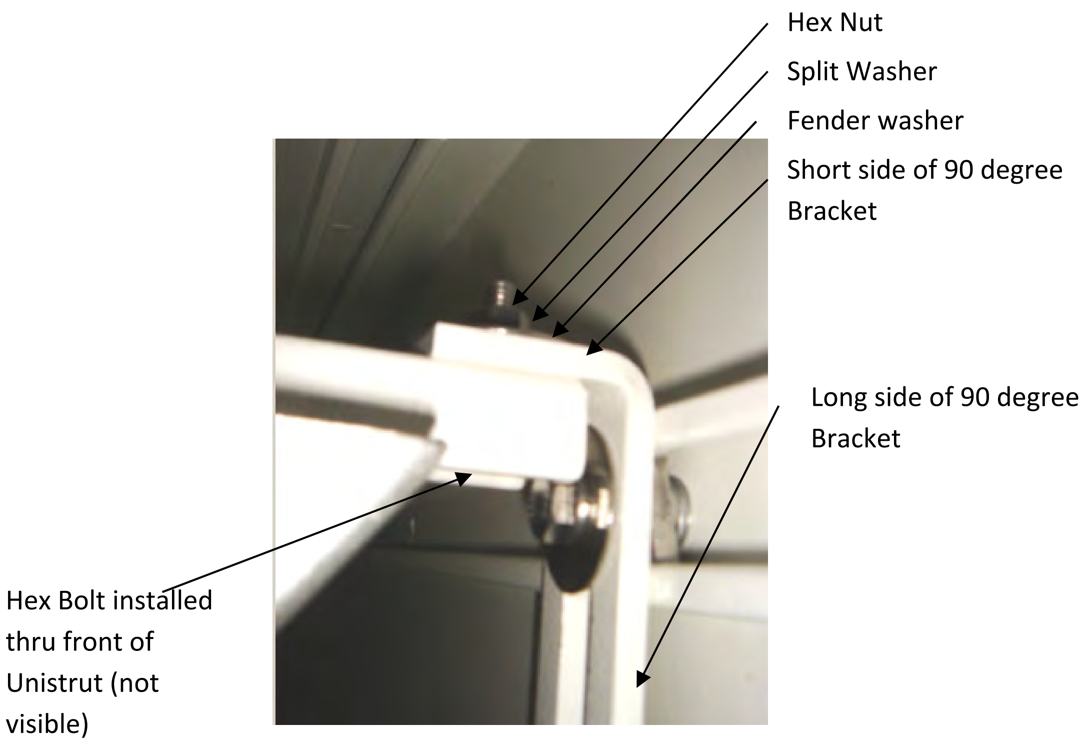


Figure 13.3.3 Top view of right side cylinder bracket assembly.

7. Install the Unistrut piece into the cabinet by doing the following:
    a. Install Qty (1) Unistrut nut into the Unistrut that is welded to the side wall of the cabinet.
        i. If no cylinder shelves are used, mount brackets approximately 16 inches from the cabinet floor.
        ii. If cylinder shelf is used and bottle size is taller than 17 inches high, mount brackets approximately 5 3/8 inches above cylinder shelf.
        iii. If cylinder shelf is used and bottle size is less than or equal to 17 inches high, mount brackets approximately 3 3/8 inches above cylinder shelf.

b. Repeat for other side.
c. Align the new Unistrut and 90 degree bracket assembly with the Unistrut nuts in the side wall.
d. Fasten the new Unistrut using a fender washer, split washer and hex head bolt.
e. Repeat for other side.
f. Tighten assembly.

Figure 13.3.4 Front view of right side cylinder bracket assembly.

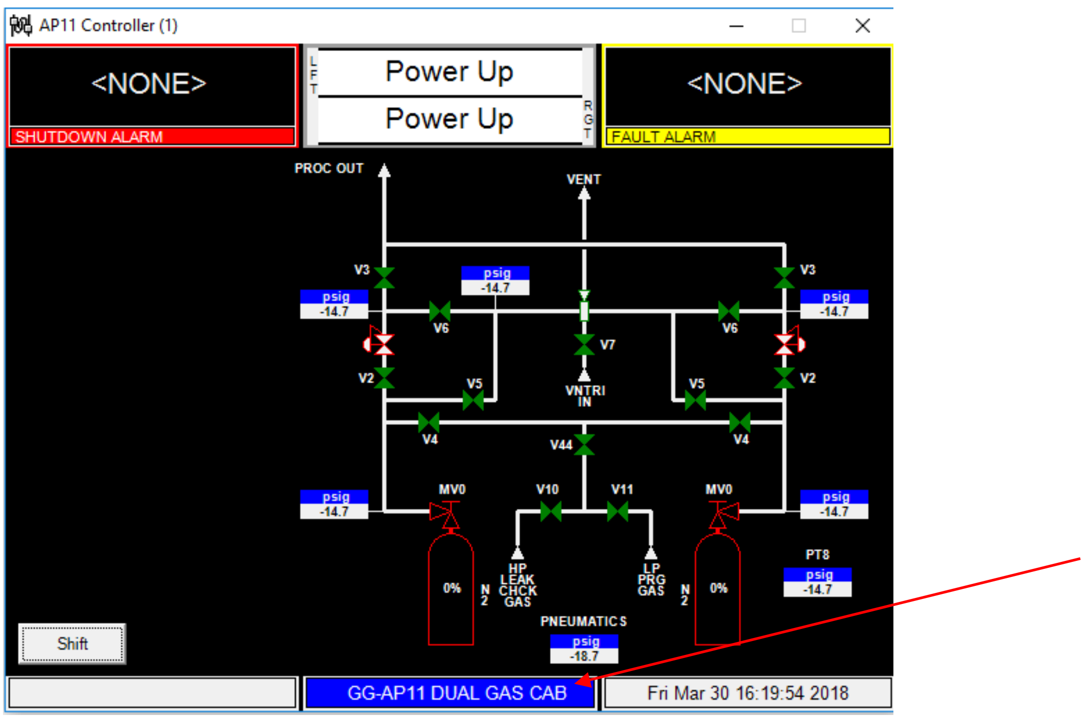
8. Install cylinder brackets.
   a. Align cylinder bracket with the installed Unistrut nuts.
   b. Fasten cylinder brackets to Unistrut nuts using hex head bolt and split washer.
   c. Verify new brackets are horizontally aligned with existing brackets. Adjust if necessary.
   d. Tighten bolts.

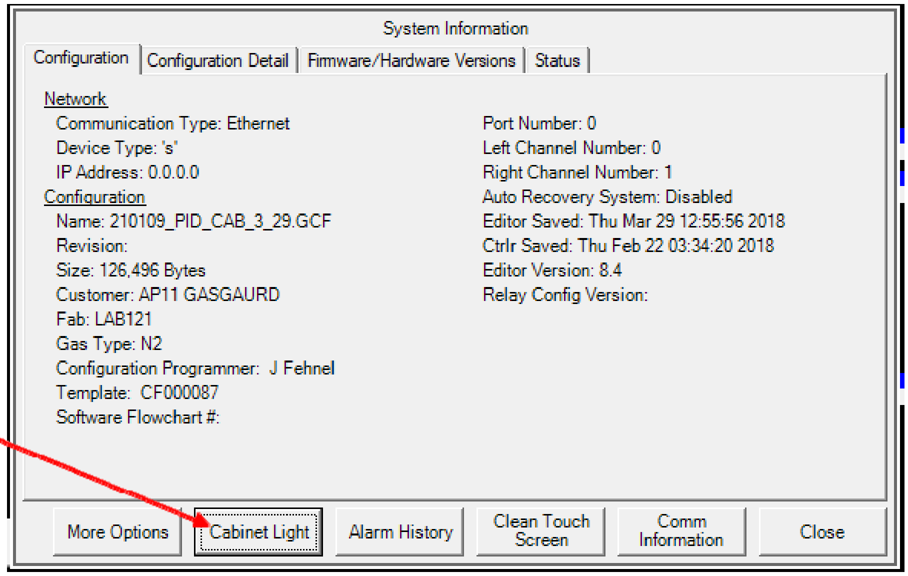
Chapter 14

New GASGUARD® Optional Features and Operation

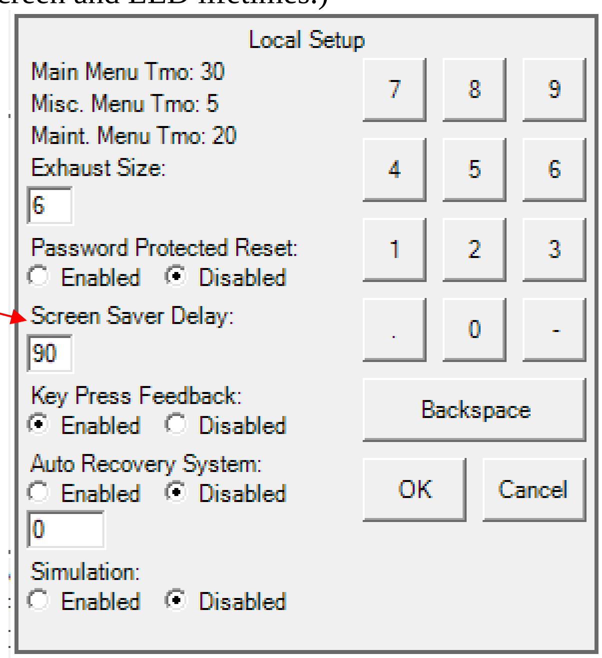
Section 1: LED Light Operation

The GASGUARD® cabinet is equipped with LED lighting in the controller and cabinet interiors. The lights are activated simultaneously using a single button located on the controller screen. To turn on / off the light, click on the blue menu bar located at the bottom middle of the controller screen, then click on the Cabinet Light button.





Note: If left activated, the LED lights will turn off at the screen saver interval. The standard setting is 90 minutes. Reference Section 7 and 8 of the standard operating manual for Screen Saver operation and time delay adjustments. The screen saver time setting is accessed through the **Configuration Menu => System Setup =>Local Setup => Screen Saver Delay** with 3rd level security privileges**.** The time values are entered as minutes, configurable from 31 to 99. A value of "0" can be entered to disable the screen saver (It is not recommended to disable the screen during normal operation. Using a screen saver will preserve screen and LED lifetimes.)



Section 2: ARS Operation with Active Pressure Control (Pneumatically Actuated Regulator)

During ARS (automatic recovery system) operation, PID control is not active. The regulator cannot adjust to changing conditions. When ARS is triggered, the regulator will hold its last known position. This fixed setting may result in a low or high delivery alarm as process gas continues if the ARS event occurs in a period of abnormally high flow, no flow, or significant transition.

All ARS alarms should be treated with appropriate urgency. An ARS alarm signifies a potential cabinet shutdown.

Section 3: Active Pressure Control Operation and Regulator Setting

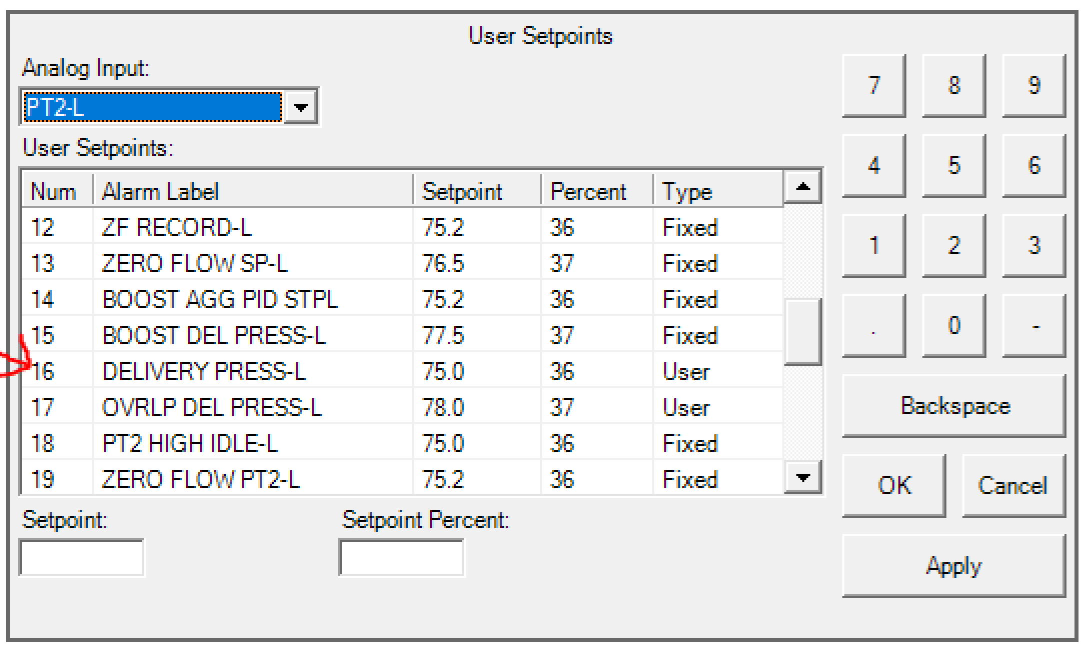
Gasguard® Active Pressure Control is a feature which provides automatic and continuous compensation of delivery pressure to a user-defined setpoint for flows >0.5 slpm. It provides:

- Elimination of source cylinder supply pressure effect
- Automatic adjustment to droop effect from flow-related pressure drop
- Enhanced auto-crossover performance
- User-configurable setpoints to customize operation, optimize performance, and utilize all available gas.

The feature is available as a new build or retrofit for any APx series controller-equipped cabinet.

Note: Contact Versum Materials representative for flow rates less than 0.5 slpm

Operation in Process Mode: During process mode, the pneumatic regulator is controlled by the AP11 PID logic. The process delivery setpoint is adjustable through the controller screen on the PT2-L and PT2-R analog inputs under the User Setpoints screen. The process regulator pressure is adjusted by entering the setpoint in the PROCESS DEL SET alarm. The PROCESS DEL SET alarm controls the regulator pressure via a PID loop which is only active in process mode. During purge and manual modes however, the control of regulator pressure is by fixed analog output, not PID control. See the following sections for adjusting the regulator in purge and manual modes.

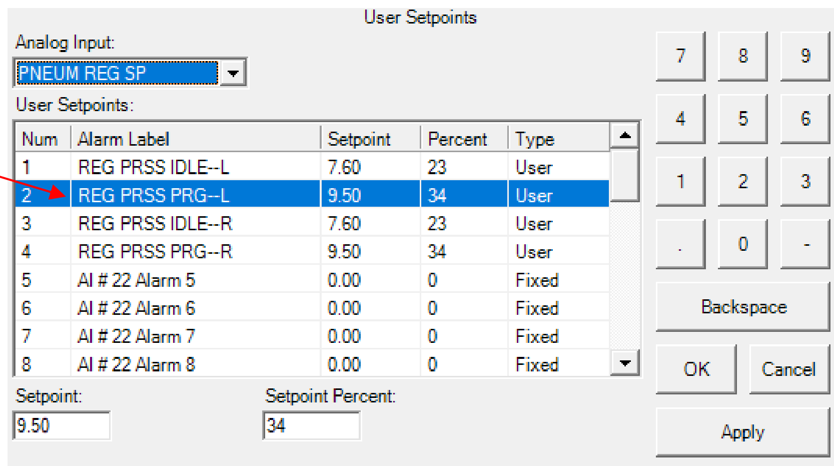


Num	Alarm Label	Setpoint	Percent	Type
12	ZF RECORD-L	75.2	36	Fixed
13	ZERO FLOW SP-L	76.5	37	Fixed
14	BOOST AGG PID STPL	75.2	36	Fixed
15	BOOST DEL PRESS-L	77.5	37	Fixed
16	DELIVERY PRESS-L	75.0	36	User
17	OVRLP DEL PRESS-L	78.0	37	User
18	PT2 HIGH IDLE-L	75.0	36	Fixed
19	ZERO FLOW PT2-L	75.2	36	Fixed

*Note: User setpoint alarm number for PROCESS DEL SET may vary by specific customer software file. It may not always be found on alarm number 16.

Operation in Purge Mode:
The regulator can be adjusted through the User Setpoints screen by selecting “PNEUM REG SP” in the analog input dropdown, accessible from the **Configuration Menu => USER SETPOINTS** on the controller screen. The setpoint is input as a mA value, approximately linear value scaled from 4 to 20mA (0-110psig for high pressure systems and 0-30psig for LVP systems). For automated purge routines, this setpoint must be kept within the high and low purge alarm values. The recommended purge pressure setting is 80-90 psig for typical compressed gas systems. The factory pneumatic regulator setting provides a purge gas setpoint of approximately 70-75 psig for the low-pressure purge gas supply downstream of the regulator. For low vapor pressure systems (LVP), the factory settings should supply downstream pressure of about 25-30 psig. Adjustment may be required on site.

PURGE SETTING on HIGH PRESSURE SYSTEMS

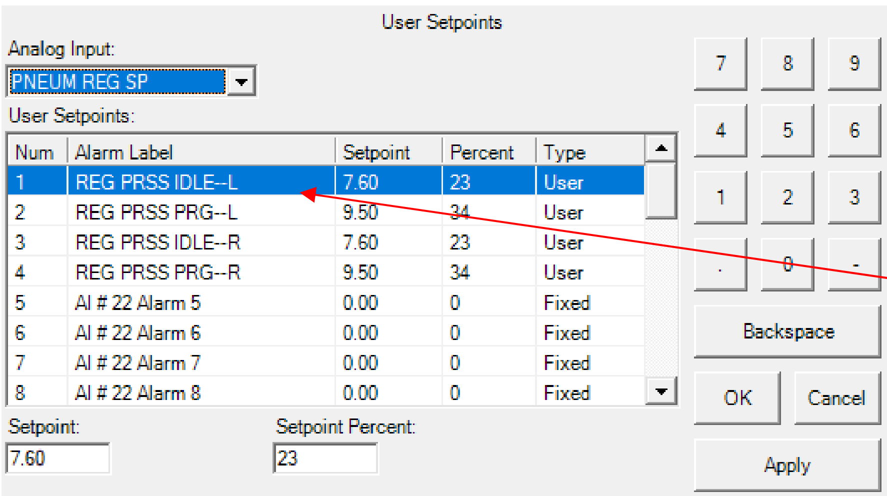


CAUTION

Be careful to select the correct Analog Input and Alarm Setpoint. “-IDLE” alarm setpoints are dedicated to manual mode operation and process standby. “- PRG” alarm setpoints control the pressure setting for automated purge modes.

Operation in Idle/Manual Mode:

The regulator can be adjusted for operation in "IDLE MODE" or "MANUAL MODE". The setpoint is input as a mA value, approximately linear value scaled from 4 to 20mA (0-110psig for high pressure systems and 0-30psig for LVP systems). The output of the regulator can be estimated from the charts on the following pages. The final output pressure is a function of inlet pressure, control pressure, and flow rate. It is not necessary or recommended to adjust this setpoint under normal operation. Please retain and return to factory settings prior to initiating process gas flow. The left-side and right-side regulators have their own dedicated analog listed in the analog Input dropdown. The factory pneumatic regulator setting provides a process gas setpoint of approximately 45 psig for a full process cylinder of high pressure compressed gas. The factory idle setpoint for LVP gases will be close to the cylinder pressure. Adjustments may be required on site.

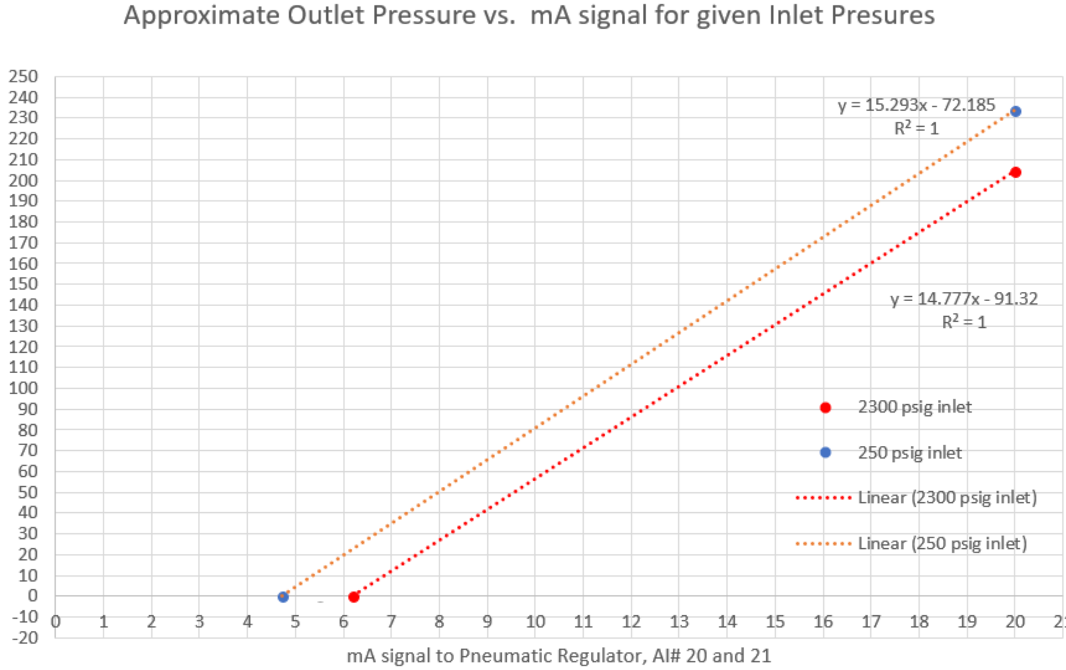


MANUAL MODE SETTING

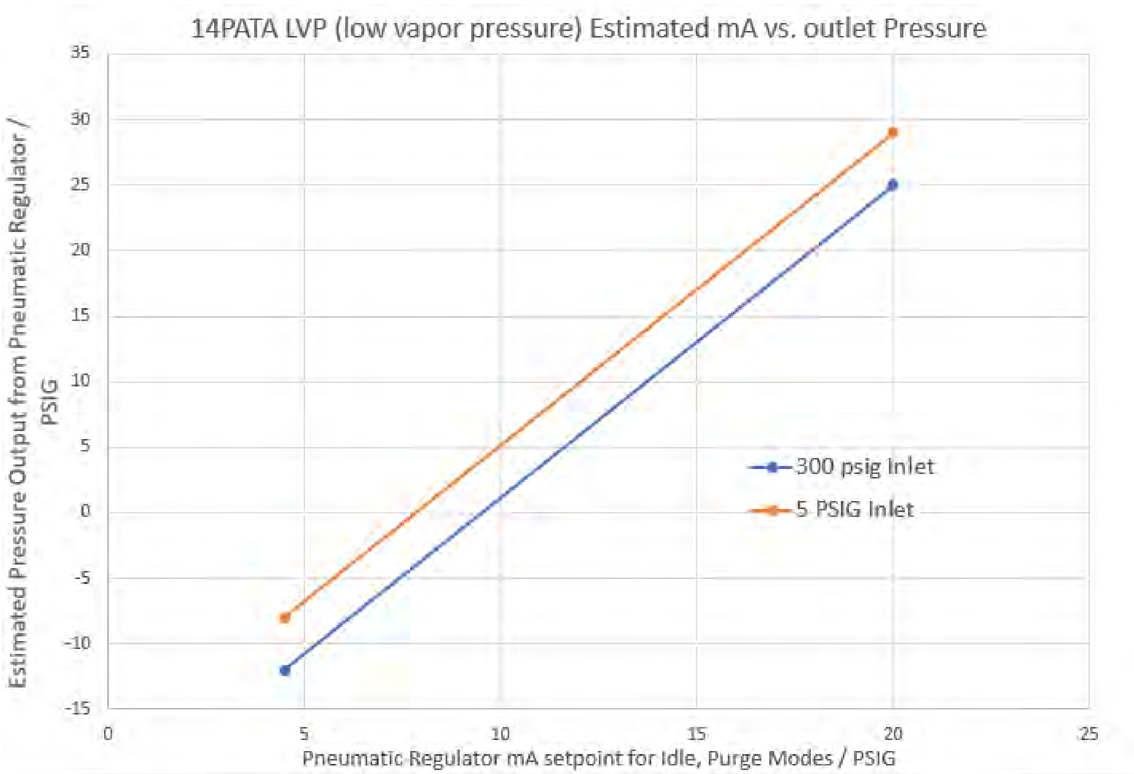
⚠CAUTION

Be careful to select the correct Analog Input and Alarm Setpoint. "-IDLE" alarm setpoints are dedicated to manual mode operation and process standby. "- PRG" alarm setpoints control the pressure setting for automated purge modes.

Reference pressure chart below for **HIGH PRESSURE** Active Control systems (0-110psig control pressure). The inlet pressure refers to the pressure upstream of the process regulator in the gas panel. The outlet pressure is the approximate outlet pressure in the gas panel measured at PT2.



Reference pressure chart below for **LOW VAPOR PRESSURE (LVP)** Active Control systems (0-110psig control pressure). The inlet pressure refers to the pressure upstream of the process regulator in the gas panel. The outlet pressure is the approximate outlet pressure in the gas panel measured at PT2.

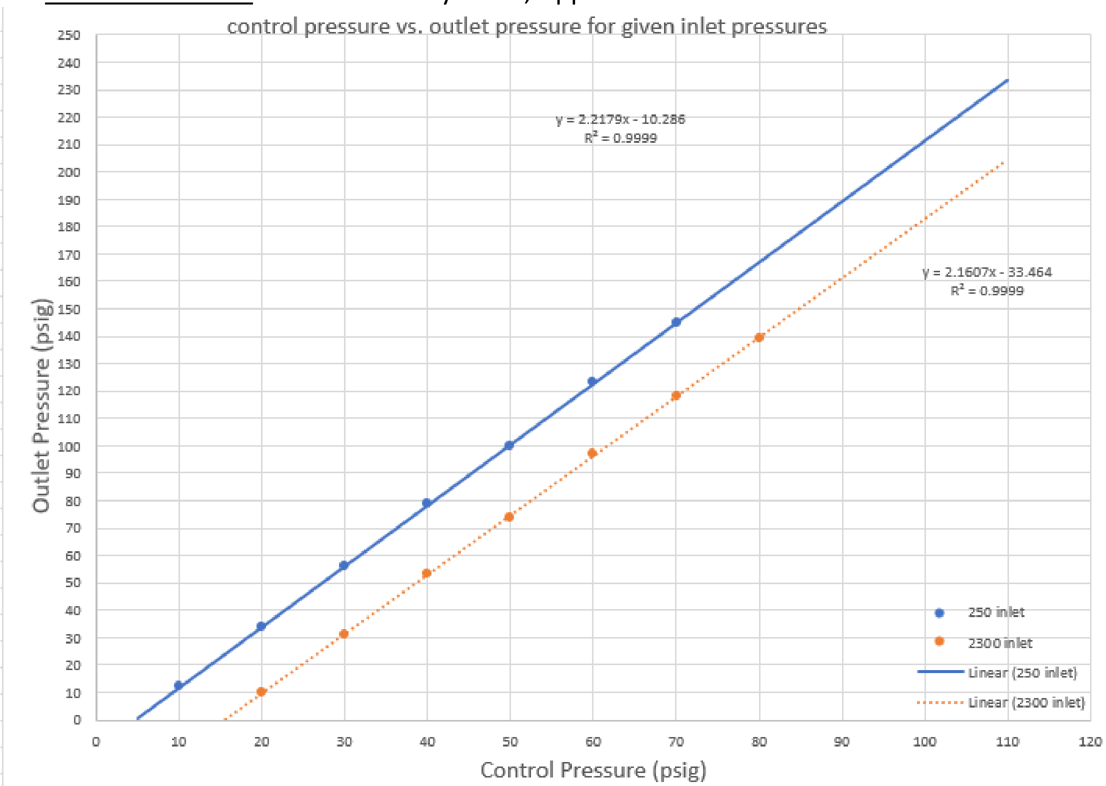


For reference and trouble shooting purposes, the following is an estimate of the pneumatic control pressure (supplied from AP11 internal regulator to dome of regulator) that is required to achieve a given outlet pressure for the process panel regulator. The control pressure applied to the regulator dome can be read through the test analog in screen A/I # 20 for the PNUEM REG – LEFT and A/I #22 PNUEM REG – RIGHT. Go to **Configuration menu => System Test => Test Analog In**

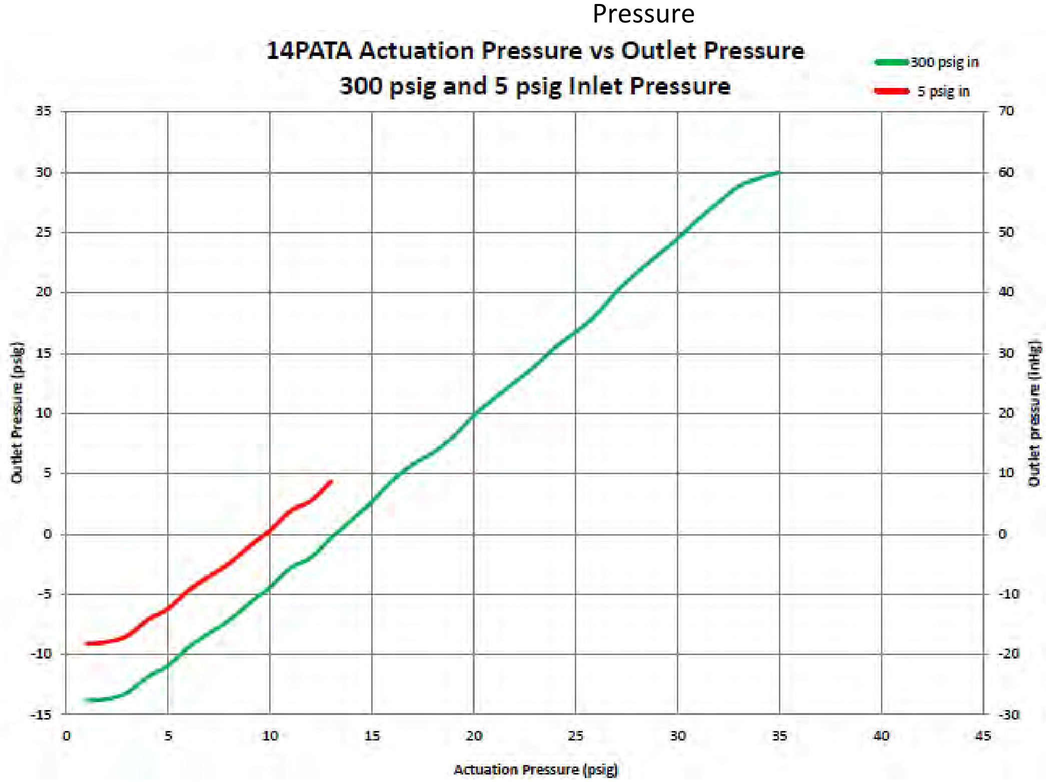
Test Analog In

Input	Label	Net	Gross	Raw	Hardwire	Connection Point
17	TCU L				N/A	Cust 1 - T1 - 4,5,6
18	TCU R				N/A	Cust 1 - T1 - 1,2,3
19	Analog 19				N/A	Cust 1 - T2 - 4,5,6
20	PNEUM REG-L		0.00 psig	0.00 mA	N/A	Cust 1 - T2 - 1,2,3
21	PNEUM REG-R		0.00 psig	0.00 mA	N/A	Cust 1 - T3 - 4,5,6

HIGH PRESSURE Active Control systems, Approximate Outlet Pressure as a function of Control Pressure



LOW VAPOR PRESSURE (LVP) Active Control systems, Approximate Outlet Pressure as a function of Control Pressure

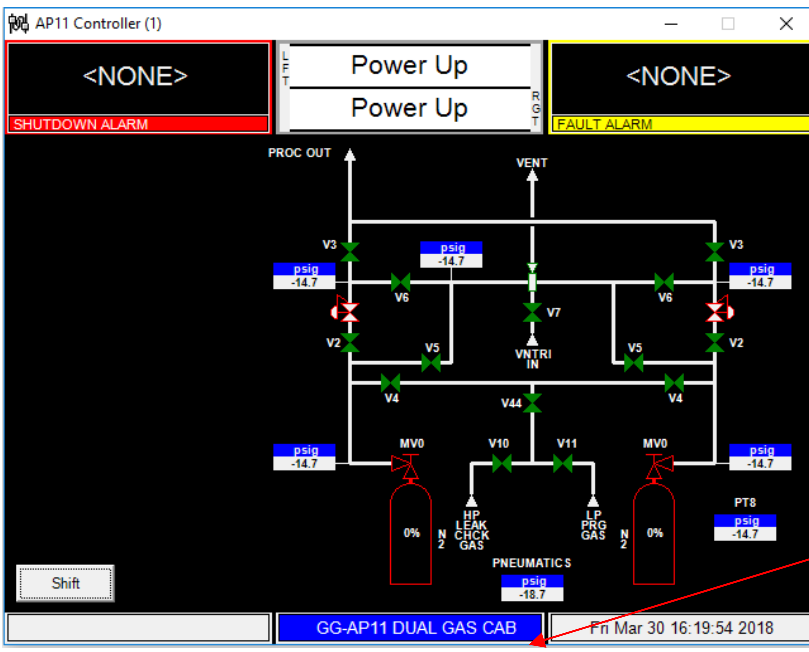


Section 4: Local Analog Trending

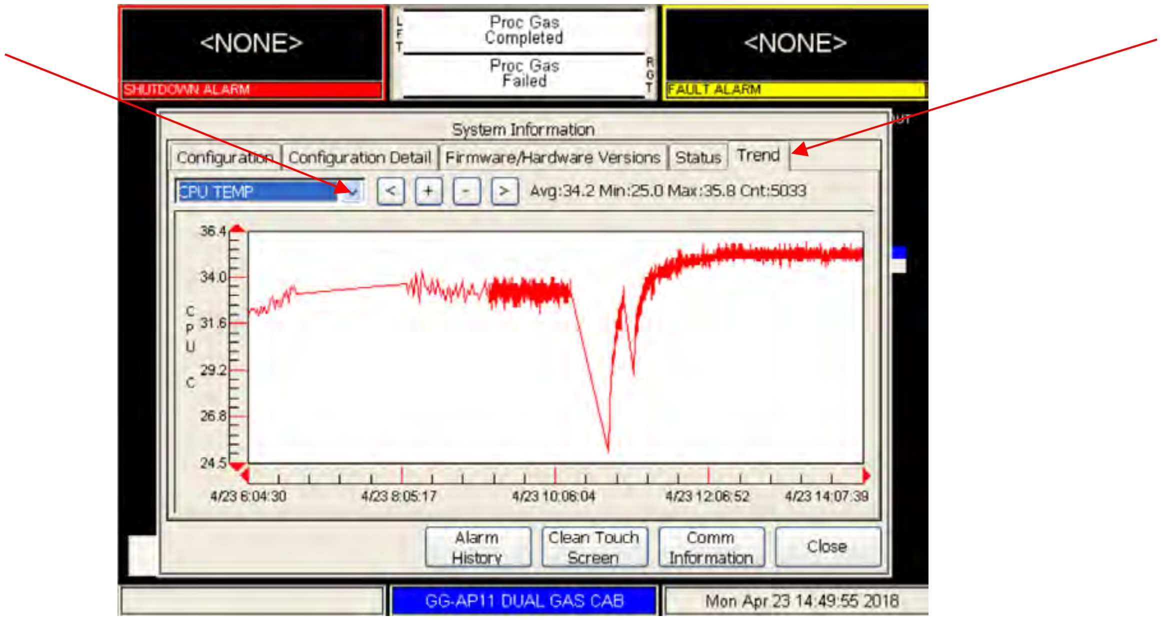
Program Operation:

The “Local Trending” software option provides the operator with analog history. This software option is available via license agreement with Versum Materials. This feature is only available while the programmed software license dongle is installed in the controller.

To view the local analog trend data, click on the blue “System information” bar at the bottom of the controller, then “Trend” tab.



System Information Tab



Trend TAB and Analog Dropdown

Upon selecting the Trend tab, an analog input can be selected from the upper left dropdown. Once selected, the trend graph will update with all available data up to 30 days. On the upper right, statistics are shown. The average, minimum, maximum and number of data points is displayed. This data is per the data shown in the window, so when an operator zooms in/out, scrolls left/right, the statistics will be updated per the data shown in the window.

An operator can zoom in/out and scroll left/right using the buttons at the top. An operator can also zoom in by dragging a box around the graph data to zoom in on. An operator can zoom in multiple times to see more data resolution. Once zoomed in, if the outside border of the trend graph is touched, a menu will appear. Select “Zoom Out” to zoom out one level or “Zoom Normal” to zoom out to the full data set. The red left/right (X/time axis) arrows can also be pressed to scroll left/right, but the larger left/right scroll buttons at the top are easier to press. The red Y axis arrows can also be used, but this access is automatically adjusted to the visible data set.

When zooming in using the "+" button, once an operator zooms in to a time span of less than 3 minutes, the trend graph changes to One Second Update Mode. During One Second Update Mode, the trend graph is automatically updated every second with the latest selected analog input value. The time span is fixed to the last 60 seconds, and all older data is purged from this view, so this view will constantly/automatically show the last 60 one second samples until the window automatically times out (due to user inactivity) and closes. During One Second Update Mode, the zoom in/out and scroll left/right buttons are disabled. To leave One Second Update Mode, reselect the same analog input or select a different analog input.

The trend data can be exported in addition to being read on the screen. The Excel ready CSV file is exported via a button below the trend graph. Note - the file is large. Allow approximately 1 minute (40 to 70 seconds) to export to a USB drive from the controller.

Associated Hardware:

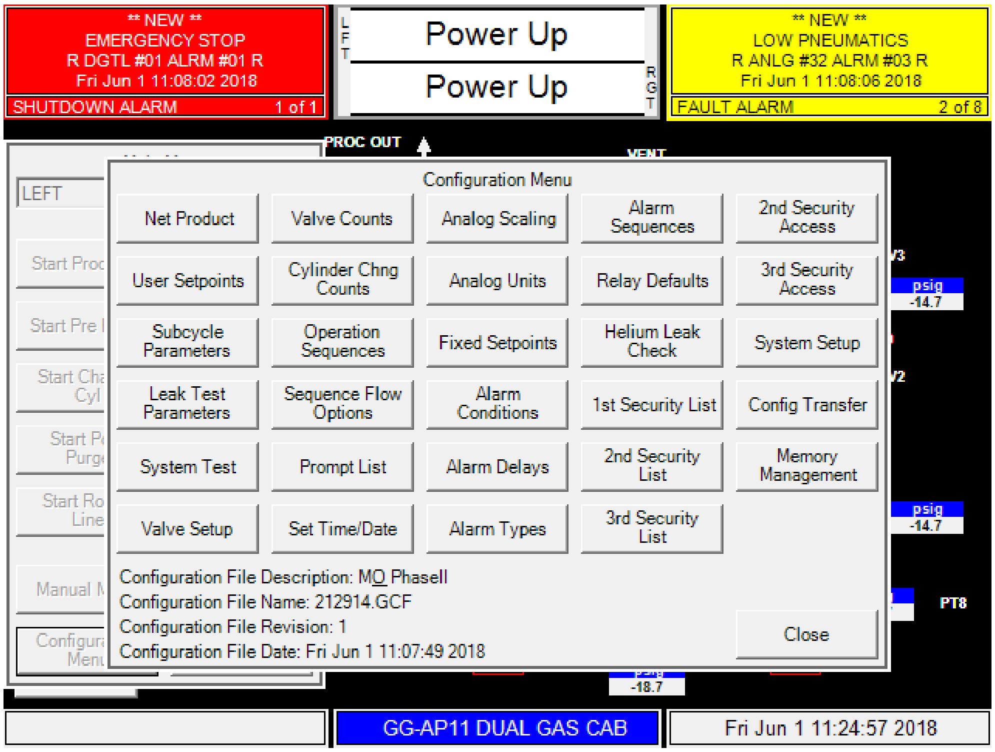
The analog trend feature is available with firmware 5.0 and greater. It is activated by installing a pre-programmed USB license key into any available AP11 controller USB port. It is recommended to install the USB key into one of the internal AP1565 Carrier board ports. This is so the device is protected, and the external USB port remains available for easy upgrades and downloads of process software. A controller reboot is not required to activate the licensed feature. A reboot, however, is required if installing a new firmware upgrade.

Reference Section 4.6 “USB Connection Port” of this operation manual before installing.

Figure: USB License Key

Section 5: Special Alarms for Active Pressure Control and other new features

This section describes the new analog user alarms that are not covered in the standard AP11 operating manual. The alarms are used to facilitate some unique features of the active control protocol and provide additional user functionality. In addition to the alarms mentioned below, Pressure Boost alarms are described in Section 6.



Crossover Alarms for Active Control AXO systems:
For **GASGUARD® Active Control Systems**, do not adjust the alarm delay on the following alarms. They are preset for optimum performance of the enhanced crossover logic. While the setpoint is user configurable, the alarm delay must be kept at **45 seconds.**

- PT1 - V LOW PROCESS CYL
- PT2 - V LOW PROCESS DEL
- SCALE - V LOW CYL WEIGHT

Special Alarms for Analog #'s 1 and 5: PT1 left and right:

PT1 alarms 11,12,13,15,17, and 18 are reserved for factory controlled setpoints. The alarms update automatically in response to user setpoint changes for delivery pressure and crossover alarm.

Special Alarms for Analog #2 and 6: PT2 left and right:

Num	Alarm Label	Brief Functional Description	Typical SP(psig) HP/LVP	Special Notes
11	V HI PROC DEL USER	This alarm can be used to lower the Overpressure process protection setpoint for a customer's downstream components	130 / 30	This alarm will be superseded by the FIXED V High Process Del alarm if the USER alarm is set higher than FIXED safety setpoint. This alarm is USER configurable
16	DELIVERY PRESS	This alarm sets the process delivery pressure.	75 / 5	Must be kept lower than V LOW PROCESS CYL for proper crossover operation. This alarm is USER configurable.
18	PT2 HIGH IDLE	This alarm provides overpressure protection during purge modes and idle status.	130 / 75 psig	Typically set to PT2 V High Pressure alarm. This alarm is FIXED and is not user configurable.

Note: PT2 alarms 12 thru 15, 17, 19, and 20 are reserved for factory controlled setpoints. The alarms update automatically in response to user setpoint changes for delivery pressure and crossover alarm.

Special Alarms for Analog # 12, 15: PT9

Num	Alarm Label	Brief Functional Description	Typical Setpoint HP/LVP psig
1	LOW PRESSURE PT9	Used to indicate low delivery pressure to houseline	20 / 2 USER configurable
2	HIGH PRESSURE PT9	Used to protect components and downstream equipment from overpressure	100 psig / 30 USER configurable
3	V HIGH PRESSURE PT9	Used to protect components and downstream equipment from overpressure	130 psig / 75 psig FIXED

Note: PT9 Alarm #4 is reserved for a factory controlled setpoint. The alarm updates automatically in response to user setpoint changes for delivery pressure and crossover alarm.

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SPECIAL HARDWIRE ALARM(s):

Hardwire Shutdown AI#2 and Hardwire Shutdown AI#6 – These alarms are configured at the factory by setting a potentiometer on the panel board. They provide increased reliability via hardwire alarm for overpressure protection of the downstream components. It is an independent, redundant alarm to the software control and overpressure setpoint. The hardwire alarms are typically set to 140psig, for high pressure compressed gases, typically 30psig for C2H2 equipment and typically not used for low vapor pressure gases. Hardwire AI#2 is associated to the PT2 on the left-side panel. Hardwire AI#6 is associated to PT2 on the right-side panel.

The hardwire alarm causes all valves to be held in closed state until the alarm is resolved. To clear the alarm, it is recommended:

1. Verify atmosphere is non-hazardous (non-flammable atmosphere)
2. Verify system is in safe state by reviewing all alarms, environmental conditions and controller screen values.
3. Disconnect the associated device – i.e. PT2 left or PT2 right- from the interface box.
4. Use manual mode to vent high pressure from panel.
5. Exit manual mode
6. Re-connect the associated device.
7. Verify pressure reading is below alarm setting.
8. Continue trouble-shooting to determine cause of excess pressure alarm or escalate to Versum field service.

SPECIAL NOTE: “Side not in Standby” Alarms (associated to Analogs 1,2,3,5,6,7):

It is recommended to set the “Side not in Standby” alarms setpoints are always set equal to the low or very low alarm setpoint on the same analog. For example, on PT1 the “Side not in Standby” would be equal to either the Low cylinder pressure or Very low Cylinder pressure alarm setpoint. These alarms apply only to automatic crossover systems. The alarm is used to warn the operator when a process cylinder is nearing end of life, but the standby side is not ready to take over. Setting the “side not in standby” setpoint to the “low” alarm setpoint typically provides a longer time period to react, but the alarm will not repeat when the “very low” setpoint is reached (not notified at the true crossover point).

The alarm labels appear as RgtSideNotInStdby and LeftSideNotInStdby on each analog.

SPECIAL NOTE: “V LOW PROCESS CYL” Alarms (associated to Analogs 1,5):

“V LOW PROCESS CYL” (Very Low Process Cylinder Pressure) must be set higher than the delivery pressure in order for the Active Control system to properly complete a crossover. If the V. Low Process Cyl alarm is set lower than the programmed process delivery pressure, the depleted process side may not shutdown. The stand-by panel will flow gas when the alarm is reached, but the depleted process side may hold open its valves until an operator intervenes. Product may backfill into the depleted panel and process cylinder for a short period of time. The backfill will stop when the pressure reaches equalizes to the delivery pressure setpoint. In that case, process valves will remain open on both sides until an operator intervenes.

Again, this condition can be avoided by ensuring that the process cylinder alarms are always set higher than the programmed delivery setpoint.

“Zero Flow Active” and Troubleshooting tips in Active Control Systems:

Whenever the system senses a no-flow condition, it will notify the operator by displaying a “**Zero Flow Active”** notification**.** During a no flow condition, the delivery pressure will be slightly increased, returning to the precise setpoint as flow resumes. A no-flow condition exists when the system is in process gas mode but the downstream equipment (i.e. tool, VMB) is not actively using product. During this time, gas is static in the houseline. The elevated pressure and notification are a normal response which enhances system performance as flow resumes.

Under a rare set of circumstances however, it is possible for the system to interpret a very low flow demand for a no flow condition. If **“Zero Flow Active”** notification is ever present during an actual flow demand and a slight increase in delivery pressure is noted, the pressure can be automatically reset to its precise setpoint with the following steps:

1. Log into Configuration menu
2. Navigate to => System Test => Test Internal Flag
3. Scroll to and highlight “Reset Zero Flow”
4. Set Apply
5. Exit screen
6. The system will automatically return to normal operation

Note: User access level 2 or greater is required to perform this function.

Section 6 Active Control with Pressure Boost

GASGUARD® Active Control features "Pressure Boost" technology which provides a supplementary flow increase for automatic crossover systems during occasional periods of high demand which exceed the source container's normal flow capacity.

Pressure Boost Logic

- Temporarily allows standby by cylinder to flow when source pressure of online cylinder is depleted due to excess demand.
- As standby cylinder is flowing, the online cylinder heats back up, replenishing the source pressure on that side of the cabinet
- When online cylinder regains enough pressure, the standby cylinder returns to idle mode
- Doubles duration of peak flow if flow rate is not also increased
- Eliminates 'early' low source pressure auto-crossovers from high flow demand
- Automatic protection from having both cylinders empty at the same time with user-defined weight setpoint for standby cylinder (pressure boost is unavailable when standby cylinder weight is below this setpoint)
- Automatic protection is also provided by a user defined timer, which limits the amount of time the boost routine will run during a single recovery period.
- "Boost" feature applies only to liquefied gases. It is not available for C2H2 or compressed gases.

The following user defined setpoints can be adjusted to optimize the boost routine for the customer's process:

> **AI#3 and AI#7 Alarm #7 - BOOST WT DELTA**: This alarm is the user-controlled weight value that is added to the low cylinder weight alarm to define the minimum cylinder weight required to run boost. In other words, the minimum stand-by weight required to run boost is =BOOST WT DELTA + LOW CYL weight. The variable can be set between 0 and the scale maximum value. It should be set high enough to always allow time for a cylinder change on the opposite side in case the primary side cannot recover. Default setting is 1 lb.
>
> **AI#1 and AI#5 Alarm #14 BOOST TIMER:** This alarm is the user-controlled time value, entered in **minutes**, that boost will run during a single recover period. Default setting is 60 minutes.

Note that for proper operation of pressure boost – and equally important for non-boosted product delivery – the operator must confirm that liquefied cylinders are positioned properly on scales with no interference that could prevent an accurate weight measurement as product is withdrawn. An inaccurate scale reading will not provide an accurate account of available product.

Analog alarms A/I#1-11, 12,13,15; A/I#5- 11, 12,13,15; A/I#2-14, 15, A/I#6 14, 15 and AI#3-8, AI#7-8 are reserved for factory controlled setpoints and cannot be changed. They will automatically adjust to delivery pressure and crossover alarm setpoint changes. Contact your Versum Materials representative for more information.

Appendix A

UHP Tubing and Fitting Specification

The Appendix contains the SEMC-QAF030 "UHP Tubing and Fitting Specification". Compressed Gas Association Technical Bulletins TB-9-1993 “Guidelines for the Proper Handling and use of the CGA 630/710 Series “Ultra High Integrity Service” Connections” and TB-4-1999 “Torque Guidelines for Sealing CGA Outlet Connections” are also included.

*S*emiconductor *E*quipment *M*anufacturing *C*enter

Quality Assurance Work Instruction: **UHP Tubing and Fitting Specification** Responsible Department: ***Quality***	Document No.: **QAF030** Revision: **A** Revision Date: **24 FEB 97** Page **1** of **6**

1.0 Purpose:

To establish the minimum requirements for materials, dimensional tolerances, surface finishing, cleaning, testing, inspection, certification, and packaging for stainless steel tube and fittings used in ultra high purity applications.

2.0 Scope:

This specification shall apply to all tubing and fittings purchased for use in all ultra high purity piping installations for the electronics industry.

3.0 Responsibility:

3.1 The Materials Management group of SEMC is responsible for communicating this requirement to its vendors and ensuring their full compliance.

3.2 The vendor shall review and respond to this specification on a line by line basis confirming acceptance or exceptions to each requirement.

3.3 The vendor shall provide any additional steps above and beyond the requirements of this specification for review.

4.0 Definitions: (None)

5.0 References:

5.1 Electronics Engineering Worldwide Standard EES 005, 0.250" and 0.375' UHP and HP Tubing and Fittings.

5.2 ASTM A269 - Specification for seamless and welded austenitic stainless steel tubes for general service.

5.3 ASTM A479 - Specification for general requirements for carbon, ferritic alloy, and austenitic alloy steel bar.

5.4 ASTM A632 - Specification for seamless and welded austenitic stainless steel tubing (small diameter for general service).

5.5 ANSI/ASME B46.1 - 1985 - Specification for surface texture-surface roughness, waviness, and lay.

6.0 Procedure:

6.1 General Requirements

6.1.1 All tube and bar stock shall be produced from ASTM grade TP316L raw material unless specified in the purchase order. Tubing sized smaller than 3" shall be seamless and larger than 3" may be welded.

6.1.2 Stainless steel tubing shall be bright annealed at the producing mill in a dry hydrogen atmosphere (dewpoint <-40°C) or vacuum annealed (10 micron Hg) to a Rockwell Rb 90 maximum hardness.

6.1.3 The sulfur content of fittings and tubing shall be in the range of 0.005-0.017 percent; type 316L VAR and VIM\VAR a maximum of 0.005%. VAR or VIM/VAR will be specified in the purchase order. This range is an actual range and does not allow for rounding of numbers as set forth in ASTM A269.

6.1.4 Tubing shall conform to the requirements of ASTM A269 for sizes one-half inch diameter and larger and ASTM A632 for sizes smaller than one-half inch, except where specified differently within this specification.

6.1.5 Bar stock shall conform to the requirements of ASTM A479, except where specified differently within this specification.

6.2 Dimensional Tolerance Requirements:

6.2.1 End connections on tubing and fittings shall be faced and squared to plus or minus one-half degree for sizes 1/4" through 3/4" inclusive. Squareness of 1" and larger shall be +.006". All ends shall be fully prepped and suitable for installation with automatic orbital welding equipment.

6.2.2 Acceptable dimensional tolerances shall not exceed the limits listed below:

Dimension	Component	Tolerance
Linear	Fittings	+- .015"
Angular	Fittings	+- 1/2 degree
Wall Thickness	Tube and Fittings (including saddle area of tees)	+- 10%

<u>Outside Diameter; Tube and Fittings</u>

1/4" up to not including 1/2", +0.004"/-0.000";
1/2" to not including 1-1/2", +- 0.005";
1-1/2" up to not including 3-1/2", +- 0.010";
3-1/2" up to and including 4"; +- 0.015"

6.3 Interior Surface Finish Requirements:

6.3.1 The interior surface of each tube and fitting shall be electropolished to a microinch surface roughness standard of 7 Ra microinch average (10 Ra maximum).

6.4 Gases and Deionized Water for Drying, Cleaning, Testing:

6.4.1 Argon or nitrogen used for drying and packaging shall be supplied from a liquid source and have the following point of use quality:

Minimum purity:	99.998 percent
Moisture:	Less than 1 ppm
Oxygen:	Less than 3 ppm
Total Hydrocarbons:	Less than 1 ppm

Filtered to no more than 10 particles per scf larger than 0.02 microns at point of use.

6.4.2 Deionized water used for cleaning shall have the following minimum point of use requirements and be verified on a monthly basis by an independent laboratory:

Resistivity: 18 megohm centimeters @ 25°C minimum
Total Organic Carbon: Less than 50 ppb
Viable Bacteria Colonies: Less than or equal to ten/100 milliliters
Filtered to: 0.1 microns at point of use

DI water purity shall conform to the guidelines set forth be SEMI.

6.5 Tube Cleaning:

6.5.1 After electropolishing, tubing shall be final cleaned with deionized water as a final cleaning agent and dried with filtered nitrogen. Freon shall not be used as a cleaning agent.

6.5.2 Final cleaning of tubing shall be performed under Class 100 clean room conditions.

6.5.3 Tube washing shall utilize heated DI water (60°C, minimum). The tube shall be flushed with heated DI water until the resistivity of the effluent measures at least 17.5 Megohm-cm for diameters less than 3 inches and 17.0 megohm-cm for diameters greater than or equal to 3 inches.

6.5.4 The tube shall be blown dry with heated nitrogen gas

6.6 Fittings Cleaning

6.6.1 Final cleaning of fittings shall be performed under Class 100 environment.

6.6.2 Fittings shall be flushed with heated DI water (60^{o}C) minimum.

6.6.3 Fittings shall be blown dry with heated nitrogen gas

6.7 Packaging:

6.7.1 Tubing ends shall be sealed with polyethylene caps pressed over polyamide nylon squares (1.75 mil) after being purged with nitrogen. Polyethylene bags (6 mil) shall then be placed over each end and taped to the tube a minimum of 3" from the end of the tube, using clean room tape. The entire tube shall then be closed in a 6 mil polyethylene bag and heat sealed at both ends.

6.7.2 Fitting ends shall be packaged in a heat sealed nylon bag with a heat sealed polyethylene bag over the nylon bag in a Class 100 environment.

6.7.3 Pack and ship to prevent damage to double bagging, tubing, and fittings.

6.7.4 Finished components shall be mill and heat traceable and permanently marked for correspondence to the applicable mill test reports.

6.8 Inspection and Testing:

6.8.1 All tests and inspections required in this section shall be performed for each order unless otherwise stated in the purchase order. The vendor shall provide a detailed procedure for each test required in Sections 6.9.1.2 - 6.9.1.10 for VERSUM MATERIALS, INC. review and acceptance.

6.8.2 One hundred percent (100%) of components shall be visually inspected to assure that interior surfaces exhibit no macroscopic pitting, staining, or discoloration as can be detected with the unaided eye.

6.8.3 A statistically valid sample of tubes and fittings shall be measured with calipers and/or micrometers or by other repeatable methods to verify conformance to the critical dimensional requirements and monitor process control. Critical dimensions will be identified in the purchase order. Statistical procedures must be submitted to VERSUM MATERIALS, INC. for review and approval prior to receipt of material.

6.8.4 All welded fittings shall be inboard helium leak tested to a 1 x 10^{-9} atm cc/sec gaseous helium with a mass spectrometer leak detector.

6.8.5 Finished tube and fittings in each lot shall be measured for interior surface finish with a stylus type measuring device in accordance with ASME B46.1 - 1985. Surface roughness shall be measured at three locations for each piece tested. Sample quantity for tubing shall be 10% of tube ends and 1% of middle sections. Sample quantity for fittings shall be 10% of fitting ends. The average of the readings shall not exceed 7 microinch Ra with no single reading above 10 microinch Ra. Sampling length cutoff shall be 0.030" and traverse length will be 0.150".

6.8.6 Scanning electron microscopy (SEM) photographs of finished component surfaces shall be analyzed for each machining, honing, polishing, or electropolishing process change or supply of material other than stainless steel. SEM analysis shall verify that no more than 40 defects shall be distinguishable in a 3600X field of view. A sample shall be taken from the middle of the tube or fitting. The test method shall conform to SEMATECH standard 90120401A-STD.

6.8.7 Chemistry analysis (ESCA) of electropolished surfaces shall be performed for each electropolishing process change to verify surface elemental composition. Elemental composition shall be expressed in atomic percent units and shall verify chromium to iron ratio of 1.5:1 and a minimum chromium oxide to iron oxide ratio of 3:1 for stainless steel.

6.8.8 Moisture testing shall be performed on one length of cleaned and packaged tube from each heat for each size (O.D. and nominal wall thickness). Testing shall verify the addition of less than 1 ppm moisture to nitrogen gas as described in Section 8.1 of this specification while flowing N_2 gas at a flow not to exceed 10ÿSCFH/IN2.

6.8.9 Particle testing shall be performed on one length of cleaned and packaged tube from each size (O.D. and nominal wall thickness). Testing shall verify that particle counts be no more than 10 per cubic foot of size greater than or equal to 0.1 microns and zero particles of size 0.3 microns or larger while flowing nitrogen gas at a velocity of 133 ft/sec.

6.8.10 A weld test shall be performed for each heat and lot number of material that is used. Weld tests on fittings can be avoided by completing this requirement on the tube that will be used to make the fitting. The test welds shall be made per Semiconductor Equipment Manufacturer Center specification, QAF020. Weld test shall be deemed acceptable if no internal discoloration of the weld is visible. Samples can be developed between VERSUM MATERIALS, INC. and the tube vendor to judge acceptable welds.

6.8.11 A Rockwell hardness test shall be performed on each mill heat of material to assure a Rockwell Rb 90 maximum hardness. This test shall be performed for each size after "pulling".

6.8.12 VERSUM MATERIALS, INC. reserves the right to source inspect all tubing and fittings and inspect the manufacturer’s facilities upon request.

6.9 Reports and Certifications:

6.9.1 The vendor shall supply the following reports and certifications as follows:

6.9.1.1 One set of reports shall be sent to SEMC QA prior to receipt of material at SEMC. The components will be cross referenced to the received reports for acceptable vendor traceability numbers.

6.9.1.2 Mill Test Reports

6.9.1.3 Certificate of compliance to the specifications within this document. Reference to pre-approved exceptions to this Work Instruction.

Appendix B

N2 MSDS

This Appendix contains the Nitrogen (N2) Material Safety Data Sheet.

Safety Data Sheet

Version 1.10 SDS Number 300000000099

Revision Date 01/26/2015 Print Date 06/24/2016

1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	
Chemical formula	:	N2
Synonyms	:	Nitrogen, Nitrogen gas, Gaseous Nitrogen, GAN
Product Use Description	:	General Industrial
Manufacturer/Importer/Distributor	:	IDES Holding AG , Postfach 16 05 29, D-60070 Frankfurt/M &ULINE(35)&
Telephone	:	
Emergency telephone number (24h)	:	1-800-424-9300 (CHEMTREC) and (+1) 703-741-5970 (CHEMTREC)

2. HAZARDS IDENTIFICATION

GHS classification

Gases under pressure - Simple Asphyxiant Compressed gas.

GHS label elements

Hazard pictograms/symbols

Signal Word: Warning

Hazard Statements:

H280:Contains gas under pressure; may explode if heated.
May displace oxygen and cause rapid suffocation.

Precautionary Statements:

Storage : P410+P403:Protect from sunlight. Store in a well-ventilated place.

Hazards not otherwise classified

High pressure gas.
Can cause rapid suffocation.
Self contained breathing apparatus (SCBA) may be required.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Components	CAS Number	Concentration (Volume)
Nitrogen	7727-37-9	100 %

Concentration is nominal. For the exact product composition, please refer to technical specifications.

4. FIRST AID MEASURES

General advice : Remove victim to uncontaminated area wearing self contained breathing apparatus. Keep victim warm and rested. Call a doctor. Apply artificial respiration if breathing stopped.

Eye contact : Not applicable.

Skin contact : Not applicable.

Ingestion : Ingestion is not considered a potential route of exposure.

Inhalation : Remove to fresh air. If breathing has stopped or is labored, give assisted respirations. Supplemental oxygen may be indicated. If the heart has stopped, trained personnel should begin cardiopulmonary resuscitation immediately. In case of shortness of breath, give oxygen.

Most important symptoms/effects - acuate and delayed : Exposure to oxygen deficient atmosphere may cause the following symptoms: Dizziness. Salivation. Nausea. Vomiting. Loss of mobility/consciousness.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media : All known extinguishing media can be used.

Specific hazards : Upon exposure to intense heat or flame, cylinder will vent rapidly and or rupture violently. Product is nonflammable and does not support combustion. Move away from container and cool with water from a protected position. Keep containers and surroundings cool with water spray. Most cylinders are designed to vent contents when exposed to elevated temperatures.

Special protective equipment : Wear self contained breathing apparatus for fire fighting if necessary.

for fire-fighters

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment, and Emergency Procedures	: Evacuate personnel to safe areas. Wear self-contained breathing apparatus when entering area unless atmosphere is proved to be safe. Monitor oxygen level. Ventilate the area.
Environmental precautions	: Do not discharge into any place where its accumulation could be dangerous. Prevent further leakage or spillage if safe to do so.
Methods for cleaning up	: Ventilate the area.
Additional advice	: If possible, stop flow of product. Increase ventilation to the release area and monitor oxygen level. If leak is from cylinder or cylinder valve, call the Air Products emergency telephone number. If the leak is in the user's system, close the cylinder valve and safely vent the pressure before attempting repairs.

7. HANDLING AND STORAGE

Handling

Protect cylinders from physical damage; do not drag, roll, slide or drop. Do not allow storage area temperature to exceed 50°C (122°F). Only experienced and properly instructed persons should handle compressed gases/cryogenic liquids. Before using the product, determine its identity by reading the label. Know and understand the properties and hazards of the product before use. When doubt exists as to the correct handling procedure for a particular gas, contact the supplier. Do not remove or deface labels provided by the supplier for the identification of the cylinder contents. When moving cylinders, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport cylinders. Leave valve protection caps in place until the container has been secured against either a wall or bench or placed in a container stand and is ready for use. Use an adjustable strap wrench to remove over-tight or rusted caps. Before connecting the container, check the complete gas system for suitability, particularly for pressure rating and materials. Before connecting the container for use, ensure that back feed from the system into the container is prevented. Ensure the complete gas system is compatible for pressure rating and materials of construction. Ensure the complete gas system has been checked for leaks before use. Employ suitable pressure regulating devices on all containers when the gas is being emitted to systems with lower pressure rating than that of the container. Never insert an object (e.g. wrench, screwdriver, pry bar, etc.) into valve cap openings. Doing so may damage valve, causing a leak to occur. Open valve slowly. If user experiences any difficulty operating cylinder valve discontinue use and contact supplier. Close container valve after each use and when empty, even if still connected to equipment. Never attempt to repair or modify container valves or safety relief devices. Damaged valves should be reported immediately to the supplier. Close valve after each use and when empty. Replace outlet caps or plugs and container caps as soon as container is disconnected from equipment. Do not subject containers to abnormal mechanical shock. Never attempt to lift a cylinder by its valve protection cap or guard. Do not use containers as rollers or supports or for any other purpose than to contain the gas as supplied. Never strike an arc on a compressed gas cylinder or make a cylinder a part of an electrical circuit. Do not smoke while handling product or cylinders. Never re-compress a gas or a gas mixture without first consulting the supplier. Never attempt to transfer gases from one cylinder/container to another. Always use backflow protective device in piping. When returning cylinder install valve outlet cap or plug leak tight. Never use direct flame or electrical heating devices to raise the pressure of a container. Containers should not be subjected to temperatures above 50°C (122°F).

Storage

Open/close valve slowly. Close when not in use. Wear Safety Eye Protection. Check Safety Data Sheet before use. Use a back flow preventative device in the piping. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Read and follow the Safety Data Sheet (SDS) before use. Full containers should be stored so that oldest s tock is used first. Containers should be stored in a purpose build compound which should be well ventilated, preferably in the open air. Stored containers should be periodically checked for general condition and leakage. Observe all regulations and local requirements regarding storage of containers. Protect containers stored in the open against rusting and extremes of weather. Containers should not be stored in conditions likely to encourage corrosion. Containers should be stored in the vertical position and properly secured to prevent toppling. The container valves should be tightly closed and where appropriate valve outlets should be capped or plugged. Container valve guards or caps should be in place. Keep containers tightly closed in a cool, well-ventilated place. Store containers in location free from fire risk and away from sources of heat and ignition. Full and empty cylinders should be segregated. Do not allow storage temperature to exceed 50°C (122°F). Return empty containers in a timely manner.

Technical measures/Precautions

Containers should be segregated in the storage area according to the various categories (e.g. flammable, toxic, etc.) and in accordance whit local regulations. Keep away from combustible material.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering measures

Provide natural or mechanical ventilation to prevent oxygen deficient atmospheres below 19.5% oxygen.

Personal protective equipment

Respiratory protection	:	Self contained breathing apparatus (SCBA) or positive pressure airline with mask are to be used in oxygen-deficient atmosphere. Air purifying respirators will not provide protection. Users of breathing apparatus must be trained.
Hand protection	:	Wear working gloves when handling gas containers. Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.
Eye protection	:	Safety glasses recommended when handling cylinders.
Skin and body protection	:	Safety shoes are recommended when handling cylinders.
Special instructions for protection and hygiene	:	Ensure adequate ventilation, especially in confined areas.
Remarks	:	Simple asphyxiant.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Compressed gas. Colorless gas
Odor	:	No odor warning properties.
Odor threshold	:	No data available.
pH	:	Not applicable.
Melting point/range	:	-346 °F (-210 °C)
Boiling point/range	:	-321 °F (-196 °C)
Flash point	:	Not applicable.
Evaporation rate	:	Not applicable.
Flammability (solid, gas)	:	Refer to product classification in Section 2
Upper/lower explosion/flammability limit	:	No data available.
Vapor pressure	:	Not applicable.
Water solubility	:	0.02 g/l
Relative vapor density	:	0.97 (air = 1) Lighter or similar to air.
Relative density	:	No data available.
Partition coefficient (n-octanol/water)	:	Not applicable.
Auto-ignition temperature	:	No data available.
Decomposition temperature	:	No data available.
Viscosity	:	Not applicable.
Molecular Weight	:	28 g/mol
Density	:	0.075 lb/ft3 (0.0012 g/cm3) at 70 °F (21 °C) Note: (as vapor)
Specific Volume	:	13.80 ft3/lb (0.8615 m3/kg) at 70 °F (21 °C)

10. STABILITY AND REACTIVITY

Chemical Stability	: Stable under normal conditions.
Conditions to avoid	: No data available.
Materials to avoid	: No data available.
Hazardous decomposition products	: No data available.
Possibility of hazardous Reactions/Reactivity	: No data available.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Likely routes of exposure

Effects on Eye	: No adverse effect.
Effects on Skin	: No adverse effect.
Inhalation Effects	: In high concentrations may cause asphyxiation. Asphyxiation may bring about unconsciousness without warning and so rapidly that victim may be unable to protect themselves.
Ingestion Effects	: Ingestion is not considered a potential route of exposure.
Symptoms	: Exposure to oxygen deficient atmosphere may cause the following symptoms: Dizziness. Salivation. Nausea. Vomiting. Loss of mobility/consciousness.

Acute toxicity

Acute Oral Toxicity	: No data is available on the product itself.
Inhalation	: No data is available on the product itself.
Acute Dermal Toxicity	: No data is available on the product itself.
Skin corrosion/irritation	: No data available.
Serious eye damage/eye irritation	: No data available.
Sensitization.	: No data available.

Chronic toxicity or effects from long term exposures

Carcinogenicity	: No data available.
Reproductive toxicity	: No data is available on the product itself.

Germ cell mutagenicity	:	No data is available on the product itself.
Specific target organ systemic toxicity (single exposure)	:	No data available.
Specific target organ systemic toxicity (repeated exposure)	:	No data available.
Aspiration hazard	:	No data available.

Delayed and Immediate Effects and Chronic Effects from Short and Long Term Exposure

Not applicable.

12. ECOLOGICAL INFORMATION

Ecotoxicity effects

Aquatic toxicity	:	No data is available on the product itself.
Toxicity to other organisms	:	No data available.

Persistence and degradability

Biodegradability	:	No data is available on the product itself.
Mobility	:	No data available.
Bioaccumulation	:	No data is available on the product itself.

Further information

No ecological damage caused by this product.

13. DISPOSAL CONSIDERATIONS

Waste from residues / unused products	:	Contact supplier if guidance is required. Return unused product in original cylinder to supplier.
Contaminated packaging	:	Return cylinder to supplier.

14. TRANSPORT INFORMATION

DOT

UN/ID No.	:	UN1066
Proper shipping name	:	Nitrogen, compressed

Class or Division	:	2.2
Label(s)	:	2.2
Marine Pollutant	:	No

IATA

UN/ID No.	:	UN1066
Proper shipping name	:	Nitrogen, compressed
Class or Division	:	2.2
Label(s)	:	2.2
Marine Pollutant	:	No

IMDG

UN/ID No.	:	UN1066
Proper shipping name	:	NITROGEN, COMPRESSED
Class or Division	:	2.2
Label(s)	:	2.2
Marine Pollutant	:	No

TDG

UN/ID No.	:	UN1066
Proper shipping name	:	NITROGEN, COMPRESSED
Class or Division	:	2.2
Label(s)	:	2.2
Marine Pollutant	:	No

Further Information

Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency. The transportation information is not intended to convey all specific regulatory data relating to this material. For complete transportation information, contact a Versum Materials customer service representative.

15. REGULATORY INFORMATION

Toxic Substance Control Act (TSCA) 12(b) Component(s):

None.

Country	Regulatory list	Notification
USA	TSCA	Included on Inventory.
EU	EINECS	Included on Inventory.
Canada	DSL	Included on Inventory.
Australia	AICS	Included on Inventory.
South Korea	ECL	Included on Inventory.
China	SEPA	Included on Inventory.
Philippines	PICCS	Included on Inventory.
Japan	ENCS	Included on Inventory.

EPA SARA Title III Section 312 (40 CFR 370) Hazard Classification
Sudden Release of Pressure Hazard.

US. California Safe Drinking Water & Toxic Enforcement Act (Proposition 65)
This product does not contain any chemicals known to State of California to cause cancer, birth defects or any other harm.

Appendix C

PED Assessment

PED Assessment

in accordance with the Pressure Equipment Directive 97/23/EC

Versum Materials, Inc., Kanaalweg 15, P.O. Box 3193, 3502 GD Utrecht, Netherlands

Equipment Description: **GASGUARD® UHP Delivery Systems**

Fluid state:	All
Fluid group:	All
Design Pressure:	All
Piping nominal size (DN):	Less than DN25 [Less than one inch nominal diameter]
Classification according to Table 7:	SEP

This equipment has been classified as SEP in accordance with Article 3, Section 1.3 of the Pressure Equipment Directive 97/23/EC on the basis that all components contained herein are less than DN25. The equipment has been designed and manufactured following 'Sound Engineering Practice' and Versum Materials' Engineering Standards. Instructions for its safe use and installation are documented in the accompanying Operation and Installation Manual.

Appendix D

Supplemental Information for GASGUARD® Acetylene (C2H2) Source System

Section 1: Special Operating Instructions

1.1 Process Regulator

1.1.1 Warning! Do not set process regulator above 15 psig. Acetylene may spontaneously decompose (explode) at pressures exceeding 15 psig.

1.1.2 Process regulators are located on the pigtail instead of the process panel so that pressure is regulated < 15 psig throughout entire system. The process regulators will not be displayed on the controller screen.

1.2 Purging

1.2.1 Warning! Always evacuate acetylene from process panel and piping before introducing purge gas. Acetylene may explode if pressurized above 15 psig.

1.2.2 Warning! Never exceed 10 psig purge regulator setting or purge inlet pressure. Residual acetylene may be compressed to a dangerous level if pressure exceeds 15 psig. Maximum purge pressure should not to exceed 10psig.

1.2.3 Caution: Do not pressurize downstream piping beyond outlet setting of regulator. This will damage process regulator seat and prevent backflow through process regulator to the CGA connection. High purge pressure can also cause ‘low purge’ alarms on automated systems because there is no backflow.

1.2.4 Do not install trickle purge gasket or trickle purge valve in the purge line. Due to the very low purge pressure, full flow is required to provide adequate backflow protection in an open pigtail. In addition, trickle purge gasket will cause auto-purge systems to ‘time out’ and shutdown on low purge pressure alarm due to reduced purge flow rate.

1.3 Determining Product Contents

1.3.1 Cylinder scales are recommended. Under normal operating conditions, pressure measurement may not be an accurate indication of remaining product. The cylinder pressure (PT1 reading) of dissolved acetylene is more significantly affected by ambient temperature changes and product flow rates than a typical compressed gas.

1.3.2 Where scales are not available, a combination of temperature and pressure readings must be used to determine the remaining cylinder contents. It is necessary to shutoff all flow and confirm that cylinder contents have been stabilized at 70°F before relying on the pressure reading alone.

Section 2: Maximum System Flow Rates

2.1 Maximum system flow should be limited in order to prevent acetone from being withdrawn from the source cylinder and contaminating the delivered product. The maximum recommended flow rate is 1/15th of the cylinder contents on a continuous basis, and 1/10th of the cylinder contents for peak flows. For typical cylinders, these rates are:

A-size cylinder:	Peak flow = 16.5 slpm Sustained Flow = 11 slpm
C-size cylinder:	Peak flow = 3.4 slpm Sustained Flow = 2.3 slpm

Section 3: System Options

3.1 Purge Inlet Regulator: On some systems, an optional regulator may have been installed on the purge inlet line. This regulator can be used to reduce incoming purge pressure coming from a shared house line.

3.2 Excess Flow Switch (EFS): Although an EFS is not a safety requirement for acetylene, an EFS can be used to warn when flows exceed the recommended limit and present a risk for acetone contamination. When an EFS is selected, the alarm will be configured as a fault (standard EFS alarms is a shutdown for other gas types). The recommended EFS float sizes are:

A-size cylinder = 7132
C-size cylinder = D-float

3.3 Trickle purge Gasket: Not permitted in purge inlet line for auto-purge systems. Refer to Section 1.2.4.

3.4 Scales: Scales are recommended to determine remaining contents in cylinder. Process cylinder pressure readings are significantly affected by temperature changes and product withdrawal rates.

3.5 Conditioning Cycle: The conditioning cycle is designed to help remove impurities and residual purge gas after a cylinder change. To account for the lower purge pressure, acetylene systems are pre-programmed with two of these conditioning cycles as a standard. During the initial process gas phase, the conditioning cycle will fill the piping with process gas and automatically vent the initial charge instead of sending it downstream to the tool. The number of conditioning cycles may be adjusted on site through the face of the controller. If no cycles are desired, the value can be set to zero.

Section 4: Further Safety Information

4.1 Safetygram

Acetylene

General

Pure acetylene is a colorless, highly flammable gas with an agreeable ethereal (ether-like) odor, but the odor of the commercial purity grade is distinctively garlic-like. Acetylene can be safely stored and used in cylinders filled with a porous material and containing a solvent (acetone) into which the acetylene has been dissolved.

Acetylene, when not dissolved in a solvent (free acetylene), can begin to dissociate (decompose) at pressures above 15 pounds per square inch gauge (psig). The products of dissociation are carbon, in the form of lampblack, and hydrogen. Considerable amounts of heat are generated by dissociation, which may produce explosions of great violence.

Steel and wrought iron are recommended for use in acetylene piping. Rolled, forged, or cast steel, or malleable iron fittings may be used. Cast iron is **not permissible** for fittings. Unalloyed copper, silver, or mercury should never be used in direct contact with acetylene since there is the possibility of forming explosive acetylides. Wet acetylene will produce explosive acetylides on copper, 70-30 brass, and aluminum-bronze. Weight (not pressure) is used to determine the amount of acetylene in a cylinder. The tare weight is subtracted from the actual weight, and the difference is multiplied by 14.7 to determine the amount of gas in standard cubic feet.

The molecular symbol for acetylene is C_2H_2.

Toxicity

Acetylene is a simple asphyxiant and anesthetic. Experiments have shown there to be no harmful effects from chronic exposure to acetylene at high concentrations.

Manufacture

Acetylene is manufactured by the reaction of water with calcium carbide. It is also manufactured by thermal cracking of hydrocarbons, or by partial combustion of methane with oxygen.

Uses

Approximately 80% of the annual acetylene production of the United States is used for chemical syntheses. Acetylene has become increasingly prominent as a raw material for a whole series of organic compounds, among them acetaldehyde, acetic acid, and acetic anhydride. The remaining 20% of the acetylene production is principally used for oxyacetylene cutting, heat treating, and welding.

Containers

Acetylene cylinders contain a filler material and a solvent in addition to the safety relief devices, valves, and protection caps normally supplied on standard-sized hollow steel cylinders for compressed gas service.

Shell

The shell is manufactured according to Department of Transportation DOT-8 or DOT-8AL specifications. It may have formed sides and a welded bottom, or be welded on the sides with a formed bottom. They are used at a service pressure of 250 psi at 70°F. The cylinders are initially hydrostatically tested to pressures two to three times the service pressure. DOT regulations require that the shell of all acetylene cylinders be inspected and requalified on a periodic basis. Typically, for a cylinder manufactured after 1991, the shell is requalified within 10 years of manufacture and every 10 years thereafter. Shells manufactured prior to 1991 must be requalified by 2001, and every 10 years thereafter.

Filler Material

Early cylinders were completely filled with a porous filler material consisting of diatomaceous earth (a porous calcium material formed from the accumulation of small organisms on ocean and lake beds millions of years ago), charcoal, asbestos, and cement.

Diatomaceous earth and charcoal are the porous elements, asbestos the strengthening material, and the cement is the binder. Present-day cylinders have a silica lime filler to which some manufacturers add asbestos, charcoal, and other materials to provide a lightweight filler with a higher porosity. The filler materials must be correctly proportioned to provide a homogenous mass in such a manner as to completely fill the shell within the maximum clearances specified by DOT to resist cracking of filler during rough handling of the cylinder, and to obtain the best acetylene charging and discharging capabilities. DOT-8 or DOT-8AL specifications define the requirement of the porosity of the filler material. DOT regu-

Properties

Molecular Weight	26.04
Specific Gravity, Gas (Air = 1) @ 68°F (20°C), 1 atm	0.906
Specific Gravity, Liquid @ -116°F (-82°C), 1 atm	0.621
Specific Volume @ 68°F (20°C), 1 atm	14.7 cu. ft./lb.
Flammable Limits @ 1 atm in air	2.5% – 100% (by volume)
Autoignition Temperature @ 1 atm	581°F (305°C)
Flash Point (Closed Cup)	0°F (-18°C)
Solubility in Acetone @ 59°F (15°C), 1 atm	20 cu. ft./cu. ft. acetone
Solubility in Acetone @ 59°F (15°C), 12 atm	240 cu. ft./cu. ft. acetone

Cylinder Specifications

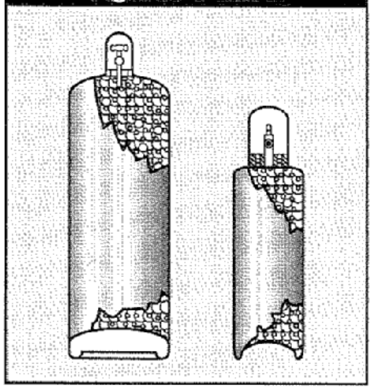
Size	Nominal Dimension w/o valve	Empty Wt. (lbs.)	Full Wt. (lbs.)	Full Capacity (cu. ft.) Std. Press.
MC	4" x 12"	7 1/2	8 1/2	10
B	6" x 19"	22 1/2	25 1/2	40
1	7" x 25"	47	52 1/2	75
2	8" x 30"	70	79	130
3	10" x 30"	100	113	190
4	12" x 36"	175	197 3/4	330
5	12" x 39"	185	209 3/4	360

2 Safetygram-13

lations require that the filler of all acetylene cylinders undergo a one-time inspection and requalification. Cylinders manufactured after 1991 will be requalified at least 3 years after but before 20 years of the date of manufacture. Cylinders manufactured before 1991 will be requalified before 2001. The construction of acetylene cylinders is shown by the cutaway views: Figure 1, the large, and Figure 2, the small-type cylinder.

Requalification of cylinder shell and filler material can only be performed by a facility that has been authorized by and registered with DOT.

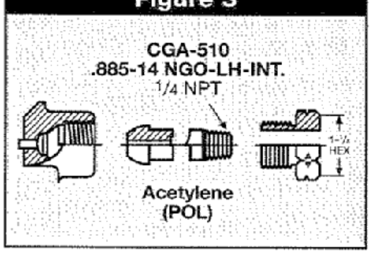
Figures 1 and 2



Valves

The Compressed Gas Association (CGA) and the American National Standards Institute have adopted a thread size of 0.885 inch I.D.—14 threads per inch. It is left-hand with internal threads, accepting a bullet-shaped nipple. It is designated as Valve Outlet No. 510 and shown in Figure 3. Figure 4 shows the alternate CGA standard valve outlet used on some acetylene cylinders. The valve outlet has a thread size of 0.825 inch O.D.—14 threads per inch with external right-hand threads.

Figure 3

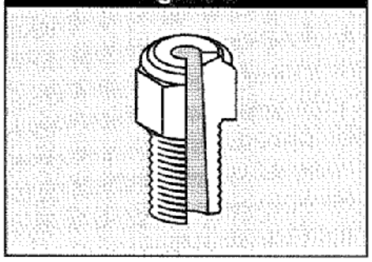


Safety Devices

Protection against excessive temperatures is provided in part by plugs filled with fusible metal which melt at about 212°F. Smaller cylinders may have a small passage in the valve body filled with fusible metal. A fusible plug is illustrated in Figure 5.

Never attempt to stop a fusible plug leak by any means. Notify supplier immediately.

Figure 5



Acetone

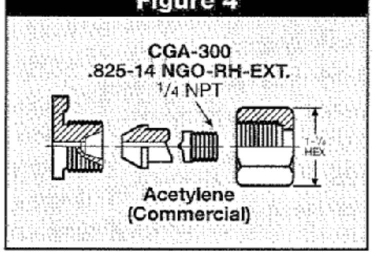
Acetone is charged into the cylinder and completely fills the pores of the filler material. Acetone is the solvent which will dissolve the acetylene gas charged into the cylinder. DOT regulations control the amount of acetone and acetylene allowed in each size cylinder.

Identification

Each cylinder is identified by:

1. DOT-8 or DOT-8AL, the specifications controlling the manufacture of the cylinder.
2. The serial number, manufacturer's symbol, and owner's symbol.
3. The date of test.
4. The tare weight, expressed in pounds and ounces. The tare weight includes the cylinder, filler, acetone, valve, saturation gas and plugs, but not the cylinder cap.
5. Retest markings that indicate the shell or filler was requalified.

Figure 4



Sizes of Cylinders

The table, Cylinder Specifications, lists some of the physical specifications of some of the more common sizes of acetylene cylinders in service.

Shipment of Acetylene Cylinders

Shipments of acetylene cylinders by highway transportation must conform to Department of Transportation regulations as set forth in the Code of Federal Regulations, Title 49, which describes the labeling and identification required. A DOT 4" x 4" flammable gas label or tag is required for common carrier shipments. Figure 6 illustrates the label that is required.

Shipments by air must conform with Title 49 Code of Federal Regulations (FAA Regulations). 49 CFR is the official publication of the Department of Transportation concerning transport of hazardous materials by any mode. These regulations are also found in the Civil Aeronautics Board No. 82 Restricted Articles Tariff No. 6-D, but the designation of this tariff may change from time to time. The weight limitations for passenger and cargo aircraft remain the same.

Figure 6

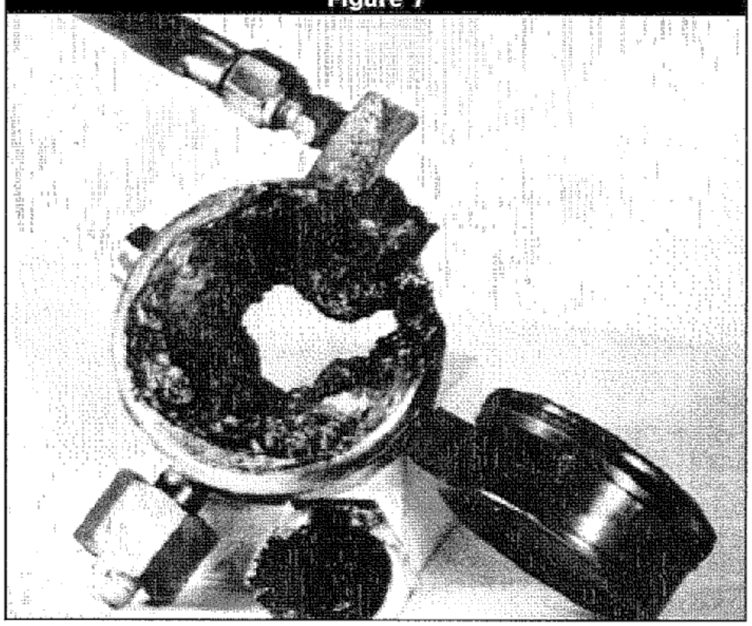
Safety Considerations

Figure 7 shows the damage that can be done to regulating equipment when the basic safety rules governing the handling and use of acetylene and acetylene cylinders are violated.

Users of acetylene should know and understand the construction of the cylinders and the properties of acetylene. The following basic safety rules are a guide to storage, handling, and use of acetylene cylinders.

1. Always store and use acetylene cylinders in an upright position to prevent loss of acetone which reduces the cylinder's ability to hold dissolved acetylene.
2. Do not handle cylinders roughly or carelessly to prevent damage to the cylinder or the filler. Dropping cylinders can cause leaks to develop at fuse plugs. Sharp dents in the cylinder can break up the filler in the area of the dent and cause voids where free acetylene can accumulate and decompose at cylinder pressures.
3. Keep cylinders away from external sources of heat. Cylinders are not designed for temperatures in excess of 125°F (52°C).
4. Protect the bottom heads of acetylene cylinders from damp ground.
5. Separate flammable gas cylinders from oxygen and other oxidizing gas cylinders during storage. Separate full acetylene cylinders from empty cylinders. Provide a means of preventing cylinders from falling if accidentally bumped.
6. Use regulators and pressure relief devices when connecting cylinders to circuits having lower pressure service ratings.
7. Always soap-test all regulator, torch, hose, and cylinder connections before placing acetylene equipment in service. Leaks in a confined area can cause acetylene to collect and readily attain concentrations above the lower flammability limit of 2.5 percent acetylene in the air.
8. Do not use acetylene at pressures above 15 psig, the pressure where decomposition can begin, to avoid explosion and fire hazard.
9. Remove leaking acetylene cylinders to an open area and tag them indicating the danger. Never attempt to stop a fuse plug leak. Notify your supplier immediately.
10. In most cases, it is best to allow a burning acetylene cylinder to burn itself out. The exception is small fires at fitting connections which can effectively be extinguished by applying a wet rag, wet asbestos, or similar types of material. Caution must be exercised because the heat from a small flame can melt the fuse plugs and cause a rapid discharge of acetylene which can produce a large fire. Water may be effectively used to prevent involvement of additional cylinders and to protect equipment and property adjacent to burning acetylene cylinders. Adequate distance must be maintained between personnel and burning cylinders because cylinders may rupture.
11. Keep valves closed when cylinders are not in service or empty. At the end of the shift or work day, close the cylinder valve and bleed the pressure off the regulator and torch equipment. Keep cylinder caps on the cylinders provided with threaded spuds when in storage or being moved.
12. If an acetylene cylinder receives a sharp or deep dent, the metal is gouged, or any other mechanical defect, circle the defect with a marking pen to alert the supplier of the defect. Federal Law prohibits persons, other than cylinder manufacturers, from repairing acetylene cylinders. Disposal of unserviceable cylinders should only be attempted by experienced personnel.

Figure 7



13. An acetylene cylinder valve should not be opened more than approximately 1 1/2 turns.
14. To minimize the withdrawal of liquid solvent, acetylene should be withdrawn from the cylinder at a rate not to exceed 1/10 (one-tenth) of the capacity of the cylinder per hour during intermittent use. For full withdrawal of the contents of the cylinder on a continuous basis, the flow rate should be no more than 1/15 (one-fifteenth) of the capacity of the cylinder per hour.
15. If a cylinder protective cap is extremely difficult to remove, do not apply excessive force or pry the cap loose with a bar inserted into the ventilation openings. Attach a label or tag to the cylinder identifying the problem and return the cylinder to the supplier.
16. Wrenches should not be used on valves equipped with a handwheel. If the valve is faulty, attach a label or tag to the cylinder identifying the problem and return the cylinder to the supplier.
17. Compressed gas cylinders should not be refilled except by qualified producers of compressed gases.
18. Shipment of a compressed gas cylinder filled without the consent of the owner is a violation of Federal Law.

Personnel Equipment

Safety glasses, safety shoes, and ordinary work gloves are recommended for cylinder handling. Welder's gloves, welder's goggles, leather sleeves, a leather apron, and other standard protective equipment must be worn for cutting and welding operations.

First Aid

Persons who have become incapacitated or comatose through the anesthetic action of acetylene or oxygen deprivation should be moved promptly to fresh air. If breathing has stopped or is ineffective, assisted respiration is essential. Give oxygen if available. Seek medical assistance.

Fire Fighting

Since acetylene is a flammable gas, caution should be taken in extinguishing the fire until the source of acetylene gas can be stopped. It is important to prevent acetylene gas from collecting in a confined area because the gas may reignite and explode.

In all cases of acetylene cylinder fires, the area should be evacuated as quickly as possible. Someone knowledgeable in handling acetylene fires should be left in charge. If possible, first stop the flow of acetylene gas by closing the valve and then cool all materials in the area below the ignition temperature.

The fusible metal plugs at the top and bottom of the cylinder will melt at 212°F. If the fusible metal plugs relieve, flames can be projected approximately 15 feet from the top and bottom of the cylinder. Dry powder or carbon dioxide fire extinguishers can be used to extinguish small acetylene flames. If an acetylene cylinder fire could involve additional acetylene cylinders, it is very important to spray a large quantity of water on adjacent cylinders to cool the cylinder and prevent the fusible metal plugs on the adjacent cylinders from becoming heated, melting, and discharging additional acetylene.

4.1 CGA SA-2 2003 Acetylene Safety Alert

COMPRESSED GAS ASSOCIATION, INC.

SA-2—2003
REAFFIRMED 2004

SAFETY ALERT

4221 WALNEY ROAD, 5TH FLOOR
CHANTILLY, VA 20151
703-788-2700
cga@cganet.com

ACETYLENE SAFETY ALERT

This alert is intended to communicate the dangers of using acetylene for anything other than its intended purposes.

Over the years, there have been a number of reported incidents involving acetylene being used improperly. In 1994 alone, there were two documented incidents brought to the attention of the Compressed Gas Association. In both cases individuals were using acetylene to inflate either balloons or plastic shopping bags. The inflated bags or balloons were then to be ignited to produce a large bang. In one case, an individual was burned over 50% of his body. In the other case, a father was not only killed by the shock wave in front of his children, but some of his children suffered injuries too. Both incidents resulted in a significant amount of property damage as well. Damage ranged from windows and doors being blown out of a warehouse to windows being shattered in the neighborhood.

The same properties that make acetylene an attractive gas for cutting and welding also make it an extremely dangerous gas to abuse in this manner. Any effort to transfer or mix acetylene into another container including a balloon, plastic bag, or another cylinder is highly dangerous. See CGA G-1, *Acetylene,* for additional information.

Even under circumstances where a "knowledgeable" person thinks he or she can do it safely, "playing" with acetylene is a very high risk activity. Acetylene can easily be ignited by static electricity. It is because of this fact that plastic piping is not used in the transmission of acetylene.

Engaging in any practices such as these is extremely hazardous. Not only can one be severely burned by acetylene's high heat content, but one can also be killed or severely injured by the intense shock wave that may be created by a small quantity of gas when ignited.

Please use this alert to communicate the hazards of acetylene abuse to your employees and custoers.

Section 7: Additional detail for System Description- Unique C2H2 Source System Design Features

The C2H2 (Acetylene) cabinet differs from the standard GASGUARD® design in some important aspects:

- The C2H2 cabinet locates the pressure regulator immediately downstream of the P1 monitor on the pigtail.
- There is no V2 contained in the system. A V1 valve, located immediately downstream of the regulator is always required
- A flexhose connects the panel to the cylinder.
- A flash arrestor is located on the panel where a traditional system would have a regulator. This flash arrestor prevents a flashback from reaching the C2H2 cylinder which would result in an explosion. The device is necessary because C2H2 is an unstable gas that can violently decompose with small initiation force. The flash arrestor has three safety features to prevent a reaction in the piping line from reaching the cylinder:
  a) Flame Arrestor (FA): Large surface area of stainless steel mesh that extinguishes any flame
  b) Temperature sensitive cut-off Valve (TV): Special valve that closes in the event of rising temperature long before the internal temperature of the arrestor reaches a dangerous level
  c) Non-Return Valve (NV): A high quality check valve which prevents the slow or sudden reverse gas flow from forming explosive mixtures in the gas supply.
- Purifiers/Filters may be located upstream of V6 to facilitate conditioning and change-out.
- The HPLT option (High Pressure Leak Test) is not allowed with C2H2
- PRE-PURGE and POST PURGE modes are not available with C2H2. Instead, PANEL PURGE is run before and after cylinder change.

Schematics: Figure 7.1 shows a typical flow schematic for the C2H2 models. The symbol key is shown below. Purge panels may not be used. System may be automatic crossover, independent panel outlets, or single process configuration. Purifier / filter location may vary or not be used. Certain valves may be pneumatic or manual. Additional VCR breaks may be added for service.

Figure 7.1: 3 Cylinder Auto Crossover

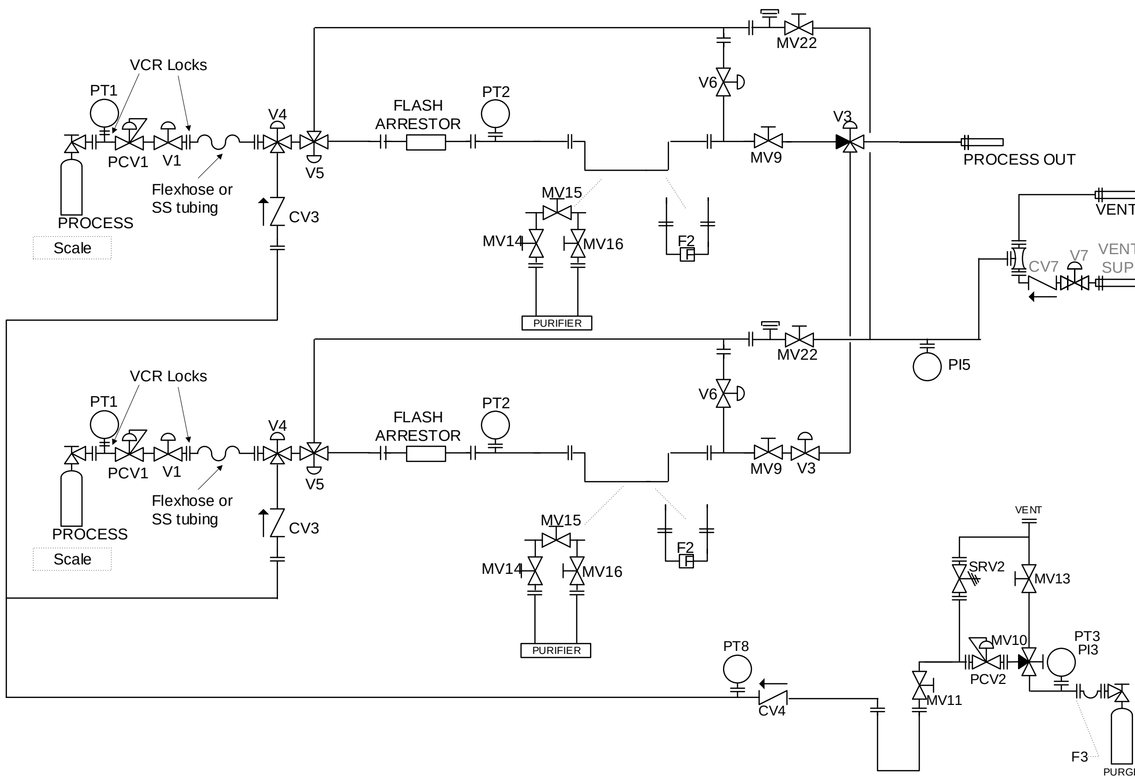
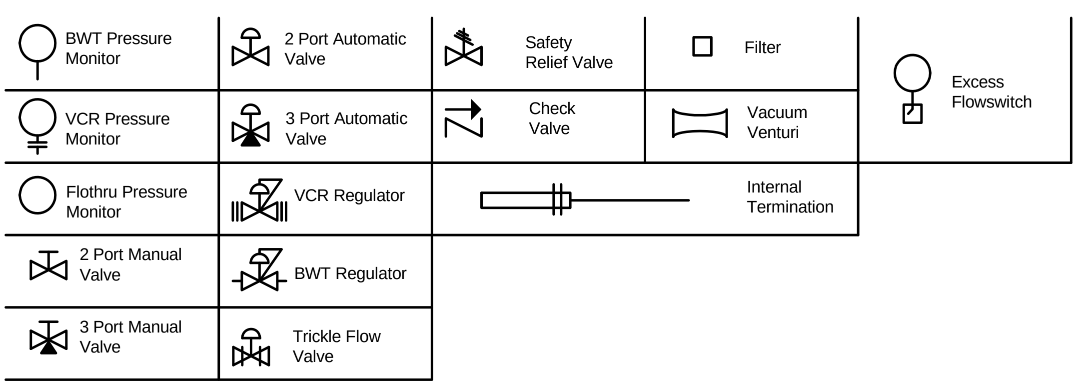


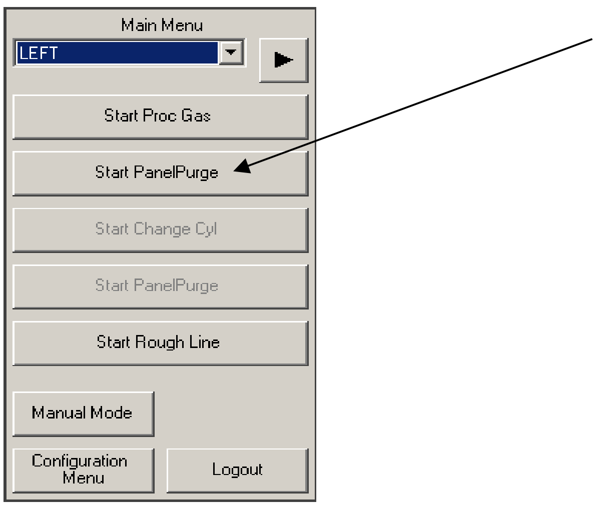
Figure 7.2: Symbol Legend for C2H2 Acetylene Schematic



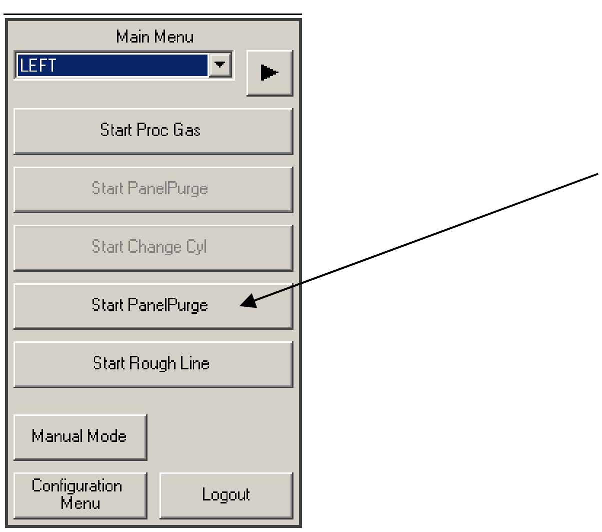
Section 8: Additional detail for Operating Procedures for C2H2 Source System

The C2H2 source equipment operates essentially the same as other GASGUARD® source equipment with a few key exceptions:

The systems does not have a traditional Pre-Purge Mode. Prior to performing system maintenance or cylinder changes, Panel Purge must be run instead of Pre-Purge. Follow routine operating instructions as usual, except select “Start Panel Purge” above the change cylinder command where Pre-Purge would typically be located.



- The systems does not have a traditional Post-Purge Mode. After performing system maintenance or cylinder changes, Panel Purge must be run instead of Post-Purge. Follow routine operating instructions as usual, except select “Start Panel Purge” below the change cylinder command where Post-Purge would typically be located.

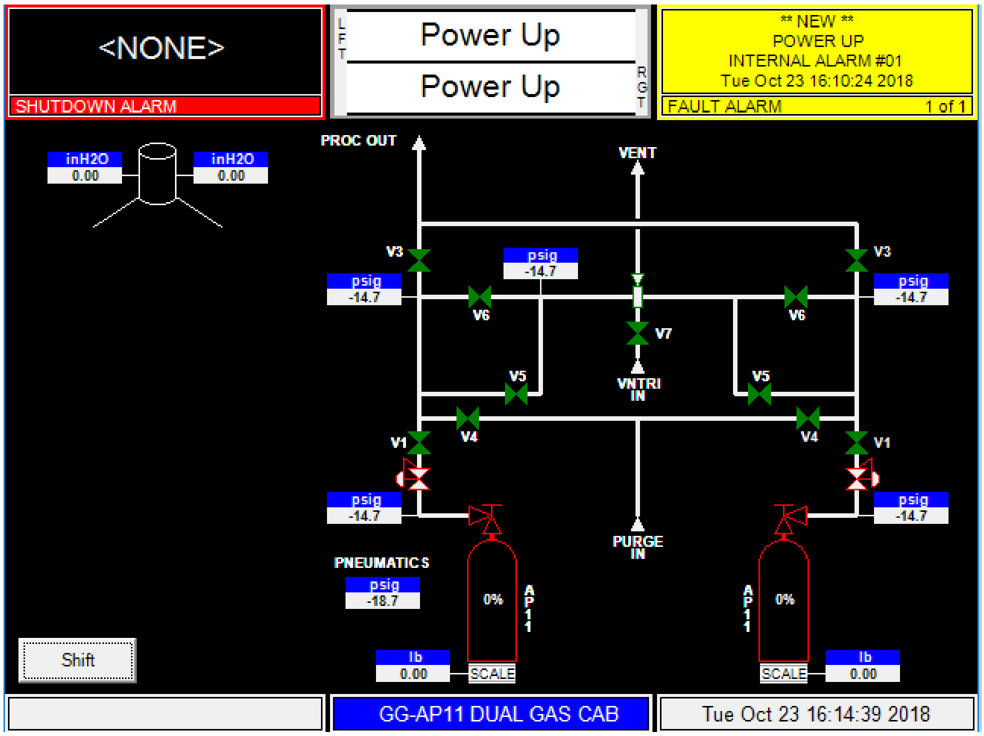


- The purge pressure for C2H2 equipment must be limited to < 10psig. See Section 1.2 of this supplement for more information.

- The system contains no V2. Any local operating procedures using manual mode must be carefully reviewed.

- The purifier or filter may be located in an atypical location. Carefully review actual system schematic to ensure purifiers are properly isolated and conditioned as necessary.

- The following is a typical C2H2 screen layout:



Section 9: Active Control Option

GASGUARD ® Active Control technology is available for Acetylene systems. Reference Chapter 14 of this O&M Manual for details on active control operation.

Note that the analog alarm numbers referenced in Chapter 14 may be different for C2H2 than other gas type equipment.

GASGUARD® Active Pressure Control is a feature which provides automatic and continuous compensation of delivery pressure to a user-defined setpoint for flows >0.5 slpm. It provides:

- Elimination of source cylinder supply pressure effect
- Automatic adjustment to droop effect from flow-related pressure drop

- Enhanced auto-crossover performance
- User-configurable setpoints to customize operation, optimize performance, and utilize all available gas.

Appendix E

Remote eV Heater Controller

System Specification

Each Remote eV Controller is a remotely mounted electrical control cabinet (ECC) that are intended to provide heater control for up to 2 heater blankets, heat trace piping, purge gas heater, and 3 zones of heat trace. These ECC's are intended to work in conjunction with a GASGUARD® or CHEMGUARD® Gen III controller that is equipped with an AP1602 circuit board. The GASGUARD® or CHEMGUARD® Gen III controller receives the thermocouple and thermostat status and controls the relays located inside each ECC.

Each Remote eV Controller has separate power and pneumatic feed from the GASGUARD® or CHEMGUARD® Gen III controller.

Range of Environmental Conditions and Conditions of Use:

- -20 to 40° C Operating Temperature Range
- 95% Maximum Relative Humidity
- 2000 Meters Above Sea Level, Maximum
- 120VAC or 208-240VAC Nominal Voltage Ranges, 3 wire, 50 to 60 Hertz
- ± 10% Fluctuation of Nominal Voltage Range
- Short Circuit Current Rating (SCCR) is 5 kA
- Must be installed with appropriate protection from light to ensure that the resistance to light of the Remote eV Controllers or parts of the Remote eV Controllers is satisfactory.
- This equipment is intended for installation only in locations providing adequate protection against entry of solid foreign objects and water capable of impairing safety.
- Equipment is intended for indoor installation. It has been evaluated for installation in locations provided adequate protection against the entry of water. The equipment is intended to be afforded the equivalent of ingress protection IP54 by location.
- Upon installation, all conduit connections must be sealed appropriately for type protection "pzc".

Electrical Specifications

Grounding Method

The equipment must be grounded in accordance with Article 250 - Grounding in the National Electrical Code, if installed in the United States. The customer is responsible for connections to earth ground. See Figure E.2 for grounding location.

Use of #4 AWG ground wire will not maintain CE marking. Use Alpha #1239, 1-3/8” flat braid or equivalent for CE marked systems (total length not to exceed 10 feet or 3 meters).

After grounding the overall resistance must be measured. This resistance for the equipment ground to the grounding electrode should not exceed one ohm (1Ω). Check the effectiveness of grounding by using a ground resistance meter (i.e., an AEMC clamp on ground resistance tester or equivalent).

Power Supply Connection

Each Remote eV Heater Controller should be installed with an independent external circuit interrupting device to remove power from the units when maintenance on the controllers are required and should be Lockout/Tagout capable. These devices should be rated as a minimum at 240 volts, 30 amps, 50/60 Hz and 10,000 rms symmetrical ampere interrupting capacity. These devices should be accessible to the operators, marked as the disconnecting device for the cabinet, and must have the on/off position clearly marked for the operator, and should be near the cabinet.

Disconnect switches shall meet the requirements of IEC 60947-1 and IEC 60947-3 and the disconnect switch must not interrupt the protective earth conductor.

Power Requirements

120 VAC, 17A, 50/60Hz, 3 wire
OR
208-240 VAC, 9A, 50/60Hz, 3 wire

Acceptable wire gauge:

L1 & L2/N: 14-4 AWG
GND: 14-6 AWG

Replaceable fuses:

FS-107, located each Remote eV Heater Controller adjacent the DC power supply, is a 2A fast acting fuse.
See the Spare Parts List for manufacturer and part numbers and specifications.

Field Connections

WARNING

In NEC Class I, Division 2 areas (only in the U.S.A.), a conduit seal ("pour fitting") or equivalent must be installed between each electrical connection point on the cabinet and the electrical source. Liquid tight flexible conduit can be installed between the Remote eV Controller connectors and the conduit seals to facilitate these connections. A maximum length of 18" (457 mm) is allowed between the last pour fitting and the cabinet connector. All conduits shall be sealed in accordance to Sections 501-5, 502-5 or 504-70 of the National Electric Code.

WARNING

In classified hazardous areas – Do not separate electrical terminations or connectors while energized due to risk of electrical arc or spark which can ignite potentially flammable atmospheres.

Explosive Atmosphere (ATEX) Installations

Remote eV Heater Controllers that have the label shown in Figure 4.8a has been certified to comply with European Union ATEX Directive 2014/34/EU of the European Parliament and Council when properly installed in accordance with the guidelines and instructions referenced in this section.

Remote eV Heater Controllers with the following label attached for explosion protection are of Group II, Category 3; intended for use only in areas where explosive atmospheres of gas are unlikely to occur, or if they do occur are likely to do so infrequently or for a short period.

ATEX Label Markings

The ATEX label placed on the AP11 controller includes the following information (symbols follow in order starting at the upper left corner):

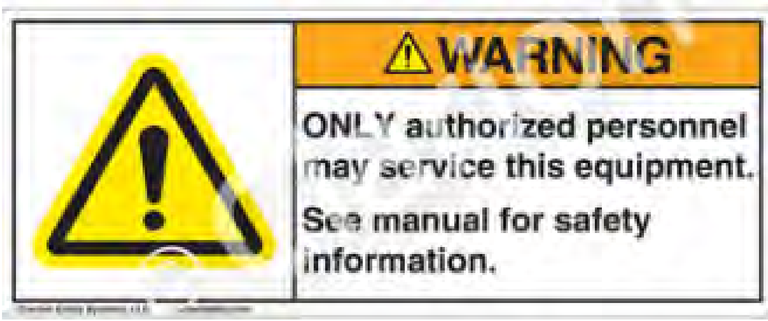
- The CE Symbol which reflects conformity with the European Directives
- The Hexagonal "Ex" Symbol for Explosive Atmosphere
- The equipment group symbol for the electrical apparatus which is II. All industry gases are classified as Group II gases.
- The equipment category number 3. The equipment category number 3 means the equipment is suitable for an environment where an explosive atmosphere is unlikely to occur, occurs infrequently, or occurs for only a short period of time.
- The atmosphere symbol "G". "G" means that product is safe in an explosive GAS atmosphere.
- Symbol "Ex". This symbol stands for the equipment has been tested under the latest European Harmonized Standard for use in Explosive Atmospheres.
- Symbol "ic" for int rinsic safety.
- Symbol "pz" for pressurization. Pressurization prevents the ingress of an explosive atmosphere to a space that may contain a source of ignition. This is used for the controller.
- Symbol "IIC' for the apparatus gas group.
- The symbol indicating the maximum surface temperature, T4. T4 indicates that the maximum surface temperature does not exceed 135°C.
- The symbol "X" for special conditions of installation and relevant use for safety. The normal ambient temperature range in the ATEX standard is considered to be -20°C to 40°C. Since the temperature range for the Remote eV Heater Controller varies from the normal range, an X is included on the label markings.
- The ambient temperature range, Ta.

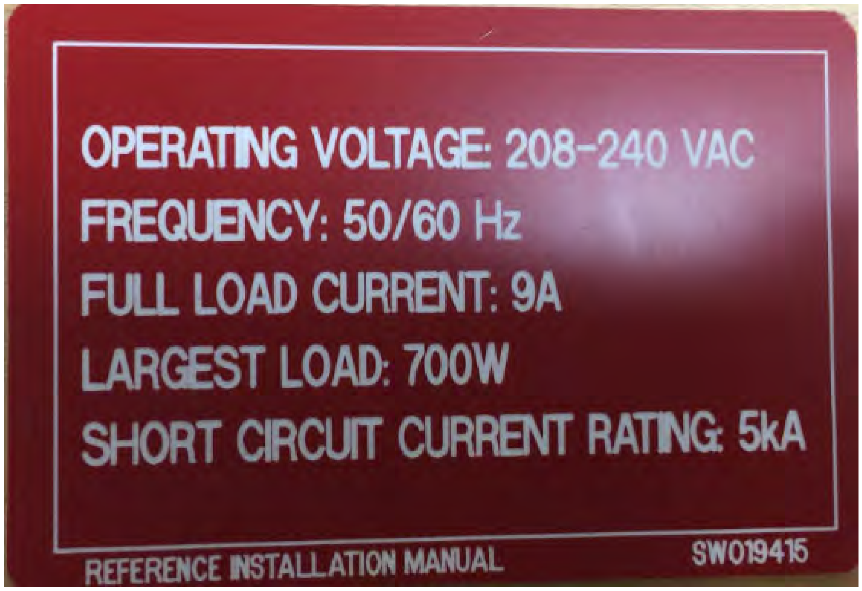
Special Conditions for Safe Use (X)

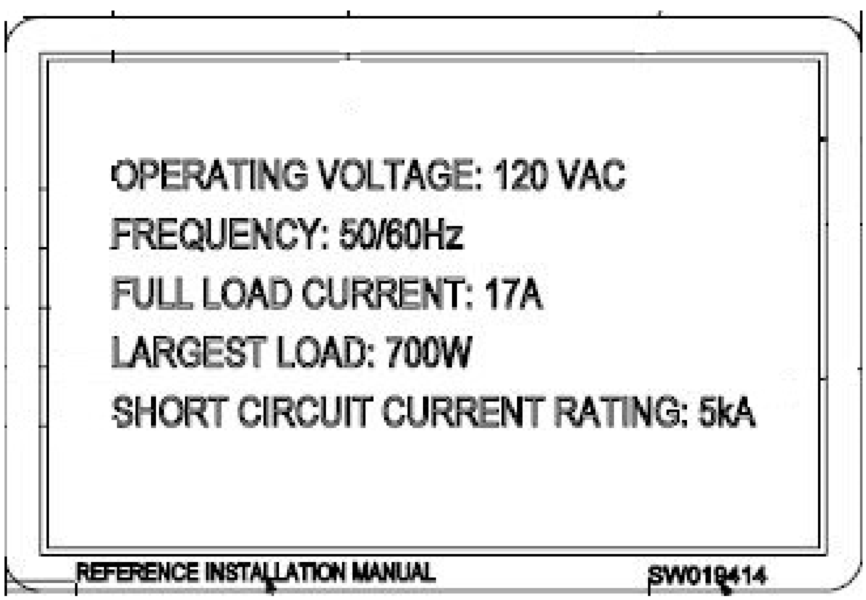
- **Environmental Limits**
  - Remote eV Heater Controllers are intended for indoor installation. They have been evaluated for installation in locations providing adequate protection against the entry of water.
  - Remote eV Heater Controllers are intended for use in ambient temperatures in the range of -20°C to +40°C and should not be used outside this range.
  - DO NOT rub the surface of the touch screen with a dry cloth. Electrostatic charge generated by the friction may result. When cleaning the face with a damp cloth, take the measures of an electrostatic discharge such as earth band, ionic shower, etc.
- **Installation Conditions**
  - When installing the equipment, appropriate precautions must be taken to ensure that the equipment has been connected to earth. Refer to the Grounding Method section of this appendix for more information.
  - Installation of this equipment shall be carried out in accordance with the installation standards for potentially explosive atmospheres. Installation, startup and maintenance must be carried out only by personnel trained in explosion protection.
- **Power Supply**
  - Input power supply specs must not exceed the maximum values as listed in the power supply connection of this appendix.
- **Maintenance**
  - Before opening the controller enclosure ensure that there is no danger of explosion in the atmosphere and wait at least 10 minutes after the power has been removed.
  - Before turning the power supply ON, be sure to close the enclosure cover tightly and securely fasten the latch. Ensure that z purge is operating and functional for at least 30 minutes prior to turning the power on.
  - Only qualified Versum Materials personnel should service the controller. Substitution of components (other than those recommended by Versum Materials) may impair its suitability for use in hazardous locations.

Safety Signs and Labels

The following labels are located on the exterior door of the eV Heater Controller.




OPERATING VOLTAGE: 208-240 VAC
FREQUENCY: 50/60 Hz
FULL LOAD CURRENT: 9A
LARGEST LOAD: 700W
SHORT CIRCUIT CURRENT RATING: 5kA
REFERENCE INSTALLATION MANUAL
SW019415


OPERATING VOLTAGE: 120 VAC
FREQUENCY: 50/60Hz
FULL LOAD CURRENT: 17A
LARGEST LOAD: 700W
SHORT CIRCUIT CURRENT RATING: 5kA
REFERENCE INSTALLATION MANUAL
SW019414

WARNING PRESSURIZED ENCLOSURE

"This enclosure shall not be opened unless the area is known to be free of flammable materials. If power has been removed, if the enclosure has been opened, or if the minimum overpressure has not been maintained, the enclosure should be purged for 30 minutes at a flow rate of 5CFH. WARNING: In the case where power has been removed, power cannot be restored until the purge is complete.

Purged and pressurized enclosure conforms to NFPA496. Type Z Requirement.

Temperature Index is T4. Approved for NEC CLASS I, DIVISION 2, Groups B,C and D locations.

This enclosure also contains a flammable substance that may be within the flammable limits when exposed to air.

WARNING ASPHYXIATION HAZARD

Protective Gas Release Poses Potential for Asphyxiation

SW019815

Pneumatic Supply

The Remote eV Heater Controller requires a pneumatic supply for Z-purge. **A pneumatic supply of inert gas without oxygen, such as nitrogen, is recommended**. **It is strongly advised to <u>not use clean dry air</u> for pneumatic supply unless there is a high degree of confidence that it will maintain purity as per ISO 8573-1 Class 2.** Moisture in clean dry air will promote corrosion of electrical components and reduce controller performance and reliability.

This pneumatic supply needs to be regulated to 85-95 psig (5.9-6.6 barg). If compressed air is used as the pneumatic source, the compressor shall be located in a non-classified area. If the air intake line for the compressor passes through a classified location, the line shall be made of a non-combustible material designed to prevent leakage and protect against mechanical damage. If electrical power for the purge air is required, this power shall be on a separate disconnect or before the gas ***source system*** disconnect.

In NEC Class I, Division 2 applications (in U.S.A.) and in ATEX Zone (Group) 2, Category 3 (in Europe) this supply is also used for Type Z purge of the electrical enclosure. The Type Z purge is required to maintain a positive pressure at or above 0.1" H_2O (24.9 Pa) as dictated by the National Fire Protection Agency (NFPA) and the European directives (ATEX). In applications where Type Z purge is required, the controller will be equipped with a pressure switch to monitor the pressure. The Type Z purge will require a flow rate of up to 2.4 LPM (5 CFH).

Typically this supply is taken from a houseline nitrogen source. A 1/4" Swagelok® connection at the bottom of the controller is provided for the pneumatic supply inlet connection as shown in Figure E.2. Piping for the pneumatic supply must be protected from mechanical damage. Maximum allowable working pressure is 100 psig (6.9 barg). Over-pressurization protection, such as a safety relief valve, must be provided to prevent overpressurization of the enclosure.

⚠CAUTION

To prevent overpressurization of enclosure, do not exceed 100psig.

Z-purge Procedure

The Z purge pressure is controlled by a needle valve on the bottom of controller. After opening the controller in a suspected hazardous area it is necessary to use the following procedure to re-establish the Z-purge before operating the controller:

1. Close the controller front and tighten both latches completely.
2. Open the needle valve fully (counter-clockwise). Allow the controller to purge for 30 minutes.
3. Adjust needle valve to satisfy the "Z-Purge" alarm (approximately 1/4 total turn open).

Flow during purge will reach 2.4 LPM (5 CFH). Flow requirements to satisfy Z-Purge are typically very low and is dependent on the tightness of the individual controller and the installation.

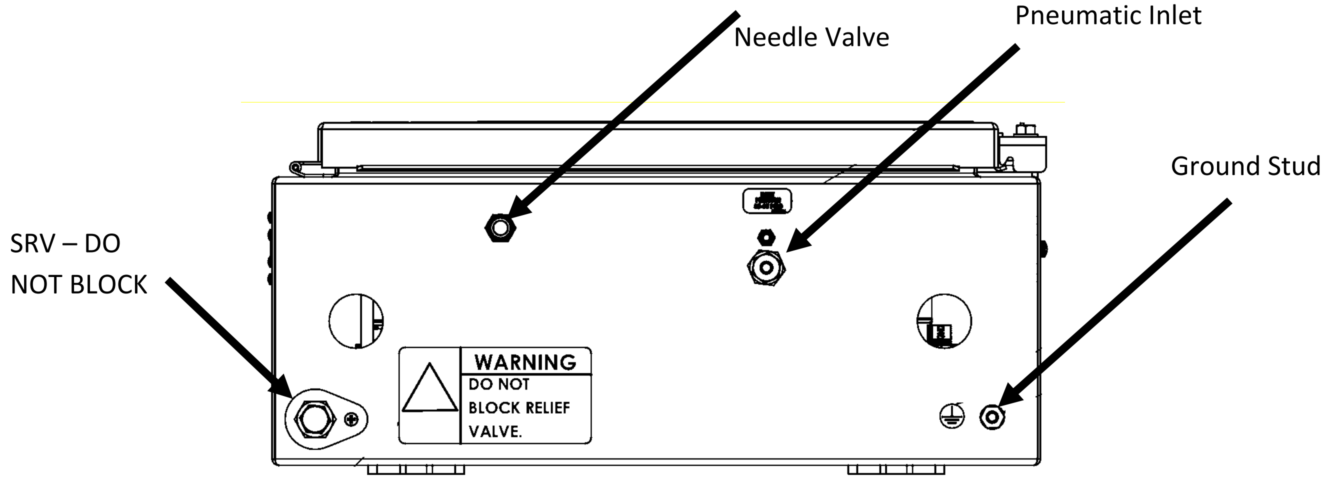


Figure E.2: Bottom View of Remote eV Controller

Remote eV Installation

Refer to drawing SW0019142 for installation information and instructions.

Addendum C

Heat Trace Installation and Operation

For Your Safety, Read This First

WARNING

You must read and understand the Safety Information Section of this manual before installing, operating, or maintaining the Gas System. All operating and maintenance personnel must complete the Gas System training course administered by Versum Materials, Inc.

Failure to comply with these requirements can result in *serious injury or death*.

WARNING

System Hazards

Potential hazards when working with this Specialty Gas System are:

- **Health Hazard Gases**
- **Reactive Gases**
- **Flammable Gases**
- **Oxidizing Gases**
- **Oxygen-Deficient Atmosphere**
- **Pressurized Gases Hazards**
- **Cylinder Handling Hazards**
- **Electrical Hazards**

WARNING

Equipment Changes

Do not make any changes to the Gas System without authorization from a Versum Materials' Representative. Death or serious injury may result from unauthorized Gas System changes.

Section 1: General Considerations:

Heat trace may be installed by the factory or in the field.

For Factory installed heat trace, the end user is responsible for installing the appropriate circuit breaker, providing power, installing the poured seals, adjusting the heat traces setting and any applicable alarms. In addition, the end user will need to complete the heat trace and insulation installation on any field installed components (such as purifiers) following the same general guidelines as for field installed heat trace.

For field installed heat trace, it is highly recommended to purchase GASGUARD® Heat Trace Installation kit. Versum Materials does not recommend 3rd party heat trace. The directions provided here pertain only GASGUARD® approved kits. Installation of any other heat trace may invalidate NRTL listing and ATEX approval for the system. In addition to the responsibilities listed for field installed heat trace, the end user is responsible for installing the heat trace cable, thermocouples, insulation, heat trace controller and wiring to the Gas System AP10/AP11 controller (if required).

⚠CAUTION

Heat trace is only approved to be installed on Class 1, Division 2, Groups B, C and D. Heat trace is not approved for Group A (Acetylene (C2H2)) systems that require NRTL listing or ATEX approval.

All GASGUARD® controllers with heat trace and Class 1 Division 2 requirements must contain the following label, exclusive of Group A. The classification label must not include Group A. See figure below:

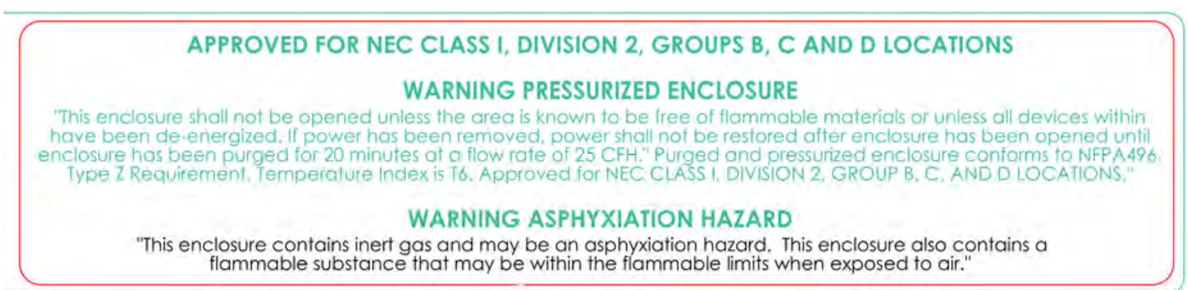


FIGURE A

⚠CAUTION

Before installing or operating heat trace, it is important to read and thoroughly understand this procedure. Contact your GASGUARD® representative if you have any questions.

There are two types of heat trace control used in the GASGUARD® product line. They can be identified by the equipment shown below:

GASGUARD® eV local mount: available only with AP11 systems

Legacy UE controllers: AP10 or AP11 systems

Section 2: Power Requirements

The required Heat Trace voltage is either 120VAC or 208VAC-240VAC, depending on the type of heat trace cable supplied.

- For PT-10-SB, the voltage requirements are 120VAC. PT-10 insulation color code is brown with green stripe, rated 10 watts per foot @120VAC. 50/60Hz, single phase
- For PT-3-SB, the voltage requirements are between 208-240VAC. PT-3 insulation color code is white with green stripe, rated 12 watts per foot @ 240VAC, 9 watt per foot at 208VAC, 50/60Hz, single phase.

⚠CAUTION

Do not use PT-10 cable (insulation color code is brown with green stripe) at voltages above 120V.

For GASGUARD® eV

Heat trace is powered through the GASGUARD® eV enclosure and controlled using the AP11's software. Power is supplied to the GASGUARD® eV enclosure as specified in Chapter 4 of this manual. Conduit seals are to be poured during installation.

The circuit breaker for GASGUARD® eV heat trace may be common to the controller and cylinder heaters. Reference Chapter 4 for local(top) mount eV power requirements or Appendix E for remote mount eV.

For legacy UE controller

Note: All Referenced Drawings are located at the end of this procedure

Heat trace is powered by the Heat Trace Temperature Control Unit (United Electric Controls Company P/N: E-122-2BSB-2000). Power to the Heat Trace Control Unit must be field installed by the customer through conduit poured seals and conduit joint sealant on threads. Refer to drawing SW006666 located at the end of this procedure. In order to provide power to the Control Unit, the customer is required to drill the enclosure. See drawing SW005627 for the suggested location.

The recommended circuit breaker size for both PT-3 and PT-10 types of heat trace cable using the UE controller is 10Amp Max **GFCI** circuit (some drawings may say 20Amp GFCI, but 10Amp is sufficient). Ensure proper grounding of the Control Unit. Refer to drawing SW005622.

Section 3: Process Piping Heat Trace Setting (GASGUARD® eV):

The heat trace ships from the factory with a standard setpoint of 35°C (95°F), unless otherwise specified by the customer. This setpoint should be adjusted in the field to meet the system requirements. Reference the following guidelines:

- The setpoint should be between 0°C and 60°C.
- The process piping (heat trace) temperature inside the gas cabinet should be set at least 8°C (15°F) higher than the heated process gas container to prevent the formation of liquid in the process piping upstream of the regulator, if a cylinder heater is used.
- The process piping (heat trace) temperature should be set at least 5°C (10°F) higher than the ambient temperature.

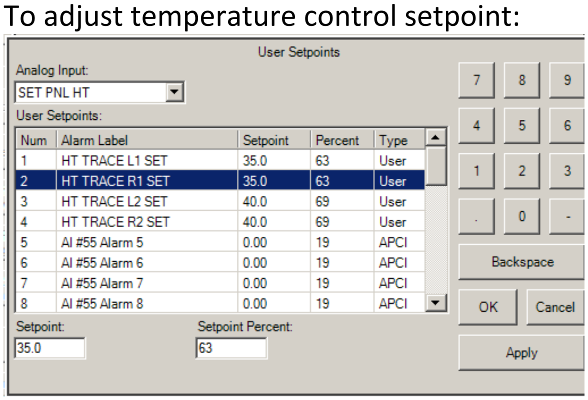
Note: Once the process gas is throttled to houseline delivery pressure, the saturation temperature (point at which liquid begins to form inside the piping) changes. Heat trace on the houseline should be set at least 5°C (10°F) higher than the saturation temperature at the maximum delivery pressure.

CAUTION

Be Careful not to touch exposed tubing or heat trace cable

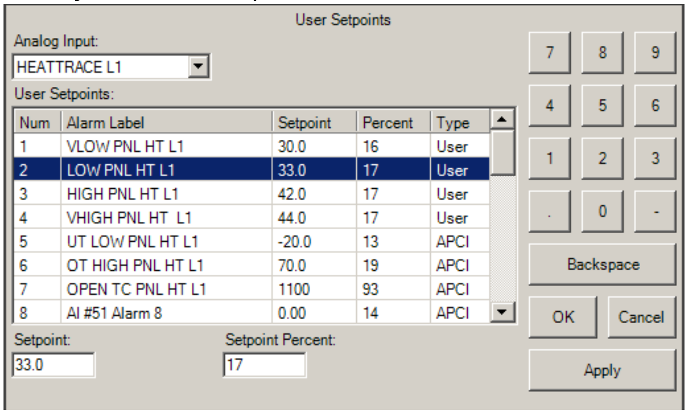
Alarm setpoints will vary by system. Temperature and alarm setpoints can be adjusted through the controller menu. Reference Section 8 for logging into the controller menu.

- To adjust temperature control setpoint:



Select SET PNL HT from the User Setpoint menu. Highlight the corresponding process line (L1 for left process panel, R1 for right process panel), enter new setpoint in the Setpoint: window, then click “Apply” to save or “OK” to save and exit.

- To adjust alarm setpoints:

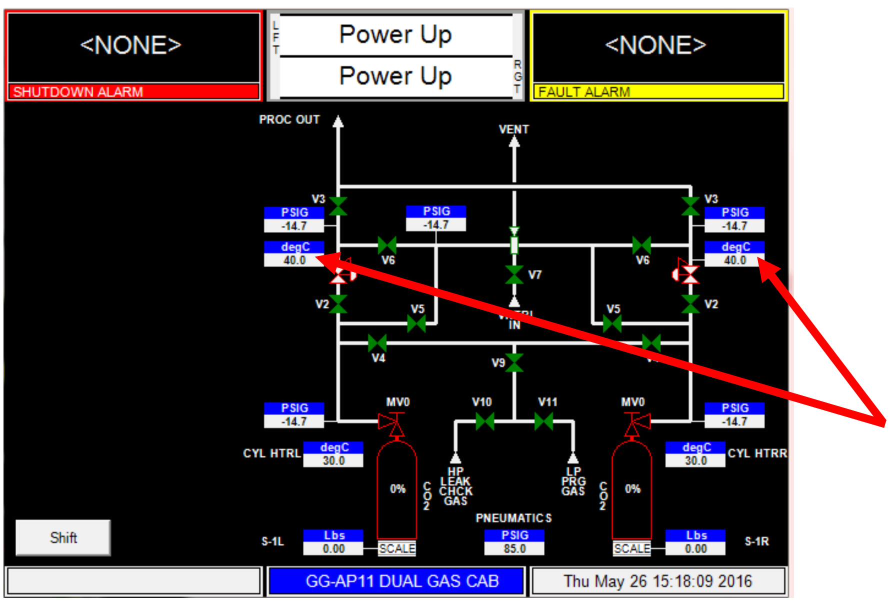


Select HEATTRACE L1 or R1 from the User Setpoint menu. Highlight the alarm to be changed, enter new setpoint in the Setpoint window, then click "Apply" to save or "OK" to save and exit.

The thermocouples are wired to the Heater control board as shown in the following table:

Analog Input #	AP1602 Heater Control Board	Signal Name
51	Heater TB9 1(-), 2(+)	Heat Trace - L1
52	Heater TB9 3(-), 4(+)	Heat Trace - R1

The following figure depicts where the heat trace temperature display box is located on the GASGUARD® eV.



Heat Trace Thermocouple Temperature reading

Section 4: Process Piping Heat Trace Setting (legacy UE controller)

The heat trace ships from the factory with a standard setpoint of 100°F, unless otherwise specified by the customer. This setpoint should be adjusted in the field to meet the system requirements. Reference the following guidelines:

- The process piping (heat trace) temperature inside the gas cabinet should typically be set at least 15°F (8°C) higher than the heated process gas container to prevent the formation of liquid in the process piping upstream of the regulator, if a cylinder heater is used.
- The process piping (heat trace) temperature should be set at least 10°F (5.5°C higher than the ambient temperature.
- The process piping temperature setpoint should not exceed 130°F (55°C)

Note: Once the process gas is throttled to houseline delivery pressure, the saturation temperature (point at which liquid begins to form inside the piping) changes. Heat trace on the houseline should be set at least 10°F (5.5°C) higher than the saturation temperature at the maximum delivery pressure.

The heat trace temperature control setting is adjusted by a dial on the UE controller.

CAUTION ***Be Careful not to touch exposed tubing or heat trace cable***

Section 5: Panel Heat Trace Monitoring and Display (Optional with UE controller)

Your system may be equipped with the ability to monitor the heat trace temperature through the AP10 or AP11 controller. If this option is selected, the system has the ability to display the process piping temperature, communicate the temperature to customer's network system, and/or alarm if the temperature shifts outside of the selected range. The temperature is displayed in degrees Celsius. The following alarms are available, as selected by the customer at time of order:

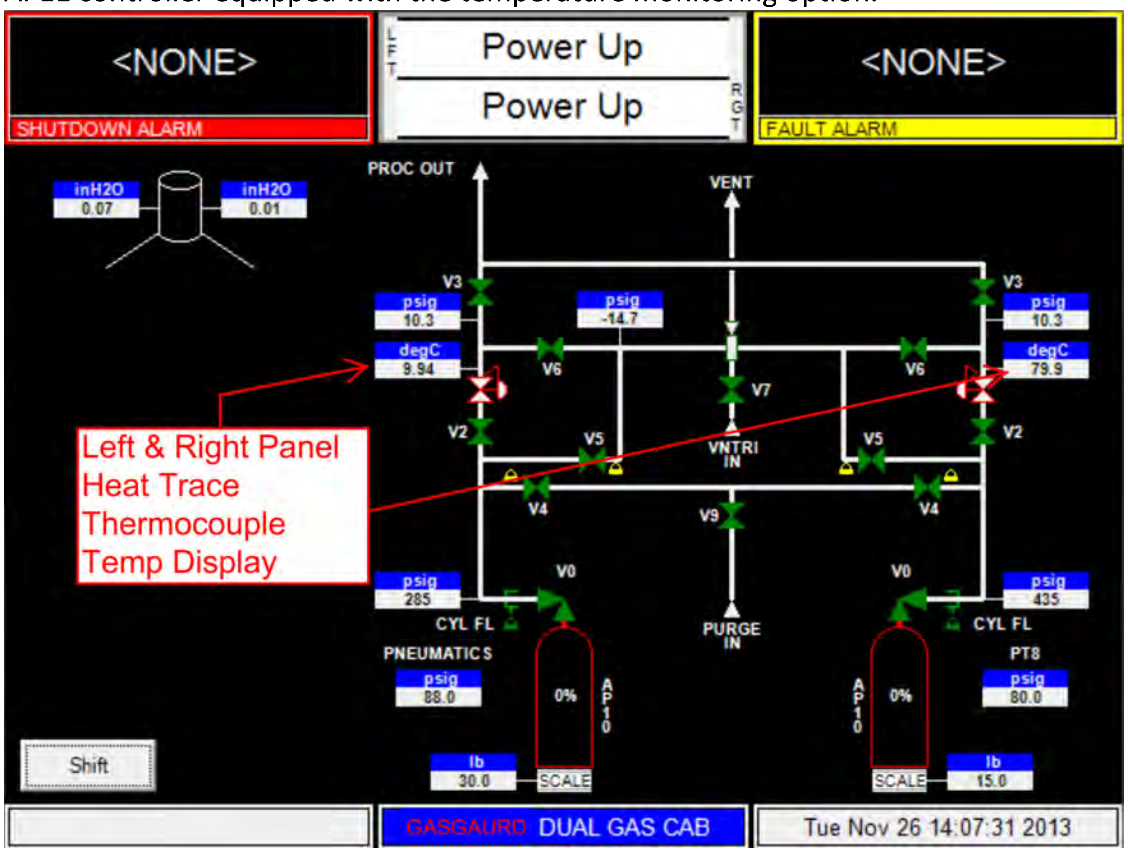
- VERY LOW PANEL TEMPEARTURE – FAULT
- LOW PANEL TEMPEARTURE – FAULT
- HIGH PANEL TEMPEARTURE – FAULT
- VERY HIGH PANEL TEMPEARTURE – FAULT

The alarms are available for both Left and Right side panels. The setpoints will vary by system. The setpoints may be adjusted in the field through the face of the controller. See Section 8 in the operating manual for instructions on how to adjust user analog setpoints.

For field installed heat trace, the AP10 thermocouple wiring instructions are included in the heat trace monitoring kit. For AP11 controllers with heat trace monitoring, the thermocouple wiring location will be shown the system EE drawing. The AP11 standard wiring locations are as follows:

ANALOG INPUT NO.	CUSTOMER EXPANSION BOARD AP1574			ANALOG INPUT DESCRIPTION
	TERMINAL BLOCK	THERMOCOUPLE VDC - (Red Wire)		
33	T10 (TC1)	T1-	T1+	PANEL HEAT TEMP – L
34	T10 (TC2)	T2-	T2+	PANEL HEAT TEMP - R

The following figure depicts where the heat trace temperate display box is located on the AP10 and AP11 controller equipped with the temperature monitoring option.



Section 6: Field Installed Heat trace

Note: All Referenced Drawings are located at the end of this procedure.

See Section 2 for power requirements.

For GASGUARD® eV, heat trace power connections are made in the junction box located inside the piping cabinet.

For legacy systems, heat trace is powered by the Heat Trace Temperature Control Unit (United Electric Controls Company P/N: E-122-2BSB-2000). Mounting of the Heat Trace Controller unit is done by the customer on the inside right cabinet side wall. Refer to drawing SW005622 for mounting details. Repeat these steps as required for installing multiple heat trace power control units.

The Heat Trace Cable must exit the strain relief at either the conduit or junction box and begin its run on the process piping, from the fitting at the cylinder connection to the process piping outlet bulkhead.

The capillary bulb (if using United Electric Controller) must be installed upstream of regulator on the opposite side of the heat trace.

The thermocouple (if GASGUARD® eV or legacy UE systems with optional temperature monitoring) must be installed at the top of the panel near the process outlet.

This procedure must be performed at each cylinder/panel location Process side A and/or Process side B and/or purge cylinder.

Installation Procedure:

1. Start at the cylinder fitting. Route heat trace cable straight along tubing axis. (Do not coil heat trace around circumference of tubing or over itself). Begin routing the heat trace with the heat trace end termination. The end termination can be identified by a boot installed over the end of the cable. Affix the heat trace to the tubing, components and standoffs with fiberglass banding tape. Do not affix boot end of heat trace to piping.

2. Refer to Figure 1 to understand path of heat trace cable and location of capillary bulb. Heat trace is only required to touch one side of each component unless otherwise noted. The heat trace must make good contact with the tubing and components to maximize heat transfer. Heat trace should coil one time around regulator bodies. Allow heat trace to contact the top of tubing

standoffs. Service loops around mechanical points such as VCR and threaded connections are required. Do not cover any weep holes on valves or regulators. Continue installing heat trace along process tubing towards the process outlet bulkhead following the dotted lines for either the right or left process panel per Figure 1 below.

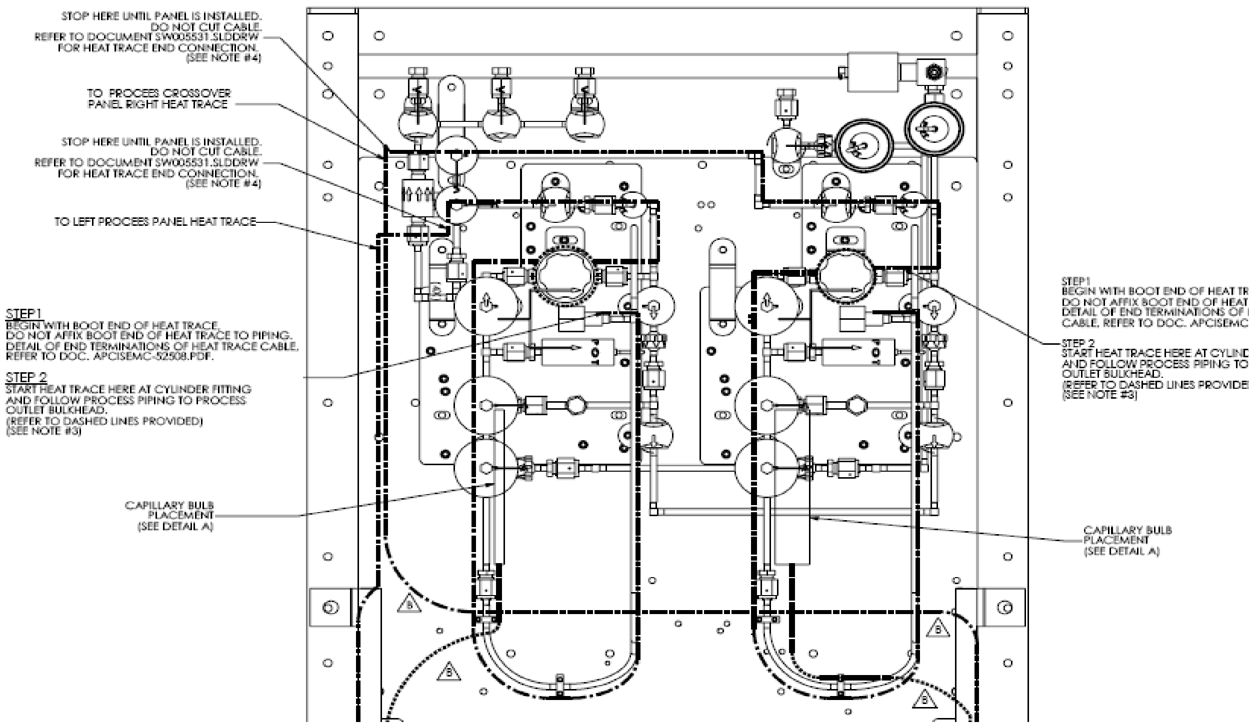
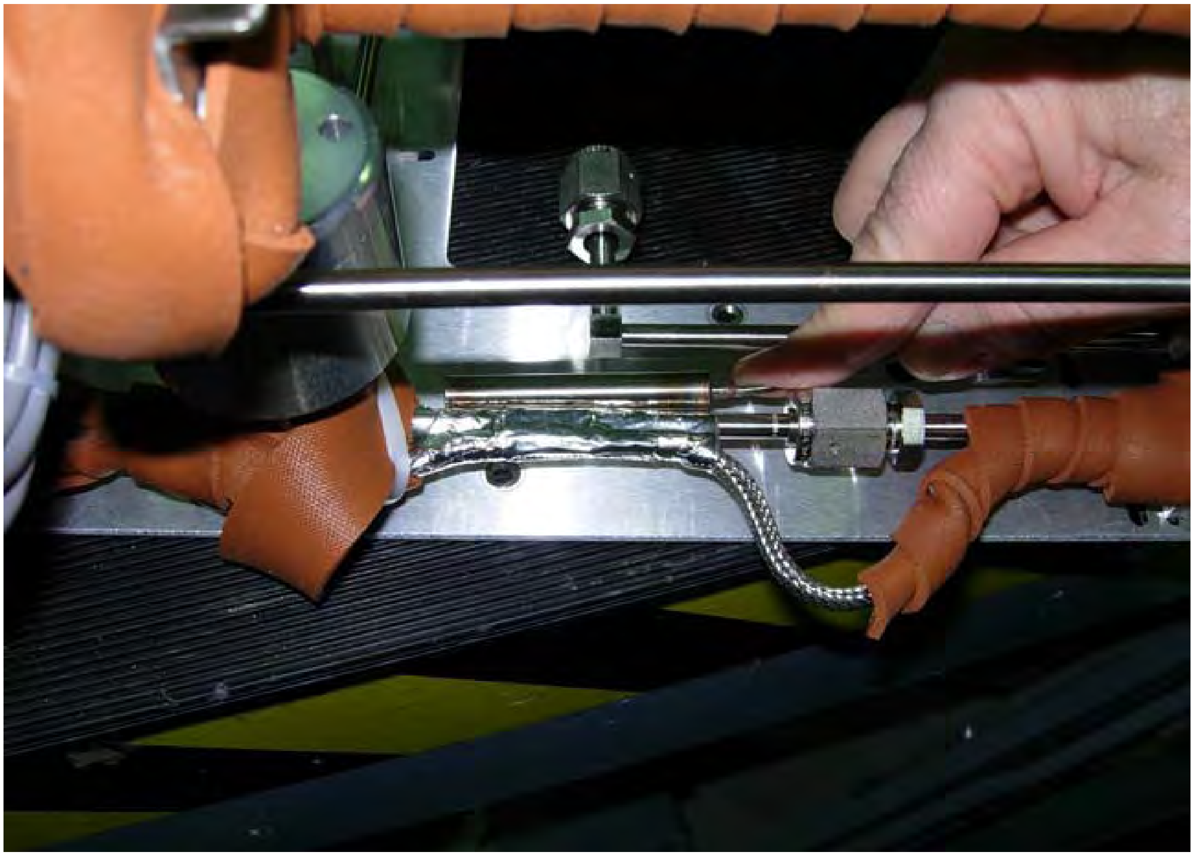


FIGURE 1

3. Stop routing the heat trace per as shown in Figure 1. Do not cut cable.

4. If using legacy United Electric heat trace controller, install the capillary bulb in the location per Figure 1. Install it 180 degree opposite the heat trace cable. Bend as needed to fit to process line. See Photo below for detail.



IMPORTANT! - *Before installing heat transfer tape in the area of the capillary bulb, please read the next step 8 of this procedure.*

5. If using GASGUARD® eV or legacy UE systems with optional temperature monitoring, install thermocouple per SW013116. Install 180 degrees opposite the heat trace.

6. Install aluminum heat transfer tape to areas where the heat trace contacts the tubing, components or standoffs. Mechanical flow switches equipped with a mechanical indicator may be wrapped with aluminum tape, but the mechanical indicator portion of the switch shall remain exposed. Do not apply aluminum tape to areas where the heat trace does not contact the tubing or component (service loops). Wrap each strip of aluminum heat transfer tape around the circumference of the tubing and heat trace. Continue installing heat transfer tape on all surfaces where heat trace contacts the process tubing.

7. Do not overlap the heat trace and thermocouple element with the same piece of heat transfer tape. Install heat transfer tape along the axis of the tubing, encapsulating the heat trace first. Install the thermocouple element diametrically opposite (180° from) the heat trace. The thermocouple element must sense process gas temperature, not heat trace temperature. Install heat transfer tape along the axis of the capillary bulb and tubing, encapsulating the capillary bulb to the process tubing.

8. Heat trace cable end terminations must now be performed in the Heat Trace Temperature Controller Unit. Refer to drawing SW005531. First, determine the approximate length of heat trace required to enter the junction box and install strain relief. Cut off the excess heat trace. Slide the stainless steel braided overjacket from the power termination point toward the piping. Inspect the underlying cable for a buss connection, signified by a protruding band under the insulating jacket. A buss connection must not be located at the junction box entrance rubber grommet, or inside the junction box. Buss connections are located every 24" on the heat trace. See sheet 1 of 3 of drawing SW005531.

9. Now that the location of the buss connection has been established, push the stainless steel braid over the insulating jacket, toward the power termination end of the cable. Place a piece of fiberglass banding tape around the stainless steel braid to mark the location of the buss connection.

10. Mark the location where the heat trace enters the junction box, using a piece of fiberglass banding tape. Again, *make sure the buss connection is located outside the junction box.* Slide the strain relief over the braided cable to the location where the heat trace will enter the junction box. Do not install the strain relief over the banding tape.

11. STEP #1 - Unwind the stainless steel over braid back toward the strain relief. Twist the stainless steel over braid strands into a single conductor to be grounded to the junction box later.

12. Strip the outer jacket plastic shell, nichrome wire, and insulating jacket to expose the insulated buss wires.

13. STEP #2 – Install heat shrink over the stainless steel overbraid strand and wires.

14. STEP #3, 4 & 5 – Install second, third and final heat shrink per the drawing.

15. Feed the heat trace buss wires into the junction box. Refer to drawing SW006658 for termination details. Remove bottom cover of the heat trace controller unit, set temperature to 100°F (or as otherwise determined) and replace cover. See Drawing SW005622.

16. Apply the foam tape around the circumference of the tubing. Overlap the foam tape approximately 3/8” continue wrapping the top sections of standoffs and around the lower section of valves and regulator bodies. Cover all the areas where aluminum tape was applied. Also wrap the foam tape around the heat trace in areas where the heat trace does not contact piping or components (i.e. service loops). Excess flow switches equipped with a mechanical indicator may be wrapped with foam tape but the mechanical indication portion of the switch shall remain exposed.

17. Apply the insulation tape around the circumference of the piping. Overlap the insulation tape approximately 3/8”. Wrap the insulation tape in the same manner as the foam tape.

Section 7: Heat Trace with Purifiers (Optional):

Gas cabinet purifiers (optional) are shipped loose to be installed in the field. For systems with factory supplied heat trace, the final cable routing and insulation must also be completed in the field. A service loop (Figure 3) is provided to be wrapped around the purifier. The purifiers must be installed according to the manufacturer’s installation and operation manual, while incorporating these additional steps:

1. Gather installation materials:
    a. Foam insulation sheet, approximately 12 x 9 inch, 3/8 to ½ inch thick
    b. Foam insulation strips, approximately 3 x 5 inch, ½ inch thick
    c. Aluminum tape (GASGUARD® MM#176950 or similar)
    d. Fiberglass banding tape, high temp reinforced (GASGUARD® MM#171861 or similar)
    e. Rubber adhesive (3M Scotch-Weld C4A, McMasterCarr #75445A72 or similar)
    f. Rubberized tape, High temperature self-fusing. (McMasterCarr #7643A79 or similar)
2. Wrap the Heat Trace service loop around the purifier (Figure 4). This can be accomplished by rotating the purifier and cable as the purifier is placed into the process piping.

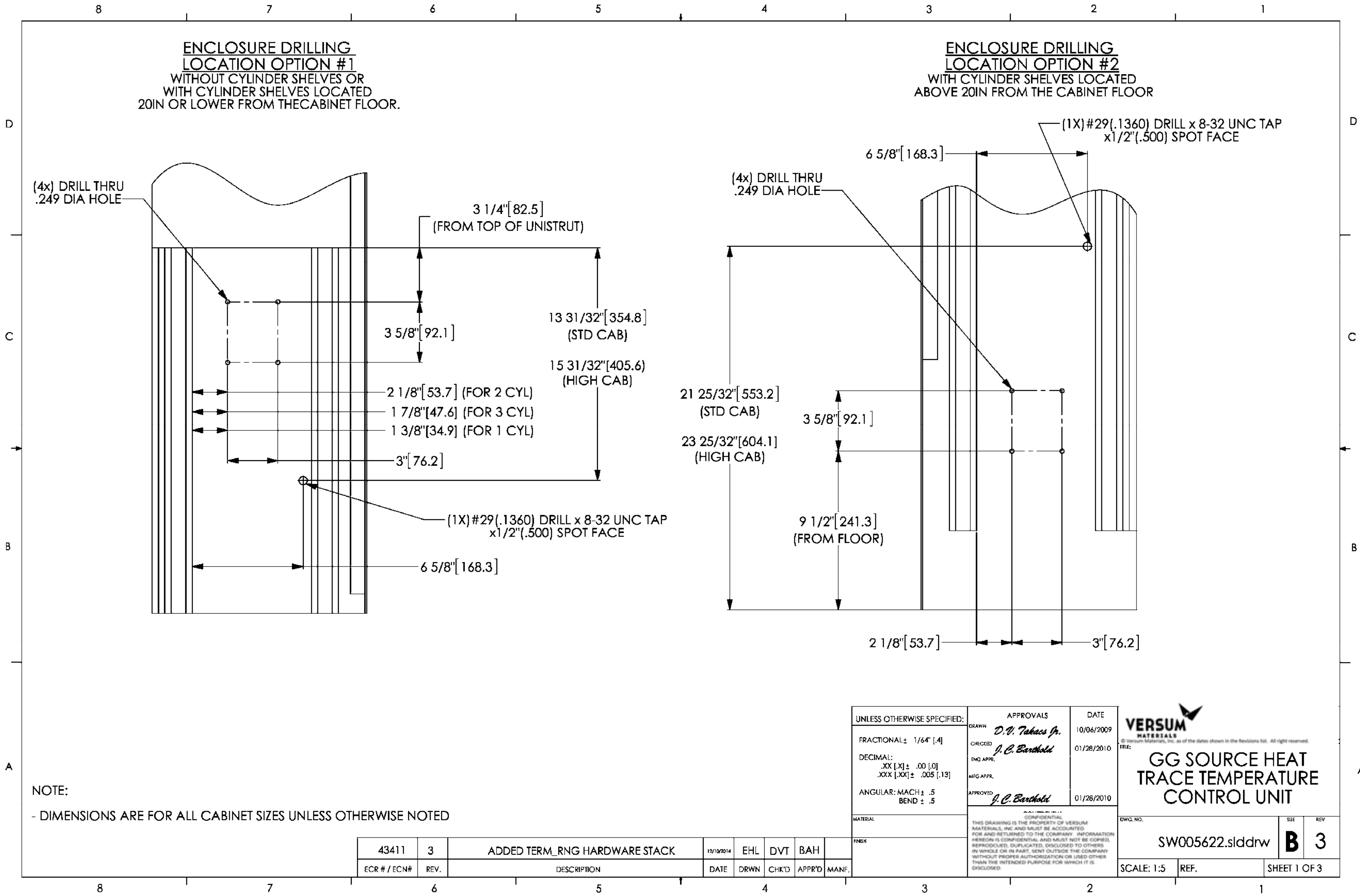
Figure 3: Service loop of heat trace cable for purifier, as shipped.

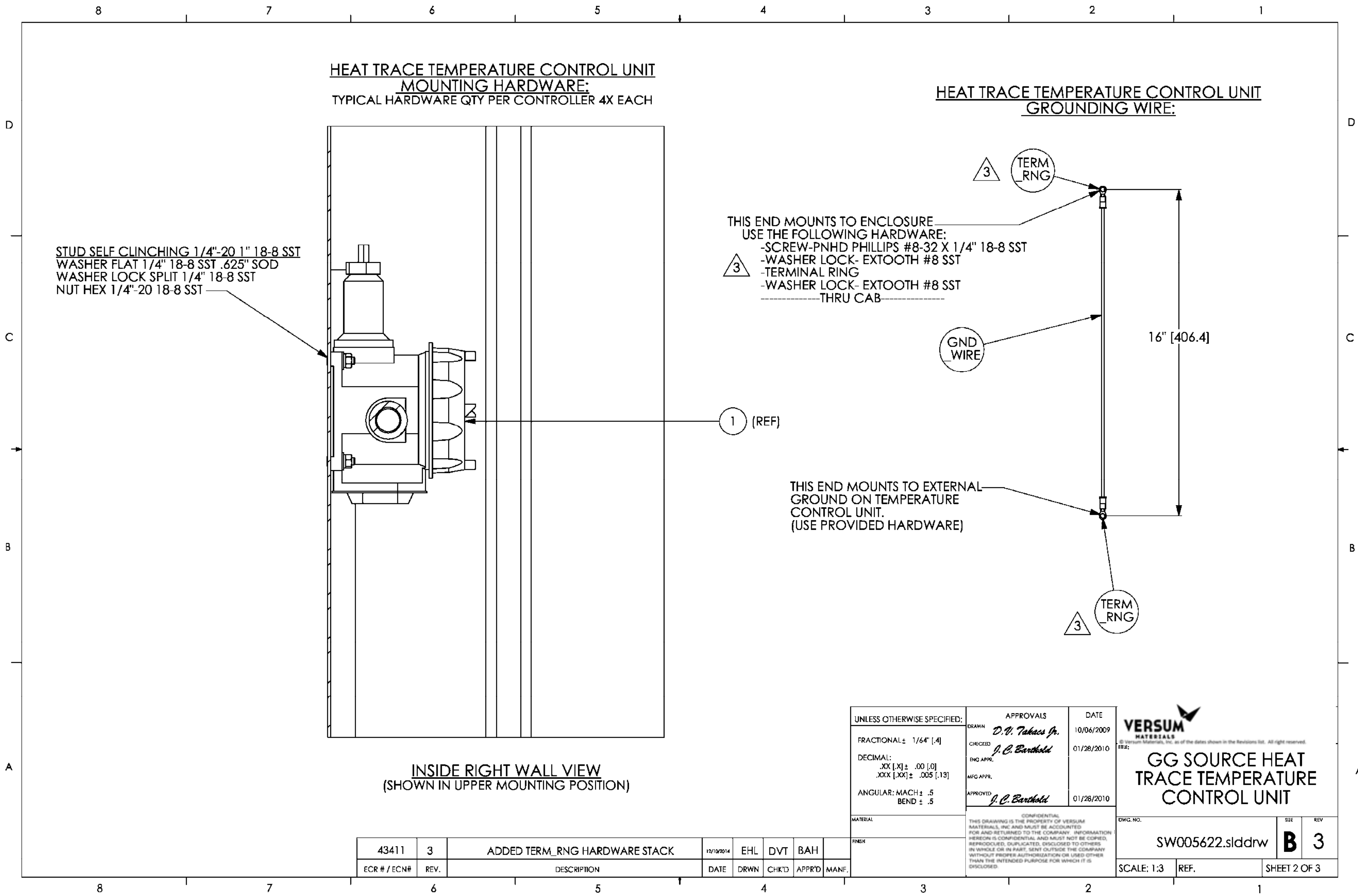
Figure 4: Purifier with cable wrapped around it, before loops are separated and secured.

3. Secure the cable with fiberglass tape. Separate cable loops as evenly as possible before taping. Do not allow loops to overlap or touch as they appear in the picture above. It is incorrect to have the heat trace cable touching itself.
4. Wrap the purifier with aluminum tape.
5. Wrap the foam sheet around the purifier. If necessary, trim the sheet to fit snuggly and butt ends together. Allow the foam to extend an extra 1-2 inches past the top and bottom of purifier.
6. Seal the foam ends together with rubber adhesive.
7. For additional security, wrap foam sheet with rubber tape around the purifier.

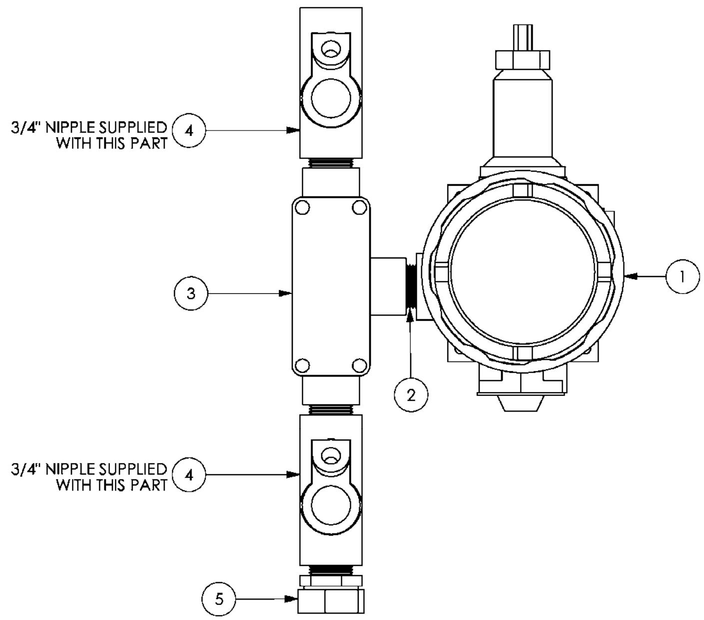
8. Scrunch together top and bottom to insulate the purifier faces. Secure with rubber tape.
9. Insulate any exposed heat trace cable remaining in the service loop.
10. After pressure and leak-checking the assembly, install foam strips on VCR fittings. Secure with adhesive and rubber tape.

Section 8: Reference Drawings

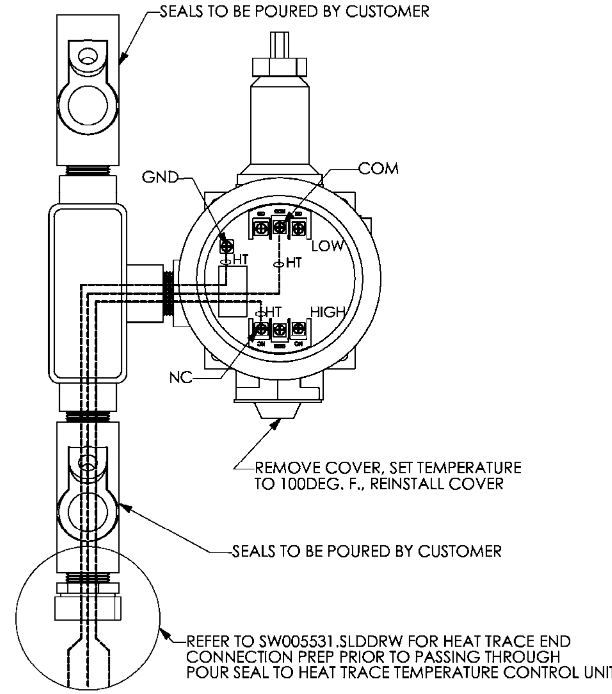



HEAT TRACE TEMPERATURE CONTROL UNIT
MOUNTING HARDWARE:
TYPICAL HARDWARE QTY PER CONTROLLER 4X EACH
STUD SELF CLINCHING 1/4"-20 1" 18-8 SST
WASHER FLAT 1/4" 18-8 SST .625" SOD
WASHER LOCK SPLIT 1/4" 18-8 SST
NUT HEX 1/4"-20 18-8 SST
1 (REF)
INSIDE RIGHT WALL VIEW
(SHOWN IN UPPER MOUNTING POSITION)
HEAT TRACE TEMPERATURE CONTROL UNIT
GROUNDING WIRE:
3
TERM_RNG
THIS END MOUNTS TO ENCLOSURE
USE THE FOLLOWING HARDWARE:
-SCREW-PNHD PHILLIPS #8-32 X 1/4" 18-8 SST
-WASHER LOCK- EXTOOTH #8 SST
-TERMINAL RING
-WASHER LOCK- EXTOOTH #8 SST
THRU CAB
GND WIRE
16" [406.4]
THIS END MOUNTS TO EXTERNAL GROUND ON TEMPERATURE CONTROL UNIT.
(USE PROVIDED HARDWARE)
TERM_RNG
3
43411 | 3 | ADDED TERM_RNG HARDWARE STACK | 17/10/2014 | EHL | DVT | BAH
ECR # / ECN# | REV. | DESCRIPTION | DATE | DRWN | CHK'D | APPR'D | MANF.
UNLESS OTHERWISE SPECIFIED:
FRACTIONAL ± 1/64" [.4]
DECIMAL: .XX [.X] ± .00 [.0] .XXX [.XX] ± .005 [.13]
ANGULAR: MACH ± .5 BEND ± .5
APPROVALS
DATE
DRAWN D.V. Takacs Jr. 10/06/2009
CHECKED J.C. Barthold 01/28/2010
APPROVED J.C. Barthold 01/28/2010
VERSUM MATERIALS
GG SOURCE HEAT TRACE TEMPERATURE CONTROL UNIT
SW005622.slddrw
B
3
SCALE: 1:3
REF.
SHEET 2 OF 3

HEAT TRACE TEMPERATURE CONTROL UNIT ASSEMBLY:



HEAT TRACE CABLE END TERMINATIONS IN HEAT TRACE TEMPERATURE CONTROL UNIT:



NOTES:

1. REPEAT STEPS AS REQUIRED FOR MULTIPLE HEAT TRACE TEMPERATURE CONTROL UNITS.
2. ALL ITEMS MUST BE ASSEMBLED USING CONDUIT JOINT SEALANT.

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
43411	3	ADDED TERM_RNG HARDWARE STACK	12/10/2014	EHL	DVT	BAH	

UNLESS OTHERWISE SPECIFIED:
FRACTIONAL ± 1/64" [.4]
DECIMAL: .XX [.X] ± .00 [.0] .XXX [.XX] ± .005 [.13]
ANGULAR: MACH ± .5 BEND ± .5

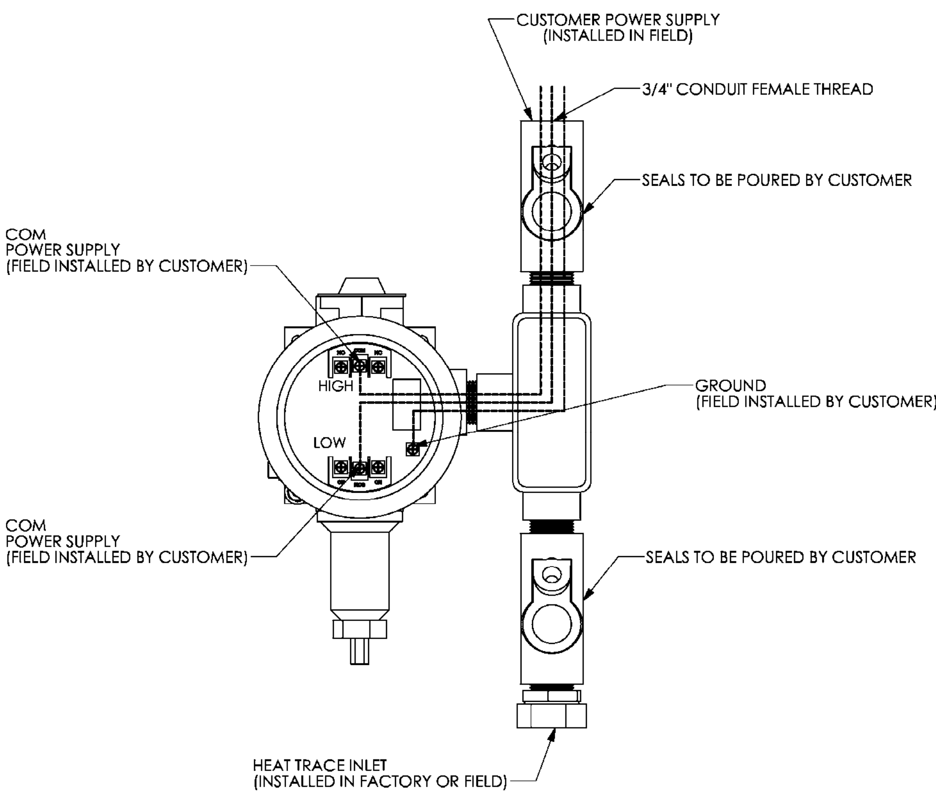
APPROVALS		DATE
DRAWN	D.V. Takacs Jr.	10/06/2009
CHECKED	J.C. Barthold	01/28/2010
ENG APPR.		
MFG APPR.		
APPROVED	J.C. Barthold	01/28/2010

VERSUM MATERIALS

TITLE: GG SOURCE HEAT TRACE TEMPERATURE CONTROL UNIT

DWG. NO. SW005622.slddrw SIZE B REV 3

SCALE: 1:2.5 REF. SHEET 3 OF 3



NOTES:

1. CUSTOMER IS REQUIRED TO DRILL THE ENCLOSURE TO PROVIDE POWER TO THE HEAT TRACE TEMPERATURE CONTROL UNIT(S). THE SUGGESTED LOCATION TO DRILL WOULD BE ANY WHERE ON THE TOP FLAT SURFACE OF ENCLOSURE SHEET METAL. DO NOT ATTEMPT TO DRILL INTO CONTROLLER.

2. ELECTRICAL TEMPERATURE CONTROL UNIT REQUIREMENTS:
---VOLTAGE: 120/240VAC 50/60Hz, SINGLE PHASE
---CURRENT: 20A MAX GFCI CIRCUIT
---INTERIOR ELECTRICAL CLASSIFICATION: CLASS 1 DIV2

UNLESS OTHERWISE SPECIFIED:	APPROVALS	DATE
FRACTIONAL ± 1/64" [.4]	DRAWN J. C. Barthold	08/20/2010
DECIMAL: .XX [.X] ± .00 [.0] .XXX [.XX] ± .005 [.13]	CHECKED P. M. Herwig	08/20/2010
ANGULAR: MACH ± .5 BEND ± .5	ENG APPR. X. X. Xxxxxx	00/00/0000
	MFG APPR. X. X. Xxxxxx	00/00/0000
	APPROVED P. M. Herwig	08/20/2010
MATERIAL Material <not specified>		
FINISH XXXXX		

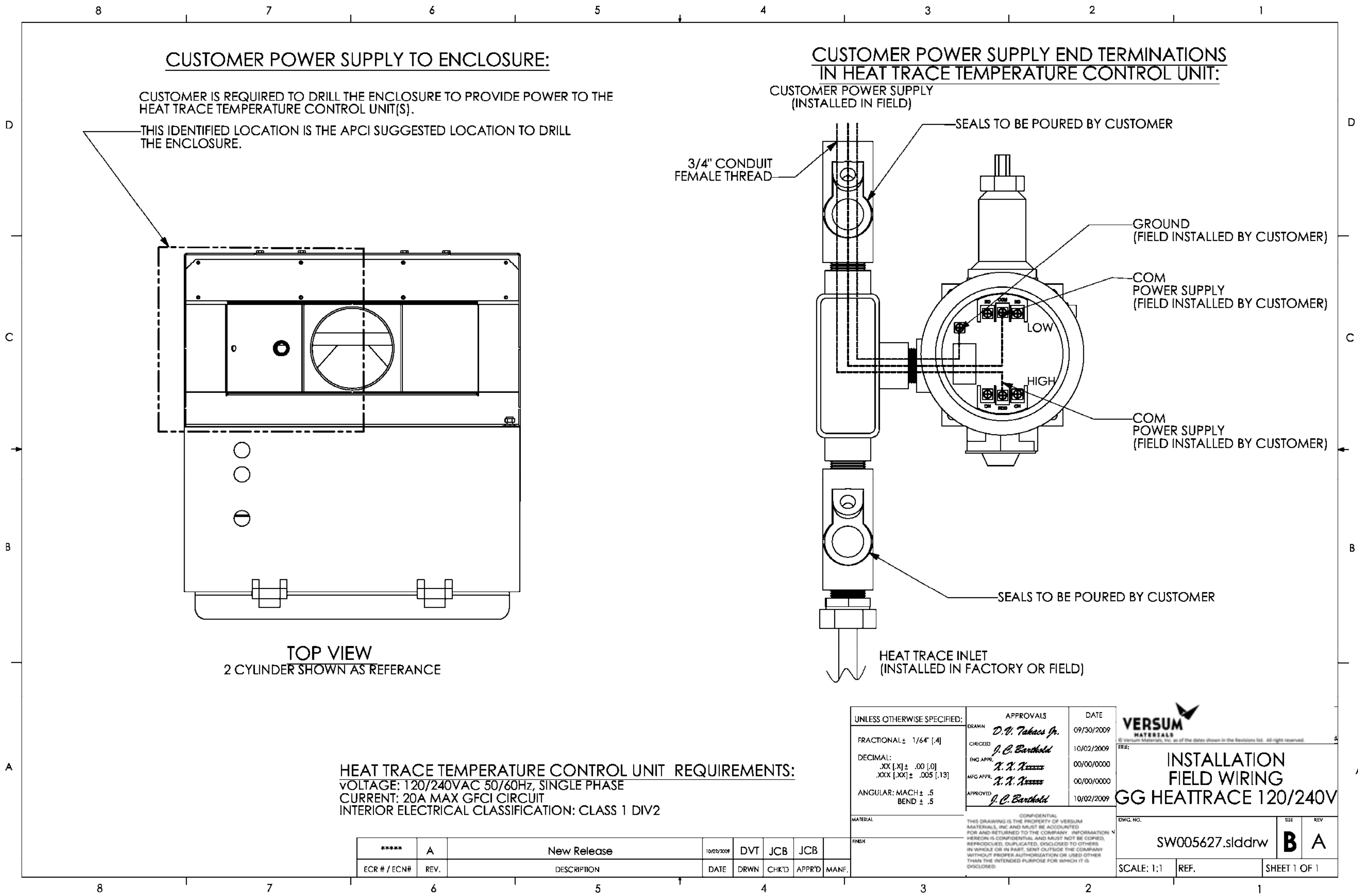
VERSUM MATERIALS

TITLE: Installation Field Wiring HeatTrace 120/240V

DWG. NO.	SIZE	REV
SW006666.slddrw	B	A

SCALE: 1:1 REF. SHEET 1 OF 1

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
*****	A	New Release	08/20/2010	JCB	PMH	PMH	XXX


CUSTOMER POWER SUPPLY TO ENCLOSURE:
CUSTOMER IS REQUIRED TO DRILL THE ENCLOSURE TO PROVIDE POWER TO THE HEAT TRACE TEMPERATURE CONTROL UNIT(S).
THIS IDENTIFIED LOCATION IS THE APCI SUGGESTED LOCATION TO DRILL THE ENCLOSURE.
TOP VIEW
2 CYLINDER SHOWN AS REFERANCE
CUSTOMER POWER SUPPLY END TERMINATIONS IN HEAT TRACE TEMPERATURE CONTROL UNIT:
CUSTOMER POWER SUPPLY (INSTALLED IN FIELD)
SEALS TO BE POURED BY CUSTOMER
3/4" CONDUIT FEMALE THREAD
GROUND (FIELD INSTALLED BY CUSTOMER)
COM POWER SUPPLY (FIELD INSTALLED BY CUSTOMER)
LOW
HIGH
COM POWER SUPPLY (FIELD INSTALLED BY CUSTOMER)
SEALS TO BE POURED BY CUSTOMER
HEAT TRACE INLET (INSTALLED IN FACTORY OR FIELD)
HEAT TRACE TEMPERATURE CONTROL UNIT REQUIREMENTS:
VOLTAGE: 120/240VAC 50/60Hz, SINGLE PHASE
CURRENT: 20A MAX GFCI CIRCUIT
INTERIOR ELECTRICAL CLASSIFICATION: CLASS 1 DIV2
ECR # / ECN# | REV. A | DESCRIPTION New Release | DATE 10/02/2009 | DRWN DVT | CHK'D JCB | APPR'D JCB | MANF.
UNLESS OTHERWISE SPECIFIED:
FRACTIONAL± 1/64" [.4]
DECIMAL: .XX [.X]± .00 [.0] .XXX [.XX]± .005 [.13]
ANGULAR: MACH± .5 BEND ± .5
MATERIAL
FINISH
APPROVALS | DATE
DRAWN D.V. Takacs Jr. 09/30/2009
CHECKED J.C. Barthold 10/02/2009
ENG APPR. X.X. Xxxxxx 00/00/0000
MFG APPR. X.X. Xxxxxx 00/00/0000
APPROVED J.C. Barthold 10/02/2009
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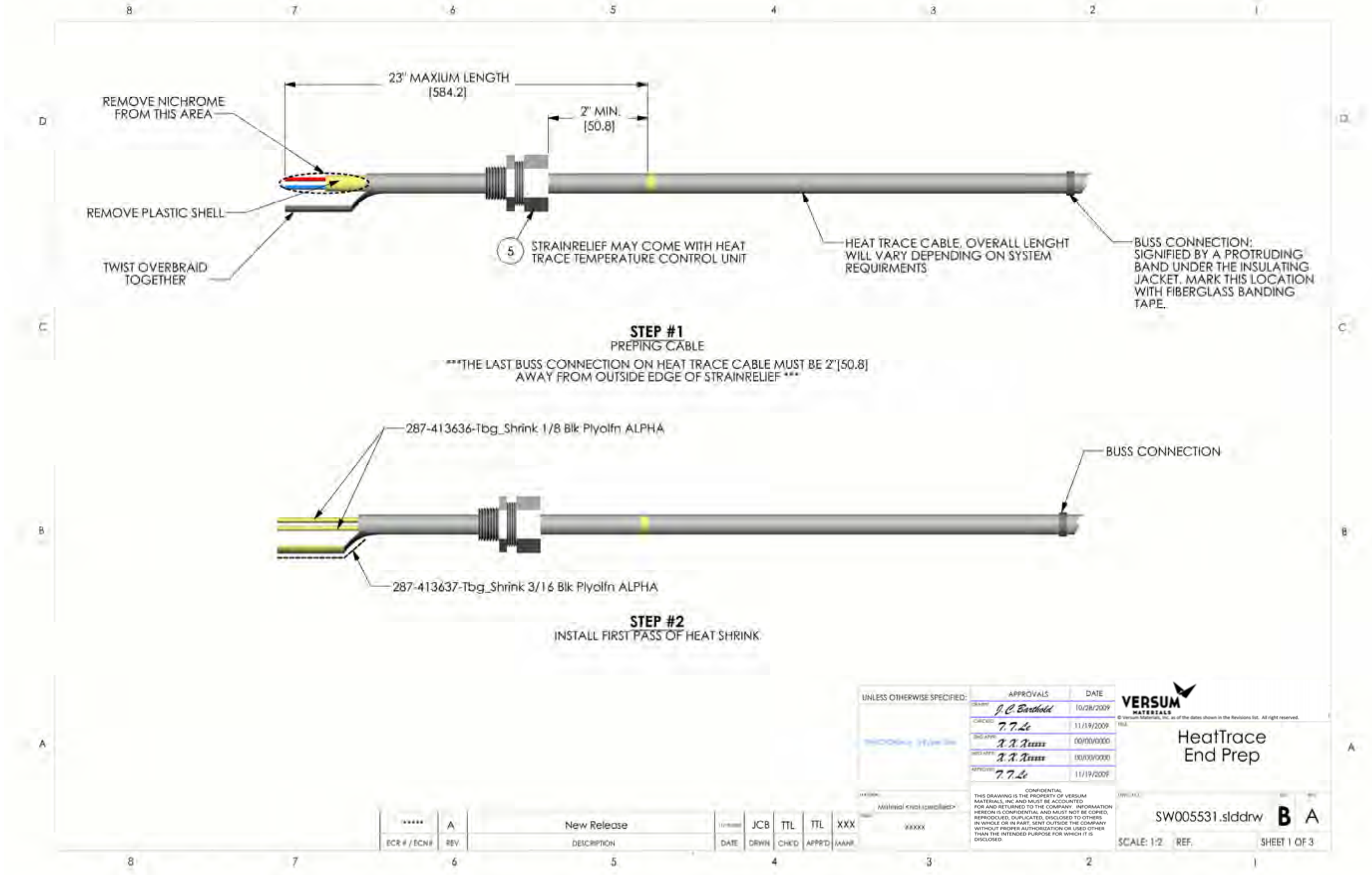
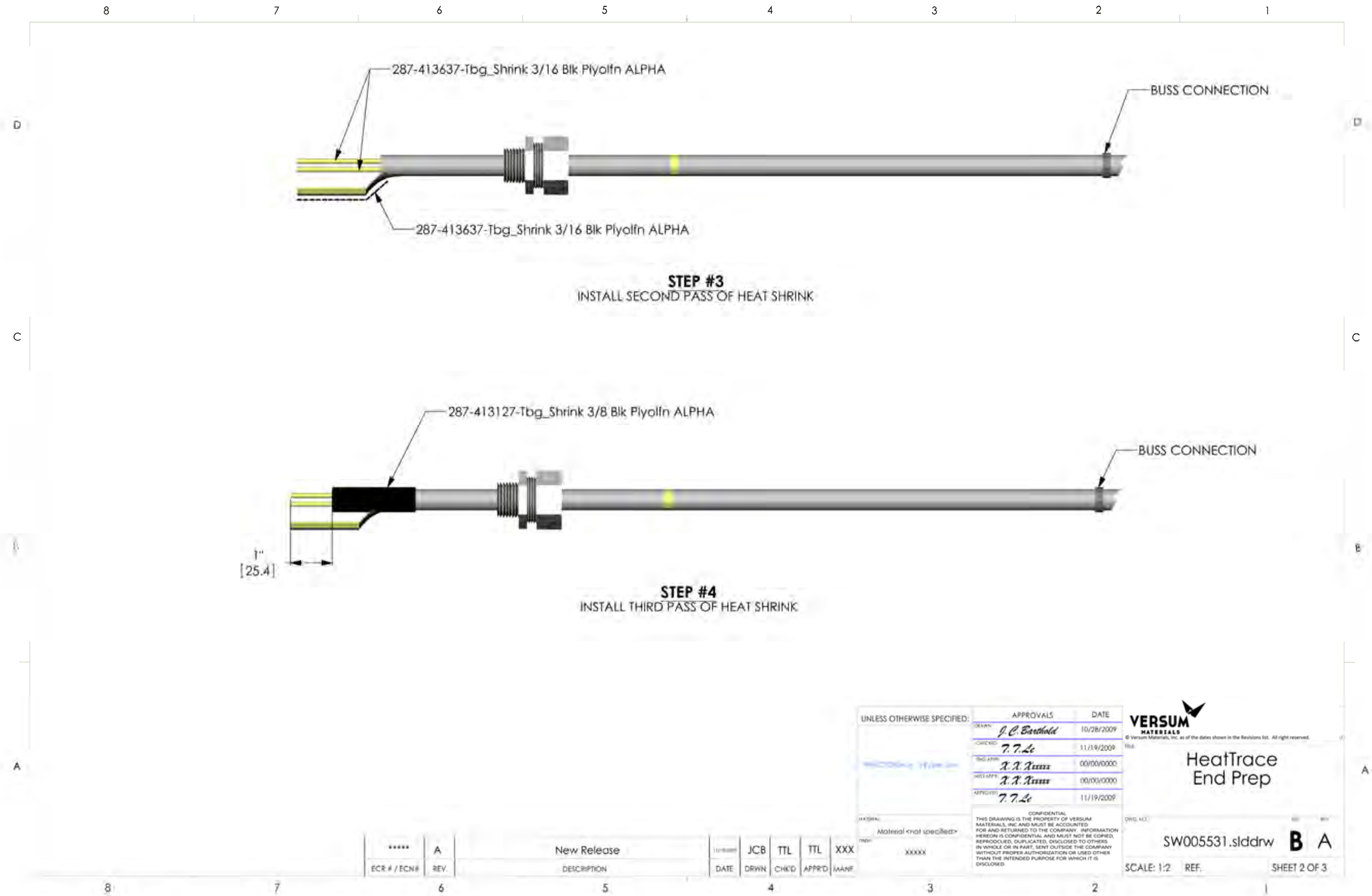
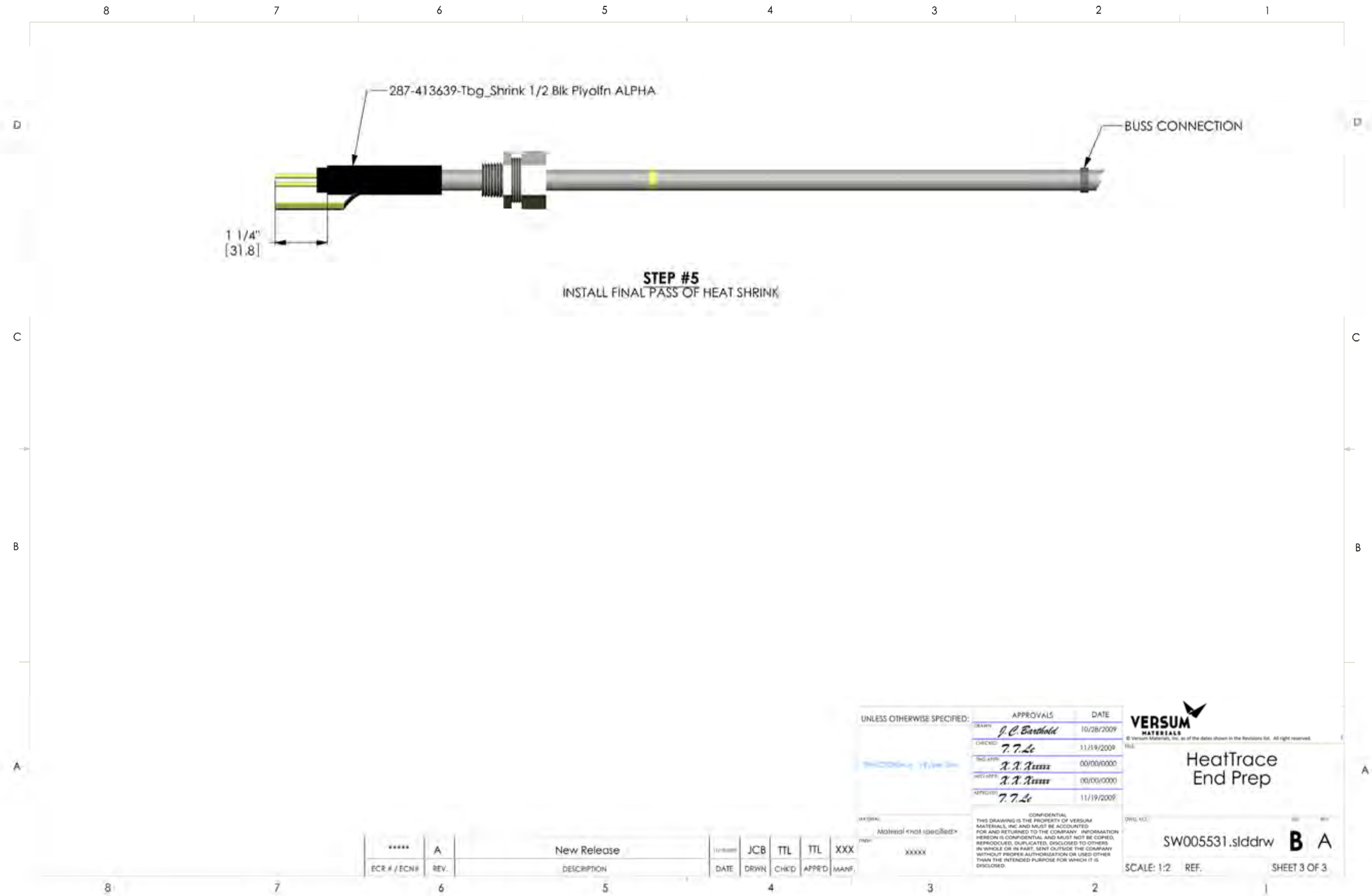
VERSUM MATERIALS
TITLE: INSTALLATION FIELD WIRING GG HEATTRACE 120/240V
DWG. NO. SW005627.slddrw
SIZE B
REV A
SCALE: 1:1
REF.
SHEET 1 OF 1



23" MAXIUM LENGTH
[584.2]
2" MIN.
[50.8]
REMOVE NICHROME FROM THIS AREA
REMOVE PLASTIC SHELL
TWIST OVERBRAID TOGETHER
5
STRAINRELIEF MAY COME WITH HEAT TRACE TEMPERATURE CONTROL UNIT
HEAT TRACE CABLE, OVERALL LENGHT WILL VARY DEPENDING ON SYSTEM REQUIRMENTS
BUSS CONNECTION: SIGNIFIED BY A PROTRUDING BAND UNDER THE INSULATING JACKET. MARK THIS LOCATION WITH FIBERGLASS BANDING TAPE.
STEP #1
PREPING CABLE
***THE LAST BUSS CONNECTION ON HEAT TRACE CABLE MUST BE 2"[50.8] AWAY FROM OUTSIDE EDGE OF STRAINRELIEF ***
287-413636-Tbg_Shrink 1/8 Blk Plyolfn ALPHA
BUSS CONNECTION
287-413637-Tbg_Shrink 3/16 Blk Plyolfn ALPHA
STEP #2
INSTALL FIRST PASS OF HEAT SHRINK
UNLESS OTHERWISE SPECIFIED:
APPROVALS
DATE
J. C. Barthold
10/28/2009
T. T. Le
11/19/2009
X. X. Xxxxx
00/00/0000
X. X. Xxxxx
00/00/0000
T. T. Le
11/19/2009
VERSUM MATERIALS
HeatTrace
End Prep
SW005531.slddrw
B
A
SCALE: 1:2
REF.
SHEET 1 OF 3
*****
A
New Release
JCB
TTL
TTL
XXX
ECR # / ECN#
REV
DESCRIPTION
DATE
DRWN
CHK'D
APPR'D

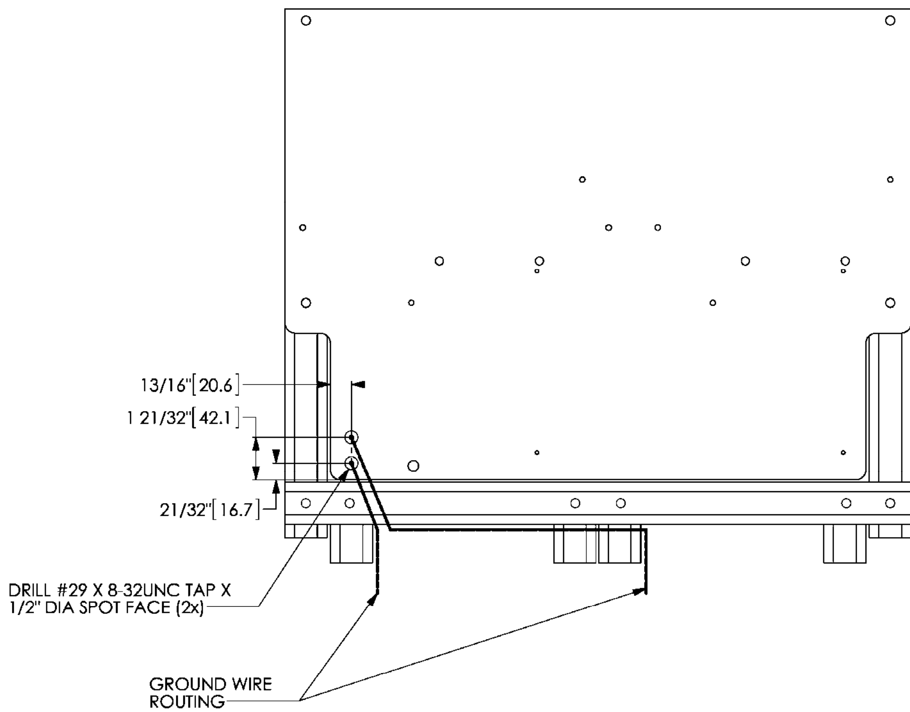

287-413637-Tbg_Shrink 3/16 Blk Plyolfn ALPHA
BUSS CONNECTION
287-413637-Tbg_Shrink 3/16 Blk Plyolfn ALPHA
STEP #3
INSTALL SECOND PASS OF HEAT SHRINK
287-413127-Tbg_Shrink 3/8 Blk Plyolfn ALPHA
BUSS CONNECTION
1"
[25.4]
STEP #4
INSTALL THIRD PASS OF HEAT SHRINK
UNLESS OTHERWISE SPECIFIED:
APPROVALS
DATE
J. C. Barthold
10/28/2009
T. T. Le
11/19/2009
X. X. Xxxxx
00/00/0000
X. X. Xxxxx
00/00/0000
T. T. Le
11/19/2009
HeatTrace
End Prep
***** A New Release JCB TTL TTL XXX
ECR # / ECN# REV. DESCRIPTION DATE DRWN CHK'D APPR'D MANF
Material <not specified>
XXXXX
SW005531.slddrw B A
SCALE: 1:2 REF. SHEET 2 OF 3



287-413639-Tbg_Shrink 1/2 Blk Plyolfn ALPHA
BUSS CONNECTION
1 1/4"
[31.8]
STEP #5
INSTALL FINAL PASS OF HEAT SHRINK
UNLESS OTHERWISE SPECIFIED:
APPROVALS
DATE
J.C.Barthold 10/28/2009
T.T.Le 11/19/2009
X.X.Xxxxx 00/00/0000
X.X.Xxxxx 00/00/0000
T.T.Le 11/19/2009
VERSUM MATERIALS
HeatTrace
End Prep
SW005531.slddrw
B
A
SCALE: 1:2
REF.
SHEET 3 OF 3
*****
A
New Release
JCB
TTL
TTL
XXX
ECR # / ECN#
REV.
DESCRIPTION
DATE
DRWN
CHK'D
APPR'D
MANF.
Material <not specified>
XXXXX

HEAT TRACE CONTROLLER MOUNTING
FOR HEAT TRACE WITH CYLINDER SHELVES
(MOUNT IN "UPPER POSITION" WHEN CYLINDER SHELVES ARE NOT REQUIRED)

DIA. x 12"	LOWER POSITION
DIA. x 16"	LOWER POSITION
DIA. x 17"	LOWER POSITION
DIA. x 19"	LOWER POSITION
DIA. x 22"	LOWER POSITION
DIA. x 25"	LOWER POSITION
DIA. x 26"	LOWER POSITION
DIA. x 31.5"	UPPER POSITION
DIA. x 33"	UPPER POSITION
DIA. x 36"	UPPER POSITION
DIA. x 350mm	LOWER POSITION
DIA. x 430mm	LOWER POSITION
DIA. x 450mm	LOWER POSITION
DIA. x 530mm	LOWER POSITION
DIA. x 555mm	LOWER POSITION
DIA. x 830mm	UPPER POSITION
DIA. x 850mm	UPPER POSITION
DIA. x 845mm	UPPER POSITION
DIA. x940mm	UPPER POSITION
DIA. x 1000mm	UPPER POSITION



FRONT VIEW
(DRILLING DETAIL)

NOTE:

1. 2 CYL WLMNT OPTION SHOWN, FOLLOW SAME ROUTING PATTERN AND PENETRATIONS FOR RACK SYSTEMS
2. USE DIMENSIONS FOR ALL ENCLOSURE SIZES. USE LOWER PENETRATION FOR 1 CYL OR SINGLE HEAT TRACE SYSTEMS
3. USE TY-WRAPS TO SECURE GROUND WIRE

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
	2	ADDED SHEET 1	12/22/2014	KZ	TTL	TTL	

UNLESS OTHERWISE SPECIFIED:
FRACTIONAL ± 1/64" [.4]
DECIMAL:
.XX [.X] ± .00 [.0]
.XXX [.XX] ± .005 [.13]
ANGULAR: MACH ± .5
BEND ± .5

Weld Station: NA

APPROVALS		DATE
DRAWN	J. C. Barthold	8/19/2010
CHECKED	P. M. Herwig	8/23/2010
ENG APPR.		
MFG APPR.		
APPROVED	P. M. Herwig	8/23/2010

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VERSUM MATERIALS
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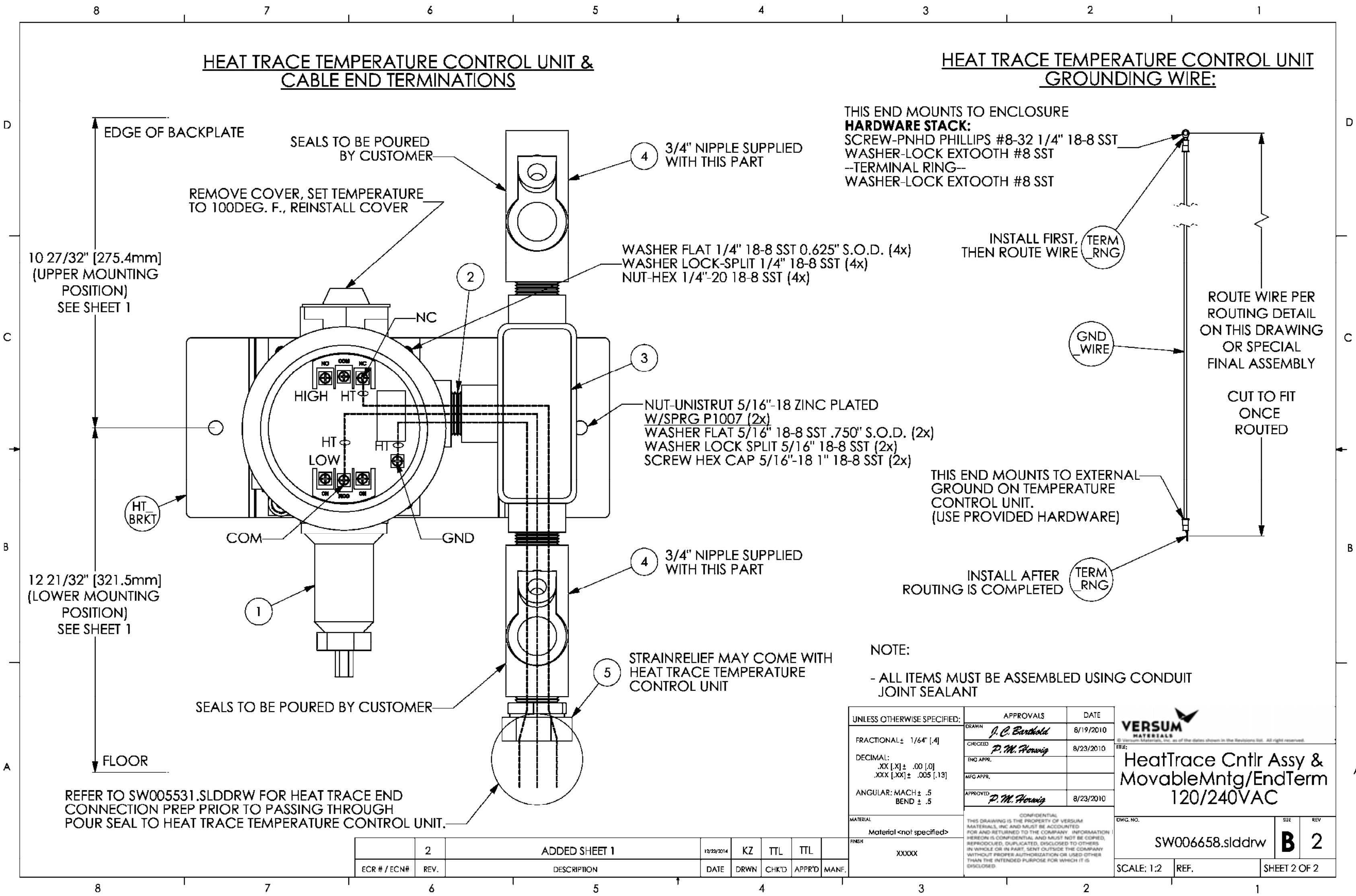
TITLE: HeatTrace Cntlr Assy & MovableMntg/EndTerm 120/240VAC

DWG. NO.: SW006658.slddrw | SIZE: B | REV: 2

SCALE: 1:4 | REF. | SHEET 1 OF 2


HEAT TRACE TEMPERATURE CONTROL UNIT & CABLE END TERMINATIONS
HEAT TRACE TEMPERATURE CONTROL UNIT GROUNDING WIRE:
EDGE OF BACKPLATE
SEALS TO BE POURED BY CUSTOMER
REMOVE COVER, SET TEMPERATURE TO 100DEG. F., REINSTALL COVER
3/4" NIPPLE SUPPLIED WITH THIS PART
WASHER FLAT 1/4" 18-8 SST 0.625" S.O.D. (4x)
WASHER LOCK-SPLIT 1/4" 18-8 SST (4x)
NUT-HEX 1/4"-20 18-8 SST (4x)
10 27/32" [275.4mm] (UPPER MOUNTING POSITION) SEE SHEET 1
NC
HIGH
HT
LOW
HT BRKT
COM
GND
NUT-UNISTRUT 5/16"-18 ZINC PLATED W/SPRG P1007 (2x)
WASHER FLAT 5/16" 18-8 SST .750" S.O.D. (2x)
WASHER LOCK SPLIT 5/16" 18-8 SST (2x)
SCREW HEX CAP 5/16"-18 1" 18-8 SST (2x)
12 21/32" [321.5mm] (LOWER MOUNTING POSITION) SEE SHEET 1
STRAINRELIEF MAY COME WITH HEAT TRACE TEMPERATURE CONTROL UNIT
SEALS TO BE POURED BY CUSTOMER
FLOOR
REFER TO SW005531.SLDDRW FOR HEAT TRACE END CONNECTION PREP PRIOR TO PASSING THROUGH POUR SEAL TO HEAT TRACE TEMPERATURE CONTROL UNIT.
THIS END MOUNTS TO ENCLOSURE
HARDWARE STACK:
SCREW-PNHD PHILLIPS #8-32 1/4" 18-8 SST
WASHER-LOCK EXTOOTH #8 SST
--TERMINAL RING--
WASHER-LOCK EXTOOTH #8 SST
INSTALL FIRST, THEN ROUTE WIRE
TERM RNG
GND WIRE
ROUTE WIRE PER ROUTING DETAIL ON THIS DRAWING OR SPECIAL FINAL ASSEMBLY
CUT TO FIT ONCE ROUTED
THIS END MOUNTS TO EXTERNAL GROUND ON TEMPERATURE CONTROL UNIT. (USE PROVIDED HARDWARE)
INSTALL AFTER ROUTING IS COMPLETED
NOTE:
- ALL ITEMS MUST BE ASSEMBLED USING CONDUIT JOINT SEALANT
UNLESS OTHERWISE SPECIFIED:
APPROVALS
DATE
DRAWN J.C. Barthold 8/19/2010
CHECKED P.M. Herwig 8/23/2010
APPROVED P.M. Herwig 8/23/2010
FRACTIONAL ± 1/64" [.4]
ANGULAR: MACH ± .5 BEND ± .5
Material <not specified>
XXXXX
VERSUM MATERIALS
HeatTrace Cntlr Assy & MovableMntg/EndTerm 120/240VAC
SW006658.slddrw
B
2
SCALE: 1:2
REF.
SHEET 2 OF 2
2
ADDED SHEET 1
KZ
TTL
TTL
ECR # / ECN#
REV.
DESCRIPTION
DATE
DRWN
CHK'D
APPR'D
MANF.

HARDWARE TABLE				
ITEM NO.	QTY.	PART NO.	VENDOR	DESCRIPTION
1	A/R	889-606432	SAP	RC_TapeInsltn_1SilicnFoam .125inTHKx30ft
2	A/R	889-606433	SAP	RC_TapeInsltn_1 SilcnFoam .030inTHKx60ft

NOTES:

1. REFER TO DOC000009.DOC FOR GENERIC HEAT TRACE INSTRUCTIONS.
2. FLEX STYLE PIGTAILS ONLY, SEE PAGE 7 DETAIL'A' ON THIS DOCUMENT.
3. WHEN OPTION MV30 IS REQUIRED, INSULATE PIPING ONLY. USE ONE LAYER OF EACH INSULATION MATERIAL LISTED IN HARDWARE TABLE ON PAGE 1.
4. IF EXTERNAL PROCESS OUTLET IS REQUIRED (1X, 2X, OR 3X) WRAP ALL PROCESS OUTLET(S) AND HEADER PIPING IF ANY, BETWEEN VCR BREAK AND BULKHEAD(S). ANY OUTLET PIPING OTHER THAN PROCESS DOES NOT GET INSULATION OR HEAT TRACE. (SEE PAGE 8 FOR SPECIAL CASES AND INSULATION MATERIAL)
5. FLEXIBLE FOAM RUBBER 3/8" x 9" x 11" AND 4 TY-WRAPS TO BE SHIPPED LOOSE WITH UNIT.
6. IF BLANK FILTER SPOOL IS USED WITH CLSTR, VERIFY WITH DESIGN BEFORE HEAT TRACING.
7. BEGIN WITH BOOT END OF HEAT TRACE, DO NOT AFFIX BOOT END OF HEAT TRACE TO PIPING. DETAIL OF END TERMINATIONS OF HEAT TRACE CABLE, REFER TO WOK-INS1133A.DOC.
8. STOP HERE, DO NOT CUT CABLE. REFER TO SW005531.SLDDRW FOR HEAT TRACE BEGINNING TERMINATION. MAKE CONNECTION INSIDE JUNCTION BOX.
9. CAPILLARY BULB PLACEMENT IF V4 IS ON PIGTAIL,SEE DOC000011.DOC FOR CAPILLARY BULB ORIENTATION.
10. CAPILLARY BULB PLACEMENT IF V4 IS ON PANEL, SEE DOC000011.DOC FOR CAPILLARY BULB ORIENTATION. SEE PAGE 7 DETAIL'B' ON THIS DOCUMENT FOR SPECIAL TUBE SUPPORT PLACEMENT AND DRILLING.
11. NON GASGUARD eV UNITS: RETRANSMISSION THERMOCOUPLE IS OPTIONAL, SPEC SHEET WILL INFORM YOU WHEN REQUIRED. SEE SW011286.SLDDRW FOR THERMOCOUPLE ORIENTATION. CREATE QTY.2 BRADY LABELS AND PLACE THEM 2" FROM BOTH ENDS OF CABLE. TEXT ON LABEL WILL READ "DT-A".

    GASGUARD eV UNITS: THERMOCOUPLE IS REQUIRED. SEE SW011286.SLDDRW FOR THERMOCOUPLE ORIENTATION. CREATE QTY.2 BRADY LABELS AND PLACE THEM 2" FROM BOTH ENDS OF CABLE. TEXT ON LABEL WILL READ "TC1".
12. NON GASGUARD eV UNITS: RETRANSMISSION THERMOCOUPLE IS OPTIONAL, SPEC SHEET WILL INFORM YOU WHEN REQUIRED. SEE SW011286.SLDDRW FOR THERMOCOUPLE ORIENTATION. CREATE QTY.2 BRADY LABELS AND PLACE THEM 2" FROM BOTH ENDS OF CABLE. TEXT ON LABEL WILL READ "DT-B".

    GASGUARD eV UNITS: THERMOCOUPLE IS REQUIRED. SEE SW011286.SLDDRW FOR THERMOCOUPLE ORIENTATION. CREATE QTY.2 BRADY LABELS AND PLACE THEM 2" FROM BOTH ENDS OF CABLE. TEXT ON LABEL WILL READ "TC2".
13. USE ONE LAYER OF EACH INSULATION MATERIAL LISTED IN HARDWARE TABLE ON PAGE 1.

TABLE OF CONTENT

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
48714	6	ADDED eV THERMOCOUPLE OPTIONS	05/10/2016	JCB	SSC	SSC	

UNLESS OTHERWISE SPECIFIED:
FRACTIONAL± 1/64" [.4]
DECIMAL:
.XX [.X]± .00 [.0]
.XXX [.XX]± .005 [.13]
ANGULAR: MACH± .5
BEND ± .5
Weld Station

APPROVALS		DATE
DRAWN	K. Zechman	1/24/2014
CHECKED	E.H. Lewis	10/17/2014
ENG APPR.		
MFG APPR.		
APPROVED	E.H. Lewis	10/17/2014

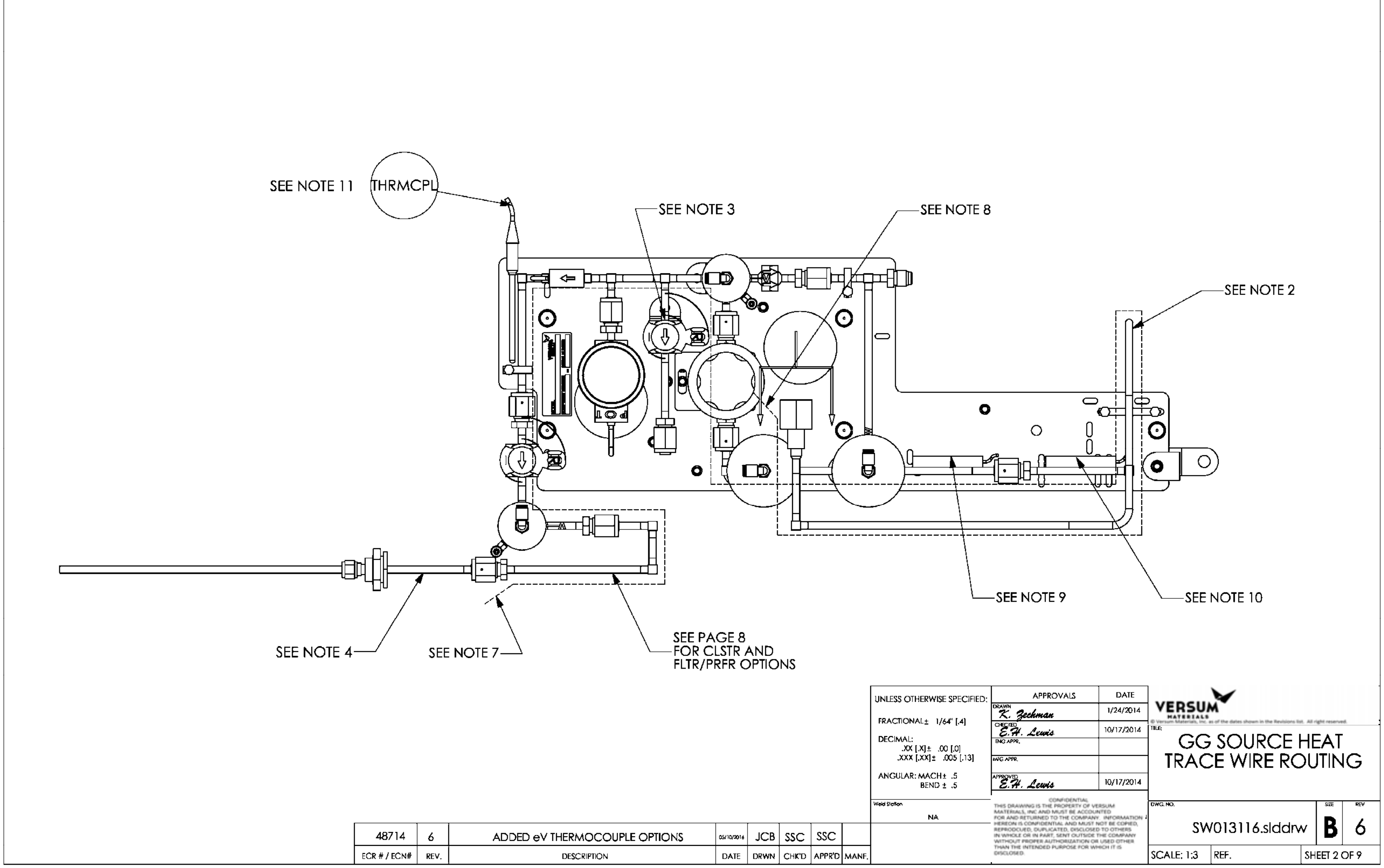
VERSUM MATERIALS

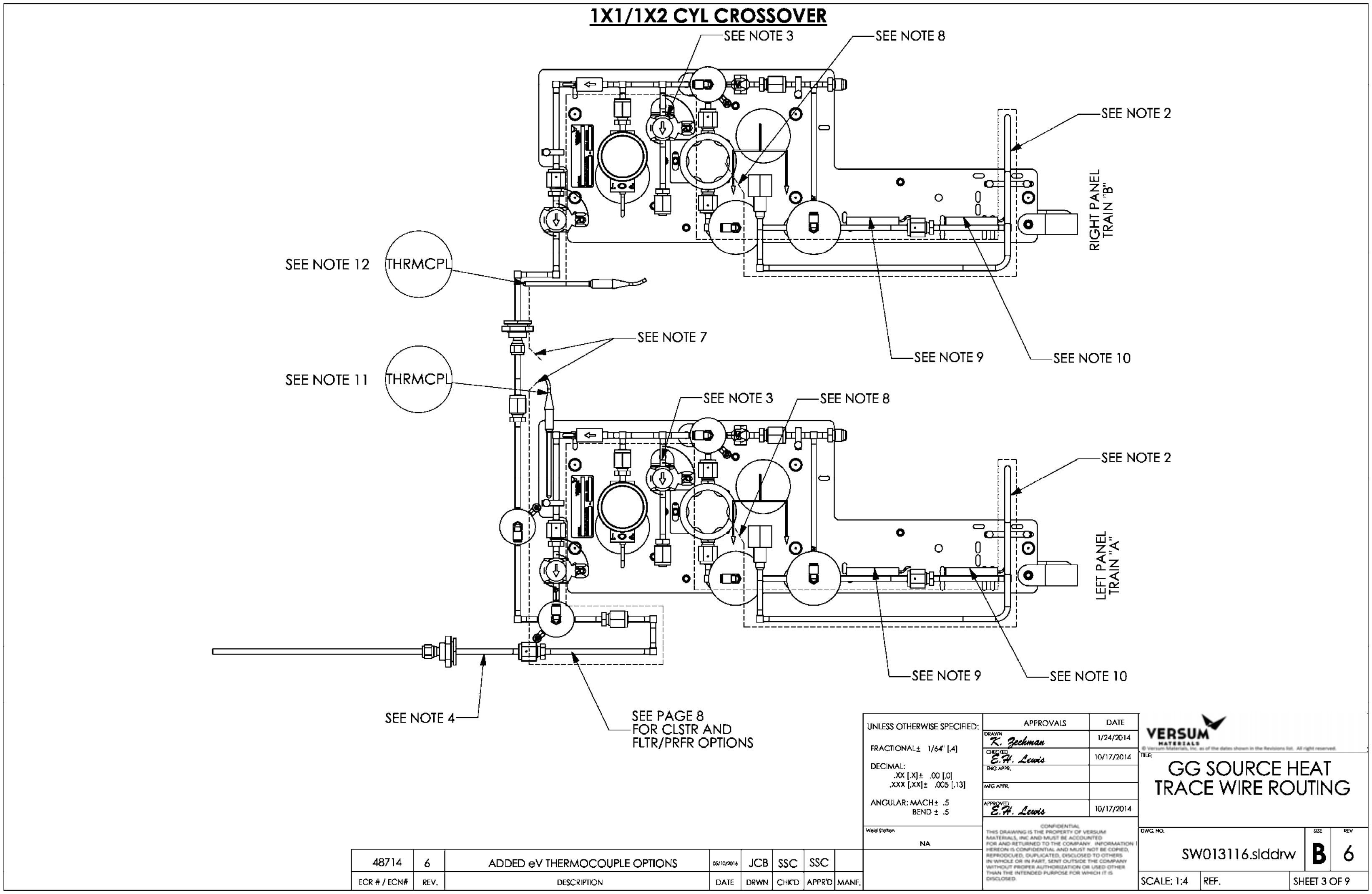
TITLE: GG SOURCE HEAT TRACE WIRE ROUTING

DWG. NO. SW013116.slddrw | SIZE B | REV 6

SCALE: 1:5 | REF. | SHEET 1 OF 9

1 CYLINDER


SEE NOTE 11
THRMCPL
SEE NOTE 3
SEE NOTE 8
SEE NOTE 2
SEE NOTE 9
SEE NOTE 10
SEE NOTE 4
SEE NOTE 7
SEE PAGE 8
FOR CLSTR AND
FLTR/PRFR OPTIONS
UNLESS OTHERWISE SPECIFIED:
FRACTIONAL ± 1/64" [.4]
DECIMAL:
.XX [.X] ± .00 [.0]
.XXX [.XX] ± .005 [.13]
ANGULAR: MACH ± .5
BEND ± .5
APPROVALS
DATE
K. Zeckman
1/24/2014
E.H. Lewis
10/17/2014
E.H. Lewis
10/17/2014
NA
CONFIDENTIAL
VERSUM MATERIALS
GG SOURCE HEAT
TRACE WIRE ROUTING
SW013116.slddrw
B
6
SCALE: 1:3
REF.
SHEET 2 OF 9
48714
6
ADDED eV THERMOCOUPLE OPTIONS
JCB
SSC
SSC
ECR # / ECN#
REV.
DESCRIPTION
DATE
DRWN
CHK'D
APPR'D
MANF.


1X1/1X2 CYL CROSSOVER
SEE NOTE 3
SEE NOTE 8
SEE NOTE 2
RIGHT PANEL
TRAIN "B"
SEE NOTE 12
THRMCPL
SEE NOTE 7
SEE NOTE 9
SEE NOTE 10
SEE NOTE 11
THRMCPL
SEE NOTE 3
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LEFT PANEL
TRAIN "A"
SEE NOTE 9
SEE NOTE 10
SEE NOTE 4
SEE PAGE 8
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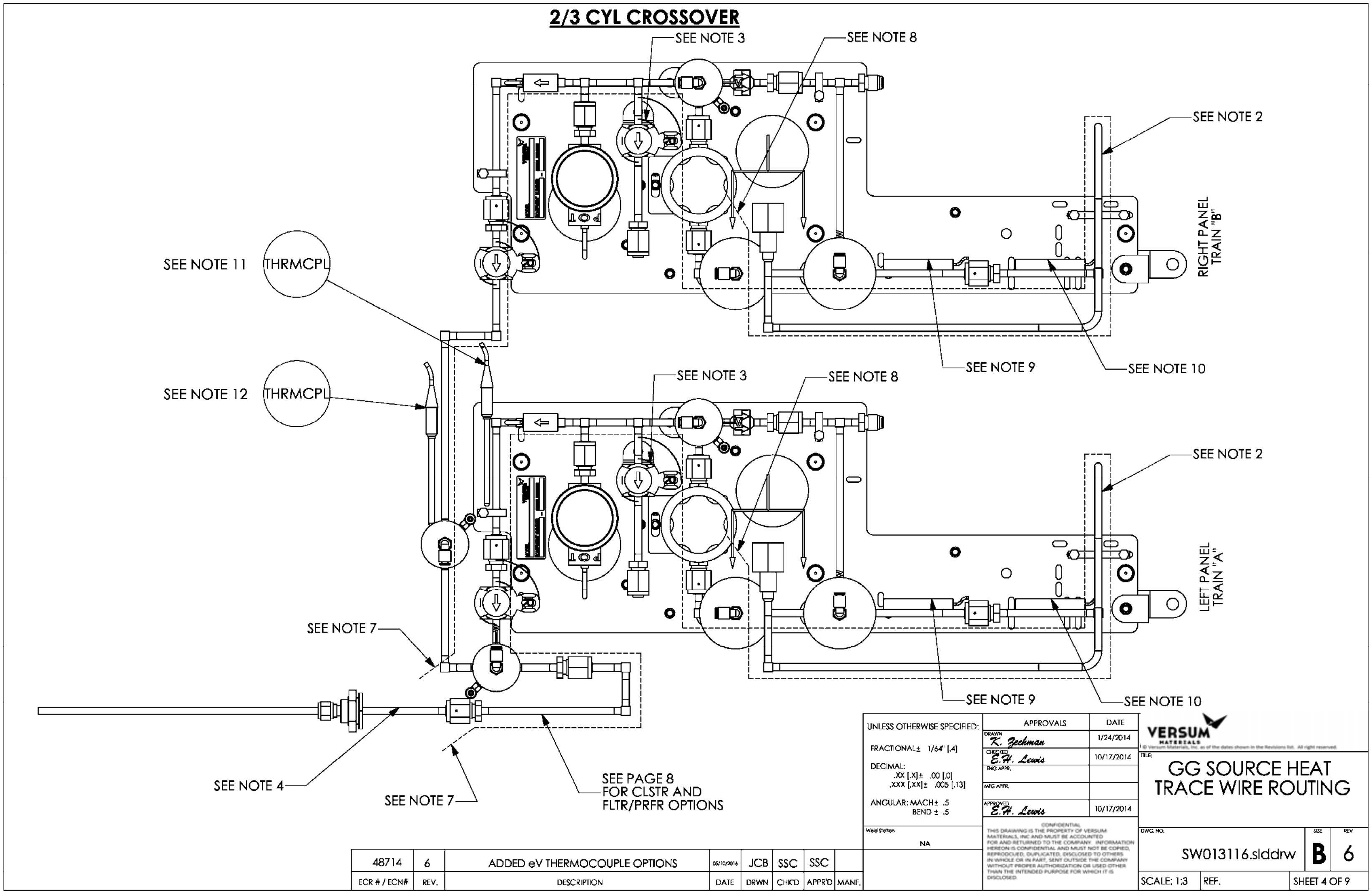
.XX [.X] ± .00 [.0]
.XXX [.XX] ± .005 [.13]
ANGULAR: MACH ± .5
BEND ± .5
Weld Station
NA
APPROVALS
DATE
DRAWN K. Zechman 1/24/2014
CHECKED E.H. Lewis 10/17/2014
ENG APPR.
MFG APPR.
APPROVED E.H. Lewis 10/17/2014
VERSUM MATERIALS
TITLE:
GG SOURCE HEAT
TRACE WIRE ROUTING
DWG. NO.
SW013116.slddrw
SIZE
B
REV
6
SCALE: 1:4
REF.
SHEET 3 OF 9
48714
6
ADDED eV THERMOCOUPLE OPTIONS
JCB
SSC
SSC
ECR # / ECN#
REV.
DESCRIPTION
DATE
DRWN
CHK'D
APPR'D
MANF.


2/3 CYL CROSSOVER
SEE NOTE 3
SEE NOTE 8
SEE NOTE 2
RIGHT PANEL TRAIN "B"
SEE NOTE 11
THRMCPL
SEE NOTE 9
SEE NOTE 10
SEE NOTE 3
SEE NOTE 8
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SEE NOTE 2
LEFT PANEL TRAIN "A"
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SEE NOTE 4
SEE NOTE 7
SEE PAGE 8 FOR CLSTR AND FLTR/PRFR OPTIONS
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Weld Station
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DATE
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CHECKED E.H. Lewis 10/17/2014
ENG APPR.
MFG APPR.
APPROVED E.H. Lewis 10/17/2014
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VERSUM MATERIALS
TITLE:
GG SOURCE HEAT TRACE WIRE ROUTING
DWG. NO.
SW013116.slddrw
SIZE B
REV 6
SCALE: 1:3
REF.
SHEET 4 OF 9
48714 | 6 | ADDED eV THERMOCOUPLE OPTIONS | 06/10/2016 | JCB | SSC | SSC
ECR # / ECN# | REV. | DESCRIPTION | DATE | DRWN | CHK'D | APPR'D | MANF.

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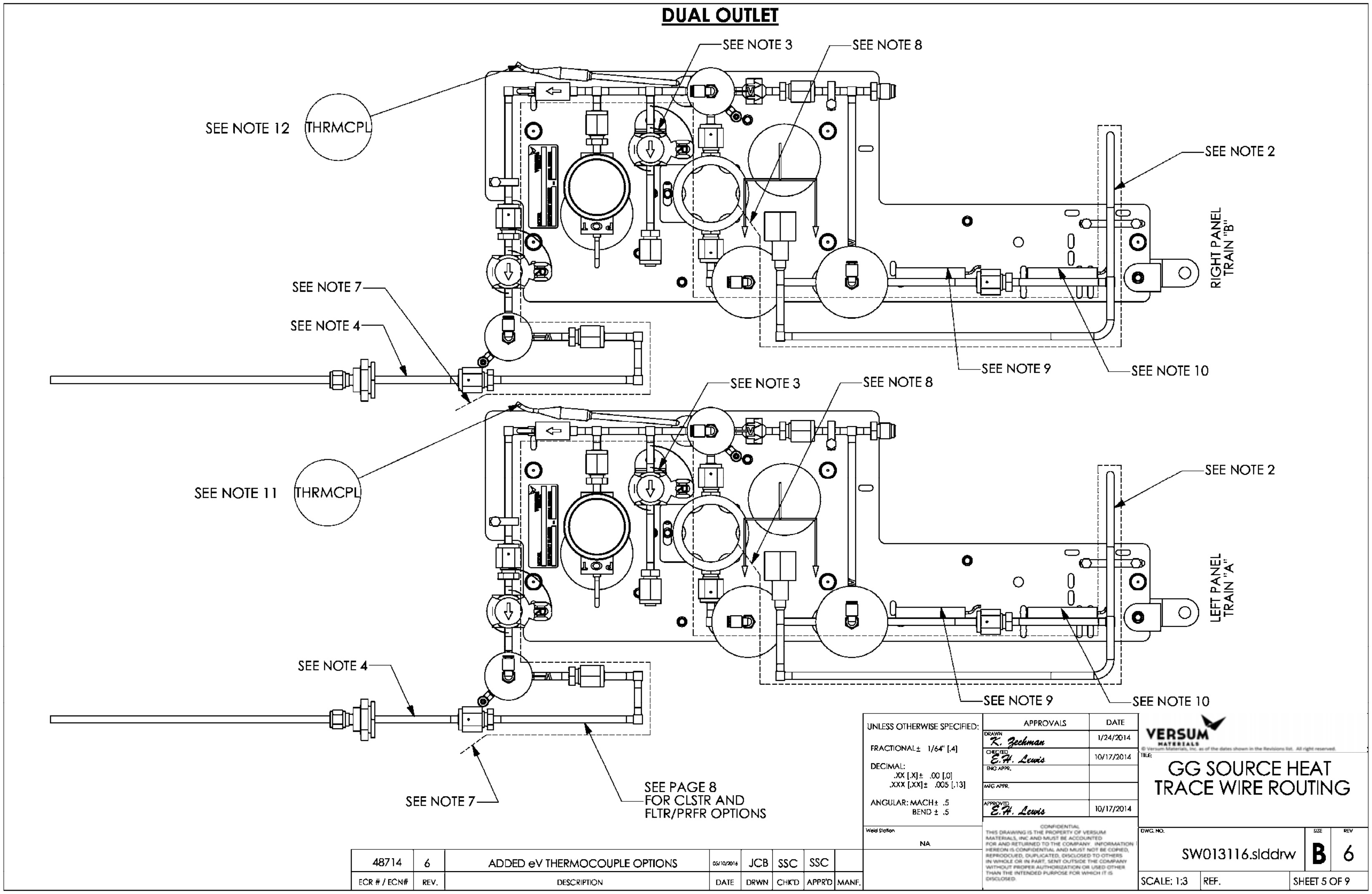
DUAL OUTLET
SEE NOTE 3
SEE NOTE 8
SEE NOTE 12
THRMCPL
SEE NOTE 2
RIGHT PANEL TRAIN "B"
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SEE NOTE 9
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LEFT PANEL TRAIN "A"
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SEE NOTE 7
SEE PAGE 8
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.XX [.X]± .00 [.0]
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ANGULAR: MACH± .5
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APPROVALS
DATE
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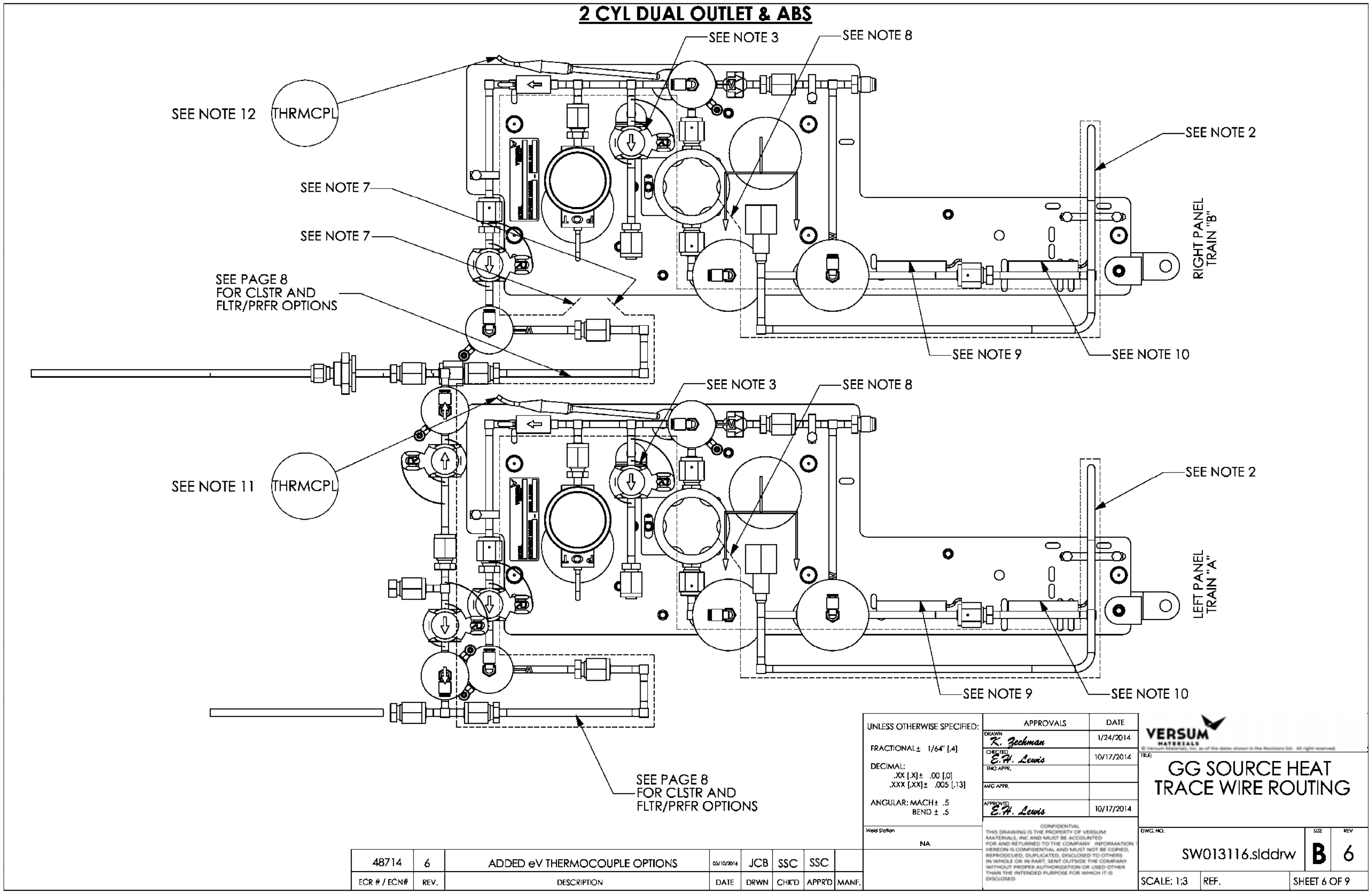
CHECKED E.H. Lewis 10/17/2014
APPROVED E.H. Lewis 10/17/2014
NA
VERSUM MATERIALS
GG SOURCE HEAT TRACE WIRE ROUTING
SW013116.slddrw
B
6
SCALE: 1:3
SHEET 5 OF 9
48714
6
ADDED eV THERMOCOUPLE OPTIONS
JCB
SSC
SSC
ECR # / ECN#
REV.
DESCRIPTION
DATE
DRWN
CHK'D
APPR'D
MANF.



2 CYL DUAL OUTLET & ABS
SEE NOTE 3
SEE NOTE 8
SEE NOTE 12
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SEE NOTE 2
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SEE NOTE 7
RIGHT PANEL TRAIN "B"
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SEE PAGE 8 FOR CLSTR AND FLTR/PRFR OPTIONS
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BEND ± .5
Weld Station
NA
APPROVALS
DATE
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MFG APPR.
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VERSUM MATERIALS
TITLE:
GG SOURCE HEAT TRACE WIRE ROUTING
DWG. NO.
SW013116.slddrw
SIZE B
REV 6
SCALE: 1:3
REF.
SHEET 6 OF 9
48714
6
ADDED eV THERMOCOUPLE OPTIONS
06/10/2016
JCB
SSC
SSC
ECR # / ECN#
REV.
DESCRIPTION
DATE
DRWN
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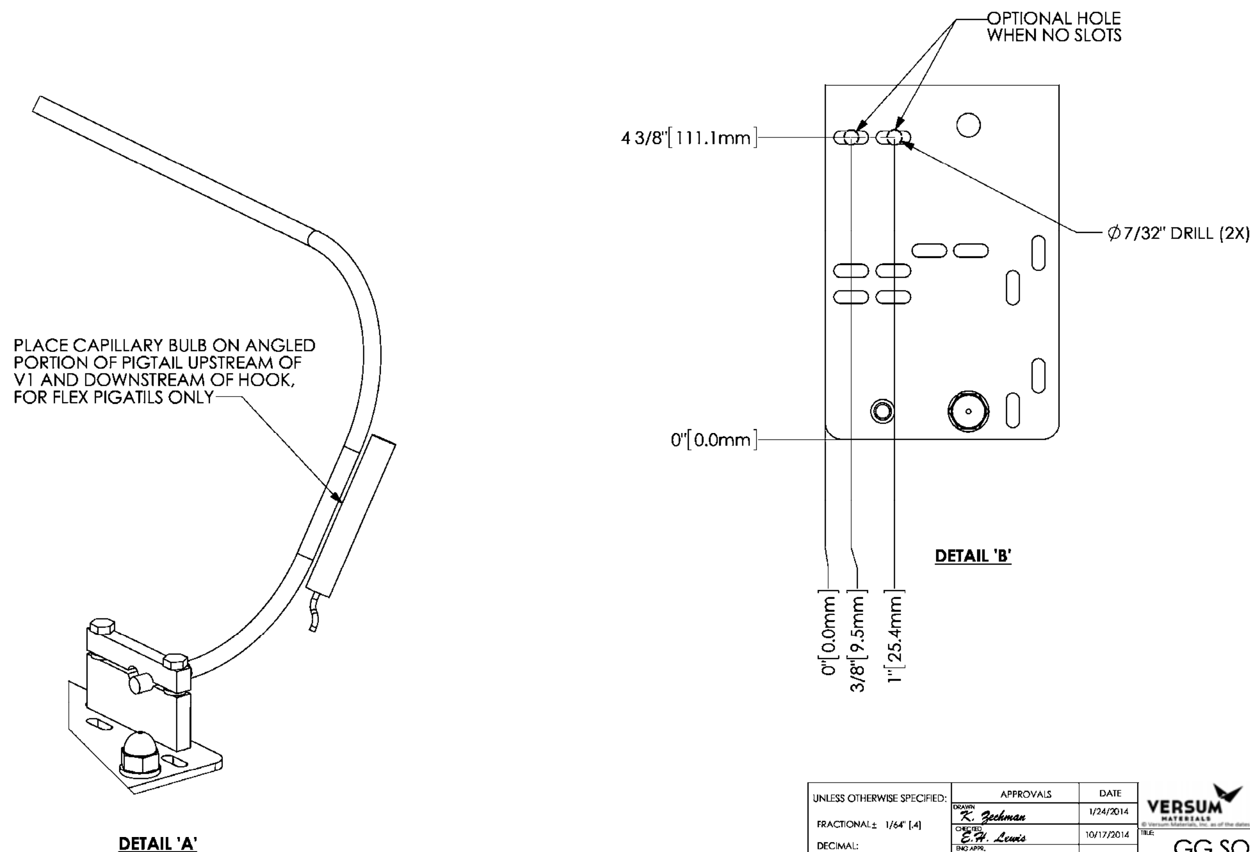

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
48714	6	ADDED eV THERMOCOUPLE OPTIONS	05/10/2016	JCB	SSC	SSC	

UNLESS OTHERWISE SPECIFIED:
FRACTIONAL± 1/64" [.4]
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.XXX [.XX]± .005 [.13]
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BEND ± .5

Weld Station
NA

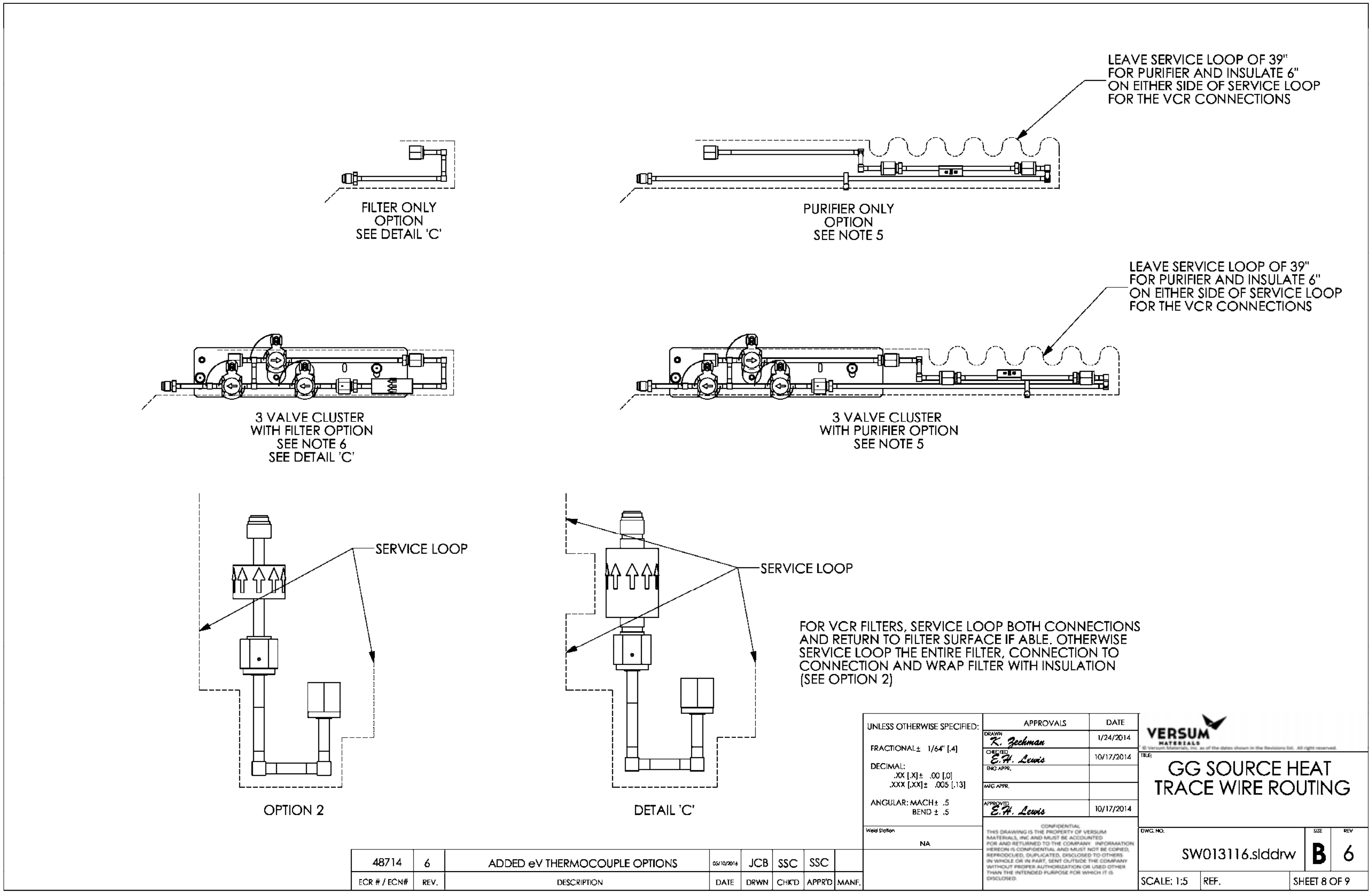
APPROVALS	DATE
DRAWN K. Zechman	1/24/2014
CHECKED E.H. Lewis	10/17/2014
ENG APPR.	
MFG APPR.	
APPROVED E.H. Lewis	10/17/2014

VERSUM MATERIALS

TITLE: GG SOURCE HEAT TRACE WIRE ROUTING

DWG. NO. SW013116.slddrw | SIZE B | REV 6

SCALE: 2:3 | REF. | SHEET 7 OF 9


LEAVE SERVICE LOOP OF 39" FOR PURIFIER AND INSULATE 6" ON EITHER SIDE OF SERVICE LOOP FOR THE VCR CONNECTIONS
FILTER ONLY OPTION SEE DETAIL 'C'
PURIFIER ONLY OPTION SEE NOTE 5
LEAVE SERVICE LOOP OF 39" FOR PURIFIER AND INSULATE 6" ON EITHER SIDE OF SERVICE LOOP FOR THE VCR CONNECTIONS
3 VALVE CLUSTER WITH FILTER OPTION SEE NOTE 6 SEE DETAIL 'C'
3 VALVE CLUSTER WITH PURIFIER OPTION SEE NOTE 5
SERVICE LOOP
SERVICE LOOP
FOR VCR FILTERS, SERVICE LOOP BOTH CONNECTIONS AND RETURN TO FILTER SURFACE IF ABLE, OTHERWISE SERVICE LOOP THE ENTIRE FILTER, CONNECTION TO CONNECTION AND WRAP FILTER WITH INSULATION (SEE OPTION 2)
OPTION 2
DETAIL 'C'
UNLESS OTHERWISE SPECIFIED:
FRACTIONAL± 1/64" [.4]
DECIMAL: .XX [.X]± .00 [.0] .XXX [.XX]± .005 [.13]
ANGULAR: MACH± .5 BEND ± .5
Weld Station NA
APPROVALS DATE
DRAWN K. Zechman 1/24/2014
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MFG APPR.
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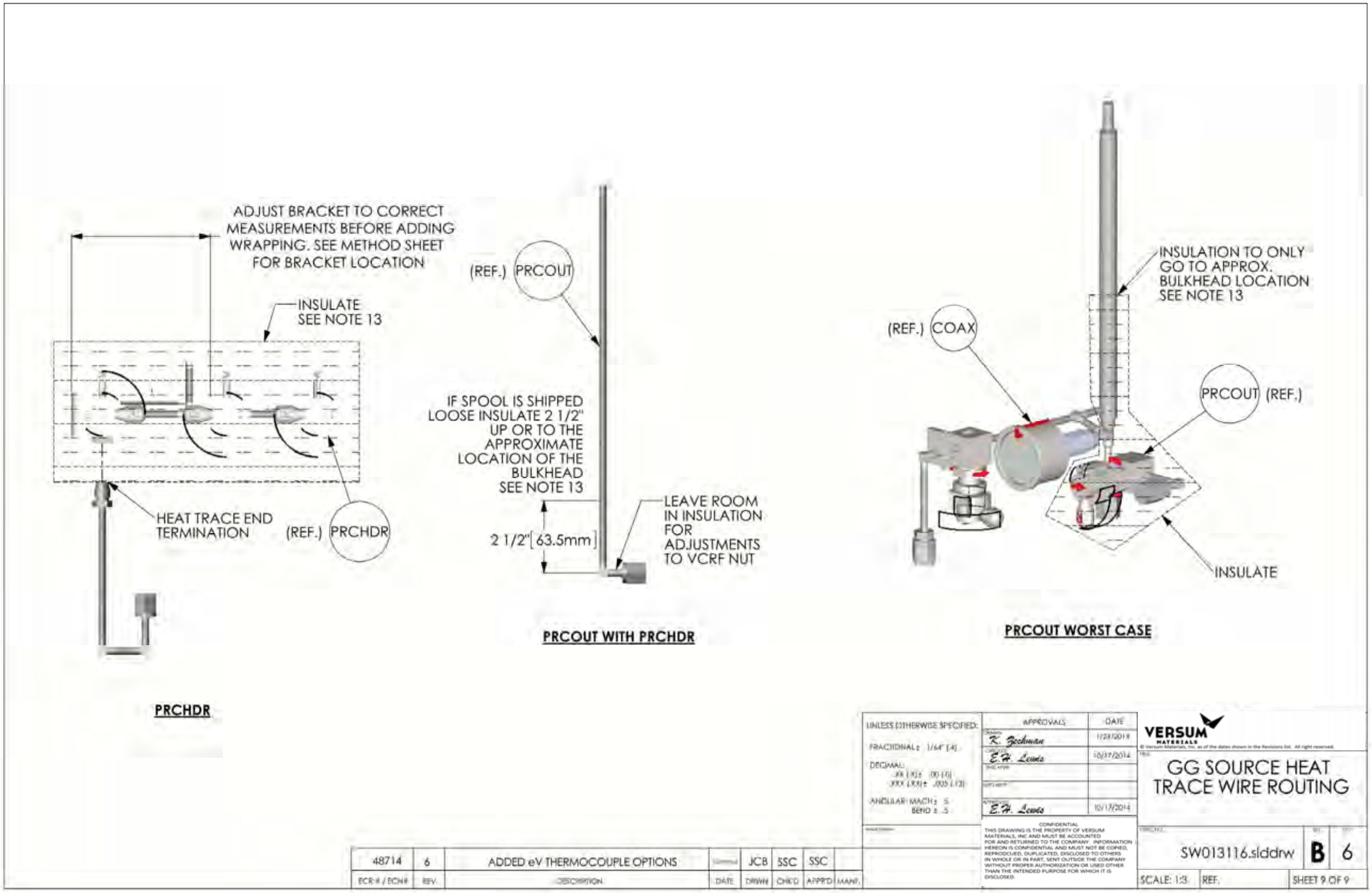
VERSUM MATERIALS
TITLE: GG SOURCE HEAT TRACE WIRE ROUTING
DWG. NO. SW013116.slddrw
SIZE B
REV 6
SCALE: 1:5
REF.
SHEET 8 OF 9
48714 | 6 | ADDED eV THERMOCOUPLE OPTIONS | 05/10/2016 | JCB | SSC | SSC
ECR # / ECN# | REV. | DESCRIPTION | DATE | DRWN | CHK'D | APPR'D | MANF.


ADJUST BRACKET TO CORRECT MEASUREMENTS BEFORE ADDING WRAPPING. SEE METHOD SHEET FOR BRACKET LOCATION
INSULATE SEE NOTE 13
HEAT TRACE END TERMINATION
(REF.) PRCHDR
PRCHDR
(REF.) PRCOUT
IF SPOOL IS SHIPPED LOOSE INSULATE 2 1/2" UP OR TO THE APPROXIMATE LOCATION OF THE BULKHEAD SEE NOTE 13
2 1/2" [63.5mm]
LEAVE ROOM IN INSULATION FOR ADJUSTMENTS TO VCRF NUT
PRCOUT WITH PRCHDR
INSULATION TO ONLY GO TO APPROX. BULKHEAD LOCATION SEE NOTE 13
(REF.) COAX
PRCOUT (REF.)
INSULATE
PRCOUT WORST CASE
UNLESS OTHERWISE SPECIFIED:
APPROVALS
DATE
K. Zechman
E.H. Lewis
E.H. Lewis
VERSUM MATERIALS
GG SOURCE HEAT TRACE WIRE ROUTING
48714
6
ADDED eV THERMOCOUPLE OPTIONS
JCB
SSC
SSC
ECR # / ECN#
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DESCRIPTION
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APPR'D
MANF.
SW013116.slddrw
B
6
SCALE: 1:3
REF.
SHEET 9 OF 9