Installation / Operation / Maintenance
Manual

GASGUARD®

Very High Flow System
AP11

Manual Part Number: 432226

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Revision Control Summary

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Chapter 1 –Safety Warnings			
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• Updated company name and logo.			
Chapter 2 – Installation			
	Rev-5	July 2016	MNL000215.doc
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Appendix A - Module Specifications

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Appendix B - Installation

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Appendix C – Pressure Equipment Directive Statement

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Appendix D – Process Heater PID Controller Setup

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Appendix E – Pre-Facilitation Checklist

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Appendix F – Startup and Commissioning Checklist

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Appendix G – Spare Parts List

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Appendix H – UVIR Detector

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Appendix I – Peer-To-Peer Communications

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Appendix J – Y Cylinder Heaters Description

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Appendix K – Operational Readiness Inspection (ORI) Checklist

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- Updated company name and logo.

Addendum Z – USB Barcode

Rev-1	July 2016	MNL000235.doc

- Updated company name and logo.

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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

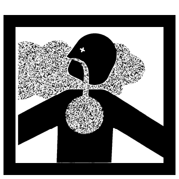
Indicates an immediate hazard, which if not avoided, <u>will</u> result in death or serious injury.

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.

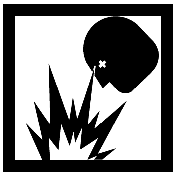
1.1.2 Hazard Types (Symbols)

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:

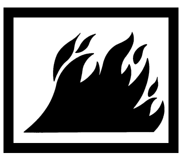


Explosive gases! Gases used with the GASGUARD® can cause an explosion when combined with air.

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.

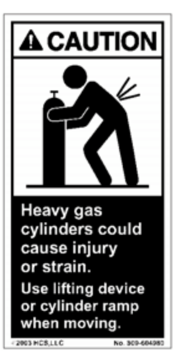
Energy release which may result from pneumatic or hydraulic pressure rapidly escaping from a portion of the equipment.



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.

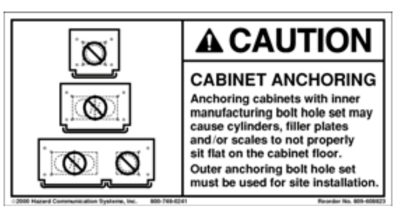


This symbol warns of potential strain or injury when lifting cylinders.

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

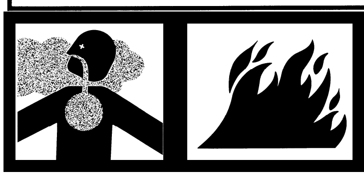
⚠WARNING

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

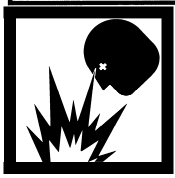


All cylinder storage areas must be continually monitored with an air quality monitor to prevent the danger of a hazardous atmosphere.

⚠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

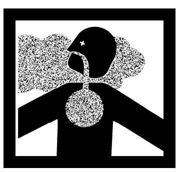


Do not use this device in any manner other than specified in this manual.

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

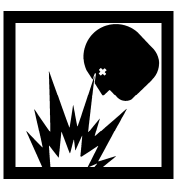
- Faulty judgment
- Insensitivity to pain
- Abnormal emotions

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



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.

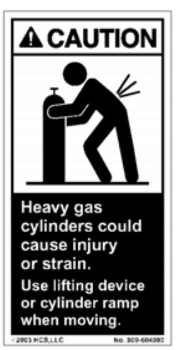
The control circuits for the system use 115/220 VAC, 50/60 Hz. Do not attempt to work on the system without first turning the power off and tagging out and locking out the electrical supply disconnect switch per plant lock out procedures. ***Follow the Typical Minimal Lockout or Tagout System Procedures 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, DO NOT 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 REQUIRE 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 <u>MUST</u> 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.

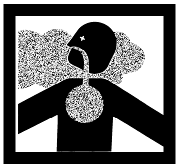
WARNING

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.

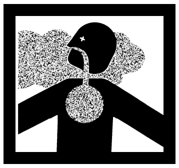
Personal protective equipment required for use with toxic gases is detailed in Chapter 1 Section 9 of this manual.

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

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

1.10.2 Corrosive Gas Hazards

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***.

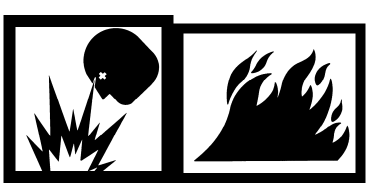
Chapter 1 Section 9 of this manual lists the personal protective equipment required for use with corrosive gases.

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

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:

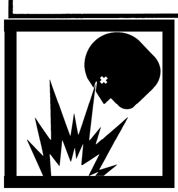
Diborane	**Phosphine**
Disilane	**Silane**

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.

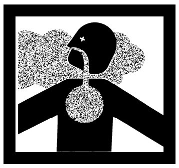
When entering a confined area or area which may contain high inert gas concentrations, a **"Buddy System"** must be used. One person should remain outside the suspect area, but within view of the other person. This method ensures that the other person can respond in the event of an emergency.

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**

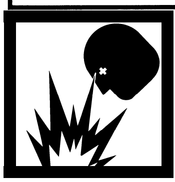
⚠WARNING



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

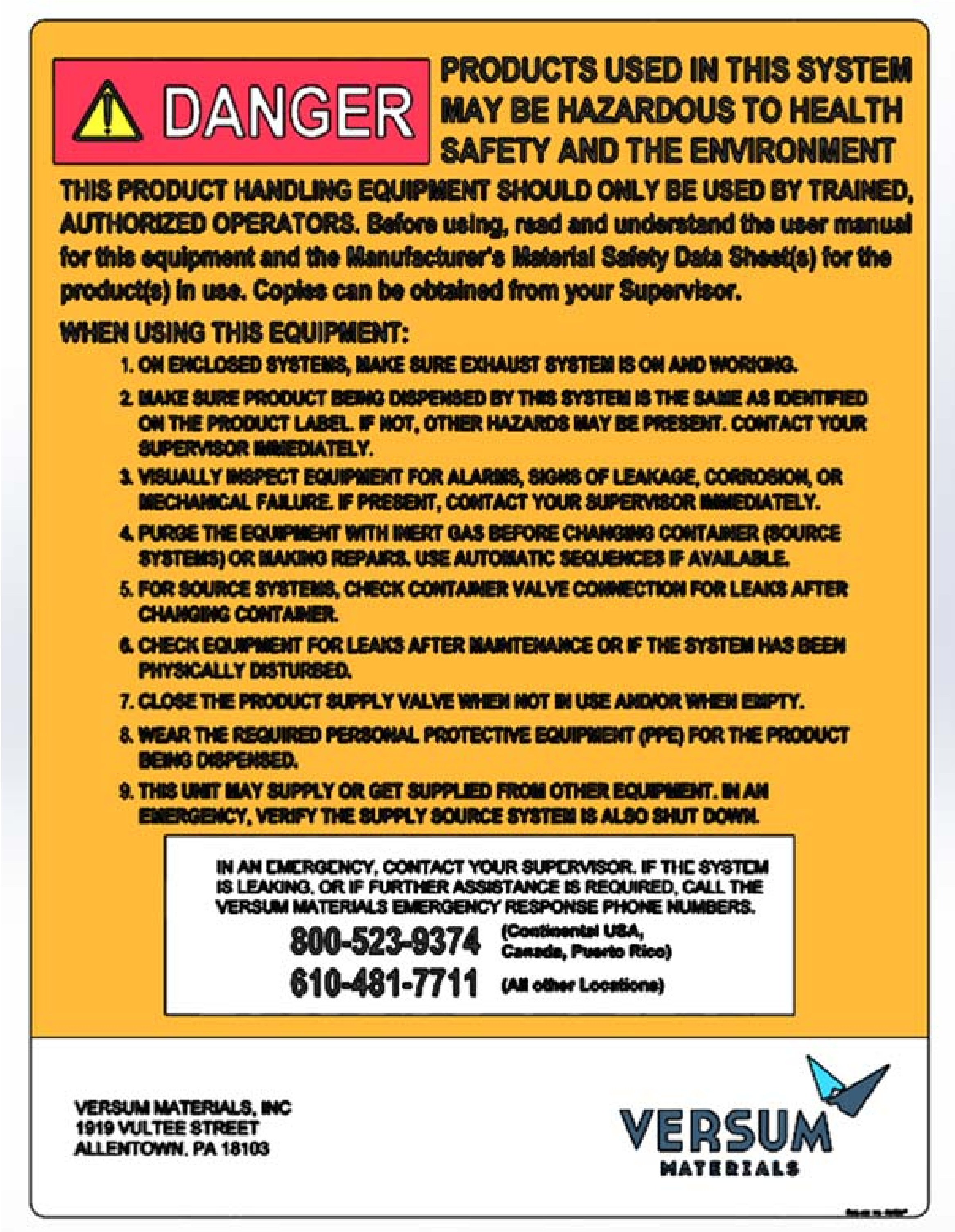
All equipment shall be locked or tagged out to protect against accidental or inadvertent operating when such operation could cause injury to personnel. Do not attempt to operate any switch, valve or other energy isolating device where it is locked or tagged.

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

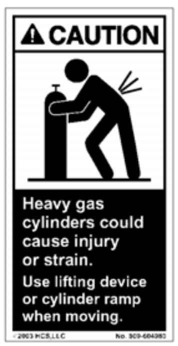
WARNING PRESSURIZED ENCLOSURE

"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.



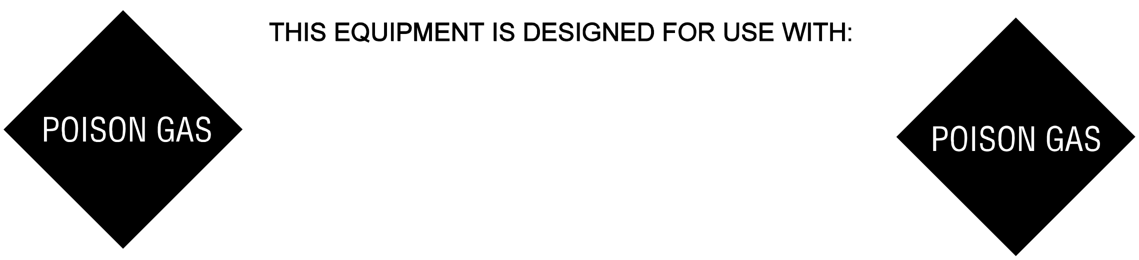
The following label appears inside doors of cabinets.

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.

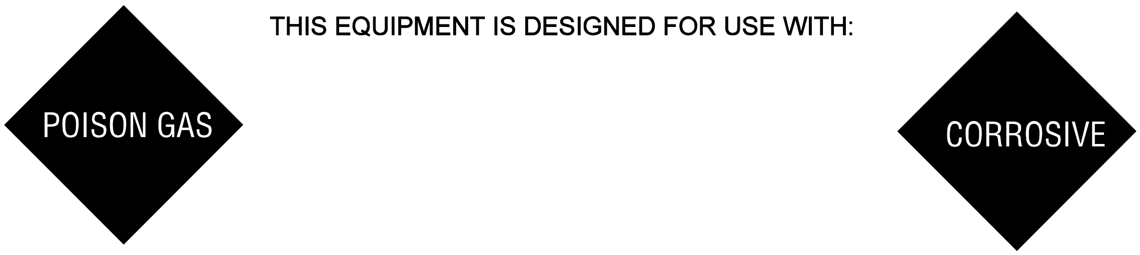
NOTE: The signs shown below are United States DOT classifications. They are not to be used to classify gas hazards. Refer to the appropriate MSDS provided with the system documentation.

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



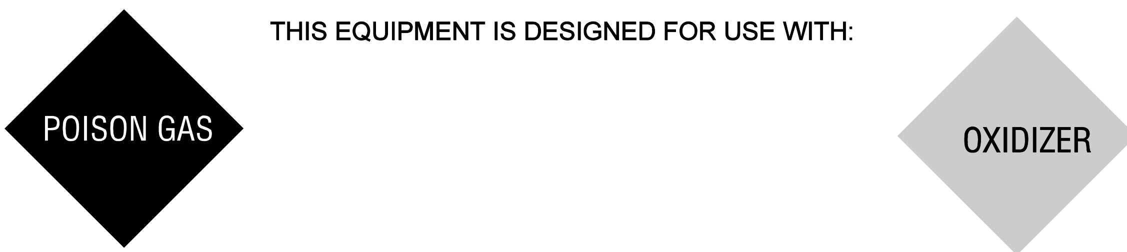
Boron trifluoride	**Phosphorous pentafluoride**
Chlorine	**Sulfur dioxide**
Carbon tetrachloride	**Sulfur tetrafluoride**
Nitrogen dioxide	**Tungsten hexafluoride**
Nitric oxide	

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



Boron trichloride	**Hydrogen fluoride**
Hydrogen bromide	**Silicon tetrafluoride**
Hydrogen chloride	

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



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

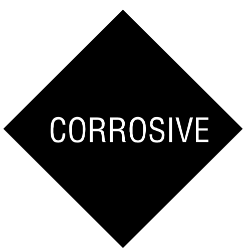
The following label would be used with the gases listed below it:

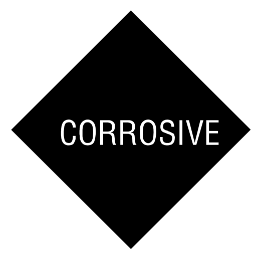
THIS EQUIPMENT IS DESIGNED FOR USE WITH:

Arsine mixtures	**Germane**
Carbon monoxide	**Hydrogen selenide**
Diborane mixtures	**Hydrogen sulfide**
Dichlorosilane	**Phosphine mixtures**
Diethyl telluride	

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:

NON FLAMMABLE GAS

THIS EQUIPMENT IS DESIGNED FOR USE WITH:

NON FLAMMABLE GAS

Ammonia

Argon

Carbon dioxide

Halocarbon 11

Halocarbon 12

Halocarbon 13

Halocarbon 13B1

Halocarbon 14

Halocarbon 21

Halocarbon 22

Halocarbon 23

Halocarbon 113

Halocarbon 115

Halocarbon 116

Halocarbon 125

Halocarbon 128

Halocarbon C141B

Halocarbon C318

Helium

Krypton

Neon

Nitrogen

Nitrous oxide

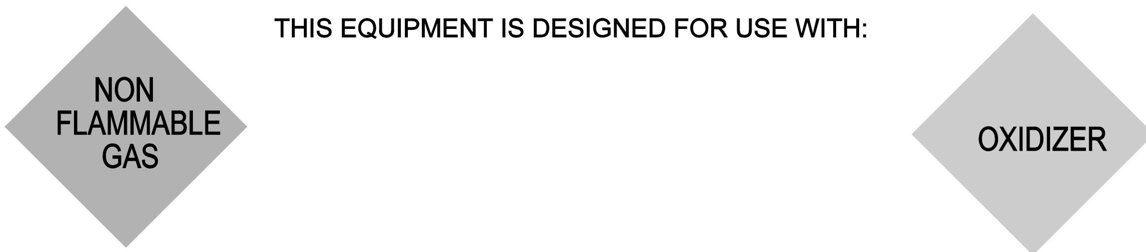
Perfluoropropane

Sulfur hexafluoride

Teteafluoroethane

Xenon

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



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

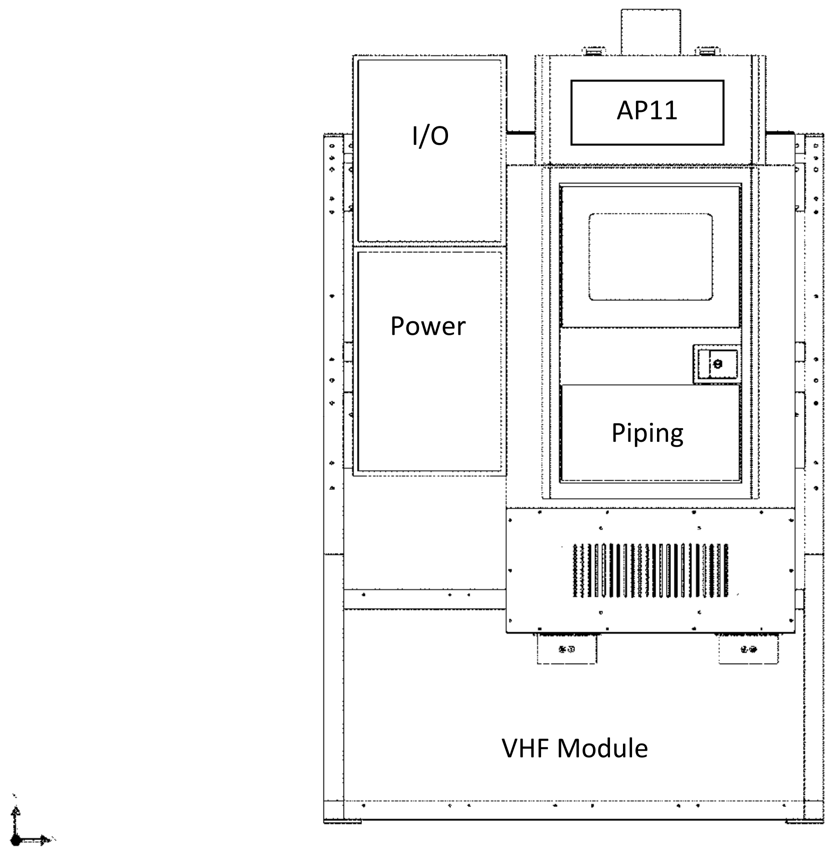
Nitrogen Material Safety Data Sheet (Included as Appendix B)

Chapter 2

Installation

1.0 Receiving Inspection

The Very High Flow module is shipped in a large wooden crate. When the crate is delivered to the site, ensure that the shipping manifest properly documents the shipment. Verify that the delivery date, time, and the item delivered are accurately shown on the shipping manifest. Look for signs of any damage that may have occurred during shipment. Note on the bill of lading any manifest discrepancies and any significant crate damage found. Alert your Versum Materials, Inc. representative of any damage that has occurred.



2.0 Unpacking and Handling

The Very High Flow (VHF) module is shipped inside a large box designed to protect the unit from minor shipping damage. Extreme care should be taken in handling the large crate since the equipment can be damaged if it is tipped on its side or dropped. The equipment should not be removed from its crate until it has been moved by forklift to a location near its final installation area. Approximate weight of the crated VHF module is 1500 lbs. (680 Kg.).

CAUTION

1. Once the Very High Flow Module is moved to near its final location, remove the walls and roof of the box.

- Inspect the equipment for shipping damage.
- The outside of the equipment cabinet should be checked for scratches, dents, or damaged external piping.
- The door of the Very High Flow module should be opened and the piping system should be carefully inspected for damage.
- The front door of the AP11 controller, I/O enclosure, and Power enclosure should be opened to check for damaged electrical components.

NOTE:
Any damage observed on the equipment must be immediately reported to the shipping company and to the Versum Materials, Inc. factory.

2. Using a forklift, lift the equipment off the crate and carefully set it on the floor.

3. Roll the unit to its final location.

3.0 Module Installation

All equipment must be installed in accordance with the following drawings and codes.

- Very High Flow module drawings included in Appendix B – Installation Drawing Package.
- Seismic Codes per ASME, UBC, or applicable local codes. Reference Drawing BKA004 MECH 0034 located in Appendix B – Installation Drawings.

NOTE: It is the responsibility of the owner to ensure that all equipment modules are mounted in accordance with all applicable civil and seismic codes.

Additional considerations and notes:

1. VHF modules and source containers (Y containers, Drums, Trailers, etc.) must be sited per Code requirements and Versum Materials, Inc. criteria away from fire and combustible sources.

Contact your Versum Materials, Inc. representative for assistance with Versum Materials, Inc. siting criteria.

2. An overhead roof or canopy is recommended for source vessels and VHF equipment. The equipment is designed to NEMA 3R, and must be protected against direct rain. It should also be noted that snow and ice accumulation could make weight scale readings inaccurate. A roof overhead will also protect operators and the container process connection during container changes in inclement weather.
3. The electrical Power and I/O Enclosures must not be installed in direct sunlight. Heat from solar gain is the primary reason for increased electrical enclosure temperature. Overexposure to high temperature over time will reduce component longevity.
4. The mounting location for all equipment modules should be clean and level. It is recommended that the equipment modules be placed on concrete pads prepared per drawing BKA004 MECH 0034 located in Appendix B – Installation Drawings.
5. The outline dimensions and mounting hole locations are shown in Figure 4-1 below for a rack assembly.
6. When installing a VHF module configured with a trailer or ISO container, they must be located on side A, unless the optional source B tube switcher has been purchased. The VHF module graphic and solenoid bank only support a trailer or ISO container for source A. The optional source B tube switcher graphic and solenoid bank support a trailer or ISO container for source B.
7. There shall be no obstructions in front of any access covers, including controller, electrical enclosures, or piping cabinet.

Mounting Holes
9/16" (14.3mm) Diameter
Typical 4 Places

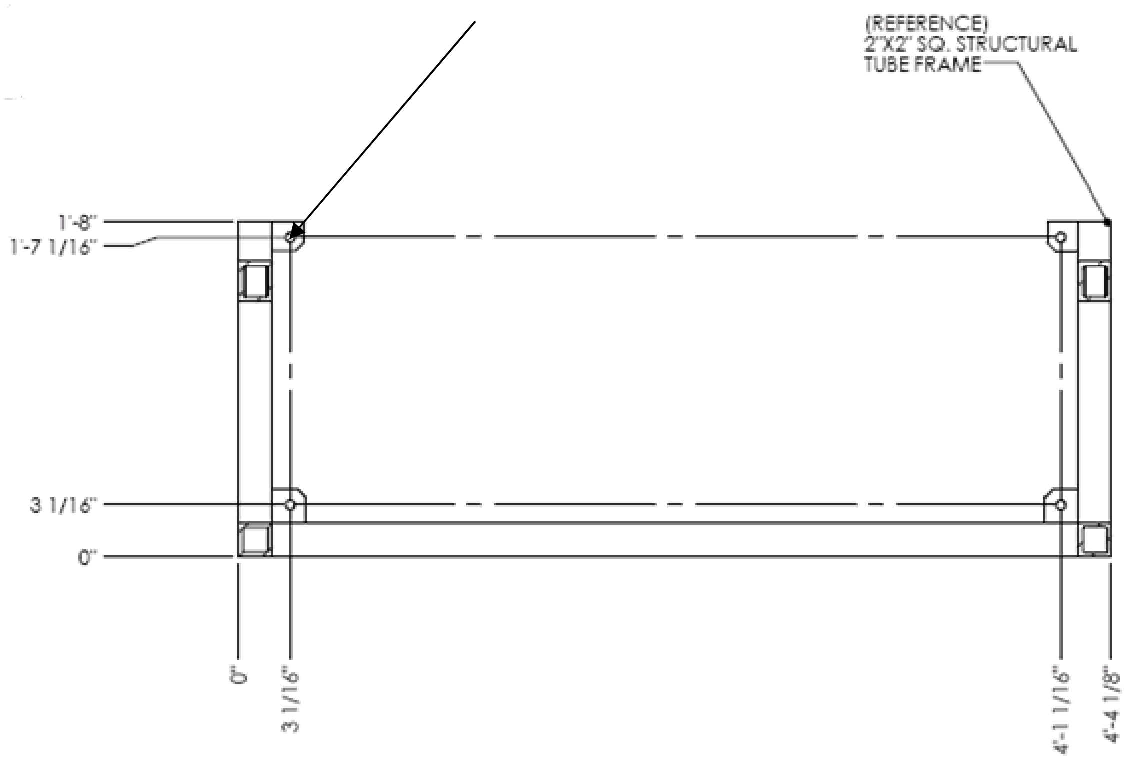


Figure 4-1. Rack Mounting Hole Locations

8. Final equipment layout and mounting locations are the responsibility of the owner. It is recommended that the process gas container be located to the back of the VHF module to allow easy access to the display and piping system components. See Appendix B – Installation Drawing Package, VHF Pigtail assembly installation drawings.
9. If the painted surfaces of the enclosure cabinets are nicked or scratched during handling and installation, they must be painted to prevent rust from forming. Touch up paint is not provided with the equipment. Touch up paint must be purchased from a local paint supplier. The Paint Specification is included in Appendix A – System Specifications.
10. Supporting the source container piping and source container ventilation duct is the responsibility of the owner. The piping should be supported to prevent the accidental opening of the face seal connection. See Appendix B – Installation Drawing Package, VHF Pigtail assembly installation drawings for general routing and support information.
11. ½" process gas flex hoses supplied by Versum Materials, Inc. for approved gases, provide a more forgiving means of connecting process gas piping to a source container with respect to container location, but do have limitations. The following is a list of those limitations and recommendations for proper installation.

Installation Information

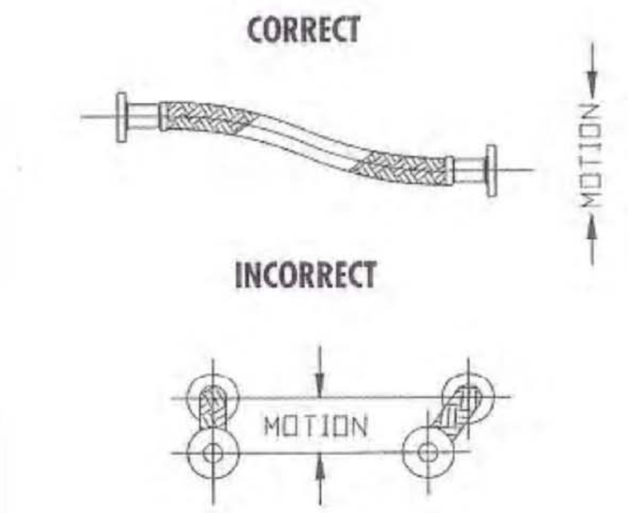
1. Avoid torque.
Do not twist the hose assembly during installation when aligning the bolt holes in a flange or in mating up pipe threads. The utilization of lap joint flanges or pipe unions will minimize this condition. It is recommended that two wrenches be used in making the union connection: one to prevent the hose from twisting and the other to tighten the coupling.

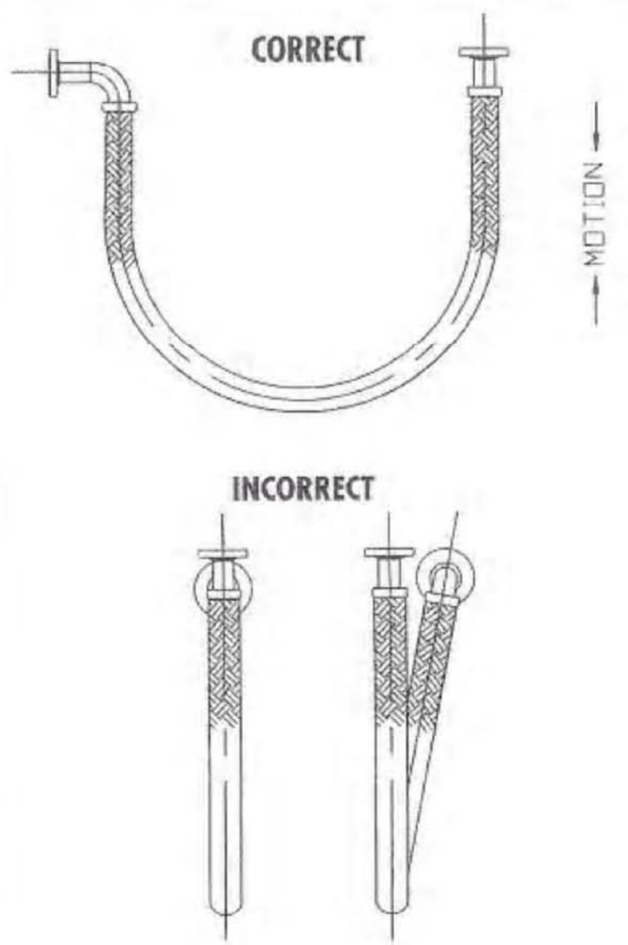
2. Prevent out-of-plane flexing in an installation.
Always install the hose so that the flexing takes place in only one plane—this being the plane in which the bending occurs.

3. Avoid over bending.
The repetitive bending of a hose to a radius smaller than the radius listed in the specification tables for corrugated hose will result in early hose failure. Always provide sufficient length to prevent over-bending and to eliminate strain on the hose.

4. Avoid careless handling of the hose assembly.
Always lift or carry metal hose to prevent abrasion damage particularly to braided corrugated hose. Store metal hose assemblies away from areas where it can be subjected to spillage, corrosive fumes or sprays, weld splatter, etc.

5. Always support the piping.
A piping system which utilizes metal hose to absorb movement must be properly anchored and /or guided. Always support the piping to prevent excessive weight from compressing the hose and relaxing the braid tension.





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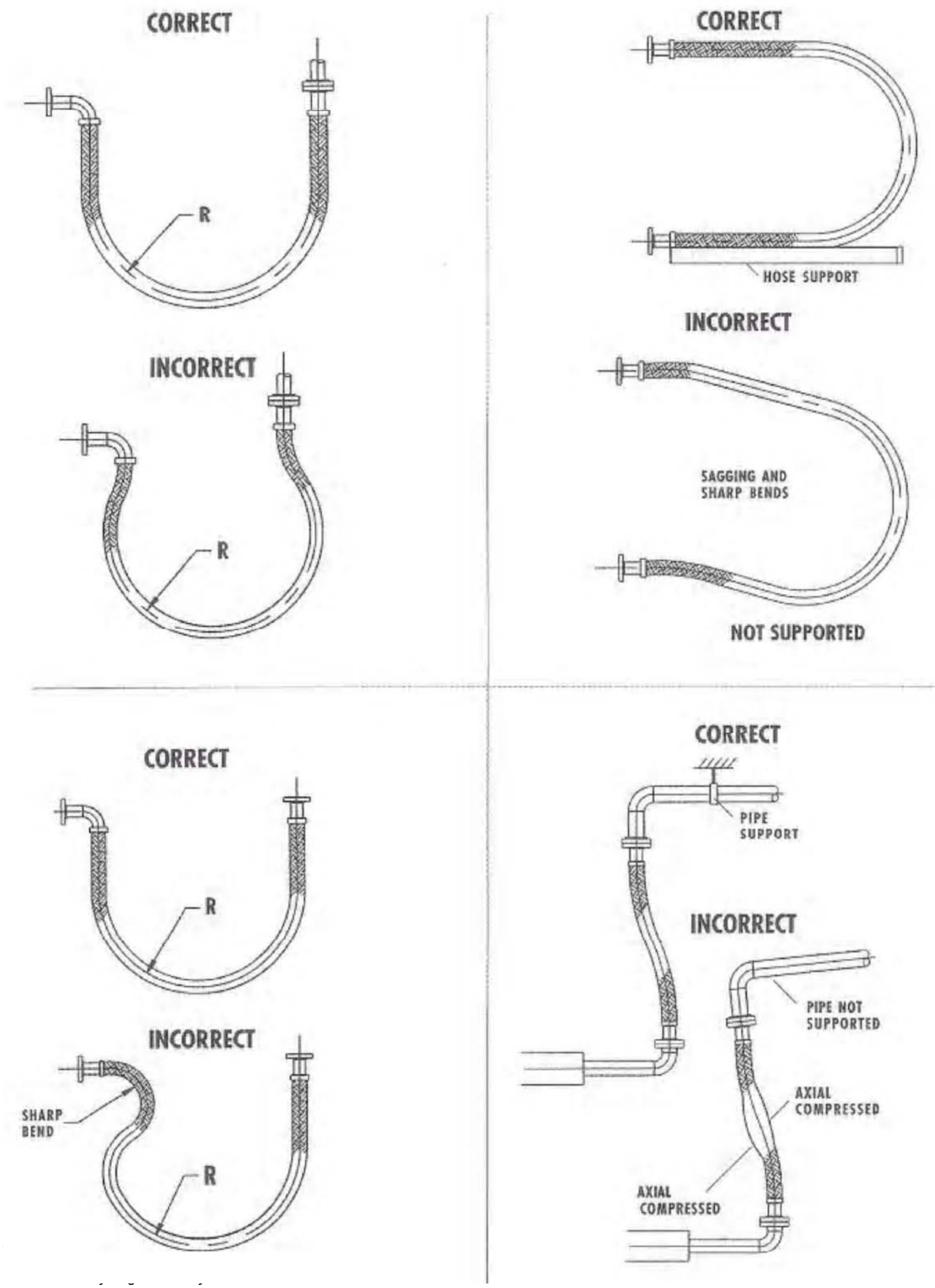
CORRECT
R
INCORRECT
R
CORRECT
HOSE SUPPORT
INCORRECT
SAGGING AND
SHARP BENDS
NOT SUPPORTED
CORRECT
R
INCORRECT
SHARP
BEND
R
CORRECT
PIPE
SUPPORT
INCORRECT
PIPE NOT
SUPPORTED
AXIAL
COMPRESSED
AXIAL
COMPRESSED

2016

Flex Hose Specifications for VHF							
Nominal Diameter (inches)	Actual I.D. (mm)	Number of Braids	Nominal O.D. (inches)	Minimum Bend Radius (inches)	Maximum Working Pressure @ 70 deg F (psig)	Burst Pressure @ 70 deg F (psig)	Weight per foot (lbs.)
1/2	12	1	0.79	1.34	2973	6104	0.24

4.0 Piping Connections

All tubing connections to the Very High Flow should be designed and installed following all 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, but is Hastelloy C-22 on Hydrogen Chloride (HCl) VHF modules.

All piping must be installed in accordance with the installation drawings located in Appendix B of this manual.

Connection Points

All tubing connections are made at the top rear of the Very High Flow. 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 prior to welding.

Piping connection points for each piece of equipment can be found in the drawings located in Appendix B of this manual.

Process piping connections are double bagged and taped at the factory prior to shipment. Vent piping connections are single bagged and taped. Tube ends have been faced and are ready for welding.

Depending on the configuration, the following facility tubing connections may be supplied with a Very High Flow module:

Process outlet A: 1/2" (12.7 mm) diameter, 0.049" (1.2 mm) wall thickness
Optional coax 3/4" (19 mm) diameter, 0.065” (1.6 mm) wall thickness

Process outlet B (optional): 1/2" (12.7 mm) diameter, 0.049" (1.2 mm) wall thickness
Optional coax 3/4" (19 mm) diameter, 0.065" (1.6 mm) wall thickness

HCl Purifier Supply (optional):
1/2" (12.7 mm) diameter, 0.049" (1.2 mm) wall thickness
Optional coax 3/4" (19 mm) diameter, 0.065" (1.6 mm) wall thickness

HCl Purifier Return (optional):
1/2" (12.7 mm) diameter, 0.049" (1.2 mm) wall thickness
Optional coax 3/4" (19 mm) diameter, 0.065" (1.6 mm) wall thickness

Purge and High Pressure Leak Check (HPLT) Gas Inlet:
1/4" (6.4 mm) diameter, 0.035" (0.9 mm) wall thickness

Venturi 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

Bonnet Vent outlet (up to three lines):
1/4" (6.4 mm) diameter, 0.035" (0.9 mm) wall thickness

Enclosure Exhaust: 6" (152.4 mm) outside diameter duct

Pneumatics and Z-Purge: ¼" (6.3 mm) outside diameter compression fitting.

The process line and HCl purifier connections can be furnished in one of two configurations: Standard Bulkhead or Coaxial Bulkhead. All other connections, such as purge, venturi inlet, and vent, will be furnished with standard bulkheads.

The standard bulkhead permits a single process out line to penetrate the enclosure, while providing an acceptable seal for enclosure ventilation purposes. Figure 4-2 shows a standard bulkhead.

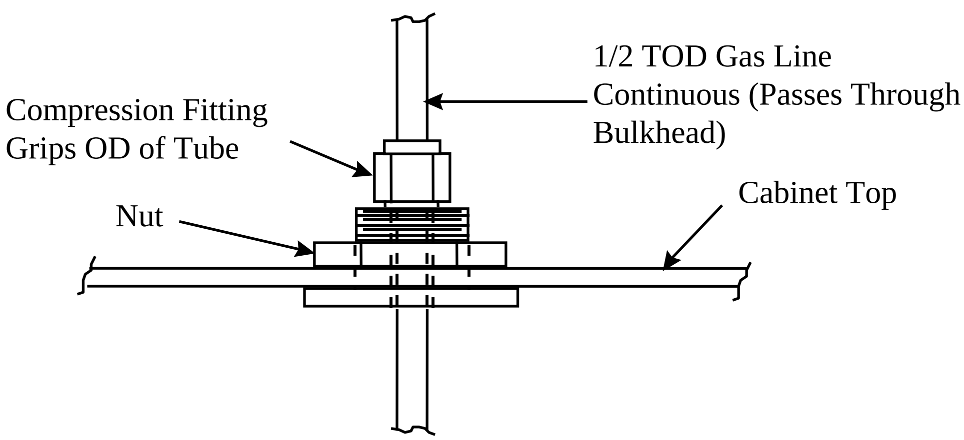

Figure 4-2. Standard Bulkhead

The optional 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.

On the branch of the coaxial bulkhead inside the enclosure, a pressure switch and manual isolation valve is installed to facilitate the fill and monitoring of the coaxial annular space. The pressure decay technique is used for coaxial annular space monitoring, and requires the annular space to be pressurized with inert gas (typically nitrogen) above the pressure switch setpoint, in this case, 120 psig. If a leak develops to atmosphere from the coaxial jacket, an alarm displays on the controller, identifying the coaxial jacket that is leaking. Similarly, if a leak develops from the process pipe into the coax annular space, the same alarm displays on the controller identifying the coaxial jacket that is leaking. Figure 4-3 shows a coaxial bulkhead.

CAUTION

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

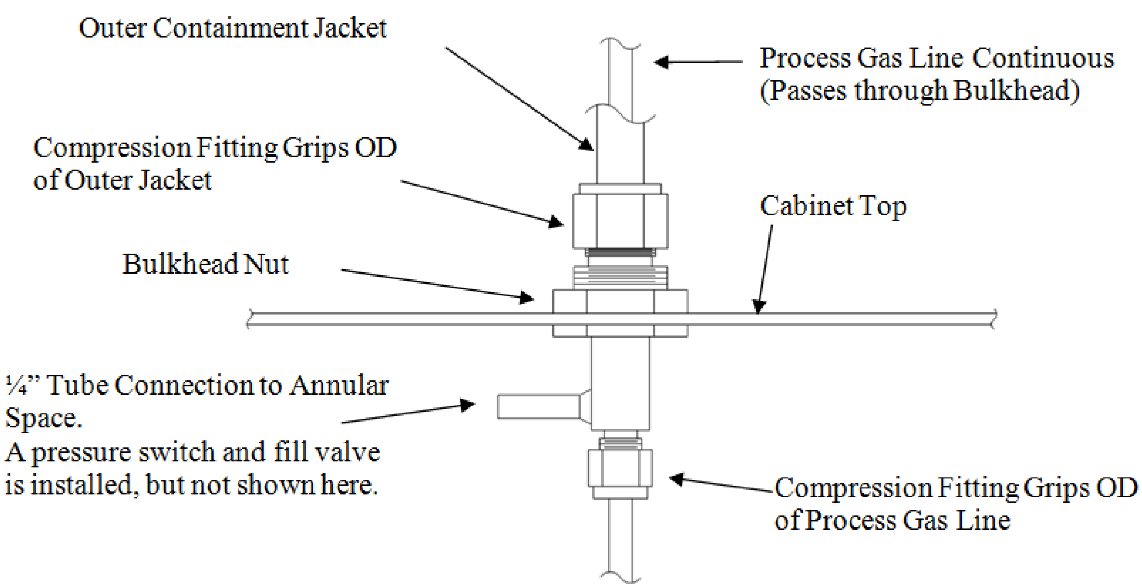

Figure 4-3. Coaxial Bulkhead (optional)

Vent Lines

Vent lines must be piped to a safe location away from personnel exposure per owner site requirements. The vent discharge opening should be constructed to prevent blockage from weather and animals. Vent gases will be introduced into the vent line during routine purging cycles.

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" and "Post-Purge" sequences, when the process gas pigtail is being purged prior to process gas cylinder removal and following gas removal, respectively. At this time, 106-127 CFH (50-60 LPM) of nitrogen is also being sent into the line through the vacuum venturi loop. The purging sequences run approximately 30-45 minutes. Process gas is also introduced during the "Conditioning" sequence where process gas is cycled through the pigtail, following the post-purge sequence and prior to on-line mode.

During a container change, it can be expected that the following volumes of gas will be vented from a VHF module.

- Pre-purge operating sequence: Total process gas mass vented:
    - 0.1 lb. SiH_4
    - 0.1 lb. NH_3
    - 0.2 lb. NF_3
    - 0.1 lb. N_2O
    - 0.1 lb. HCl
    - 0.1 lb. CO_2
    - 0.1 lb. NO

- Pre-purge operating sequence. Total mass of N_2 vented:
    - SiH_4 requires 120 purge cycles, 2.4 lb.
    - NH_3 requires 90 purge cycles, 1.8 lb.
    - NF_3 requires 75 purge cycles, 1.5 lb.
    - N_2O requires 75 purge cycles, 1.5 lb.
    - HCl requires 90 purge cycles, 1.8 lb.
    - CO_2 requires 75 purges cycles, 1.5 lb.
    - NO requires 90 purge cycles, 1.8 lb.

- Cylinder change sequence HPLT. Total mass of 10% He/N_2 mix vented = 0.2 lb.

- Post purge operating sequence. Total mass of N2 vented.
    - SiH4 requires 120 purge cycles, 2.4 lb.
    - NH3 requires 90 purge cycles, 1.8 lb.
    - NF3 requires 75 purge cycles, 1.5 lb.
    - N2O requires 75 purge cycles, 1.5 lb.
    - HCl requires 90 purge cycles, 1.8 lb.
    - CO2 requires 75 purges cycles, 1.5 lb.
    - NO requires 90 purge cycles, 1.8 lb.

- Condition operating sequence. Total mass vented during 5 conditioning cycles is:
    - 4 lb. SiH4
    - 0.2 lb. NH3
    - 6 lb. NF3
    - 8 lb. N2O
    - 7 lb. HCl
    - 8 lb. CO2
    - 1 lb. NO

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.

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 is furnished with a trickle purge orifice. The flow rate of this trickle purge is approximately 4-10 CFH (2-5 LPM). The VHF module employs a vacuum venturi module that integrates a vacuum venturi, check valve, and trickle purge valve into a single unit. Figure 4-4 depicts a typical trickle purge assembly that isn't integrated into a module for clarity.

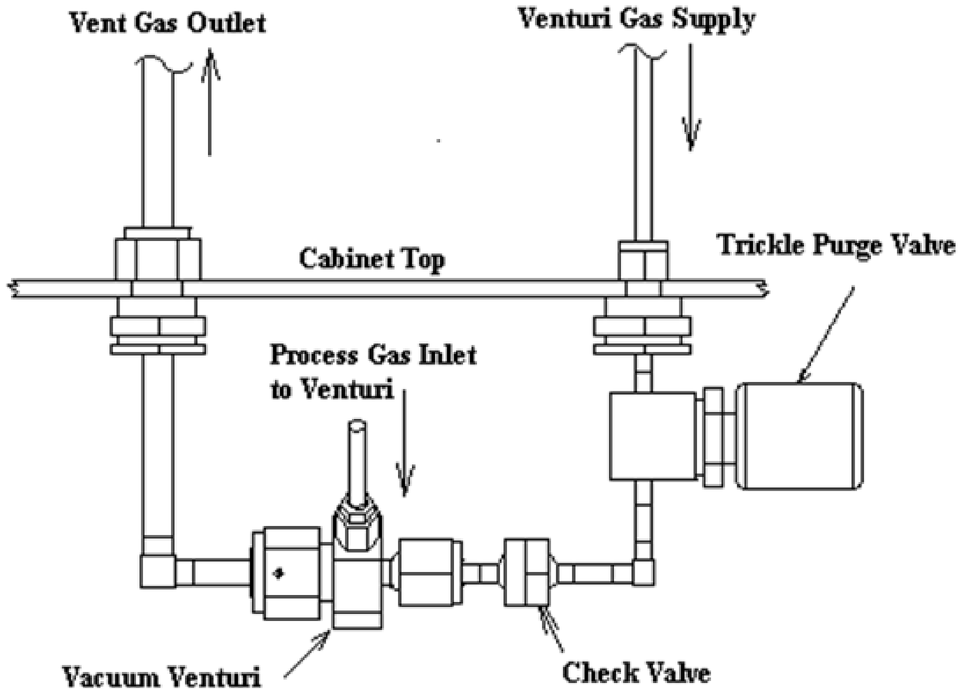

Figure 4-4. Typical Trickle Purge Assembly

Versum Materials, Inc. strongly recommends a separate venturi supply source rather than a houseline source. Most process cylinder pressures are significantly higher than houseline operating pressures. If multiple failures of certain process panel components occur, there is a remote possibility of back contamination of the houseline source connected to the vacuum venturi.

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

The venture line requires 80-90 psg (5.5-6.2 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 106-127 CFH (50-60 LPM) of nitrogen during purge cycles.

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 AP11 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.

Bonnet Vent Line

The Bonnet Vent must be kept open to allow gas to escape. It must not be sealed or routed into other vent lines. The bonnet vent discharge opening should be constructed to prevent blockage from weather, animals, and insects, but 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.

Purge and High Pressure Leak Check (HPLT) Supply Line

The purge and HPLT supply line must be connected to a dedicated purge source, and leak check source. The pressure required during cylinder purging is 80-90 psig (5.5-6.2 barg). An HPLT pressure of 950-965 psig (65.5-66.5 barg) is required for silane (SiH_4), nitrous oxide (N2O), nitrogen trifluoride (NF_3), hydrogen chloride (HCl), carbon dioxide (CO2), and nitric oxide (NO) process gases. For ammonia (NH_3) process gas, an HPLT pressure of 190-205 psig (13.1-14.1 barg) is required. Sufficient over pressure protection must be provided. Versum Materials, Inc. recommends a safety relief valve set at a maximum of 200 psig (13.8 barg) for the purge supply, and safety relief valve set at a maximum of 1200 psig (82.7 barg) for silane (SiH_4), nitrous oxide (N2O), nitrogen trifluoride (NF_3), hydrogen chloride (HCl), carbon dioxide (CO2), and nitric oxide (NO) HPLT supply. For ammonia

(NH_3) process gas, a safety relief valve set at a maximum of 250 psig (82.7 barg) is required. If a purge module has been purchased from Versum Materials, Inc., relief devices will be included.

⚠CAUTION

The purge gas source for the Very High Flow module should be used only to purge other Very High Flow modules handling the same process gas. It must not be used to purge systems handling incompatible process gases. Purge gas must not be supplied from a low pressure bulk gas source.

Purge and High Pressure Leak Check (HPLT) Backflow Prevention

All Purge and High Pressure Leak Check (HPLT) system must include backflow prevention in the form of a check valve. This will prevent process gas from migrating back into the purge panels and piping.

Enclosure Exhaust

Most VHF modules are supplied with process piping inside an exhausted enclosure. VHF modules that have been configured with a ventilation flow switch (a pitot tube will be located inside the 6” vent stack), will require 200 CFM (5663 LPM) exhaust ventilation and -0.1” (-.25 mm) water column static pressure by the customer, whether located indoors or outdoors.

VHF modules with exhausted enclosures that haven’t been configured with a ventilation flow switch are for inert gases, and don’t require exhaust ventilation if located outdoors, with the exception of nitrous oxide (N2O). In this case, the 6” (152.4 mm) diameter duct at the top of the piping enclosure may be capped. If however, the enclosure will be located indoors, it’s Versum Materials, Inc. recommendation that the enclosure be ventilated at 75 CFM (2124 LPM) minimum. If exhaust ventilation is not provided for indoor inert modules (enclosure or open air rack), then Versum Materials, Inc. recommends that forced mechanical ventilation be provided for the room per local code or regulatory requirements. A typical room ventilation requirement for indoor inert gas systems is to provide room ventilation at 6 air changes per hour, or 1 CFM/ft.^{2} (2.6 LPM/meter^2) of floor space, whichever is smaller. Also, customers should determine if additional safeguards are warranted, such as room O2 monitoring with local and remote alarms on low O2 concentration (i.e. less than 19.5% O2 detected in the room).

Nitrous oxide (N2O) VHF modules equipped with exhausted enclosures must be ventilated to 75 CFM (2124 LPM) minimum whether located indoors or outdoors to extract excess heat generated by the first stage JT heater.

VHF silane (SiH4) modules are supplied without an exhausted enclosure and must be located outdoors.

Heat Trace and Insulation

All source containers that are heated, including Y containers, Drums, and ISO containers, must have heat trace and insulated piping at least from the source container to the process regulators. If the source container is heated and the piping isn't maintained at the same temperature, liquefaction can occur and create a number of operational problems up to and including a module shutdown.
Heat trace and insulation may also be required for the houseline, from the process regulator to the facility entrance, depending on ambient temperature. If in doubt, consult your Versum Materials, Inc. representative.

If the VHF module has been ordered with source heater capability, heat trace and insulation will have been installed at the factory. If the VHF module has a flexible process pigtail, it will also be factory heat traced and insulated. If the pigtail is field piped, then the customer is responsible for installing heat trace and insulation from the DISS connection to the VHF module, although the heat trace will be supplied by the factory, coiled at the pigtail inlet to the piping cabinet. In either case, The VHF module is shipped with a bag of pre-cut, short black insulating material. This insulation is to be field installed over the piping VCR joints AFTER the joints are field pressure and leak tested.

Heat trace installation details are called out in the electrical installation drawing, located in Appendix B of this manual. Versum Materials, Inc. recommends 1" Polyisocyanurate Foam insulation covered by a 0.020" white PVC jacket for all field installed insulation.

NOTE: Heat trace and insulation should be installed after the pipeline has been pressure and leak tested.

When adding heat trace in the field the recommended material is "Delta-Therm PT3SB Heat Trace Cable" . This cable is constant watt (10 watts /ft.) so a controller must be installed to regulate heat trace temperature. Versum Materials, Inc. does not recommend self regulating heat trace because heat trace temperature cannot be changed if process conditions change.

Piping System Testing

Prior to the electrical start-up of the system, all field installed process piping should be tested. Factory installed piping has been tested prior to shipment, and is shipped under positive Argon pressure. Verify that the Argon pressure has been maintained at greater than or equal to 15 psig (1 bar g). If positive pressure has not been maintained, contact the Versum Materials, Inc. representative.

It is also recommended that the VHF module be pressure and leak tested before process gas is introduced. VCR joins may have loosened during shipment. MAWP of the piping systems within the VHF module are as follows:

- High pressure process piping, from PT-1 to PCV-1, purge inlet CV-3 to V-13, and V-13 to MV-6-3 and MV-6.
    - Process gases: Silane (SiH4), nitrous oxide (N2O), nitrogen trifluoride (NF3), and carbon dioxide (CO2). 3000 psig MAWP.
    - Process gases: Hydrogen chloride (HCl) and nitric oxide (NO). 1300 psig MAWP.
    - Process gases: Ammonia (NH3). 250 psig MAWP.
- Low pressure process piping from PCV-1 to MV-38.

Process gases: All. 250 psig MAWP.

After all the piping joints have passed the pressure and leak tests, install the factory supplied pre-cut, short black insulating material over the VCR joints. If the bag has been misplaced, ½" thick flexible Buna-N/PCV clamshell foam rubber insulation can be purchased by the installer locally.

5.0 Elecrical and Pneumatic Connections

All electrical connections must comply with Article 300 - Wiring Methods and Article 500 - Hazardous (Classified) Locations of the National Electric Code (NEC), and NFPA 70 if installed in the United States. Reference to the use of this equipment in Hazardous Locations only applies to installations located within the United States of America. VHF modules are designed for use in Explosive Atmosphere Directive (ATEX) locations, but do not have approval at the time of this printing.

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, single-phase-to-neutral (neutral solidly grounded), 3 wire, 50 to 60 Hertz
- ± 10% Fluctuation of Nominal Voltage Range
- Short Circuit Current Rating (SCCR) is 10 kA

All electrical and pneumatic connections and lines must be installed in accordance with the following drawings.

- “Electrical Details for Typical Installation” located in Appendix B.
- “Installation, VHFS Rack” located in Appendix B.

Grounding Connections

Install a grounding connection to each equipment module in accordance with NFPA 70 Article 250, “Grounding”, or applicable local codes. A grounding connection stud is supplied for hookup to the facility ground grid. Figure 4-5 shows a suggested grounding method.

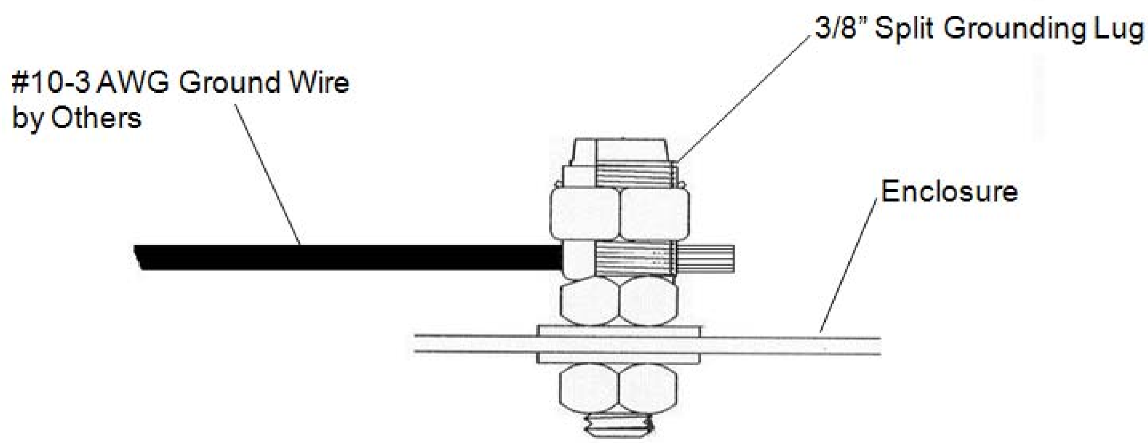

Figure 4-5. Suggested Equipment Grounding Method.

After installing the grounding connection, measure the overall grounding resistance between the piece of HFS equipment and the facility ground grid. The actual grounding resistance may be measure by attaching a wire to the facility ground grid and connecting an ohmmeter between this wire and the HFS equipment. The measured potential difference on the ohmmeter may not exceed one ohm (1Ω).

Once the grounding resistance measurement is complete, seal all exposed metal with a coat of exterior alkyd primer and exterior alkyd enamel paint to prevent corrosion from the elements.

Electrical Power Connections

Important!

All electrical penetrations, including power, I/O, and Ethernet, must be made through the bottom of the VHF Power enclosure only, and nowhere else. Penetrations made through other locations may cause equipment shutdowns due to RFI or moisture intrusion that may lead to a voided warranty. See penetration details shown in the electrical installation drawing, Appendix B of this manual.

The Power enclosure is located below the Low Voltage enclosure, adjacent to the left side of the piping cabinet. The main power disconnect switch can be found on the door of this enclosure. Inside, the main power disconnect DISC-103 is located in the upper right corner of the enclosure – all incoming power terminations are made here. Adjacent to this disconnect is LUG-103, provided for incoming power ground terminations. Power should penetrate the bottom of this enclosure and be routed through the **right** side wire way up to DISC-13 and LUG-103.

Dual power feed is required. The line side of main disconnect switch will accept the two separate power feeds, one for the VHF module Control Power, and the other for the VHF module Heater Power. It is recommended that the Control Power be supplied from a backed-up (critical) power source and the Heater Power be supplied from a utility (normal) power source. Control power has been routed from the disconnect through the low voltage enclosure to the AP11 controller at the factory. No other power terminations are made in this enclosure or required anywhere else in the VHF module. Details of the termination points are shown in the electrical installation drawing, Appendix B of this manual.

Sealing hubs and low point drains and other means of providing a watertight seal shall be utilized for outdoor installations. Additional specifications will have to be followed for installation within electrically classified areas.

Normal Power Feed for Heaters:

- 230 or 240 VAC is required for SiH_4, HCl, and N_2O modules. Do not power with less than 230 VAC.
- 208 – 240 VAC can be supplied for all other gases.
- Single phase, 50/60 HZ
- 5 amps with no J-T heater
- 36 amps with 1st stage J-T heater
- 56 amps with 1st and 2nd stage J-T heaters
- 5 KAIC @ 240 VAC, 75 deg. C terminal rating

Critical Power Feed for Control Power:

- 120-230 VAC
- Single phase, 50/60 HZ
- 3 amps
- 10 KAIC @ 277 VAC, 75 deg. C terminal rating

Note: Power conductors must be sized to deliver the required voltage at the rated current per the National Electrical Code, NFPA 70. Supply voltages should be checked at the line side of each cabinet main disconnect after the field installation to ensure proper operating voltage levels.

Field Signal Connections

In the AP11 VHF module, all field I/O wiring connections are made to the AP1563 customer I/O board located inside the left wall of the AP11 enclosure. VHF Modules requiring heat trace will be equipped with the AP1574 customer I/O board. Customer I/O termination points are the same regardless of the I/O board supplied.

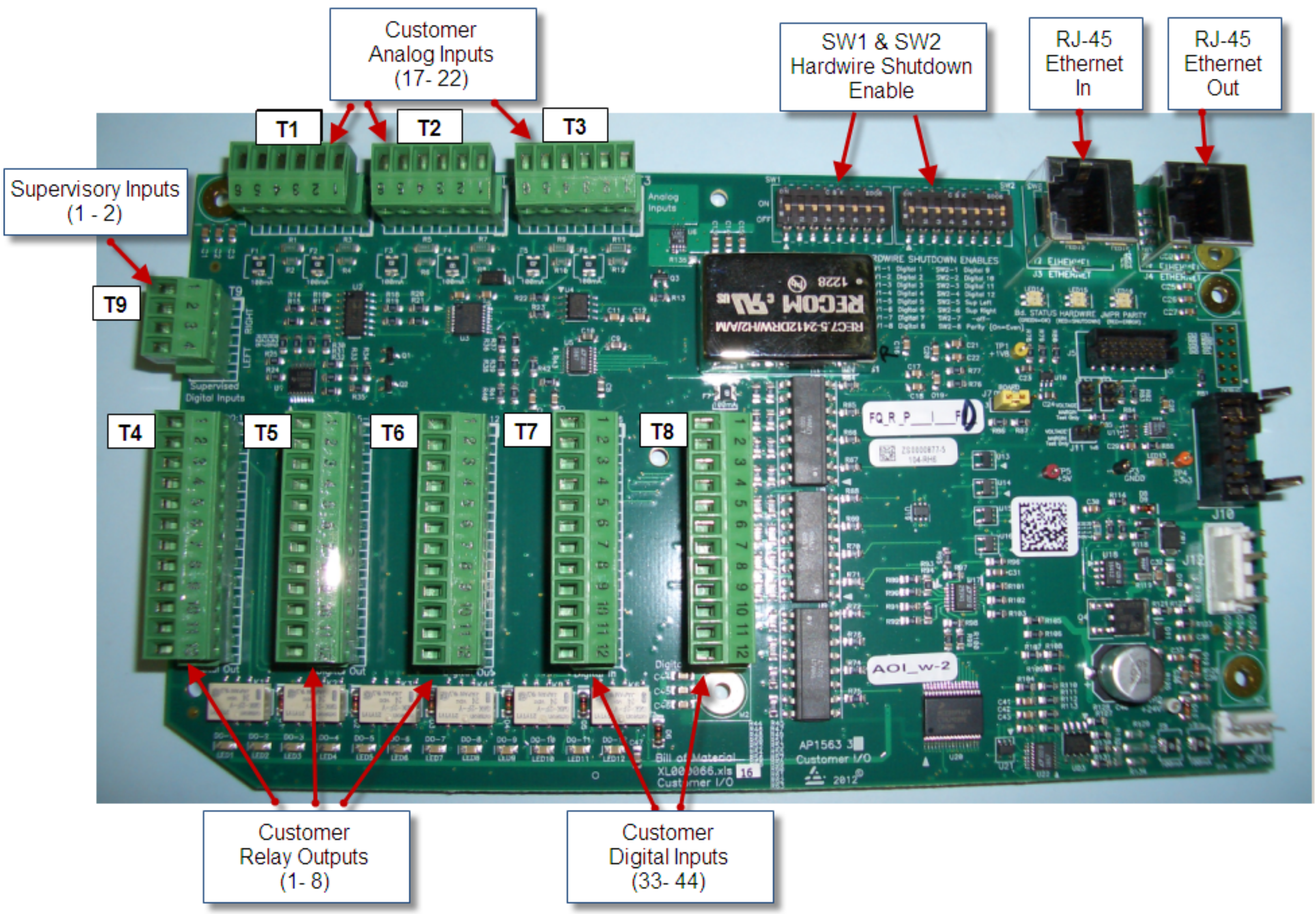

Figure 4.6: AP1563 Customer I/O Terminal Blocks

(Customer terminations are the same for the AP 1574 I/O board)

There are three types of I/O identified for the VFS field connections: discrete (digital) inputs, discrete (digital) outputs, and analog inputs. All the field and customer I/O signal connections to the AP11

Controller have been pre-assigned a specific location, although not all I/O connections or functions are required on all systems. Figure 4.6 shows the general locations of these connections. Details of these terminal blocks and termination points are shown in the electrical installation drawing, Appendix B of this manual.

CGA G-13 code, specifically section 12.2.1.5, states that an activation of the deluge sprinkler system should result in a shutdown of the silane (SiH_4) source. The customer should include this signal as part of the Life Safety System input to the VHF module, shown on the electrical installation drawing, Appendix B of this manual.

In the VHF module, the Low Voltage enclosure is located above the Power enclosure, adjacent to the left side of the AP11 controller and piping cabinet. No field I/O terminations other than peer –to-peer communications are made in this enclosure. Field wiring should be routed from the Power enclosure **left** side wire way to the Low Voltage enclosure left side wireway, across the bottom wireway of the low voltage enclosure, and on to the right side wireway and up to the 2” conduit penetration into the AP11 controller. Wiring for the optional Ethernet switch which populates the upper left corner of the I/O enclosure should be routed from the Power enclosure **left** side wire way to the Low Voltage enclosure left side wireway, and up the switch .

Supervised Inputs (AP1563 and 1574 Customer I/O boards)

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 4.7 shows the supervisor input wiring for use with the life safety system.

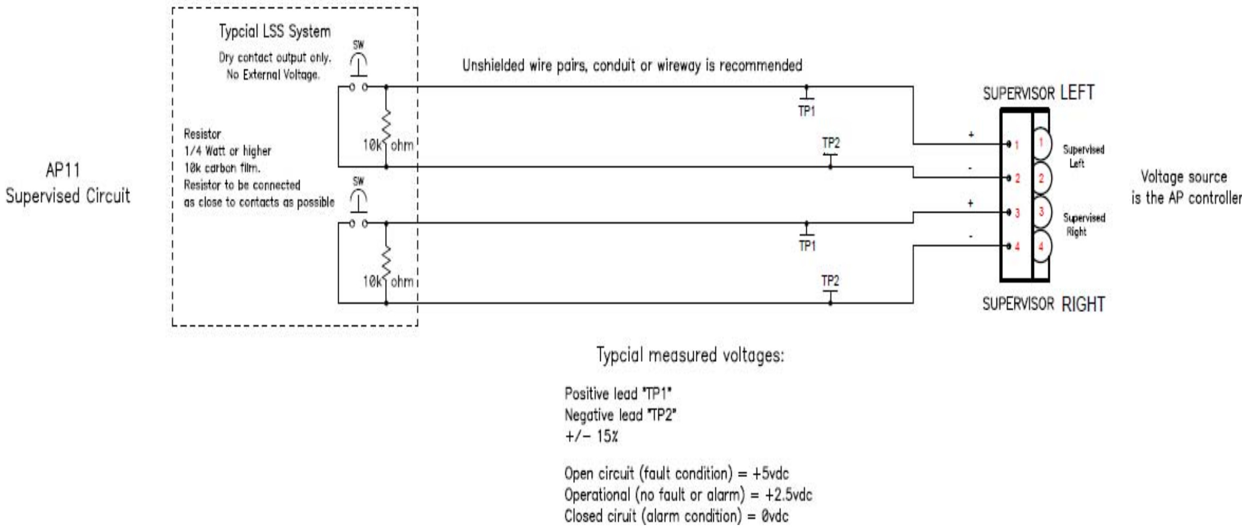

Figure 4.7: Supervisory Input Wiring

Available External I/O Communications

(Customer I/O boards AP1563 and 1574)

The VHF® 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.

For a list of alarms and shutdowns specific to your system, see the VHF Alarm Matrix included in the drawings section of the operational manual.

Digital Outputs Dry - Customer I/O boards AP1563 and AP1574

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	Factory use only	Factory use only	Factory use only
6	Factory use only	Factory use only	Factory use only
7*	T5-7	T5-8	T5-9
8*	T5-10	T5-11	T5-12
9	Factory use only	Factory use only	Factory use only
10*	N/A – wire to TB3	N/A – wire to TB3	N/A – wire to TB3
11*	N/A – wire to TB3	N/A – wire to TB3	N/A – wire to TB3
12	Factory use only	Factory use only	Factory use only

Digital Outputs Dry – Terminal Block TB3

Relay Output #	NO	Customer Brd COMMON	NC
10	N/A	TB3-1162	TB3-2191
11	N/A	TB3-1162	TB3-2201

Digital Inputs (Customer)
(Customer I/O boards AP1563 and 1574)

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

* Each digital-input can be individually configured to provide a hardwire shutdown alarm function. Figure 4.6 shows 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.

Customer Board 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)
(AP1563 and AP1574 Customer I/O boards)

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
21	T3 - 5	T3 - 6	T3 - 4
22	T3 - 2	T3 - 3	T3 - 1

User Power (Customer)
(AP1563 and AP1574 Customer I/O boards)

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 4.8 below. (AP11 connections are shown on the left)

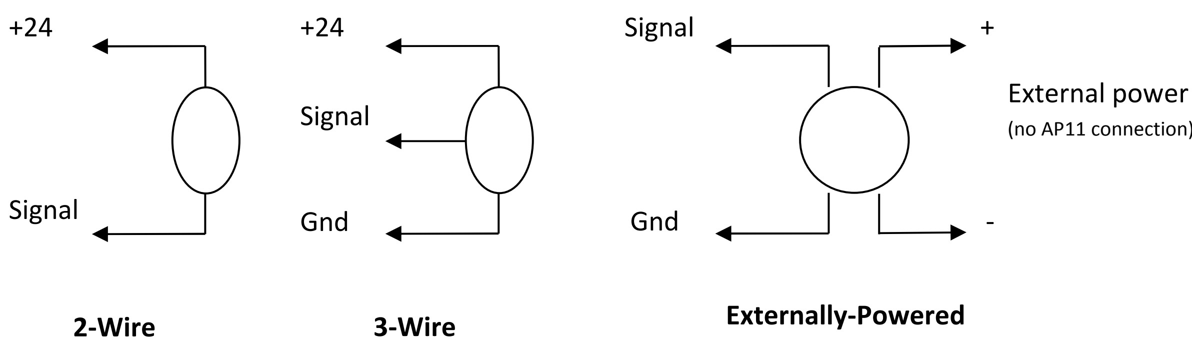

Figure 4.8

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.

<u>Cable-Resistance Calculation:</u>

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.

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

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 4.9 below:

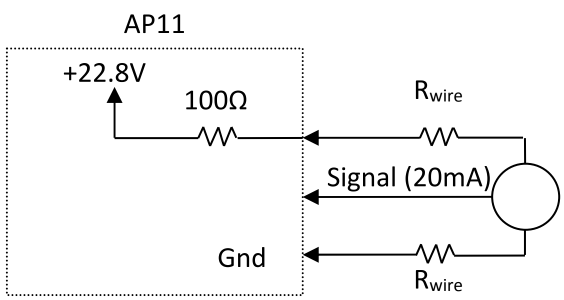

Figure 4.9

Excitation Voltage (V_E): Minimum opearating 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 it’s 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 excitiation 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.

$$Max\ Cable\ Resistance = \frac{22.8V - 18 - 100 * 0.084}{0.084 - .01} = 70\ ohms$$

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.

AP1565 Main Board Jumper for AP1563 and AP 1574 Customer I/O Boards

On VHF modules, jumper J7 is factory set as shown in Figure 4.10 for the Customer I/O board.

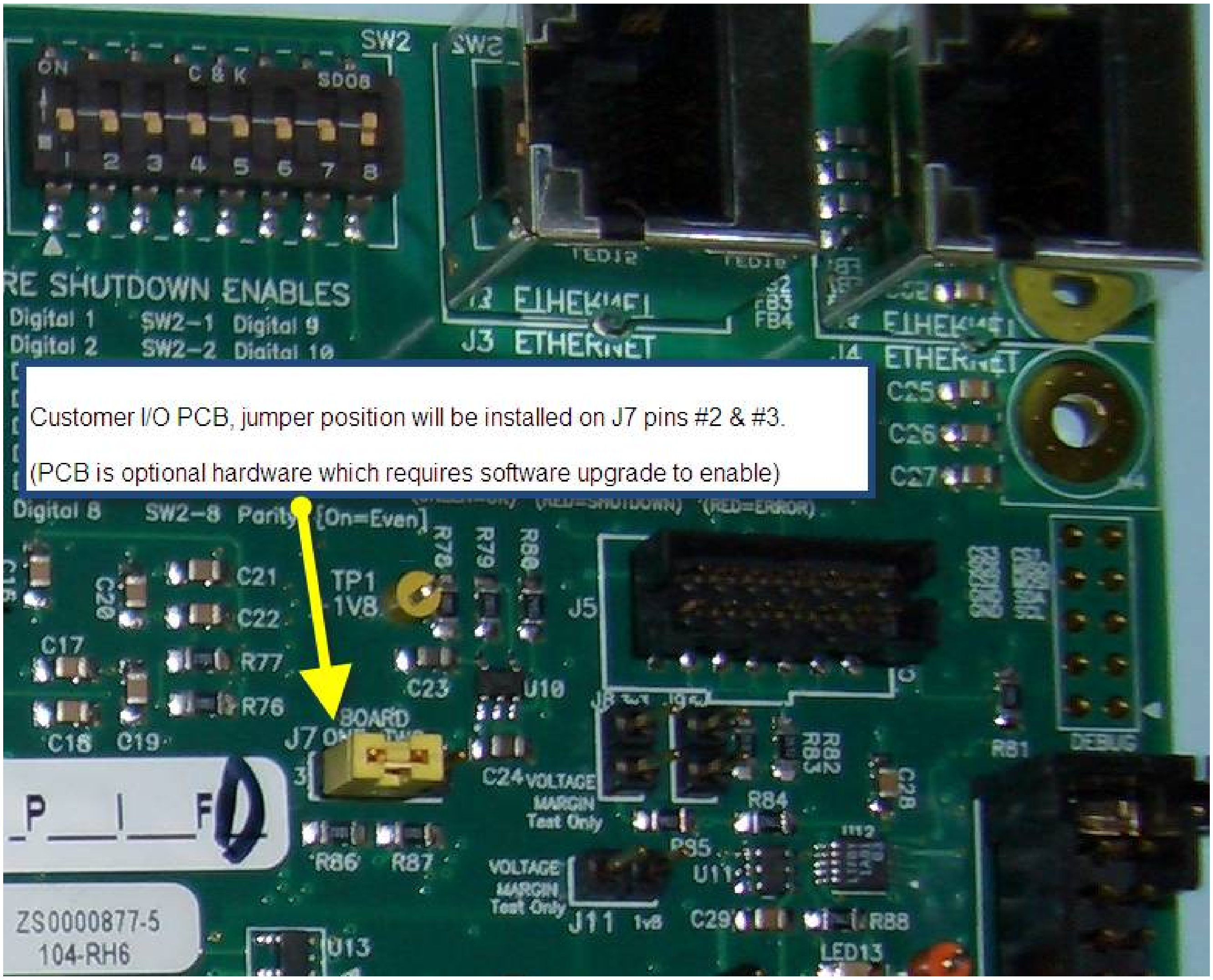

Figure 4.10: GASGUARD® AP11 Customer board "J7" jumper configuration.

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 4.11) 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 4.12

Figure 4.11: USB Port Warning Label

Figure 4.12: AP11 Controller USB Port on the Face of the Controller

The USB parameters for the port that is extended to the door of the AP11 controller, are listed below.

- Voltage: 5V +/- 10%
- Current: 2A maximum
- Capacitance : 100.01uF +/- 20%

GASGUARD® Networking

General Description

Remote monitoring of GASGUARD® systems can be attained using the GASGUARD® OPC Server software or VERSUM MATERIALS, INC.'s 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.

GCS Ethernet Network Wiring Configuration

A GCS is typically integrated into the site's Ethernet network. Figure 4.13 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 – 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 Global View 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.

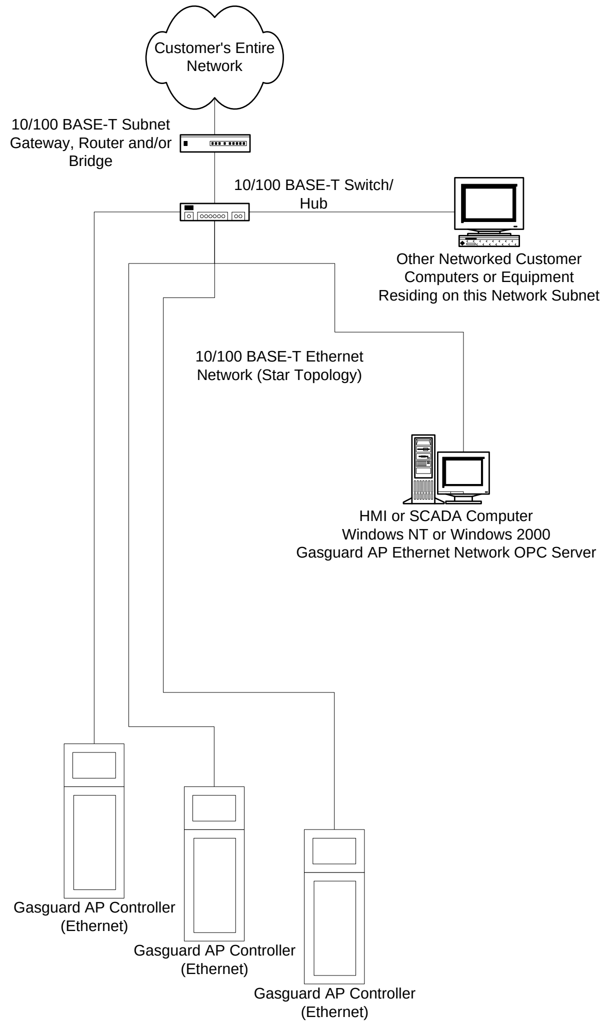

Figure 4.13 Typical GCS Network Architecture

Ethernet Connections

If multiple VHF modules are being installed as part of the same system, in a Dual Module (DM) operational configuration, peer-to-peer communication is required. A CAT5 cable must be routed from the module #1 AP11 Ethernet switch to the Ethernet switch in module #2. If data acquisition software has been purchased by the customer, a port in each Ethernet switch is available for the customer. See the electrical installation drawing, Appendix B of this manual for details. Figure 4.14 shows the location of the Ethernet switch in the Low Voltage enclosure.

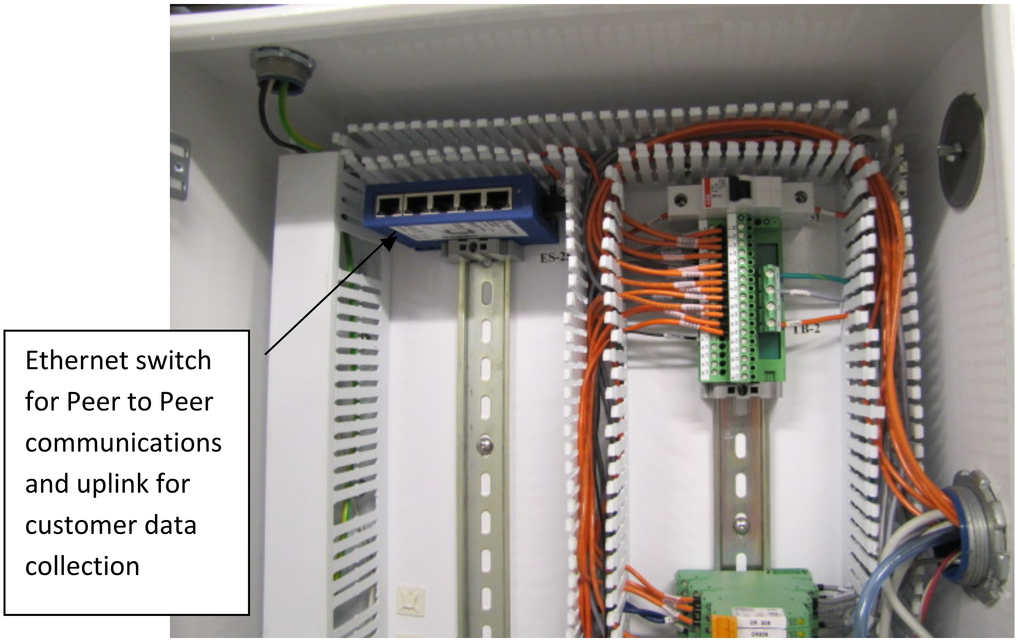

Figure 4.14. Location of Ethernet Connection on AP11VHF.

Pneumatic Connections

The VHF AP11 controller requires a pneumatic supply for Z-purge and pneumatic valve operation. **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.** Clean dry air will promote corrosion of electrical components and reduce controller performance and reliability.

The pneumatic supply must be regulated to 85-95 psig (5.9-6.6 barg). Maximum allowable working pressure is 100 psig (6.9 barg). Over-pressurization protection, such as a safety relief valve, must be provided to protect the internal solenoids. The flow rate required for pneumatic valve operation is 2 CFH (1 LPM). A 1/4" compression fitting at the back of the controller is provided for the pneumatic supply inlet connection as shown in Figure 4.7. Piping for the pneumatic supply must be protected from mechanical damage.

This supply is also used for Type Z purge of the electrical enclosure. Z-purge is enabled on all VHF module controllers because a clean, dry nitrogen purge will promote controller longevity and guard against water intrusion when installed outdoors. In certain areas, the Type Z purge is required to maintain a positive pressure at or above 0.1" water column (24.9 Pa). This is in accordance with

Article 496 of the National Fire Protection Agency (NFPA) regulations. 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 purging flow rate of 30 lpm/64 CFH for 30 minutes before applying power to the controller, each time any of the three electrical enclosure doors are opened. Following the 30 minute purge, a flow rate of approximately 6-21 CFH (3-10 LPM) is required during normal operation to continually maintain pressure above 0.1" water column.

Z-Purge Procedure

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

1. Close the Z-Purge valve on the back of the AP11 controller. See figure 4.8 for the valve location.
2. Close the controller front and tighten both latches completely.
3. Open the needle valve 6 to 7 turns (counter-clockwise). This equates to a flow rate of 30 lpm/64 CFH. Allow the controller to purge for 30 minutes if the area is classified hazardous. Only if the area is known to be non-hazardous, the controller purge time may be reduced.
4. Afterward, adjust the needle valve to satisfy the "Z-Purge" alarm (approximately 3 total turns open).

Flow requirements to operate the solenoid valves are very small, less than 2 CFH (1 LPM). If Type Z-purge is required, a flow rate of 6-21 CFH (3-10 LPM) will be needed, depending on the tightness of the individual controller and the installation.

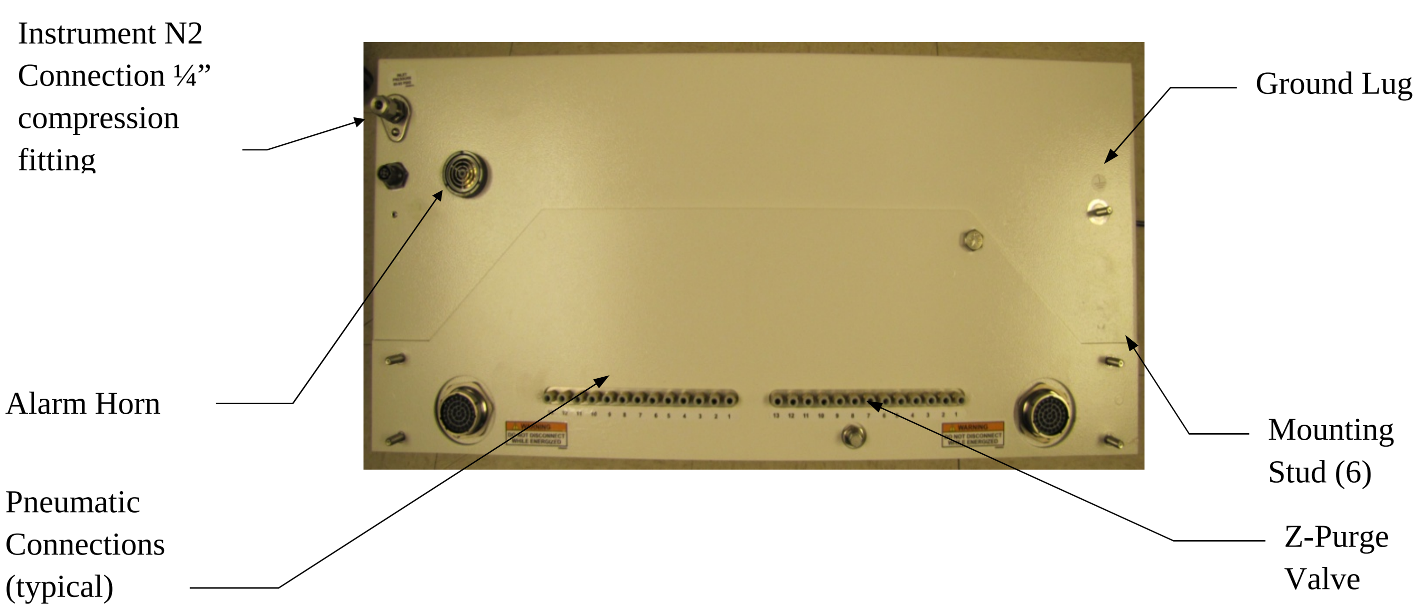

Figure 4.8. Rear View of GASGUARD® AP11 Controller

Source Container Pneumatic Connections

Depending on the VHF module configuration, the AP11 controller may be configured to supply a single pneumatic signal to the source A and B container valve, or multiple pneumatic signals to source A container valves and perform tube switching. When multiple pneumatic signals to source B are required, an additional stand alone tube switching controller is required.

If the VHF module was configured with a pneumatic signal for the source container, a single pneumatic tube or tube bundle will be supplied by Versum Materials, Inc.. A single pneumatic tube is typically supplied for Y containers, drums, and NH3 ISO containers. A pneumatic tube bundle is typically supplied for tube trailers and multi-tube ISO containers. Installation details can be found in the mechanical installation drawings located in Appendix B of this manual.

Installation and Pre-Facilitation Checklist

A GASGUARD® Very High Installation and Pre-Facilitation Checklist is provided in an appendix of this manual. This checklist will assist the owner/installer with items to be completed prior to startup. The Installation and Pre-Facilitation Checklist is included in Appendix E of this manual.

Startup and Commissioning Checklist

A GASGUARD® Very High Flow Startup and Commissioning Checklist is provided in an appendix of this manual. This checklist is used to verify that the system is connected properly and is ready for the Operational Readiness Inspection, commissioning, and start up**.** The Startup and Commissioning Checklist is included in Appendix F of this manual.

Operational Readiness Inspection

Before a VHF module or system can be started up, an Operational Readiness Inspection (ORI) must be completed. The ORI is a checklist that assures equipment placement, connection to all required utilities, verification of operability, startup and eventual commissioning prior to the introduction of process gas into the module or system. The ORI checklist is included in Appendix N of this manual.

OSHA Process Safety Management (PSM)

The United States Government, through OSHA, has established threshold quantities of hazardous gases. When exceeded, OSHA requires the system owner to establish a PSM program to inform employees of the operational characteristics and hazards of system operation. Contact OSHA, or ask your Versum Materials, Inc. representative for information on PSM threshold quantities and if establishing a PSM program applies to your facility.

Chapter 3

N/A Intentionally Left Blank

The information in this standard chapter does not pertain to the System referenced to in this manual. For this reason this chapter has been intentionally left blank.

Chapter 5

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The information in this standard chapter does not pertain to the system referenced to in this manual. For this reason this chapter has been intentionally left blank.

Chapter 4

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The information in this standard chapter does not pertain to the system referenced to in this manual. For this reason this chapter has been intentionally left blank.

Chapter 6

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The information in this standard chapter does not pertain to the system referenced to in this manual. For this reason this chapter has been intentionally left blank.

Chapter 7

System Description

⚠ WARNING

This equipment is not intended for use by the general public. Only personnel trained in GASGUARD® Very High Flow operation and the hazards associated with the fluid contained in this equipment should operate and maintain this equipment.

1.0 System and Components

The overall system consists of the source container, the VHF module, and optional equipment. Up to two source containers can be connected to each VHF module. Other options may be present in a complete Very High Flow System (VHFS). These could be a purge module, HCl purifier module, drum and Y-container blanket heaters, NH3 ISO heaters, and container scales. The following is an in-depth description of operating characteristics of the various VHF module configurations, hardware, and its interface with optional equipment.

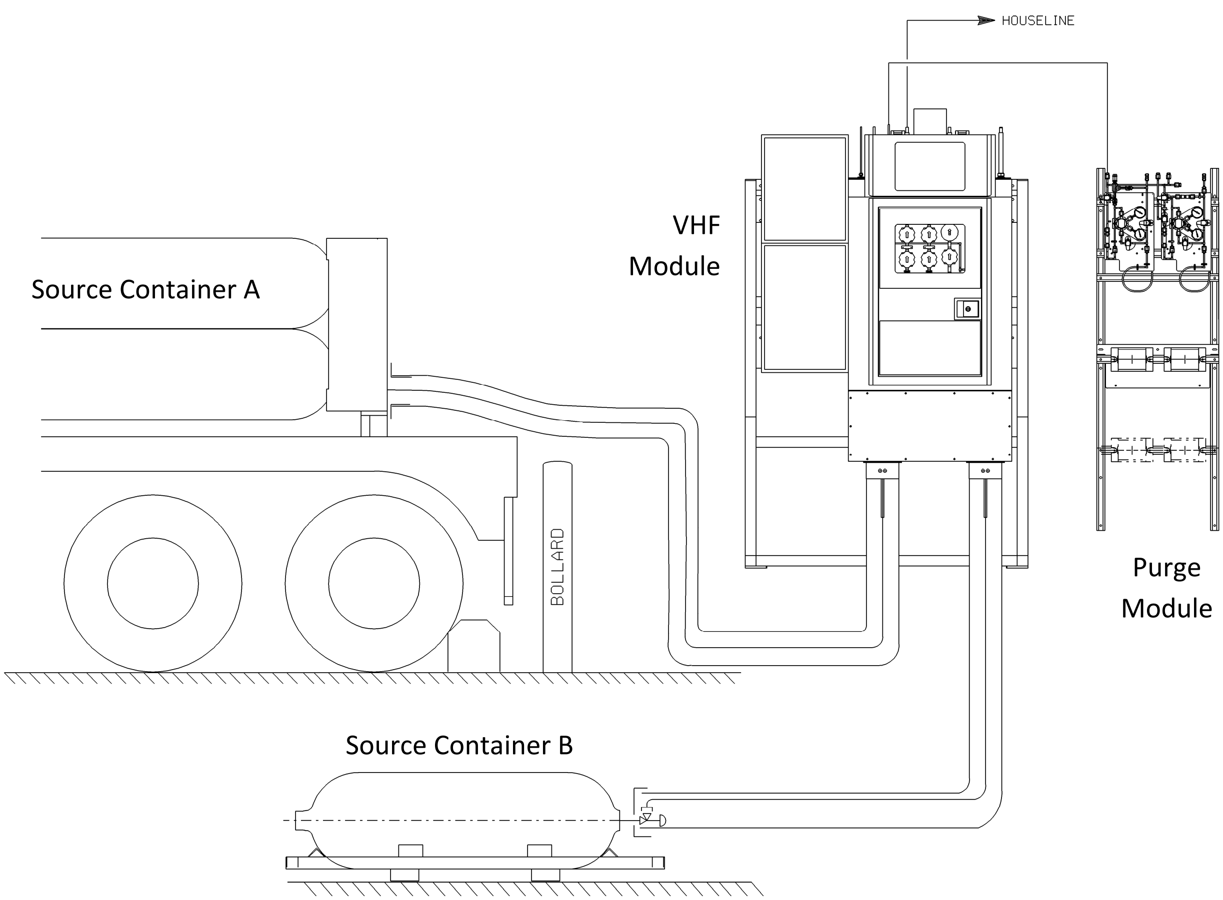


Figure 1-1. Typical Dual Source-Single Module VHF Installation

Very High Flow Module

Module Configurations

The GASGUARD® Very High Flow System (VHFS) is available in four configurations. The following is a description of each configuration:

Definitions:

Very High Flow Module (VHF) - A single flow train piping cabinet or rack, with a single AP11 controller. Either single or dual source can be connected to a VHF, but not more.

Single Module (SM) - One VHF cabinet or rack.

Dual Module (DM) – Two VHF cabinets or racks.

Single Source (SS) – One process gas container such as a Y, drum, or ISO trailer connected to a single VHF.

Dual Source (DS) - Two process gas containers such as a Y, drum, or ISO trailer connected to a single VHF.

1) Single Source, Single Module (SS-SM) –

> A stand alone module with a single source. When product in the source container is depleted, process gas stops and the module shuts down. Tube Switching is available as an option with the integral AP11 controller.

2) Dual Source, Single Module (DS-SM) –

> A stand alone module with two source containers, auto crossover operation. When product in source container A is depleted, the module crosses over and begins to dispense product from source container B, and vice versa. Tube Switching is available as an option with the integral AP11 controller managing tube switching on source container A. A separate AP11 controller is required to tube switch source container B.

3) Single Source, Dual Module (SS-DM) –

> Two modules, each with a single source container, that operate in an auto crossover configuration. When product in the module 1 source container is depleted, module 1 crosses over to module 2, and begins to dispense product from the module 2 source container, and vice

versa. Tube Switching is available as an option with the integral AP11 controller managing tube switcher on source container A.

4) Dual Source, Dual Module (DS-DM) –

Two modules, each with two source containers that operate in an auto crossover configuration. Both source containers A and B are on line simultaneously. When product in the module 1 source containers A and B is depleted, module 1 crosses over to module 2, and begins to dispense product from the module 2 source containers, and vice versa. Has the ability to operate with one source container per VHF module, if second source container isn't available. Source A and B cylinder changes are done independently, each pigtail is purged individually. Crossover occurs via. peer-to peer communications. The 2nd source can be purged and then placed on line when VHFS module is already in process gas mode. Tube Switching is available as an option with the integral AP11 controller managing tube switching on source container A. Separate AP11 controllers are required to tube switch source containers B.

Electrical Devices, Customer Digital Inputs, and Digital Outputs

The following is a list of electrical devices that may be present in the VHFS, and the alarm descriptions and functions associated with them. In the descriptions below, a crossover indicates the automatic valves on the active source (on-line) close and the automatic valves on the standby source open. There are two types of alarms associated with these devices, fault and shutdown. A fault alarm can be present and the system will continue to flow process gas, however, the source of the fault should be investigated and resolved. A shutdown alarm can be as minor as a source container crossover, or as critical as a module shutdown. All alarms should be investigated and resolved quickly to maintain system safety, reliability, and functionality.

Customer digital input signals permit the customer to remotely shut down the VHF module, stop process gas flow, or inhibit the venting of process gas by wiring to these inputs. Digital output relays provide the customer with a remote indication of system alarm status if the customer chooses to wire to these outputs.

PT-1 Standard for source A, Optional for Source B. It monitors pressure at the source container. There could be up to two PT-1s in a module if configured for two source containers. PT-1 performs multiple functions. They are:

PT-1 PAL On-Line low source pressure fault alarm. This fault alarm notifies the operator that container pressure is low. Low pressure typically means product will soon be depleted but, with liquefied compressed gas, can also indicate the liquid has been sub-cooled by an unusually high withdrawal rate or low ambient temperature. It is enabled in both on-line and standby modes. This alarm will inhibit the standby VHF module from coming on-line, until the alarm is cleared.

PT-1 PALL On-Line low source pressure shutdown alarm. This could indicate an empty source container, a sub-cooled source container, excess flow, a closed or misadjusted valve, or PT-1 failure. It is enabled in both on-line and standby modes.

- Single source, single module – PT-1 on the active side will be used to initiate a shutdown.
- Dual source, single module – PT-1 on the active side will be used to initiate a shutdown and crossover to the opposite source, if a second source is available and in standby mode. If associated with the standby side, this alarm will inhibit the standby side from coming on line until it is cleared.
- Single source, dual module – PT-1 on the active module will be used to initiate a shutdown and crossover to the opposite module, if a second module is available and in standby mode. If associated with the standby module, this alarm will inhibit the standby VHF module from coming on line until it is cleared.
- Dual source, dual module – PT-1 will close V-1 on the source that empties first, but the second source will continue to flow gas until its PT-1 signals an empty container. Following the second PT-1 shutdown signal, the controller will initiate a module shutdown and crossover to the opposite module, if the module is in standby mode. If associated with the standby module, this alarm will inhibit the standby VHF module from coming on line until it is cleared.

If BACKUP SOURCE or VHFS NOT AVAILABLE: This will cause an interruption of process gas flow to the customer.

PT-1 PAH On-Line high source pressure fault alarm. This alarm de-energizes the Source Heater Inhibit relay, causing the heater controller to stop heating the container. It indicates a possible run away source heater controller. It is enabled in both on-line and standby modes.

PT-1 Low vacuum - A shutdown alarm that will prevent any of the purge sequences from finishing until sufficient vacuum is restored. Cause could be an improperly sized or plugged vent line from the VHFS to the customer's scrubber, a closed valve or insufficient N2 pressure to drive the vacuum venturi.

PT-1 High purge pressure - A shutdown alarm that will prevent overpressure of module components if a regulator failure occurs in the customers purge gas supply system. Prevents the purge sequences from finishing until the cause is corrected.

PT-1 Low high pressure purge – A shutdown alarm during the high pressure leak test (HPLT), likely caused by insufficient cylinder pressure to perform adequate leak check. It prevents the Change Cylinder sequence from finishing until the cause is corrected.

PT-1 High-high pressure purge – A shutdown alarm during the high pressure leak test (HPLT), likely caused by a regulator failure in the leak check gas supply system. It prevents the Change cylinder sequences from finishing until the cause is corrected.

PT-1 V-4 lockout fault alarm - Prevents process gas from entering the purge gas supply during a vent cycle by inhibiting the opening of V-4 until pressure has been reduced to 150 psig.

PT-1 Pigtail trickle vent threshold – Silane only. Inhibites V-113TP trickle vent valve from opening during the pre-purge sequence initial vent, and conditioning sequence, until pressure has decreased to 75 psig. This restriction limits the amount of silane vented to the customer’s abatement system. It is the customer’s responsibility to properly construct an abatement system, and recommended that the customer consult CGA G-13 to understand and design to accommodate the hazards associated with silane. The amount of silane vented during each operating mode can be found in the installation section of this manual. V-113TP is standard on all silane modules.

PT-2 is **Standard**. It monitors VHFS houseline delivery pressure upstream of V-3, and performs multiple functions. They are:

PT-2 PAL Low delivery pressure fault alarm. This alarm notifies the operator that houseline delivery pressure is low. Low pressure typically means the regulator is set too low, or the flow rate has exceeded the system design, creating excessive pressure drop and regulator droop.

PT-2 PALL Low-low delivery pressure shutdown alarm. This alarm could indicate excess flow, a closed or misadjusted regulator or valve, JT heater failure, heat trace failure, or a PT-2 failure. PT-2 PALL on the active module will initiate a shutdown and crossover to the opposite module, if a second module is available and in standby mode.

If BACKUP VHFS NOT AVAILABLE: This would cause and interruption of process gas flow to the customer.

PT-2 PAH High delivery pressure fault alarm. This alarm notifies the operator that the regulator supplying the houseline is creeping (in standby mode), or the JT heater has failed causing liquid to flash as it’s throttled across the regulator.

PT-2 PAHH High-high delivery pressure shutdown alarm. This alarm could indicate a failed regulator or JT heater causing liquid to flash as it’s throttled across the regulator. PT-2 PAHH on the active module will initiate a shutdown and crossover to the opposite module, if a second module is available and in standby mode.

If BACKUP VHFS NOT AVAILABLE, the system will shut down and interrupt the supply of process gas to the customer.

PT-4 is **Standard**. It provides the operator with visual indication of purge gas inlet pressure, and is used by the AP11 contoller to vent HPLT gas from the purge gas inlet header in preparation for the purge sequence that follows.

PT-5 is **Standard**. It monitors vent line vacuum and pressure, and performs multiple functions. They are:

PT-5 PAL This fault alarm could indicate low vacuum venturi N2 supply pressure, a closed vent circuit valve, or a blocked or undersized vent line leading from the VHF module to the customer's scrubber.

PT-5 PAH This fault alarm could indicate a leaking purge gas isolation valve, manual process gas isolation valve left open, or a plugged vent line leading to the customer's scrubber.

PT-9 Option. It monitors houseline delivery pressure downstream of V-3, and is installed for increased reliability in the event V-3 should fail. PT-9 alarms are enabled after V-3 opens. PT-9

performs multiple functions. They are:

PT-9 Low Delivery Pressure. This fault alarm notifies the operator that houseline delivery pressure is low. Low pressure typically means the regulator is set too low, the flow rate has exceeded the system design, V-3 has failed closed, or F-2 is clogged.

PT-9 Low-Low Delivery Pressure. This shutdown alarm could indicate excess flow, a closed or misadjusted regulator or valve, JT heater failure, heat trace failure, or a PT-9 failure. PT-9 shutdown alarm on the active module will be used to initiate a shutdown and crossover to a second module, if available and in standby mode.

If BACKUP VHFS NOT AVAILABLE, the system will shut down and interrupt the supply of process gas to the customer.

PT-10 Option. PT-10 is the interstage pressure monitor, included with the dual stage regulation option. This pressure transducer indicates high interstage pressure between PCV-1 and PCV-2. PT-10 performs multiple functions. They are:

PT-10 PAH This fault alarm indicates high process gas pressure between PCV-1 and PCV-2, and could mean PCV-1 has failed, is creeping, or needs adjustment. It could also mean J-T heater temperature is too high, causing interstage pressure to increase when the module is in stand-by or idle modes.

PT-10 PSHH This shutdown alarm indicates high process gas pressure between PCV-1 and PCV-2, and could mean PCV-1 has failed, is creeping, or needs adjustment. It could also mean J-T heater temperature is too high, causing interstage pressure to increase when the module is in stand-by or idle modes. PT-10 shutdown alarm on the active module will be used to initiate a shutdown and crossover to a second module, if available and in standby mode.

PISL-35 Option PISL-35 is the coax monitoring pressure switch, located on the HCl purifier supply and return lines. It monitors the annular space between the process pipe and protective coaxial jacket, and initiates a fault alarm when pressure drops below 120 psig. The switch serves two purposes. If a leak develops to atmosphere from the coaxial jacket, an alarm displays on the controller. Similarly, if a leak develops from the process pipe into the coax annular space, an alarm displays on the controller. The annular space should be charged to a pressure above 120 psig.

PISL-36 Option PISL-36 is the coax monitoring pressure switch, located on the VHF module process out lines. It monitors the annular space between the process pipe and protective coaxial jacket and initiates a fault alarm when pressure drops below 120 psig. The switch serves two purposes. If a leak develops to atmosphere from the coaxial jacket, an alarm displays on the controller. Similarly, if a leak develops from the process pipe into the coax annular space, an alarm displays on the controller. The annular space should be charged to a pressure above 120 psig.

WT-1 Option WT-1 displays source container weight, and has multiple functions. They are:

WT-1 WAL low weight fault alarm. This alarm notifies the operator that container weight is low, and product will soon be depleted. It is enabled in both on-line and standby modes.

WT-1 WALL Low-low weight shutdown alarm. This shutdown alarm indicates an empty source container. Shutdown and crossover to the opposite source container if available, or another VHFS if available and in standby mode.

If the OPPOSITE SIDE CONTAINER OR BACKUP VHFS NOT AVAILABLE, this will cause and interruption of process gas flow to the customer.

WT-1 WALLL Low-low-low weight shutdown alarm. This shutdown alarm applies to Versum Materials, Inc. ammonia (NH_3) ISO containers only. If the PT-1 WALL shutdown setpoint is reached, the controller checks the status of the opposite source and will perform a shutdown and crossover to the opposite source container if available. If unavailable, the module will continue to flow process gas from the depleted container until this low-low-low setpoint is reached. Upon reaching this setpoint, a crossover will occur regardless of status, and if the opposite source container isn't available, process gas flow to the customer's houseline will be interrupted.

WT-1 WAH On-Line high weight fault alarm. This is an indication that the scale may not be calibrated correctly, net liquid weight is incorrect, or transfill is occurring between containers that are on line simultaneously.

WT-1 WAHH On-Line high-high weight shutdown alarm. This shutdown alarm indicates a transfill condition where two containers are on line simultaneously, one cooler than the other, being filled by the warmer container. It prevents overfill of a container resulting in an unsafe condition. When activated, it will initiate a shutdown and crossover if another VHFS is available and in standby mode, and will inhibit source heater operation.

If the BACKUP VHFS NOT AVAILABLE: This would cause and interruption of process gas flow to the customer.

TE-5 Option J-T heater discrete hardwire shutdown (included with J-T heater H-1 option). Its purpose is to turn off power to the J-T heater in the unlikely event heater temperature reaches 212 deg F (100 deg C). Following a trip, it must be manually reset. See the Troubleshooting section of this manual for the reset procedure.

TIC-6 Option Included with JT Heater H-1 option. Its purpose is to regulate J-T heater block temperature, and transmit heater block temperature to the AP 10 controller. The AP11 will alarm if heater temperature extends outside predetermined operating limits. TIC-6 is a PID controller. Programming instructions can be found in the PID Controller appendix section of this manual. TIC-6 has multiple purposes. They are:

TAL-6 J-T heater H-1 low temperature alarm. Its purpose is to detect a power reduction or power loss to the heater. Causes include failed heater element, tripped GFCB, failed SSR, or incorrectly programmed PID controller. A momentary low temperature alarm may also be caused by a drastic increase in flow rate and is considered normal. The PID controller is a reactionary device, limited in response characteristics, and cannot anticipate the additional demand on the J-T heater.

TAH-6 J-T heater H-1 high temperature alarm. Its purpose is to warn of an increase in temperature above the normal operating range of the J-T heater. Causes may include an incorrectly programmed PID controller, or a temporary overshoot as the heater block warms at startup or following an extended shutdown. The alarm can be reset after the heater block is thermally saturated. This will require a wait time of 15 to 30 minutes for the heater block to cool. A momentary high temperature alarm may also be caused by a drastic decrease in flow rate and is considered normal. The PID controller is a reactionary device, limited in response characteristics, and cannot anticipate the lack of demand on the J-T heater.

TAHH-6 J-T heater H-1 high temperature shutdown alarm. Its purpose is to stop the heater from operating above its intended setpoint in the event the PID controller is programmed incorrectly, or a PID controller failure occurs. The AP 10 controller will intercept the signal to the SSR, and turn the heater off. This shutdown alarm is non-latching, and will turn off power to the JT heater until temperature drops below the shutdown setpoint. It will not cause a module shutdown and crossover, allowing extra time for a standby source to be placed on line, or a customer's process to be completed. The heater can continue to operate temporarily in this oscillating on-off manner, but it is advisable to find and correct the problem as soon as possible. Anything more than short term temporary operation in this mode can cause equipment damage.

TE-7 Option J-T heater discrete hardwire shutdown (included with J-T heater H-2 option). Its purpose is to turn off power to the J-T heater in the unlikely event heater temperature reaches 212 deg F (100 deg C). Following a trip, it must be manually reset. See the Troubleshooting section of this manual for the reset procedure.

TIC-8 Option Included with JT Heater H-2 option. Its purpose is to regulate J-T heater block temperature, and transmit heater block temperature to the AP 10 controller. The AP11 will alarm if heater temperature extends outside predetermined operating limits. TIC-8 is a PID controller. Programming instructions can be found in the PID Controller appendix section of this manual. TIC-8 has multiple purposes. They are:

TAL-8 J-T heater H-2 low temperature alarm. Its purpose is to detect a power reduction or power loss to the heater. Causes include failed heater element, tripped GFCB, failed SSR, or incorrectly programmed PID controller. A momentary low temperature alarm may also be caused by a drastic increase in flow rate and is considered normal. The PID controller is a reactionary device, limited in response characteristics, and cannot anticipate the additional demand on the J-T heater.

TAH-8 J-T heater H-2 high temperature alarm. Its purpose is to detect an increase in power supplied to the J-T heater. Causes include an incorrectly programmed PID controller, or a temporary overshoot as the heater block warms at startup or following an extended shutdown. The alarm can be reset after the heater block is thermally saturated (typically within 15 to 30 minutes). A momentary high temperature alarm may also be caused by a drastic decrease in flow rate and is considered normal. The PID controller is a reactionary device, limited in response characteristics, and cannot anticipate the lack of demand on the J-T heater.

TAHH-8 J-T heater H-2 high temperature shutdown alarm. Its purpose is to stop the heater from operating above its intended setpoint in the event the PID controller is programmed incorrectly, or a PID controller failure occurs. The AP 10 controller will intercept the signal to the SSR, and turn the heater off. This shutdown alarm is non-latching, and will turn off power to the JT heater until temperature drops below the shutdown setpoint. It will not cause a module shutdown and crossover, allowing extra time for a standby source to be placed on line, or a customer's process to be completed. The heater can continue to operate temporarily in this oscillating on-off manner, but, it is advisable to find and correct the problem as soon as possible. Anything more that short term temporary operation in this mode can cause equipment damage.

TIC-111 is Optional It is the heat trace temperature controller. Although heat trace temperature isn't displayed on the controller main screen, it can be viewed by entering the Configuration Menu, System Test, Test Analog In screen.   There are four alarms associated with heat trace temperature. Two low alarms and two high alarms. In order to maintain product reliability, all are fault alarms.   It is possible to continue process gas flow with low heat trace temperature, although not an ideal situation. In extreme cases, low and high PT-2 pressure alarms or shutdowns will occur as liquid flashes across.

TALL-111 VHF module heat trace low-low temperature alarm. This setpoint is lower than TAL-111 in order to provide the customer with additional information regarding heat trace operation/health. Its purpose is to detect a loss of power to the heat trace. Causes include heater element cold section, tripped GFCB, failed contactor, or incorrect temperature controller setpoint.

TAL-111 VHF module heat trace low temperature alarm. Its purpose is to detect a loss of power to the heat trace. Causes include heater element cold section, tripped GFCB, failed contactor, or incorrect temperature controller setpoint.

TAH-111 VHF module heat trace high temperature alarm. Its purpose is to detect an increase in power to the heat trace. Causes include a failed contactor, or incorrect temperature controller setpoint.

TAHH-111 VHF module heat trace high-high temperature alarm. This setpoint is higher than TAH-111 in order to provide the customer with additional information regarding heat trace operation/health. Its purpose is to detect an increase in power to the heat trace. Causes include a failed contactor, or incorrect temperature controller setpoint.

UA-1 is **Standard**   It is the Emergency Stop- The emergency stop is located on the AP11 controller. By pressing this button power is removed from the J-T heater and heat trace, all valves are closed and process gas flow stops.   This contact is powered to 24 VDC, 3 mA.

UA-2 is **Standard**   It is the **c**ustomer Life Safety Shutdown. This shutdown is the result of any customer Life Safety System (LSS) device, such as a gas detector, located in or near the VHFS, sending a gas detect signal to the customer's LSS. The customer in turn sends a shutdown signal to this digital input to shut down the VHF module. Upon receipt of this signal through a hardwired shutdown input, power is removed from the J-T heater and heat trace, all valves are closed and process gas flow stops.   This contact is powered to 24 VDC, 3 mA.

In the case of an optional supervised input, all pneumatic valves will close, but power to the AP11 controller and J-T heaters will remain. This contact is powered to 24 VDC, 3 mA.

UA-7 is **Optional** It is the **c**ustomer Remote Shutdown, Supervised only. There will still be power at the AP11 controller but all the solenoids will close and the flow of gas will stop. Power will still be on to the J-T heaters and heat trace. This contact is powered to 24 VDC, 3 mA.

UA-7A is **Standard** It is the Customer Remote Shutdown Source A – The Single Module will close valves V-1 and V-8 for source A, and open the valves for source B, if in standby mode. The Dual Module system will close valves V-1 and V-8 on source A, wait for a shutdown signal for source B if available, then switch to the opposite module if it's in standby mode. This contact is powered to 24 VDC, 3 mA.

UA-7B is **Standard** It is the Customer Remote Shutdown Source B – The Single Module will close valves V-1 and V-8 for source B, and open the valves for source A, if in standby mode. The Dual Module system will close valves V-1 and V-8 on source B, wait for a shutdown signal for source A if available, then switch to the opposite module if it is in standby mode. This contact is powered to 24 VDC, 3 mA.

UA-8A is **Optional** It is Source A Heater Fault Alarm. This alarm is retransmitted from source heater A to the VHF module. Its purpose is to alert the customer through the VHF module that an alarm has occurred and must be investigated. This contact is powered to 24 VDC, 3mA.

UA-8B is **Optional** It is Source B Heater Fault Alarm. This alarm is retransmitted from source heater A to the VHF module. Its purpose is to alert the customer through the VHF module that an alarm has occurred and must be investigated. This contact is powered to 24 VDC, 3mA.

UA-14 is **Standard** It is the Vent Scrubber Unavailable alarm **–** If this customer initiated alarm is present, purge and cylinder change sequences will be inhibited, and if underway, will be aborted until the customer's scrubber is available. This contact is powered to 24 VDC, 3 mA.

TSHH-1 is Optional It is the High Temperature Alarm inside the VHFS enclosure option. The temperature switch will trigger a shutdown if temperature rises above 120 deg. F/48.8 deg C. Upon receipt of this shutdown signal through a hardwired input, power is removed from the J-T heater and heat trace, all valves are closed and process gas flow stops. If a second module is available, and in standby mode, a switch to that module will be initiated.

If the BACKUP VHFS NOT AVAILABLE: This would cause and interruption of process gas flow to the customer.

RSHH-15 is Optional It is the UVIR Detector viewing Source A. This UVIR detector is mounted and positioned in the field to view the source container connection. Its purpose is to detect and shutdown the module in the event of flame detection. The following alarms may be displayed on the AP11 controller:

UA-15 UVIR fault alarm. In addition to the fault alarm displayed on the AP11 controller, the UVIR detector will illuminate one LED to visually indicate a fault. Faults may include temperature, excessive input voltage, low input voltage, no power, detector fault, relay fault, self-checking fault, analog “0” current. Descriptions of these fault alarms can be found in the UVIR Detector appendix section of this manual.

RAHH-15 UVIR flame detect**.** If a flame is detected for more than 5 seconds at source A, the UVIR detector will send a shutdown signal. Upon receipt of this shutdown signal through a hardwired input, power is removed from the J-T heater and heat trace, all valves are closed and process gas flow stops. If a second module is available and in standby mode, a switch to that module will be initiated.

If the BACKUP VHFS NOT AVAILABLE: This would cause and interruption of process gas flow to the customer.

RSHH-16 is Optional It is the UVIR Detector viewing Source B. This UVIR detector is mounted and positioned in the field to view the source container connection. Its purpose is to detect and shutdown the module in the event of flame detection. The following alarms may be displayed on the AP11 controller:

UA-16 UVIR fault alarm. In addition to the fault alarm displayed on the AP11 controller, the UVIR detector will illuminate one LED to visually indicate a fault. Faults may include temperature, excessive input voltage, low input voltage, no power, detector fault, relay fault, self-checking fault, analog “0” current. Descriptions of these fault alarms can be found in the UVIR Detector appendix section of this manual.

RAHH-16 UVIR flame detect. If a flame is detected for more than 5 seconds at source B, the UVIR detector will send a shutdown signal. Upon receipt of this shutdown signal through a hardwired input, power is removed from the J-T heater and heat trace, all valves are closed and process gas flow stops. If a second module is available and in standby mode, a switch to that module will be initiated.

If the BACKUP VHFS NOT AVAILABLE: This would cause and interruption of process gas flow to the customer.

RSHH-17 is Optional It is the UVIR Detector viewing the VHF module piping. This UVIR detector is mounted and positioned at the factory to view the mechanical connections on the piping panel. Its purpose is to detect and shutdown the module in the event of flame detection. The following alarms may be displayed on the AP11 controller:

UA-17 UVIR fault alarm. In addition to the falt alarm displayed on the AP11 controller, the UVIR detector will illuminate one LED to visually indicate a fault. Faults may include temperature, excessive input voltage, low input voltage, no power, detector fault, relay fault, self-checking fault, analog “0” current. Descriptions of these fault alarms can be found in the UVIR Detector appendix section of this manual.

RAHH-17 UVIR flame detect. If a flame is detected for more than 5 seconds at the VHF module, the UVIR detector will send a shutdown signal. Upon receipt of this shutdown signal through a hardwired input, power is removed from the J-T heater and heat trace, all valves are closed and process gas flow stops. If a second module is available and in standby mode, a switch to that module will be initiated.

If the BACKUP VHFS NOT AVAILABLE: This would cause and interruption of process gas flow to the customer.

FSL-1 is Optional It is the Low Exhaust Alarm inside the VHFS module. The exhaust flow switch monitors velocity pressure through the VHF cabinet. If exhaust flow decreases below approximately 180 CFM, a fault alarm will be displayed.

PAL-10 is **Standard** It is the Low Pneumatic Pressure alarm. A pressure switch inside the AP11 controller monitors pneumatic pressure to the solenoid valves that send a pneumatic signal to pneumatic valves located throughout the VHF module. If pressure drops below 60 psig, process and purge valves become unreliable, therefore the VHFS module is shut down. When activated, it will initiate a shutdown and crossover to another VHFS if available and in standby mode.

If the BACKUP VHFS NOT AVAILABLE: This would cause and interruption of process gas flow to the customer.

PAL-206 is **Standard** It is the Low Z-Purge Pressure alarm. A pressure switch inside the AP11 controller monitors static pressure inside the electrical enclosures, and is set to alarm at 0.1 In. W.C. Z-Purge is required for equipment in NFPA or ATEX classified locations, but is also used in non-hazardous locations to keep the electronics in a clean dry atmosphere. Z-Purge must be maintained on all controllers located outdoors. Compressed air is not recommended because it will promote oxidation and corrosion thereby reducing the reliability of this equipment. Use dry nitrogen only for controller purging.

Relay 1; DO9 is **Standard** It is the Gas Available digital output. This relay changes state when a shutdown alarm is present and when the module is in online mode. This is a dry contact rated for 30 VDC, 1 Amp, and can be wired normally closed or normally open.

Relay 2; DO10 is **Standard** It is the module Fault Alarm digital output. This relay changes state when any fault alarm is present, in any mode. This is a dry contact rated for 30 VDC, 1 Amp, and can be wired normally closed or normally open.

Relay 3; DO11 is **Standard** It is the module Shutdown Alarm digital output. This relay changes state when any shutdown alarm is present, in any mode. This is a dry contact rated for 30 VDC, 1 Amp, and can be wired normally closed or normally open.

Relay 4; DO12 is **Optional** It is the module UVIR/High Temp alarm digital output. This relay changes state when any UVIR or temperature switch shutdown alarm is present, in any mode. This is a dry contact rated for 30 VDC, 1 Amp, and can be wired normally closed or normally open.

Mechanical Components

V-8A is **Optional** It is the container pneumatic isolation valve, source A. This option provides software and hardware to drive a container pneumatic valve. A pneumatic line is routed from the AP11 controller to the valve. The operator is prompted in the correct sequence to connect and disconnect the pneumatic supply to this valve. See the installation drawings in the appendix of this manual for more details.

V-8B is **Optional** It is the container pneumatic isolation valve, source B. This option provides software and hardware to drive a container pneumatic valve. A pneumatic line is routed from the AP11 controller to the valve. The operator is prompted in the correct sequence to connect and disconnect the pneumatic supply to this valve. See the installation drawings in the appendix of this manual for more details.

MV-0A is **Optional** It is the container manual isolation valve, source A. This option provides software with the correct prompts for a container manual valve. The operator is prompted in the correct sequence to open and close this valve.

MV-0B is **Optional** It is the container manual isolation valve, source B. This option provides software with the correct prompts for a container manual valve. The operator is prompted in the correct sequence to open and close this valve.

RFO-1A is **Optional** It is the pigtail restrictive flow orifice, source A. The Restrictive Flow Orifice (RFO) will be located immediately downstream of the DISS connection, in a ½ VCR joint labeled accordingly. If this option has been selected, excess flow rate will be limited based on the RFO size.

RFO-1B is **Optional** It is the pigtail restrictive flow orifice, Source B. The Restrictive Flow Orifice (RFO) will be located immediately downstream of the DISS connection, in a ½ VCR joint labeled accordingly. If this option has been selected, excess flow rate will be limited based on the RFO size.

MV-1A is **Standard** It is the process dual isolation manual valve. This valve is located within the VHF module, and is the first valve process gas reaches when it enters the module. Its purpose is to isolate process gas in the piping downstream from the operator during container A change out. The AP11 controller prompts the operator to open and close this valve at the appropriate time to leave a vacuum between MV-1 and V-1 during the purge and cylinder change modes.

MV-1B is **Optional** It is the process dual isolation manual valve, supplied with the Dual Source (DS) option. This valve is located within the VHF module, and is the first valve process gas reaches when it enters the module. Its purpose is to isolate process gas in the piping downstream from the operator during container B change out. The AP11 controller prompts the operator to open and close this valve at the appropriate time to leave a vacuum between MV-1 and V-1 during the purge and cylinder change modes.

V-1A is **Standard** It is the process isolation pneumatic valve. This valve is located within the VHF module, immediately downstream of MV-1A. Its primary purpose is to isolate process gas in the piping downstream from the operator during container A change out. The AP11 controller actuates this valve at the appropriate time - during a shutdown or when the container is placed on line.

V-1B is **Optional** It is the process isolation pneumatic valve, supplied with the Dual Source (DS) option. This valve is located within the VHF module, immediately downstream of MV-1B. Its primary purpose is to isolate process gas in the piping downstream from the operator during container B change out. The AP11 controller actuates this valve at the appropriate time - during a shutdown or when the container is placed on line.

F-1 is **Standard** It is the high pressure process filter. This filter is located upstream of the regulators, to protect the regulators from particles. It has a 5 micron filtration rating.

H-1 is **Optional** It is the first stage J-T heater. The first stage J-T heater is immediately upstream of the first stage regulator. It is designed to heat the process gas before throttling through the first stage regulator and prevent liquefaction that can create pressure fluctuations downstream, and ultimately cause a module shutdown. H-1 is an option, and only supplied for process gases that require it. It is powered at 6 KW, and operated at a temperature that suits the process gas thermodynamics.

PCV-1 is **Standard** It is the first stage regulator. The first stage regulator configuration is supplied based on source container pressure and flow rate. Two PCV-1 regulators in parallel are supplied for high pressure gases flowing between 500 and 1000 slpm. A single PCV-1 is supplied for high pressure gases flowing up to 500 slpm. NH3, a low pressure gas, is supplied with a single PCV-1 for the full range of flow up to 1600 slpm.
Depending on the configuration, PCV-1 adjustments may or may not be made in the field. On a two stage regulator system (PCV-1 and 2), PCV-1 will be preset to 250 psig delivery at 800 psig source pressure and is non-adjustable. If PCV-1 is stand alone (PCV-2 not installed), it will be field adjustable. Delivery pressure changes to a preset regulator should not be made in the field unless directed by an Versum Materials, Inc. EDS Engineer.

H-2 is **Optional** It is the second stage J-T heater. The second stage J-T heater is immediately upstream of the second stage regulator. It is designed to heat the process gas before throttling through the second stage regulator and prevent liquefaction that can create pressure fluctuations downstream, and ultimately cause a shutdown. H-2 is an option, and only supplied for process gases that require it. It is powered at 4 KW, and operated at a temperature that suits the process gas thermodynamics.

PCV-2 is **Optional** It is the second stage regulator. PCV-2 is optional depending on source container pressure and J-T heating requirements. It is always a hand adjustable, single regulator, without a parallel counterpart.

RFO-2 is **Optional** It is the houseline restrictive flow orifice. The Restrictive Flow Orifice (RFO) will be located at the outlet VCR connection of PCV-2, and labeled accordingly. If this option has been selected, customer flow rate will be limited to 250 slpm or less.

F-2 is **Optional** It is the low pressure houseline filter. The low pressure houseline filter is located upstream of V-3 for maintenance purposes, and is designed to protect the houseline. It has a 0.003 micron filtration rating, and is optional.

V-3 is **Standard** It is the houseline pneumatic process isolation valve. This valve is located within the VHF module, downstream of F-2. Its primary purpose is to maintain process gas pressure in the piping upstream of the regulators while in standby mode. Without this valve, pressure upstream of the regulators will bleed down to houseline pressure when the module is in any operating mode other than on-line. It can also be used to isolate process gas in the houseline from VHF module components upstream for maintenance. The AP11 controller actuates this valve at the appropriate time - during a shutdown or when the VHF module is placed on line.

MV-38A-1 is **Standard** It is the process outlet A manual isolation valve. This valve is located downstream of V-3, and is installed for the purpose of dual isolation to V-3. It can also be used as dual isolation between process out A and B, if optional process out B has been purchased.

MV-38A-2 is **Optional** It is the process outlet A manual dual isolation valve. This optional valve is located downstream of MV-38A-1, and is installed for the purpose of dual isolation to MV-38A-1, typically when optional process out B has been purchased.

MV-38B-1 is **Optional** It is the process outlet B manual isolation valve. This valve is only supplied when the process out B option has been purchased. It's located downstream of V-3, and is installed for the purpose of dual isolation to V-3. It can also be used as dual isolation between process out A and B.

MV-38B-2 is **Optional** It is the process outlet B manual dual isolation valve. This optional valve is located downstream of MV-38B-1, and is installed for the purpose of dual isolation to MV-38B-1, when optional process out A has been purchased. Dual isolation can avoid a planned module shutdown when making a tie-in to process out B after the VHF module has been started up and flowing process gas through process out A.

V-13A is **Standard** It is the purge/vent isolation valve, source A. This valve is located on a branch of pigtail A inlet piping, upstream of MV-1A. Its purpose is to isolate process gas from the purge and vent piping circuits, and is actuated by the AP11 controller during purge, change cylinder, and conditioning sequences.

V-13B is **Standard** It is the purge/vent isolation valve, supplied with the Dual Source (DS) option. This valve is located on a branch of pigtail B inlet piping, upstream of MV-1B. Its purpose is to isolate process gas from the purge and vent piping circuits, and is actuated by the AP11 controller during purge, change cylinder, and conditioning sequences.

MV-13A is **Optional** It is the purge/vent dual isolation valve, source A. This optional valve is located on a branch of pigtail A inlet piping, downstream of V-13A. Its purpose is to provide dual isolation to V-13A, isolating process gas from the purge and vent piping circuits.

MV-13B is **Optional** It is the purge/vent dual isolation valve, supplied with the Dual Source (DS) option.
This optional valve is located on a branch of pigtail A inlet piping, downstream of V-13A. Its purpose is to provide dual isolation to V-13A, isolating process gas from the purge and vent piping circuits.

V-4 is **Standard** It is the purge/HPLT isolation valve. This valve is located in a branch of the purge/vent piping circuit. Its purpose is to isolate purge and high pressure leak check gas from the vent piping circuit. It is actuated by the AP 10 controller during purge and change cylinder sequences.

CV-3 is **Standard** It is the process gas back pressure prevention valve. This valve is located upstream of V-4 in the purge/leak check gas piping circuit. Its purpose is to prevent process gas from backing into the purge/leak check gas piping circuit or containers in the event of a V-4 failure.

V-5 is **Standard** It is the vent isolation valve. This valve is located in a branch of the purge/vent piping circuit. Its purpose is to isolate the vent piping from purge and high pressure leak check gas. It is actuated by the AP 10 controller during purge, change cylinder, and conditioning sequences.

MV-6 is **Standard** It is the **l**ow pressure vent isolation valve. This valve is located in a branch of the low pressure process piping circuit, upstream of V-3. Its purpose is to isolate vent piping from process gas, and provide a means of venting/evacuation of the process piping during regulator or filter maintenance. <u>This valve should be locked closed by the customer, and only opened for maintenance purposes.</u> Only an experienced operator should be allowed to open this valve.

MV-6-2 is **Optional** It is the low pressure vent dual isolation. This optional valve is located in the low pressure process piping vent circuit, downstream of MV-6. Its purpose is to provide dual isolation between vent piping process gas. <u>This valve should be locked closed by the customer, and only opened for maintenance purposes.</u> Only an experienced operator should be allowed to open this valve.

MV-6-3 is **Standard** It is the **v**enturi isolation valve. This valve is located in the vent circuit, upstream of the vacuum venturi. Its purpose is to provide isolation between vent piping and the vacuum venturi, while a vacuum pump is connected to the VCR immediately upstream. It normally remains open, and is only used for maintenance.

V-113TP is **Optional** It is the trickle vent valve. This valve is located in the vent piping circuit, upstream of MV-6-3 and the vacuum venturi. The purpose of this valve is to limit the amount of silane vented to the customer's abatement system. It is the customer's responsibility to properly construct an abatement system, and recommended that the customer consult CGA G-13 to understand and design to accommodate the hazards associated with silane. V-113TP is inhibited from opening during the pre-purge sequence initial vent, and conditioning sequence, until pressure has decreased to 75 psig. The amount of silane vented during each operating mode can be found in the installation section of this manual. V-113TP is standard on all silane modules.

CV-7, V-7TP, Vacuum Venturi module is **Standard.** This module contains CV-7, V-7TP, and a vacuum venturi. It's located in the vent piping circuit immediately downstream of MV-6-3. Its purpose is to generate vacuum during pigtail purge sequences, prevent the backflow of process gas into the nitrogen source, and provide a trickle flow of nitrogen into the customer's vent line when the venturi is idle.

MV-22 is **Optional** It is the External purge inlet valve. This valve is only included with the HCl purifier option. Its located upstream of the HCl purifier supply connection, and is a weld gas port for installation of the optional HCl purifier module supply and return piping.

MV-28 is **Standard** It is the houseline weld gas port. This valve is located on the low pressure side of the process piping circuit, downstream of V-3 and upstream of the process out spool or spools. Its purpose is to facilitate weld gas supply when making a piping connection to the houseline or another VHF module.

MV-35A is **Optional** It is the coax fill port for HCl purifier supply. This valve is included with the HCl purifier coax monitoring option. It's located on a branch of the HCl purifier supply piping coaxial bulkhead, inside the VHF enclosure. Its purpose is to facilitate the pressurization of the coax annular space. The annular space should be charged to a pressure above 120 psig.

MV-35B is **Optional** It is the coax fill port for HCl purifier return. This valve is included with the HCl purifier coax monitoring option. It's located on a branch of the HCl purifier return piping coaxial bulkhead, inside the VHF enclosure. Its purpose is to facilitate the pressurization of the coax annular space. The annular space should be charged to a pressure above 120 psig.

MV-36A is **Optional** It is the coax fill port for process out A. This valve is included with the process out coax monitoring option. It's located on a branch of the process out A coaxial bulkhead, inside the VHF enclosure. Its purpose is to facilitate the pressurization of the coax annular space. The annular space should be charged to a pressure above 120 psig.

MV-36B is **Optional** It is the coax fill port for process out B. This valve is included with the process out coax monitoring option. It's located on a branch of the process out B coaxial bulkhead, inside the VHF enclosure. Its purpose is to facilitate the pressurization of the coax annular space. The annular space should be charged to a pressure above 120 psig.

Purge Module Option

If a standard purge module has been purchased from Versum Materials, Inc., it will come pre-configured to supply purge and High Pressure Leak Test (HPLT) gas to the VHF module. One of the purge module outlets must be field piped to the VHF module Purge N2/HPLT inlet. The VHF AP11 controller prompts the operator to switch from purge gas supply to HPLT and back again at the appropriate time.

HCl Purifier Module Option

The VHF module can be configured to send high pressure process gas to a separate HCl purifier module, and receive the purified gas back again. The purifier module can be configured with one or two HCl gas purifiers. Please see the separate HCl Purifier Module operation manual for details.

Drum and Y Container Blanket Heater Option

A container blanket heater may be needed, depending on process gas properties, flow rate, and environmental conditions. Versum Materials, Inc. offers two styles of heaters that can be used in conjunction with VHF modules.

The Gen II blanket heater design allows the controller to be remote located, with only a power and thermocouple junction box located adjacent to the container. Wiring between the junction boxes and heater controller is customer supplied and installed. Please see the separate Gen II Blanket Heater operation manual for details.

The Compact blanket heater design requires the controller to be located within 15’ of the container. Heater blanket power and thermocouple leads are wired directly into the heater controller. Please see the separate Compact Blanket Heater operation manual for details.

NH3 ISO Container Heater Option

When NH3 flow rates exceed that of heated Y containers and drums, an NH3 ISO container and heater controller are required, and can be used in conjunction with a VHF module. The NH3 ISO heater design allows the controller to be remote located, with only a power and thermocouple junction box located near the container. Wiring between the junction boxes and heater controller is to be customer supplied and installed. There are four power cables, one thermocouple cable, and one door interlock cable to be plugged into the ISO container. Please see the separate NH3 ISO Container Heater operation manual for details.

Container Weight Scales Option

Container scales are typically installed to monitor the quantity of liquefied compressed gas such as NH_3 and HCl in the container. Because these gases have a constant pressure under static conditions, it’s difficult to anticipate an empty container using pressure only. In process critical applications, scales, in addition to process calculations, can be used to anticipate a liquid dry condition. Weight scales are wired directly to the VHF module and a weight value will display on the AP11 controller screen.

Container Tube Switching Option

Tube Switching provides an automated method of systematically actuating ISO container or Tube Trailer air-operated valves without manual intervention. When the Tube Switching option is purchased for source A, the tube switching program is accessed from the VHF module AP11 controller. Tube switching for source B isn’t available with the AP11 controller.

A pneumatic tube bundle is supplied by Versum Materials, Inc., and must be routed from the AP11 controller and connected to the source container as part of the field installation scope.

USB Barcode

Refer to the section of the USB Barcode Setup and Operation Appendix for further details.

2.0 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 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 3-1. GASGUARD® AP11 Controller

Controller Components

The Display Screen

Located on the front face of the controller, the LCD display screen 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.

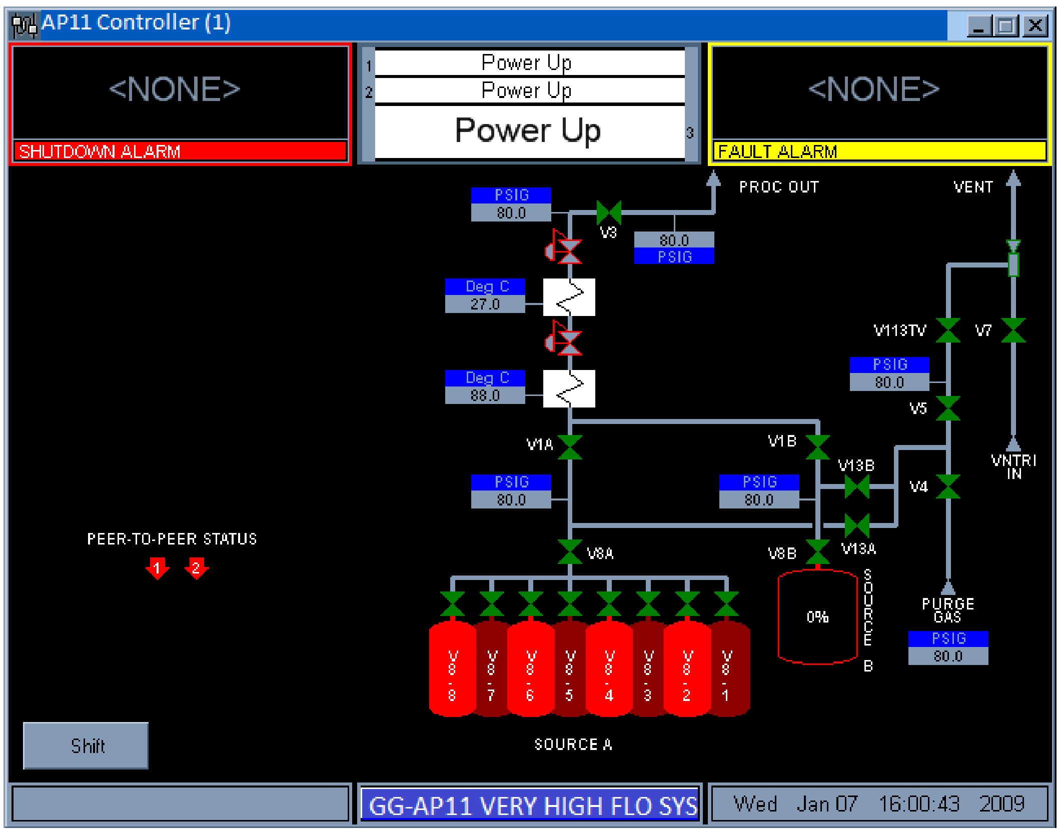


Figure 3-2. GASGUARD® AP11 Power Up Screen

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 3-3. The Main Menu will remain displayed for a configurable amount of time or until the Logout key is pressed.

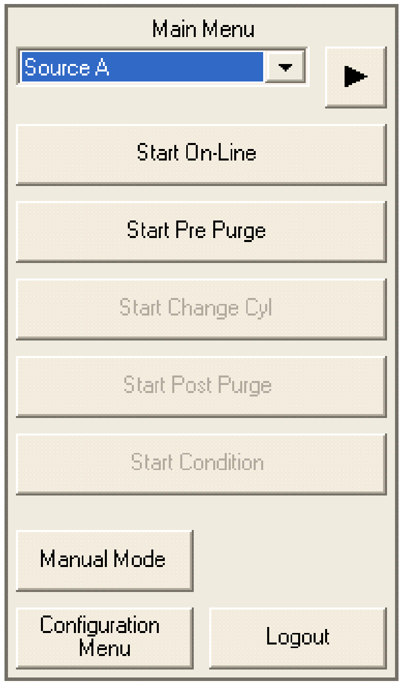


Figure 3-3. GASGUARD® AP11 Controller Main Menu

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 3-4.

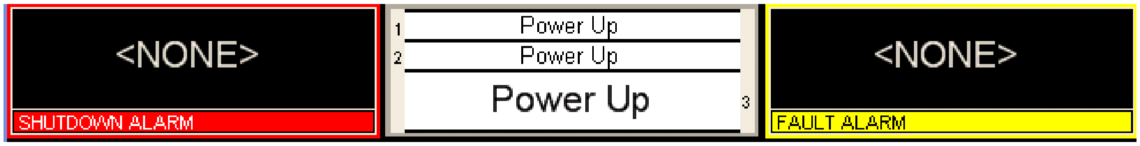


Figure 3-4. Alarm and Controller Status Boxes

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. Refer to Figure 3-5.

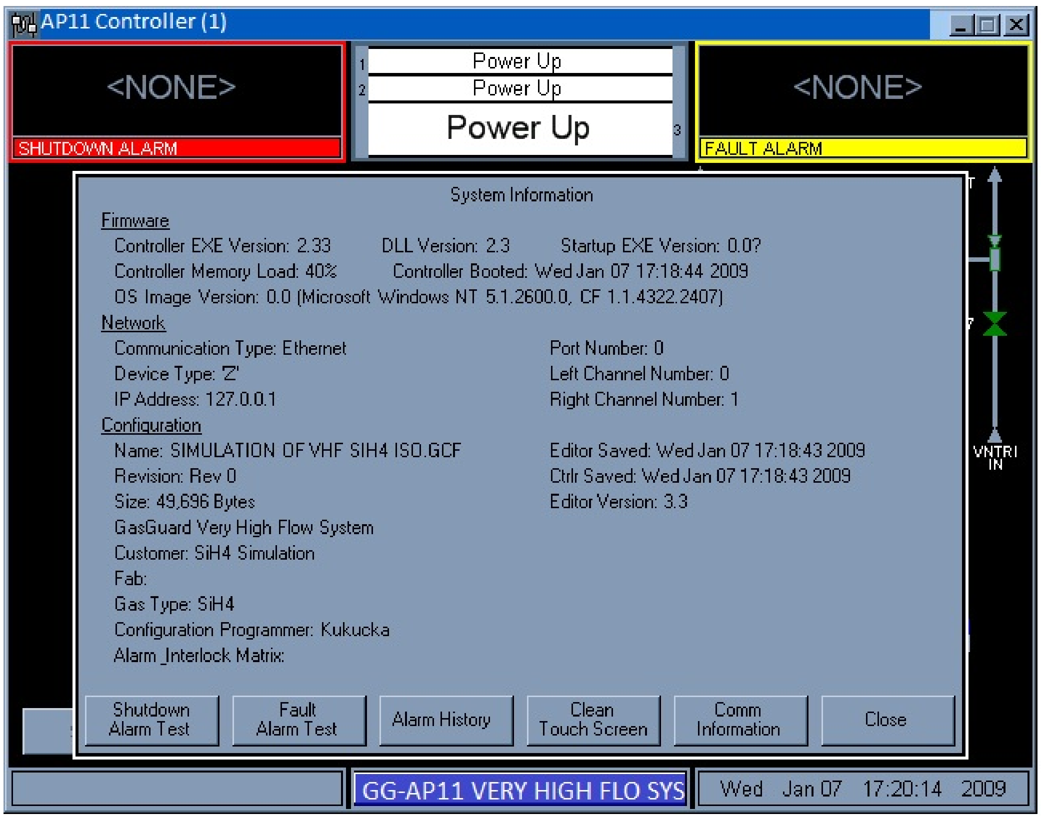


Figure 3-5. System Information Window

VGA LCD Display

The VGA LCD display on front of the cabinet controller provides a lighted display with a visual indication of pneumatic valve positions.

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.
Gas Flowing	This LED lights green when process gas is flowing.
Power	This LED indicates that there is +5 VDC power to the unit.
ARS Activity	If the ARS option has been purchased, this LED will indicate two modes of ARS operation. A steady blue light indicates ARS is in standby. A flashing blue light indicates ARS has control of the VHF module.

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 3-1 for a depiction of 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 AP11 Controller is furnished with two USB ports. Refer to Figure 3-6 for their location.

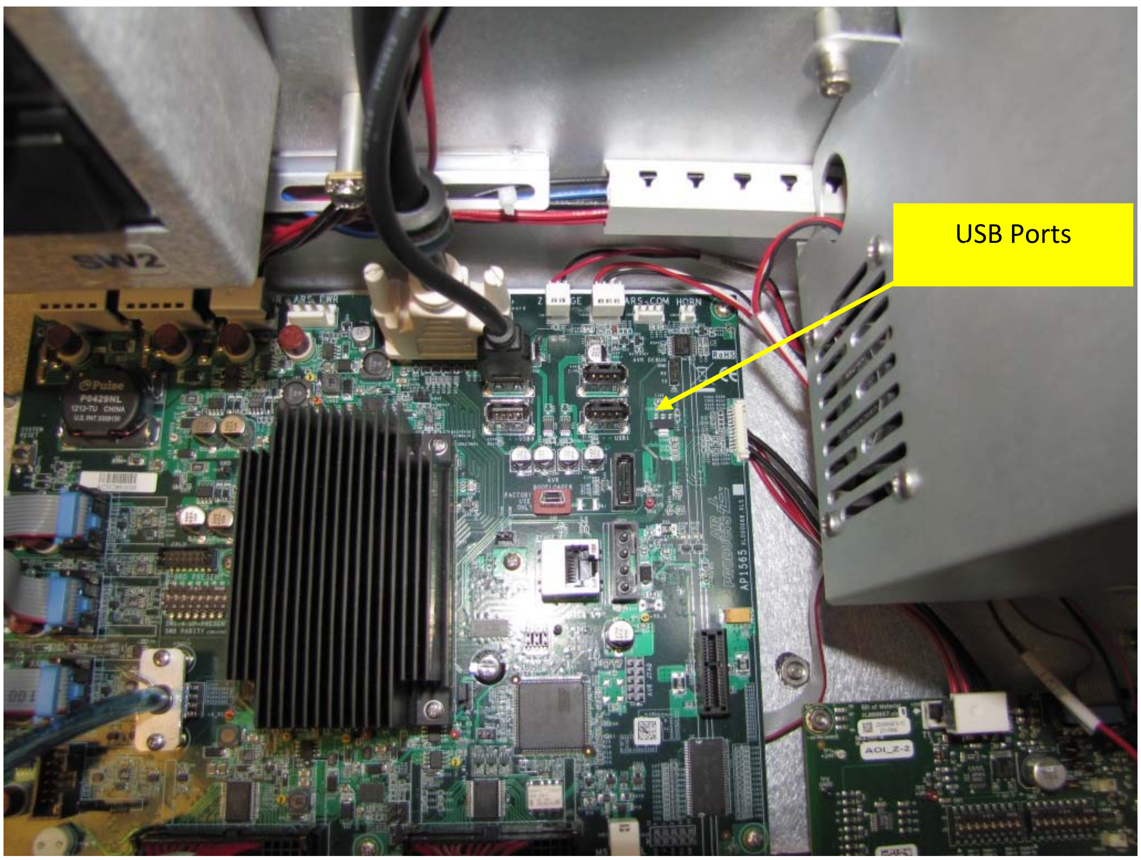


Figure 3-6. USB Ports

Any supported USB compatible device may be connected to either of the USB ports. Typically, a USB memory device may be used to transfer Configuration files or Firmware upgrades 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 in the event of a damaged or out of calibration touchscreen.

Mouse Usage

The 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.

Highlighting Text

In the Controller Configuration menu, it is possible to 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.

Z-Purge Valve

The Z-Purge flow control valve handwheel is located at the rear of the AP11 controller, beneath the left side pneumatic bulkhead bank. It can be adjusted from outside the AP11 controller enclosure.

The flow valve controls the flow of the house nitrogen to the controller interior. Its use may be required in certain areas (e.g., Class I, Division II designated areas in the U.S.A., Explosive Atmospheres (ATEX) in the European Community). It will be enabled on all systems installed outdoors to promote controller longevity.

A pressure switch is installed inside the controller to ensure adequate pressure (≥ 0.1" water column or ≥ 24.9 Pa) 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.

Main Menu Options

> ***Note: The following descriptions of system sequences are not intended as a guide to operation. Use specific operating procedures, provided in Chapter 8, Section 4, to operate the system.***

The main menu provides access to the controllers' sequences. It is password-protected. Contact your Versum Materials, Inc. Representative for your system password. Chapter 8, Section 4 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. Menu items not available will appear to be “grayed out” and will not respond if touched. Some menu items will require a “confirmation” before proceeding.

The following options are available from the main menu:

On Line

This menu option starts and stops the process gas flow from the source container to the houseline.

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 Chapter 9 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 menu option starts the pre purge sequence prior to cylinder change. This option may be repeated if needed. It is possible to return to Online mode once this sequence completes. If this sequence is stopped or aborts for an alarm condition and is restarted by the operator, it will restart at the beginning of the sequence, repeating all purge cycles.

This sequence inerts the process pigtail prior to disconnecting the source container by alternating between vacuum and pressure. The number of cycles depends on the gas being purged. Hazardous gases are typically run 40-120 cycles. The operator is prompted to open or close valves as well as disconnect the source container pneumatic signal when supplied.

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

Following the vacuum test, a series of pigtail piping purges are initiated 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 Chapter 8, Section 5 of this manual), but not reduced below the pre-configured minimum values.

Change Cylinder

This menu option is used when changing the process cylinder, and is only available in the Main Menu after the Pre Purge sequence has completed. Once started this sequence must complete prior to any other sequence becoming available.

This sequence initially tests for high pressure, which is an indication of a process cylinder valve leak, and then establishes a trickle purge flow through the pigtail to prevent atmospheric contamination during cylinder removal and replacement. If a safe condition is detected, the operator is prompted to remove the spent process container and replace it. The operator is prompted to take appropriate action to change out the container, including verify purge and leak check cylinder pressure.

A high pressure leak test (HPLT) will execute following a container change (recommended for hazardous gases).

CAUTION

Cylinder change procedures are located in Chapter 8, Section 4. 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, and starts the post cylinder change purge sequence.

A number of vacuum and pressure cycles similar to pre-purge are run, designed to remove potential atmospheric contamination that may have entered the pigtail during the container change. The number of cycles depends on the gas being purged. Hazardous gases are typically run 40-120 cycles. The operator is prompted to open and close valves as well as connect the source container pneumatic signal when supplied.

As with pre purge, the number of purge cycles is determined by the process gas type. Cycles may be increased (See AP11 Source System Configuration in Chapter 8, Section 5 of this manual), but not reduced below the minimum.

Process Gas Conditioning

This option starts the process gas conditioning sequence. It pressurizes and vents the pigtail with process gas up to 5 times in preparation for on-line mode.

The process gas condition sequence is usually run following a post purge sequence, although it can be used after a pre-purge sequence as well.

The number of conditioning cycles is typically 5. Cycles may be reduced (See AP11 Source System Configuration in Chapter 8, Section 5 of this manual), but not below the minimum of 1.

Manual Mode

Provided no alarms are present, pneumatic valves can be actuated independent of the controller program to facilitate maintenance. Only experienced operators trained to security level 2 or higher may operate the VHFS in manual mode. Actuating valves in the improper sequence could cause damage to the VHFS, interrupt process gas flow, or contaminate the process gas stream.

Tube Switching (Optional)

Prior to placing the controller into On Line mode, the appropriate tube switching mode must be selected. See Chapter 8, section 4I for a description of tube switcher operation and the modes available.

General

In the event that power is lost to the controller all of the solenoids will close. This will cause the single VHFS to shut down. If a second VHFS is available and in standby mode, that controller will be placed on line. Multiple VHFS use peer-to-peer communications to signal a crossover. Loss of peer-to-peer communication will result in a fault alarm only, and cause all available VHF modules to be placed on-line.

3.0 Power and I/O Enclosures

An integral part of the VHF module is the Power and Low Voltage enclosures. All VHF incoming power terminations are made in the Power enclosure, and all digital and analog signals are terminated in the AP11controller enclosure. The following is an overview of each.

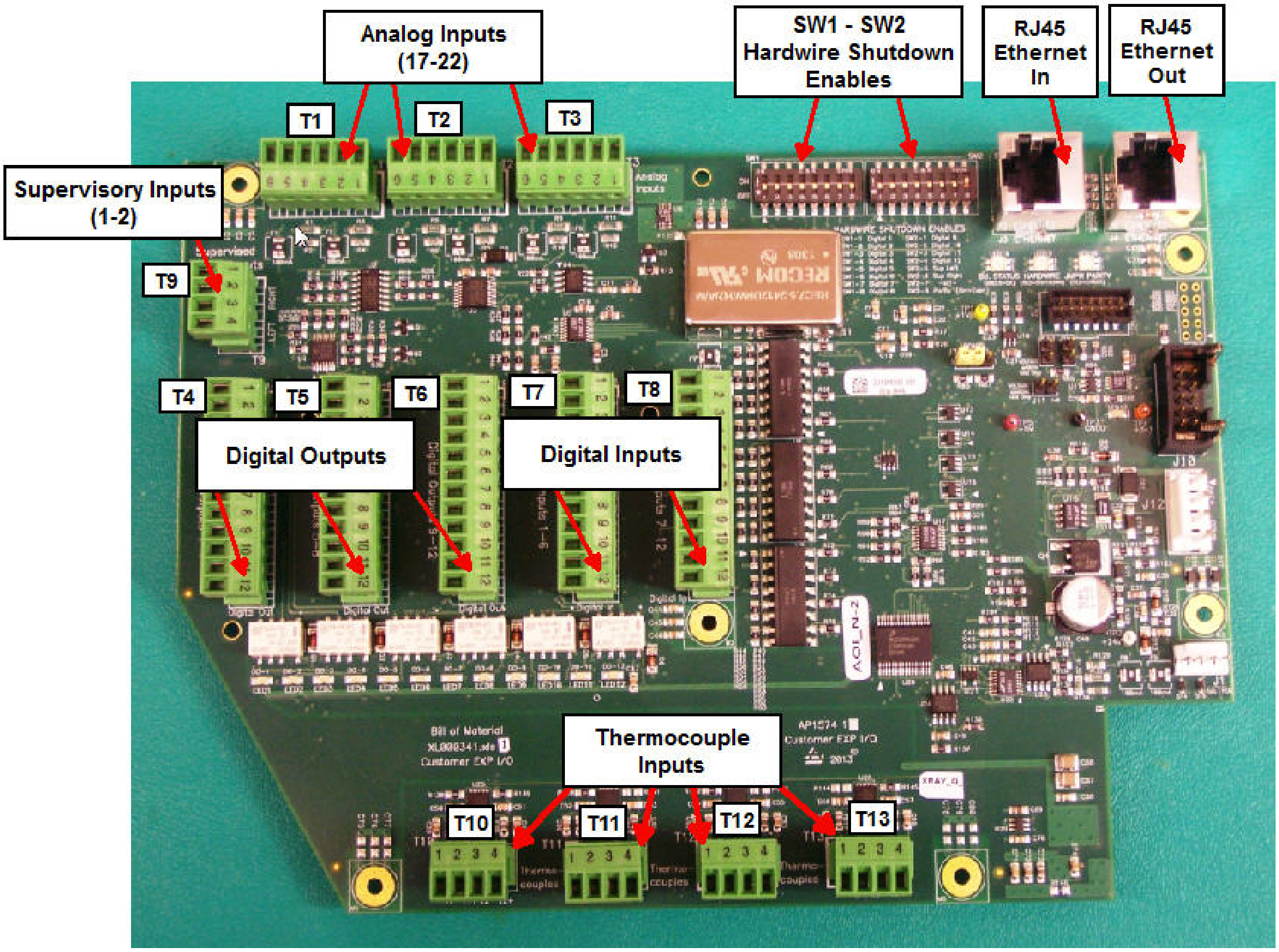
Important!

All electrical penetrations, including power, I/O, and Ethernet, must be made through the bottom of the VHF Power enclosure only, and nowhere else. Details are shown in the electrical installation drawing, Appendix B of this manual.

The Power enclosure is located below the I/O enclosure, adjacent to the left side of the piping cabinet. All Power terminations are made in this enclosure. Inside, the main power disconnect DISC-103 is located in the upper right corner of the enclosure – incoming power terminations are made here. Adjacent to this disconnect is LUG-103, provided for incoming power ground terminations. Dual power feed is required. See chapter 4 for power requirements. Control power is routed from this disconnect through the I/O enclosure to the AP11 controller at the factory. No other power terminations are made in this enclosure or required anywhere else.
The remainder of the enclosure houses Ground Fault Circuit Breakers (GFCB), Solid State Relays (SSR), and contactors for J-T heater and heat trace control. The **left** side wire way is reserved for DC wiring. AC wiring must be routed through the **right** side wire way. Details of these terminal blocks and termination points are shown in the electrical installation drawing, Appendix B of this manual.

In the VHF module, the Low Voltage enclosure is located above the Power enclosure, adjacent to the left side of the AP11 controller and piping cabinet. No field I/O terminations are made in this enclosure. Field wiring should be routed from the Power enclosure left side wire way to the Low Voltage enclosure left side wireway, across the bottom of the low voltage enclosure and up the right side wireway to the 2” conduit entering the lower left side of the AP11 controller. Terminations will be made on the customer board located on the left inside wall of the AP11 enclosure. Details of the termination points are shown in the electrical installation drawing, Appendix B of this manual.
Back inside the Low Voltage enclosure, an Ethernet switch populates the upper left corner of the enclosure. On the lower right side of the enclosure, a set of terminal blocks and PID controllers populate the area.

Figure 3.7 shows the AP1574 customer I/O board located on the left side wall of the AP11 controller. VHF Modules not requiring heat trace will be equipped with the AP1563 customer I/O board. Customer I/O termination points are the same regardless of the I/O board supplied. Supervisory inputs are terminated at T9, but all other digital inputs are terminated to T7 and T8. Digital outputs are terminated at T4. Analog inputs for weight scales are terminated at T3. Details of I/O terminations are shown in the electrical installation drawing, Appendix B of this manual.



3.7: AP1574 Expansion Customer I/O Terminal Blocks

(Customer terminations are the same for the AP 1563 I/O board)

If multiple VHF modules are being installed as part of a Dual Module (DM) operational configuration, peer-to-peer communication is required to maintain process gas flow and provide the highest level of system reliability. Ethernet based peer-to-peer communication between modules permits the standby module to come on line, if previously placed in standby mode, if for any reason the on-line module were to shut down. If a loss of peer-to-peer communication occurs between modules, both modules will be placed in on-line mode, if the standby module was previously placed in standby mode. A minimum CAT5 cable must be routed from the module #2 AP11 controller main board to the Ethernet switch in module #1. If data acquisition software has been purchased by the customer, a port in the

Ethernet switch is available for the customer. See the electrical installation drawing, Appendix B of this manual.

The optional J-T heater blocks are controlled by a PID controller digital output signal. An RTD imbedded in the heater block allows the PID controller to monitor temperature. The PID controller determines if the heater is above or below the operating setpoint, then sends an appropriate digital signal to the SSR. Power is applied or removed from the J-T heater block as required via the SSR, and protected by a GFCB. An analog signal is sent from the PID controller to the AP11 controller where J-T heater temperature is monitored and alarming notification is performed. Low and high temperature alarms alert the operator to J-T heater temperatures outside normal operating conditions. A non latching high–high shutdown alarm cuts power to the heaters in the event temperature exceeds operating limitations. In addition, a discrete hardwire shutdown circuit is provided that works off an imbedded temperature switch in the J-T heater. When the switch trips, it opens the contactor and interrupts power from SSR to the J-T heater. Similarly, any hardwired shutdown signal that occurs in the AP11 controller will also open the contactor and interrupt power from SSR to the J-T heater.

J-T heater operating temperature setpoint and alarms are pre-programmed at the factory and should not be adjusted in the field. Irreversible damage could occur to the equipment if the factory setpoint is exceeded. Contact Versum Materials, Inc. EES Mechanical/Systems Engineering before making any changes.

The optional process piping Heat Trace has an independent temperature controller located inside the piping enclosure. Power to the temperature controller is routed through a GFCB, and contactor, controlled by the AP11 hardwire shutdown circuit. In the event of a hardwire shutdown, power is removed from the heat trace controller. During a container change, interposing relays for source A and source B heat trace automatically remove power when the AP11 controller is placed in Pre-Purge or Change Cylinder modes. When source A is being changed out, pigtail A heat trace will be depowered, while pigtail B heat trace remains powered, and vice versa.

Heat trace temperature setpoint should always be at or above the source container heater to prevent liquefaction that will create pressure oscillations in the piping. Low and high heat trace temperature alarms have been set at the factory, but are user configurable. See chapter 5 section 2 – Starting up a New Module for recommendations on heat trace operating setpoint.

Most VHF modules will be supplied with the Z-Purge option enabled. Z-Purge will be included if the module will be located outdoors, in an area were flammable gas may exist, or both. When purged with clean, dry nitrogen, Z-Purge of the controller electronics promotes reliability and longevity. Purging with compressed air isn’t recommended because it promotes oxidation as well as corrosion and will reduce reliability.

See Chapter 2 for details on establishing a Z-purge. After Z-purge is established, opening the AP11 controller door, I/O enclosure door, or Power enclosure door will result in a Z-purge alarm displayed on the AP11 controller. If this occurs, re-establish Z-purge following the procedure in Chapter 2.

Chapter 8

Operating Procedures

1.0 Emergency

1. In the event of an emergency that requires the entire system to be shutdown **the remote emergency stop button or the Emergency Off Button at the Very High Flow module should be pushed**. It is strongly recommended that the Very High Flow module, or modules, have at least one remote emergency stop button located at the perimeter of the pad. Depressing the emergency stop button will stop the flow of gas at the source and shutoff power to the JT heater.

Note: The "Emergency Stop" (E-Stop) circuit closes all automatic valves and sounds the alarm horn.

2. Evacuate the area.

The Emergency Stop (E-Stop) button may be used at any time to shutdown the VHF module if any emergency condition is observed.

WARNING

Pressing the Emergency Stop button does not disconnect power to the controller. Source power (240 VAC for North America or 230 VAC for Europe) is still live within the Controller. Do not perform maintenance on the Controller without externally disconnecting or switching off power and following a Lockout and Tagout procedure.

Note: The Emergency Stop (E-Stop) button is located in the AP11 controller which sits above the VHF piping. The height of this button exceeds the SEMI standard maximum height of 64.5" (1638mm). To change the height of this button would require a redesign of the system. The button is currently reachable by 90% of the population.

2.0 Starting a New Module

1. Validate that the VHF Module is ready for startup by verifying all of the following have been completed:
   - Completion of the Startup Checklist and Operational Readiness Inspection (ORI).
   - Leak checks of field installed piping.
   - Functional testing of VHF control systems.
   - Functional testing of exhaust and gas abatement systems.
   - Facility nitrogen is connected to the vacuum venturi, and available at 80-90 psig (5.5-6.2 barg).
   - Facility nitrogen is connected to the controller for pneumatics, and available at 85-95 psig (5.9-6.5 barg).
   - If the process gas container is heated (Y or ISO heater controller present), be sure VHF heat trace temperature is set about 10 degrees F. higher than the heated process gas container, to prevent the formation of liquid in the VHF process piping. 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 10 degrees F. higher than the saturation temperature. The following are saturation temperatures for the most common liquefied compressed gases at different delivery pressures.

     Hydrogen chloride (HCl) saturation pressures/temperatures (unless ambient temperature is expected to drop below -38 deg F, houseline heat trace will not be necessary.):
     - 100 psig = -38 deg. F
     - 90 psig = -43 deg. F
     - 80 psig = -48 deg. F
     - 70 psig = -53 deg. F
     - 60 psig = -59 deg. F

     Ammonia (NH3) saturation pressures/temperatures:
     - 100 psig = 63 deg. F
     - 90 psig = 58 deg. F
     - 80 psig = 53 deg. F
     - 70 psig = 47 deg. F
     - 60 psig = 41 deg. F

Nitrous Oxide (N2O) saturation pressures/temperatures: (unless ambient temperature is expected to drop below -49 deg F, houseline heat trace will not be necessary.):

- 100 psig = -49 deg. F
- 90 psig = -53 deg. F
- 80 psig = -58 deg. F
- 70 psig = -63 deg. F
- 60 psig = -68 deg. F

- Verify the J-T heater H-1 is set to 88 deg. C, and H-2 is set to 27 deg. C for silane (SiH4) and nitrous oxide (N2O).
- Verify the J-T heater H-1 is set to 71 deg C for nitrogen trifluoride (NF3), ammonia (NH3), and hydrogen chloride (HCl). Verify H-2 is set to 27 deg. C for hydrogen chloride (HCl)

2. If the Controller is located in a Class I, Division II hazardous location, before turning on the power, perform the Z-Purge startup instructions listed below. The atmosphere within the AP11 controller as well as high and low voltage cabinets must be inerted <u>before</u> turning on the electrical power main switch.

   <u>IMPORTANT!</u> Care must be taken when introducing Z purge gas into the controller enclosure, as it is rated to a maximum pressure of 5 psig (0.3 barg). The Z purge pressure is controlled by a needle valve at the rear of controller. To prevent enclosure over-pressurization, close the needle valve prior to introducing purge gas into the enclosure. To initiate the controller purge the following procedure must be followed:

- Close the Z-Purge valve on the back of the AP11 controller. See figure 5.1 for the valve location.
- Close the controller front and tighten both latches completely.
- Open the needle valve 6 to 7 turns (counter-clockwise). This equates to a flow rate of 30 lpm/64 CFH. Allow the controller to purge for 30 minutes if the area is classified hazardous (Class I, Division II). Only if the area is known to be non-hazardous, the controller purge time may be reduced.
- Afterward, adjust the needle valve to satisfy the “Z-Purge” alarm (approximately 3 total turns open).

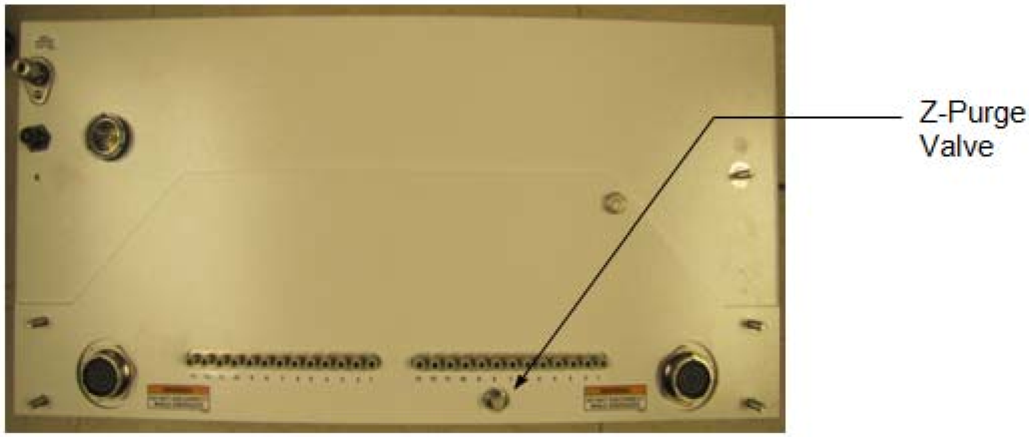
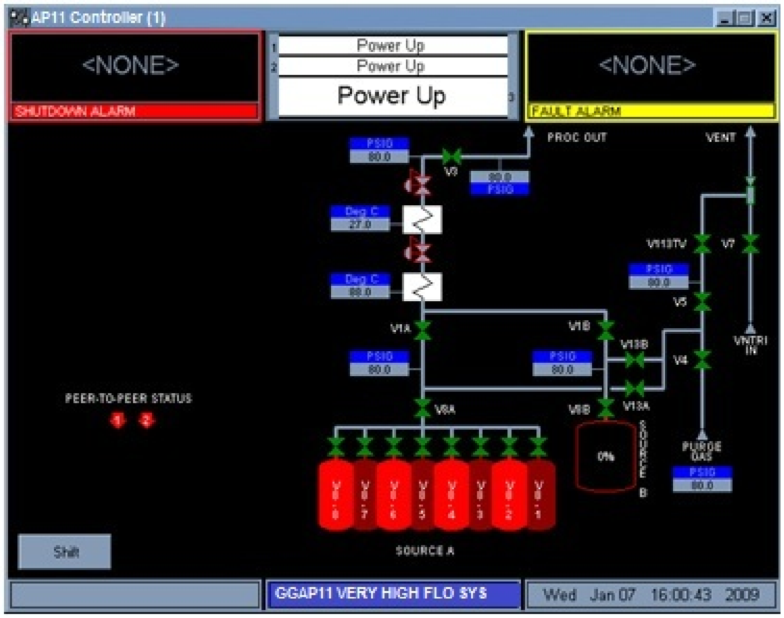


Figure 5-1. Rear View of GASGUARD® AP11 Controller.

3. On the GASGUARD® AP11 controller, press the shutdown alarm window once to acknowledge any alarms. Press the shutdown alarm window again to reset any alarms. No alarms should be present. If alarms are present, ***do not*** continue. Alarms must be cleared before the controller can be placed in an operating mode.
4. On the GASGUARD® AP11 controller, at the VHF module, verify that the system is off-line and all automatic valves indicate the closed position. A quick indication that all valves are closed is lack of piping animation on the controller screen graphic. Normally, a green valve designates a closed valve, red indicates the valve is open. (Some customers request reversed valve colors. Consult the VHF Spec. Sheet included in the gray envelope to determine if this option has been applied.)

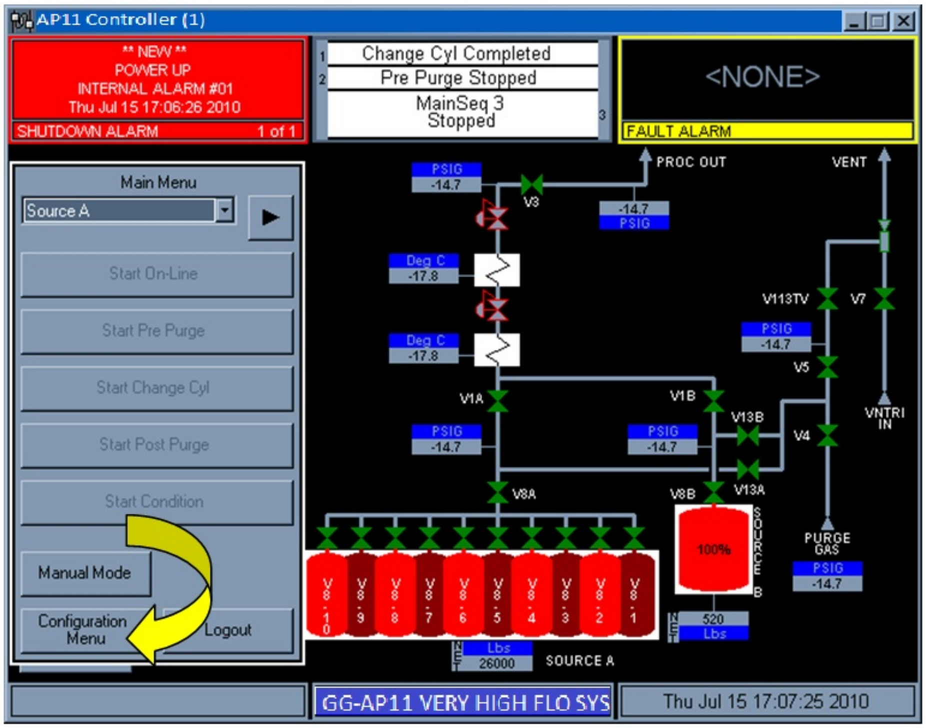


5. In the process piping cabinet verify that the adjustable process regulators are closed (knob rotated fully counterclockwise). Non adjustable regulators should not be changed since they are factory pre-set.
6. Verify the installation of the helium leak check cylinder and purge gas cylinder.
7. Verify that plugs or caps are installed on the process pigtail connections. There should not be supply containers connected at this time.
8. Verify that the Peer-to-Peer network is connected and functioning properly. Peer-to-Peer status is observed at the bottom left corner of each AP11 controller. (Standard when multiple VHF modules are installed in the same system.)
9. Systems with container scales not supplied by the Versum Materials, Inc. factory will come with pre-set analog scaling. This scaling may not match the range of the scales installed on site. Use the following procedure to change the analog scaling if necessary.

WARNING

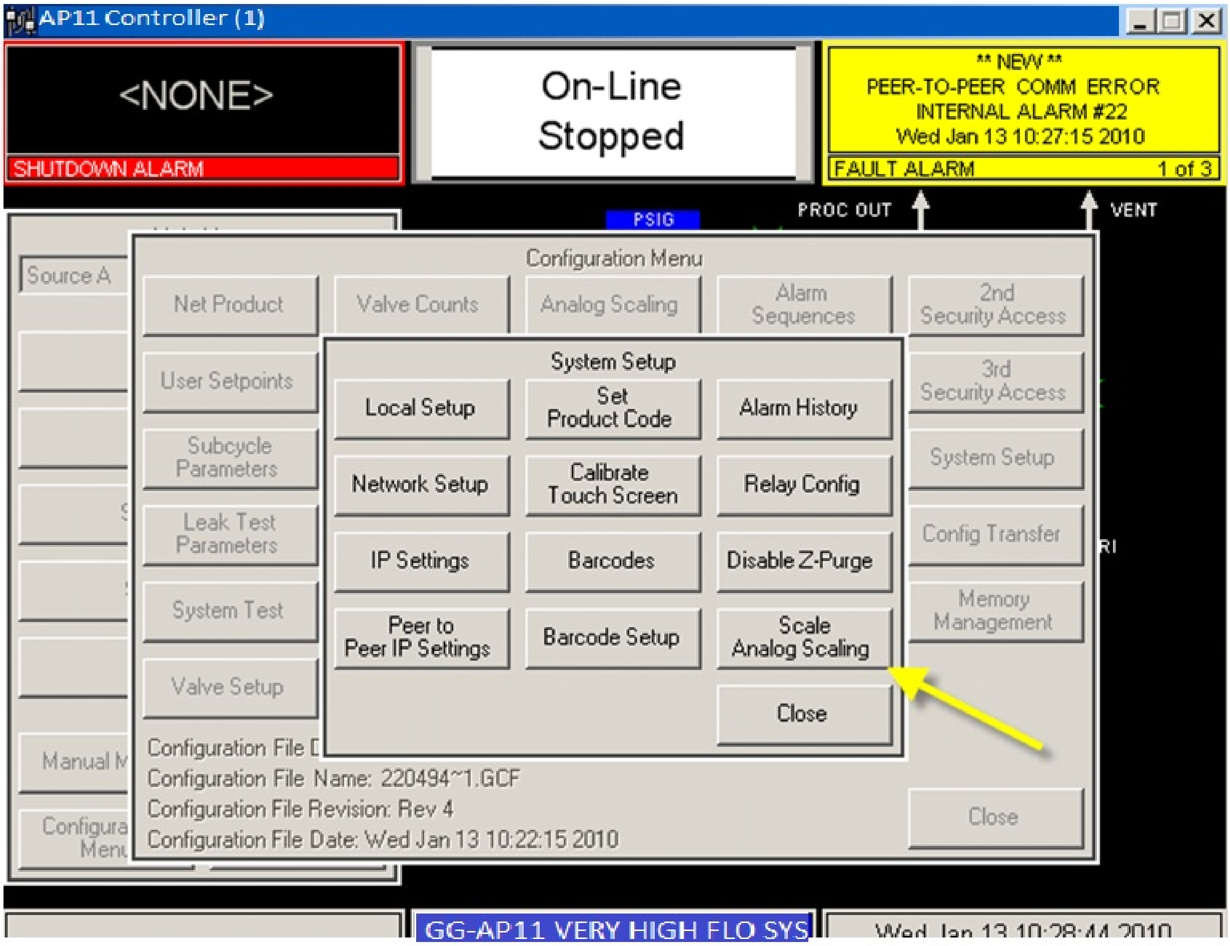
Modifying the existing analog scaling could create operational and/or safety hazards. These may include but are not limited to premature shutdown and crossover, delayed shutdown and crossover, container liquid dry or liquid full condition, reduced gas flow, and piping over pressurization. Field modification of the analog scaling value should initiate a thorough review to identify the consequences associated with the change and be documented using the Management Of Change (MOC) process.

Using a 3rd level password, log into the VHF AP11 controller. See Chapter 8, Section 4 for the log in procedure. Press the "Configuration Menu" button.

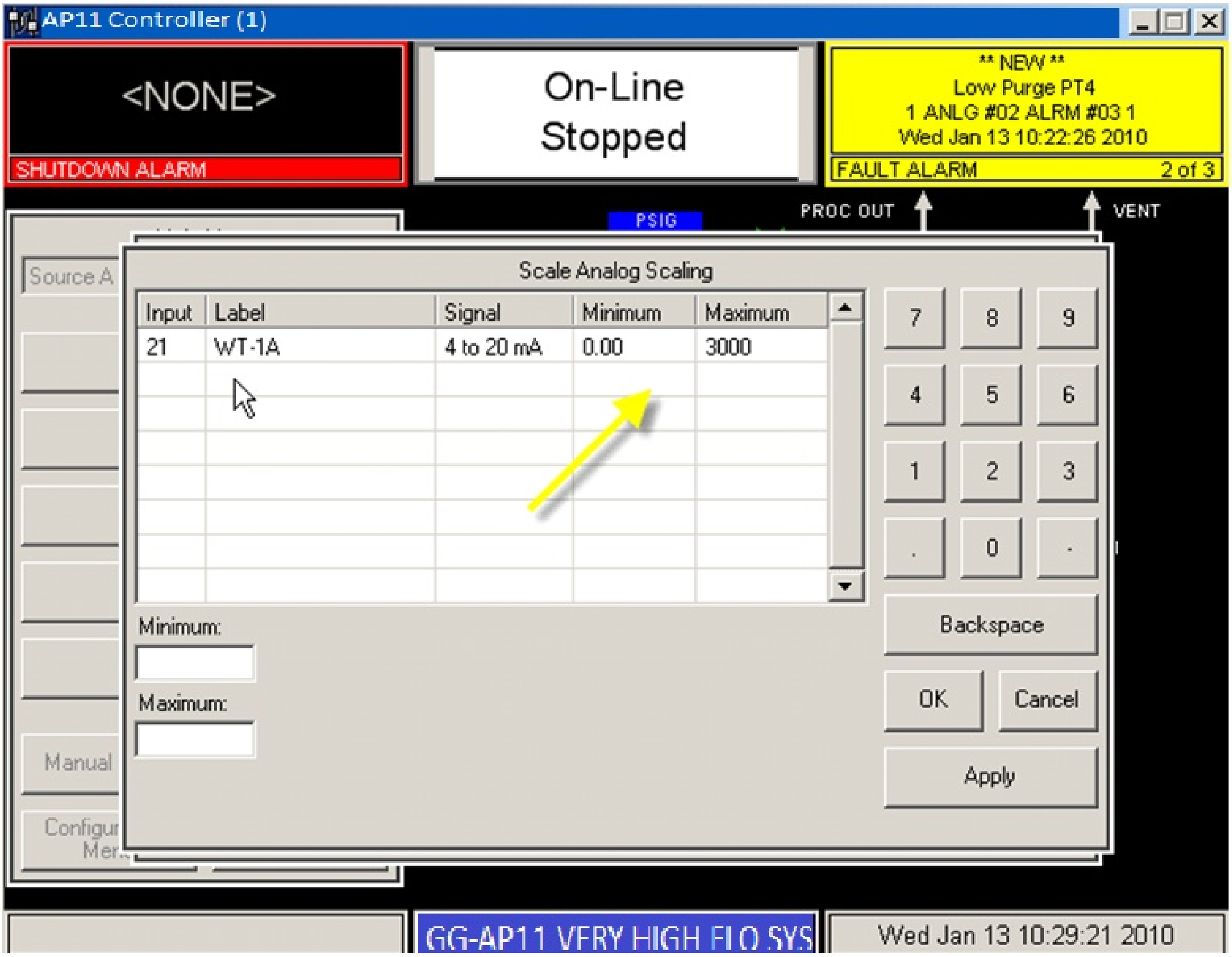


Next, press the “System Setup” button.

Press the “Scale Analog Scaling” Button.

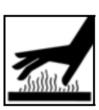


Lastly, enter the maximum scale weight value into the “Maximum” column, adjacent to the appropriet scale label. After making the change, press the “Apply” button and “OK” button, then the “Cancel” button to back out of the menu shown below.



10. Begin the Pre Purge program sequence at the VHF for each source container. Follow all onscreen operator prompts. The AP11 controller will run through the sequences necessary to install a source container for the first time and make the system ready to flow process gas.

⚠ WARNING



J-T heaters and piping downstream can become very HOT during VHF module operation. Do not touch the JT heaters or piping until power is turned off and the JT heaters are near room temperature.

3.0 System Shutdown and Startup. Planned or Unplanned.

It's prudent to maintain a log of system pressures, temperatures and weights, to aid in trouble shooting, predicting container runout, and maintenance, for example. Most importantly, this log can assist the technician during a planned or unplanned system shutdown. If the customer has purchased Versum Materials, Inc. GCS data acquisition software, this information will be logged automatically. In either case, inspection of the delivery system should be done at least once every shift.

Planned Shutdown is defined as the managed removal of electrical power, and pneumatic pressure from the Very High Flow system. With the controller in idle mode, the shutdown should be preceded by logging all system temperatures, pressures, and weights. A planned shutdown can be divided into two categories. They are a piping system that must have maintenance performed and a shutdown where no work will be performed on the piping. If maintenance will be performed on the Very High Flow system piping, process gas must be purged from the system. If the shutdown is for maintenance other than piping, process gas can remain in the piping, but the technician and facility management must be aware that any hazards associated with the process fluid remain. It must be understood that process gas remains in the piping, and that a drop in pressure will signify the formation of liquid if the gas being delivered is a liquefied compressed gas such as ammonia (NH_3), hydrogen chloride (HCl), or nitrous oxide (N_2O) for example. When power is removed from the controller, all pneumatically controlled valve valves will revert to their normally closed position.

Startup after a planned shutdown falls into the two categories described above. In either case, the following applies. After power has been restored, the controller should remain in idle mode until all heated components are up to operating temperature, by comparison to the data taken prior to the shutdown. These include the container heater, heat trace throughout the system, and the J-T heater. Additional verification is the solid state relays. A relay that begins to pulse, rather than continuously on, is a good indication that the component is up to temperature. Also make sure, if process gas remains in the piping, that pressures are at or above those recorded prior to the shutdown. This is especially important in the case of a liquefied compressed process gas. Temperatures and pressures recorded prior to the shutdown must be present before placing the Very High Flow module Online, flowing process gas. Failure to do so can result in operational problems and liquefied process gas being delivered to the process tool.

Unplanned Shutdown is defined as the removal of electrical power, and pneumatic pressure from the Very High Flow system without warning. For this case, it is assumed the AP controller is not fed power by an Uninterruptable Power Supply (UPS). Because it's impossible to anticipate a power outage, GCS data or previously logged temperatures and pressures will be required when power is restored. It must be understood that process gas remains in the piping, and that a drop in pressure will signify the formation of liquid if the gas being delivered is a liquefied compressed gas such as ammonia (NH_3), hydrogen chloride (HCl), or nitrous oxide (N_2O) for example. The technician and facility management must be aware that any hazards associated with the process gas remain. When power is removed from the controller, all pneumatically controlled valve valves will revert to their normally closed position.

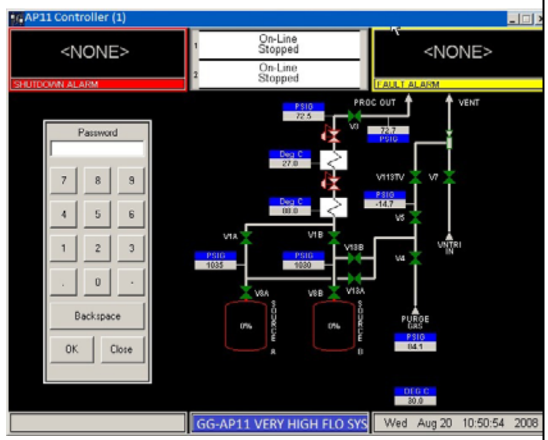
Startup after an unplanned shutdown. After power has been restored, the controller should remain in idle mode until all heated components are up to operating temperature, by comparison to the data taken prior to the shutdown. These include the container heater, heat trace throughout the system, and the J-T heater. Additional verification is the solid state relays. A relay that begins to pulse, rather than continuously on, is a good indication that the component is up to temperature. Also make sure, if process gas remains in the piping, that pressures are at or above those recorded prior to the shutdown. This is especially important in the case of a liquefied compressed process gas. Temperatures and pressures recorded prior to the shutdown must be present before placing the Very High Flow module Online, flowing process gas. Failure to do so can result in operational problems and liquefied process gas being delivered to the process tool.

The AP controller will boot up to the offline mode (On-Line Stopped will be displayed) when power is restored. The Very High Flow System will need to be put back into Online mode to start the flow of process gas, but not before the checks listed in the previous paragraphs have been performed. If an alarm is present, see the trouble shooting section of this manual to clear the alarm before proceeding to process gas mode.

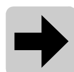
4.0 AP11 Controller Operation

Entering a Password and Selecting Menu Options

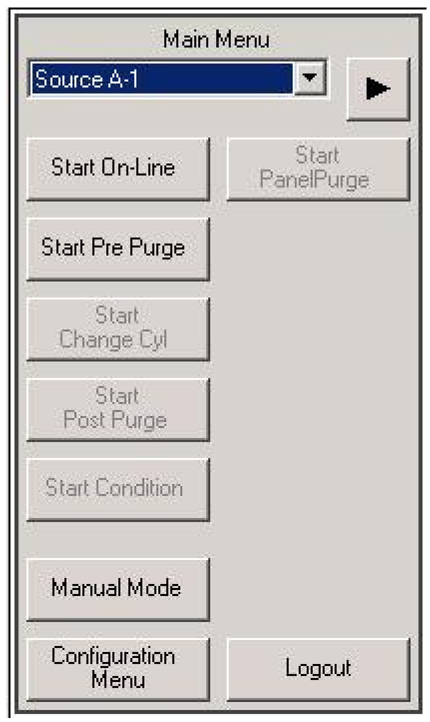
All operations must be started from the main menu screen. A password must be entered to obtain the main menu screen.

1. Touch anywhere on the graphics portion of the screen. The screen will appear as shown.	
2. Enter the password using the numeric keypad. Note: An * (asterisk) will appear instead of a number to prevent the password from being displayed.	
3. Press “OK”.	

Note: If an incorrect password is entered, the screen will display as shown. "Invalid Password" will be displayed at the bottom of the password window. Re-enter correct password, and press "OK" again.

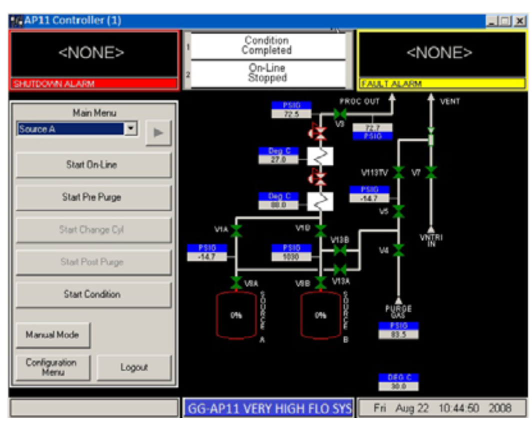
4. Use the  and  keys or the drop down menu to select the correct source line.

Note: Unavailable menu options are grayed out.



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

Note: If a menu selection is not entered within the allotted time, a menu timeout causes the controller to escape out of the main menu. This helps to prevent unauthorized personnel from operating the controller if an authorized user would enter their password and then leave the controller unattended.

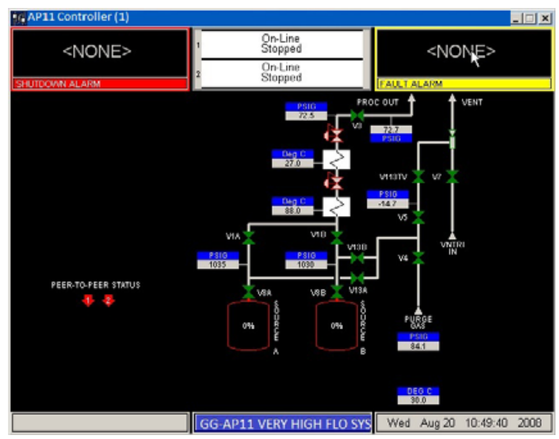
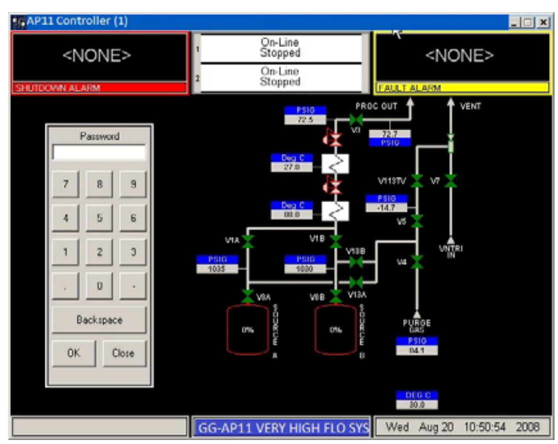


4.A Prepurge

Purpose: This sub-section describes the Very High Flow GASGUARD® AP11 Controller program routine that is used to purge and evacuate the process gas from the process pigtail prior to container change or pigtail maintenance.

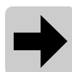
> **Caution**
>
> Before beginning the pre-purge sequence, verify low pressure vent isolation valves MV-6 and optional MV-6-2 are locked closed.

The following table describes the steps to be followed when using the Pre-Purge routine.

1. To initiate "Pre-Purge" sequence from controller keypad.	
2. Touch anywhere on the graphics portion of the screen. Display will show a request for password input.	

3. PASSWORD WINDOW

   Enter password on keypad and press the “OK” key.

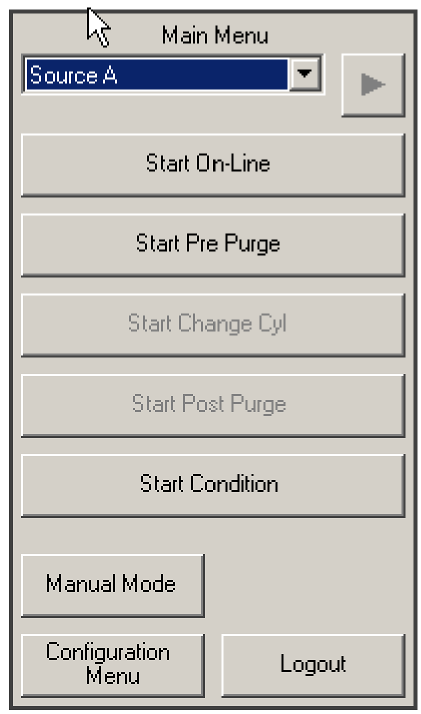
4. Use the  and  keys or the drop down menu to select the correct source line.

The following instructions are for Pre-Purge sequence source A, but the same procedure applies to source B.

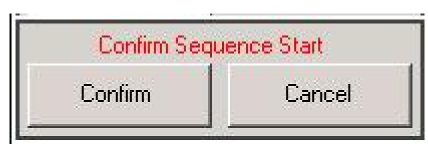
5. Press the START PRE PURGE pushbutton.

If Pre-Purge is running for source A, purge sequences for source B will not be available. Only one container can be changed at a time.

If your VHF module is equipped with the heat trace option, heat trace on the pigtail being purged will be de-energized at the start of the pre-purge sequence and remain off through the change cylinder sequence.



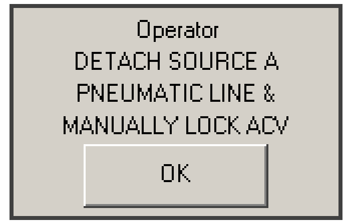
6. The Confirm Sequence Start window will be displayed. Press the CONFIRM pushbutton.



7. !!OPERATOR PROMPT!!

OPTIONAL with AUTOMATIC source valve, a prompt will appear on the display to "Disconnect Source A Pneumatic Line & Manually Lock ACV". After completing task, acknowledge prompt by pressing the "OK" Key.

The prompt on your controller may be different, depending on your source container valve configuration. Each program is written to match the source container that will be connected to the VHF module.



8. !!OPERATOR PROMPT!!

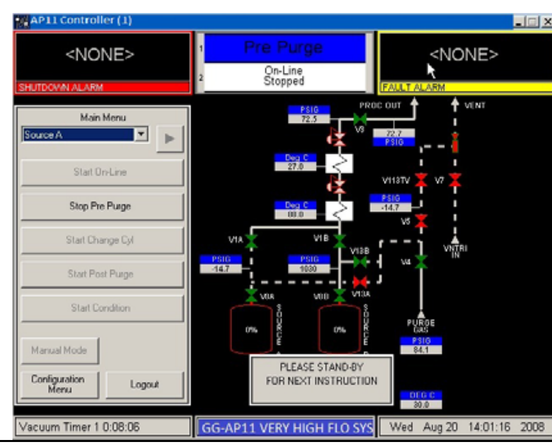
A prompt will appear on the display to "Open Manual Valve MV-1A." After opening valve, acknowledge prompt by pressing the "OK" key.

9. !!OPERATOR PROMPT!!

The panel piping will be evacuated, including the space between manual valve MV-1A and valve V-1A.

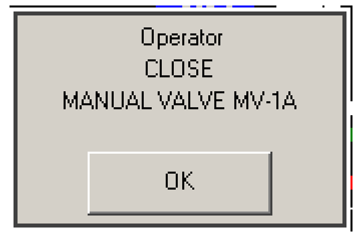
10. !!OPERATOR PROMPT!!

The process gas wetted area from the source container valve V-8 to V-1 will be evacuated of process gas.

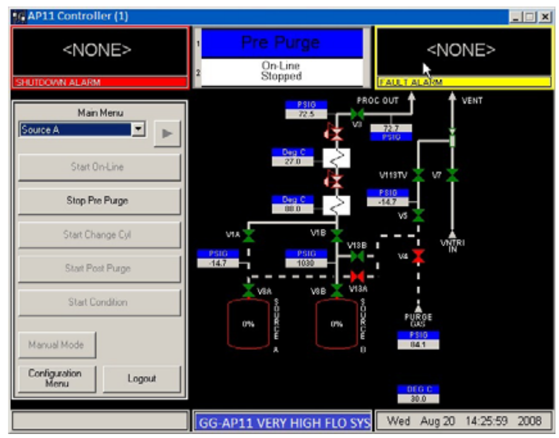


11. !!OPERATOR PROMPT!!

A prompt will appear on the display to "Close Manual Valve MV-1A." After closing valve, acknowledge prompt by pressing the "OK" key.



12. The process gas wetted area from the source container valve V-8 to MV-1 will be charged with purge gas.

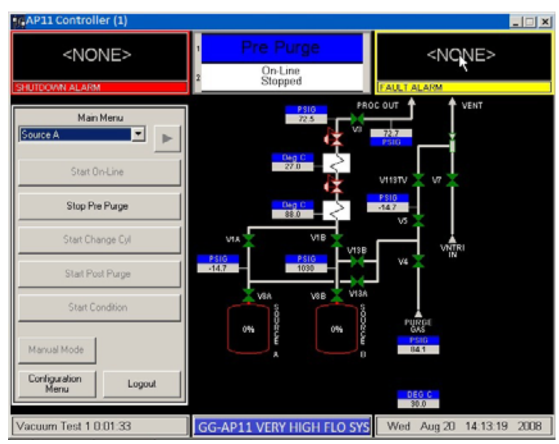


13. !!OPERATOR PROMPT!!

The process gas wetted area from the source container valve V-8 to MV-1 will be evacuated of process gas.

Note: A subroutine will perform the Vacuum Leak Test (Cylinder Leak Test) to insure the source container valve is closed.

The leak test status is displayed in the status box in the bottom left corner.

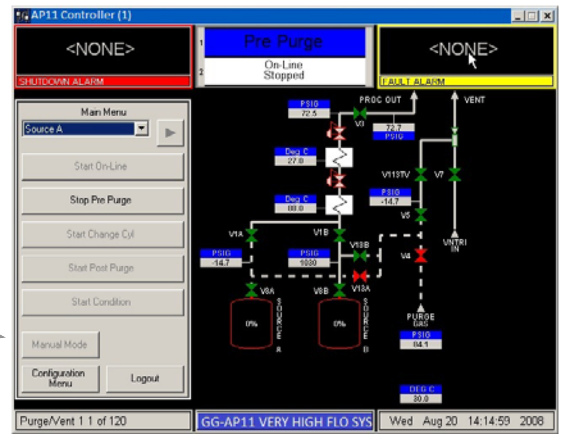


Note: During the leak test the status box displays the following:
1) The leak test being run.
2) The process line number.
   Source A = process line 1,
   Source B = process line 2
3) The time remaining until the completion of the leak test.

(1) (2) (3)

Note: Upon successful completion of the leak test, a purge/vent subroutine is run to purge out the pigtail.

During the cycle purge, status is displayed in the status box in the bottom left corner.



(1) (2) (3)

Note: During the cycle purge the status box displays the following:
1) The cycle purge being run.
2) The process line number.
3) The number of times the cycle has been run, compared to the number of times the cycle is configured to be run.

Note: All automated valves are closed at the end of the sequence. The sequence then goes to the start of “Idle Mode”.

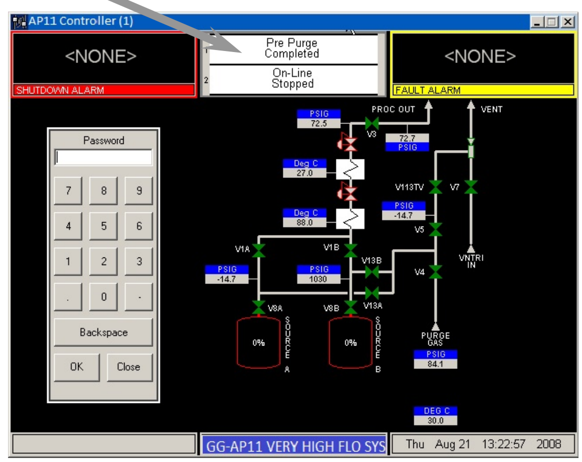
4.B Change Source Container

Purpose: This semi-automated Sub-Section describes the Very High Flow GASGUARD® AP11 Controller Program Routine that is used to change a source container.

⚠ Caution

Before beginning the change source container sequence, verify low pressure vent isolation valves MV-6 and optional MV-6-2 are locked closed.

The following table describes the steps to be followed when using the Change Cylinder routine.

<table>
<tr><td colspan="2">1. Verify that “Pre-Purge Completed” is displayed in the controller mode box.</td></tr>
<tr><td>2. Touch anywhere on the graphics portion of the screen. Display will show a request for password input.</td><td>
</td></tr>
<tr><td>3. PASSWORD WINDOW

Enter password on keypad and press the “OK” key.</td><td>
</td></tr>
</table>

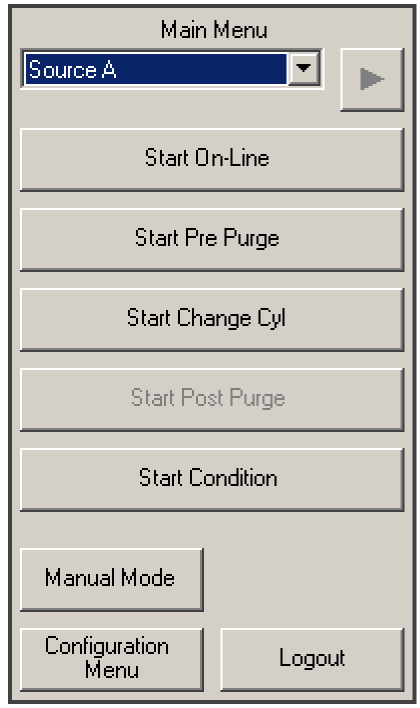
4. Use the ← and → keys or the drop down menu to select the correct source line.

The following instructions are for Change Cyl sequence source A, but the same procedure applies to source B.

5. Press the START CHANGE CYL pushbutton.

If Change Cyl is running for source A, purge sequences for source B will not be available. Only one container can be changed at a time.

If your VHF module is equipped with the heat trace option, heat trace on the pigtail being purged will be de-energized at the start of the pre-purge sequence and remain off through the change cylinder sequence.



6. !!Operator Prompt!!

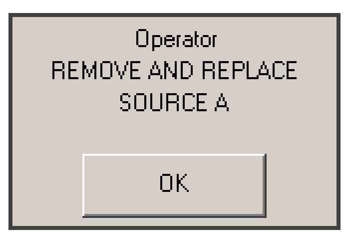
   Check and "Replace High Pressure Purge Cylinder if Necessary". After completing task, acknowledge prompt by pressing the "OK" Key.

7. !!Operator prompt!!

   "Loosen Source Pigtail Connection & Adjust Purge Regulator to 20 psi". After completing task, acknowledge prompt by pressing the "OK" Key.

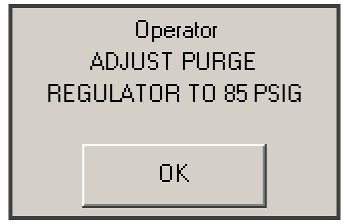
8. !!Operator prompt!!

   Replace product source container. This requires disconnecting the pigtail from the container and replacing that container with a full unit to continue delivering product to the process. After completing task, acknowledge prompt by pressing the "OK" Key.



9. !!Operator prompt!!

   "Adjust Purge Regulator to 85 psig". After completing task, acknowledge prompt by pressing the "OK" Key.



10. !!Operator prompt!!

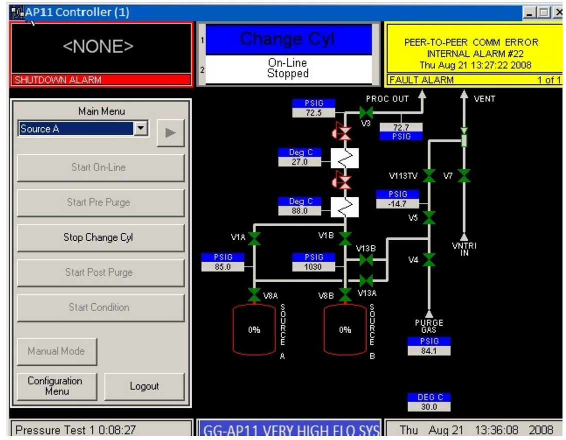
    OPTIONAL when vessel weight scales are used, product weight must be entered to monitor product usage. After completing task, acknowledge prompt by pressing the "OK" Key.

11. !!Operator prompt!!

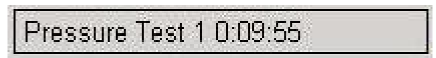
    OPTIONAL when an ISO container with manual manifold outlet valve is utilized, "Open ISO Manifold Outlet Valve MV-0". After completing task, acknowledge prompt by pressing the "OK" Key.

Note: A subroutine will perform the Pressure Decay Leak Test to insure the source vessel connection has been made.

The leak test status is displayed in the status box in the bottom left corner.



Note: During the leak test the status box displays the following:
1) The leak test being run.
2) The process line number.
3) The time remaining until the completion of the leak test.

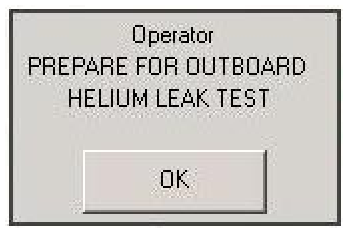


(1) (2) (3)

12. !!Operator prompt!!

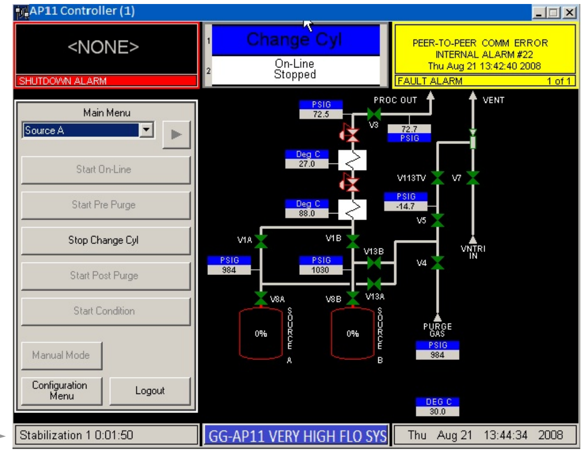
NOTE: HPLT (High Pressure Leak Test) is optional, if hardware present and requiring software option code enabled. It will display Operator prompt as show for the HPLT run routine.

This prompt ensures that the operator has all the equipment needed to perform the high pressure Helium Leak Test before the Helium Leak Test is started. After completing the task, acknowledge prompt by pressing the “OK” Key.



Note: A subroutine will wait for a period of time to allow stabilization of gas due to possible adiabatic pressure fluctuations.

The stabilization status is displayed in the status box in the bottom left corner.

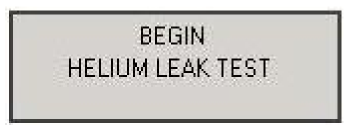


Note: During the leak test the status box displays the following:
1) The leak test being run.
2) The process line number.
3) The time remaining until the completion of the leak test.

(1) (2) (3)

13. !!Operator prompt!!

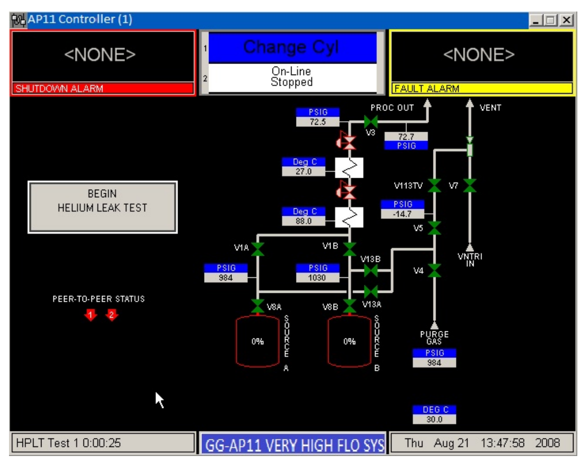
If helium is used for this check, a Mass Spectrometer may be employed for an added level of leak detection. The operator is prompted to “Begin Helium Leak Test” while the controller is running the HPLT. The prompt will automatically be cleared at the completion of the HPLT.



Note: A subroutine will perform the High Pressure Leak Test (HPLT) to insure the source vessel connection is secure.

NOTE: HPLT (High Pressure Leak Test) is optional, if hardware present and requiring software option code enabled. It will display Operator prompt as show for the HPLT run routine.

The leak test status is displayed in the status box in the bottom left corner.



Note: During the leak test the status box displays the following:
1) The leak test being run.
2) The process line number.
3) The time remaining until the completion of the leak test.

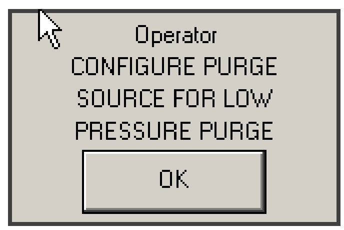
(1) (2) (3)

14. !!Operator prompt!!
NOTE: HPLT (High Pressure Leak Test) is optional, if hardware present and requiring software option code enabled. It will display Operator prompt as show for the HPLT run routine.

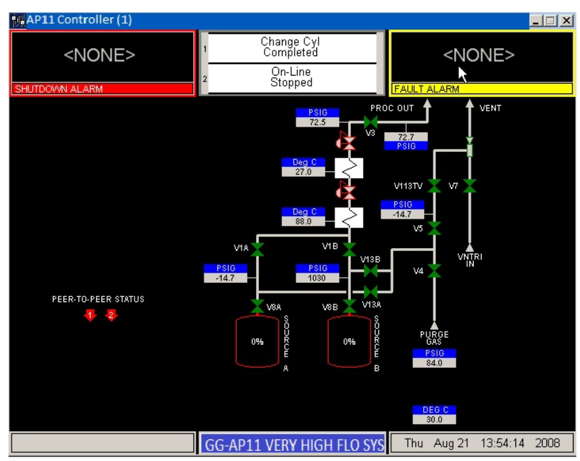
The High Pressure Leak Test has been completed. The operator is given additional time to complete the Outboard Helium Leak Test before the high-pressure leak test gas is evacuated from the pigtail. After completing task, acknowledge prompt by pressing the “OK” Key.

15. !!Operator prompt!!

The operator must return to the purge panel and configure the purge source for low pressure. After completing task, acknowledge prompt by pressing the “OK” Key.



16. CYLINDER CHANGE is now complete.

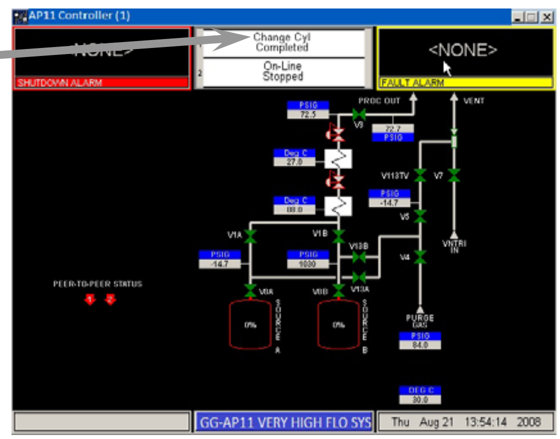
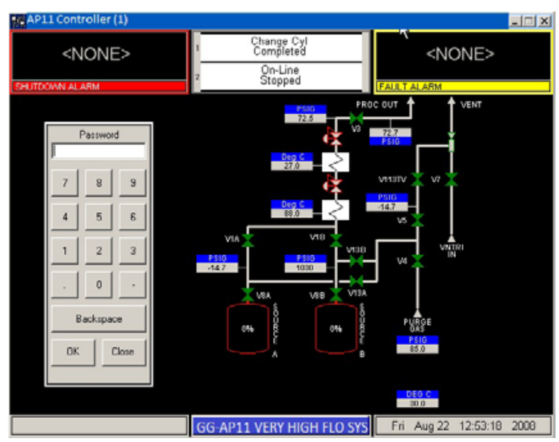


4.C Post Purge

Purpose: This Manual Sub-Section describes the Very High Flow GASGUARD® AP11 Controller Program Routine that is used to purge and evacuate all atmospheric contamination from the process pigtail after any container change or pigtail maintenance. This Sub-Section only applies to the Very High Flow.

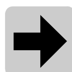
> **Caution**
>
> Before beginning the post-purge sequence, verify low pressure vent isolation valves MV-6 and optional MV-6-2 are locked closed.

The following table describes the steps to be followed when using the Post Purge routine.

1. Verify that “Change Cylinder Completed” is on the display.	
2. Press “MENU” button at the bottom of controller graphic. Display will show a request for password input.	

3. PASSWORD WINDOW

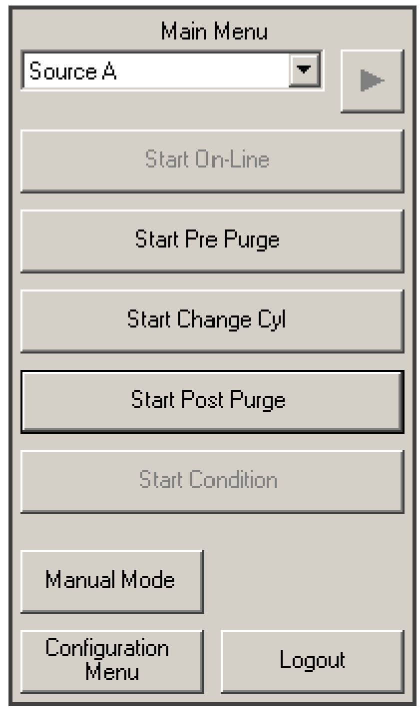
   Enter password on keypad and press the "ENTER" key.

4. Use the  and  keys or the drop down menu to select the correct source line.

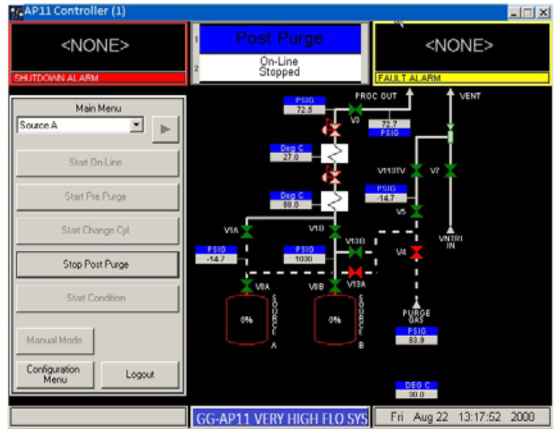
The following instructions are for Post-Purge sequence source A, but the same procedure applies to source B.

5. Press the START POST PURGE Pushbutton.

If Post-Purge is running for source A, purge sequences for source B will not be available. Only one container can be changed at a time.

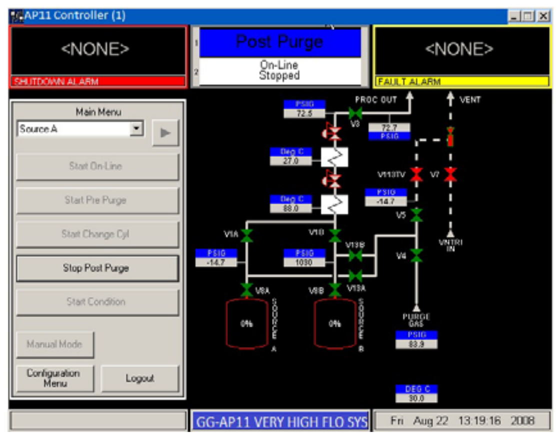


6. The process gas wetted area from the source container valve V-8 to MV-1 will be charged with purge gas.



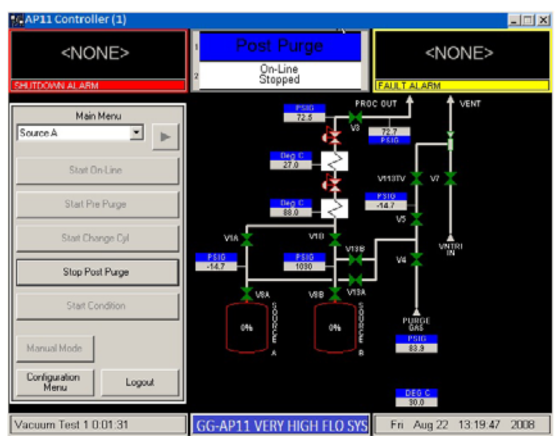
7. !!OPERATOR PROMPT!!

The process gas wetted area from the source container valve V-8 to MV-1 will be evacuated of purge gas.



Note: A subroutine will perform the Vacuum Leak Test (Cylinder Leak Test) to insure the source container valve is closed.

The leak test status is displayed in the status box in the bottom left corner.



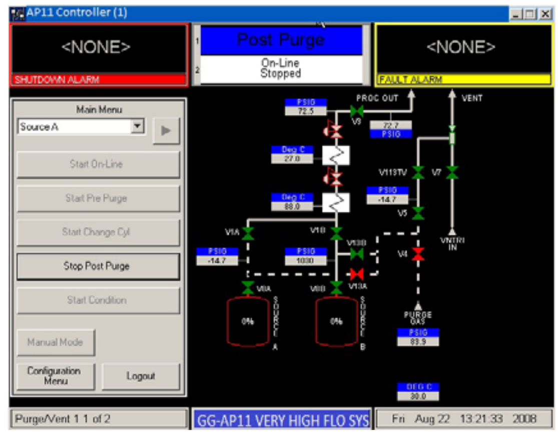
Note: During the leak test the status box displays the following:

1) The leak test being run.
2) The process line number.
3) The time remaining until the completion of the leak test.

(1) (2) (3)

Note: Upon successful completion of the leak test, a purge/vent subroutine is run to purge out the pigtail.

During the cycle purge, status is displayed in the status box in the bottom left corner.

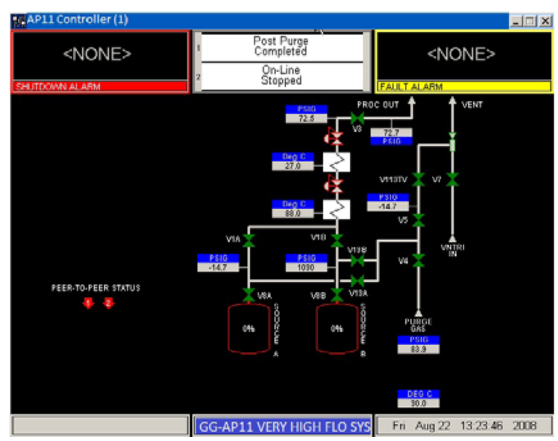


Note: During the cycle purge the status box displays the following:

1) The cycle purge being run.
2) The process line number.
3) The number of times the cycle has been run, compared to the number of times the cycle is configured to be run.

(1) (2) (3)

8. End of POST PURGE

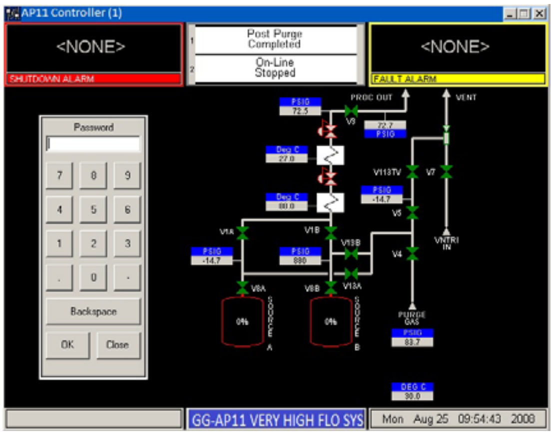


4.D Process Gas Conditioning

Purpose: This Manual Sub-Section describes the GASGUARD® AP11 Controller Program Routine that is used to initiate process gas flow within the system. This Sub-Section only applies to Very High Flow equipment modules.

> **Caution**
>
> Before beginning the process gas conditioning sequence, verify low pressure vent isolation valves MV-6 and optional MV-6-2 are locked closed.

The following table describes the steps to be followed when using the Process Gas Conditioning routine.

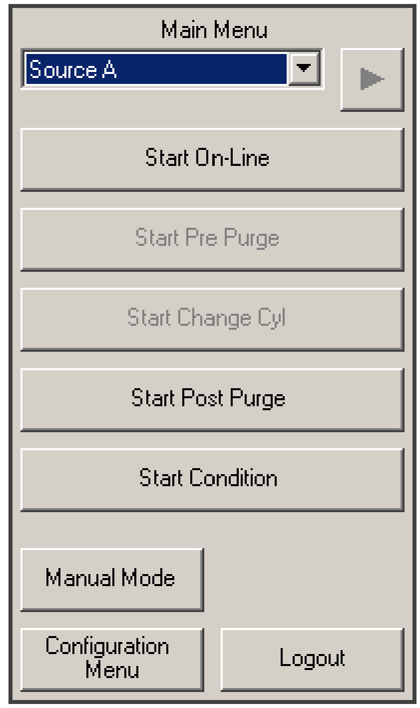
<table>
<tr>
<td>1. Touch anywhere on the graphics portion of the screen. Display will show a request for password input.</td>
<td>
</td>
</tr>
<tr>
<td>2. PASSWORD WINDOW

Enter password on keypad and press the “OK” key.</td>
<td>
</td>
</tr>
</table>

3. Main Menu screen will be displayed. Use the ← and → keys or the drop down menu to select the correct source line.

The following instructions are for Conditioning sequence source A, but the same procedure applies to source B.

4. Press the START CONDITION pushbutton.

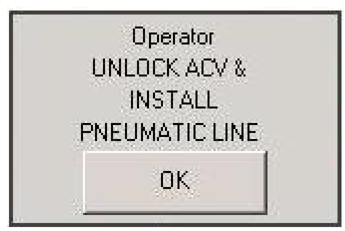


5. The Confirm Sequence Start window will be displayed. Press the CONFIRM pushbutton.

6. !!Operator Prompt!!

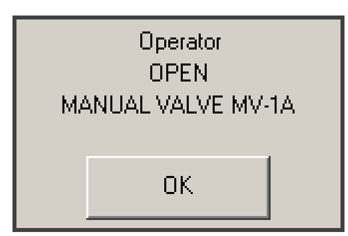
   OPTIONAL if source is automated (Y or ISO), install the pneumatic line and unlock the automated valve.

The prompt on your controller may be different, depending on your source container valve configuration. Each program is written to match the source container that will be connected to the VHF module.



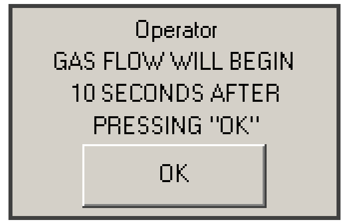
7. !!Operator Prompt!!

   A prompt will appear on the display to “Open Manual Valve MV-1A.” After opening valve, acknowledge prompt by pressing the “OK” key.



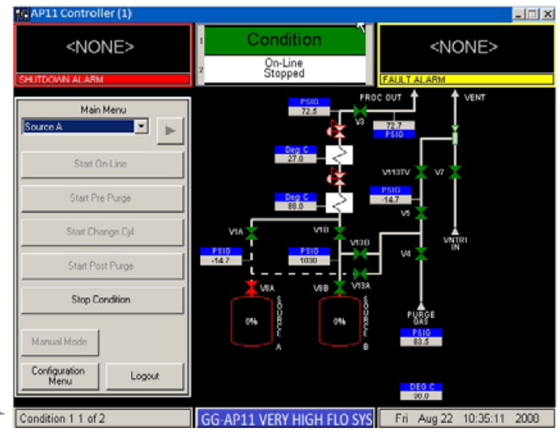
8. !!Operator Prompt!! – ***Silane (SiH4) Only.***

A prompt will appear on the display “Gas Flow Will Begin 10 Seconds After Pressing “OK”. Acknowledge prompt by pressing the “OK” key.



Note: A purge/vent subroutine is run to purge out the pigtail utilizing process gas.

During the cycle purge, the status is displayed in the status box in the bottom left corner.

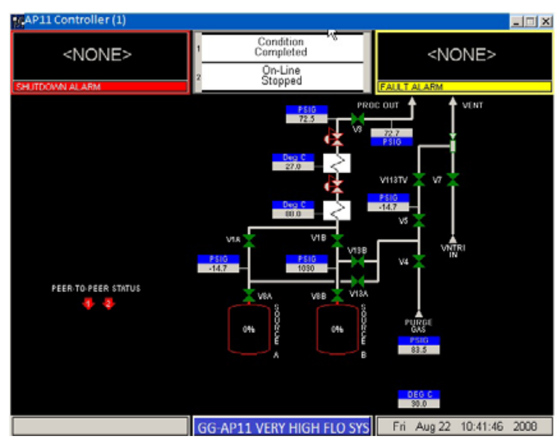


Note: During the cycle purge the status box displays the following:

1) The cycle purge being run.
2) The process line number.
   Source A = process line 1,
   Source B = process line 2
3) The number of times the cycle has been run, compared to the number of times the cycle is configured to be run.

(1) (2) (3)

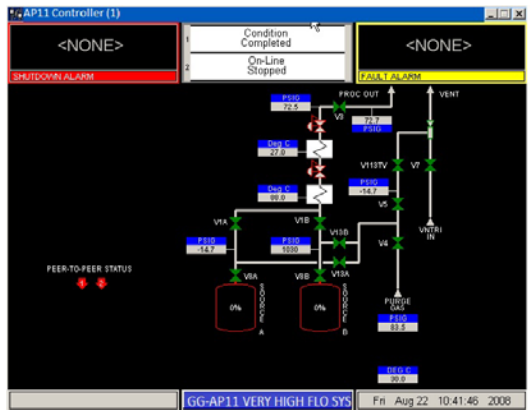
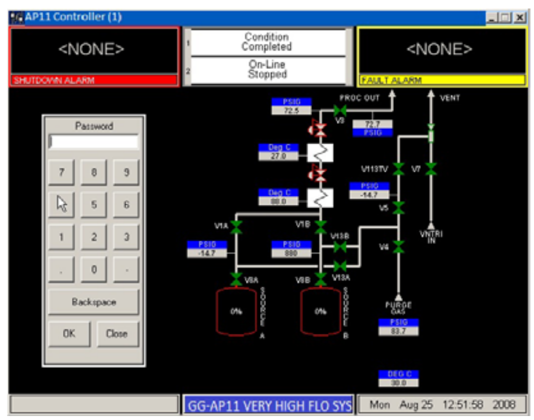
9. End of Condition.



4.E Process Gas Flow

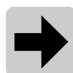
Purpose: This Manual Sub-Section describes the Very High Flow GASGUARD® AP11 Controller Program Routine that is used to initiate process gas flow within the module. This Sub-Section only applies to Very High Flow equipment modules.

The following table describes the steps to be followed when using the Process Gas Flow routine (On-Line).

1. Verify that the downstream process equipment is ready to receive process gas.	
2. Verify that the manual process flow valves in the Very High Flow System are open.	
3. Touch anywhere on the graphics portion of the screen. Display will show a request for password input.	

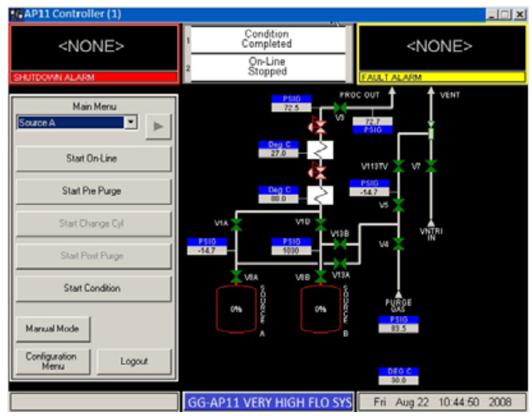
4. PASSWORD WINDOW

Enter password on keypad and press the "OK" key.

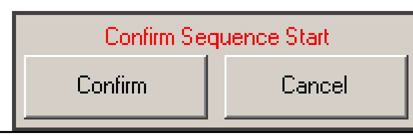
5. Main Menu screen will be displayed. Use the  and  keys or the drop down menu to select the correct source line.

The following instructions are for On-Line sequence source A, but the same procedure applies to source B.

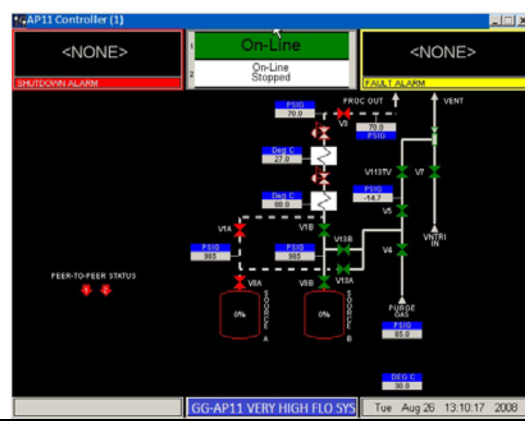
6. Press the START ON-LINE pushbutton.



7. The Confirm Sequence Start window will be displayed. Press the CONFIRM pushbutton.



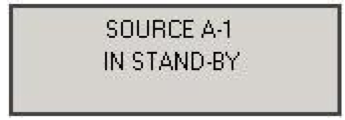
8. Process valves in the selected source line will open allowing process gas to flow.



Note: The controller opens the source valve V-8 in an automated system.

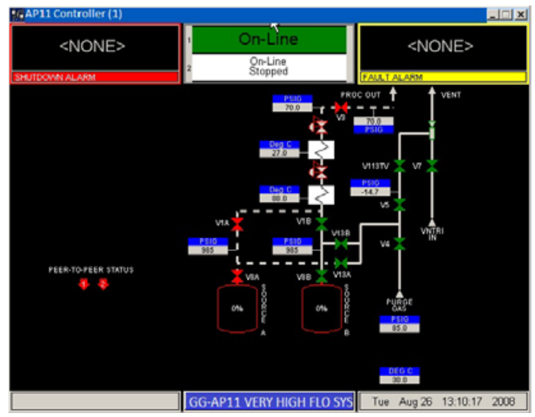
On-Line *Continuation*

9. If the Very High Flow module is configured as a Dual Source –Single Module (DS-SM) system and the opposite source is On-Line, then the controller will wait for the opposite source to go off-line before proceeding to the next step.



10. The “Gas Available” relay is energized.

11. Process gas is now available to flow from the source. The “Gas Flowing” LED will be lit.

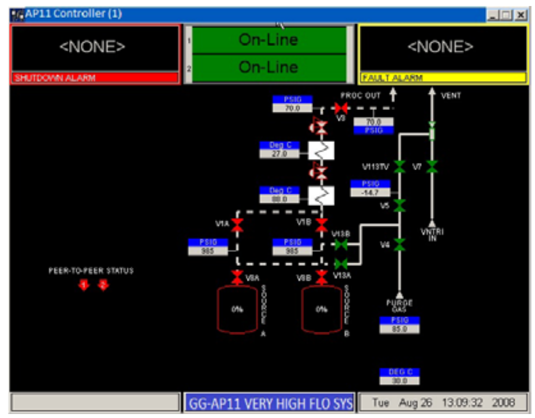
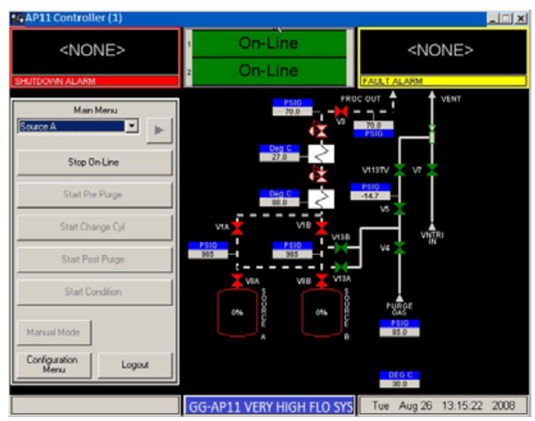


4.F Stop and Restart Process Gas Flow

Purpose: This Manual Sub-Section describes the Very High Flow GASGUARD® AP11 Controller Program Routines for stopping process gas flow and restarting process gas flow.

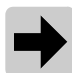
Stop Process Gas Flow

To stop the flow of process gas on the GASGUARD® AP11 Controller, the “Stop On-Line” gas flow routine must be run. The following table describes the steps to be followed when using the GASGUARD® AP11 controller “STOP On-Line” routine.

<table>
<tr>
<td>1. Verify that stopping process gas flow will not affect downstream processes.</td>
<td>
</td>
</tr>
<tr>
<td>2. Touch anywhere on the graphics portion of the screen. Display will show a request for password input.</td>
<td>
</td>
</tr>
</table>

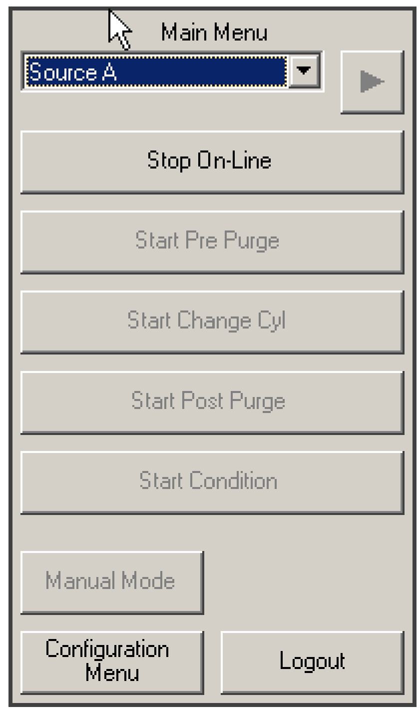
3. PASSWORD WINDOW

Enter password on keypad and press the “OK” key.

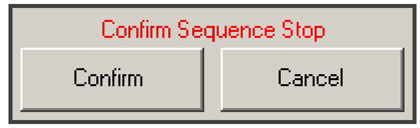
4. Main Menu screen will be displayed. Use the  and  keys or the drop down menu to select the correct source line.

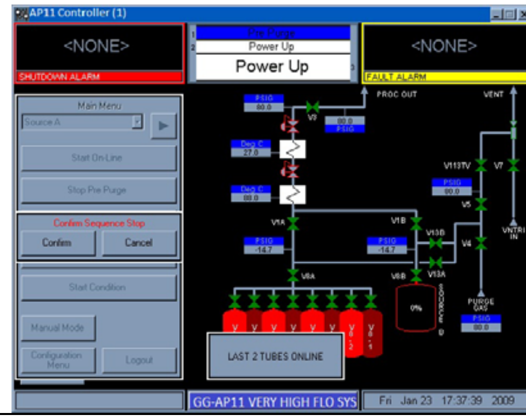
The following instructions are for source A, but the same procedure applies to source B.

5. Press the STOP ON-LINE pushbutton.

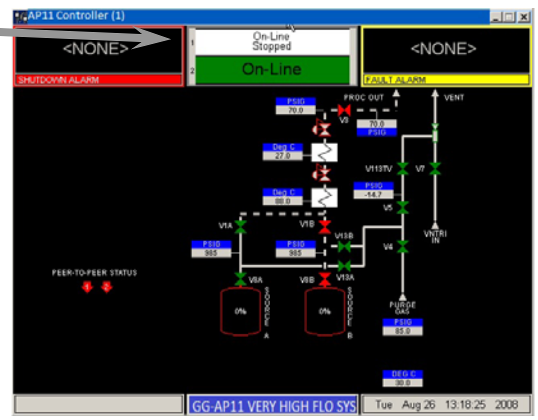


6. The Confirm Sequence **stop** window will be displayed. Press the CONFIRM pushbutton.





7. "On-Line Stopped" will be displayed.

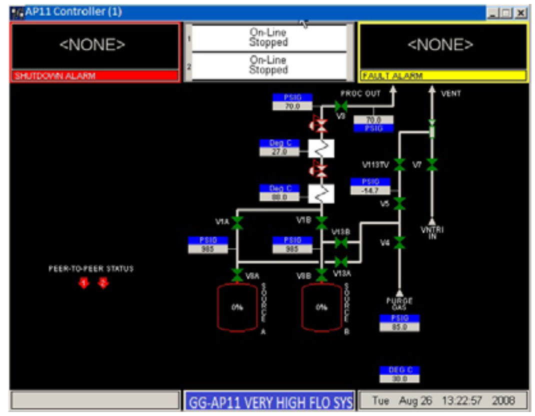
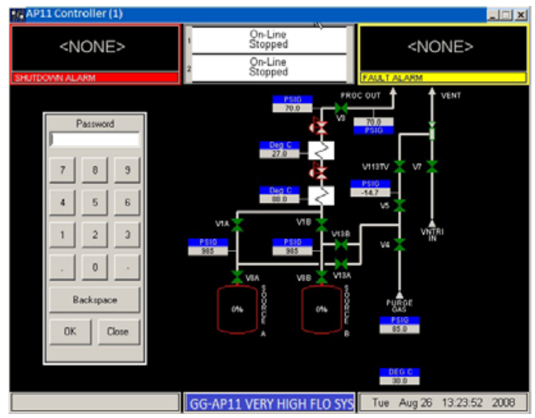


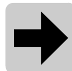
Note: Each source must be individually stopped.

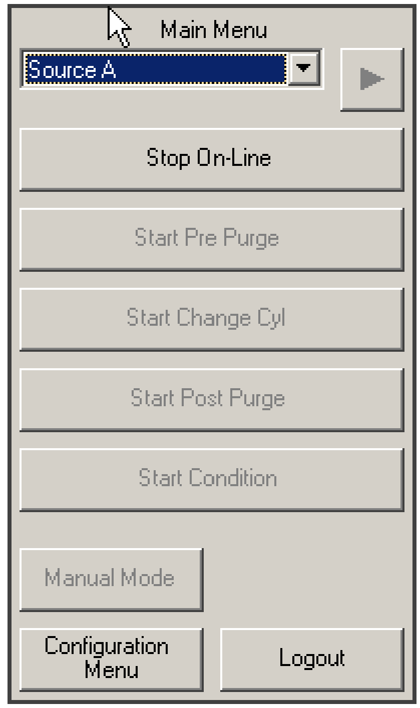
Note: For extended shutdowns, verify that the manual valves in the process lines are closed.

Restart Process Gas Flow

To restart after stopping the flow of process gas on the GASGUARD® AP11 Controller, the "Start On-Line" gas flow routine must be run. The following table describes the steps to be followed when using the GASGUARD® AP11 controller "Start On-Line" routine.

1. Verify that the downstream process equipment is ready to receive process gas. If manual valves in the process line have been closed during an extended shutdown, verify that they are open	
2. Touch anywhere on the graphics portion of the screen. Display will show a request for password input.	
3. PASSWORD WINDOW Enter password on keypad and press the "OK" key.	

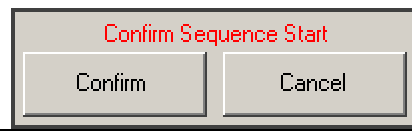
4. Main Menu screen will be displayed. Use the  and  keys or the drop down menu to select the left or right process line.



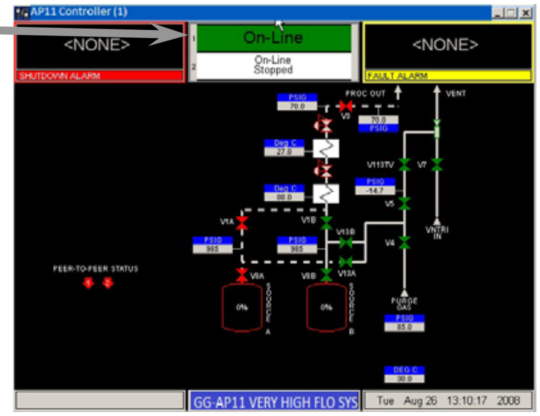
The following instructions are for source A, but the same procedure applies to source B.

5. Press the START ON-LINE pushbutton.

6. The Confirm Sequence Start window will be displayed. Press the CONFIRM pushbutton.



7. The “Gas Available” relay is energized.

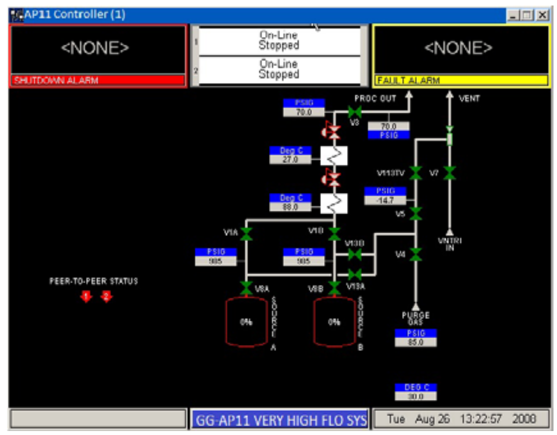
8. Display will indicate “On-Line” status.	
Note: If manual valves in the process line have been closed during an extended shutdown, verify that they are open.	
Upon display indicating “On-Line”, process gas will be flowing. The “Gas Flowing” LED on the right side of the controller will be lit.	

4.G Idle Mode

Purpose: This Manual Sub-Section describes the Very High Flow GASGUARD® AP11 Controller Program Routine that runs whenever there is no other routine running.

The GASGUARD® AP11 Controller Program Routine “Idle Mode” cannot be selected from the display MENU. Idle mode is the controller state at the end of any of the main operating modes. For example, at the end of “On-Line” or gas flow mode when “Stop On-Line” is selected, the system reverts to an Idle state.

The “Gas Available” relay is de-energized.



All system alarms are disabled.

The “Gas Flowing LED” is de-energized, unless another source cylinder is now On-Line.

All Idle Mode alarms are enabled.

4.H Manual Mode

Purpose: This Manual Sub-Section describes the GASGUARD® AP11 Controller Program Routine for Manual Mode. Manual Mode provides a means of actuating air-operated valves outside of programmed routines.

Manual Mode Operation

⚠WARNING

Only operators trained to security level 2 or higher may operate the Very High Flow System in Manual Mode. Actuating valves in an improper sequence could potentially cause damage to the Very High Flow System or provide insufficient purge gas flow. Manual Mode operation should never be used to flow process gas because critical shutdown alarms may be disabled. NOTE: The GASGUARD® AP11 Controller will not allow access to Manual Mode when certain shutdown alarms are present.

Manual 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 low pressure vent isolation valves (MV-6-1 and MV-6-2) when high pressure gas is being vented could cause damage to process gas components on the low pressure side of the system. Process gas components downstream of PCV-2 are rated for a maximum of 250 psig.

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.

How to Operate in Manual Mode

⚠WARNING

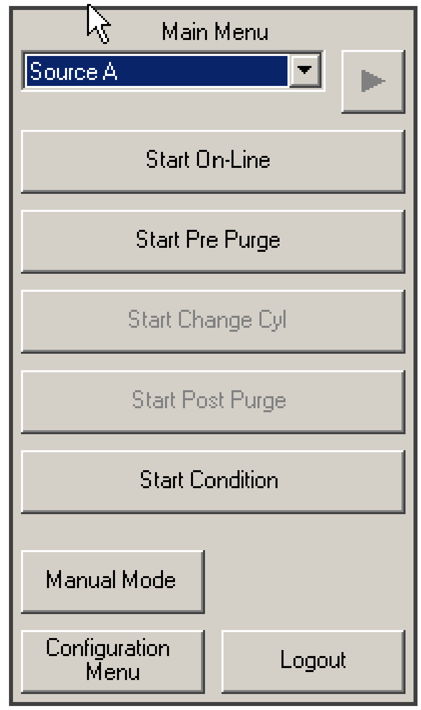
Operating in Manual Mode could cause the following hazards which can result in PERSONAL INJURY OR DEATH.

- ***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 third level security code.

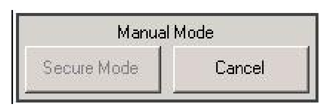
1. Touch anywhere on the graphics portion of the screen and enter the password.
2. Press OK.
3. Use the ← and → keys or the drop down menu to select the correct source line.

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



5. Press the MANUAL MODE pushbutton.

   The MANUAL MODE window will display.



6. Operate valves referring to the “How to Open and Close Valves” section that follows.

7. To exit MANUAL MODE, press CANCEL.

   NOTE: Pressing CANCEL ***will automatically close any valves that were left open unless the secure mode feature is used as described in the following “How to Open and Close Valves” section.***

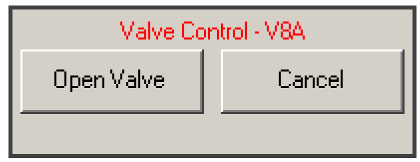
How to Open and Close Valves

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. 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:

Simply select the valve by touching the screen.

To SECURE Manual Mode:

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 from the Manual Mode window, Manual Mode will remain active or 'secured' until an operator reenters the Manual Mode menu. While manual mode is 'secured', Manual Mode will be the only selectable option on the Main Menu.

WARNING

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

General Principles of Manual Operation:

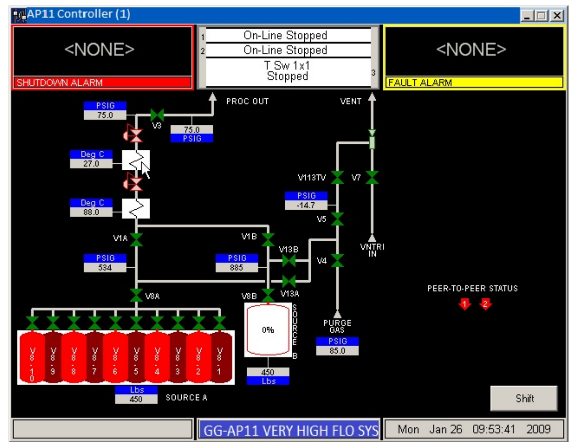
- Open valves in sequence starting at the first valve downstream of the pressure source and continuing to the next valve in sequence.
- For vacuum operation, open the valve closest to the vacuum source and continue to open the next valves in sequence.
- Close valves in reverse order.
- Frequently monitor pressures on the GASGUARD® AP11 Controller display and at local pressure indicators.
- Consider all possible consequences before opening or closing a valve.
- Do not leave Very High Flow module unattended when Manual Mode is operating.

4.I Tube Switching

Purpose: This Manual Sub-Section describes the GASGUARD® AP11 Controller Program Routine for Tube Switching. Tube Switching provides an automated method of systematically actuating ISO container or Tube Trailer air-operated valves without manual intervention. When the Tube Switching option is purchased for source A, the tube switching program is accessed from the VHF module AP11 controller. Tube switching for source B is unavailable with the AP11 controller.

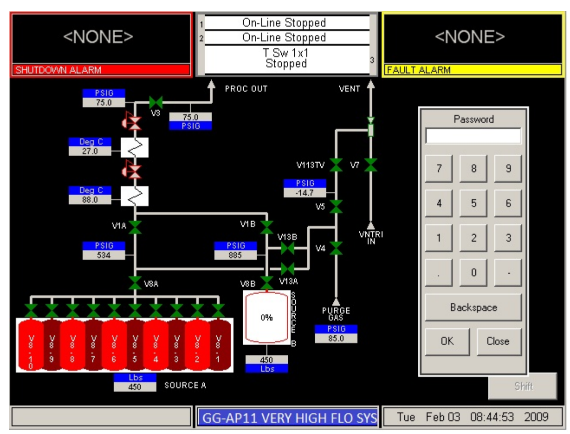
Start Tube Switcher Operation

Verify that the downstream process equipment is ready to receive process gas.



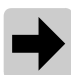
Verify that the manual process flow valves in the Very High Flow System are open.

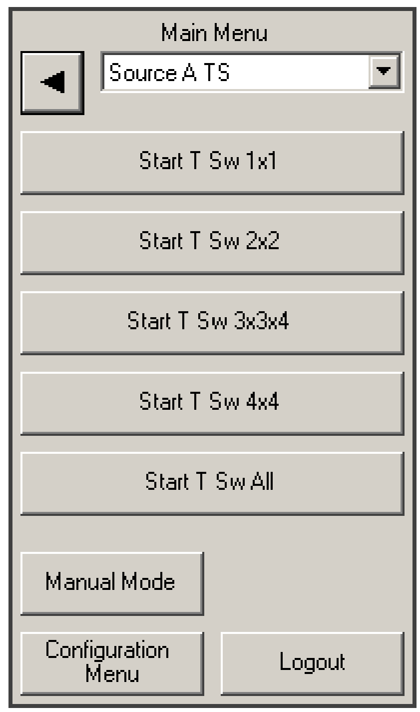
Touch anywhere on the graphics portion of the screen. Display will show a request for password input.



PASSWORD WINDOW

Enter password on keypad and press the “OK” key.

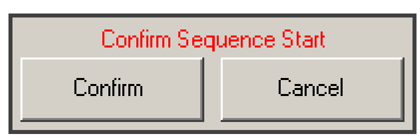
Main Menu screen will be displayed. Use the  and  keys or the drop down menu to select the correct source line.



.

Press the START T SW 1x1 pushbutton to start the Tube Switcher with a Single Source Tube. This will enable the switch to the next full tube as each tube is depleted.

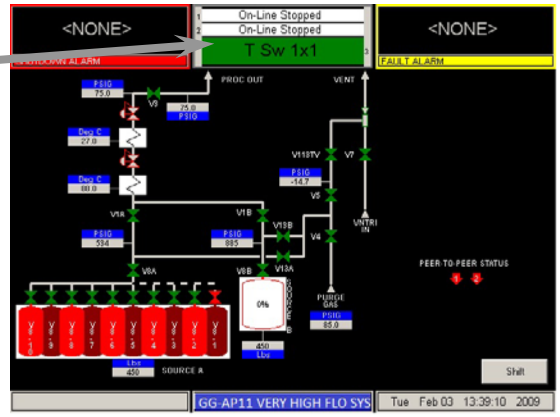
The Confirm Sequence Start window will be displayed. Press the CONFIRM pushbutton.



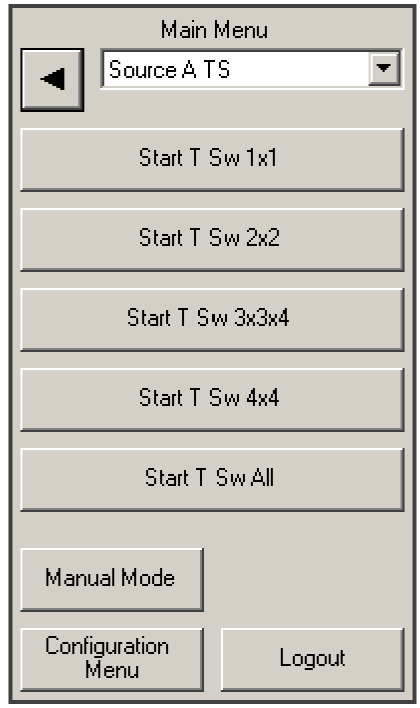
The “Gas Available” relay is energized.

“ T SW 1x1” will be displayed.

Process gas is now available to flow from the source.



For the Multiple Tube Option Press the START T SW 2x2 pushbutton to start the Tube Switcher with Dual Source Tubes. This will enable the first two tubes to come online. Upon depletion the next two tubes in sequence will come online. This will continue until all tubes have been depleted.

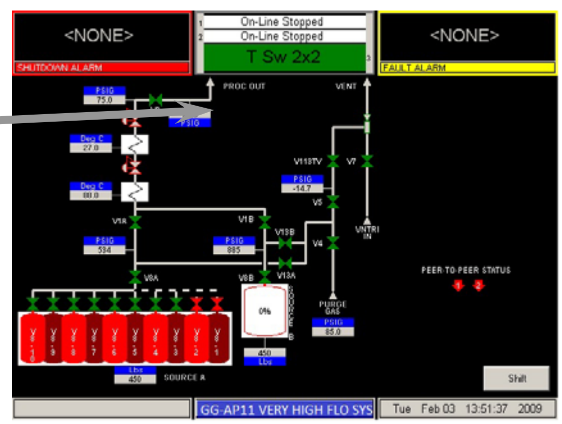


The Confirm Sequence Start window will be displayed. Press the CONFIRM pushbutton.

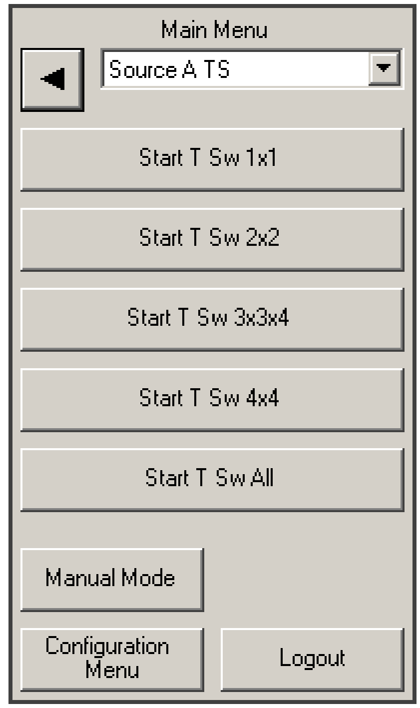
The “Gas Available” relay is energized.

“ T SW 2x2” will be displayed.

Process gas is now available to flow from the source.



For the Multiple Tube Option Press the START T SW 3x3x4 pushbutton to start the Tube Switcher with Multiple Source Tubes. This will bring the first three tubes online. Upon depletion of the first three tubes, the next three tubes will come online. Upon deletion of those three tubes, the final four tubes will come online.

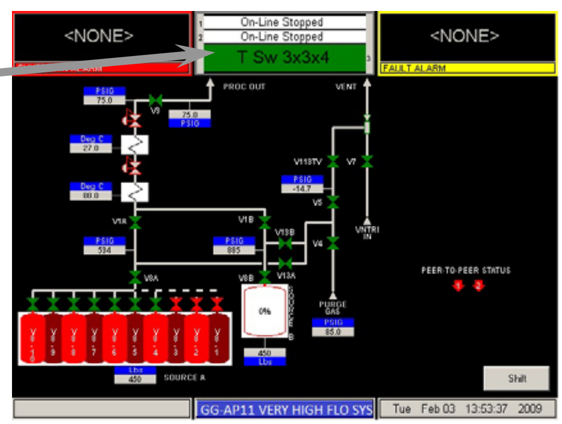


The Confirm Sequence Start window will be displayed. Press the CONFIRM pushbutton.

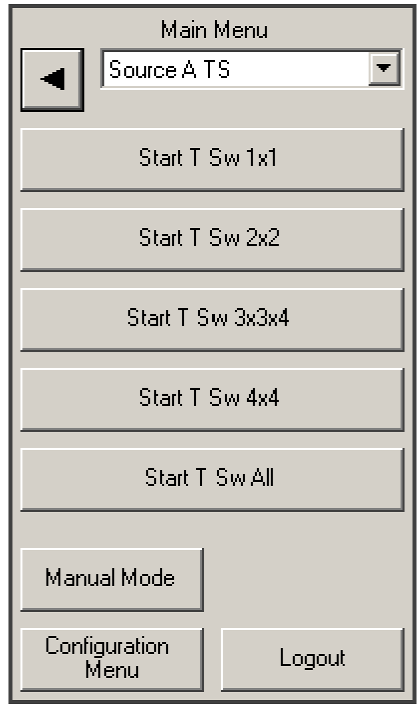
The “Gas Available” relay is energized.

“ T SW 3x3x4” will be displayed.

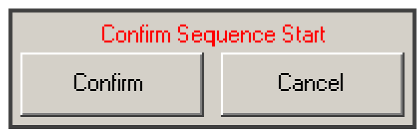
Process gas is now available to flow from the source.



For the Multiple Tube Option Press the START T SW 4x4 pushbutton to start the Tube Switcher with Multiple Source Tubes. This enables the tubes to come online in groups of four.



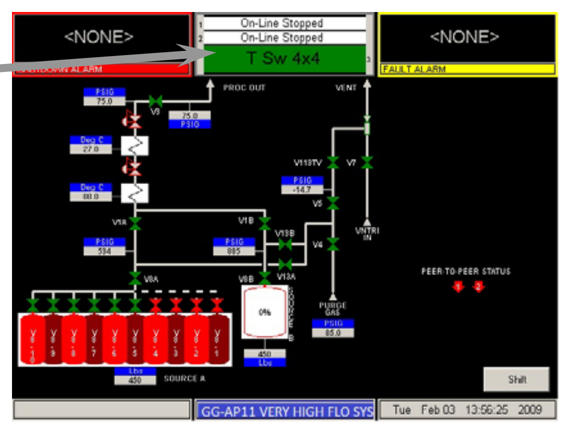
The Confirm Sequence Start window will be displayed. Press the CONFIRM pushbutton.



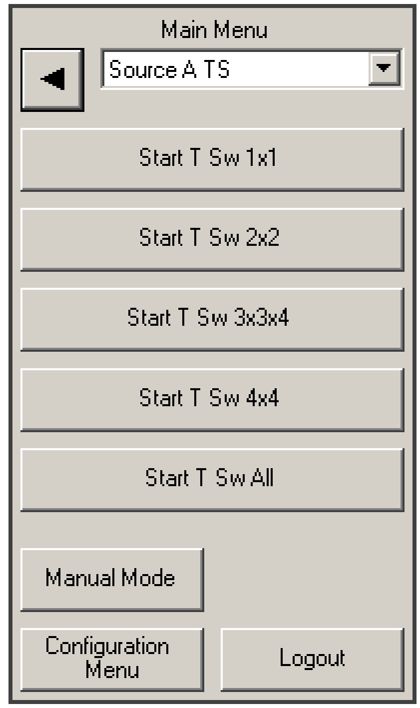
The “Gas Available” relay is energized.

“ T SW 4x4” will be displayed.

Process gas is now available to flow from the source.



For the Multiple Tube Option Press the START T SW All pushbutton to start the Tube Switcher with all source tubes opened simultaneously.

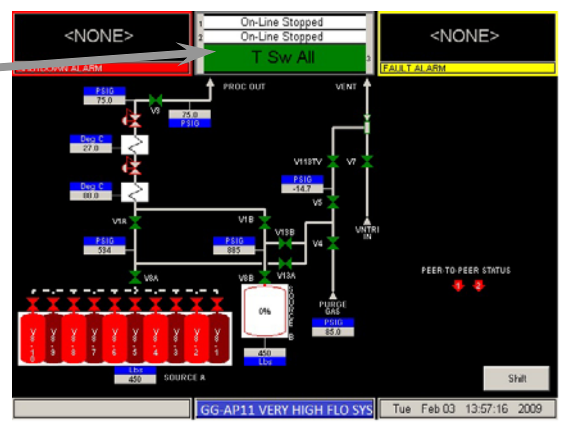


The Confirm Sequence Start window will be displayed. Press the CONFIRM pushbutton.

The “Gas Available” relay is energized.

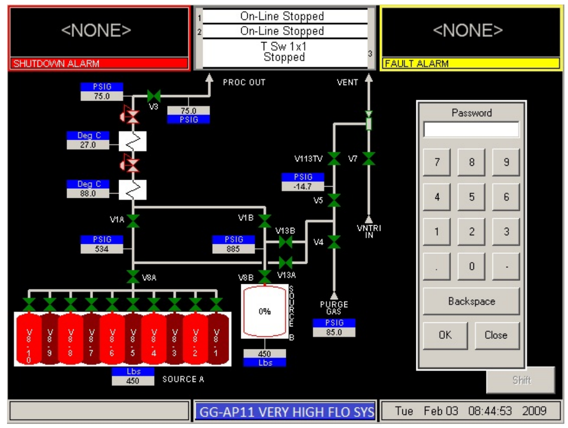
“ T SW All” will be displayed.

Process gas is now available to flow from the source.



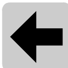
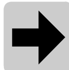
Stop Tube Switcher Operation

Touch anywhere on the graphics portion of the screen. Display will show a request for password input.



PASSWORD WINDOW

Enter password on keypad and press the "OK" key.

Main Menu screen will be displayed. Use the  and  keys or the drop down menu to select the correct source line.

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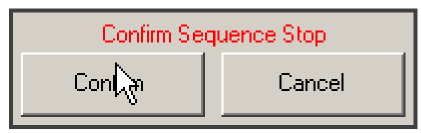
Press the STOP T SW 1x1 pushbutton to stop the Tube Switcher with a Single Source Tube.

The Confirm Sequence Stop window will be displayed. Press the CONFIRM pushbutton.



Use the appropriate pushbutton to stop other Tube Switcher Sources.

4.J Y-Container or Drum Source

Purpose: This Manual Sub-Section provides basic operation details for the Y-container or drum source when used with the Very High Flow module. It covers the topics listed below.

- Emergency Stop
- Change Y-Container

Emergency Stop

The Emergency Stop (E-Stop) button, which is located on the GASGUARD® AP Controller front panel, may be used at any time to manually shut down the Very High Flow module if any emergency condition is observed.

The Emergency Stop (E-Stop) button closes all valves (if applicable), sounds the alarm horn, and energizes the shutdown alarm light. It also turns off power to the optional JT heater and heat trace if present.

Change Y-Container

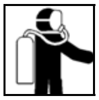
These procedures cover the steps the operator must follow to safely change a Y-container or drum. In the following procedure, “drum” is synonomous with “Y-container”.

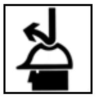
WARNING

Prior to performing a Y-container change, perform or verify the following:

1. Verify that the operator has been trained in Y-container change and Y-container heater procedures.
2. Verify that there are no alarms displayed on the AP Controller.
3. If the Y-Container has a heater unit, verify that the heater power has been turned off and the Y-container has been allowed to cool off.
4. If the pigtail flexible ventilation duct has exhaust ventilation, verify that the exhaust system is functioning properly.
5. Two or more operators are present for this procedure. One person alone should not perform Y-container handling.
6. Read and understand CGA (Compressed Gas Association) Technical Bulletin TB-9, 1993, “Guidelines for the Proper Handling and Use of the CGA Series

'Ultra High Integrity Service' Connections". (Contact your gas supplier or the Compressed Gas Association to order CGA pamphlets.)





Personal protective equipment for loading Y-containers is as follows:

- Safety glasses with side shields.
- Hardhat.
- Safety shoes with toe caps.

Improper Y-container handling may cause a strain or injury.

Disconnect Pigtail from Y-container or Drum

1. Follow the cylinder change-out sequence and perform all the tasks identified on the controller. When instructed to disconnect the Y-container, proceed with the following.
2. Remove the clevis that holds the flexible ventilation duct to the PVC end cap. Slide the PVC end cap over the cylinder valve neck, and set aside. Pull back the flexible ventilation duct slightly to expose the cylinder valve.
3. Verify that the cylinder valve is closed. If the cylinder valve is pneumatic, verify the pneumatic signal to the valve has been removed.
4. Disconnect the pigtail piping from the cylinder valve and install the cylinder valve outlet protective plug.
5. Install the protective plug on the process pigtail piping .
6. Install the cylinder cap onto the Y-container.
7. Remove the heater blanket if one is present. Consult the Operating manual for the Y-cylinder heater for this procedure.

Remove Empty Y-Container or Drum

1. Place an “Empty” tag on the empty Y-container.
2. Using a forklift to pick up the empty Y-container from the module with end caps and plug in place.
3. Return the empty Y-container to the appropriate storage area.

Install Full Y-Container or Drum

1. The Y-Container is attached to a cradle, which supports it during transportation. The Y-container can be lifted from either side or end using a forklift.
2. Stage the full Y-container near the pigtail connection and verify that the full Y-container process gas label is correct. The cylinder valve end of the Y-container must be located closest to the pigtail connection.

⚠WARNING

Never attempt to replace a specified gas with another gas without consulting Versum Materials, Inc.. Incompatible gases could cause fires, explosions, or extremely corrosive or toxic compounds that lead to personal injury or death.

Connect Pigtail to Y-container or Drum

1. Remove the cylinder cap from the cylinder valve end of the Y-container.

WARNING

If the cylinder 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 Y-container and repeat this procedure from step 1. Do not attempt to open a frozen cap as this might damage the cylinder valve and cause a high-pressure gas leak that could result in personal injury or death.

3. Verify that the cylinder valve is tightly closed.
4. Remove the cylinder valve outlet protective plug.
5. Inspect the cylinder valve outlet for contamination or damage. If any damage or visible contamination is observed, replace the cylinder valve outlet protective plug and cylinder cap, and tag the defective Y-container indicating the problem. Obtain another Y-container and repeat this procedure from step 1. Do not attempt to use gas cylinder with a damaged or contaminated valve outlet.
6. Remove the process pigtail piping protective plug.
7. Fasten the cylinder-valve-to-pigtail connection hand-tight. If a DISS connection is utilized, install a new (unused) gasket. Be careful not to cross-thread the connections.
8. Fully tighten connection using the proper wrenches. Be sure to support the connection and pigtail tubing. Do not apply excessive torque. Recommended torque values are as follows.

Cylinder valve	Pigtail connection	Torque
Brass CGA	Stainless steel CGA	80 ft-lb
Stainless steel CGA	Stainless steel CGA	90 ft-lb
Stainless steel DISS	Stainless steel DISS	35 ft-lb

9. Follow the instructions on the controller to properly purge the system before opening the cylinder valve.

10. Immediately after opening the cylinder valve, install the PVC end cap over the cylinder valve and secure the flexible ventilation duct by pulling the duct inside the PVC cap and inserting two clevis pins to secure the duct to the PCV cap.
11. Install the heater blanket if one is present. Consult the Operating manual for the Y-cylinder heater for this procedure.

4.K ISO Container or Tube Trailer Source

Purpose: This Manual Sub-Section provides the basic operation details for removing and connecting an ISO container or tube trailer. It describes the topics listed below.

- Emergency Stop
- Change ISO Container or tube trailer

Emergency Stop

The Emergency Stop (E-Stop) button, which is located on the Very High Flow Controller front panel, may be used at any time to manually shut down the system if any emergency condition is observed.

The Emergency Stop (E-Stop) button closes all automatic valves, sounds the alarm horn, and energizes the shutdown alarm light. It also turns off the power to the optional JT heater and heat trace if present.

Change ISO Container

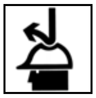
These procedures cover the steps the operator must follow to safely change an ISO Container or tube trailer. In the following procedure, “tube trailer” is synonomous with “ISO container”.

WARNING

Prior to performing a ISO Container change, perform or verify the following:

1. Verify that the operator has been trained in ISO Container change procedures
2. Verify that there are no alarms displayed on the AP Controller.
3. If the ISO-Container has a heater unit, verify that the heater power has been turned off and the ISO-container has been allowed to cool off.
4. If the pigtail flexible ventilation duct has exhaust ventilation, verify that the exhaust system is functioning properly.
5. Two or more operators are present for this procedure. One person alone should not perform ISO Container handling.
6. Read and understand CGA (Compressed Gas Association) Technical Bulletin TB-9, 1993, “Guidelines for the Proper Handling and Use of the CGA Series ‘Ultra High Integrity Service’ Connections”. (Contact your gas supplier or the Compressed Gas Association to order CGA pamphlets.)

Personal protective equipment for loading ISO Containers is as follows:



- Safety glasses with side shields.
- Hard hat.
- Safety shoes with toe caps.

Improper ISO Container handling may cause a strain or injury.

Disconnect Pigtail from ISO Container

1. Follow the source change-out sequence and perform all the tasks identified on the controller. When instructed to disconnect the ISO container, proceed with the following.
2. Verify that the container discharge valve is closed when prompted. If multiple tube valves are present, make sure they are closed. If the valve(s) are pneumatic, verify the pneumatic signal to the valve(s) has been removed. Disconnect the exhaust connection if present.
3. Install the ISO container discharge valve locking device, and tube valve locking devices if applicable.
4. Disconnect the pigtail piping from the ISO container and install the outlet protective plug.
5. Install the pigtail connection protective plug and carefully lay pigtail on a protected surface.

Remove Empty ISO Container

1. Place an "EMPTY" tag on the empty ISO container.
2. Return the empty ISO container to the appropriate storage area.

Connect Pigtail to ISO Container

1. Verify that the container valve or valves are tightly closed.

2. Inspect the container discharge connection for contamination or damage. If any damage or visible contamination is observed, replace the container discharge connection protective cap, and tag the defective ISO container indicating the problem. Obtain another ISO container and repeat this procedure from step 1. Do not attempt to use an ISO container with a damaged or contaminated discharge connection.
3. Remove the pigtail connection protective plug.
4. Fasten the pigtail hose to the container discharge connection hand-tight. If a DISS or face seal connection is utilized, install a new (unused) gasket. Be careful not to cross-thread the connections.
5. Fully tighten connection using the proper wrenches. Be sure to support the connection and pigtail tubing. Do not apply excessive torque. Recommended torque values are as follows.

Cylinder valve	Pigtail connection	Torque
Brass CGA	Stainless steel CGA	80 ft-lb
Stainless steel CGA	Stainless steel CGA	90 ft-lb
Stainless steel DISS	Stainless steel DISS	35 ft-lb

Face seal connections should be tightened 1/8 turn past finger tight.

6. Reconnect the exhaust hose to the ISO if present. Follow the Instructions on the controller to properly purge the system before opening the source container valves.

Section 5 AP11 Configuration Menu

The following table outlines the Configuration Menu options.
Note: Specific operating sequences are covered in the Operating Procedures section.

Configuration Menu	**Access by Security Level**	
	2nd	**3rd**
Manual Mode	W	W
Net Product	W	W
User Analog Setpoints	RO	W
Subcycle Parameters	RO	W
Leak Test Parameters	RO	W
System Test	W	W
Valve Setup	NA	RO
Valve Counts	RO	W
Operation Sequences	NA	RO
Sequence Flow Options	NA	RO
Prompt List	NA	RO
Set Time/Date	RO	W
Analog Scaling	RO	RO
VERSUM MATERIALS, INC. Analog Setpoints	RO	RO
Alarm Conditions	RO	RO
Alarm Delays	RO	W
Alarm Types	NA	RO
Alarm Sequences	NA	RO
Relay Defaults	NA	RO
Helium Leak Check	NA	W
1st Security	NA	W
2nd Security	NA	W
3rd Security	NA	W
System Setup	NA	W
Config Transfer	NA	W
Memory Management	NA	NA

Table 5-1

W: Write = parameter changes may be made.
RO: Read Only = parameters may be viewed, but not changed.
NA: No Access = parameters may not be viewed. For Versum Materials, Inc. use only.

Certain GASGUARD® 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.

For safety considerations, most configuration parameters may be changed only by Versum Materials, Inc. technical personnel.

The following paragraphs describe the parameters that you may view and/or change.

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.

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 VERSUM MATERIALS, INC. 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 Low Process Cyl Pressure
- Low Process Del. Pressure
- Low Cyl Weight
- Low 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..

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 minimum values differ depending on the process gas, and are not user configurable. The following is an example of their Versum Materials, Inc. minimum values:

- Purge/Vent = 120 Cycles
- Condition = 5 Cycles
- Outboard (Helium Leak Test) = 1 Cycle

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.

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 example of their Versum Materials, Inc. minimum values follow:

*	Vacuum Test	Min. of Testing = 5	Press. Differ. = 5 psi (.344 barg)
*	Pressure Test	Min. of Testing = 10	Press. Differ. = -5 psi (-.344 barg)
*	HPLT Test	Min. of Testing = 5	Press. Differ.= -5 psi (.344 barg)
*	Stabilization	Min. of Testing = 6	Press. Differ. = -80 psi (5.5 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.

WARNING ***All Decay Test parameters must have a negative value for the pressure difference in order to detect a leak and alarm.***

System Tests

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.

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 this chapter. It is the customer's responsibility to adhere to all operational warnings in this chapter 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.***

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.

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.

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.

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.

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

Apply OK

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 to accept the changes. Press the pushbutton to exit the window.

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.

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.

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.

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.

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

Apply

OK

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 to accept the changes. Press the pushbutton to exit the window.

VERSUM MATERIALS, INC. Analog Setpoints (VERSUM MATERIALS, INC. Setpoints)

The VERSUM MATERIALS, INC. 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 VERSUM MATERIALS, INC. Setpoints window will display the VERSUM MATERIALS, INC. defined analog alarm data. The window will display the alarm number, alarm label, and current alarm setpoint for each VERSUM MATERIALS, INC. alarm. A total of ten setpoints will exist per analog input. The number of VERSUM MATERIALS, INC. 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 VERSUM MATERIALS, INC. Setpoints window will only be accessible with an VERSUM MATERIALS, INC. level password.

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 either a closed, open, or not used. The alarm condition for analog alarms is either a high, low, or not used. The window will allow the operator to change one or more alarms or to exit the window without changes

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.

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.

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.

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 either a No Default, Energize, or De-energize.

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.

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.

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.

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.

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.

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. Only users with the VERSUM MATERIALS, INC. password will be allowed to change the 3rd security access.

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.

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” sound associated with pressing a touch screen key or button.

Simulation

Permits the user to enable or disable simulation capabilities.

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.

IP Settings

The IP settings option allows the user to modify the IP address, subnet mask, and default gateway.

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.

Set Product Code

The set product code option allows the user to modify the product code.

Calibrate Touch Screen

Allows the User to Calibrate the Touch Screen

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.

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.

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. This option will only be accessible by users with the VERSUM MATERIALS, INC. level password.

Memory Management

The Memory Management window will display the options listed below. The operator will be allowed to choose an option or exit the window.

USB to Controller Firmware

This option will begin the Firmware file transfer from the source device attached to the controller USB port.

Controller to USB Memory Contents

This option will begin the file transfer of the firmware executable files, Configuration File, and NV Data File from the memory of the Controller to the attached USB Device.

Delete Nonvolatile Data File And Reboot

The Delete Nonvolatile Data File option will delete the nonvolatile (NV) data file from the memory. The controller will reboot after completing deleting the NV data file from memory.

Other Options

Return to Power Up Mode – Returns the Controller to Power Up Mode.

Reboot – Reboots the Controller.

Reboot to OS – Reboots the Controller to the Operating System.

Disable/Enable OS Access – Permits Access to the Operating System Task Bar.

Variables – Allows viewing and modifying variables from the controller.

Chapter 9

Troubleshooting

1.0 System Errors

Problem sources, tests, and solutions are suggested for the following system conditions:

- System Down, No Lights on Controller
- No or Low Purge Gas Pressure
- No or Low Purge Gas Flow
- Insufficient Vacuum
- No or Low Process Gas Pressure
- No or Low Process Gas Flow

System Down, No Lights on Controller

Possible Source of Problem	Test	Solution
No electrical power.	Check circuit breakers.	Reset as necessary.
	Check fuses.	Replace as required.
	Check power supply to system.	Restore specified power to electrical control panel.

No or Low Purge Gas Pressure

Possible Source of Problem	Test	Solution
Purge gas cylinder valve closed.	Check position of cylinder valve.	Open cylinder valve, pressure should indicate the current purge cylinder pressure.
Purge gas cylinder pressure is low.	Check cylinder pressure.	Change purge cylinder.
Purge gas panel isolation valve is closed.	Check position of manual purge isolation valves to High Flow System Process line.	As applicable, open manual valves.
Purge gas pneumatic valves not receiving sufficient pressure to open.	Check if instrument supply is adequate.	Adjust to 85-95 psig (5.9-6.6 barg) if necessary.
Purge gas regulator is set incorrectly.	Check setting on pressure regulator.	Set pressure regulator to correct delivery pressure.

No or Low Purge Gas Flow

Possible Source of Problem	Test	Solution
No or low purge gas pressure.	Check position of cylinder valve.	Open cylinder valve, pressure should indicate the current purge cylinder pressure.
Purge gas manual isolation valve(s) closed or partially closed.	Check position of purge gas manual isolation valve(s).	Open fully.
Purge vent valves open.	Check position of all purge vent valves.	Close any purge vent valves if open.
Purge gas pneumatic valves not receiving sufficient pressure to open.	Check if instrument supply is adequate.	Adjust to 85-95 psig (5.9-6.6 barg) if necessary.

Insufficient Vacuum

Possible Source of Problem	Test	Solution
No or low nitrogen supply pressure to vacuum venturi.	Check position of customer supply valve.	Open valve, check venturi vacuum.
V-7 TP pneumatic valve not receiving sufficient pressure to open.	Check if instrument nitrogen supply is adequate.	Adjust to 85-95 psig (5.9-6.6 barg) if necessary.
Improperly sized vacuum venturi vent piping.	Check that vent piping complies with “Vacuum Venturi Vent Line Sizing” recommendations in Chapter 2.	Comply with recommendation and resize the vent line.

No or Low Process Gas Pressure

Possible Source of Problem	Test	Solution
Low supply container pressure.	Check supply pressure.	Follow procedures to change out supply container.
Process gas pressure regulator set incorrectly.	Check setting on pressure regulator.	Set pressure regulator to correct pressure.
Process gas pressure transducer(s) malfunctioning.	Check input to controller, Check connections and signal from pressure transducers. Check transducer calibration.	Repair connections. Repair, replace, or re-calibrate transducer(s) as necessary.

Manual valve closed in the process stream.	Check to make sure the manual valves are all open.	Open closed manual valve.
Automatic Valve in the Process stream is closed.	Check to make sure the automatic valves are working properly.	Repair any malfunctioning automatic valves.
Instrument nitrogen supply not adequate.	Check instrument nitrogen pressure.	Adjust instrument nitrogen to 75-95 psig (5.2-6.5 barg).
JT Process Heater(s) loss of power. (*Gas may be condensing as it's throttled across the regulator*.)	Check for power, verify temperature setting. Check TSH-5 and TSH-7 manual reset switch.	Reset breaker, input correct temperature into TIC-6 and TIC-8. Reset TSH-5 and TSH-7 (*see section 3 of this chapter*).
Heat Trace loss of power . (*Gas may be condensing in the process line creating slugs of liquid in the piping low points*.)	Check for power, verify temperature setting.	Reset breaker, input correct temperature into controller. Heat trace upstream of PCV-1 must be set at or above source heater temperature. Houseline heat trace must be set above the process gas saturation temperature.

No or Low Process Gas Flow

Possible Source of Problem	Test	Solution
No or low process gas pressure.	Check supply pressure.	Follow procedures to change out supply container.
Process gas manual isolation valve(s) closed or partially closed.	Check position of process gas isolation valve(s).	Open fully.
Automatic Valve in the Process stream is closed.	Check to make sure the automatic valves are working properly.	Repair any malfunctioning automatic valves.

Vent valves open.	Check position of all vent valves.	Close any vent valves if open.
JT Process Heater(s) loss of power. (*Gas may be condensing as it's throttled across the regulator*.)	Check for power, verify temperature setting. Check TSH-5 and TSH-7 manual reset switch.	Reset breaker, input correct temperature into TIC-6 and TIC-8. Reset TSH-5 and TSH-7 (*see section 3 of this chapter*).
Heat Trace low temperature alarm. (*Gas may be condensing in the process line creating slugs of liquid in the piping low points*.)	Check for power, verify proper temperature setting.	Reset breaker, input correct temperature into controller. Heat trace upstream of PCV-1 must be set at or above source heater temperature. Houseline heat trace must be set above the process gas saturation temperature.

2.0 Typical Alarms

This section provides information on possible alarms that can occur while operating a GASGUARD® Very High Flow module. This assumes that all devices are calibrated and functioning according to the manufacturer's specification. Probable causes and corrective actions are suggested for the following types of alarms:

- E-Stop Interlock
- Process Inlet Alarms
- Process Delivery Alarms
- Purge Supply Alarms
- Vacuum/Vent Line Alarms
- Z-Purge

- Process Heater Alarms

E-Stop Interlock

Probable Cause	Corrective Action
Emergency stop button has been pressed.	Resolve emergency situation.

Process Inlet Alarms

High Process inlet Pressure

Probable Cause	Corrective Action
Malfunction of pressure indicating transducer, PT1.	Check electrical connections, and output signal, repair as necessary.
Run away source heater controller.	Check source heater for proper operation and setpoint.

Low Process Inlet Pressure

Probable Cause	Corrective Action
Process supply container is below the low pressure or weight setpoint.	Follow the procedure to change out the supply container.
Applicable manual valves are not open.	Ensure the applicable manual valves are open.
Withdrawal rate from the container is too high, causing container pressure to drop. (*Liquefied compressed gases only*)	Decrease withdrawal rate. Wait for container to warm. If installed, increase source heater temperature, but not above 110 deg F. (*Note: heat trace temperature from source container to PCV-1 must also be increased to same temperature or higher.)*
V-1 is closed.	Check for proper pneumatic pressure to the AP11 controller. Adjust to 85-95 psig (5.9-6.6 barg) if necessary. Check for pneumatic pressure at V-1. Replace the pneumatic solenoid valve if required.

Process Delivery Alarms

Pressure Transducer Malfunction

Probable Cause	Corrective Action
Malfunction of pressure indicating transducer PT-2, or PT-9 if installed.	Check electrical connections, and output signal, repair as necessary.

Low Process Delivery Pressure

Probable Cause	Corrective Action
Process delivery pressure PCV-1 is below the low set-point.	Adjust process pressure regulator to the desired delivery pressure.
HCl Purifier Module only – purifier module manual valves are closed.	Verify HCl purifier manual valves are open.
Withdrawal rate is high, causing container excessive pressure drop and regulator droop.	Reduce the withdrawal rate to within equipment specifications.
Single stage regulator only – delivery pressure is low after installing a full container.	Adjust PCV-1. This is a normal condition called inlet pressure decay effect. As source pressure decreases, delivery pressure will increase. Delivery pressure will decrease when inlet pressure increases. On single stage regulator systems the regulator will require periodic readjustment as source container pressure drops.
Heat trace temperature is set lower than source heater temperature – pressure oscillations are occurring.	Adjust heat trace temperature at, or above, source container heater temperature. Temperature lower than the source container will cause process gas to condense and form liquid slugs in the piping low points.

High Process Delivery Pressure

Probable Cause	Corrective Action
Regulation is set high.	Adjust process pressure regulator (PCV-1) to the desired delivery pressure.

Single stage regulator only- delivery Pressure is increasing as the container Empties.	Adjust PCV-1. This is a normal condition called inlet pressure decay effect. As source pressure decreases, Delivery pressure will increase. On single stage regulator systems the regulator will require periodic readjustment as source container pressure drops.
Heat trace temperature is set lower than Source heater temperature – pressure Oscillations are occurring.	Adjust heat trace temperature above source container heater temperature. Temperature lower than the source Liquid slugs in the piping low points.

Low Houseline Pressure

Probable Cause	Corrective Action
Manual process isolation valve (MV-38) is closed.	Open manual isolation valve.
Filter F-2 plugged.	Replace filter, additional troubleshooting would be required to try and determine the source of the particles that plugged the filter.
V-3 is closed.	Check for proper pneumatic pressure to the AP11 controller. Adjust to 85-95 psig (5.9-6.6 barg) if necessary.
	Check for pneumatic pressure at V-3. Replace the pneumatic solenoid valve if required.

Purge Supply Alarms

High Purge 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. If regulator creeps, replace the regulator.

Low Purge Pressure

Probable Cause	Corrective Action
Purge gas delivery pressure is too low.	Adjust purge pressure regulator to the desired pressure. Purge gas cylinder is low. Replace purge gas cylinder with a new one.
V-4 pneumatic valve not receiving sufficient pressure to open.	Check if instrument nitrogen supply is adequate. Adjust to 85-95 psig (5.9-6.6 barg) if necessary. Replace the pneumatic solenoid valve if required.

High Vacuum

Probable Cause	Corrective Action
Vacuum decay due to leak in piping or through valves during purge/evacuate sequence.	Check for and repair external leaks. Check that valves are sealing correctly and repair or replace any valves that are leaking through.

Vacuum/Vent Line Alarms

High Vacuum

Probable Cause	Corrective Action
Vacuum decay due to leak in piping or through valves.	Check for and repair external leaks. Check that valves are sealing correctly and repair or replace any valves that are leaking through.
Improperly sized vacuum venturi vent piping.	Check that vent piping complies with "Vacuum Venturi Vent Line Sizing" recommendations in Chapter 4. Comply with recommendation and resize the vent line.
V-7 TP pneumatic valve not receiving sufficient pressure to open.	Check if instrument nitrogen supply is adequate. Adjust to 85-95 psig (5.9-6.6 barg) if necessary. Replace the pneumatic solenoid valve if required.

Flow Switch Alarm (Exhausted Enclosures)

Exhaust Flow Switch Low (FSL)

Probable Cause	Corrective Action
Exhaust flowrate is below flow switch low setpoint.	Increase exhaust flow until flow switch is satisfied. The specification is 200 CFM.

Z-Purge

Low Z-Purge

Probable Cause	Corrective Action

Pressure inside the controller is less than 0.1"water column (24.9 Pa).	Increase the flow rate until the pressure switch can be satisfied and the alarm can be reset. The flow rate is adequate if there is no alarm.

Process Heater Alarms (If Present)

Low Temperature

Probable Cause	**Corrective Action**
Heater temperature below the low setpoint.	Check the operation of the heater controller. Re-adjust as necessary. A momentary low temperature alarm may be caused by a drastic increase in flow rate and is considered normal. The PID controller is a reactionary device and cannot anticipate the additional demand on the J-T heater.

High Temperature

Probable Cause	**Corrective Action**
Heater temperature above the high set-point.	Check the operation of the heater controller. Readjust as necessary. A momentary high temperature alarm may be caused by a drastic decrease in flow rate and is considered normal. The PID controller is a reactionary device and cannot anticipate the lack of demand on the J-T heater. A temporary overshoot as the heater block warms at startup or following an extended shutdown is also considered normal. The alarm can be reset after the heater block is thermally saturated (typically within 15 to 30 minutes).

3.0 J-T Process Heater Reset Procedure

Each JT heater has a discrete hardwire shutdown. Its purpose is to turn off power to the J-T heater in the unlikely event heater temperature reaches 212 deg F. Following a trip, it must be manually reset. The following paragraphs describe the reset procedure.

CAUTION! Before performing the following task, power must be removed from the heater to avoid shock during the TSH-5 reset. Turn off the main power disconnect located on the low voltage electrical enclosure door.

Be sure to use Lockout/Tagout procedures in addition to turning off power at the VHF main disconnect switch.

TSH-5 (JT heater H-1) or TSH-7 (J-T heater H-2) is reset manually by opening the top of the J-T heater and pressing the reset button located in the center of the heater block. See figure 7-3-1 for the location of the reset button.

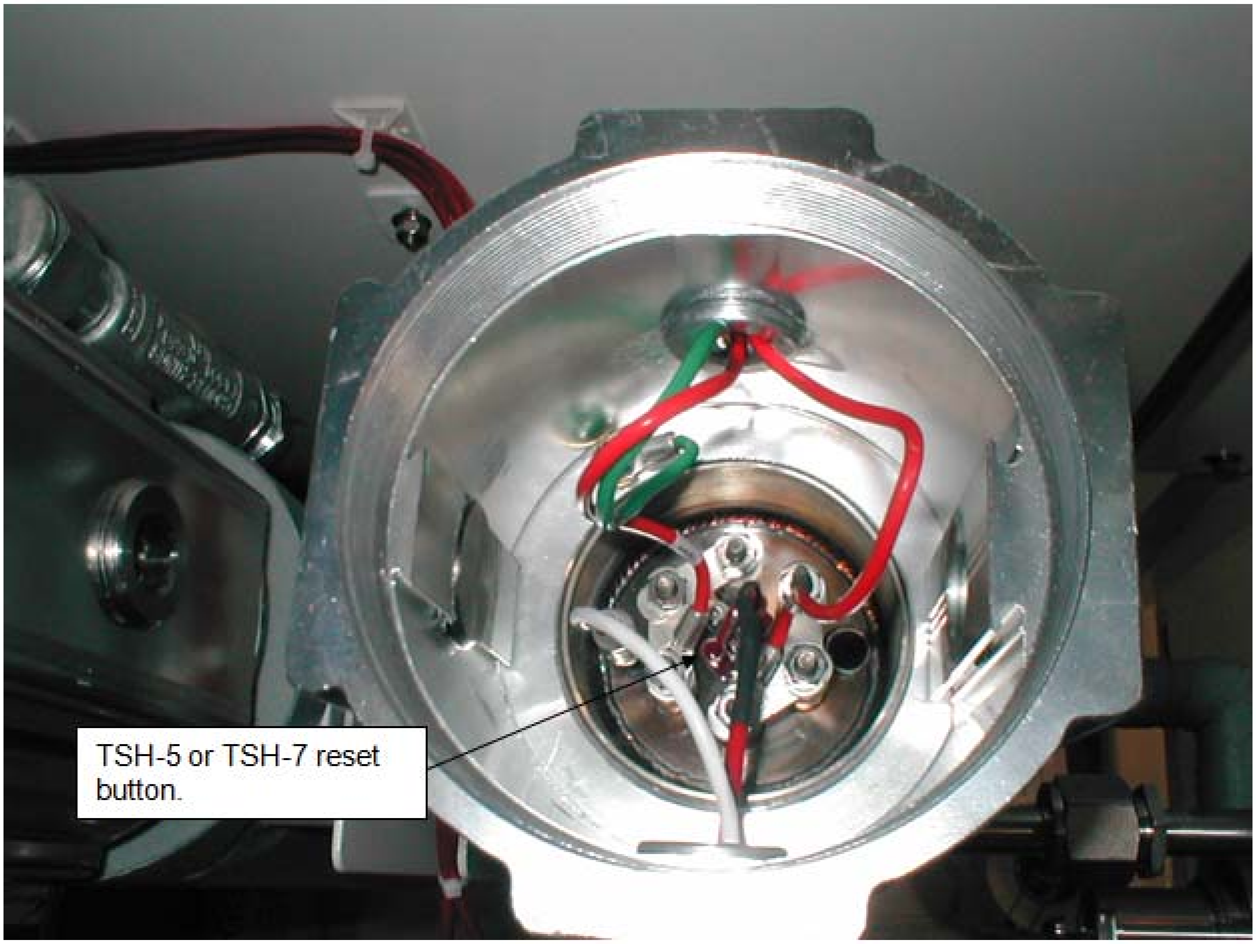


Figure 7-3-1 J-T Heater Reset Button

CAUTION! ***Before closing the lid on the J-T heater and restoring power in a hazardous gas location, verify no flammable atmosphere is present. Read and comply with the pressurized enclosure warning on the AP11 controller.***

After resetting TSH-5 or TSH-7, and closing the top of the J-T heater, power can safely be restored by turning on the main power disconnect. However, the cause of the over temperature situation must be investigated and remedied. Control of the TIC-6 or TIC-8 circuit should be reviewed.

Chapter 10

Maintenance

1.0 Routine Maintenance

The following maintenance must be performed at the indicated times. It is critical that replacement components and parts are identical to the original item to avoid hazardous malfunctions or leaks. Note: All components and parts have been selected to be compatible with the gases to which they may be exposed. This is particularly critical for the soft goods (e.g., O-rings, valves, seats and seals, etc.). Consult Versum Materials, Inc. if there is any question about part compatibility with a particular gas.

If necessary, maintenance personnel should make use of a step stool or small ladder to safely access the controller.

⚠CAUTION

Maintenance is only to be performed by trained personnel who understand the hazards of the system.

⚠WARNING

Electrical power to the system must be turned off before servicing system components is attempted.

⚠WARNING

Personal injury or death may result if proper personal protective equipment (PPE) is not worn when performing troubleshooting and maintenance.

⚠WARNING

Burn Hazard. Before performing maintenance, allow J-T heaters and piping downstream to cool to room temperature.

The following list of maintenance tasks is arranged according to frequency.

Every Cylinder/Trailer Change

Component	Task
Electrical Control System	Verify warning labels are in place and legible.
Pigtail Heat Trace (if installed)	Inspect pigtail heat trace for abrasion damage to the stainless steel over braid and jacket. Replace if signs of damage are present. Inspect heat trace end termination for abrasion and assure it's fastened tightly to the heat trace. Reinstall and secure to the heat trace as required.
Regulators	Observe operation of regulators during pressure adjustment. If pressure changes are not smooth, remove and replace regulator.
Process Flex Hose (if installed)	Inspect the process flex hose for signs of abrasion and kinks. If the stainless steel overbraid or bellows is damaged, the hose must be replaced as soon as possible.
Source Container Pneumatic Valve Supply	Inspect the pneumatic tube, or tube bundle for kinks and deep abrasion that could cause failure. Replace the pneumatic tube if any of these signs exist. Replace the tube bundle jacket as soon as it is worn through.

When Pressure Loss is Detected

Component	Task
Filter	Replace filter if a change in pressure across the filter is observed. Note: Install new VCR gaskets as required.

Daily

Component	Task
Very High Flow Module	Visually inspect the cabinet for damage, leaks, or malfunctioning components. As needed, touch up damaged paint on cabinets using paint specification included in the back of this manual section.
	Inspect the interior of cabinet for any signs of corrosion caused by gas leakage. Replace components as required.
Pressure Transducers	Check and record process and purge pressures for readings that are outside of the specification range. Look for dramatic changes in readings from previous values. If re-calibration doesn't work, replace the transducer.

Every 3 Months

Component	Task
Very High Flow Module	Sweep enclosures and racks. Clean all external surfaces with a clean, damp cloth. **Note: Do not perform this activity inside the AP11 controller or electrical cabinet interior s. Do not use pressurized water to clean inside or outside of cabinets as serious damage could occur to the electronic components.**
Electrical Control System	Test operation of Ground Fault Circuit Breaker **GFCB-103**. Press the integral TEST button on the device and verify that the unit trips. Reset the device after testing. ***WARNING: The system must be energized when this task is performed. Reference written procedure in Chapter 6 Section 4.***
Pneumatic System	Inspect all pneumatic connections for signs of leakage. Inspect tubing for signs of deterioration or cracking. Replace any tubing displaying signs of potential failure.

Every 6 Months

Component	**Task**
Valves	Examine each valve for external leaks. Replace as required.
E-Stop Interlock	Verify that when the emergency stop button is depressed, the High Flow System shuts down.
Low- Low Process Source Pressure on PT-1A and PT-1B if installed.	Verify that process source pressure below the low-low setpoint initiates a module shutdown, and a switch over to the opposite VHF module if available and in standby mode.
High-High Process Source Weight on WT-1A, and 1B if installed.	Verify that process liquid weight above the high-high setpoint initiates a module shutdown, and a switch over to the opposite VHF module if available and in standby mode.
Low-Low Process Source Weight on WT-1A, and 1B if installed.	Verify that process liquid weight below the low-low setpoint initiates a module shutdown, and a switch over to the opposite VHF module if available and in standby mode.
High-High Interstage Pressure on PT-10.	Verify that interstage pressure above the high-high setpoint initiates a module shutdown, and a switch over to the opposite VHF module if available and in standby mode.
High-High Delivery Pressure on PT-2A and PT-2B.	Verify that process delivery pressure above the high- high setpoint initiates a module shutdown, and a switch over to the opposite VHF module if available and in standby mode.
Low-Low Delivery Pressure on PT-2A and PT-2B.	Verify that process delivery pressure below the low-low setpoint initiates a module shutdown, and a switch over to the opposite VHF module if available and in standby mode.
Low-Low Houseline Pressure on	Verify that houseline pressure below the low- low setpoint initiates a module shutdown, and a switch over to the opposite

PT-9.	VHF module if available and in standby mode.

Every 6 Months Continued

Component	Task
Remote Shutdown Signal	Verify that if the customer's remote shutdown signal is activated, the system shuts down.
JT Process Heater	Visually inspect for damage, corrosion, or malfunctioning components.

Every 12 Months

Component	Task
Electrical Control System	Inspect the integrity of the gasketing on the door of the electrical enclosures. Repair any damaged areas.
	Inspect the electrical enclosure for signs of water entering the enclosure. Isolate leak point and repair.
	Verify that all covers are in place on electrical fittings and that the covers are tight. Inspect all conduit auto-drains and verify that discharge openings are clear of any obstructions.
	Inspect the painted surfaces on the exterior of electrical enclosures. Repaint any damaged areas as required.
	Verify operation of the EMO circuit by initiating a shutdown using the EMO push button on the system.
	Verify operation of Audible alarm horn.
	Check and adjust if necessary ECC 24VDC power supply.
	Check and adjust if necessary Z-Purge static pressure.

Every 12 Months Continued

Component	Task
Heat Trace	Verify resistance of heat trace element using a DVM or a megger. Use a megger (if available) to test the integrity of the insulation jacket on the heat trace.
	Verify the integrity of the temperature element and capillary used for the heat trace control. Verify that it is securely attached to surface being measured, and no kinks are visible in the capillary.
JT Heater Assembly	Verify resistance of heater element using a DVM or a megger. Use a megger (if available) to test the integrity of the insulation of the heater plate assembly.
	Verify the integrity of the two RTD's utilized on the JT heater assembly. **TE-6 and TE-8**
Pressure Transducers	Recalibrate and span transducers.
Valves	Observe ¼ turn diaphragm valves in closed position. If the needle is not in the green zone, follow manufacturer's adjustment or repair procedure.
Regulators	Examine each regulator for external leaks. Replace as required.

2.0 Mechanical Integrity

This section provides four different mechanical integrity (MI) maintenance activity forms for the following equipment components:

- Very High Flow Modules
- Specialty Gas Systems
- Gas Detection Systems
- Valve Manifold Boxes

MI Maintenance Activities for Very High Flow Modules (VHF)

Name of Equipment: ______________________________
Name of Inspector(s): ______________________________
Signature of Inspector(s): ______________________________

INSPECTION OR TEST	SYSTEM TYPE	ACCEPTABLE (Y/N/NA)	INSPECTED BY (Initial)
3 Months Date:			
Visual inspection of piping and wetted components for leaks and damage that could lead to loss of containment.	T,F,P,C		
Visual inspection of wiring and electrical components for damage to insulation, corrosion	T,F,P,C		
1 Year Date:			
Inspect cylinder restraining strap/chain	All		
Verify accuracy of transducers activating high pressure shutdown (delivery and cylinder)	All		
Gas Detection System	T, F, P, C		
Inspect Burst Disk	All		
Grounding Inspection and Verification	F,P		
Flexible hose inspection	All		
Cabinet Exhaust Low alarm	T,F,P,C		
Sprinkler Visual Inspection	F,P		
Verify delay timer for process gas (if applicable)	T,F,P		
2 Years Date:			
Verify self-closing mechanism for cabinet doors and windows closes.	F,P,T, C		
High Temperature Sensor Test	F,P		
High Pressure Shutdown	T,F,P,C		
Co-axial pressure shutdown	T,F,P,C		
Excess Flow Switch	T,F,P,C		
3 Years Date:			
Test or Replace safety relief valves	C		
EGO, EMP or EPO or E-stop or Remote E-stop or Customer remote shutdown	T,F,P,C		
Flexible hose testing or replacement (flexible hose prohibited on T, P)	C,F		
4 Years Date:			
Test or Replace safety relief valves	F,P,T		
6 Years Date:			
Flexible hose testing or replacement	I,O		
Test or Replace safety relief valves	I,O		

C=corrosive; F=flammable; P= pyrophoric; T= Toxic; I = Inerts; O = Oxidizers

Corrective Actions Required:

MI Maintenance Activities for Gas Detection Systems

Name of Equipment: ______________________________

Name of Inspector(s): ______________________________

Signature of Inspector(s): ______________________________

INSPECTION OR TEST	SYSTEM TYPE	ACCEPTABLE (Y/N/NA)	INSPECTED BY (Initial)
1 Month Date:			
UVIR (outdoor), clean glass and verify aim in proper direction	Outdoor systems		
MDA Tape Change	T,P,F, C		
6 months Date:			
UVIR (Indoor), clean glass and verify aim	Indoor Systems		
1 Year Date:			
Optics Check	All		
Flow Verification	All		
Point testing	All		
UVIR test	All		
3 Year Date:			
Replace UV Source for auto self-check	All		

C=corrosive; F=flammable; P= pyrophoric; T= Toxic; I = Inerts; O = Oxidizers

Corrective Actions Required:

MI Maintenance Activities for Valve Manifold Boxes

Name of Equipment: ______________________________

Name of Inspector(s): ______________________________

Signature of Inspector(s): ______________________________

INSPECTION OR TEST	SYSTEM TYPE	ACCEPTABLE (Y/N/NA)	INSPECTED BY (Initial)
3 Months Date:			
Visual inspection of piping and wetted components for leaks and damage that could lead to loss of containment.	T,F,P,C		
Visual inspection of wiring and electrical components for damage to insulation, corrosion	T,F,P,C		
1 Year Date:			
Cabinet Exhaust Low alarm	T,F,P,C		
Grounding Inspection and Verification	F,P		
Gas Detection System	T, F, P, C		
2 Years Date:			
Line heater over-temperature interlock test (if applicable)	All		
Verify that self-closing mechanism for cabinet doors and windows closes.	F,P,T, C		
Verify High Pressure Shutdown	T,F,P,C		
Co-axial pressure shutdown	T,F,P,C		
3 Years Date:			
Test or Replace safety relief valves	C		
EGO, EMP or EPO or E-stop or Remote E-stop or Customer remote shutdown	T,F,P,C		
4 Years Date:			
Test or Replace safety relief valves	F,P,T		
6 Years Date:			
Test or Replace safety relief valves	Inerts		
10 Years Date:			
Replace Exhaust Switch per 3EQ95702	T,F,P,C		

C=corrosive; F=flammable; P= pyrophoric; T= Toxic; I = Inerts; O = Oxidizers

Corrective Actions Required:

3.0 Electrical Maintenance and Test Procedures

When performing maintenance on Gasguard® Very High Flow module electrical components, the personnel performing such tasks must be trained and qualified to work on electrical apparatus.

When replacing electrical components, personnel must use replacement components that are an exact replacement for the removed device. Substitution of devices or components is prohibited. This act renders the warranty invalid, and also can result in a hazardous operating situation.

Prior to performing any test, verify the area surrounding the equipment is free of a flammable atmosphere.

Nonincendive Electrical Components

Nonincendive circuitry is utilized within this equipment as an approved protection technique for hazardous area use per NFPA 70. Devices associated with the nonincendive circuitry, the associated field wiring, and the field apparatus connected to the nonincendive circuit, must be replaced “in kind” with components that have the exact part number and specifications as those provided. Failure to conform to this requirement may compromise the integrity of the protective circuit and result in explosion, personnel injury, or death.

JT Heater/Heat Trace Ground Leakage/Power Failure Alarm Verification

Shock Hazard

With the control system energized open the ECC enclosure door. With ground fault circuit breaker **GFCB-103** energized heater line voltage should be present on the output terminals (Wires 1033 & 1043). Use a DVM to verify.
Perform the same test for **GFCB-107** (Wires 1071 & 1081).

Press the **TEST** button on **GFCB-103** and verify that the breaker trips. Use a DVM to verify.
Reset GFCB-103.
Do the same for **GFCB-107.** Press the **TEST** button on **GFCB-107** and verify that the breaker trips. Use a DVM to verify. **Reset GFCB-107**.

4.0 Electrical Component Life Expectancy

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 the Preventive Maintenance section, 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. The life of the system as a whole is considered to be 10 years.

Electrical Components

Component	Expected Life / Changeout Frequency
24 Volt Power Supply **AP11 Controller**	10 yrs
24 Volt Power Supply **PS-115**	10 yrs
Temperature Controllers **TIC-6, TIC-8**	10 yrs
High-High Temperature Switch **TSH-5 and TSH-7**	5 yrs
Power Solid state Relay **IY-103 and IY- 107**	5 yrs (typical) Life expectancy varies depending on the frequency the device is cycled between the on and off state.
Power Contactor **CON-103, CON- 107, and CON-111**	5 yrs (typical) Life expectancy varies depending on the frequency the device is cycled between the on and off state.
Control Relays **ALL 24 VDC coils**	10 yrs (typical) Life expectancy varies depending on the frequency the device is cycled between the on and off state.
E-Stop push button **PB-112**	10 yrs
AP11 Programmable Micro-controller	10 yrs
Z-Purge Pressure Switch **PAL-206**	10 yrs

Appendix A

System Specifications

System Specifications

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, single-phase-to-neutral (neutral solidly grounded), 3 wire, 50 to 60 Hertz
- ± 10% Fluctuation of Nominal Voltage Range
- Short Circuit Current Rating (SCCR) is 10 kA

Paint Specification

The paint specification for touch up painting of all enclosure cabinets:

Touch-up paint for the cabinet can be purchased from Sherwin Williams. The paint is from Sherwin Williams Polane S Plus White textured blending FG3W25.

Pressure

MAWP of the piping systems within the VHF module are as follows:

- High pressure process piping, from PT-1 to PCV-1, purge inlet CV-3 to V-13, and V-13 to MV-6-3 and MV-6.
  - Process gases: Silane (SiH_4), nitrous oxide (N_2O), nitrogen trifluoride (NF_3). And carbon dioxide (CO_2). 3000 psig MAWP.
  - Process gases: Hydrogen chloride (HCl) and nitric oxide (NO). 1300 psig MAWP.
  - Process gases: Ammonia (NH_3). 250 psig MAWP.
- Low pressure process piping from PCV-1 to MV-38.
  - Process gases: All. 250 psig MAWP.

Filtration

High pressure filter:	5.0 micron
Outlet filter:	0.003 micron –opt. (recommended)

Physical Characteristics

Weight (estimated):	1500 lbs. (680 kg)
Footprint:	4’-5” wide x 3’-2” deep* x 7’-1” tall (1245 mm x 966 mm x 2159 mm) AP11 controller door fully open
Clearance:	Front: 48 in (1220 mm) Back: distance to install the source container Sides: None
Anchoring:	(Qty 4) 9/16” (14.3 mm) mounting holes

Process Connections

Depending on the configuration, the following facility tubing connections may be supplied with a Very High Flow module:

Process outlet A:	1/2" (12.7 mm) diameter, 0.049" (1.2 mm) wall thickness
Optional coax	3/4" (19 mm) diameter, 0.065” (1.6 mm) wall thickness
Process outlet B (optional):	1/2" (12.7 mm) diameter, 0.049" (1.2 mm) wall thickness

Optional coax 3/4" (19 mm) diameter, 0.065" (1.6 mm) wall thickness

HCl Purifier Supply (optional):
1/2" (12.7 mm) diameter, 0.049" (1.2 mm) wall thickness
Optional coax 3/4" (19 mm) diameter, 0.065" (1.6 mm) wall thickness

HCl Purifier Return (optional):
1/2" (12.7 mm) diameter, 0.049" (1.2 mm) wall thickness
Optional coax 3/4" (19 mm) diameter, 0.065" (1.6 mm) wall thickness

Purge and High Pressure Leak Check (HPLT) Gas Inlet:
1/4" (6.4 mm) diameter, 0.035" (0.9 mm) wall thickness

Venturi 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

Bonnet Vent outlet (up to three lines):
1/4" (6.4 mm) diameter, 0.035" (0.9 mm) wall thickness

Enclosure Exhaust: 6" (152.4 mm) outside diameter duct

Pneumatics and Z-Purge: ¼" (6.3 mm) outside diameter compression fitting.

Miscellaneous Connections

Exhaust Duct: 6 in (152 mm) diameter

Tubing connections are made at the top rear of the enclosure. The GASGUARD® Very High Flow module is designed for indoor or protected outdoor installation. Outdoors, the system must be installed under a roof that extends 40 in (1000 mm) beyond the equipment footprint. The roof height above the equipment should be minimized to protect the equipment against wind-driven rain.

Exhaust Flow All Hatches Closed Condition: 200 CFM @ 0.1 inch water column

(5664 LPM @ 0.19 mm Hg)

Material of Construction

Piping and Valves: Stainless Steel or Hastelloy C-22

Wetted components: PCTFE or Vespel

Flow Capacities

A Very High Flow module can be ordered to any one of three flow options. Flow options for each process gas are listed below.

- Silane (SiH4)
    - 250 slpm, with 120 psig minimum source pressure at DISS connection
    - 500 slpm, with 125 psig minimum source pressure at DISS connection
    - 1000 slpm, with 160 psig minimum source pressure at DISS connection

- Nitrous Oxide (N2O)
    - 250 slpm, with 105 psig minimum source pressure at DISS connection
    - 500 slpm, with 130 psig minimum source pressure at DISS connection
    - 1000 slpm, with 175 psig minimum source pressure at DISS connection

- Ammonia (NH3)
    - 400 slpm, with 100 psig minimum source pressure at DISS connection
    - 800 slpm, with 105 psig minimum source pressure at DISS connection
    - 1600 slpm, with 110 psig minimum source pressure at DISS connection

- Nitrogen Trifluoride (NF3)
    - 250 slpm, with 110 psig minimum source pressure at DISS connection
    - 500 slpm, with 145 psig minimum source pressure at DISS connection
    - 1000 slpm, with 210 psig minimum source pressure at DISS connection

- Hydrogen Chloride (HCl), without HCl purifier module
    - 250 slpm, with 120 psig minimum source pressure at DISS connection.
    - 500 slpm, with 120 psig minimum source pressure at DISS connection
    - 1000 slpm, with 145 psig minimum source pressure at DISS connection

- Hydrogen Chloride (HCl), with HCl purifier module
    - 250 slpm, with 120 psig minimum source pressure at DISS connection.
    - 500 slpm, with 130 psig minimum source pressure at DISS connection
    - 1000 slpm, with 175 psig minimum source pressure at DISS connection

- Carbon Dioxide (CO_2)
    - o 250 slpm, with 100 psig minimum source pressure at DISS connection.
    - o 500 slpm, with 130 psig minimum source pressure at DISS connection
    - o 1000 slpm, with 175 psig minimum source pressure at DISS connection

- Nitric Oxide (NO)
    - o 250 slpm, with 110 psig minimum source pressure at DISS connection.

Venting Criteria

During a container change, it can be expected that the following volumes of gas will be vented from a VHF module.

- Pre-purge operating sequence: Total process gas mass vented:
    - 0.1 lb. SiH_4
    - 0.1 lb. NH_3
    - 0.2 lb. NF_3
    - 0.1 lb. N_2O
    - 0.1 lb. HCl
    - 0.1 lb. CO_2
    - 0.1 lb. NO

- Pre-purge operating sequence. Total mass of N_2 vented:
    - SiH_4 requires 120 purge cycles, 2.4 lb.
    - NH_3 requires 90 purge cycles, 1.8 lb.
    - NF_3 requires 75 purge cycles, 1.5 lb.
    - N_2O requires 75 purge cycles, 1.5 lb.
    - HCl requires 90 purge cycles, 1.8 lb.
    - CO_2 requires 75 purges cycles, 1.5 lb.
    - NO requires 90 purges cycles, 1.8 lb.

- Cylinder change sequence HPLT. Total mass of 10% He/N_2 mix vented = 0.2 lb.

- Post purge operating sequence. Total mass of N_2 vented.
    - SiH_4 requires 120 purge cycles, 2.4 lb.
    - NH_3 requires 90 purge cycles, 1.8 lb.
    - NF_3 requires 75 purge cycles, 1.5 lb.
    - N_2O requires 75 purge cycles, 1.5 lb.
    - HCl requires 90 purge cycles, 1.8 lb.
    - CO_2 requires 75 purges cycles, 1.5 lb.
    - NO requires 90 purges cycles, 1.8 lb.

- Condition operating sequence. Total mass vented during 5 conditioning cycles is:
  - 4 lb. SiH_4
  - 0.2 lb. NH_3
  - 6 lb. NF_3
  - 8 lb. N_2O
  - 7 lb. HCl
  - 8 lb. CO_2
  - 1 lb. NO

Electrical Requirements

Normal Power Feed for Heaters:

- 230 or 240 VAC is required for SiH_4, HCl, and N_2O modules. Do not power with less than 230 VAC.
- 208 – 240 VAC can be supplied for all other gases.
- Single phase, 50/60 HZ
- 5 amps with no J-T heater
- 36 amps with 1st stage J-T heater
- 56 amps with 1st and 2nd stage J-T heaters

- 5 KAIC @ 240 VAC, 75 deg. C terminal rating

Critical Power Feed for Control Power:

- 120-230 VAC
- Single phase, 50/60 HZ
- 3 amps
- 10 KAIC @ 277 VAC, 75 deg. C terminal rating

Customer Digital Outputs:

R1 Gas available digital output. This relay changes state when a shutdown alarm is present or when the module is in any mode except online and standby. This dry contact can be wired normally closed or normally open.

R2 Module fault alarm digital output. This relay changes state when any fault alarm is present, in any mode. This dry contact that be wired normally closed or normally open. .

R3 Module shutdown alarm digital output. This relay changes state when any shutdown alarm is present, in any mode. This dry contact can be wired normally closed or normally open.

R4 Module UVIR/high temp alarm digital output. This relay changes state when any UVIR or temperature switch shutdown alarm is present, in any mode. This dry contact can be wired normally closed or normally open.

Customer Digital Inputs:

DI-6 Optional Supervised customer Life Safety Shutdown. . This shutdown is the result of any customer Life Safety System (LSS) device. Upon receipt of this signal, all pneumatic valves will close, but power to the AP11 controller and J-T heaters will remain.

DI-8 Optional Supervised Remote Shutdown. Upon receipt of this signal, all pneumatic valves will close, but power to the AP11 controller and J-T heaters will remain.

DI-35 Customer Life Safety Shutdown. This shutdown is the result of any customer Life Safety System (LSS) device alarm. Upon receipt of this signal through a hardwired shutdown input, power is removed from the J-T heater, all valves are closed and process gas flow stops.

DI-36 Remote Shutdown Source A – The Single Module will close valves V-1 and V-8 for source A, and open the valves for source B, if in standby mode. The Dual Module system will close valves V-1 and V-8 on source A, wait for a shutdown signal for source B if available, then switch to the opposite module if its in standby mode.

DI-37 Remote Shutdown Source B – The Single Module will close valves V-1 and V-8 for source B, and open the valves for source A, if in standby mode. The Dual Module system will close valves V-1 and V-8 on source B, wait for a shutdown signal for source A if available, then switch to the opposite module if its in standby mode.

DI-38 Vent Scrubber Unavailable – If this customer initiated alarm is present, purge and cylinder change sequences will be inhibited, and if underway, will be aborted until the customer's scrubber is available.

Optional Components than can be part of aVHF system

Additional VHF Module

Purge Module

Generation 2 Y-Cylinder Heater

Compact Y Cylinder Heater

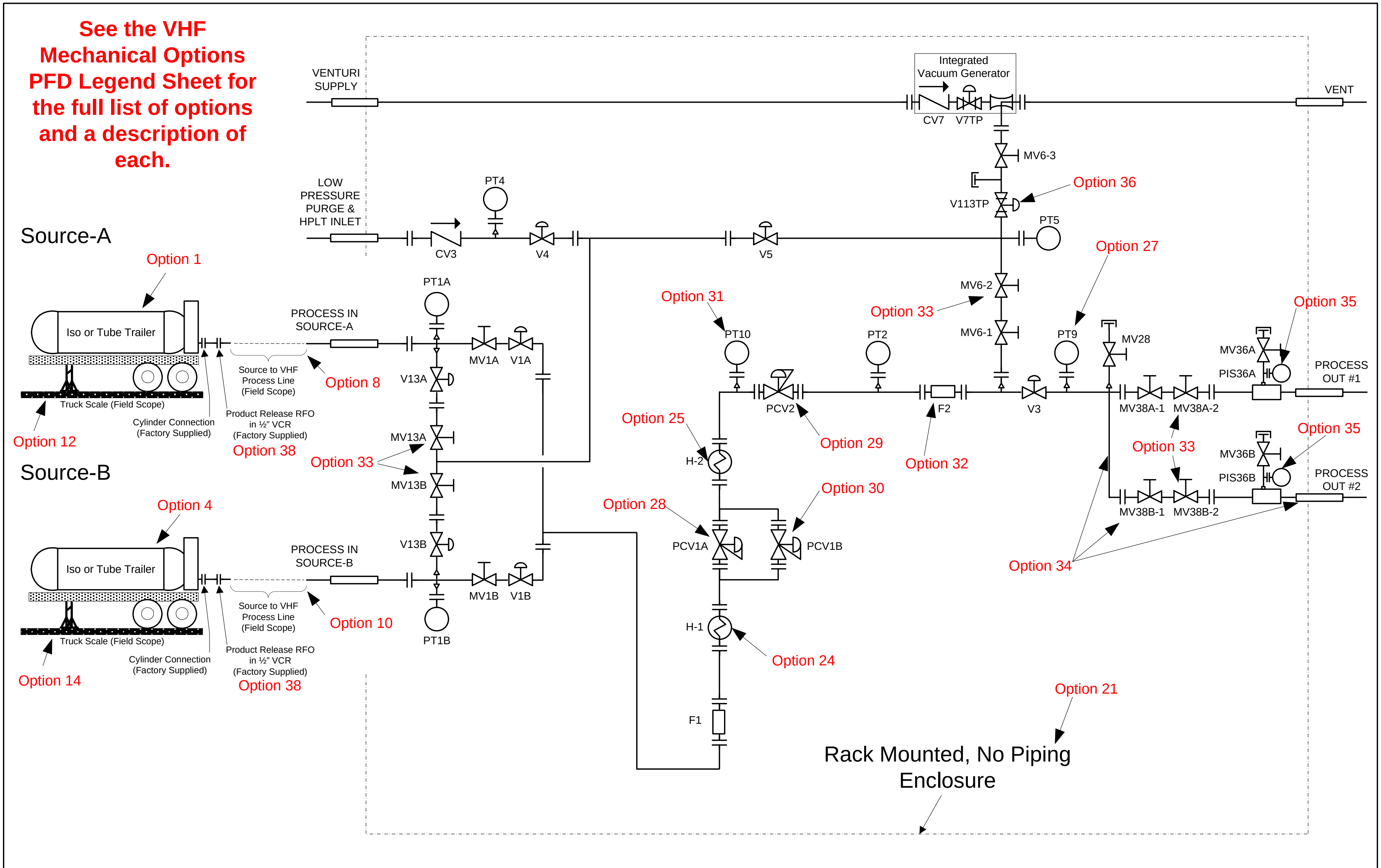
NH3 ISO Container Heater

Scales

HCl Purifier Module

Appendix B

Installation Drawing Package



2 Port Manual Valve	2 Port Automatic Valve	'L' Port Automatic Valve	VCR
3 Port Manual Valve	3 Port Automatic Valve	Check Valve	Standard Bulkhead
BWT Pressure Monitor	Trickle Flow Valve	Vacuum Venturi	Coaxial Bulkhead
VCR Pressure Monitor	VCR Regulator	Filter	Capped Port
Flothru Pressure Monitor	BWT Regulator	Excess Flowswitch	Plugged Port

REF. **VHFS**

SYSTEM DESCRIPTION
VHF
Mechanical Options PFD

AIR PRODUCTS
ALLENTOWN, PENNSYLVANIA

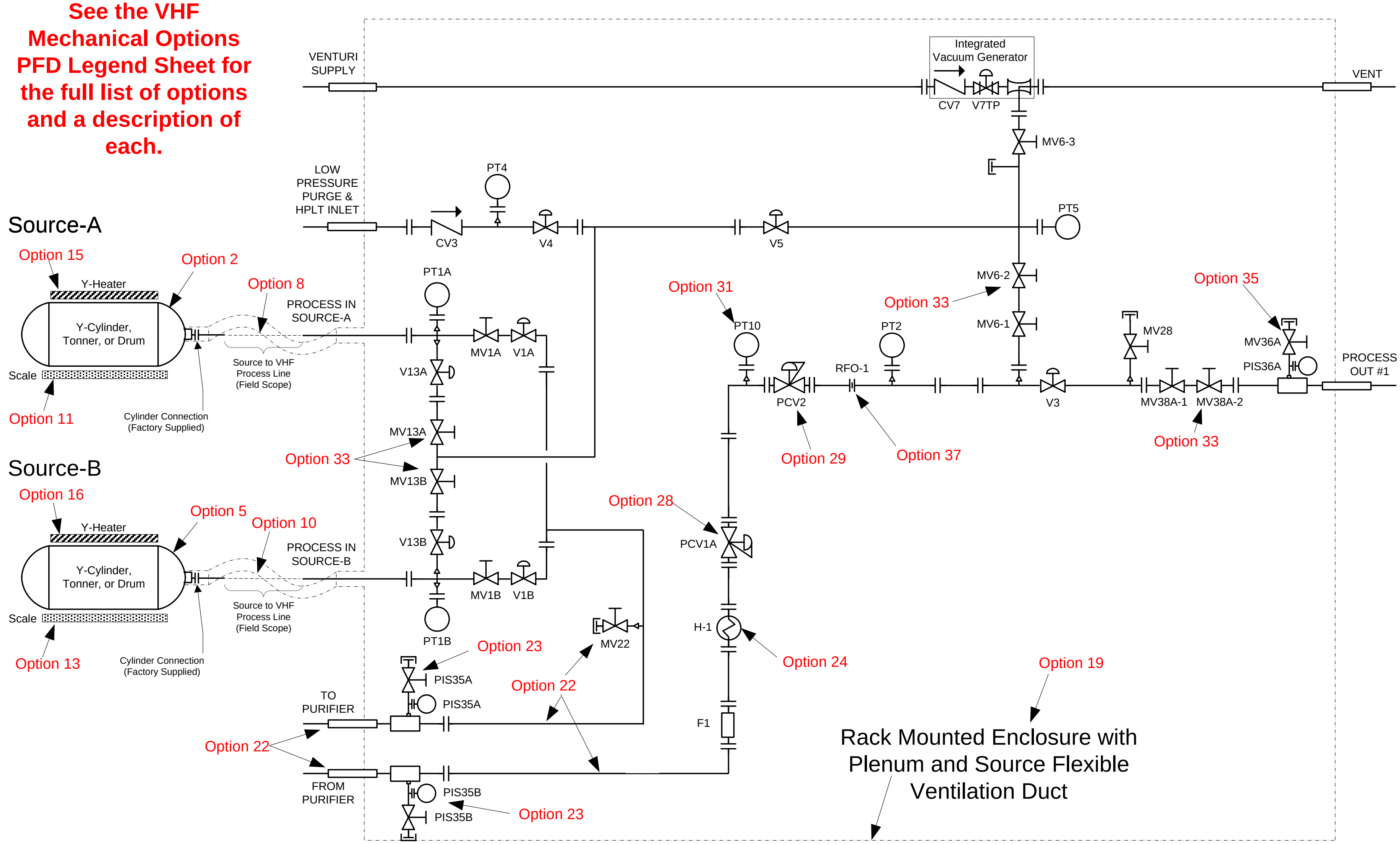
ORIGINATOR **Dave Kukucka**

CUSTOMER / LOCATION **Generic**

SIZE **A**
REV. **0**

DATE **1/23/09**
SHEET **1** OF **3**
M&O Rev. No. 11
FILE
DWG NO **BKA004 MECH 0021**

See the VHF Mechanical Options PFD Legend Sheet for the full list of options and a description of each.



2 Port Manual Valve	2 Port Automatic Valve	'L' Port Automatic Valve	VCR
3 Port Manual Valve	3 Port Automatic Valve	Check Valve	Standard Bulkhead
BWT Pressure Monitor	Trickle Flow Valve	Vacuum Venturi	Coaxial Bulkhead
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ALLENTOWN, PENNSYLVANIA

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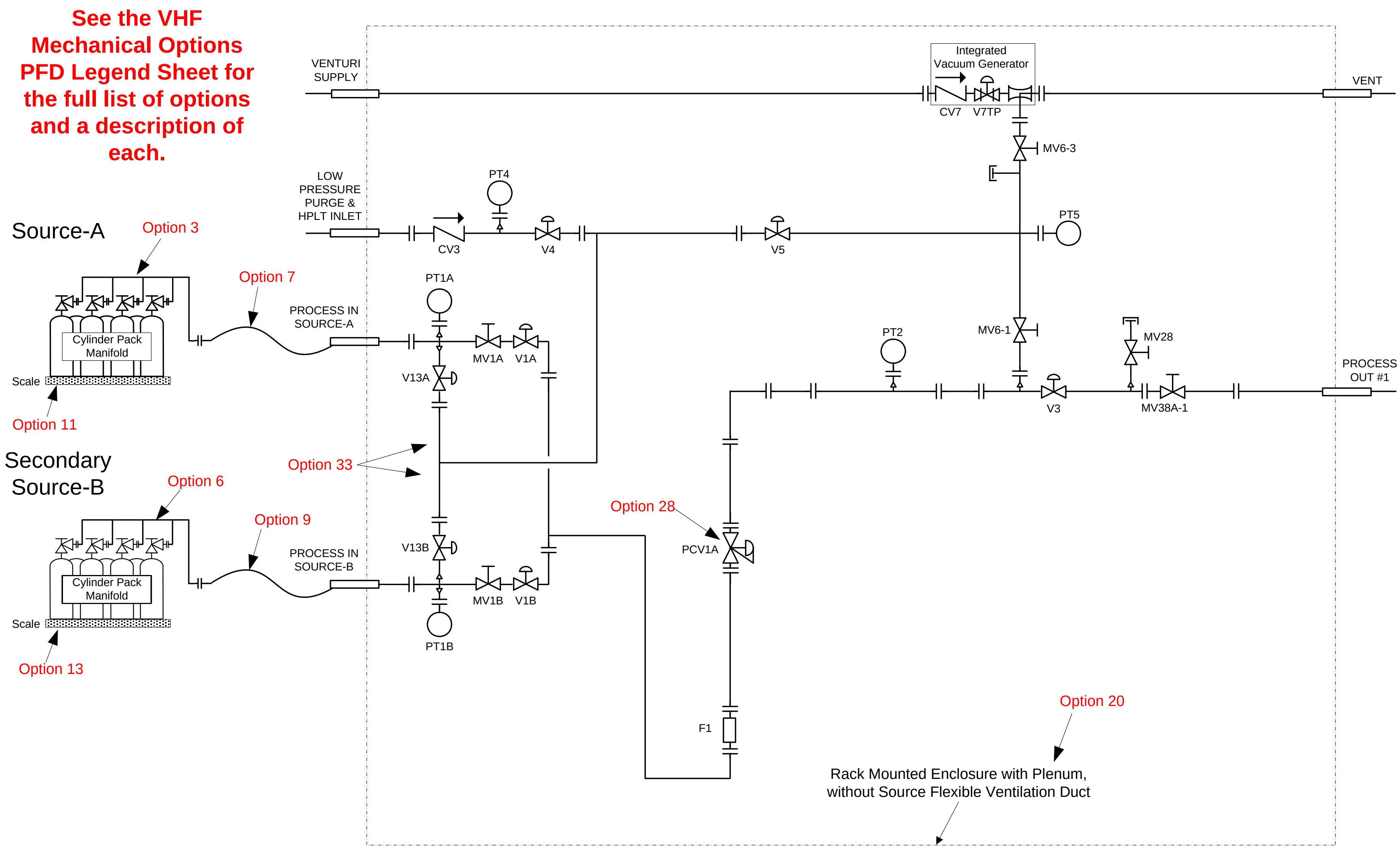
ORIGINATOR **Dave Kukucka**

CUSTOMER / LOCATION **Generic**

SIZE **A** REV. **0**

DATE **1/23/09**
SHEET **2** OF **3**
M&O Rev. No. 11
FILE
DWG NO **BKA004 MECH 0021**



2 Port Manual Valve	2 Port Automatic Valve	'L' Port Automatic Valve	VCR
3 Port Manual Valve	3 Port Automatic Valve	Check Valve	Standard Bulkhead
BWT Pressure Monitor	Trickle Flow Valve	Vacuum Venturi	Coaxial Bulkhead
VCR Pressure Monitor	VCR Regulator	Filter	Capped Port
Flothru Pressure Monitor	BWT Regulator	Excess Flowswitch	Plugged Port

SYSTEM DESCRIPTION

VHF

Mechanical Options PFD

AIR PRODUCTS

ALLENTOWN, PENNSYLVANIA

REF. **VHFS**

ORIGINATOR **Dave Kukucka**

CUSTOMER / LOCATION **Generic**

SIZE **A**

REV. **0**

DATE **1/23/09**

SHEET **3** OF **3**

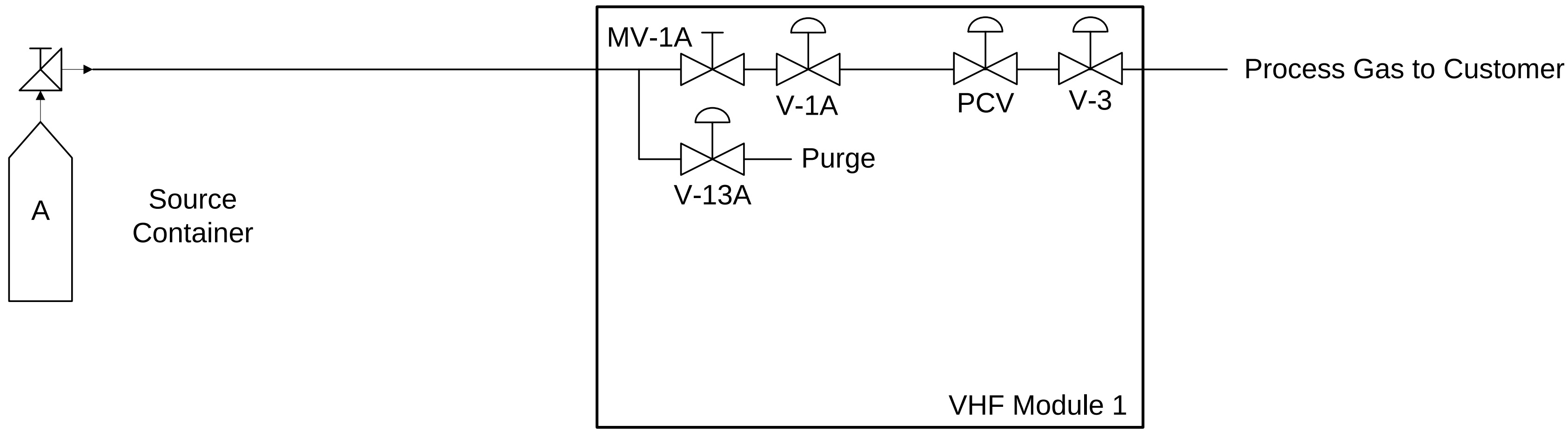
M&O Rev. No. 11

FILE

DWG NO **BKA004 MECH 0021**

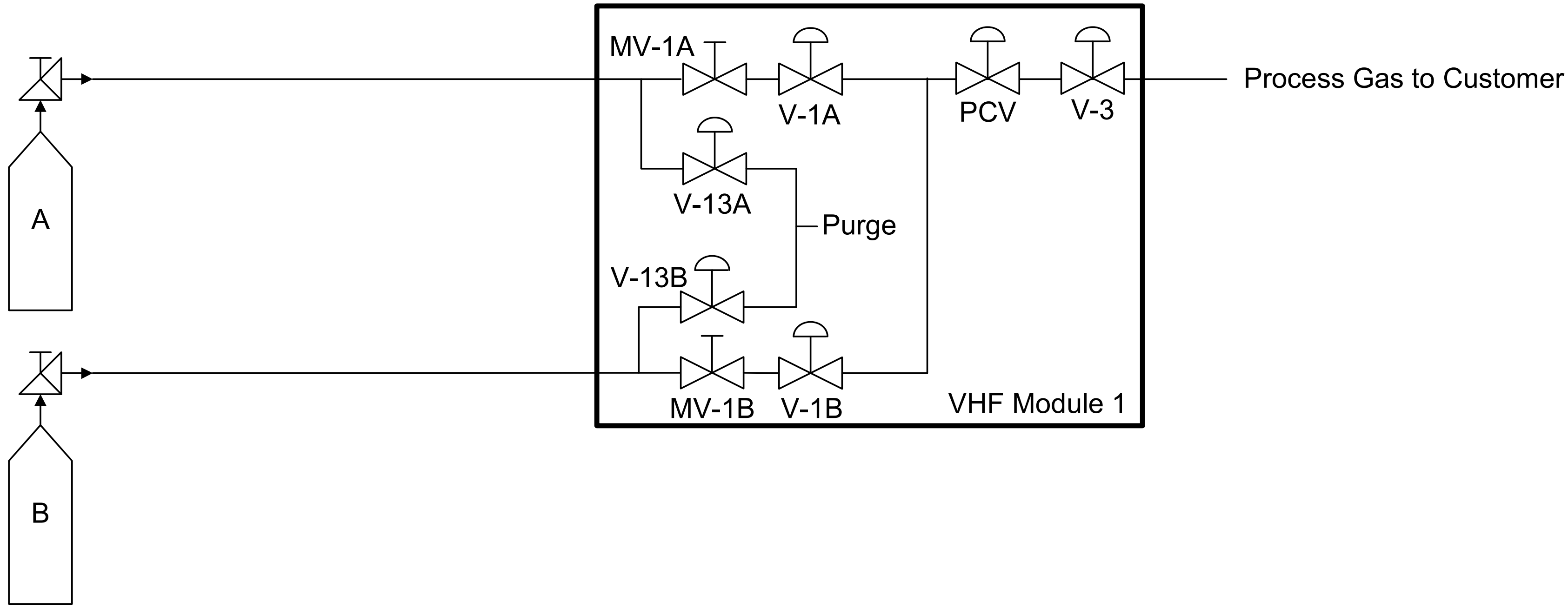
VHF Mechanical Options PFD Legend				
VHF Mechanical Options		Option codes for VHF Mechanical Options PFD	Notes	Sheet Number where the mechanical option can be found
Source Container A:	ISO or Tube Trailer	1	Option 1,2,or 3 is always present	1
	Drum/Y	2	Option 1,2,or 3 is always present	2
	Cyliner Bundle	3	Option 1,2,or 3 is always present	3
Source Container B:	ISO or Tube Trailer	4		1
	Drum/Y	5		2
	Cyliner Bundle	6		3
Source "A" Piping	Flex Hose	7	Option 8 or 9 is always present	3
	Hard Piped	8		1,2
Source "B" Piping	Flex Hose	9		3
	Hard Piped	10		1,2
Scale - source "A":	Y, Drum, or Bundle	11		2,3
	Truck Scale - purchased and installed by customer	12	Required for NH3 ISO containers	1
Scale - source "B":	Y, Drum, or Bundle	13		2,3
	Truck Scale - purchased and installed by customer	14	Required for NH3 ISO containers	1
Source Heater Side A	Y or NH3 ISO	15	Required for NH3 ISO containers	2
Source Heater Side B	Y or NH3 ISO	16	Required for NH3 ISO containers	2
Tube Switching Source A:	ISO or Tube Trailer	17	Air Products Containers Only	Not Shown
Tube Switching Source B:	ISO or Tube Trailer	18	Air Products Containers Only	Not Shown
Enclosure:	Rack Mounted Enclosure with Plenum and Source Flexible Ventilation Duct	19		2
	Rack Mounted Enclosure with Plenum, without Source Flexible Ventilation Duct	20		3
	Rack Mounted, No Enclosure	21		1
HCl Purifier	Piping connections	22		2
HCl Purifier Coax Monitoring	Supply and Return Coax Monitoring	23		2
J-T Heater	First Stage J-T Heater	24		1,2
	Second Stage J-T Heater	25		1
Heat Trace:	Module process piping	26	Required when options 15 and 16 are present	Not Shown
Houseline Pressure Monitor	PT-9	27		1
Pressure Regulation	Single Stage	28		1,2,3
	Dual Stage	29	Required when option 25 is present	1,2
	Dual PCV-1	30		1
Interstage Pressure Monitor	PT-10	31	Required when option 29 is present	1,2
Houseline Filtration	F-2	32		1

Dual Valve Isolation		33		1
Process Out Piping	Dual Outlet	34		1
Process Out Coax Monitoring		35		1
Trickle Vent Valve	V-113TP	36		1
RFO	Downstream of PCV-2	37		2
	Downstream of DISS Fitting	38		1



A stand alone module with single source. When product in the source container is depleted, process gas stops and the module shuts down.
Optional tube switching software integral to the module controller, performing the tube switching function on a single source container such as an ISO or tube trailer.

AIR PRODUCTS	**Process Flow Diagram (PFD)**			
	VHFS Single Source, Single Module **Software Logic Option 1**			
Date: 22 January 2009	SIZE: A	FSCM NO	DWG NO: BKA004 PFD 0001	REV: 1
By: Dave Kukucka	SCALE: N/A		SHEET: 1 OF 1	

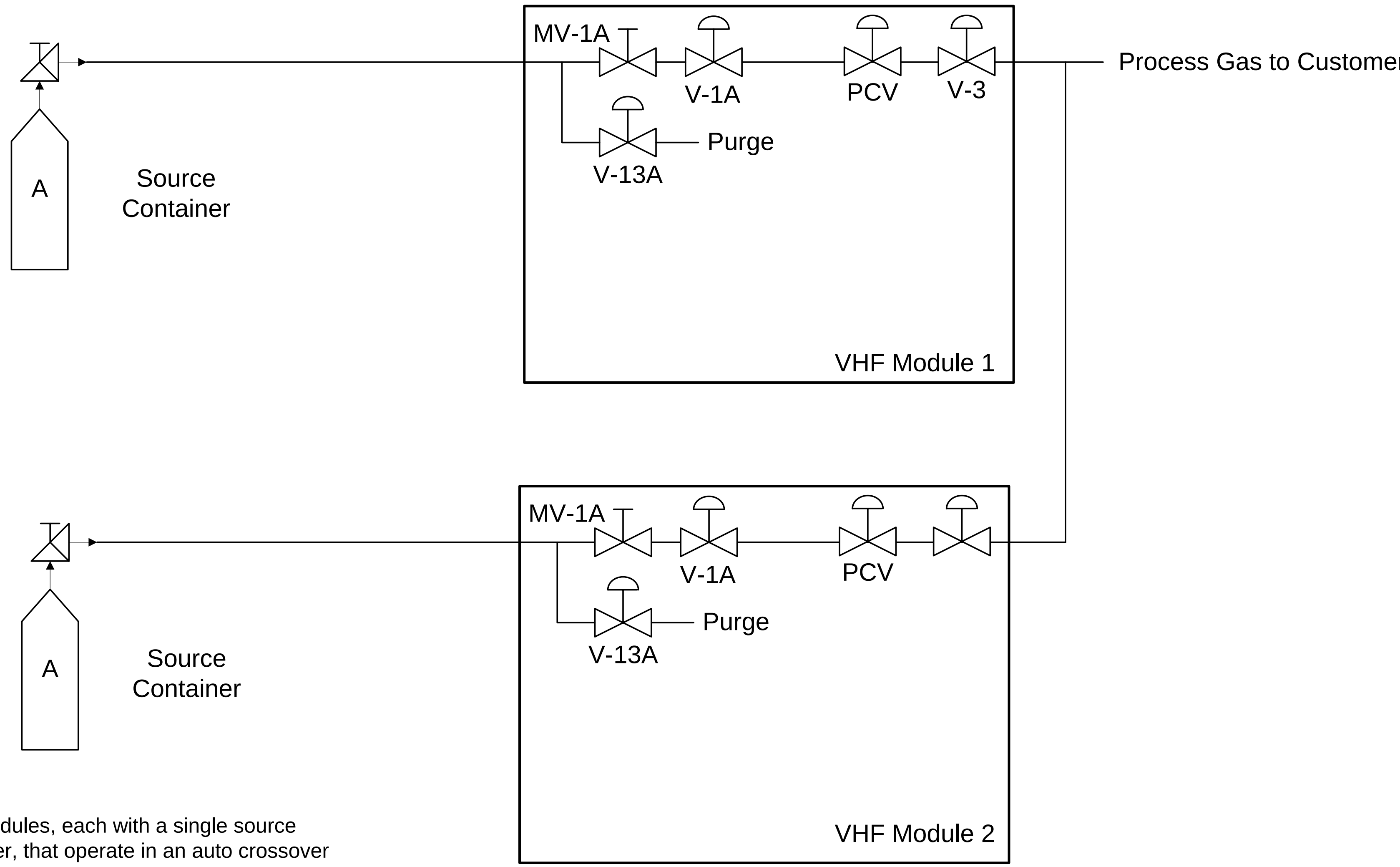


A stand alone module with two source containers, auto crossover operation. When product in source container A is depleted, the module crosses over and begins to dispense product from source container B, and vice versa.

Optional source A tube switching software is integral to the module controller, performing the tube switching function on a single source container such as an ISO or tube trailer.

Source B tube switching isn't available with the AP11 controller.

AIR PRODUCTS	**Process Flow Diagram (PFD)**			
	VHFS Dual Source, Single Module AP11 Software Logic Option 2			
Date: 17 February 2014	SIZE A	FSCM NO	DWG NO BKA004 PFD 0008	REV 0
By: Dave Kukucka	SCALE	N/A	SHEET	1 OF 1



Two modules, each with a single source container, that operate in an auto crossover configuration. When product in module 1 source container is depleted, module 1 crosses over to module 2, and begin to dispense product from the module 2 source container, and vice versa.

Optional tube switching Software is integral to each module controller, performing the tube switching function on a single source container such as an ISO or tube trailer

Process Flow Diagram (PFD)

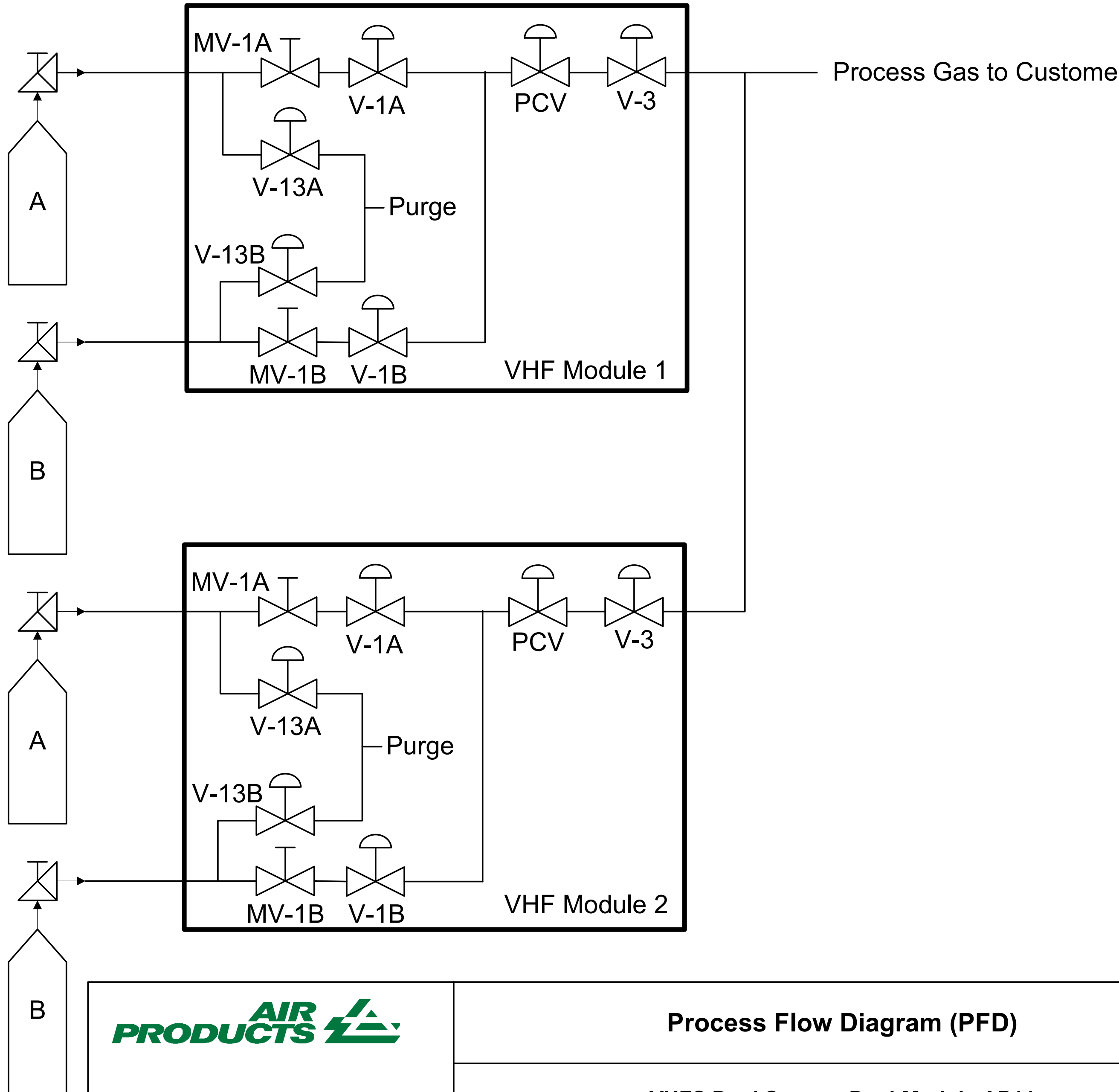
VHFS Single Source, Dual Module Software Logic Option 3

Date: 22 January 2009

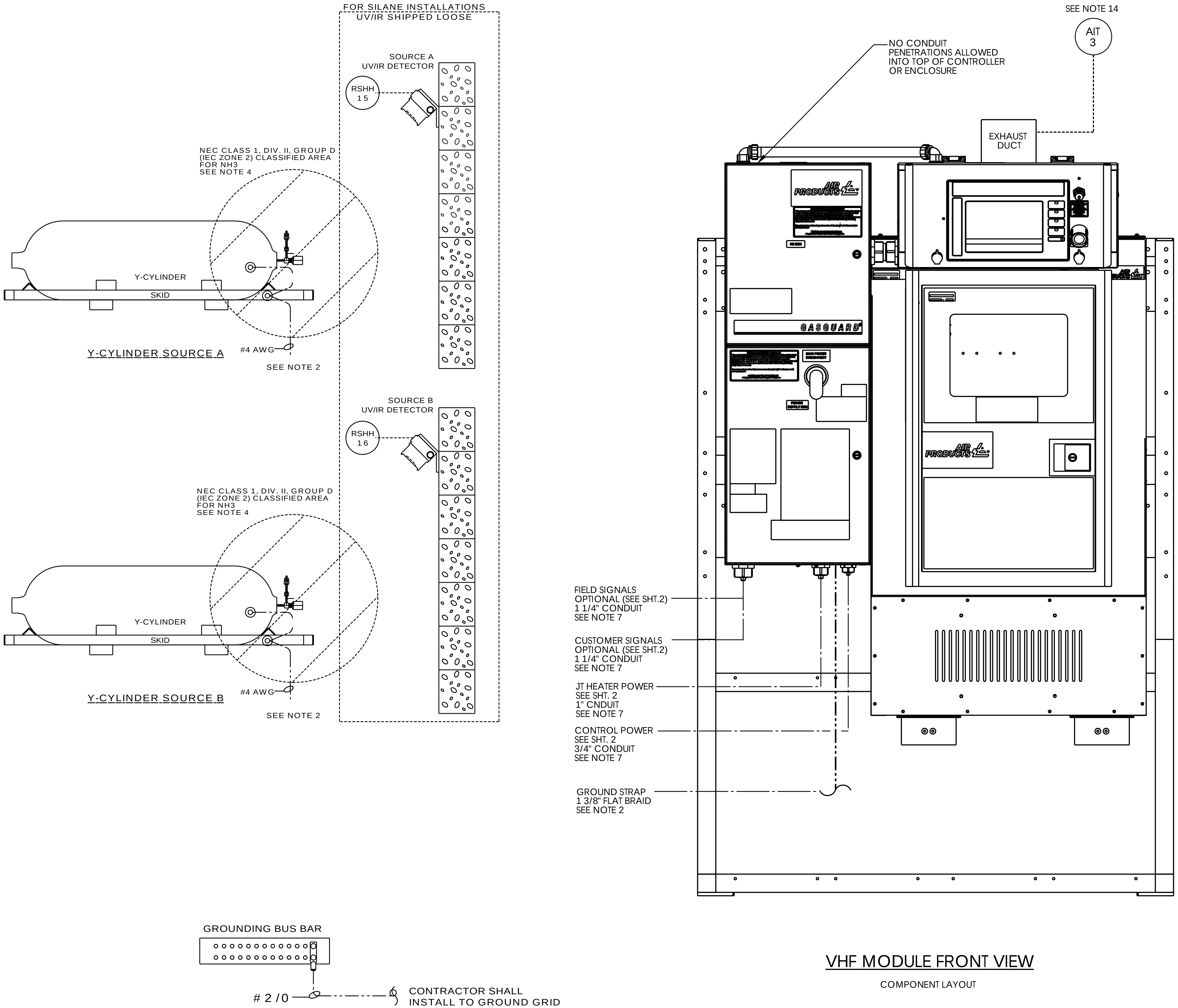
By: Dave Kukucka

SIZE	FSCM NO	DWG NO	REV
A		BKA004 PFD 0003	1
SCALE N/A		SHEET 1 OF 1	

Two modules, each with two source containers, that operate in an auto crossover configuration. Both source containers A and B are on line simultaneously. When product in module 1 source containers is depleted, module 1 crosses over to module 2, and begins to dispense product from both module 2 source containers, and vice versa. Has the ability to operate with one source container per VHF module, if second source container isn't available.
Source A and B container changes are done independently, each pigtail is purged individually.
2nd source can be purged and then placed on line when VHFS module is already in process gas mode.
Optional source A tube switching software is integral to the module controller, performing the tube switching function on a single source container such as an ISO or tube trailer.
Tube switching for source B isn't availabe with the AP11 controller.



AIR PRODUCTS	Process Flow Diagram (PFD)				
	VHFS Dual Source, Dual Module AP11 Software Logic Option 4				
Date: 17 February 2014	SIZE A	FSCM NO		DWG NO BKA004 PFD 0009	REV 0
By: Dave Kukucka	SCALE	N/A		SHEET	1 OF 1



VHF MODULE FRONT VIEW

COMPONENT LAYOUT

NOTES:

1. TYPICAL ELECTRICAL INSTALLATION FOR ONE HIGH FLOW SYSTEM CABINET, SHOWN WITH FOUR POSSIBLE SOURCES. THE ELECTRICAL INSTALLATION SHALL COMPLY WITH SITE SPECIFIC CONSTRUCTION SPECIFICATIONS, THE NATIONAL ELECTRICAL CODE AND LOCAL REQUIREMENTS.

2. INSTALL #4 AWG CONCENTRIC STRANDED COPPER, CLASS B STRAND GROUND CONDUCTOR FROM EQUIPMENT GROUND LUG TO SITE GROUND GRID. REFER TO SHEET 3 FOR VERY HIGH FLOW MODULE GROUNDING REQUIREMENTS.

3. ALL CONDUIT ENTRIES MUST ONLY BE INSTALLED INTO BOTTOM OF THE EQUIPMENT, ADDITIONAL TOP ENTRY PENETRATION IS NOT ALLOWED. CONDUIT PENETRATION ON THE BOTTOM OF THE ENCLOSURES SHALL USE A LOW POINT DRAIN WITH CONDULET TEE.

4. FOR NH3 SYSTEM INSTALLATION:
FOR ANY CONDUITS INSTALLED IN THIS AREA; SIZE AND INSTALL CONDUIT SEAL FITTINGS PER THE LATEST VERSION OF THE N.E.C. AND LOCAL CODES, WHICHEVER IS MORE STRINGENT. ANY ELECTRICAL EQUIPMENT AND COMPONENTS LOCATED DIRECTLY WITHIN RADIUS OF 1 METER (3-1/4 FEET) OF THE CYLINDER VALVE FOR Y-CYLINDERS, DRUMS, AND WITHIN RADIUS OF 3.6 METERS (11-3/4 FEET) OF THE VALVE BOX ON TOP OF THE ISO CONTAINER MUST COMPLY WITH NEC CLASS 1, DIVISION 2 GROUP D (IEC ZONE 2) DESIGN REQUIREMENTS.

5. INSULATED FERRULES SHALL BE INSTALLED ON ALL WIRES. FERRULES SHALL BE SIZED TO MATCH WIRE SIZE AND BE COMPRESSED WITH MANUFACTURER'S APPROVED RATCHETING TYPE CRIMPING TOOL.

6. ALL CABLES AND WIRES SHALL BE INSTALLED WITH THE APPROPRIATE CABLE/WIRE TAG PERMANENTLY ATTACHED AT BOTH ENDS FOR EASY IDENTIFICATION. POWER CABLES SHALL BE LABELED WITH THE POWER PANEL DESIGNATION, CIRCUIT BREAKER NUMBER, AND THE SUFFIX "H" TO INDICATE HOT, "N" TO INDICATE NEUTRAL, OR "G" TO INDICATE GROUND. (e.g. NP-10-H)

7. EXPLOSION PROOF POUR SEAL FITTINGS SHALL BE INSTALLED BY CUSTOMER IF ENCLOSURE IS INSTALLED IN A CLASSIFIED AREA. DUCT SEAL MAY BE USED IF CABINET IS LOCATED IN A NON-CLASSIFIED AREA IN ORDER TO MAINTAIN ENCLOSURE PRESSURE.

8. PRIOR TO START-UP OF THE SYSTEM, THE INSTALLATION CONTRACTOR SHALL POUR ALL EXTERNAL AND VHF MODULE INTERNAL SEALING FITTINGS ONCE ALL TESTING AND CHECKOUT IS COMPLETE.

9. IF STATE, LOCAL OR AUTHORITY HAVING JURISDICTION REQUIRE IT, THE CUSTOMER SHALL SUPPLY AND INSTALL A DISCONNECT SWITCH AT EACH PIECE OF EQUIPMENT.

10. VERY HIGH FLOW MODULE CONTROLLER IS PRESSURIZED TO MAINTAIN TYPE 3R RATING, CUSTOMER IS REQUIRED TO SUPPLY COMPRESSED NITROGEN.

11. ALL PNEUMATIC TUBING AND HARDWARE SHALL BE FIELD INSTALLED.

12. PNEUMATIC TUBING SHALL BE 1/4" O.D. X 0.035" WALL 304 STAINLESS STEEL TUBING, MILL FINISH. ASSEMBLE JOINTS USING COMPRESSION FITTINGS.

13. A REMOTE GLOBAL EMERGENCY STOP IS INSTALLED WHEN A PERIMERTER EMERGENCY STOP PUSHBUTTON IS REQUIRED TO SHUTDOWN THE ENTIRE SYSTEM. THE REMOTE GLOBAL EMERGERCY STOP IS WIRED TO THE CUSTOMER'S SIL-2 LIFE SAFETY SYSTEM OR UTILIZE MULTI-CONTACT PUSHBUTTON. THE EMERGENCY STOP PUSHBUTTON IS A MAINTAINED ACTION UNIT AND IS TYPICALLY LOCATED 25 FEET FROM THE SYSTEM.

14. THE GAS DETECTORS, FLOW TRANSMITTERS, FLOW SWITCHES SHOWN ARE SUPPLIED, INSTALLED, AND CALIBRATED BY THE CUSTOMER. THE CUSTOMER SHALL PROVIDE A DIGITAL ALARM OUTPUT, IN THE FORM OF A RELAY CONTACT (NORMALLY CLOSED IN THE OPERATION MODE AND OPEN IN THE ALARM MODE), VIA THE CUSTOMER'S LIFE SAFETY SYSTEM.

15. LEGEND:

PT = PRESSURE TRANSDUCER	EX = EXPLOSION PROOF FITTING
WE = WEIGHT ELEMENT	VHF = VERY HIGH FLOW
WT = WEIGHT TRANSDUCER	RSHH = UV/IR DETECTION
JB = JUNCTION BOX	

16. REFERENCE SHEET 3 FOR CONDUIT ROUTING INTO ENCLOSURE.

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
43618	3	CHANGED CABLE TO 18 AWG ALPHA 5368C	3/6/14	JRB	DLH	AJS	

Part no.

UNLESS OTHERWISE SPECIFIED:
FRACTIONAL: ± NA
DECIMAL: ± NA

MATERIAL: Material <not specified>
FINISH: XXXXX XXXXX XXXXX

APPROVALS		DATE
DRAWN	J.R Barker	02/24/2014
CHECKED	D.L.Hockenberry	03/06/2014
ENG APPR.		
MFG APPR.		
APPROVED	A.J. Smith	03/06/2014

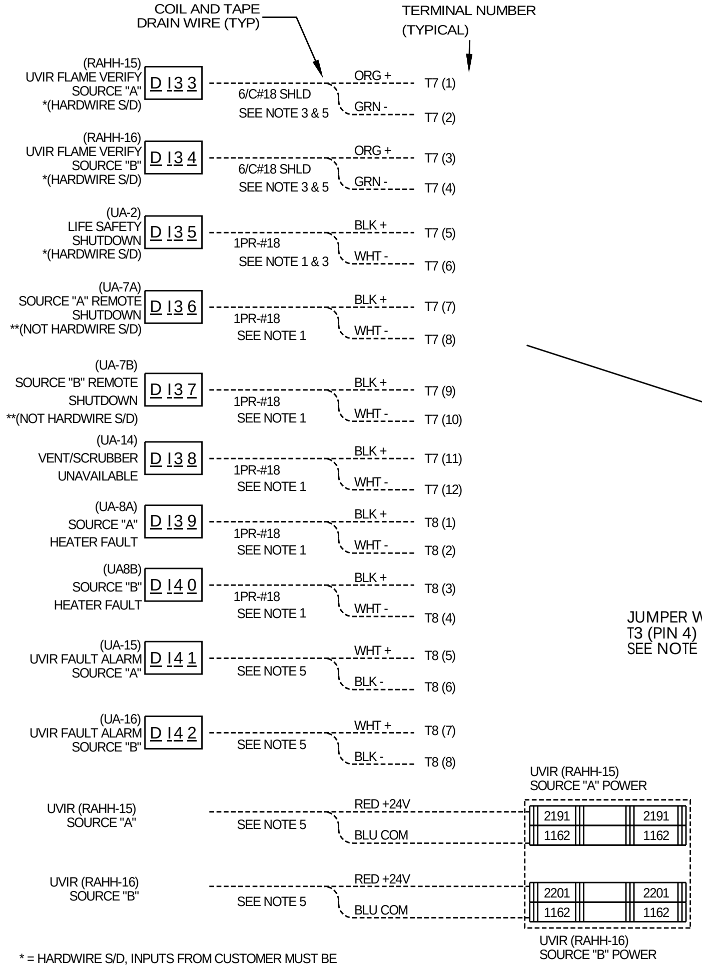
AIR PRODUCTS

TITLE: Drawing Title

DWG. NO. SW013145.slddrw SIZE D REV 3

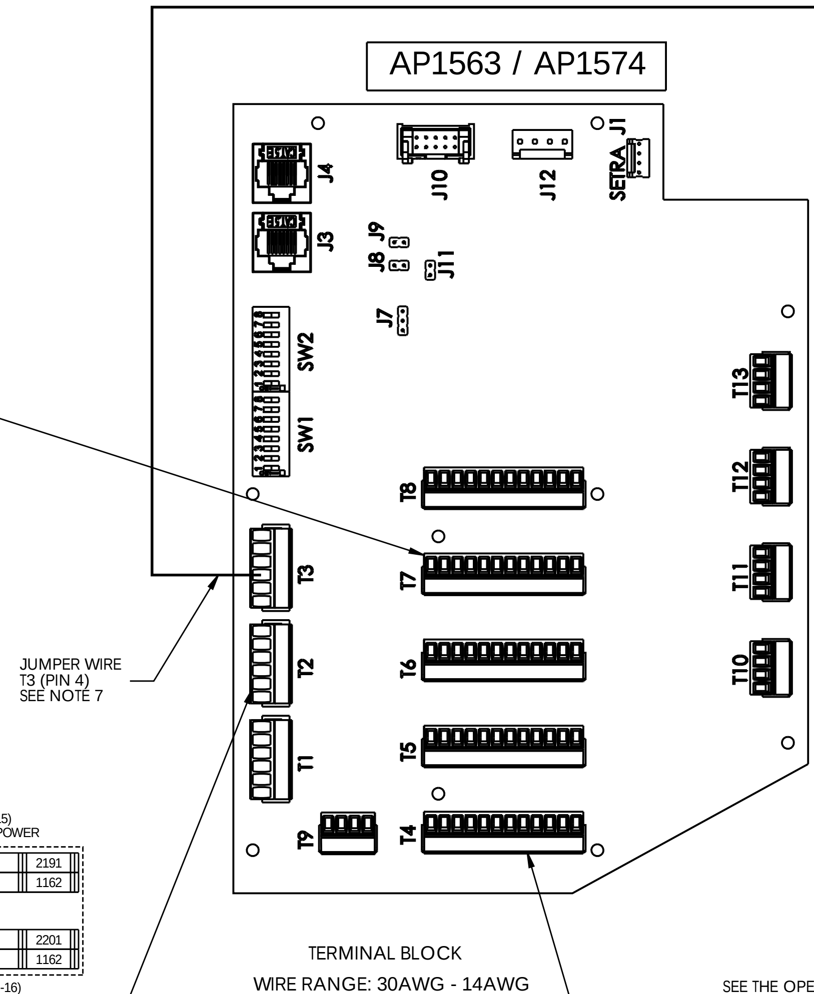
SCALE: 1:12 REF. SHEET 1 OF 5

DIGITAL INPUTS

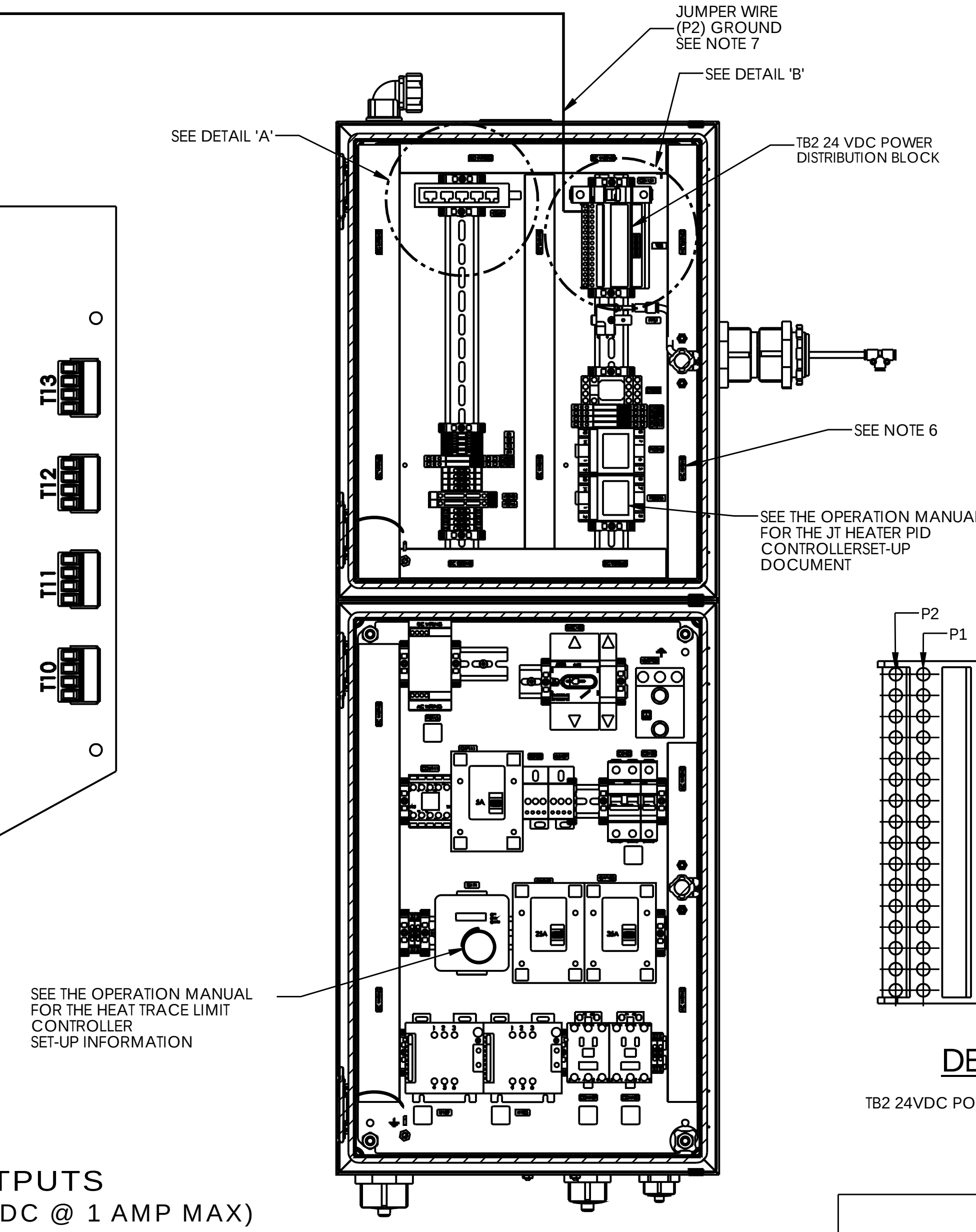


* = HARDWIRE S/D, INPUTS FROM CUSTOMER MUST BE MAINTAINED AS OPEN CONTACT UNTIL SYSTEM IS RESET.

**= NOT HAREWIRE S/D, SOURCE "A" SHUTDOWN ONLY CLOSES VALVES V-1A AND V-8A. SOURCE "B" SHUTDOWN ONLY CLOSES VALVES V-1B AND V-8B.



TERMINAL BLOCK
WIRE RANGE: 30AWG - 14AWG

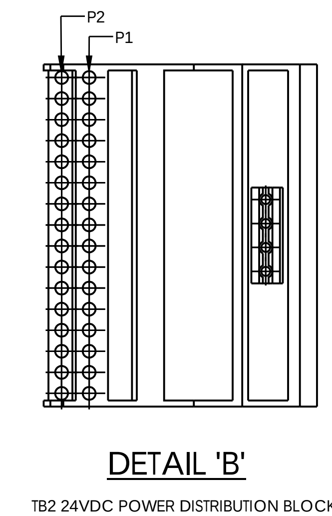


VERY HIGH FLOW ECC

FRONT VIEW WITH DOOR OPEN

NOTES:

1. DASHED LINES INDICATE OPTIONAL CONNECTIONS REQUIRED BASED ON SYSTEM CONFIGURATION.
2. POWER PANEL GROUND CONDUCTORS SHALL BE TERMINATED TO THE GROUNDING LUG (LUG-103) LOCATED ON THE BACK PANEL
3. INPUT SHALL BE CONFIGURED AS A HARDWIRE SHUTDOWN. FOR DI-33 SET SW1-1 TO ON POSITION FOR DI-34 SET SW1-2 TO ON POSITION FOR DI-35 SET SW1-3 TO ON POSITION
4. CONNECT ANALOG DRAIN WIRES TO THE PROVIDED GROUND BLOCKS. LOCATED BELOW THE UVIR POWER TERMINALS.
5. UVIR "A" AND UVIR "B" DETECTORS ARE CONNECTED WITH A 6-CONDUCTOR SHIELDED CABLE. SEE SHEET 4 FOR ADDITIONAL UVIR CONNECTION AND SET-UP DETAILS.
6. MAINTAIN AC AND DC WIRING SEPARATION. EACH WIREWAY IS LABELED TO INDICATE POWER LEVEL.
7. CONNECT 24 VDC WIRE TO P1 SCREW TERMINAL AT TB2 IN ECC. CONNECT GROUND WIRE TO P2 SCREW TERMINAL. INSTALL 24 AWG (3'-6" LG) JUMPER WIRE FROM TB2 (P2) TO T3 (4) ON AP1563/AP1574. TWO WIRES CAN BE INSTALLED IN ONE SCREW TERMINAL AT TB2, BUT THEY MUST BE CRIMPED TOGETHER USING A SINGLE FERRULE.
8. THE COMBINED POWER SUPPLY LOADING OF ALL ANALOG CHANNELS MUST BE LESS THAN 200 mA. SEE AP11 VHF MANUAL, CHAPTER 2.

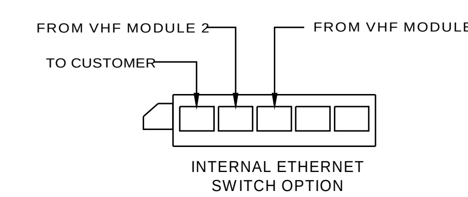


DETAIL 'B'

TB2 24VDC POWER DISTRIBUTION BLOCK

PEER-TO-PEER CONNECTION

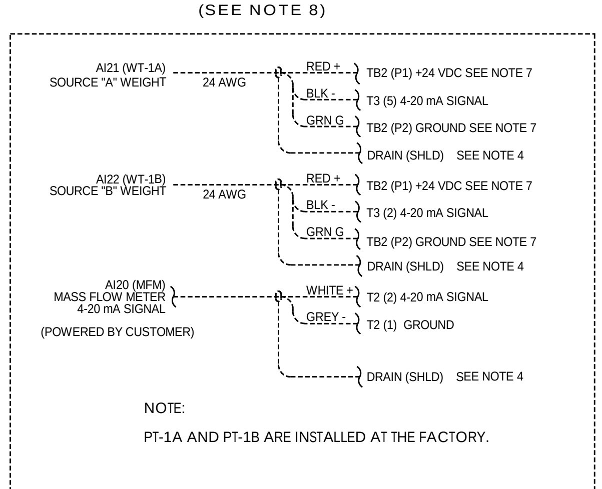
(OPTIONAL)



DETAIL 'A'

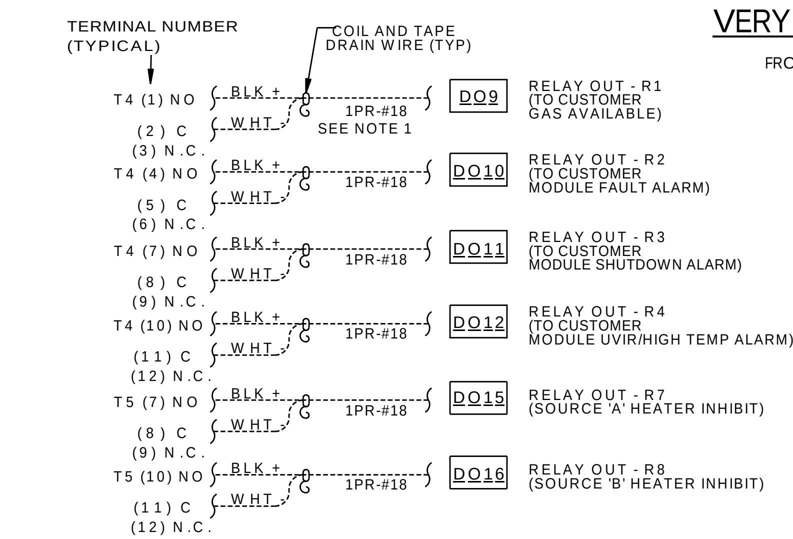
ANALOG INPUTS

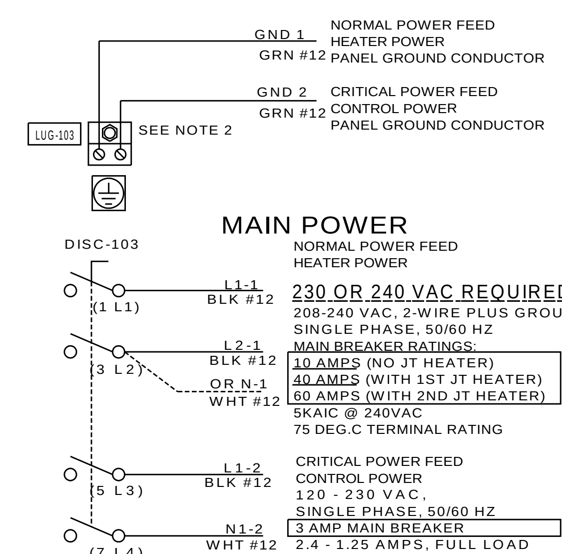
(SEE NOTE 8)



DIGITAL OUTPUTS

⚠ (DRY CONTRACT: 30 VDC @ 1 AMP MAX)





THE POWER PANEL HAS A SHORT CIRCUIT CURRENT RATING(SCCR)OF 5KA AND THE INSTALLER MUST PROVIDE THE PROPER UPSTREAM FAULT PROTECTION TO MATCH THE AVAILABLE POWER SYSTEM FAULT CURRENT.

CONNECTIONS REQUIRED

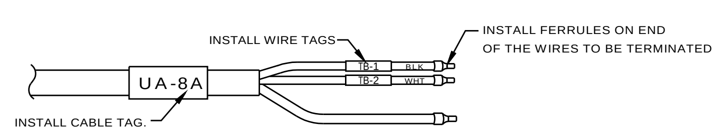
- ☐ HEATER POWER AND GROUND CONDUCTOR
- ☐ CONTROL POWER AND GROUND CONDUCTOR
- ☐ MAIN EQUIPMENT GROUND

CONNECTIONS OPTIONAL

- ☐ DIGITAL INPUT SIGNALS
- ☐ DIGITAL OUTPUT SIGNALS
- ☐ SOURCE WEIGHT SIGNALS
- ☐ PEER TO PEER CABLE
- ☐ REMOTE EMERGENCY STOP

THIS DRAWING REFLECTS ALL REQUIRED AND OPTIONAL WIRING FOR THE HIGH FLOW SYSTEM CABINET. THE CUSTOMER IS RESPONSIBLE FOR DETERMINING WHICH OF THE OPTIONAL WIRING IS REQUIRED FOR THEIR INDIVIDUAL INSTALLATION.

#12 AWG (SHOWN) IS THE MINIMUM POWER WIRE SIZE. THE INSTALLER MUST SIZE THE FEEDER CONDUCTOR PER THE SYSTEM CONFIGURATION, LOADING, N.E.C. AND LOCAL REQUIREMENTS.



TYPICAL CABLE DETAIL

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
43618	3	CHANGED CABLE TO 18 AWG ALPHA 5368C		JRB	DLH	AJS	

UNLESS OTHERWISE SPECIFIED:

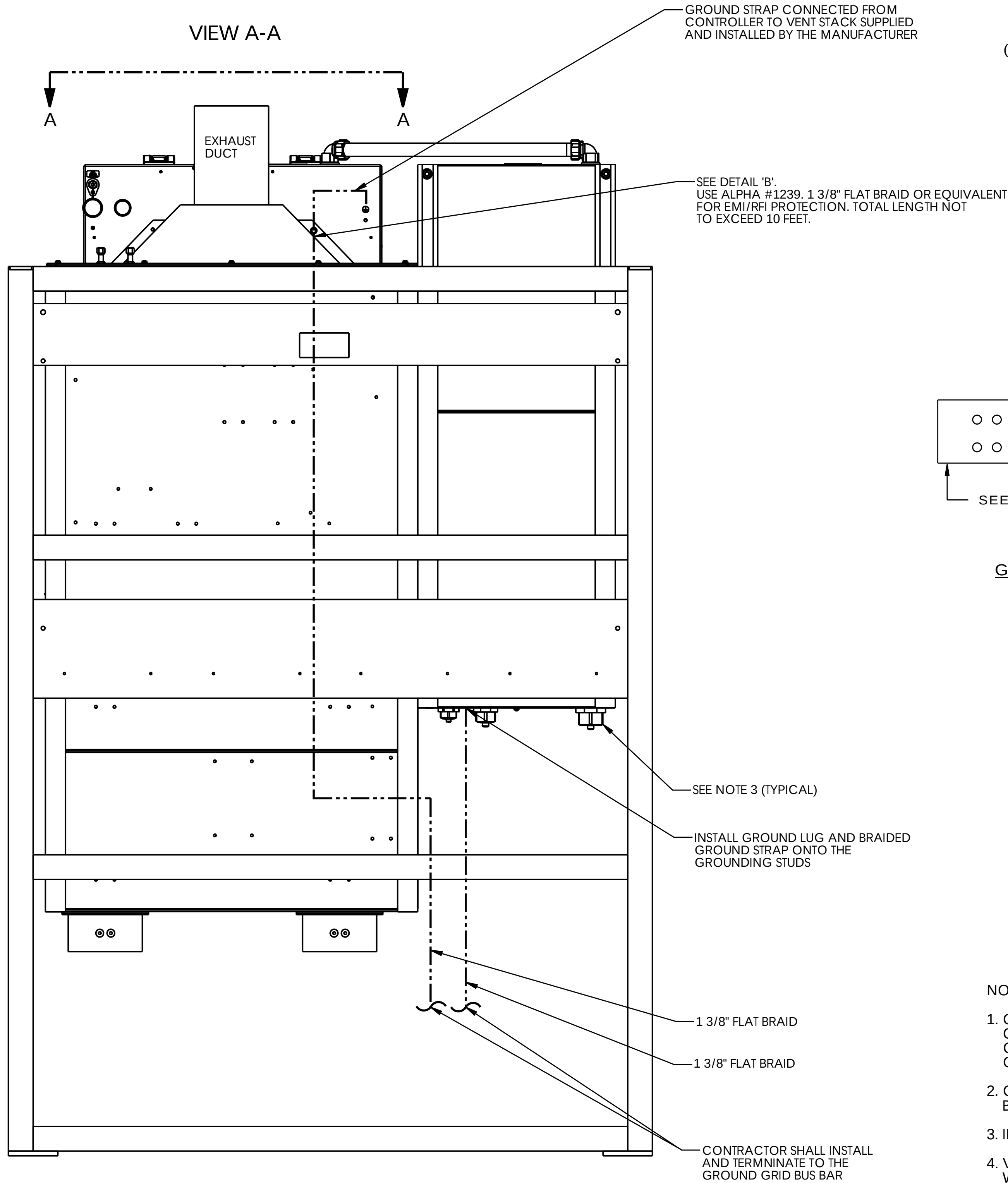
APPROVALS		DATE
DRAWN	J.R.Barber	02/24/2014
CHECKED	D.L.Hockenberry	03/06/2014
APPROVED	A.J.Smith	03/06/2014

AIR PRODUCTS

Drawing Title

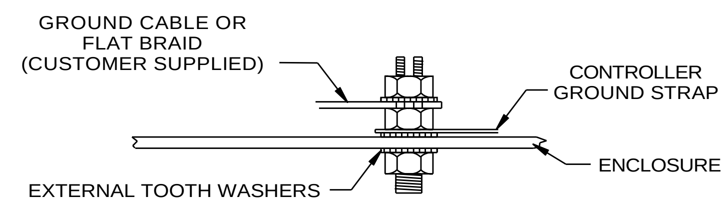
DWG. NO. SW013145.slddrw SIZE D REV 3

SCALE: 1:8 REF. SHEET 2 OF 5



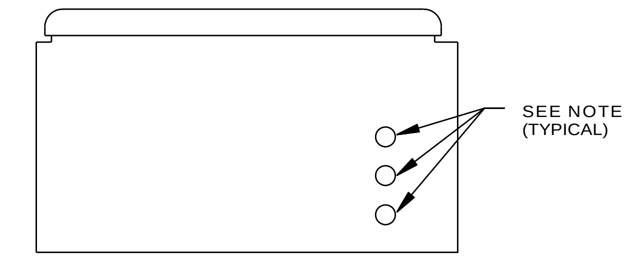
VHF MODULE REAR VIEW

COMPONENT LAYOUT

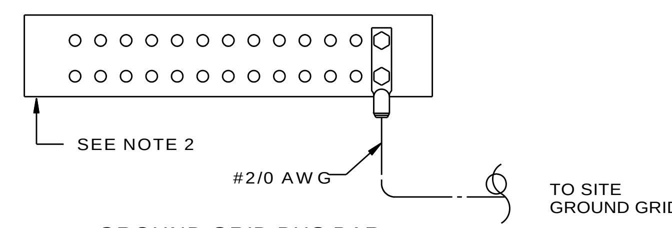


DETAIL "B"

3/8" GROUND LUG

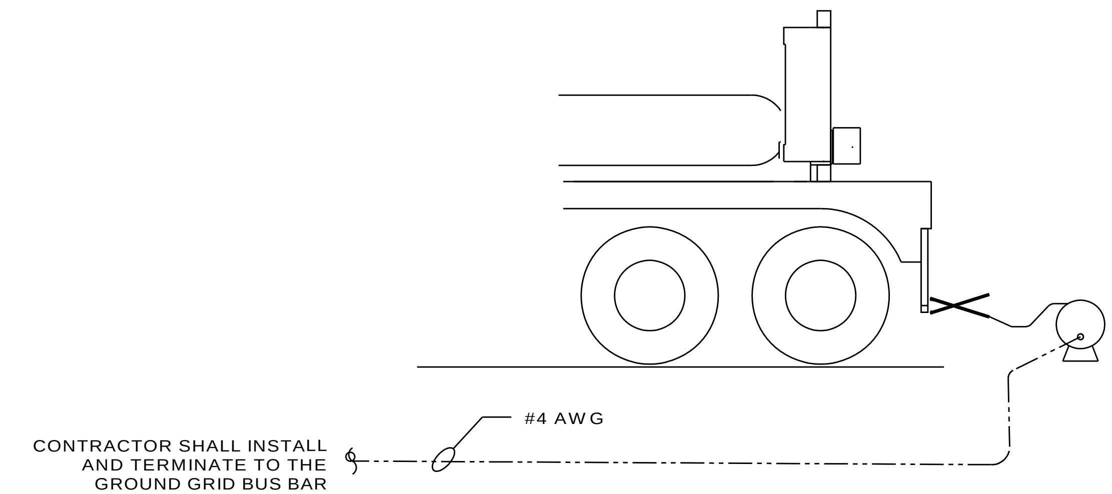


CONTROLLER TOP VIEW "A-A"

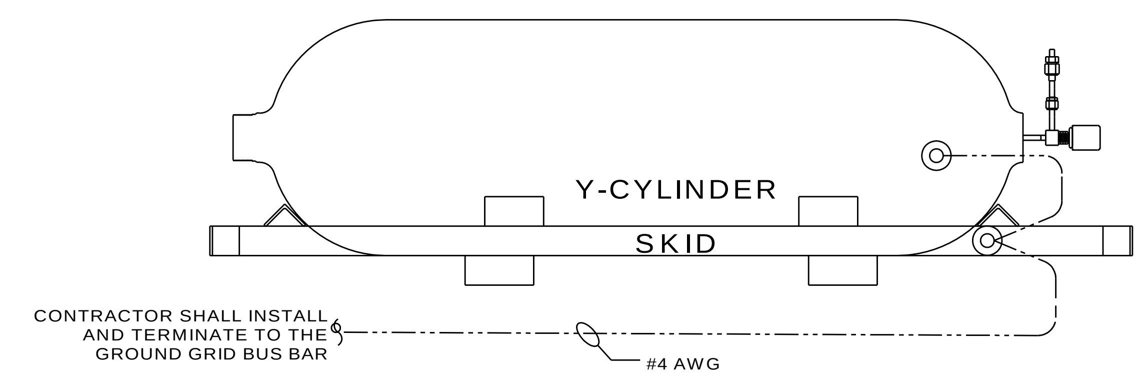


GROUND GRID BUS BAR

SUPPLIED BY CUSTOMER



TRAILER GROUNDING DETAIL



Y-CYLINDER GROUNDING DETAIL

NOTES

1. GROUNDING CONDUCTOR FROM VERY HIGH FLOW CABINET TO SITE GROUND GRID SHALL BE SIZED SO THAT A MAXIMUM RESISTANCE OF ONE (1) OHM CAN BE MEASURED FROM THE CONTROLLER AND CONNECTION TO THE SITE GROUND GRID.
2. COPPER GROUNDING BUS BAR, 1/4" X 4" X 20", LOCATED NEAR SYSTEM. GROUNDING BUS BAR SHALL BE DRILLED AND TAPPED FOR NEMA TWO HOLE GROUNDING LUG.
3. INSTALLATION OF CONDUITS AND LOW POINT DRAINS BY COSTOMER (TYPICAL).
4. VERIFY THAT ALL UNUSED CONTROLLER PENETRATIONS ARE WATERTIGHT AND PLUGGED WITH NEMA TYPE 4 HOLE SEALS (HOFFMAN OR EQUAL).
5. CONTRACTOR SHALL TERMINATE #4 AWG GROUND CONDUCTOR FROM THE GROUND LUG TO THE MAGNETIC GROUNDING CLAMPS. MAGENTIC GROUNDING CLAMPS (BY CUSTOMER/CONTRACTOR) AIRGAS CAT# RAD64002120. INSTALL CLAMPS TO SKID AND Y-CYLINDER AS SHOWN.
6. CONTRACTOR SHALL TERMINATE #4 AWG GROUND CONDUCTOR TO GROUNDING REEL, AND THEN CLAMP ASSEMBLY TO ISO CONTAINER TRAILER.
7. CONTRACTOR SHALL SUPPLY A GROUNDING REEL FOR THE ISO-CONTAINER, HUBBELL CAT # HBL50SD OR EQUAL. REEL SHALL BE UL LISTED AND RATED FOR EQUIPMENT GROUNDING USE.

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
43618	3	CHANGED CABLE TO 18 AWG ALPHA 5368C	3/6/14	JRB	DLH	AJS	

UNLESS OTHERWISE SPECIFIED:	APPROVALS	DATE
	DRAWN J.R Barker	02/24/2014
	CHECKED D.L.Hockenberry	03/06/2014
	ENG APPR.	
	MFG APPR.	
	APPROVED A.J. Smith	03/06/2014

MATERIAL: Material <not specified>

FINISH: XXXXX XXXXX XXXXX

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AIR PRODUCTS

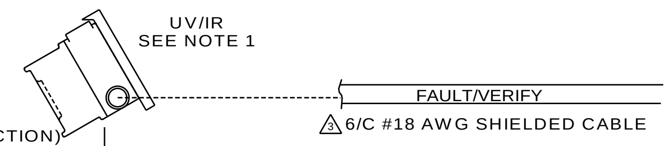
TITLE: Drawing Title

DWG. NO.	SIZE	REV
SW013145.slddrw	D	3

SCALE: 1:12 | REF. | SHEET 3 OF 5

UV/IR-15/16 DETECTOR WIRING AND SETTINGS

OPTIONAL



TWO SEPERATE UV/IR DETECTORS ARE SHIPPED LOOSE AND SHALL BE MOUNTED AT THE SOURCE (TO VIEW THE SOURCE CONNECTION) AND WIRED BY THE CUSTOMER.

WITH ALPHA #5386C CABLE	
WIRE COLOR	DETECTOR TERMINAL
RED	J1-4 (+24VDC)
BLUE	J1-1 (-24VDC)
BLACK	J5-3 (FAULT N.C.)
WHITE	J5-4 (FAULT COM.)
GREEN	J6-4 (VERIFY N.C.)
ORANGE	J6-3 (VERIFY COM)

FIRE SENTRY MODEL SS4-A

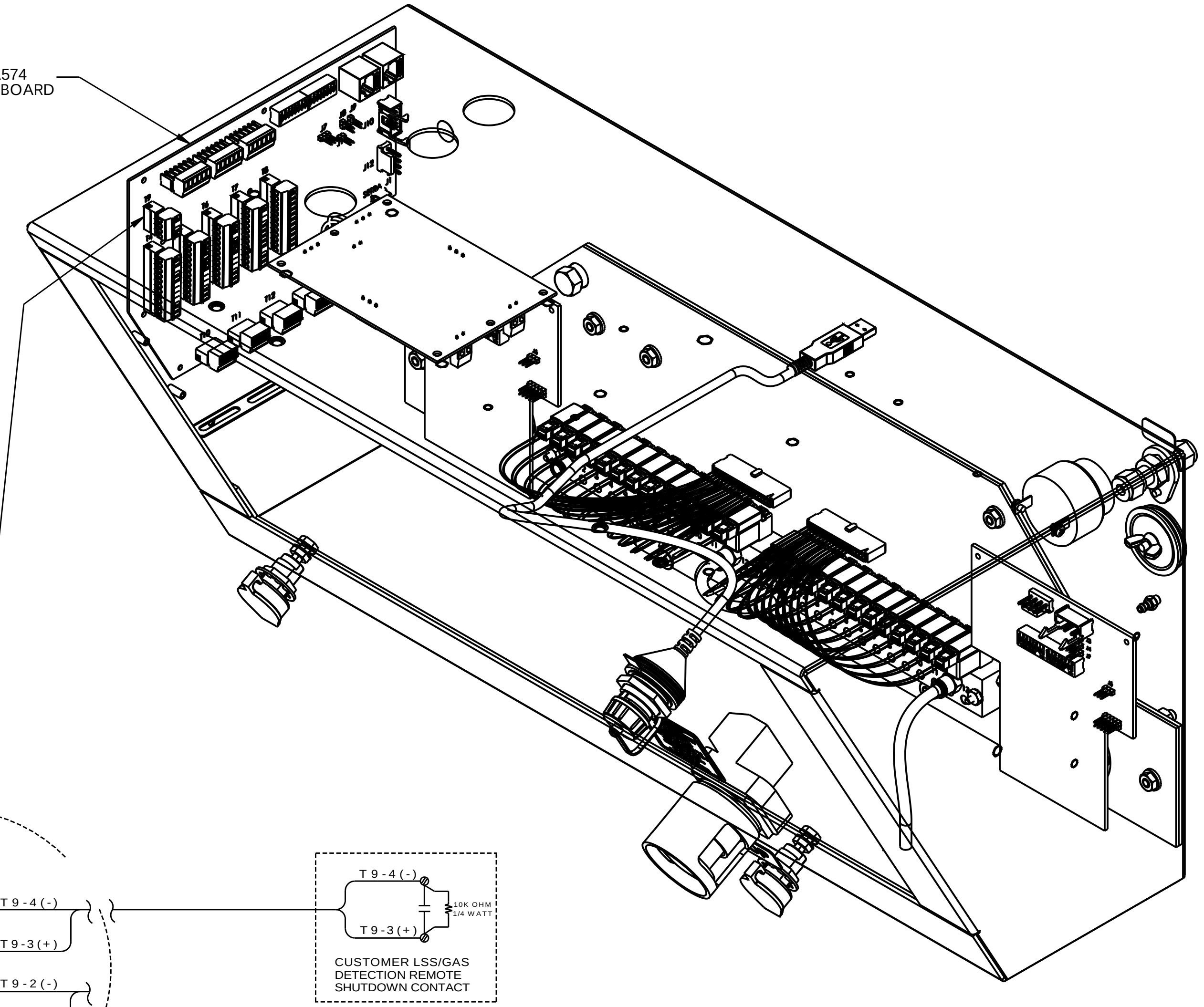
DETECTOR WIRING

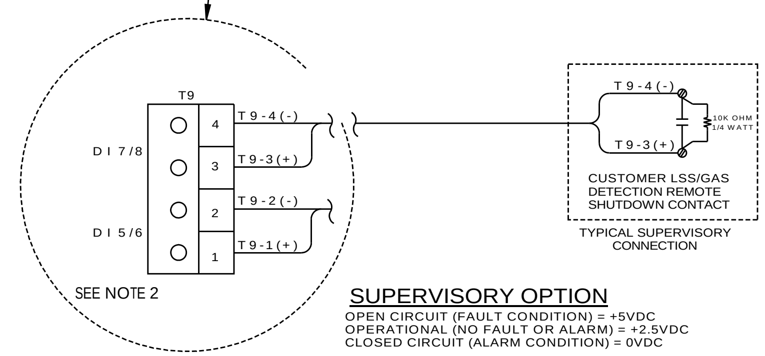
UV/IR DIP SWITCH SETTINGS

* VERIFICATION TIME (5 SEC)
  DIP SWITCH 1: CLOSED
  DIP SWITCH 2: OPEN
  DIP SWITCH 3: OPEN
* LATCHING (LATCHING MODE)
  DIP SWITCH 4: CLOSED
* IR-ONLY ENABLE (UV AND IR)
  DIP SWITCH 5: OPEN
* TEST CYCLE (30 MIN)
  DIP SWITCH 6: OPEN
* FIRE RANGE (45 FT)
  DIP SWITCH 7: OPEN
  DIP SWITCH 8: CLOSED

NOTES:

1. TWO ADDITIONAL UV/IR DETECTORS (UV/IR-15 AND UV/IR-16) ARE SHIPPED LOOSE WITH THE VHF MODULE AND SHALL BE MOUNTED AT THE SOURCE (AS SHOWN ON SHEET 1) AND WIRED BY THE CONTRACTOR DIRECTLY TO THE VERY HIGH FLOW MODULE (VHF) ECC. THE UV/IR FAULT AND VERIFY SIGNALS SHALL BE WIRED TO DIGITAL INPUTS AS SHOWN ON SHEET 2. ALL CABLES, CONDUIT AND MOUNTING HARDWARE SHALL BE SUPPLIED BY CONTRACTOR. RECOMMENDED CABLE TYPE IS ALPHA # 5386C.
2. IF THE UV/IR DETECTORS ARE NOT BEING WIRED DIRECTLY TO THE VERY HIGH FLOW (VHF) ECC AS SHOWN, THEN THEY MUST BE WIRED TO THE CUSTOMERS LIFE SAFETY SYSTEM BY THE CONTRACTOR. THE CUSTOMER MUST ALSO DETERMINE THE PROPER WIRING FROM THE DETECTORS TO THE LIFE SAFETY SYSTEM AND SEND BOTH, A UV/IR FAULT AND SHUTDOWN SIGNAL TO THE VERY HIGH FLOW (VHF) ECC.



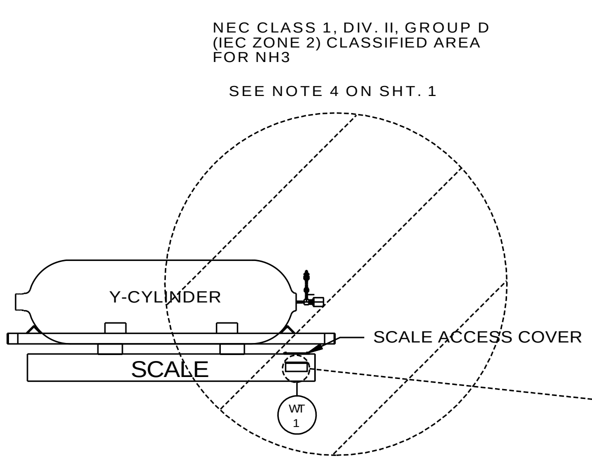


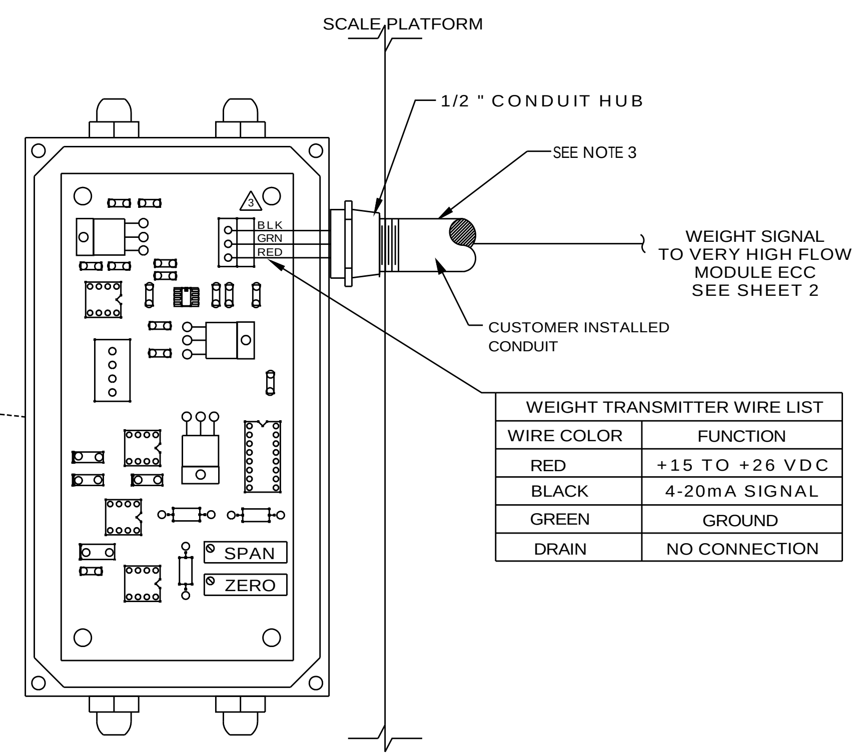
SUPERVISORY OPTION

OPEN CIRCUIT (FAULT CONDITION) = +5VDC
OPERATIONAL (NO FAULT OR ALARM) = +2.5VDC
CLOSED CIRCUIT (ALARM CONDITION) = 0VDC

SOURCE WEIGHT DETAILS

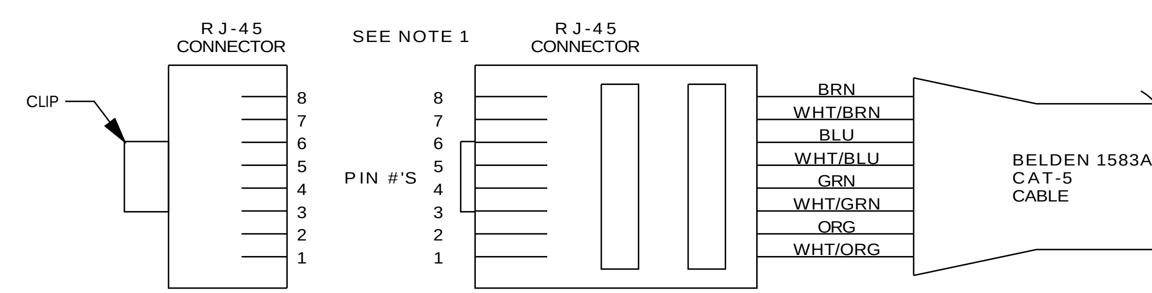
OPTIONAL





WEIGHT TRANSMITTER WIRE LIST	
WIRE COLOR	FUNCTION
RED	+15 TO +26 VDC
BLACK	4-20mA SIGNAL
GREEN	GROUND
DRAIN	NO CONNECTION

WEIGHT TRANSMITTER



CAT-5 CABLE AND CONNECTOR ASSEMBLY

NOTES:

1. RJ-45 CONNECTORS SHALL BE INSTALLED ON BOTH ENDS OF THE CAT-5 CABLE AS SHOWN. CONTRACTOR SHALL SUPPLY CABLE AND CONNECTORS.
2. INPUT SHALL BE CONFIGURED AS A HARDWIRE SHUTDOWN.
   FOR DI-5/6 SET SW 2-5 TO ON POSITION
   FOR DI 7/8 SET SW 2-6 TO ON POSITION
3. CABLE LENGTH NOT TO EXCEED 100 FEET MAX.

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
43618	3	CHANGED CABLE TO 18 AWG ALPHA 5368C	5/5/14	JRB	DLH	AJS	

UNLESS OTHERWISE SPECIFIED:

MATERIAL

FINISH

APPROVALS	DATE
DRAWN J.R.Barker	02/24/2014
CHECKED D.L.Hockenberry	03/06/2014
ENG APPR.	
MFG APPR.	
APPROVED A.J.Smith	03/06/2014

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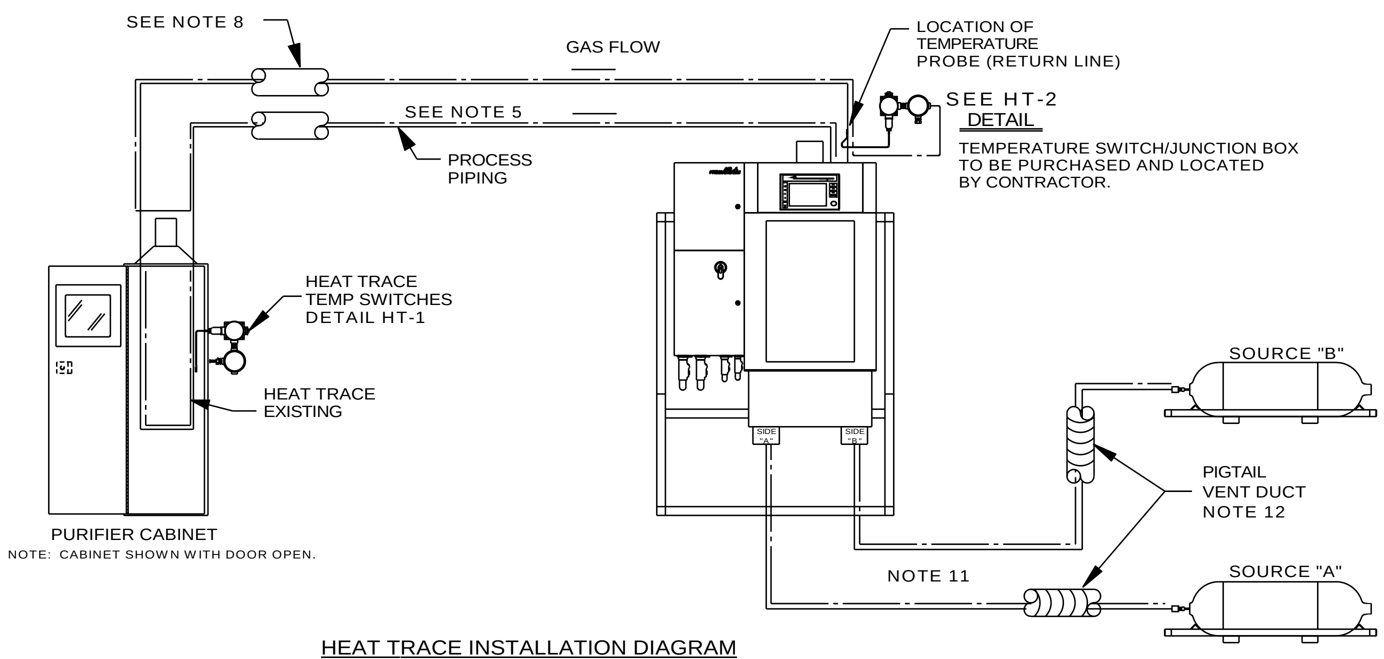
AIR PRODUCTS

TITLE: Drawing Title

DWG. NO. SW013145.slddrw | SIZE D | REV 3

SCALE: 1:4 | REF. | SHEET 4 OF 5

HEAT TRACE DETAILS



HEAT TRACE INSTALLATION DIAGRAM

HEAT TRACE REQUIREMENTS ARE BASE ON:
GAS TYPE, EQUIPMENT SET, AND SCOPE DOCUMENT.
IF VHF WAS ORDERED WITH INTERNAL HEAT TRACING THEN HEAT TRACE SHALL BE INSTALLED FROM THE SOURCE TO VHF, AND ALSO IF A PURIFIER CABINET IS SUPPLIED THEN HEAT TRACE WILL ALSO BE INSTALLED FROM THE VHF TO PURIFIER CABINET.

IF THE PURIFIER CABINET WAS ORDERED WITH HEAT TRACING AND TEMPERATURE CONTROLLER. THE CONTRACTOR WILL ONLY NEED TO SUPPLY POWER CONNECTION.

HEAT TRACE PARTS LIST (SUPPLIED BY ELECTRICAL CONTRACTOR)

ITEM	DESCRIPTION	MANUFACTURER PART NUMBER	QTY	MANUFACTURER
1	HEAT TRACE CABLE, 240 VAC, 12 WATTS/FT., SS OVERBRAID	PT-3SB	AS REQ.	DELTA THERM
2	BANDING TAPE	T-F50	AS REQ.	DELTA THERM
3	ALUMINUM TAPE	T-AL200	AS REQ.	DELTA THERM
4	HEAT TRACE TEMP CONTROLLER, 120/240 VAC	E-122	AS REQ.	UNITED ELECTRIC
5	COMPRESSSION FITTING, 3/4" HUB, .375"-.500"	2532	AS REQ.	THOMAS & BETTS
6	BOX, ROUND, 3/4" HUBS	EABC26	AS REQ.	CROUSE-HINDS
7				
8				
9				

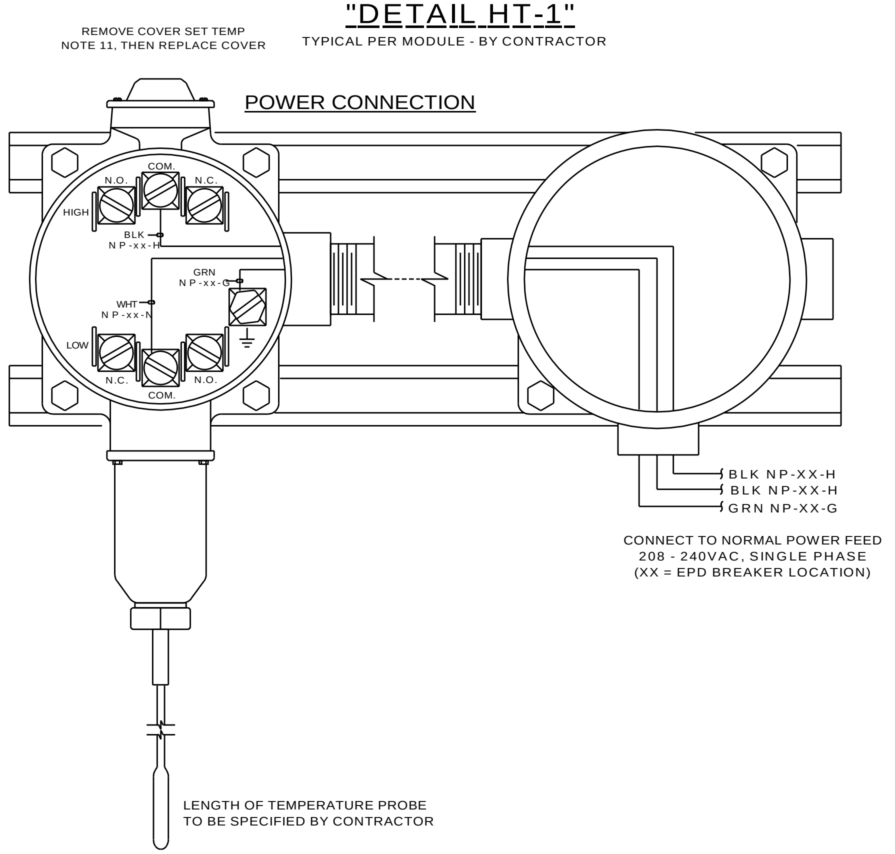
ITEM 1: SEE NOTES 3 & 4 ITEM 2: SEE NOTE 5 ITEM 3: SEE NOTE 6

NOTES:

1. HEAT TRACE BRAIDING SHALL BE TWISTED TOGETHER TO FORM A CONDUCTOR THAT WILL BE INSTALLED INTO THE GROUND CONNECTOR ASSEMBLY.
2. HEAT SHRINK TUBING SHALL BE INSTALLED ON ALL HEAT TRACE CONDUCTORS.
3. HEAT TRACE CABLE SHALL BE SPECIFIED FACTORY TERMINATED AND TESTED WITH AN END SEAL.
4. HEAT TRACE CABLE SHALL BE INSTALLED PER MANUFACTURERS INSTRUCTIONS.
5. THE BANDING TAPE SHALL BE USED TO SECURE THE HEAT TRACE CABLE TO THE PIPING.
6. THE ALUMINUM TAPE SHALL BE INSTALLED OVER THE HEAT TRACE CABLE AND PIPING.
7. HEAT TRACE CABLE SHALL BE INSTALLED PARALLEL TO THE PIPING, SPIRALING OR WRAPPING HEAT TRACE CABLE ON PIPING SHALL BE AVOIDED.
8. THERMOCOUPLES SHALL BE INSTALLED DIAMETRICALLY OPPOSITE OF THE HEAT TRACE CABLE ON PROCESS PIPING.
9. CONTRACTOR SHALL RE-LABEL CONDUCTORS AS FOLLOWS: THE POWER PANEL DESIGNATION, CIRCUIT BREAKER NUMBER, AND THE SUFFIX "H" TO INDICATE HOT, "N" TO INDICATE NEUTRAL, OR "G" TO INDICATE GROUND. (e.g. NP-10-H)
10. CUSTOMER IS REQUIRED TO PROCURE AND INSTALL INSULATION ON HEAT TRACED PIPING USING APCI SPECIFICATIONS 4WPI-INS006 AND 4WPI-INS0008. SUBSITUTE 0.020" THICK WHITE PVC JACKET FOR METAL JACKET. A COPY OF THE SPECIFICATIONS CAN BE FOUND IN THE NH3 OPERATION AND INSTALLATION MANUAL.
11. IF THERE IS A SOURCE HEATER BEING USED THEN ENSURE THE HEAT TRACE TEMPERATURE CONTROLLER SET TO THE SAME (OR SLIGHTLY HIGHER) AS THE SOURCE HEATER TEMPERATURE.
12. WHEN HEAT TRACE IS REQURED BETWEEN THE SOURCE AND VHF MODULE, THE HEAT TRACE IS SUPPLIED AND POWERED FROM THE VHF MODULE.

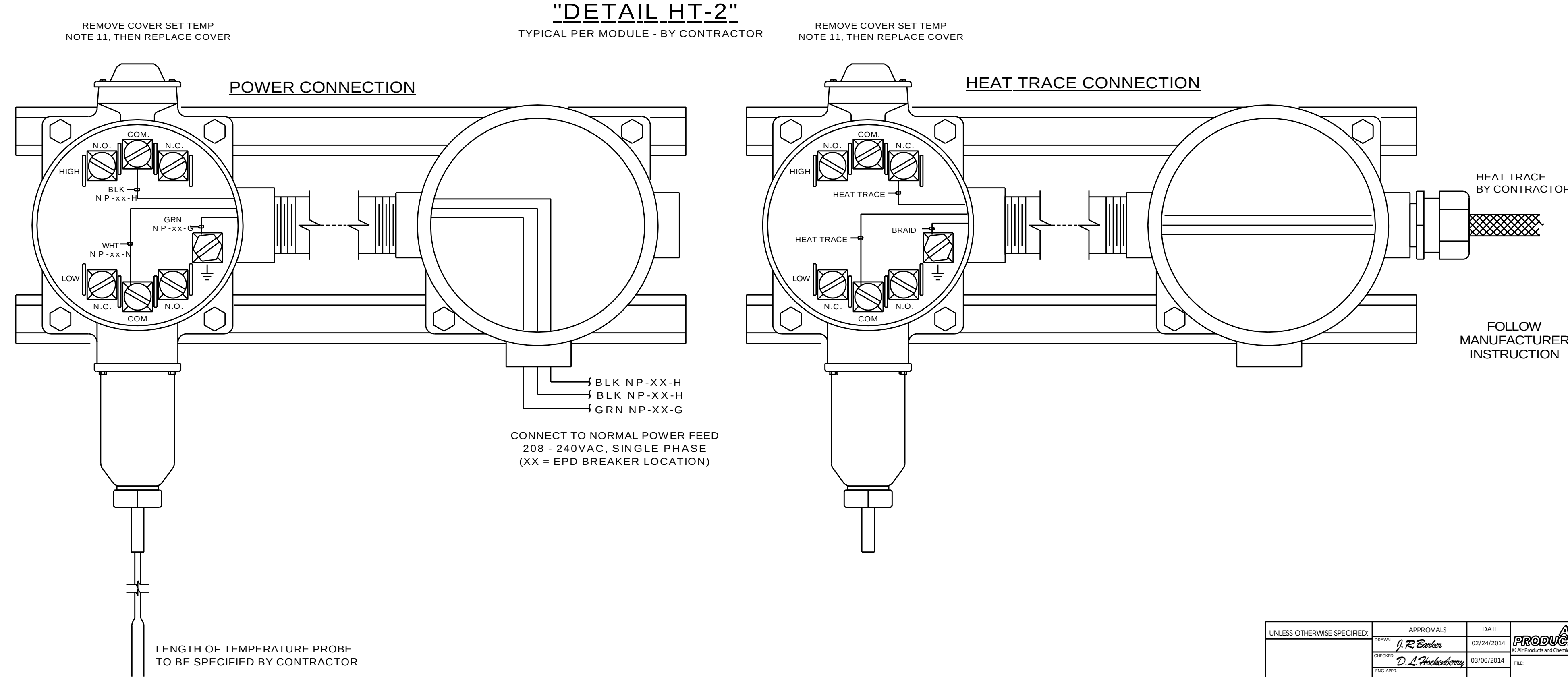
"DETAIL HT-1"

TYPICAL PER MODULE - BY CONTRACTOR



"DETAIL HT-2"

TYPICAL PER MODULE - BY CONTRACTOR



ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
43618	3	CHANGED CABLE TO 18 AWG ALPHA 5368C	3/6/14	JRB	DLH	AJS	

UNLESS OTHERWISE SPECIFIED:	APPROVALS	DATE
	DRAWN J.R Barker	02/24/2014
	CHECKED D.L Hockenberry	03/06/2014
	ENG APPR.	
	MFG APPR.	
	APPROVED A.J. Smith	03/06/2014
MATERIAL		
FINISH		

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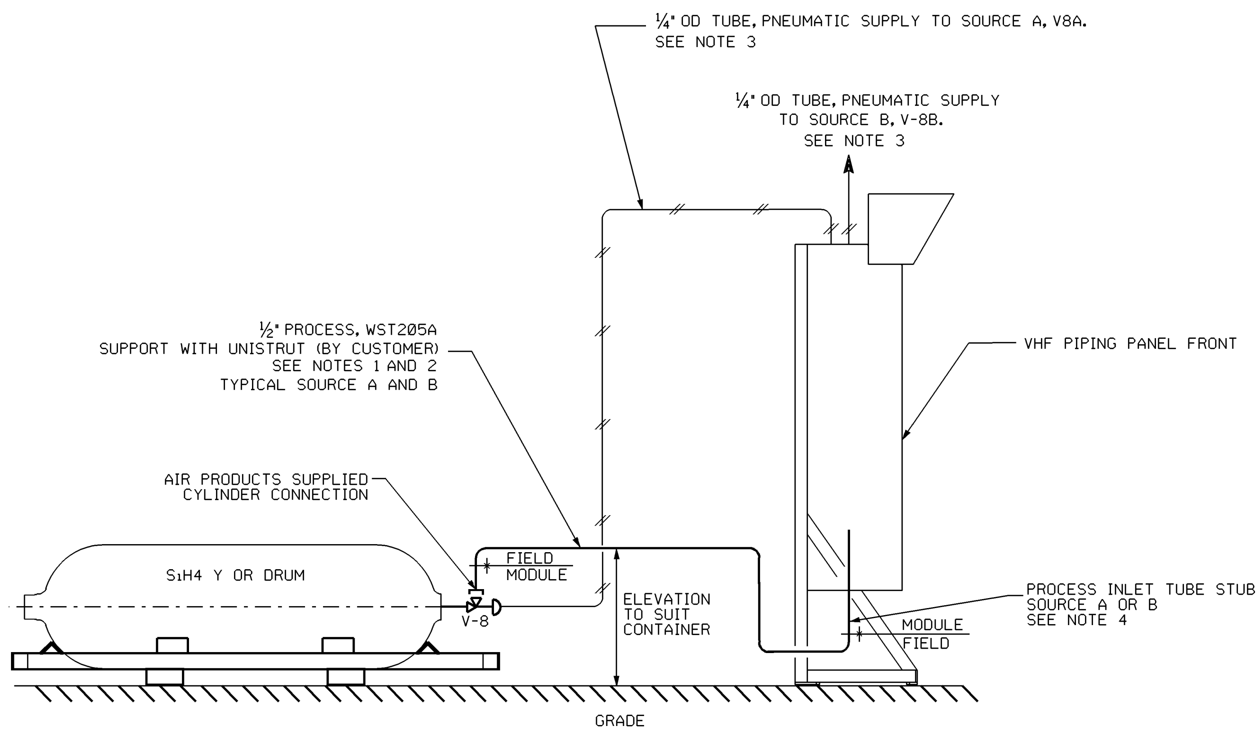
AIR PRODUCTS

TITLE: Drawing Title

DWG. NO. SW013145.slddrw SIZE D REV 3

SCALE: 1:2 REF. SHEET 5 OF 5



NOTES:

1. SPECIFICATION WST205A DESIGNATES 316 SEAMLESS STAINLESS STEEL TUBING, ELECTROPOLISHED TO 10RA MAX., BUTT WELDED JOINTS, AND INSTALLED TO ASME B31.3 DESIGN CODE. A COPY OF THIS SPECIFICATION CAN BE FOUND IN THE OPERATION MANUAL APPENDIX.
2. FIELD INSTALLED TUBE FROM CYLINDER CONNECTION TO VHF PROCESS INLET MUST NOT EXCEED 9FT.
3. 9FT. OF POLYURETHANE PNEUMATIC TUBING IS SUPPLIED BY AIR PRODUCTS.
4. FOR VHF MODULE PROCESS CONNECTIONS, SEE DRAWING INS 10554. SLDDRW.

TOLERANCES UNLESS OTHERWISE SPECIFIED
LINEAR ± HOLE SIZE ±
ANGLE ± HOLE LOCATION ±
ALL DIMENSIONS IN inches
THIRD ANGLE PROJECTION
WEIGHT

REV	CN No	REVISION DESCRIPTION	DATE	BY	CHK'D	APP'D
0		APPROVED FOR CONSTRUCTION	07/31/08	KMN	DJK	DJK

AIR PRODUCTS
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As of Dates in REVISIONS list
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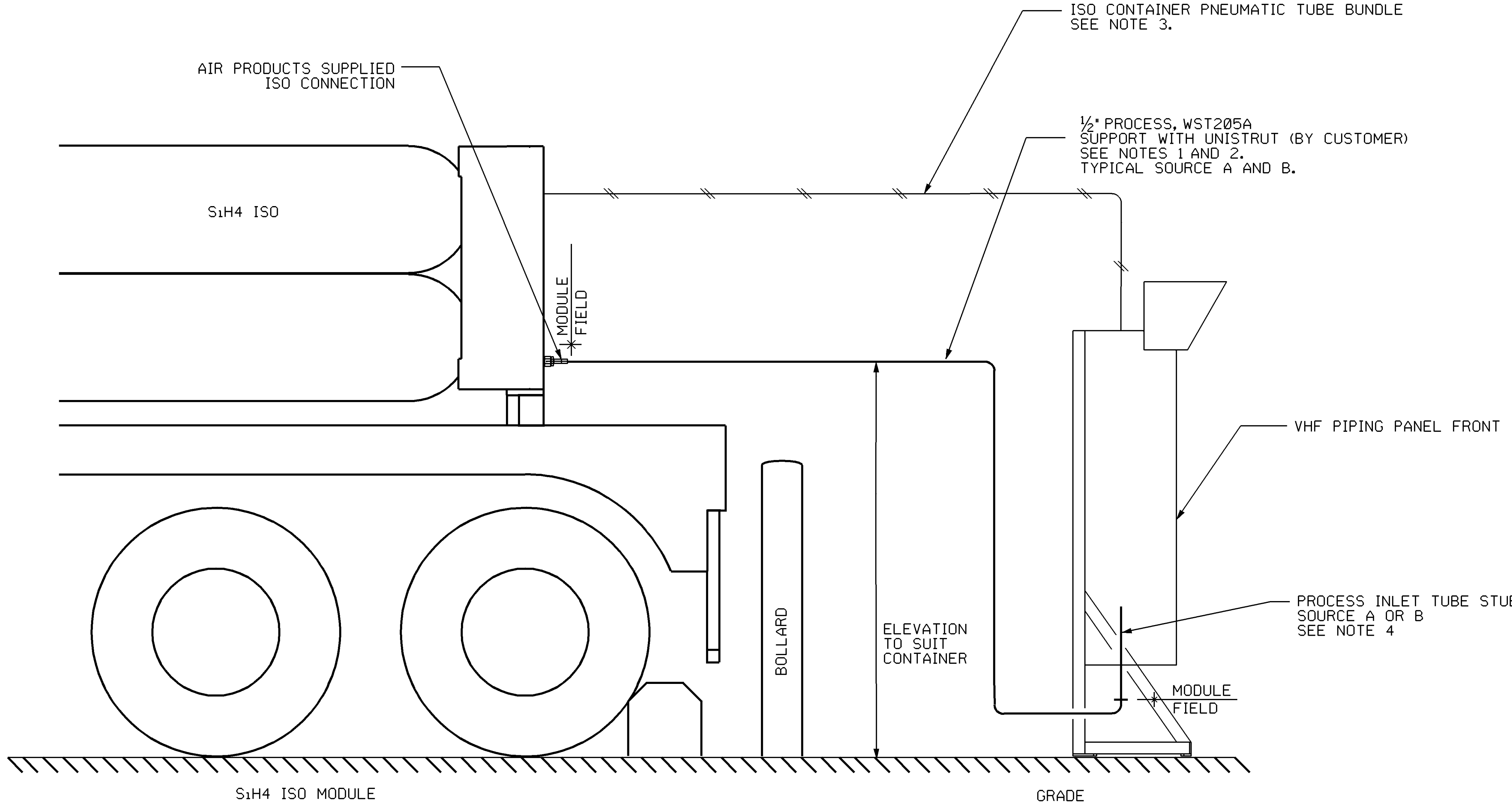
TITLE
INSTALLATION DRAWING
VHF PIGTAIL ASSEMBLY
Y/ DRUM
SiH4

USED ON 051105
OWNER GROUP PRODUCT ENG
RELEASE PURPOSE PRELIMINARY
REFERENCE
DOC No BKA004 MECH 0010
SCALE SHEET 1 OF 1

M:\Product\HIGH FLOW SYSTEM\BKA004\BKA004MECH\BKA004 MECH 0010.dgn



NOTES:

1. SPECIFICATION WST205A DESIGNATES 316 SEAMLESS STAINLESS STEEL TUBING, ELECTROPOLISHED TO 10RS MAX., BUTT WELDED JOINTS, AND INSTALLED TO ASME B31.3 DESIGN CODE. A COPY OF THIS SPECIFICATION CAN BE FOUND IN THE OPERATION MANUAL APPENDIX.
2. FIELD INSTALLED TUBE FROM CYLINDER CONNECTION TO VHF PROCESS INLET MUST NOT EXCEED 16FT.
3. A PNEUMATIC TUBE BUNDLE WILL BE SUPPLIED BY AIR PRODUCTS. SEE DRAWING BBB018 MECH 0016 FOR SOURCE A INSTALLATION DETAILS. TUBE SWITCHING FOR SOURCE B IS HANDLED BY A SEPERATE CONTROLLER. SEE DRAWINGS BBG006 MECH 0001 FOR INSTALLATION DETAILS.
4. FOR VHF MODULE PROCESS CONNECTIONS, SEE DRAWING INS 10554.SLDDRW.

TOLERANCES UNLESS OTHERWISE SPECIFIED
LINEAR ± HOLE SIZE ±
ANGLE ± HOLE LOCATION ±
ALL DIMENSIONS IN inches
THIRD ANGLE PROJECTION
WEIGHT

REV	CN No	REVISION DESCRIPTION	DATE	BY	CHK'D	APP'D
0		APPROVED FOR CONSTRUCTION	07/31/08	KMN	DJK	DJK

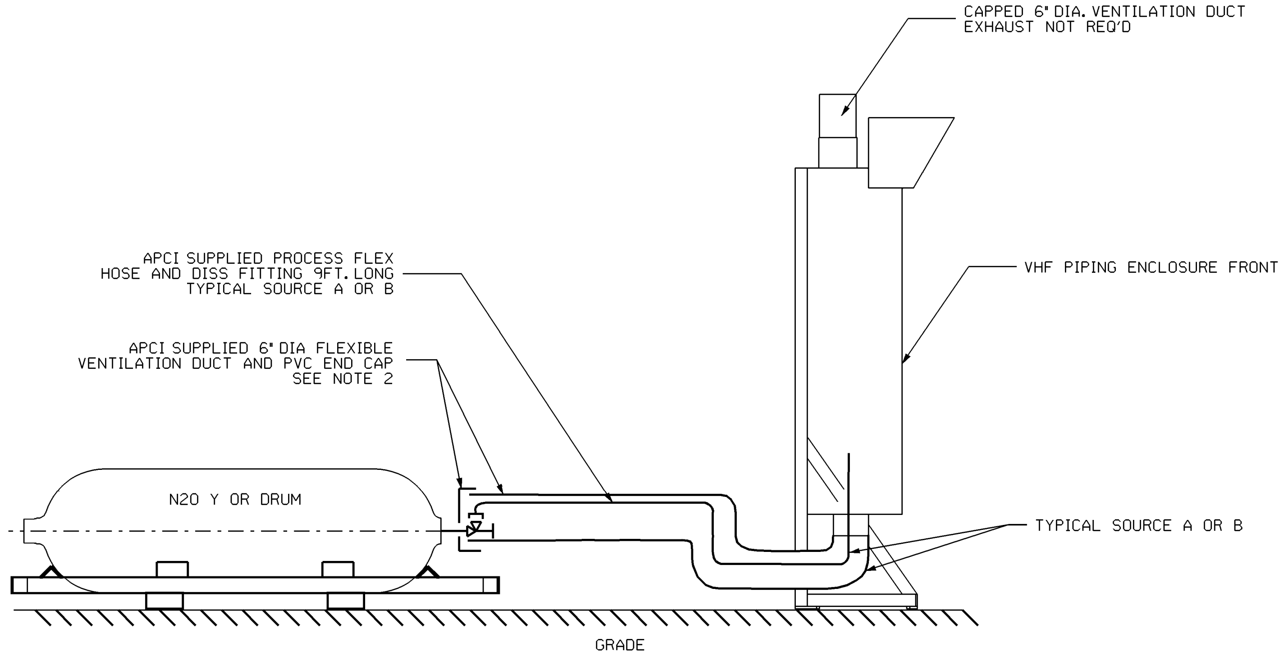
AIR PRODUCTS

TITLE: INSTALLATION DRAWING VHF PIGTAIL ASSEMBLY ISO CONTAINER SiH4

USED ON	051105
OWNER GROUP	PRODUCT ENG
RELEASE PURPOSE	PRELIMINARY
REFERENCE	
DOC No	BKA004 MECH 0011
SCALE	SHEET 1 OF 1

AI_D : 16OCT2002

M:\Product\HIGH FLOW SYSTEM\BKA004\BKA004MECH\BKA004 MECH 0011.dgn



NOTES:

1. FOR VHF PIPING CONNECTIONS, SEE DRAWING SW003730.SLDDRW.
2. PUSH FLEXIBLE VENTILATION DUCT INTO PVC CAP, THEN INSTALL 2 CLEVIS PINS TO LOCK DUCT IN PLACE.

REV	CN No	REVISION DESCRIPTION	DATE	BY	CHK'D	APP'D
0		APPROVED FOR CONSTRUCTION	07/31/08	KMN	DJK	DJK

TOLERANCES UNLESS OTHERWISE SPECIFIED: LINEAR ± HOLE SIZE ± ANGLE ± HOLE LOCATION ±
ALL DIMENSIONS IN inches
THIRD ANGLE PROJECTION
WEIGHT

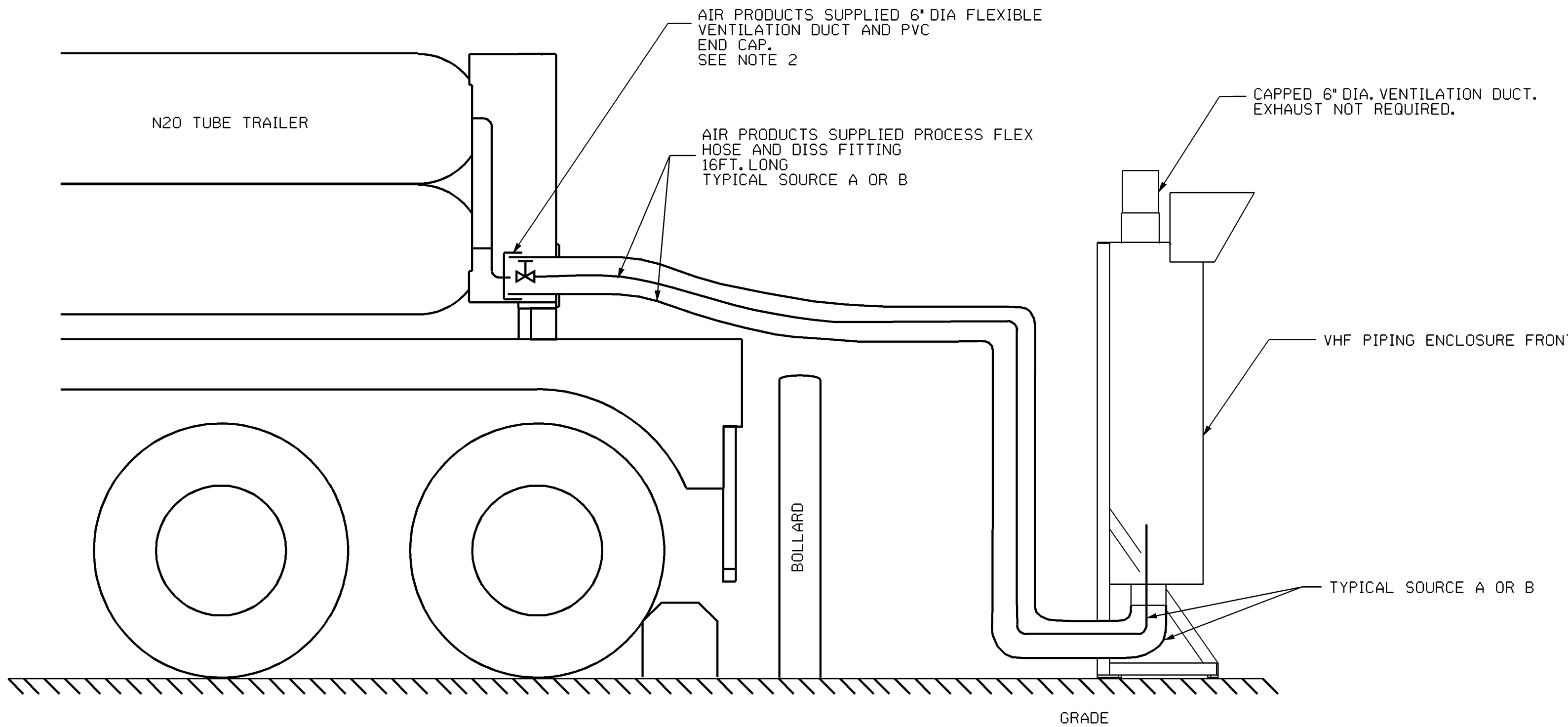
AIR PRODUCTS

TITLE: INSTALLATION DRAWING
VHF PIGTAIL ASSEMBLY
Y/ DRUM
N2O

USED ON	051105
OWNER GROUP	PRODUCT ENG
RELEASE PURPOSE	PRELIMINARY
REFERENCE	
DOC No	BKA004 MECH 0012
SCALE	SHEET 1 OF 1

AI_D - 16OCT2002

M:\Product\HIGH FLOW SYSTEM\BKA004\BKA004MECH\BKA004 MECH 0012.dgn



NOTES:

1. FOR VHF PIPING CONNECTIONS, SEE DRAWING SW003730.SLDDRW

2. PUSH FLEXIBLE VENTILATION DUCT INTO PVC CAP, THEN INSTALL
   2 CLEVIS PINS TO LOCK DUCT IN PLACE.

TOLERANCES UNLESS OTHERWISE SPECIFIED
LINEAR ± HOLE SIZE ±
ANGLE ± HOLE LOCATION ±
ALL DIMENSIONS IN inches
THIRD ANGLE PROJECTION
WEIGHT

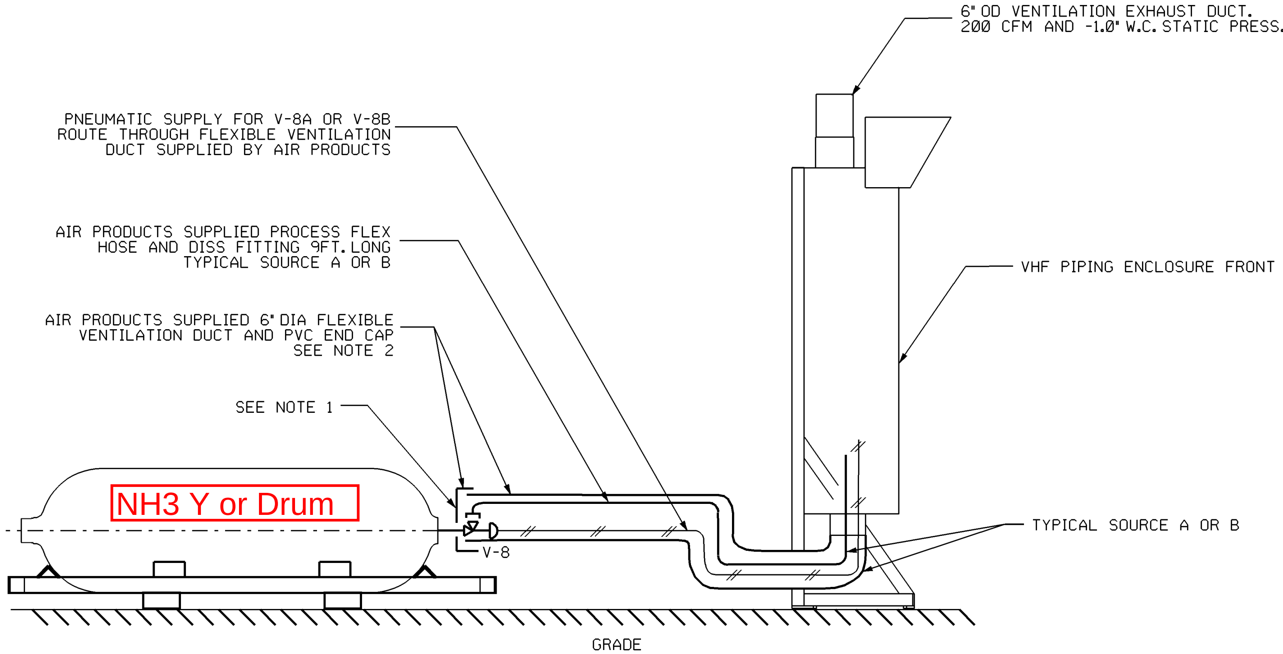
REV	CN No	REVISION DESCRIPTION	DATE	BY	CHK'D	APP'D
0		APPROVED FOR CONSTRUCTION	07/31/08	KMN	DJK	DJK

AIR PRODUCTS

TITLE
INSTALLATION DRAWING
VHF PIGTAIL ASSEMBLY
TUBE TRAILER
N2O

USED ON	051105
OWNER GROUP	PRODUCT ENG
RELEASE PURPOSE	PRELIMINARY
REFERENCE	
DOC No	BKA004 MECH 0013
SCALE	SHEET 1 OF 1

M:\Product\HIGH FLOW SYSTEM\BKA004\BKA004MECH\BKA004 MECH 0013.dgn



NOTES:

1. BALANCE EXHAUST ON DUAL SOURCE VHF MODULES BY DRILLING HOLES IN PVC CAP TO ADJUST FLOW AND STATIC PRESSURE. THE SAME FLOW AND STATIC PRESSURE ADJUSTMENTS CAN BE MADE FOR SINGLE SOURCE VHF MODULES.

2. PUSH FLEXIBLE VENTILATION DUCT INTO PVC CAP, THEN INSTALL 2 CLEVIS PINS TO LOCK DUCT IN PLACE.

3. FOR VHF PIPING CONNECTIONS, SEE DRAWING SW003730.SLDDRW

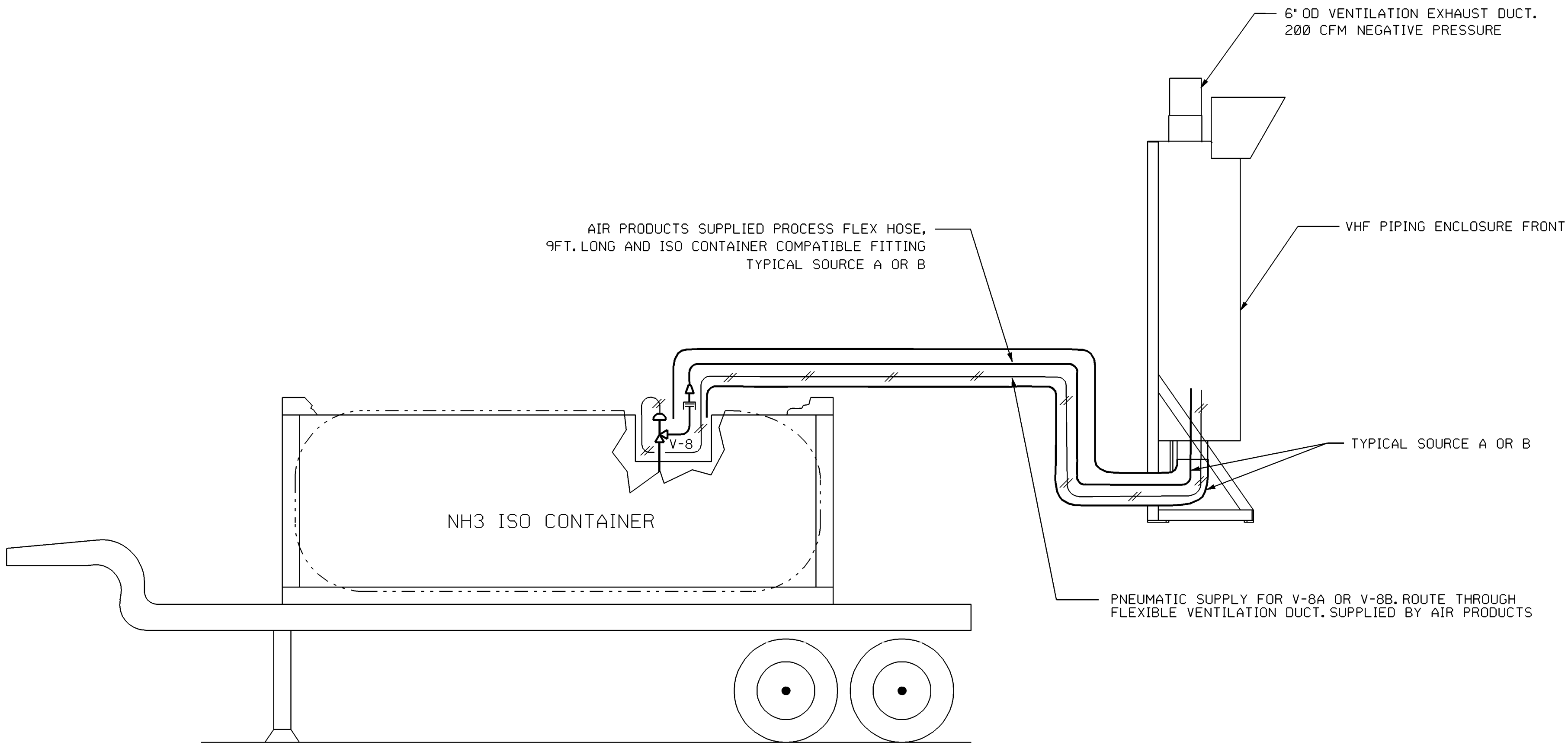
TOLERANCES UNLESS OTHERWISE SPECIFIED
LINEAR ± HOLE SIZE ±
ANGLE ± HOLE LOCATION ±
ALL DIMENSIONS IN inches
THIRD ANGLE PROJECTION
WEIGHT

REV	CN No	REVISION DESCRIPTION	DATE	BY	CHK'D	APP'D
0		APPROVED FOR CONSTRUCTION	07/31/08	KMN	DJK	DJK

TITLE
INSTALLATION DRAWING
VHF PIGTAIL ASSEMBLY
Y/ DRUM
NH3

USED ON	051105
OWNER GROUP	PRODUCT ENG
RELEASE PURPOSE	PRELIMINARY
REFERENCE	
DOC No	BKA004 MECH 0014
SCALE	SHEET 1 OF 1

M:\Product\HIGH FLOW SYSTEM\BKA004\BKA004MECH\BKA004 MECH 0014.dgn



NOTES:

1. FOR VHF PIPING CONNECTIONS, SEE DRAWING SW003730.SLDDRW.

TOLERANCES UNLESS OTHERWISE SPECIFIED
LINEAR ± HOLE SIZE ±
ANGLE ± HOLE LOCATION ±
ALL DIMENSIONS IN inches
THIRD ANGLE PROJECTION
WEIGHT

REV	CN No	REVISION DESCRIPTION	DATE	BY	CHK'D	APP'D
0		APPROVED FOR CONSTRUCTION	07/31/06	KMN	DJK	DJK

AIR PRODUCTS
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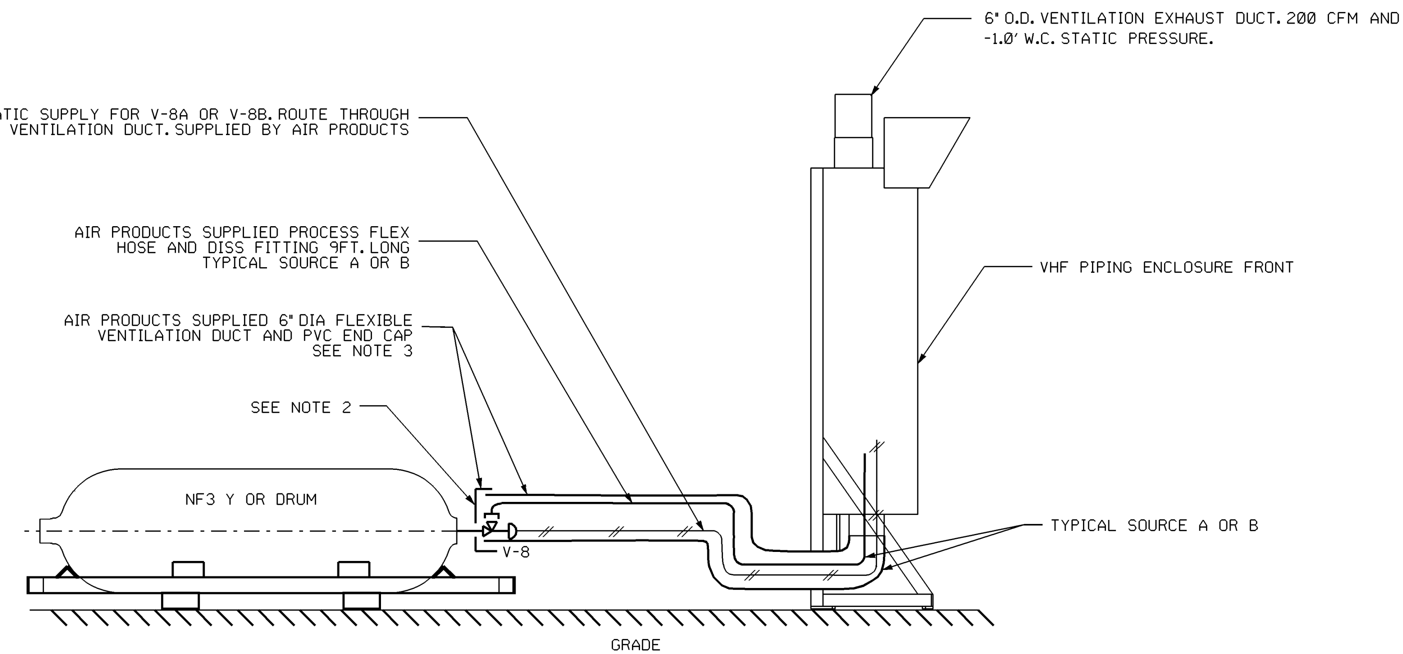
TITLE
INSTALLATION DRAWING
VHF PIGTAIL ASSEMBLY
ISO CONTAINER
NH3

USED ON 051105
OWNER GROUP PRODUCT ENG
RELEASE PURPOSE PRELIMINARY
REFERENCE
DOC No BKA004 MECH 0015
SCALE SHEET 1 OF 1

M:\Product\HIGH FLOW SYSTEM\BKA004\BKA004MECH\BKA004 MECH 0015.dgn



NOTES:

1. FOR VHF PIPING CONNECTIONS, SEE DRAWING SW003730.SLDDRW.
2. BALANCE EXHAUST ON SINGLE AND DUAL SOURCE VHF MODULES BY DRILLING HOLES IN PVC CAP TO ADJUST FLOW AND STATIC PRESSURE.
3. PUSH FLEXIBLE VENTILATION DUCT INTO PVC CAP, THEN INSTALL 2 CLEVIS PINS TO LOCK DUCT IN PLACE.

TOLERANCES UNLESS OTHERWISE SPECIFIED
LINEAR ± HOLE SIZE ±
ANGLE ± HOLE LOCATION ±
ALL DIMENSIONS IN inches
THIRD ANGLE PROJECTION
WEIGHT

REV	CN No	REVISION DESCRIPTION	DATE	BY	CHK'D	APP'D
0		APPROVED FOR CONSTRUCTION	07/31/08	KMN	DJK	DJK

AIR PRODUCTS
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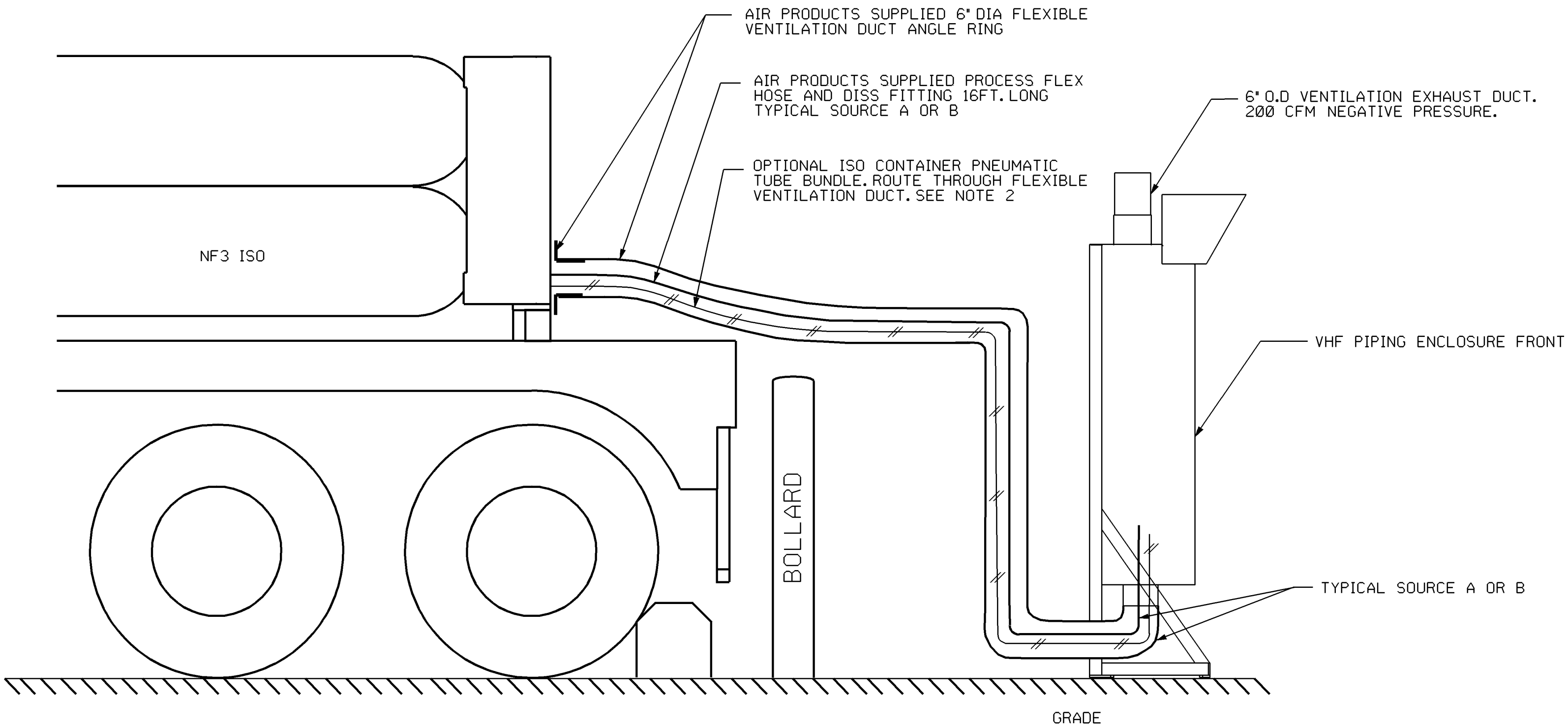
TITLE
INSTALLATION DRAWING
VHF PIGTAIL ASSEMBLY
Y/ DRUM
NF3

USED ON	051105
OWNER GROUP	PRODUCT ENG
RELEASE PURPOSE	PRELIMINARY
REFERENCE	
DOC No	BKA004 MECH 0016
SCALE	SHEET 1 OF 1

M:\Product\HIGH FLOW SYSTEM\BKA004\BKA004MECH\BKA004 MECH 0016.dgn



NOTES:

1. FOR VHF PIPING CONNECTIONS, SEE DRAWING SW003730.SLDDRW.
2. IF THE TUBE SWITCHING OPTION HAS BEEN SELECTED, A PNEUMATIC TUBE BUNDLE WILL BE SUPPLIED BY AIR PRODUCTS. SEE DRAWING BBG018 MECH 0014 FOR SOURCE A INSTALLATION DETAILS. TUBE SWITCHING FOR SOURCE B IS HANDLED BY A SEPERATE CONTROLLER. SEE DRAWING BBG002 MECH 001 FOR INSTALLATION DETAILS.

TOLERANCES UNLESS OTHERWISE SPECIFIED
LINEAR ± HOLE SIZE ±
ANGLE ± HOLE LOCATION ±
ALL DIMENSIONS IN inches
THIRD ANGLE PROJECTION
WEIGHT

REV	CN No	REVISION DESCRIPTION	DATE	BY	CHK'D	APP'D
0		APPROVED FOR CONSTRUCTION	07/31/08	KMN	DJK	DJK

AIR PRODUCTS

TITLE
INSTALLATION DRAWING
VHF PIGTAIL ASSEMBLY (GAS)
ISO CONTAINER
NF3

USED ON	051105
OWNER GROUP	PRODUCT ENG
RELEASE PURPOSE	PRELIMINARY
REFERENCE	
DOC No	BKA004 MECH 0017
SCALE	SHEET 1 OF 1

AI_D - 16OCT2002
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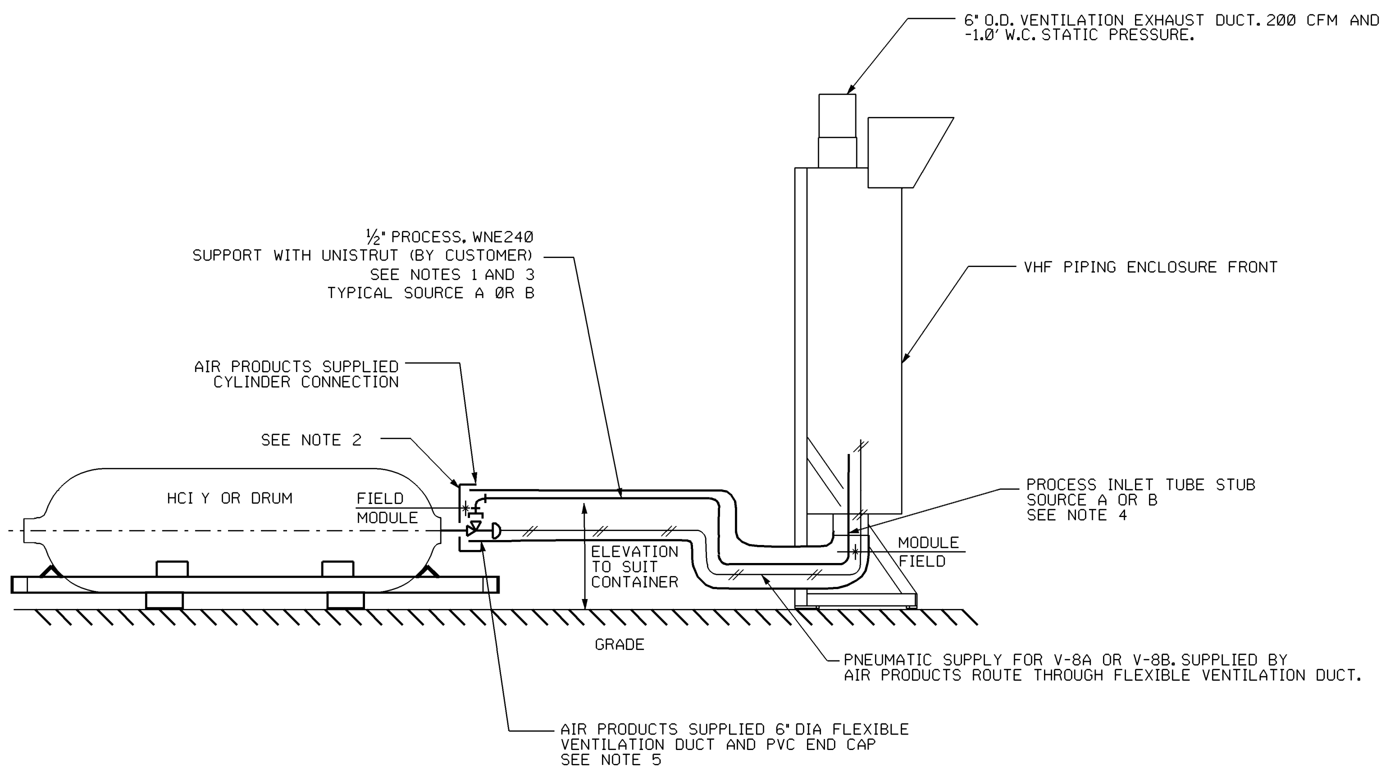

NOTES:

1. SPECIFICATION WNE240 DESIGNATES HASTELLOY C-22 TUBING, 25 RA MAX., BUTT WELDED JOINTS, AND INSTALLED TO ASME B31.3 DESIGN CODE. A COPY OF THIS SPECIFICATION CAN BE FOUND IN THE OPERATION MANUAL APPENDIX.
2. BALANCE EXHAUST ON SINGLE AND DUAL SOURCE VHF MODULES BY DRILLING HOLES IN PVC CAP TO ADJUST FLOW AND STATIC PRESSURE.
3. MAXIMUM FIELD INSTALLED 1/2" TUBE IS 9' FROM DISS TO VHF PROCESS INLET.
4. FOR VHF MODULE PROCESS CONNECTIONS, SEE DRAWING SW003730.SLDDRW.
5. PUSH FLEXIBLE VENTLAT ION DUCT OVER HARD PIPING AND ATTACH TO VHF MODULE. PUSH THE FLEXIBLE VENTILATION DUCT INTO PVC CAP, AND INSTALL 2 CLEVIS PINS TO LOCK DUCT IN PLACE.

TOLERANCES UNLESS OTHERWISE SPECIFIED
LINEAR ± HOLE SIZE ±
ANGLE ± HOLE LOCATION ±
ALL DIMENSIONS IN inches
THIRD ANGLE PROJECTION
WEIGHT

REV	CN No	REVISION DESCRIPTION	DATE	BY	CHK'D	APP'D
0		APPROVED FOR CONSTRUCTION	07/31/08	KMN	DJK	DJK

AIR PRODUCTS
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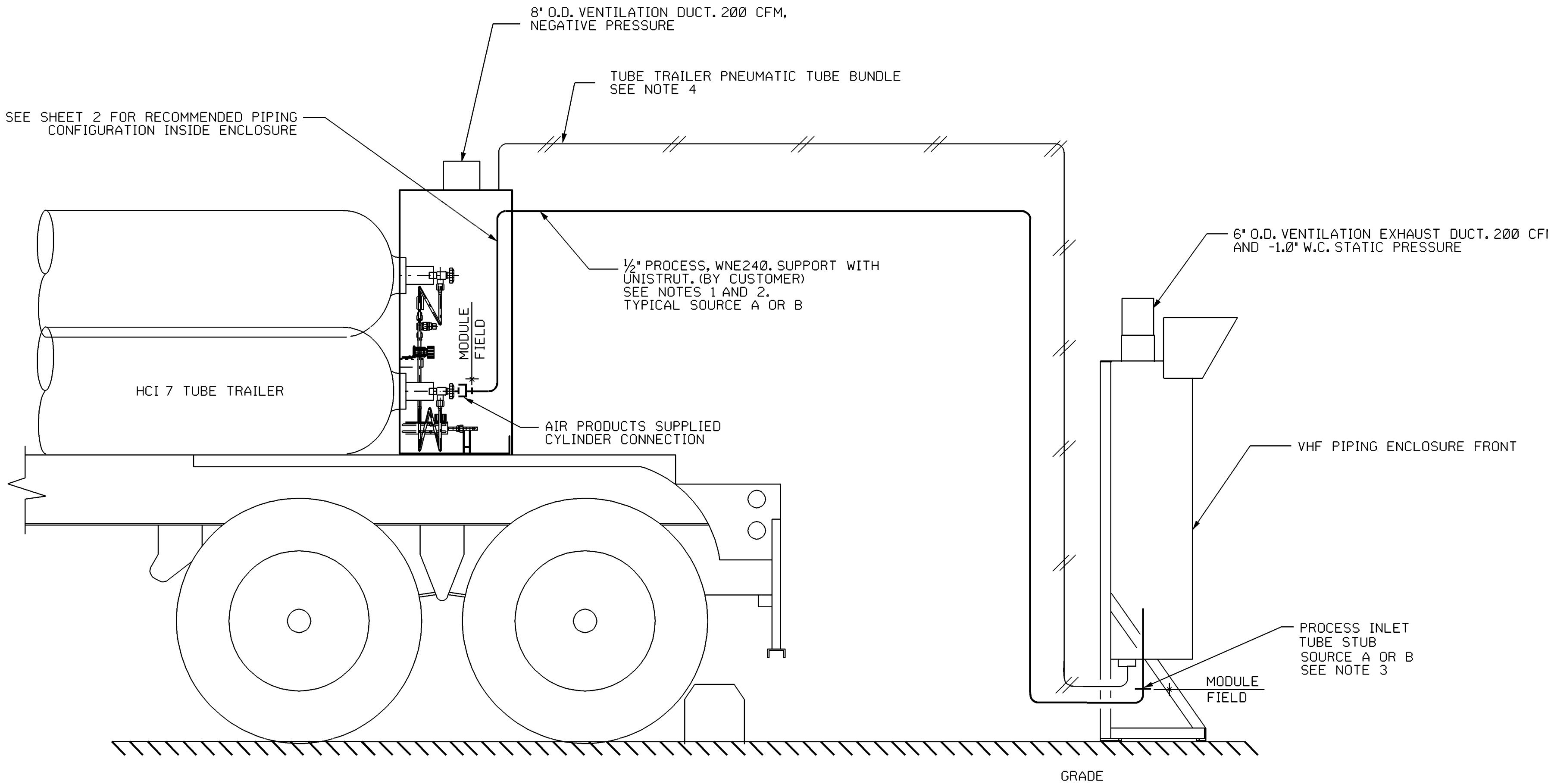
TITLE
INSTALLATION DRAWING
VHF PIGTAIL ASSEMBLY
Y/ DRUM
HCl

USED ON	051105
OWNER GROUP	PRODUCT ENG
RELEASE PURPOSE	PRELIMINARY
REFERENCE	
DOC No	BKA004 MECH 0018
SCALE	SHEET 1 OF 1

M:\Product\HIGH FLOW SYSTEM\BKA004\BKA004MECH\BKA004 MECH 0018.dgn

AI_D - 16OCT2002



NOTES:

1. SPECIFICATION WNE240 DESIGNATED HASTELLOY C-22 TUBING, 25 RA MAX., BUTT WELD JOINTS, AND INSTALLED TO ASME B31.3 DESIGN CODE. A COPY OF THIS SPECIFICATION CAN BE FOUND IN THE OPERATION MANUAL APPENDIX.
2. MAXIMUM FIELD INSTALLED ½" TUBE IS 16 FT. FROM DISS TO VHF PROCESS INLET.
3. FOR VHF MODULE PROCESS CONNECTIONS, SEE DRAWING (SW003821.SLDDRW).
4. A PNEUMATIC TUBE BUNDLE WILL BE SUPPLIED BY AIR PRODUCTS. SEE DRAWING BBB018 MECH 0020 FOR SOURCE A INSTALLATION DETAILS.

TOLERANCES UNLESS OTHERWISE SPECIFIED
LINEAR ± HOLE SIZE ±
ANGLE ± HOLE LOCATION ±
ALL DIMENSIONS IN inches
THIRD ANGLE PROJECTION
WEIGHT

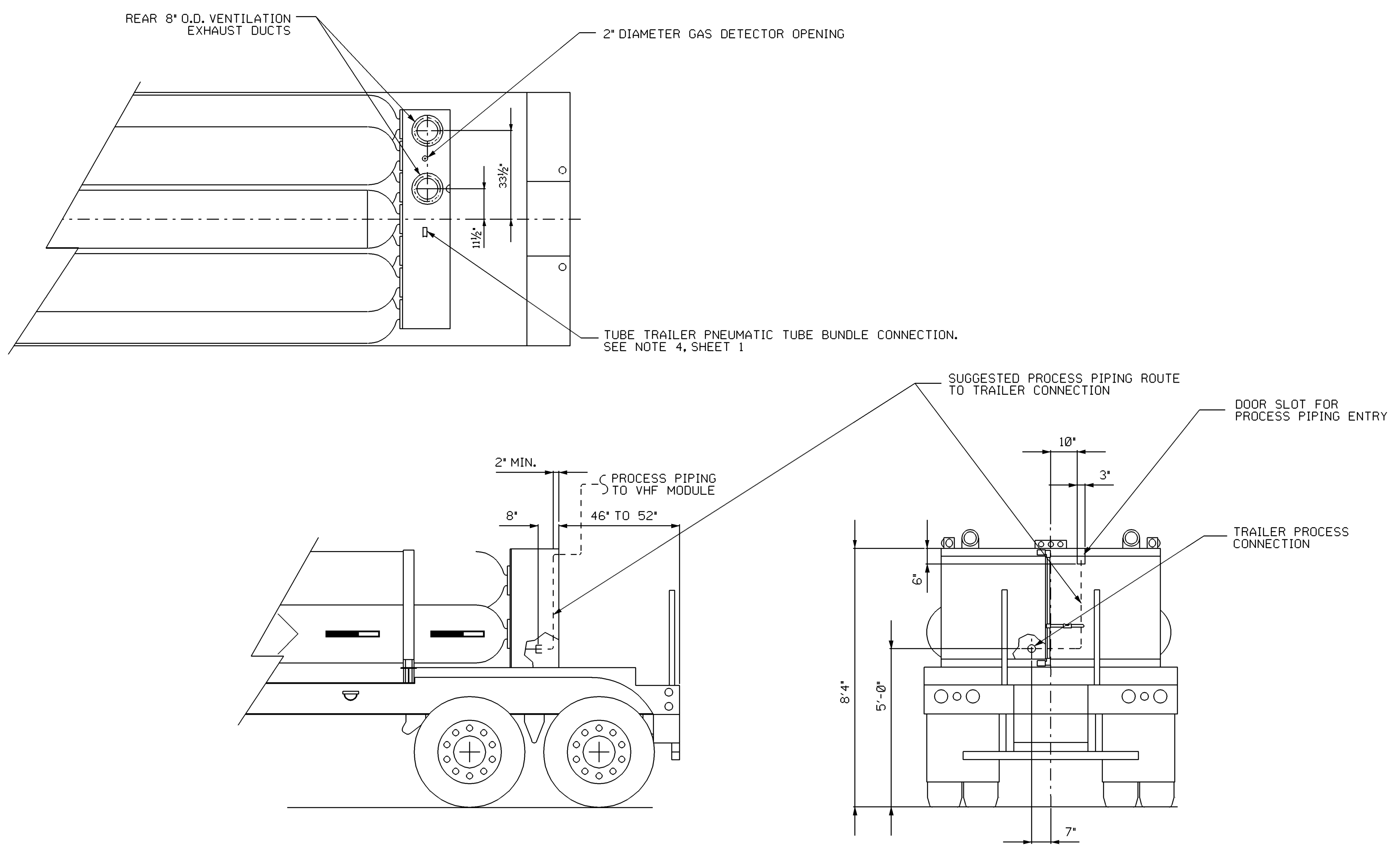
REV	CN No	REVISION DESCRIPTION	DATE	BY	CHK'D	APP'D
0		APPROVED FOR CONSTRUCTION	07/31/08	KMN	DJK	DJK

AIR PRODUCTS

TITLE
INSTALLATION DRAWING
VHF PIGTAIL ASSEMBLY (GAS)
7 TUBE TRAILER
HCl

USED ON	051105
OWNER GROUP	PRODUCT ENG
RELEASE PURPOSE	PRELIMINARY
REFERENCE	
DOC No	BKA004 MECH 0019
SCALE	SHEET 1 OF 2

M:\Product\HIGH FLOW SYSTEM\BKA004\BKA004MECH\BKA004 MECH 0019.dgn



TOLERANCES UNLESS OTHERWISE SPECIFIED	REV	CN No	REVISION DESCRIPTION	DATE	BY	CHK'D	APP'D
LINEAR ± HOLE SIZE ± ANGLE ± HOLE LOCATION ± ALL DIMENSIONS IN inches; THIRD ANGLE PROJECTION; WEIGHT	0		APPROVED FOR CONSTRUCTION	07/31/08	KMN	DJK	DJK

AIR PRODUCTS
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TITLE
INSTALLATION DRAWING
VHF PIGTAIL ASSEMBLY
7 TUBE TRAILER
HCl

USED ON	051105
OWNER GROUP	PRODUCT ENG
RELEASE PURPOSE	PRELIMINARY
REFERENCE	
DOC No	BKA004 MECH 0019
SCALE	SHEET 2 OF 2

ALD - 18OCT2002

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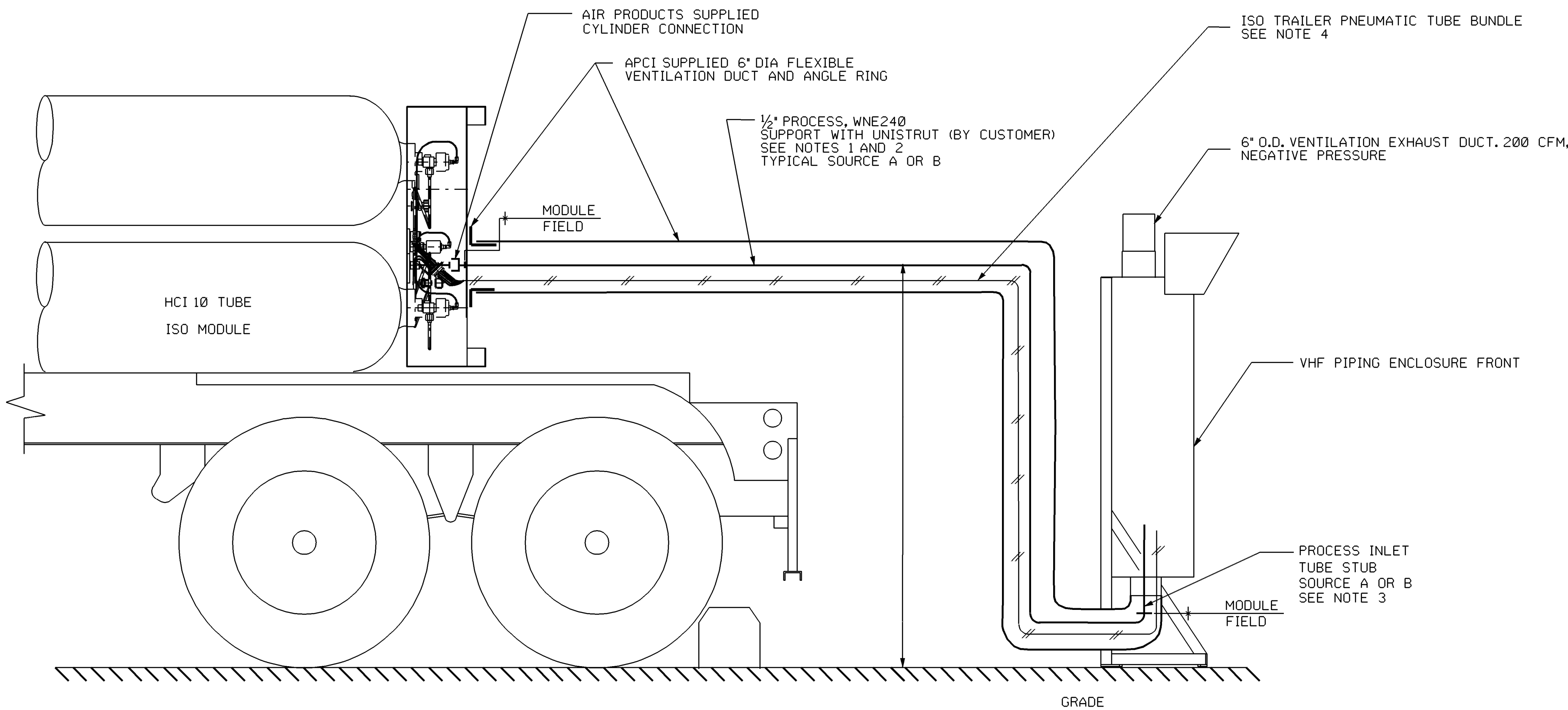


NOTES:

1. SPECIFICATION WNE240 DESIGNATES HASTELLOY C-22 TUBING, 25 RA MAX., BUTT WELDED JOINTS, AND INSTALLED TO ASME B31.3 DESIGN CODE. A COPY OF THIS SPECIFICATION CAN BE FOUND IN THE OPERATION MANUAL APPENDIX.
2. MAXIMUM FIELD INSTALLED ½" TUBE IS 16 FT. FROM DISS TO VHF PROCESS INLET.
3. FOR VHF MODULE PROCESS CONNECTIONS, SEE DRAWING SW003730.SLDDRW.
4. A PNEUMATIC TUBE BUNDLE WILL BE SUPPLIED BY AIR PRODUCTS. SEE DRAWING BBB018 MECH 0018 FOR SOURCE A INSTALLATION DETAILS.

TOLERANCES UNLESS OTHERWISE SPECIFIED
LINEAR ± HOLE SIZE ±
ANGLE ± HOLE LOCATION ±
ALL DIMENSIONS IN inches
THIRD ANGLE PROJECTION
WEIGHT

REV	CN No	REVISION DESCRIPTION	DATE	BY	CHK'D	APP'D
0		APPROVED FOR CONSTRUCTION	07/31/08	KMN	DJK	DJK

AIR PRODUCTS

TITLE
INSTALLATION DRAWING
VHF PIGTAIL ASSEMBLY
10 TUBE ISO
HCI

USED ON	051105
OWNER GROUP	PRODUCT ENG
RELEASE PURPOSE	PRELIMINARY
REFERENCE	
DOC No	BKA004 MECH 0020
SCALE	SHEET 1 OF 1

ALD - 16OCT2002

M:\Product\HIGH FLOW SYSTEM\BKA004\BKA004MECH\BKA004 MECH 0020.dgn

PVC End Cap/Flexible Ventilation Duct Installation

Many bulk gas delivery modules are equipped with a 6” diameter flexible ventilation duct, and PVC end cap. This assembly permits a simple and lightweight design for the operator . The following describes how this assembly fits together.

The assembly is comprised of three main parts –

- 6” diameter flexible ventilation duct
- 6” diameter gray PCV end cap
- Two ¼” diameter clevis pins.

These items are shown in figure 1 below.

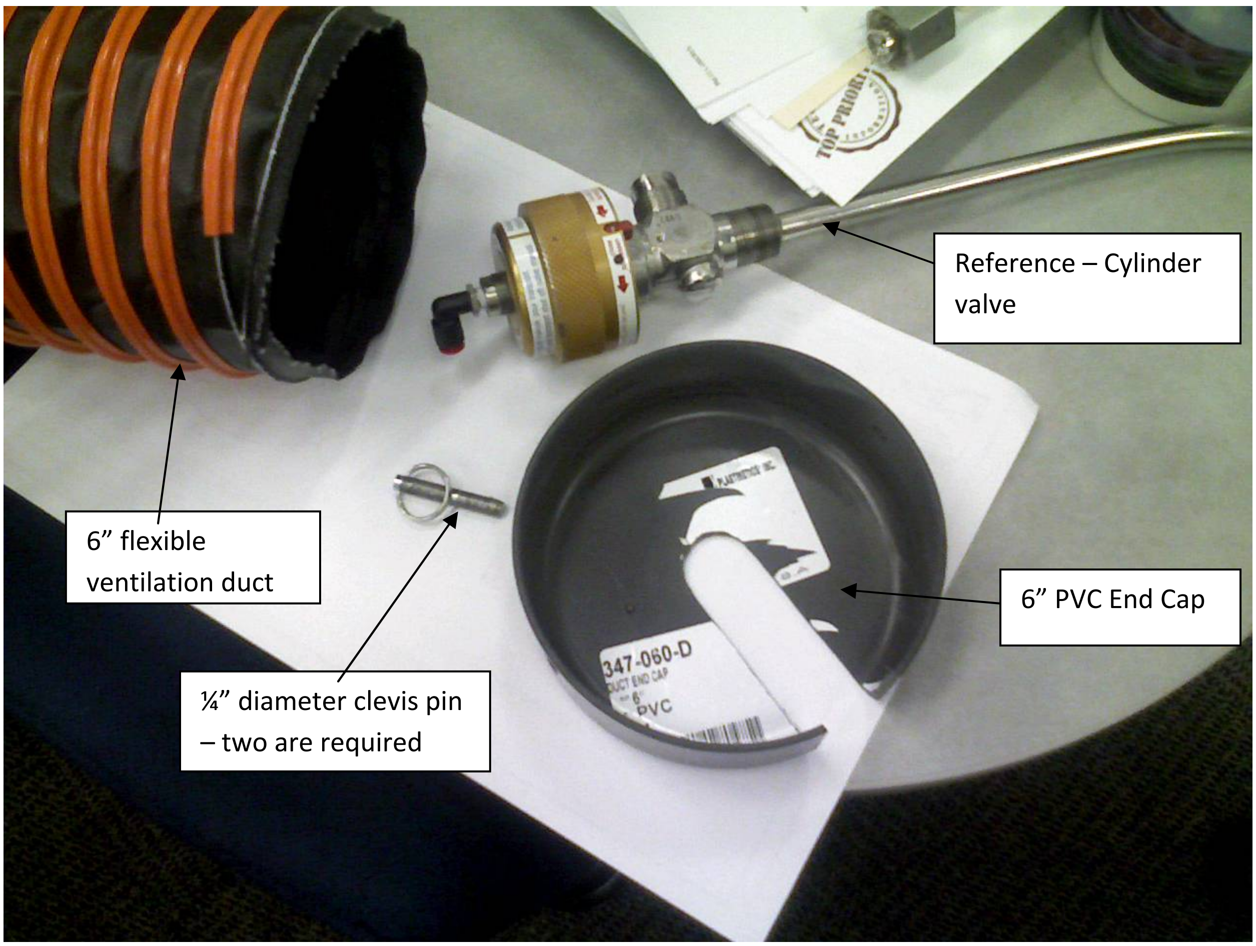


Figure 1 - Flexible ventilation duct, and PVC end cap.

PVC End Cap/Flexible Ventilation Duct Installation

Procedure:

1. Slide the slot in the PVC end cap over the neck of the cylinder valve, between the valve and the container.
2. Pull the flexible ventilation duct up and inside the PVC end cap.
3. Push two clevis pins, 180 degrees apart, into the PVC end cap and into the ventilation duct. The clevis pins should capture the metal spiral ring in the flex duct, between the clevis pin and the face of the PVC end cap.
4. If necessary, reduce enclosure static pressure by drilling holes in the end of the PVC cap.

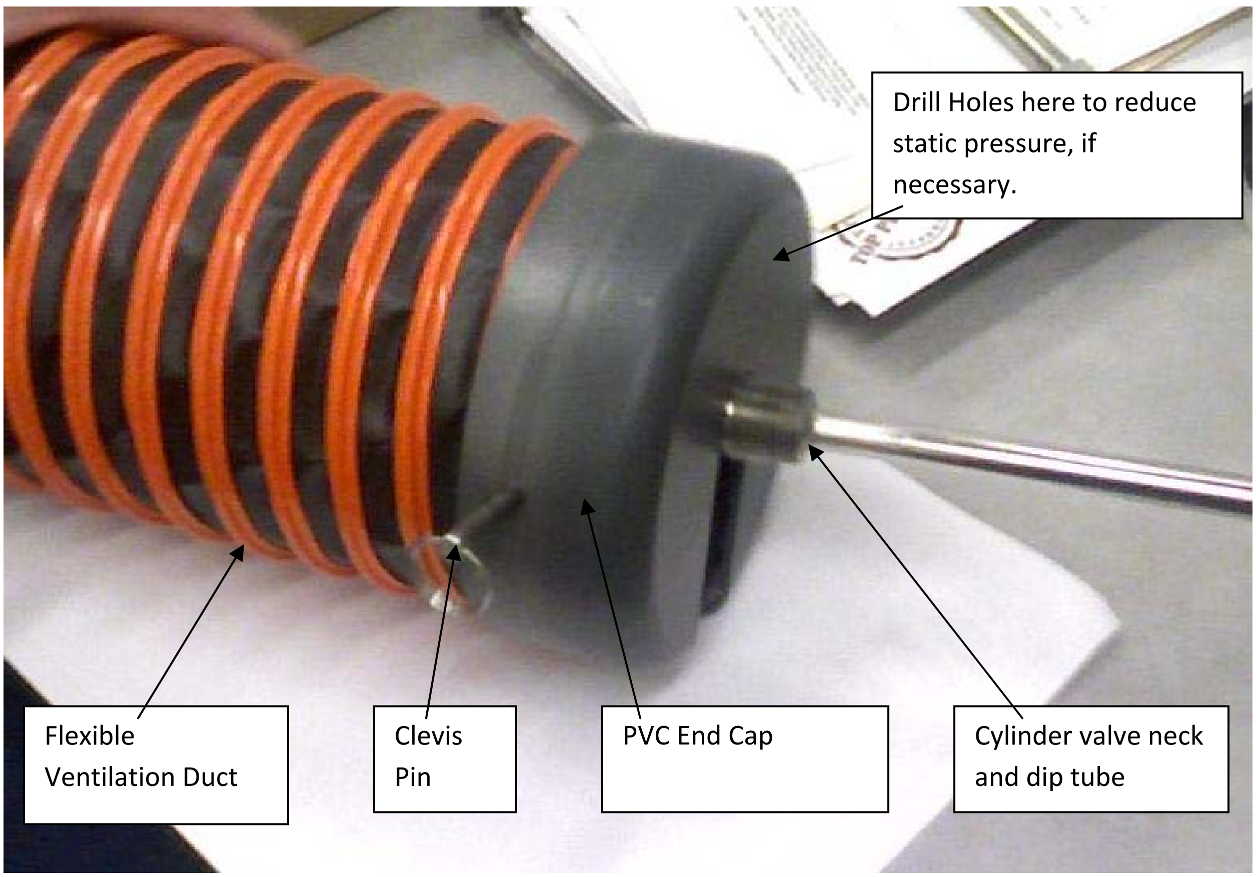
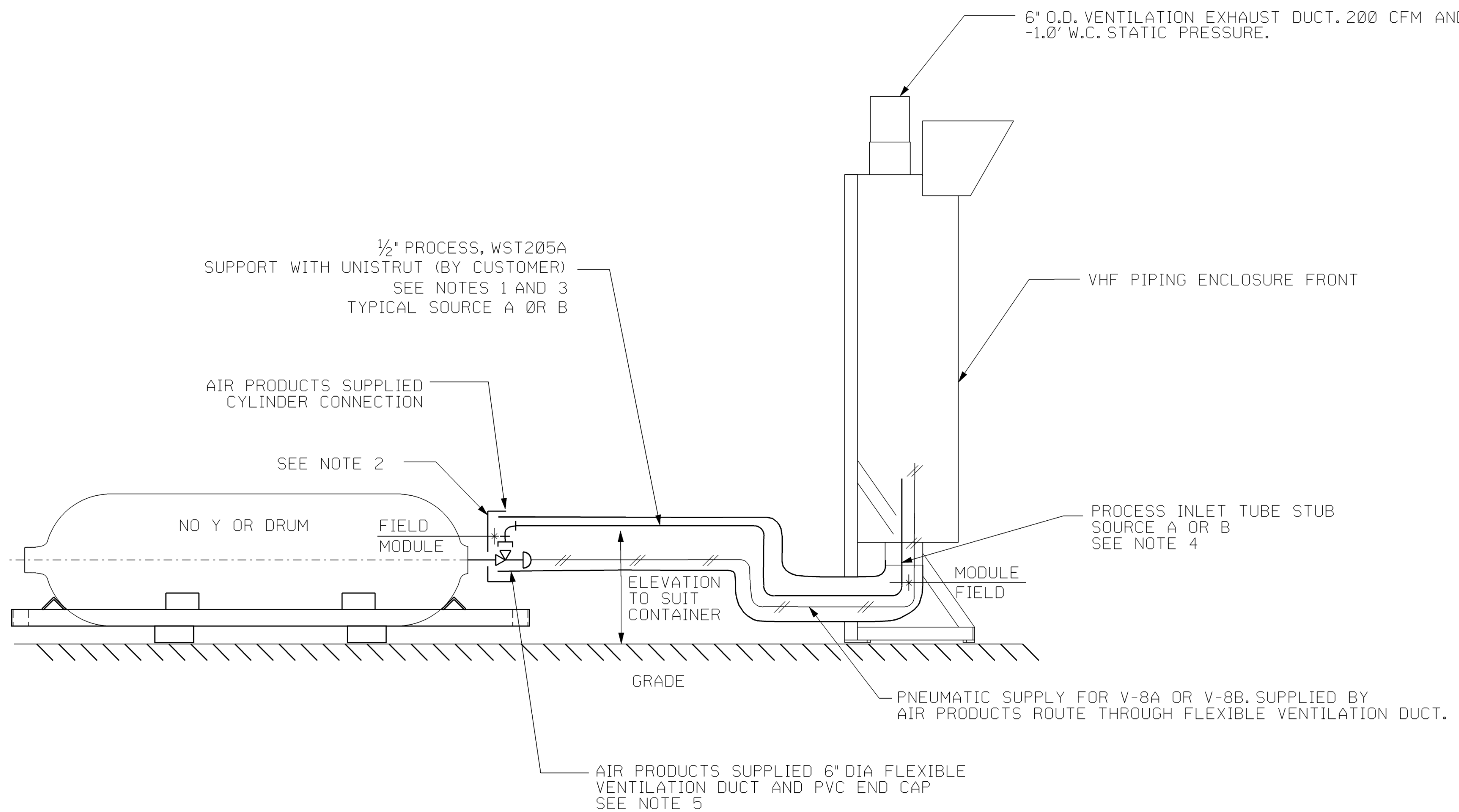


Figure 2 - Flexible ventilation duct, and PVC end cap Assembled



NOTES:

1. SPECIFICATION WST205A DESIGNATES 316 SEAMLESS STAINLESS STEEL TUBING, ELECTROPOLISHED TO 10RA MAX., BUTT WELDED JOINTS, AND INSTALLED TO ASME B31.3 DESIGN CODE. A COPY OF THIS SPECIFICATION CAN BE FOUND IN THE OPERATION MANUAL APPENDIX.

2. BALANCE EXHAUST ON SINGLE AND DUAL SOURCE VHF MODULES BY DRILLING HOLES IN PVC CAP TO ADJUST FLOW AND STATIC PRESSURE.

3. MAXIMUM FIELD INSTALLED ½" TUBE IS 9' FROM DISS TO VHF PROCESS INLET.

4. FOR VHF MODULE PROCESS CONNECTIONS, SEE DRAWING SW003730.SLDDRW.

5. PUSH FLEXIBLE VENTLAT ION DUCT OVER HARD PIPING AND ATTACH TO VHF MODULE. PUSH THE FLEXIBLE VENTILATION DUCT INTO PVC CAP, AND INSTALL 2 CLEVIS PINS TO LOCK DUCT IN PLACE.

6. 9FT. OF POLYURETHANE PNEUMATIC TUBING IS SUPPLIED BY AIR PRODUCTS.

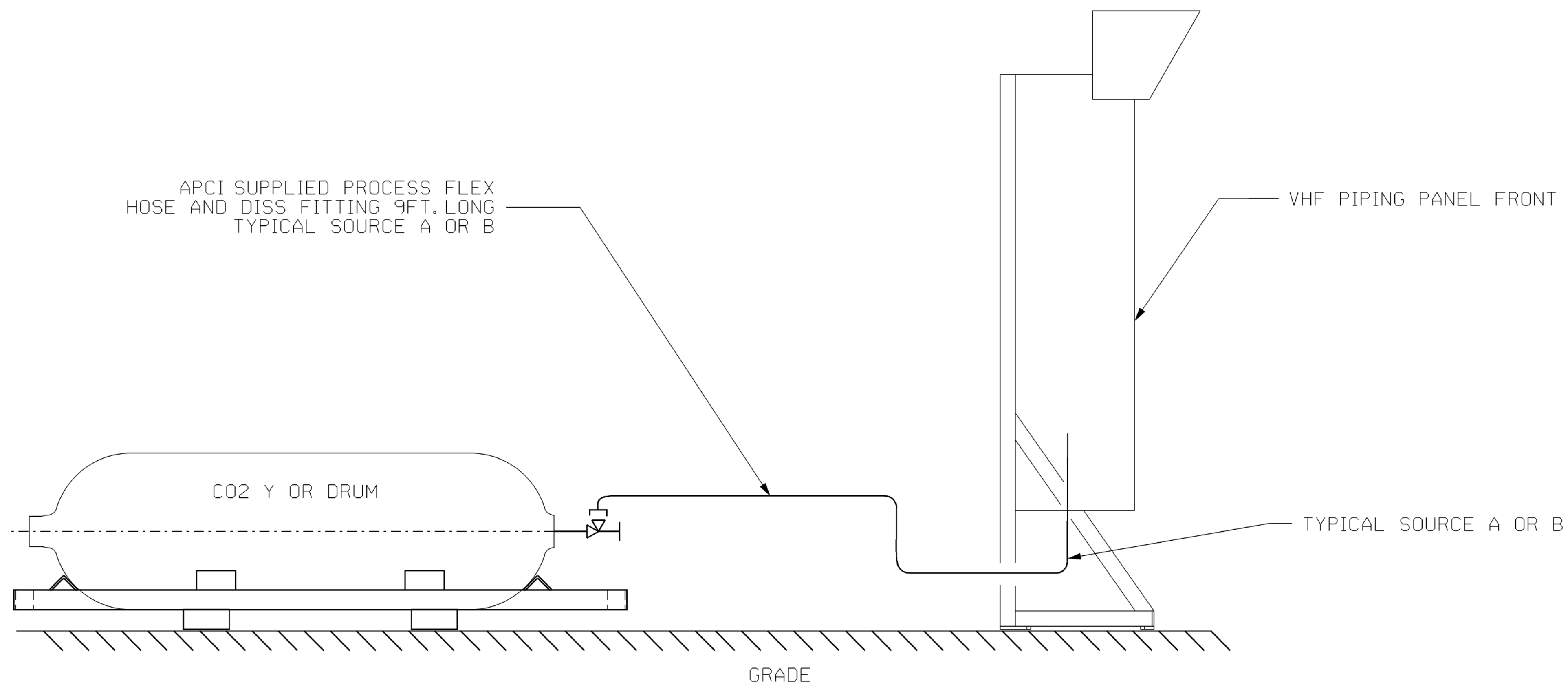
TOLERANCES UNLESS OTHERWISE SPECIFIED
LINEAR ± HOLE SIZE ±
ANGLE ± HOLE LOCATION ±
ALL DIMENSIONS IN inches
THIRD ANGLE PROJECTION
WEIGHT

REV	CN No	REVISION DESCRIPTION	DATE	BY	CHK'D	APP'D
0		APPROVED FOR CONSTRUCTION	23FEB11	KMN	MLC	DJK

TITLE: INSTALLATION DRAWING VHF PIGTAIL ASSEMBLY Y/ DRUM NO

USED ON	051105
OWNER GROUP	PRODUCT ENG
RELEASE PURPOSE	PRELIMINARY
REFERENCE	
DOC No	BKA004 MECH 0025
SCALE	SHEET 1 OF 1

M:\Product\HIGH FLOW SYSTEM\BKA004\BKA004MECH\BKA004 MECH 0025.dgn



NOTES:

1. FOR VHF PIPING CONNECTIONS, SEE DRAWING INS10554.SLDDRW.

TOLERANCES UNLESS OTHERWISE SPECIFIED
LINEAR ± HOLE SIZE ±
ANGLE ± HOLE LOCATION ±
ALL DIMENSIONS IN inches
THIRD ANGLE PROJECTION
WEIGHT

REV	CN No	REVISION DESCRIPTION	DATE	BY	CHK'D	APP'D
Ø		APPROVED FOR CONSTRUCTION	23FEB11	KMN	MLC	DJK

AIR PRODUCTS

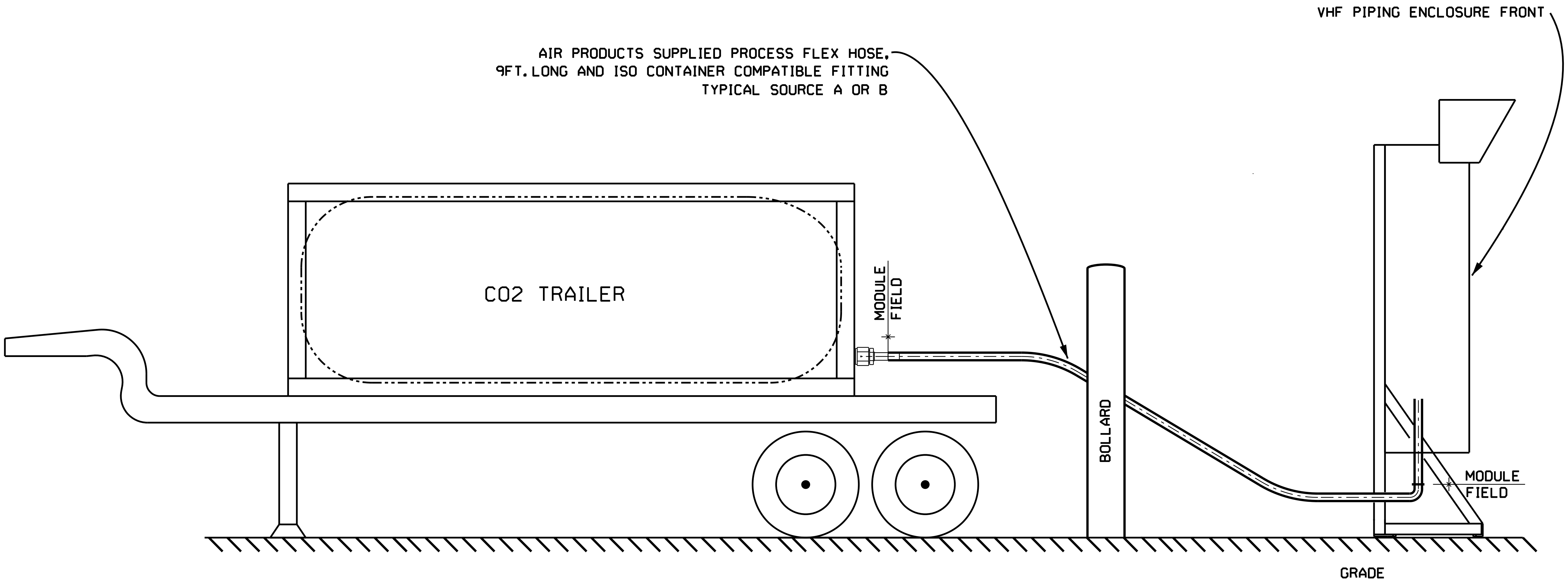
TITLE
INSTALLATION DRAWING
VHF PIGTAIL ASSEMBLY
Y/ DRUM
CØ2

USED ON	Ø511Ø5
OWNER GROUP	PRODUCT ENG
RELEASE PURPOSE	PRELIMINARY
REFERENCE	
DOC No	BKAØØ4 MECH ØØ26
SCALE	SHEET 1 OF 1

A1_D : 16OCT2002

M:\Product\HIGH FLOW SYSTEM\BKA004\BKA004MECH\BKA004 MECH 0026.dgn

-INE: LEV=10 D: 22" X 34" (558.5 X 863.6) - CO=6, LC=2, WT=0



NOTES:

1. FOR VHF MODULE PROCESS CONNECTIONS, SEE DRAWING INS 10554.SLDDRW.

TOLERANCES UNLESS OTHERWISE SPECIFIED	REV	CN No	REVISION DESCRIPTION	DATE	BY	CHK'D	APP'D
LINEAR ± HOLE SIZE ± ANGLE ± HOLE LOCATION ± ALL DIMENSIONS IN inches							
THIRD ANGLE PROJECTION	0		APPROVED FOR CONSTRUCTION	04/14/11	JRB	MLC	MLC
WEIGHT							

AIR PRODUCTS

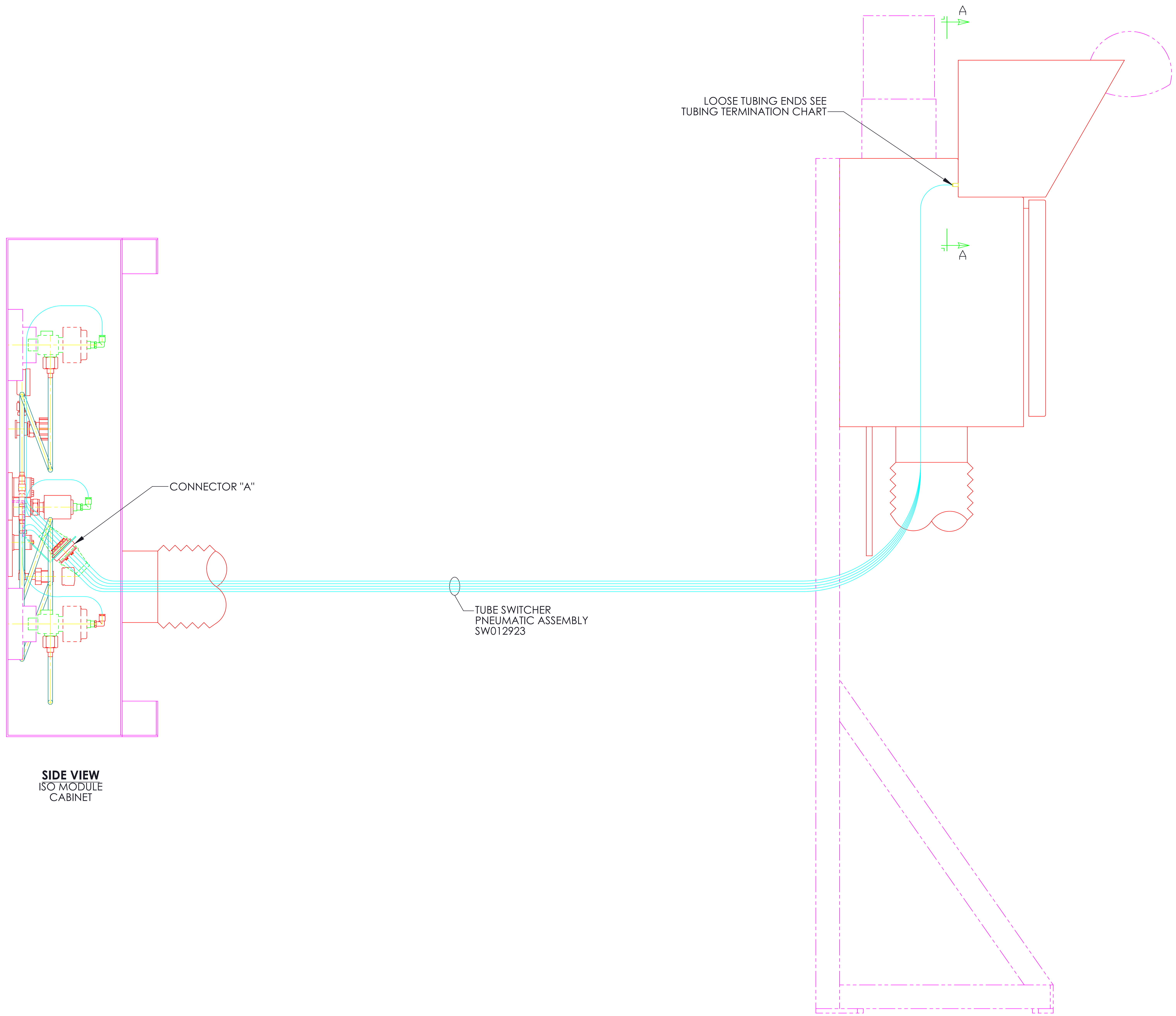
TITLE: INSTALLATION DRAWING VHF PIGTAIL ASSEMBLY CO2 TRAILER

USED ON	
OWNER GROUP	
RELEASE PURPOSE	
REFERENCE	
DOC No	BNTLY00434
SCALE	SHEET 1 OF 1

A1_D : 16OCT2002

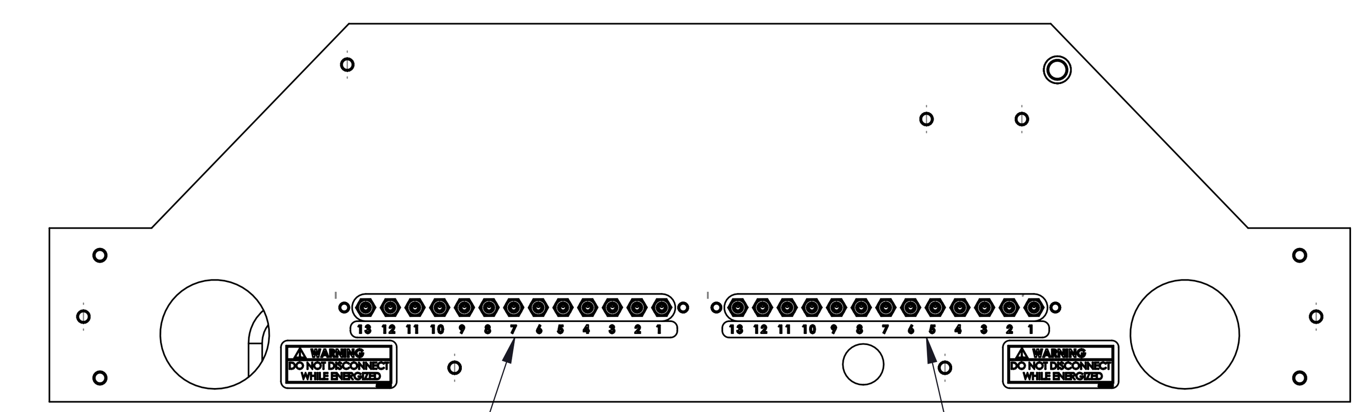
$FILES

ING SCALE = 1":1'



SIDE VIEW
ISO MODULE
CABINET

SIDE VIEW
UNIVERSAL PIGTAIL
ENCLOSURE



VIEW "A-A"
REAR VIEW
CONTROLLER
(NTS)

TUBING TERMINATION CHART	
LOOSE END TUBING LABEL	AP11 CONTROLLER SOLENOID LOCATION
R1 TO V8-1	R1
R2 TO V8-2	R2
R3 TO V8-3	R3
R4 TO V8-4	R4
R5 TO V8-5	R5
R6 TO V8-6	R6
R7 TO V8-7	R7
R8 TO V8-8	R8
R9 TO V8-9	R9
R10 TO V8-10	R10
R11 TO V8-11	R11
R12 TO V8-12	R12
L8 TO V8	L8

NOTES:

1. PNEUMATIC SUPPLY, 85-95 PSIG. OVERPRESSURE PROTECTION MUST BE PROVIDED BY THE FACILITY, SET AT 100 PSIG NITROGEN OR ANOTHER INERT GAS IS RECOMMENDED FOR PNEUMATIC SUPPLY. IF COMPRESSED DRY AIR IS USED IT MAY PROMOTE THE CORROSION OF ELETRICAL CONNECTORS WITH A CONCURRENT DETERIORATION OF CONTROLLER PERFORMANCE.
2. REMOVE ONLY THE REQUIRED PNEUMATIC PLUGS ON BACK OF AP11 CONTROLLER IN SOLENOID MANIFOLDS, DISCARD PLUGS.

UNLESS OTHERWISE SPECIFIED:

FRACTIONAL: ± NA

DECIMAL: ± NA

APPROVALS		DATE
DRAWN	D.J. Amelio	04/09/2014
CHECKED	J.C. Barthold	04/14/2014
ENG APPR.		00/00/0000
MFG APPR.		00/00/0000
APPROVED	T.W. Piltz	04/14/2014

AIR PRODUCTS

TITLE: Installation for BSGS 8/12 Switcher AP11

Part no.

MATERIAL

FINISH

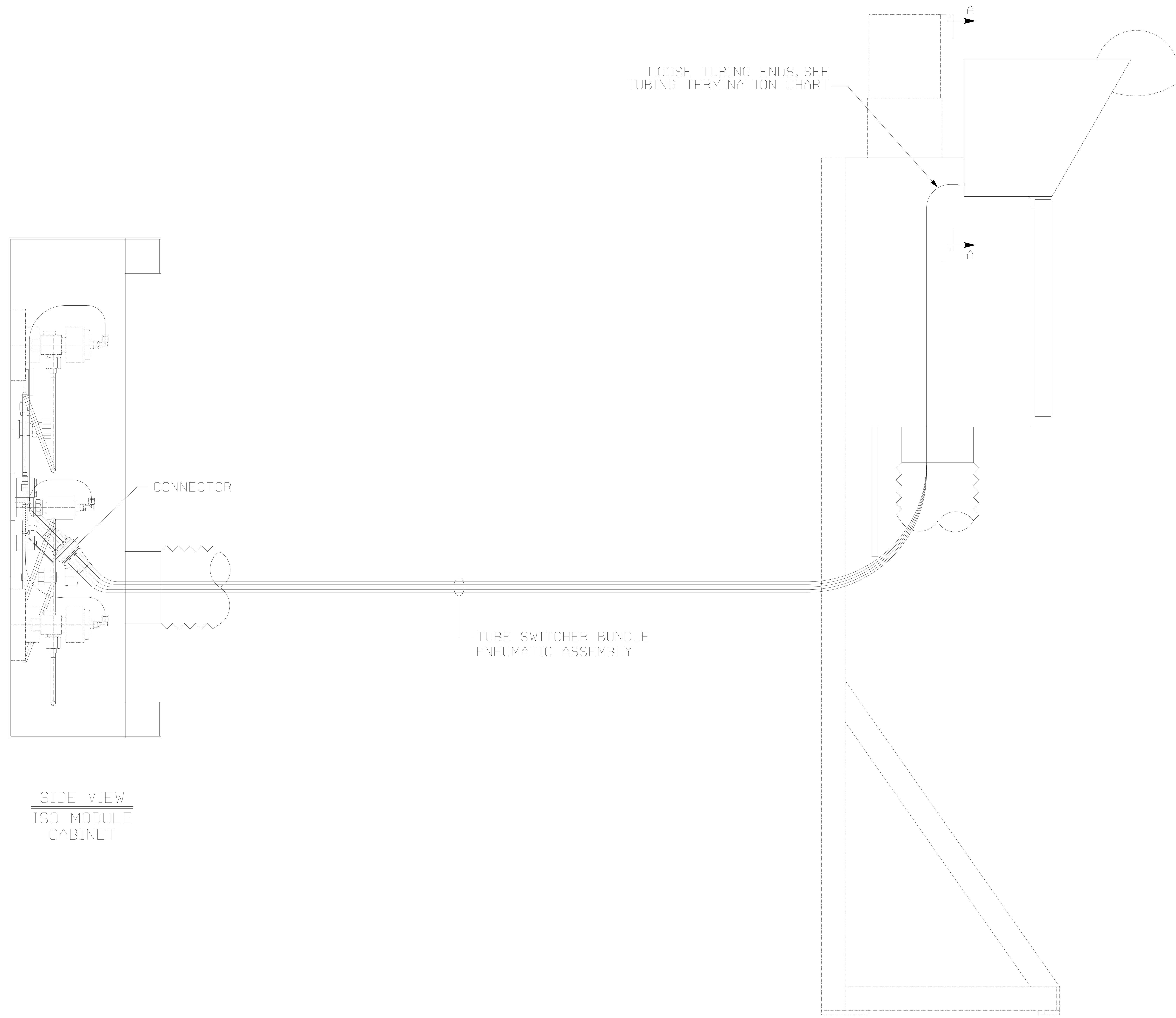
DWG. NO. SW012922.slddrw | SIZE D | REV 0

SCALE: 1:1 | REF. | SHEET 1 OF 1

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
34924	0	INITIAL RELEASE	04/14/2014	DJA	JCB	TWP	XXX

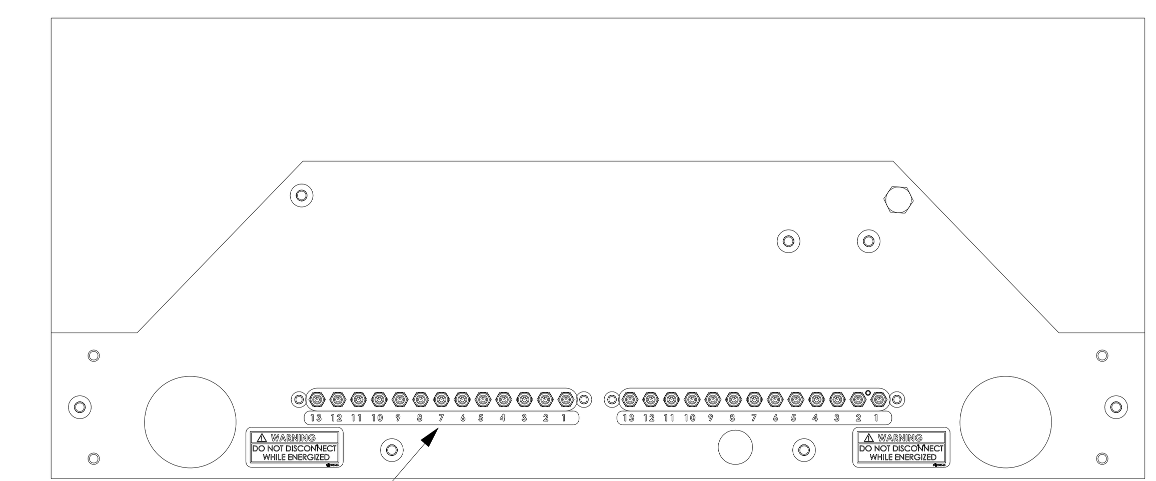
NOTES:

1. PNEUMATIC SUPPLY, 85-95 PSIG. OVERPRESSURE PROTECTION MUST BE PROVIDED BY THE FACILITY, SET AT 100 PSIG. NITROGEN OR ANOTHER INERT GAS IS RECOMMENDED FOR PNEUMATIC SUPPLY. IF COMPRESSED DRY AIR IS USED IT MAY PROMOTE THE CORROSION OF ELECTRICAL CONNECTORS WITH A CONCURRENT DETERIORATION OF CONTROLLER PERFORMANCE.



SIDE VIEW
ISO MODULE CABINET

SIDE VIEW
UNIVERSAL PIGTAIL ENCLOSURE



VIEW "A-A"
REAR VIEW CONTROLLER (NTS)

TUBING TERMINATION CHART	
LOOSE END TUBING LABEL	AP11 CONTROLLER RIGHT SIDE SOLENOID MANIFOLD
R1-V-8-1	R1
R2-V-8-2	R2
R3-V-8-3	R3
R4-V-8-4	R4
R5-V-8-5	R5
R6-V-8-6	R6
R7-V-8-7	R7
R8-V-8-8	R8
L8-V-8	L8

REMOVE ONLY THE REQUIRED PNEUMATIC PLUGS ON BACK OF AP11 CONTROLLER IN THE RIGHT SIDE SOLENOID MANIFOLD. DISCARD PLUGS.

ECN NO.	REV.	ECR NO.	REVISION DESCRIPTION	DATE	BY	CHK'D	APPD.
	0		NEW RELEASE	02/20/13	JCB	JMF	JMF

UNLESS OTHERWISE SPECIFIED TOLERANCES ARE
FRACTION ± N/A DECIMAL ± N/A ANGLE ± N/A
HOLE LOCATION ± N/A HOLE SIZE ± N/A

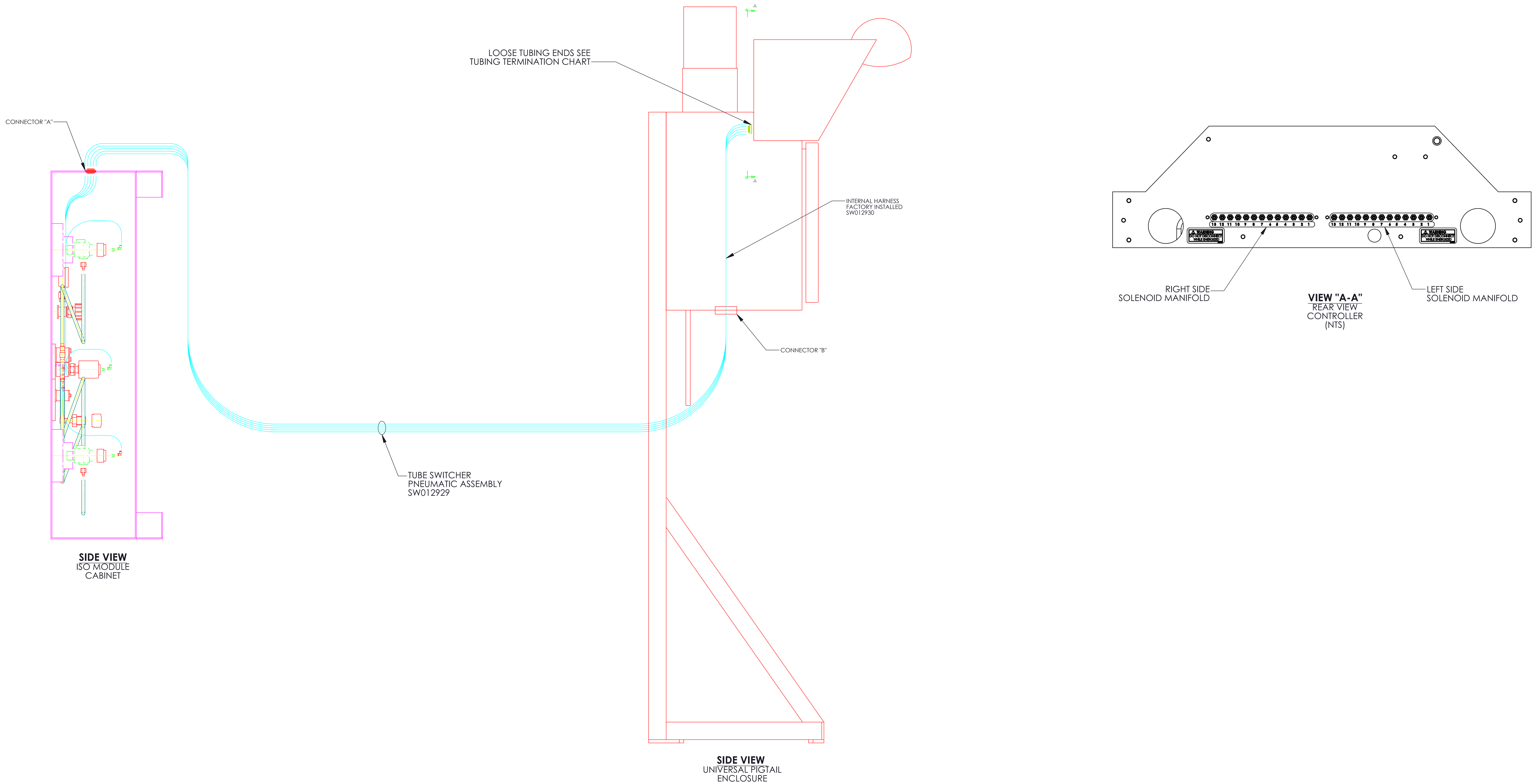
INCHES
MILLIMETERS
INCHES (MILLIMETERS)

		DATE
DRAWN	J.BARTHOLD	02/19/13
CHECKED	J. FEHNEL	02/20/13
MANUFACTURING		
ENGINEER		
APPD.	J. FEHNEL	02/20/13

TITLE
INSTALLATION DRAWING
AP11 UNIVERSAL PIGTAIL
8 TUBE TRAILER
PNEUMATIC INTERCONNECTION

AIR PRODUCTS
ALLENTOWN, PENNSYLVANIA

DWG NO. BNTLY00827.DGN
D REV. 0
SCALE NTS REF. SHEET 1 OF 1



NOTES:

1. PNEUMATIC SUPPLY, 85-95 PSIG. OVERPRESSURE PROTECTION MUST BE PROVIDED BY THE FACILITY, SET AT 100 PSIG NITROGEN OR ANOTHER INERT GAS IS RECOMMENDED FOR PNEUMATIC SUPPLY. IF COMPRESSED DRY AIR IS USED IT MAY PROMOTE THE CORROSION OF ELETRICAL CONNECTORS WITH A CONCURRENT DETERIORATION OF CONTROLLER PERFORMANCE.

2. REMOVE ONLY THE REQUIRED PNEUMATIC PLUGS ON BACK OF AP11 CONTROLLER IN SOLENOID MANIFOLDS, DISCARD PLUGS.

TUBING TERMINATION CHART	
LOOSE END TUBING LABEL	AP11 CONTROLLER SOLENOID LOCATION
R1 TO V8-1	R1
R2 TO V8-2	R2
R3 TO V8-3	R3
R4 TO V8-4	R4
R5 TO V8-5	R5
R6 TO V8-6	R6
R7 TO V8-7	R7

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
34918	0	INITIAL RELEASE	04/18/2014	DJA	JCB	TWP	XXX

Part no.

UNLESS OTHERWISE SPECIFIED:
FRACTIONAL: ± NA
DECIMAL: ± NA

MATERIAL

FINISH

APPROVALS		DATE
DRAWN	D.J. Amelio	04/14/2014
CHECKED	J.C. Barthold	04/18/2014
ENG APPR.		
MFG APPR.		00/00/0000
APPROVED	T.W. Piltz	04/18/2014

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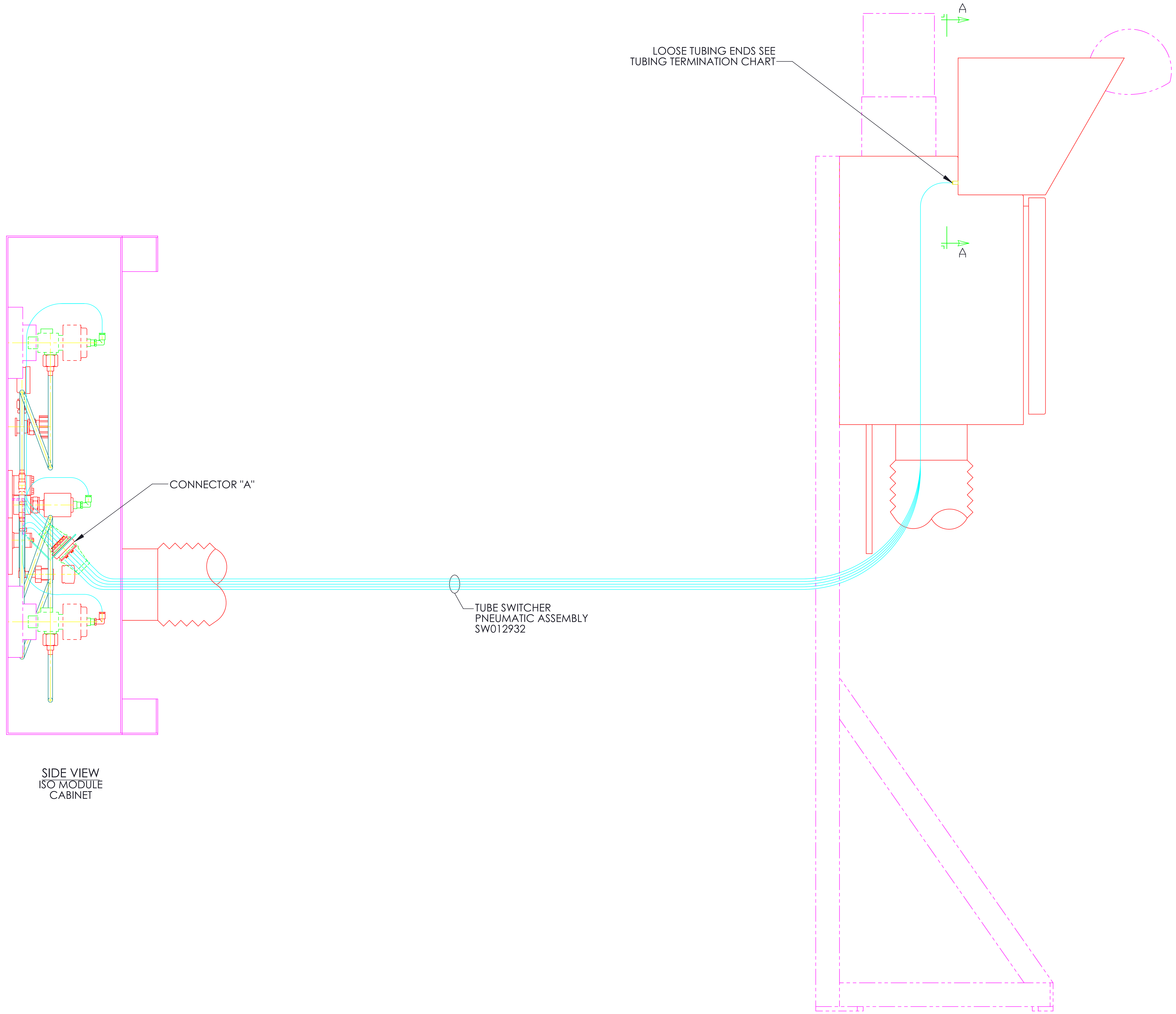
AIR PRODUCTS

TITLE: INSTALLION FOR BSGS HCL 7 TUBE SWITCHER AP11

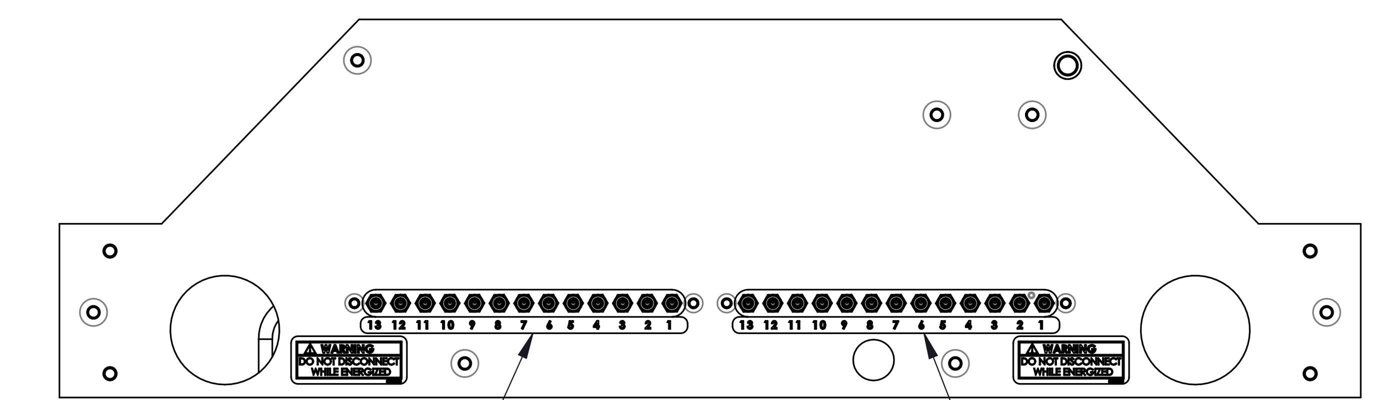
DWG. NO. SW012928.slddrw | SIZE D | REV 0

SCALE: 1:0.5 | REF. | SHEET 1 OF 1



SIDE VIEW
ISO MODULE
CABINET

SIDE VIEW
UNIVERSAL PIGTAIL
ENCLOSURE



VIEW "A-A"
REAR VIEW
CONTROLLER
(NTS)

TUBING TERMINATION CHART	
LOOSE END TUBING LABEL	AP11 CONTROLLER SOLENOID LOCATION
R1 TO V8-1	R1
R2 TO V8-2	R2
R3 TO V8-3	R3
R4 TO V8-4	R4
R5 TO V8-5	R5
R6 TO V8-6	R6
R7 TO V8-7	R7
R8 TO V8-8	R8
R9 TO V8-9	R9
R10 TO V8-10	R10

NOTES:

1.PNEUMATIC SUPPLY, 85-95 PSIG, OVERPRESSURE PROTECTION MUST BE PROVIDED BY THE FACILITY, SET AT 100 PSIG NITROGEN OR ANOTHER INERT GAS IS RECOMMENDED FOR PNEUMATIC SUPPLY. IF COMPRESSED DRY AIR IS USED IT MAY PROMOTE THE CORROSION OF ELETRICAL CONNECTORS WITH A CONCURRENT DETERIORATION OF CONTROLLER PERFORMANCE.

2.REMOVE ONLY THE REQUIRED PNEUMATIC PLUGS ON BACK OF AP11 CONTROLLER IN SOLENOID MANIFOLDS, DISCARD PLUGS.

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
34917	0	INITIAL RELEASE	04/17/2014	DJA	JCB	TWP	XXX

Part no.

UNLESS OTHERWISE SPECIFIED:
FRACTIONAL: ± NA
DECIMAL: ± NA

MATERIAL

FINISH

APPROVALS		DATE
DRAWN	D.J. Amelio	04/17/2014
CHECKED	J.C. Barthold	04/17/2014
ENG APPR.		00/00/0000
MFG APPR.		00/00/0000
APPROVED	T.W. Piltz	04/17/2014

AIR PRODUCTS

TITLE:
INSTALLATION FOR
BSGS HCL
10 TUBE SWITCHER AP11

DWG. NO. SW012931.slddrw
SIZE D
REV 0
SCALE: 1:1
REF.
SHEET 1 OF 1

NOTES:

1. 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. REROUTE TO SAFE LOCATION DURING INSTALLATION IF THE STANDARD OUTLET LOCATION IS DIRECTED TOWARD FLAMMABLE MATERIAL, PERSONNEL WALKWAYS OR PRESENTS OTHER POTENTIALLY DANGEROUS SITUATION. IT IS RECOMMENDED THAT GAS DETECTED AND/OR UVIR'S BE USED IN THE SURROUNDING AREA TO MONITOR POTENTIAL LEAK.

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
*****	C	added missing info	10/29/2009	JCB	DJK	DJK	

Part no.

UNLESS OTHERWISE SPECIFIED:
FRACTIONAL: ± NA
DECIMAL: ± NA

MATERIAL

FINISH: 1300LBS/589.7kg

APPROVALS		DATE
DRAWN	T. Guth	5/22/2008
CHECKED	J. Barthold	5/22/2008
ENG APPR.		
MFG APPR.		
APPROVED	J. Barthold	5/22/2008

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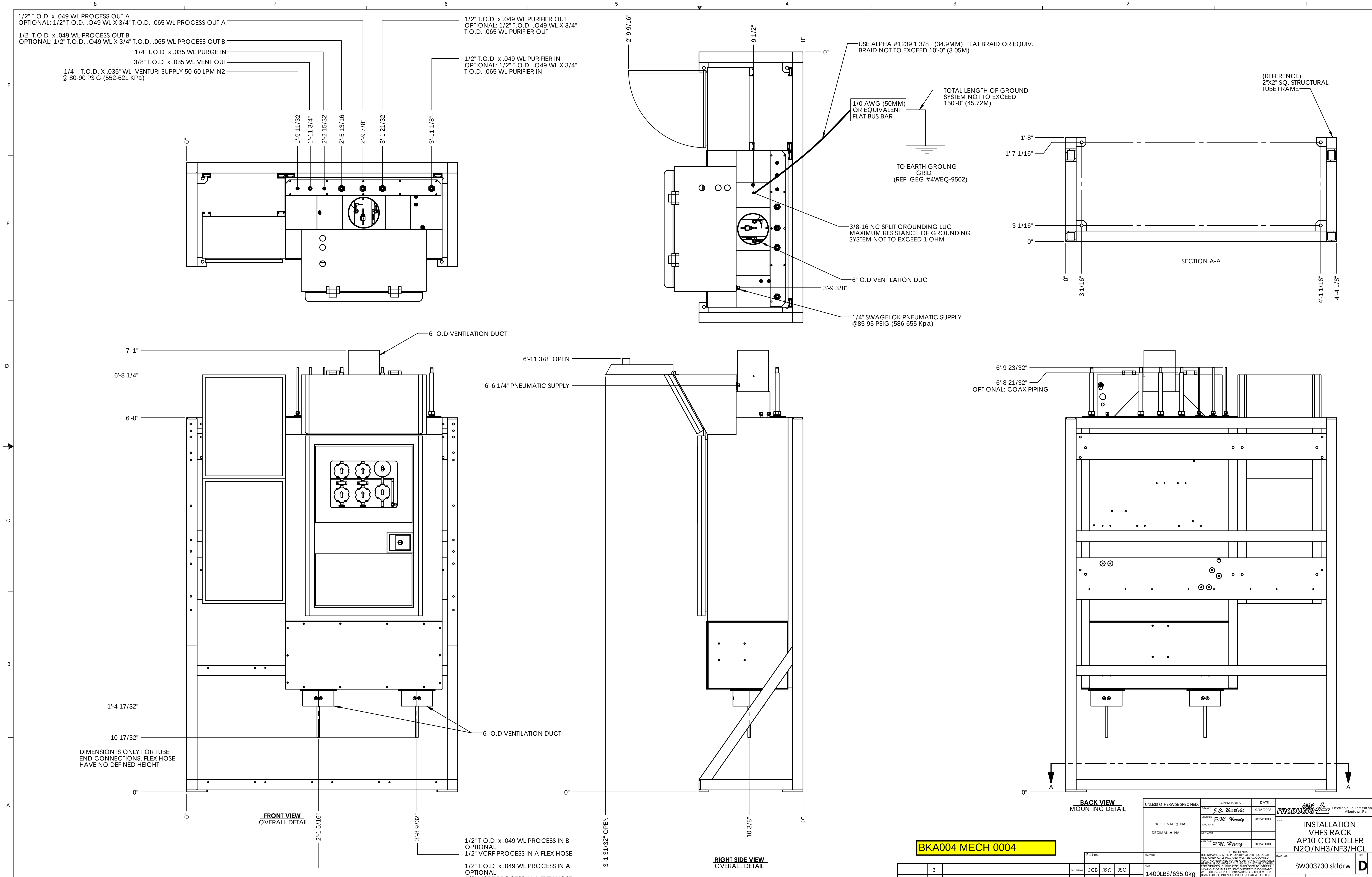
AIR PRODUCTS

TITLE: INSTALLATION VHFS RACK AP10 CONTOLLER SIH4/N2O

DWG. NO. INS10554.slddrw | SIZE D | REV C

SCALE: 1:9 | REF. | SHEET 1 OF 1



BKA004 MECH 0004

	B		04/16/2009	JCB	JSC	JSC		
ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.	

Part no.

UNLESS OTHERWISE SPECIFIED:

FRACTIONAL: ± NA

DECIMAL: ± NA

MATERIAL

FINISH 1400LBS/635.0kg

APPROVALS		DATE
DRAWN	J.C. Barthold	9/15/2008
CHECKED	P.M. Herwig	9/15/2008
ENG APPR.		
MFG APPR.		
APPROVED	P.M. Herwig	9/15/2008

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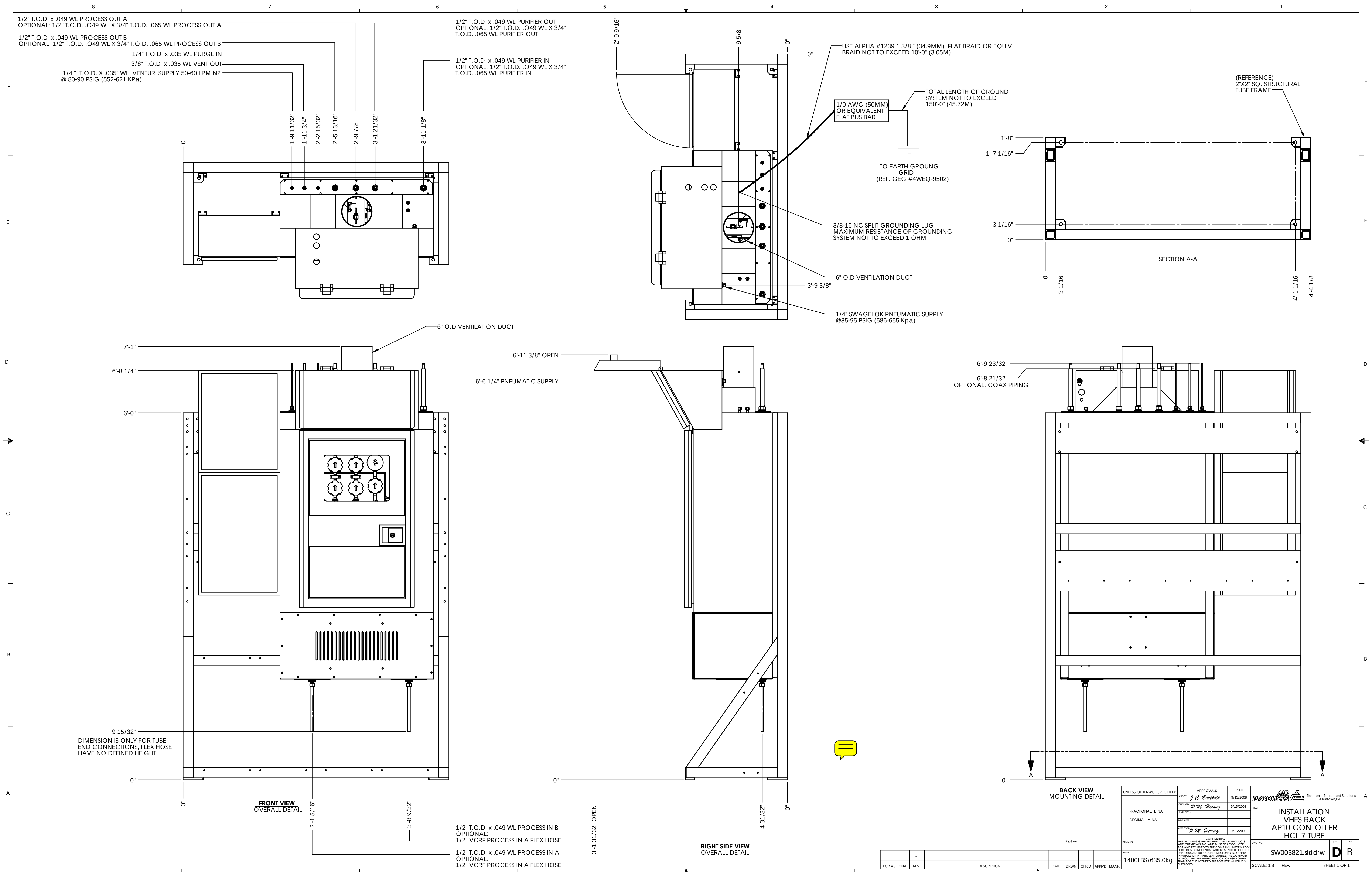
AIR PRODUCTS Electronic Equipment Solutions Allentown,Pa.

TITLE: INSTALLATION VHFS RACK AP10 CONTOLLER N2O/NH3/NF3/HCL

DWG. NO. SW003730.slddrw SIZE D REV B

SCALE: 1:8 REF. SHEET 1 OF 1


1/2" T.O.D x .049 WL PROCESS OUT A
OPTIONAL: 1/2" T.O.D. .O49 WL X 3/4" T.O.D. .065 WL PROCESS OUT A
1/2" T.O.D x .049 WL PROCESS OUT B
OPTIONAL: 1/2" T.O.D. .O49 WL X 3/4" T.O.D. .065 WL PROCESS OUT B
1/4" T.O.D x .035 WL PURGE IN
3/8" T.O.D x .035 WL VENT OUT
1/4 " T.O.D. X .035" WL VENTURI SUPPLY 50-60 LPM N2
@ 80-90 PSIG (552-621 KPa)
1/2" T.O.D x .049 WL PURIFIER OUT
OPTIONAL: 1/2" T.O.D. .O49 WL X 3/4"
T.O.D. .065 WL PURIFIER OUT
1/2" T.O.D x .049 WL PURIFIER IN
OPTIONAL: 1/2" T.O.D. .O49 WL X 3/4"
T.O.D. .065 WL PURIFIER IN
1'-9 11/32"
1'-11 3/4"
2'-2 15/32"
2'-5 13/16"
2'-9 7/8"
3'-1 21/32"
3'-11 1/8"
0"
2'-9 9/16"
9 5/8"
USE ALPHA #1239 1 3/8 " (34.9MM) FLAT BRAID OR EQUIV.
BRAID NOT TO EXCEED 10'-0" (3.05M)
1/0 AWG (50MM)
OR EQUIVALENT
FLAT BUS BAR
TOTAL LENGTH OF GROUND
SYSTEM NOT TO EXCEED
150'-0" (45.72M)
TO EARTH GROUNG
GRID
(REF. GEG #4WEQ-9502)
3/8-16 NC SPLIT GROUNDING LUG
MAXIMUM RESISTANCE OF GROUNDING
SYSTEM NOT TO EXCEED 1 OHM
6" O.D VENTILATION DUCT
3'-9 3/8"
1/4" SWAGELOK PNEUMATIC SUPPLY
@85-95 PSIG (586-655 Kpa)
(REFERENCE)
2"X2" SQ. STRUCTURAL
TUBE FRAME
1'-8"
1'-7 1/16"
3 1/16"
0"
SECTION A-A
3 1/16"
4'-1 1/16"
4'-4 1/8"
6" O.D VENTILATION DUCT
7'-1"
6'-8 1/4"
6'-0"
9 15/32"
DIMENSION IS ONLY FOR TUBE
END CONNECTIONS, FLEX HOSE
HAVE NO DEFINED HEIGHT
0"
FRONT VIEW
OVERALL DETAIL
2'-1 5/16"
3'-8 9/32"
1/2" T.O.D x .049 WL PROCESS IN B
OPTIONAL:
1/2" VCRF PROCESS IN A FLEX HOSE
1/2" T.O.D x .049 WL PROCESS IN A
OPTIONAL:
1/2" VCRF PROCESS IN A FLEX HOSE
6'-11 3/8" OPEN
6'-6 1/4" PNEUMATIC SUPPLY
0"
3'-1 31/32" OPEN
4 31/32"
RIGHT SIDE VIEW
OVERALL DETAIL
6'-9 23/32"
6'-8 21/32"
OPTIONAL: COAX PIPING
A
A
BACK VIEW
MOUNTING DETAIL
UNLESS OTHERWISE SPECIFIED:
FRACTIONAL: ± NA
DECIMAL: ± NA
APPROVALS
DATE
DRAWN J.C. Barthold 9/15/2008
CHECKED P.M. Herwig 9/15/2008
ENG APPR.
MFG APPR.
APPROVED P.M. Herwig 9/15/2008
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AIR PRODUCTS
Electronic Equipment Solutions
Allentown,Pa.
TITLE:
INSTALLATION
VHFS RACK
AP10 CONTOLLER
HCL 7 TUBE
Part no.
MATERIAL
FINISH
1400LBS/635.0kg
DWG. NO.
SW003821.slddrw
SIZE D
REV B
SCALE: 1:8
REF.
SHEET 1 OF 1
B
ECR # / ECN#
REV.
DESCRIPTION
DATE
DRWN
CHK'D
APPR'D
MANF.

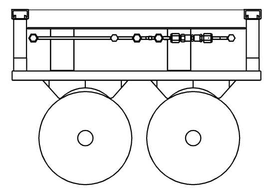
NOTES:

1. ESTIMATED WEIGHT= 150 LBS.

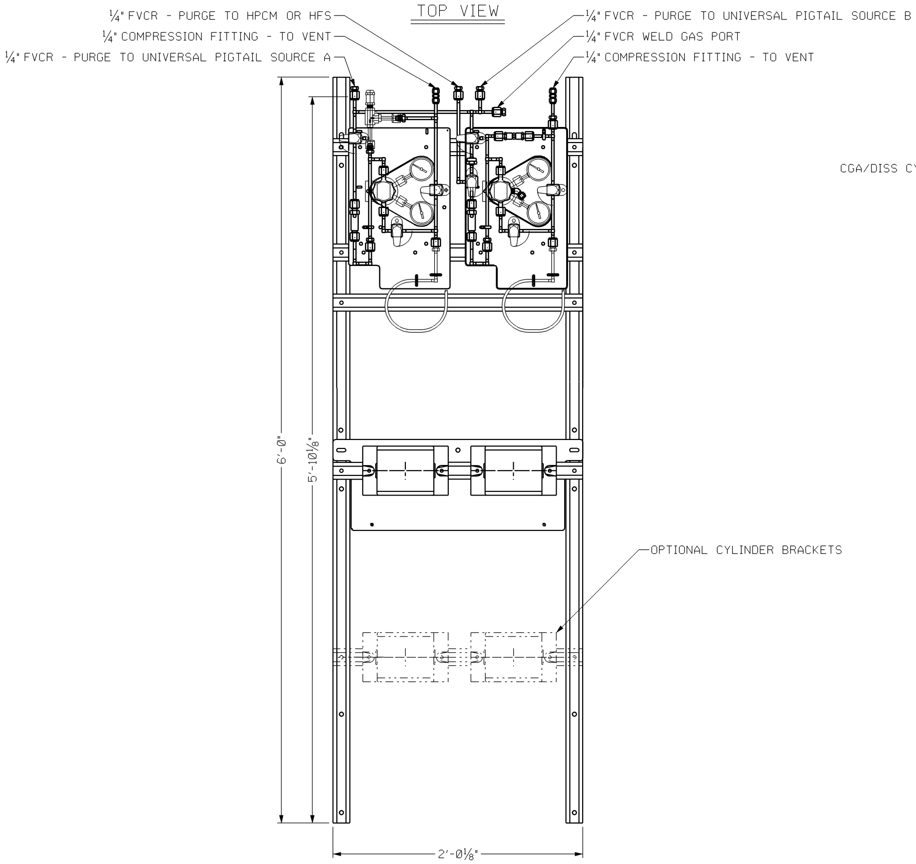
2. RECOMMENDED VENT LINE SIZES.

LINE LENGTH	MIN. RECOMMENDED TUBE DIAMETER
1 FT. THRU 5 FT.	½" TUBE
5 FT. THRU 100 FT.	¾" TUBE
100 FT. THRU 400 FT.	1" TUBE
OVER 400 FT.	1 ½" TUBE

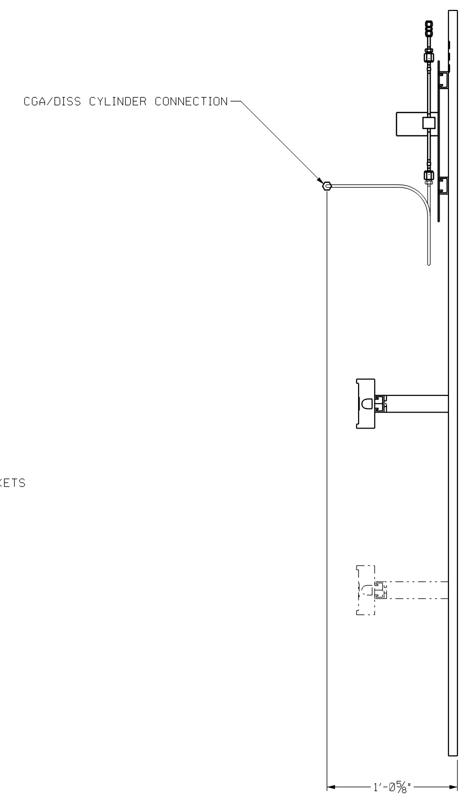
SEE GASGUARD BSGS, PURGE MODULE, CHAPTER 2-INSTALLATION, SECTION: EMERGENCY VENT LINES FOR ADDITIONAL DETAILS.



TOP VIEW



FRONT VIEW



RIGHT VIEW

REV. NO.	ECN/MOC	REVISION DESCRIPTION	DATE	DRAWN	MFG.	PRODUCT	PROJECT	PROCESS	IE & C	PIPING/MECH.	OPERATIONS	SAFETY	APPROVED
3		ADDED NOTE 2	30MAR06	AC									ARK
2	ECN2	GENERAL REVISIONS	07OCT04	CRE			ONC			DJK			GLM
1		NO CHANGES, REV 1 IS FOR STAC RELEASE PURPOSES ONLY	23JUL02	CRE									

REVISIONS — APPROVALS

MASTER FILE

THIS DRAWING HAS BEEN PLOTTED FROM THE ELECTRONICS ENGINEERING MASTER FILE

AIR PRODUCTS

TITLE MECHANICAL DETAIL
BULK SPECIALTY GAS SYSTEM
PURGE MODULE
WALL MOUNT

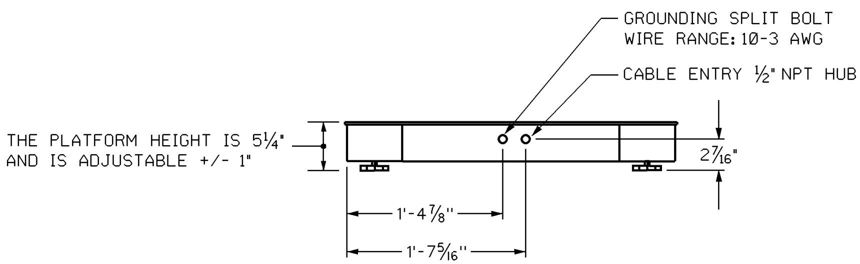
AIR PRODUCTS & CHEMICALS
ALLENTOWN, PA

SCALE: ½" = 1'-0" | B

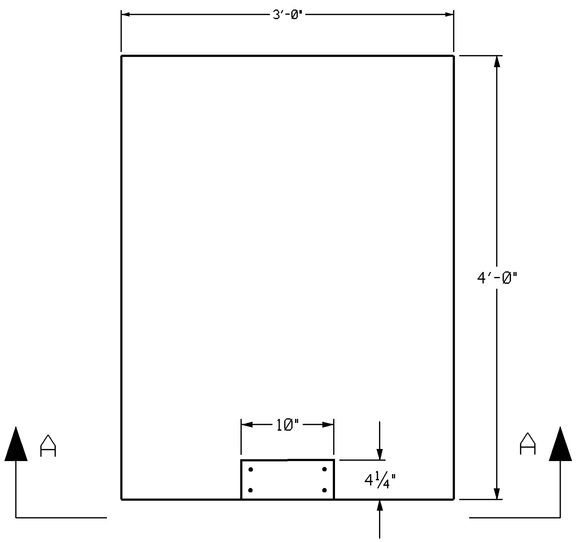
DWG. NO./CAD FILE NO. WREDV1805 MECH 0014 | REV. 3

SHEET: 1 OF 1

30-MAR-2006 14:56 PM

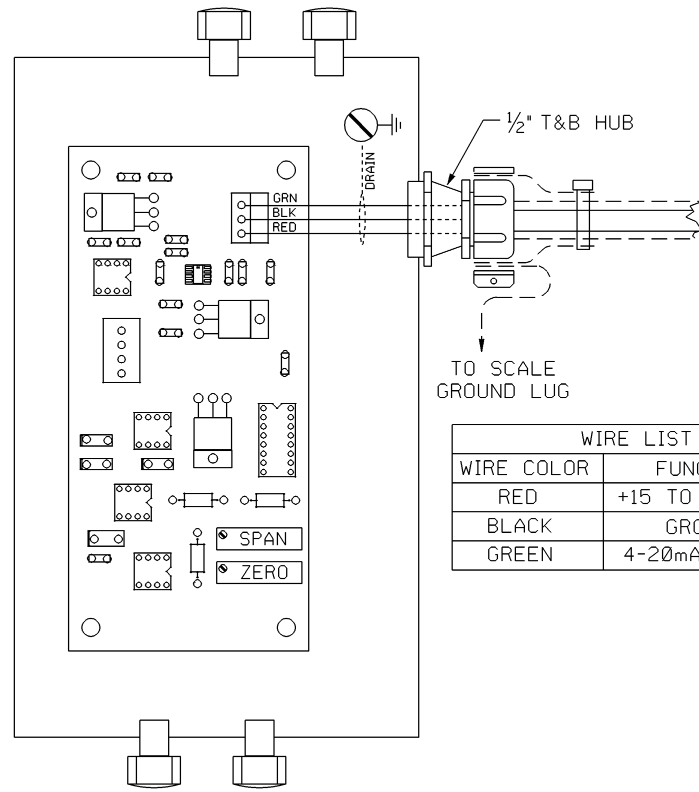


SECTION A-A



WEIGH SCALE

SCALE: 7/8"=1'



SCALE WIRING DIAGRAM

SCALE: N/A
SEE NOTE 1

WIRE LIST	
WIRE COLOR	FUNCTION
RED	+15 TO +26 VDC
BLACK	GROUND
GREEN	4-20mA SIGNAL

NOTES:

1. GROUND DRAIN WIRE & OVERBRAID AS SHOWN.
2. THIS DRAWING WAS FORMERLY ELEC 103910B.

REV. NO.	ECN/MOC	REVISION DESCRIPTION	DATE	DRAWN	MFG.	PRODUCT	PROJECT	PROCESS	I E & C	PIPING/MECH.	OPERATIONS	SAFETY	APPROVED
1	ECN01087	CHANGED BROWN SIGNAL WIRE TO GREEN	07FEB03	AC		GLM				DJK			RJO
0		APPROVED FOR CONSTRUCTION	07NOV00	JDF		DJK							KHH
		REVISIONS						APPROVALS					

MASTER FILE

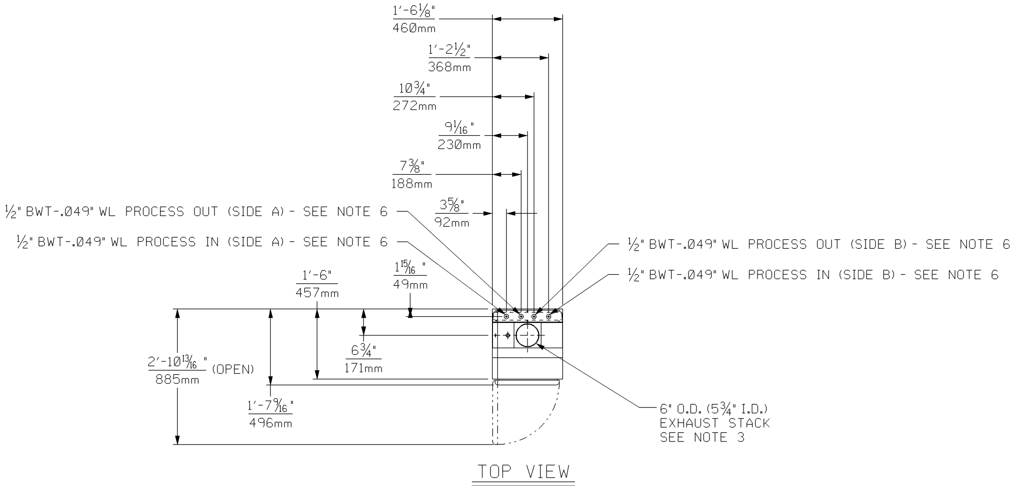
THIS DRAWING HAS BEEN PLOTTED FROM THE ELECTRONICS ENGINEERING MASTER FILE

TITLE INSTALLATION DRAWING
BSGS
WEIGH SCALE
3000# ARLYN

AIR PRODUCTS & CHEMICALS
ALLENTOWN, PA

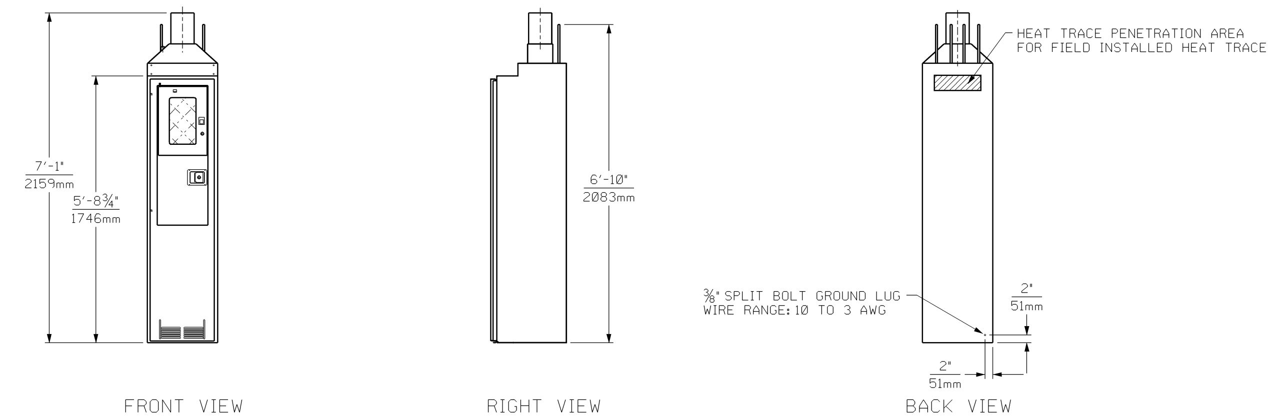
SCALE: N/A | B
DWG. NO./CAD FILE NO. BBA001 MECH 0002 | REV. 1
SHEET: 1 OF 1

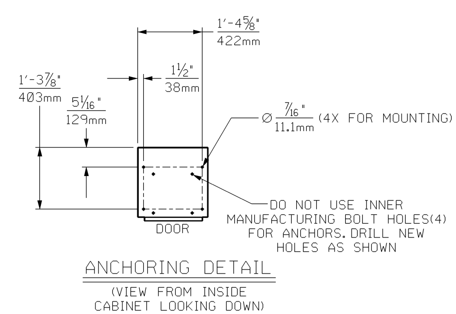
05-MAR-2003 10:27 AM



NOTES:

1. FOR CONDUIT DESIGNATIONS, LOCATIONS AND SIZES SEE APCI DRAWING SERIES "ELECTRICAL DETAIL BULK SPECIALTY GAS SYSTEMS POWER AND INSTRUMENTATION CONNECTIONS".
2. "BTW" DESIGNATES BUTT WELD TUBE STUB. SUFFIX .035 OR .049 DESIGNATES WAS THICKNESS IN INCHES.
3. ENCLOSURE EXHAUST 75 CFM., -1.0" W.C. STATIC PRESSURE.
4. ESTIMATED WEIGHT= 350 LBS.
5. LEAVE 6' OF CLEARANCE BEHIND CABINET FOR HEAT TRACE PENETRATIONS AND GROUNDING.
6. HASTELLOY C-22 PER SPEC 4WPI-CWNE240.





REVIEWER	REVIEWER	REVIEWER	REV	CN No	REVISION DESCRIPTION	DATE	BY	CHK'D	APP'D
			1		ADDED NOTE 6	11JUL07	JSS	DJK	DJK
			0		APPROVED FOR CONSTRUCTION	11JUL05	AC	DJK	GLM

AIR PRODUCTS

TITLE
INSTALLATION DRAWING
BULK SPECIALTY GAS SYSTEM
HCl PURIFIER CABINET

AIR PRODUCTS & CHEMICALS
ALLENTOWN, PA

USED ON	BBH001
OWNER GROUP	PRODUCT ENG.
RELEASE PURPOSE	DESIGN
REFERENCE	NONE
DOC No	BBH001 MECH 0001
SCALE ¾"=1'	SHEET 1 OF 1

M:\Product\BSGS\BBH001\BBH001MECH0001.dgn

ELECTRONICS EQUIPMENT SOLUTIONS

AIR PRODUCTS

GasGuard VHF ***AP11 Shutdown Tables***

Single Source - Four Module (SS-FM)

NH3 ISO Only

Product: D. Kukucka
Process: T.Piltz
Controls
Safety:
Approved: C. Cless

Doc. Number	**XL000356**
Revision	1
Date	10/16/13
ECN	
Reference P&ID	BKA004 P&ID 0001

Shutdown	Safety Layer Ref. 2S113	Description	Cause: Tag	Cause: Cause Description	Cause: Notes	Effect: Tag	Effect: Effect Description	Effect: Notes
SD-1 Module 1	3	Module 1 Shutdown (Total Run/Stop)	UA-1	Emergency Stop	Hard Wired	SD-2	Shutdown Module 1	Shutdown Module 1 and initiate switch to Module 2, if Module 2 is in standby mode, else Module 3, else Module 4.
			UA-2	Customer LSS - Gas Leak	Hard Wired	SD-6	Purge Sequence Shutdown Module 1	
			TSHH-1	High-High Cabinet Temperature	Hard Wired			
SD-1 Module 2	3	Module 2 Shutdown (Total Run/Stop)	UA-1	Emergency Stop	Hard Wired	SD-2	Shutdown Module 2	Shutdown Module 2 and initiate switch to Module 3, if Module 3 is in standby mode, else Module 4, else Module 1.
			UA-2	Customer LSS - Gas Leak	Hard Wired	SD-6	Purge Sequence Shutdown Module 2	
			TSHH-1	High-High Cabinet Temperature	Hard Wired			
SD-1 Module 3	3	Module 3 Shutdown (Total Run/Stop)	UA-1	Emergency Stop	Hard Wired	SD-2	Shutdown Module 3	Shutdown Module 3 and initiate switch to Module 4, if Module 4 is in standby mode, else Module 1, else Module 2.
			UA-2	Customer LSS - Gas Leak	Hard Wired	SD-6	Purge Sequence Shutdown Module 3	
			TSHH-1	High-High Cabinet Temperature	Hard Wired			
SD-1 Module 4	3	Module 4 Shutdown (Total Run/Stop)	UA-1	Emergency Stop	Hard Wired	SD-2	Shutdown Module 4	Shutdown Module 4and initiate switch to Module 1, if Module 1 is in standby mode, else Module 2, else Module 3.
			UA-2	Customer LSS - Gas Leak	Hard Wired	SD-6	Purge Sequence Shutdown Module 4	
			TSHH-1	High-High Cabinet Temperature	Hard Wired			
SD-2 Module 1	2	Module Shutdown Module 1	UA-2	Customer Gas Leak	Supervised	XV-8A	De-energize XV-8A Close valve V-8A	Shutdown Module 1 and initiate switch to Module 2, if Module 2 is in standby mode, else Module 3, else Module 4.
			UA-7	Remote Shutdown	Supervised	XV-1A	De-energize XV-1A Close valve V-1A	
			PSLL-2	Low-Low Pressure Shutdown		XV-3A	De-energize XV-3A Close valve V-3	
			PSHH-2	High-High Pressure Shutdown		XV-4A	De-energize XV-4A Close valve V-4	
			PSLL-9	Low-Low Pressure Shutdown		XV-5A	De-energize XV-5A Close valve V-5	

ELECTRONICS EQUIPMENT SOLUTIONS

GasGuard VHF ***AP11 Shutdown Tables***		Doc. Number **XL000356**
	Product: D. Kukucka	Revision 1
Single Source - Four Module (SS-FM)	**Process:** T.Piltz	Date 10/16/13
NH3 ISO Only	**Controls**	ECN
	Safety:	Reference P&ID BKA004 P&ID 0001
	Approved: C. Cless	

			Cause			Effect		
Shutdown	Safety Layer Ref. 2S113	Description	Tag	Cause Description	Notes	Tag	Effect Description	Notes
						XV-6A	De-energize XV-6A Close valve V-113TP	
						XV-7A	De-energize XV-7A Close valve V-7TP	
						XV-12A	De-energize XV-12A Close valve V-13A	
SD-2	2	Module Shutdown	UA-2	Customer Gas Leak	Supervised	XV-8A	De-energize XV-8A Close valve V-8A	Shutdown Module 2 and initiate switch to Module 3, if Module 3 is in standby mode, else Module 4, else Module 1.
Module 2		Module 2	UA-7	Remote Shutdown	Supervised	XV-1A	De-energize XV-1A Close valve V-1A	
			PSLL-2	Low-Low Pressure Shutdown		XV-3A	De-energize XV-3A Close valve V-3	
			PSHH-2	High-High Pressure Shutdown		XV-4A	De-energize XV-4A Close valve V-4	
			PSLL-9	Low-Low Pressure Shutdown		XV-5A	De-energize XV-5A Close valve V-5	
						XV-6A	De-energize XV-6A Close valve V-113TP	
						XV-7A	De-energize XV-7A Close valve V-7TP	
						XV-12A	De-energize XV-12A Close valve V-13A	
SD-2	2	Module Shutdown	UA-2	Customer Gas Leak	Supervised	XV-8A	De-energize XV-8A Close valve V-8A	Shutdown Module 3 and initiate switch to Module 4, if Module 4 is in standby mode, else Module 1, else Module 2.
Module 3		Module 3	UA-7	Remote Shutdown	Supervised	XV-1A	De-energize XV-1A Close valve V-1A	
			PSLL-2	Low-Low Pressure Shutdown		XV-3A	De-energize XV-3A Close valve V-3	
			PSHH-2	High-High Pressure Shutdown		XV-4A	De-energize XV-4A Close valve V-4	
			PSLL-9	Low-Low Pressure Shutdown		XV-5A	De-energize XV-5A Close valve V-5	
						XV-6A	De-energize XV-6A Close valve V-113TP	
						XV-7A	De-energize XV-7A Close valve V-7TP	
						XV-12A	De-energize XV-12A Close valve V-13A	

ELECTRONICS EQUIPMENT SOLUTIONS

AIR PRODUCTS

GasGuard VHF ***AP11 Shutdown Tables***		Doc. Number **XL000356**
	Product: D. Kukucka	Revision: 1
	Process: T.Piltz	Date: 10/16/13
Single Source - Four Module (SS-FM)	**Controls**	ECN
NH3 ISO Only	**Safety:**	Reference P&ID: BKA004 P&ID 0001
	Approved: C. Cless	

			Cause			Effect		
Shutdown	Safety Layer Ref. 2S113	Description	Tag	Cause Description	Notes	Tag	Effect Description	Notes
SD-2 Module 4	2	Module Shutdown Module 4	UA-2	Customer Gas Leak	Supervised	XV-8A	De-energize XV-8A Close valve V-8A	Shutdown Module 4and initiate switch to Module 1, if Module 1 is in standby mode, else Module 2, else Module 3.
			UA-7	Remote Shutdown	Supervised	XV-1A	De-energize XV-1A Close valve V-1A	
			PSLL-2	Low-Low Pressure Shutdown		XV-3A	De-energize XV-3A Close valve V-3	
			PSHH-2	High-High Pressure Shutdown		XV-4A	De-energize XV-4A Close valve V-4	
			PSLL-9	Low-Low Pressure Shutdown		XV-5A	De-energize XV-5A Close valve V-5	
						XV-6A	De-energize XV-6A Close valve V-113TP	
						XV-7A	De-energize XV-7A Close valve V-7TP	
						XV-12A	De-energize XV-12A Close valve V-13A	
SD-3A Module 1	2	Source A Shutdown Module 1	UA-7A	Customer Remote Shutdown - Source A	Shutdown Source A	XV-8A	De-energize XV-8A Close valve V-8A	Shutdown Module 1 and initiate switch to Module 2, if Module 2 is in standby mode, else Module 3, else Module 4. If module 2, 3, or 4 isn't in standby mode, continue to flow until Low-Low-Low weight shutdown is reached, then initiate final switch to the standby module.
			WALL-1A	Low-Low Weight Shutdown		XV-1A	De-energize XV-1A Close valve V-1A	
			PSLL-1A	Low-Low Pressure Shutdown				
			WALLL-1A	Low-Low-Low Weight Shutdown (NH3 ISO Only)				
SD-3A Module 2	2	Source A Shutdown Module 2	UA-7A	Customer Remote Shutdown - Source A	Shutdown Source A	XV-8A	De-energize XV-8A Close valve V-8A	Shutdown Module 2 and initiate switch to Module 3, if Module 3 is in standby mode, else Module 4, else Module 1.
			WALL-1A	Low-Low Weight Shutdown				

ELECTRONICS EQUIPMENT SOLUTIONS

GasGuard VHF ***AP11 Shutdown Tables***			Doc. Number **XL000356**
	Product:	D. Kukucka	Revision 1
	Process:	T.Piltz	Date 10/16/13
Single Source - Four Module (SS-FM)	**Controls**		ECN
NH3 ISO Only	**Safety:**		Reference P&ID BKA004 P&ID 0001
	Approved:	C. Cless	

			Cause			Effect		
Shutdown	Safety Layer Ref. 2S113	Description	Tag	Cause Description	Notes	Tag	Effect Description	Notes
			PSLL-1A	Low-Low Pressure Shutdown		XV-1A	De-energize XV-1A Close valve V-1A	If module 3, 4, or 1 isn't in standby mode, continue to flow until Low-Low-Low weight shutdown is reached, then initiate final switch to the standby module.
			WALLL-1A	Low-Low-Low Weight Shutdown (NH3 ISO Only)				

SD-3A Module 3	2	Source A Shutdown Module 3	UA-7A	Customer Remote Shutdown - Source A	Shutdown Source A	XV-8A	De-energize XV-8A Close valve V-8A	Shutdown Module 3 and initiate switch to Module 4, if Module 4 is in standby mode, else Module 1, else Module 2.
			WALL-1A	Low-Low Weight Shutdown				
			PSLL-1A	Low-Low Pressure Shutdown		XV-1A	De-energize XV-1A Close valve V-1A	If module 4, 1, or 2 isn't in standby mode, continue to flow until Low-Low-Low weight shutdown is reached, then initiate final switch to the standby module.
			WALLL-1A	Low-Low-Low Weight Shutdown (NH3 ISO Only)				

SD-3A Module 4	2	Source A Shutdown Module 4	UA-7A	Customer Remote Shutdown - Source A	Shutdown Source A	XV-8A	De-energize XV-8A Close valve V-8A	Shutdown Module 4 and initiate switch to Module 1, if Module 1 is in standby mode, else Module 2, else Module 3.
			WALL-1A	Low-Low Weight Shutdown				
			PSLL-1A	Low-Low Pressure Shutdown		XV-1A	De-energize XV-1A Close valve V-1A	If module 1, 2, or 3 isn't in standby mode, continue to flow until Low-Low-Low weight shutdown is reached, then initiate final switch to the standby module.
			WALLL-1A	Low-Low-Low Weight Shutdown (NH3 ISO Only)				

SD-6 Module 1	2	Purge Sequence Shutdown Module 1	UA-14	Vent Scrubber Unavailable		XV-4A	De-energize XV-4A Close valve V-4	
			PSHH-5	High High Vent Pressure		XV-5A	De-energize XV-5A Close valve V-5	
			PT-1A	Trickle Vent Threshold		XV-6A	De-energize XV-6A Close valve V-113TP	
				Low Vacuum		XV-7A	De-energize XV-7A Close valve V-7TP	

ELECTRONICS EQUIPMENT SOLUTIONS

AIR PRODUCTS

GasGuard VHF ***AP11 Shutdown Tables***		Doc. Number **XL000356**
	Product: D. Kukucka	Revision 1
	Process: T.Piltz	Date 10/16/13
Single Source - Four Module (SS-FM)	**Controls**	ECN
NH3 ISO Only	**Safety:**	Reference P&ID BKA004 P&ID 0001
	Approved: C. Cless	

			Cause			Effect		
Shutdown	Safety Layer Ref. 2S113	Description	Tag	Cause Description	Notes	Tag	Effect Description	Notes
				High Purge Pressure		XV-12A	De-energize XV-12A Close valve V-13A	
				Low Purge Pressure				

SD-6	2	Purge Sequence Shutdown	UA-14	Vent Scrubber Unavailable		XV-4A	De-energize XV-4A Close valve V-4	
Module 2		Module 2	PSHH-5	High High Vent Pressure		XV-5A	De-energize XV-5A Close valve V-5	
			PT-1A	Trickle Vent Threshold		XV-6A	De-energize XV-6A Close valve V-113TP	
				Low Vacuum		XV-7A	De-energize XV-7A Close valve V-7TP	
				High Purge Pressure		XV-12A	De-energize XV-12A Close valve V-13A	
				Low Purge Pressure				

SD-6	2	Purge Sequence Shutdown	UA-14	Vent Scrubber Unavailable		XV-4A	De-energize XV-4A Close valve V-4	
Module 3		Module 3	PSHH-5	High High Vent Pressure		XV-5A	De-energize XV-5A Close valve V-5	
			PT-1A	Trickle Vent Threshold		XV-6A	De-energize XV-6A Close valve V-113TP	
				Low Vacuum		XV-7A	De-energize XV-7A Close valve V-7TP	
				High Purge Pressure		XV-12A	De-energize XV-12A Close valve V-13A	
				Low Purge Pressure				

SD-6	2	Purge Sequence Shutdown	UA-14	Vent Scrubber Unavailable		XV-4A	De-energize XV-4A Close valve V-4	
Module 4		Module 3	PSHH-5	High High Vent Pressure		XV-5A	De-energize XV-5A Close valve V-5	
			PT-1A	Trickle Vent Threshold		XV-6A	De-energize XV-6A Close valve V-113TP	
				Low Vacuum		XV-7A	De-energize XV-7A Close valve V-7TP	
				High Purge Pressure		XV-12A	De-energize XV-12A Close valve V-13A	
				Low Purge Pressure				

ELECTRONICS EQUIPMENT SOLUTIONS

AIR PRODUCTS

GasGuard VHF
DIGITAL INPUT
MASTER ALARM AND INTERLOCK MATRIX
AP11 Controller

Mechanical/Systems D. Kukucka
Controls:
Check T. Piltyz
Approved: C. Cless

Doc. Number	XL000355
Revision	2
Date	1/23/2014
MOC:	
Reference Software Flow Logic	BKA004 ELEC AP10VHFS

Digital Input Number	Alarm Description	Alarm Tag	Alarm Label (Controller)	Comments	Hardwire Jumper	Time Delay (sec)	Alarm Condition (O / C)	Special Condition	Response Sequence	Operating Mode Alarms: On-Line Mode - Source A	On-Line Mode - Source B	Online Standby Mode	Pre-Purge Mode	Change Cylinder Mode (and HPLT)	Post-Purge Mode	Conditioning Cycle Mode	Idle Mode	Customer Digital Outputs (Relay Default State): (Relay 1; DO9) Gas Available	(Relay 2; DO10) Module Fault	(Relay 3; DO11) Module Shutdown	(Relay 4; DO12) UVIR / High Temp	(Relay 5; DO13) H-1 Shutdown	(Relay 6; DO14) H-2 Shutdown	(Relay 7; DO15) Source A Heater Inhibi	(Relay 8; DO16) Source B Heater Inhibi	(Relay 9; DO17) Source A Heat Trace Permissive	(Relay 10; DO18) Reset UVIR Source /	(Relay 11; DO19) Reset UVIR Source B	(Relay 12; DO20) Source B Heat Trace Permissive
																		ND	E	E	D	E	E	E	E	E	D	D	E
1	Emergency Stop	UA-1	EMERGENCY STOP			0	O		11	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)			D		N8	N8	D	D	N8			N8
2	Low Z-Purge	PAL-206	LOW Z-PURGE			10	O			F	F	F	F	F	F	F	F		D										
3	Power Supply #1 Fault	QA-1	Power Supply #1			0	O			F	F	F	F	F	F	F	F		D										
4	Power Supply #2 Fault	QA-2	Power Supply #2			0	O			F	F	F	F	F	F	F	F		D										
5	Supervisory Open		SUPERVISORY OPEN			0	O			F	F	F	F	F	F	F	F		D										
6	Life Safety System (supervised)	UA-2	LIFE SAFETY SYSTEM			0	O		11	S	S	S	S	S	S	S	S			D		N8	N8	D	D	N8			N8
7	Supervisory Open		SUPERVISORY OPEN			0	O			F	F	F	F	F	F	F	F		D										
8	Remote Shutdown (supervised)	UA-7	REMOTE SHUTDOWN			0	O		11	S	S	S	S	S	S	S	S			D		N8	N8	D	D	N8			N8
9	Purifer Supply Coax Jacket Leak	PAL-35A	COAX LK PURIFR SUP			0	O			F	F	F	F	F	F	F	F		D										
10	Purifier Return Coax Jacket Leak	PAL-35B	COAX LK PURIFR RET			0	O			F	F	F	F	F	F	F	F		D										
11	Coax Jacket Leak A (Houseline)	PAL-36A	COAX LEAK-DELIVERY			0	O			F	F	F	F	F	F	F	F		D										
12	Cabinet Exhaust Switch	FSL-1	LOW EXHAUST			10	O			F	F	F	F	F	F	F	F		D										
13	Coax Jacket Leak B (Houseline)	PAL-36B	COAX LEAK-DELIVERY			0	O			F	F	F	F	F	F	F	F		D										
14																													
15	UVIR Fault Alarm - VHFS	UA-17	UVIR FAULT			0	O			F	F	F	F	F	F	F	F		D										
16																													
17																													
18																													
19	UVIR Flame Detected - VHFS	RAHH-17	UVIR FLAME DETECT			0	O		12	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)			D	E	N8	N8	D	D	N8			N8
20	High Temperature Switch	TSHH-1	HIGH TEMP SWITCH			0	O		13	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)			D	E	N8	N8	D	D	N8			N8
21																													
22																													
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29																													
30																													
31																													
32																													
33	UVIR Flame Verify - Source A	RAHH-15	UVIR FIRE S-A			0	O		14	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)			D	E	N8	N8	D	D	N8	E		N8
34	UVIR Flame Verify - Source B	RAHH-16	UVIR FIRE S-B			0	O		15	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)			D	E	N8	N8	D	D	N8		E	N8
35	Life Safety System	UA-2	LIFE SAFETY SYSTEM			0	O		11	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)			D		N8	N8	D	D	N8			N8
36	Source A Remote Shutdown	UA-7A	REMOTE SHUTDOWN A			0	O		14	S		S	S	S	S	S	S			D				D		D			
37	Source B Remote Shutdown	UA-7B	REMOTE SHUTDOWN B			0	O		15		S	S	S	S	S	S	S			D					D				D
38	Vent/Scrubber Unavailable	UA-14	VENT UNAVAILABLE			0	O		27	N (F)	N (F)	N (F)	N (S)	N (S)	N (S)	N (S)	N (S)		D	D									
39	Source A Heater Fault	UA-8A	SOURCE A HEATER			0	O			F		F	F	F	F	F	F		D										
40	Source B Heater Fault	UA-8B	SOURCE B HEATER			0	O				F	F	F	F	F	F	F		D										
41	UVIR Fault Alarm - Source A	UA-15	UVIR FAULT S-A			0	O			F		F	F	F	F	F	F		D										
42	UVIR Fault Alarm - Source B	UA-16	UVIR FAULT S-B			0	O				F	F	F	F	F	F	F		D										

Notes:

8 - JT heater and heat trace hardwire shutdown is controlled by AP11 pneumatics and PPS-1. When a shutdown occurs, pneumatic pressure is removed, PPS-1 contacts open and remove power form CR200.

Legend	
AD = Autodialer	N = Non-Latching
C = Alarm On Closed Contacts	ND = No default / Not configured
CL = Close and lock	Nx = Note number "x"
D = De-energize	O = Alarm On Open Contacts
E = Energize	R = Hardwire Right Side
F = Fault	S = Shutdown (& Crossover)
I = Inhibit from open/start	SB = Shutdown(& Crossover) when backup source is in standby
L = Hardwire Left Side	

ELECTRONICS EQUIPMENT SOLUTIONS

AIR PRODUCTS

GasGuard VHF
ANALOG INPUT
MASTER ALARM AND INTERLOCK MATRIX
AP11 Controller

Mechanical/Stystems D. Kukucka
Controls:
Safety: T. Piltyz
Approved: C. Cless

Doc. Number	XL000355
Revision	2
Date	1/23/2014
MOC:	
Reference Software Flow Logic	BKA004 ELEC AP10VHFS

Analog/Alarm Number	Analog Description	Alarm Description	Alarm Tag	Alarm Label (Controller)	Comments	Time Delay (sec)	HCl 1000 slpm No Purifier (ISO or TT)	HCl 1000 slpm with Purifier (ISO or TT)	HCl 500 slpm No Purifier (ISO or TT)	HCl 500 slpm with Purifier (ISO or TT)	HCl 250 slpm (900 L Drum)	HCl 250 slpm (Y)	NF3 1000 slpm (ISO or TT)	NF3 500 slpm (ISO or TT)	NF3 250 slpm (Y or Drum)	NH3 1600 slpm (ISO)	NH3 800 slpm (ISO)	NH3 400 slpm (930L Drum)	NH3 400 slpm (Y Cyl.)	N2O 1000 slpm (ISO or TT)	N2O 500 slpm (ISO or TT)	N2O 250 slpm (Drum)	N2O 250 slpm (Y)	SiH4 1000 slpm (ISO)	SiH4 500 slpm (ISO)	SiH4 250 slpm (Y or Drum)	CO2 1000 slpm (ISO or TT)	CO2 500 slpm (ISO or TT)	CO2 250 slpm (Drum)	CO2 250 slpm (Y)	NO 250 slpm (Y or Drum)
							Alarm / Trip Set Point	Alarm / Trip Set Point	Alarm / Trip Set Point	Alarm / Trip Set Point	Alarm / Trip Set Point	Alarm / Trip Set Point	Alarm / Trip Set Point	Alarm / Trip Set Point	Alarm / Trip Set Point	Alarm / Trip Set Point	Alarm / Trip Set Point	Alarm / Trip Set Point	Alarm / Trip Set Point	Alarm / Trip Set Point	Alarm / Trip Set Point	Alarm / Trip Set Point	Alarm / Trip Set Point	Alarm / Trip Set Point	Alarm / Trip Set Point	Alarm / Trip Set Point	Alarm / Trip Set Point	Alarm / Trip Set Point	Alarm / Trip Set Point	Alarm / Trip Set Point	Alarm / Trip Set Point
1/1	PT-2																														
1/2		High High Delivery Pressure PT-2	PSHH-2	H H Delivery PT-2		0	175	125	125	125	125	125	175	125	125	175	125	125	125	175	125	125	125	175	125	125	125	125	125	125	125
1/3		High Delivery Pressure PT-2	PAH-2	High Delivery PT2		0	160	110	110	110	110	110	160	110	110	160	110	110	110	160	110	110	110	160	110	110	110	110	110	110	110
1/4		Low Delivery Pressure PT-2	PAL-2	Low Delivery PT-2		1	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65
1/5		Low Low Delivery Pressure PT-2	PSLL-2	L L Delivery PT-2		1	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
2/1	PT-4																														
2/2																															
2/3																															
2/4		HPLT Vent Threshold		High PT-4		120	75.1	75.1	75.1	75.1	75.1	75.1	75.1	75.1	75.1	75.1	75.1	75.1	75.1	75.1	75.1	75.1	75.1	75.1	75.1	75.1	75.1	75.1	75.1	75.1	75.1
3/1	PT-5	High Vent Pressure	PAH-5	High Vent PT5		10	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
3/2		Low Vacuum Pressure	PAL-5	Low Vacuum PT-5		0	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
3/3		High Pressure PT5		High PT-5		255	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
3/4		High Pressure PT5		High PT-5		0	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
4/1	TIC-6	1st Stage High JT Heater Temp	TAH-6	High Temp TIC-6		0	81	81	81	81	81	81	81	81	81	N/A	N/A	N/A	N/A	105	105	105	105	105	105	105	81	81	81	81	N/A
4/2		1st Stage Low JT Heater Temp	TAL-6	Low Temp TIC-6		0	61	61	61	61	61	61	61	61	61	N/A	N/A	N/A	N/A	76	76	76	76	76	76	76	61	61	61	61	N/A
4/3		1st Stage High-High JT Heater Temp	TSHH-6	Hi-Hi Temp TIC-6	(N7)	0	86	86	86	86	86	86	86	86	86	N/A	N/A	N/A	N/A	111	111	111	111	111	111	111	86	86	86	86	N/A
5/1	TIC-8	2nd Stage High JT Heater Temp	TAH-8	High Temp TIC-8		0	81	81	81	81	81	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	105	105	105	105	105	105	105	N/A	N/A	N/A	N/A	N/A
5/2		2nd Stage Low JT Heater Temp	TAL-8	Low Temp TIC-8		0	21	21	21	21	21	21	N/A	N/A	N/A	N/A	N/A	N/A	N/A	21	21	21	21	21	21	21	N/A	N/A	N/A	N/A	N/A
5/3		2nd Stage High-High JT Heater Temp	TSHH-8	Hi-Hi Temp TIC-8	(N7)	0	86	86	86	86	86	86	N/A	N/A	N/A	N/A	N/A	N/A	N/A	111	111	111	111	111	111	111	N/A	N/A	N/A	N/A	N/A
6/1	PT-9	Low Delivery Pressure PT-9	PAL-9	Low Delivery PT-9		1	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
6/2		Low Low Delivery Pressure PT-9	PSLL-9	L L Delivery PT-9		1	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
7/1	PT-10	High-High Interstage Pressure	PSHH-10	Hi-Hi Interstage Pres		0	600	600	600	600	600	600	600	600	600	N/A	N/A	N/A	N/A	600	600	600	600	600	600	600	600	600	600	600	N/A
7/2		High Interstage Pressure	PAH-10	Hi Intrstg Pres		0	450	450	450	450	450	450	450	450	450	N/A	N/A	N/A	N/A	450	450	450	450	450	450	450	450	450	450	450	N/A
8		(Reserved for Vacuum Pump Transducer)																													
9																															
10																															
11																															
12																															
13																															
14																															
15																															
16																															
17/1	PT-1A	High Source Pressure PT-1A	PAH-1A	High Source PT1A		0	1300	1300	1300	1300	1300	1300	2060	2060	2060	250	250	235	235	1600	1600	1600	1600	2300	2300	2300	1900	1900	1900	1900	335
17/2		Low Source Pressure PT-1A	PAL-1A	Low Source PT-1A		1	195	225	170	180	170	170	260	195	160	110	125	90	90	225	180	155	155	210	175	155	225	180	150	150	160
17/3		Low Low Source Pressure PT-1A	PSLL-1A	L L Source PT-1A	(N1)	1	145	175	120	130	120	120	210	145	110	90	105	80	80	175	130	105	105	160	125	105	175	130	100	100	110
17/4		Low Vacuum PT-1A		Low Vacuum PT-1A		0	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
17/5		Sufficient Vacuum		Sufficient Vacuum	(N1)	15	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
17/6		Sufficient Purge		Sufficient Purge	(N1)	3	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70
17/7		High Purge PT-1A		High Purge PT-1A		0	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125
17/8		Low HP Purge PT-1A		Low HP Purge PT1A		0	900	900	900	900	900	900	900	900	900	170	170	170	170	900	900	900	900	900	900	900	900	900	900	900	170
17/9		High HP Purge PT-1A		H HP Purge PT-1A		0	1050	1050	1050	1050	1050	1050	1050	1050	1050	220	220	220	220	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	220
17/10		V-4 Lockout		V-4 Lockout PT-1A		0	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
17/11		Pigtail Trickle Vent Threshold PT-1A		High PT-1A		255	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
17/12		Pigtail Trickle Vent Threshold PT-1A		High PT-1A		0	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
17/13		Low Tube Pressure PT-1A (Tube Switch)		Low Tube PT-1A		1	205	235	180	190	N/A	N/A	270	205	N/A	N/A	N/A	N/A	N/A	235	190	N/A	N/A	220	185	N/A	N/A	N/A	N/A	N/A	N/A
18																															
19/1	PT-1B	High Source Pressure PT-1B	PAH-1B	High Source PT1B		0	1300	1300	1300	1300	1300	1300	2060	2060	2060	N/A	N/A	235	235	1600	1600	1600	1600	2300	2300	2300	1900	1900	1900	1900	335
19/2		Low Source Pressure PT-1B	PAL-1B	Low Source PT-1B		1	195	225	170	180	170	170	260	195	160	N/A	N/A	90	90	225	180	155	155	210	175	155	225	180	150	150	160
19/3		Low Low Source Pressure PT-1B	PSLL-1B	L L Source PT-1B	(N1)	1	145	175	120	130	120	120	210	145	110	N/A	N/A	80	80	175	130	105	105	160	125	105	175	130	100	100	110
19/4		Low Vacuum PT-1B		Low Vacuum PT-1B		0	-5	-5	-5	-5	-5	-5	-5	-5	-5	N/A	N/A	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
19/5		Sufficient Vacuum		Sufficient Vacuum	(N1)	15	-5	-5	-5	-5	-5	-5	-5	-5	-5	N/A	N/A	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
19/6		Sufficient Purge		Sufficient Purge	(N1)	3	70	70	70	70	70	70	70	70	70	N/A	N/A	70	70	70	70	70	70	70	70	70	70	70	70	70	70
19/7		High Purge PT-1B		High Purge PT-1B		0	125	125	125	125	125	125	125	125	125	N/A	N/A	125	125	125	125	125	125	125	125	125	125	125	125	125	125
19/8		Low HP Purge PT-1B		Low HP Purge PT1B		0	900	900	900	900	900	900	900	900	900	N/A	N/A	170	170	900	900	900	900	900	900	900	900	900	900	900	170
19/9		High HP Purge PT-1B		H HP Purge PT-1B		0	1050	1050	1050	1050	1050	1050	1050	1050	1050	N/A	N/A	220	220	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	220
19/10		V-4 Lockout		V-4 Lockout PT-1B		0	150	150	150	150	150	150	150	150	150	N/A	N/A	150	150	150	150	150	150	150	150	150	150	150	150	150	150
19/11		Pigtail Trickle Vent Threshold PT-1B		High PT-1B		255	75	75	75	75	75	75	75	75	75	N/A	N/A	75	75	75	75	75	75	75	75	75	75	75	75	75	75
19/12		Pigtail Trickle Vent Threshold PT-1B		High PT-1B		0	75	75	75	75	75	75	75	75	75	N/A	N/A	75	75	75	75	75	75	75	75	75	75	75	75	75	75
19/13		Low Tube Pressure PT-1B (Tube Switch)		Low Tube PT-1B		1	205	235	180	190	N/A	N/A	270	205	N/A	N/A	N/A	N/A	N/A	235	190	N/A	N/A	220	185	N/A	N/A	N/A	N/A	N/A	N/A
20		MFM INPUT (ALWAYS ENABLED) 0-1800 SLPM																													
21/1	WT-1A	High High Source Weight WT-1A	WSHH-1A	H H Source WT-1A		0	N/A	N/A	N/A	N/A	1287	641	N/A	N/A	N/A	N/A	N/A	1105	533	N/A	N/A	TBD	670	N/A	N/A	N/A	TBD	TBD	TBD	670	N/A
21/2		High Source Weight WT-1A	WAH-1A	High Source WT1A		0	N/A	N/A	N/A	N/A	1250	620	N/A	N/A	N/A	26000	26000	1090	525	N/A	N/A	TBD	660	N/A	N/A	N/A	TBD	TBD	TBD	660	N/A
21/3		Low Source Weight WT-1A	WAL-1A	Low Source WT-1A		1	N/A	N/A	N/A	N/A	125	125	N/A	N/A	N/A	4000	4000	80	80	N/A	N/A	90	90	N/A	N/A	N/A	100	100	100	100	N/A
21/4		Low Low Source Weight WT-1A	WSLL-1A	L L Source WT-1A	(N1,4)	3	N/A	N/A	N/A	N/A	100	100	N/A	N/A	N/A	3100	3100	40	40	N/A	N/A	45	45	N/A	N/A	N/A	60	60	60	60	N/A
21/5		Low Low Low Source Weight WT-1A	WSLLL-1A	L L L Source WT-1A	(N5)	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2100	2100	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
21/10		Low mAmp WT-1A		Low Milliamp WT-1A		1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
22/1	WT-1B	High High Source Weight WT-1B	WSHH-1B	H H Source WT-1B		0	N/A	N/A	N/A	N/A	1287	641	N/A	N/A	N/A	N/A	N/A	1105	533	N/A	N/A	TBD	670	N/A	N/A	N/A	TBD	TBD	TBD	670	N/A
22/2		High Source Weight WT-1B	WAH-1B	High Source WT1B		0	N/A	N/A	N/A	N/A	1250	620	N/A	N/A	N/A	N/A	N/A	1090	525	N/A	N/A	TBD	660	N/A	N/A	N/A	TBD	TBD	TBD	660	N/A
22/3		Low Source Weight WT-1B	WAL-1B	Low Source WT-1B		1	N/A	N/A	N/A	N/A	125	125	N/A	N/A	N/A	N/A	N/A	80	80	N/A	N/A	90	90	N/A	N/A	N/A	100	100	100	100	N/A
22/4		Low Low Source Weight WT-1B	WSLL-1B	L L Source WT-1B	(N1,6)	3	N/A	N/A	N/A	N/A	100	100	N/A	N/A	N/A	N/A	N/A	40	40	N/A	N/A	45	45	N/A	N/A	N/A	60	60	60	60	N/A
22/5		Low Low Low Source Weight WT-1B	WSLLL-1B	L L L Source WT-1B	(N5)	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
22/10		Low mAmp WT-1B		Low Milliamp WT-1B		1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
23																															
24																															
25																															
26																															
27																															
28																															
29																															
30	CPU	CPU Temp (APCI Internal)	TAH-CPU	CPU High Temp		0	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70
31		Door Temp (APCI Internal)	N/A	N/A																											
32/1	U14	Pneumatic Pressure High-High (APCI Internal)	PSHH-U14	High-High Pneum		1	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110
32/2	U14	Pneumatic Pressure High (APCI Internal)	PSH-U14	High Pneum		5	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102
32/3	U14	Pneumatic Pressure Low (APCI Internal)	PSL-U14	Low Pneum		5	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
32/4	U14	Pneumatic Pressure Low-Low (APCI Internal)	PSLL-U14	Low-Low Pneum		5	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65
33/1	TIC-111	Low Heat Trace Temperature TIC-111	TAL-111	Low HT Temp		0	21.1	21.1	21.1	21.1	21.1	21.1	N/A	N/A	N/A	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	N/A	N/A	N/A	21.1	21.1	21.1	21.1	N/A
33/2		High Heat Trace Temperature TIC-111	TAH-111	High HT Temp		0	73.8	73.8	73.8	73.8	73.8	73.8	N/A	N/A	N/A	73.8	73.8	73.8	73.8	73.8	73.8	73.8	73.8	N/A	N/A	N/A	73.8	73.8	73.8	73.8	N/A

Analog/Alarm Number	Engineering Units	Alarm Condition (H / L)	User/APCI Configurable (U / A)	Response Sequence	Operating Mode Alarms: On-Line Mode - Source A	On-Line Mode - Source B	Online Standby Mode	Pre-Purge Mode	Change Cylinder Mode (and HPLT)	Post-Purge Mode	Conditioning Cycle Mode	Idle Mode	Customer Digital Outputs (Relay Default State): (Relay 1; DO9) Gas Available	(Relay 2; DO10) Module Fault	(Relay 3; DO11) Module Shutdown	(Relay 4; DO12) UVIR / High Temp	(Relay 5; DO13) H-1 Shutdown	(Relay 6; DO14) H-2 Shutdown	(Relay 7; DO15) Source A Heater Inhi	(Relay 8; DO16) Source B Heater Inhi	(Relay 9; DO17) Source A Heat Trace Permissive	(Relay 10; DO18) Reset UVIR Source	(Relay 11; DO19) Reset UVIR Source	(Relay 12; DO20) Source B Heat Trace Permissive
													ND	E	E	D	E	E	E	E	E	D	D	E
1/2	PSIG	H	A		S	S	S								D									
1/3	PSIG	H	U		F	F	F							D										
1/4	PSIG	L	U		F	F	F							D										
1/5	PSIG	L	A		S	S	S								D									
2/4	PSIG	H	U						N															
3/1	PSIG	H	A		F	F	F	F	F	F	F	F		D										
3/2	PSIG	H	A					F	F	F	F			D										
3/3	PSIG	H	A							S					D									
3/4	PSIG	L	A							N														
4/1	DEG C	H	A		F	F	F	F	F	F	F	F		D										
4/2	DEG C	L	A		F	F	F	F	F	F	F	F		D										
4/3	DEG C	H	A	23	N (S)	N (S)	N (S)	N (S)	N (S)	N (S)	N (S)	N (S)		D			D							
5/1	DEG C	H	A		F	F	F	F	F	F	F	F		D										
5/2	DEG C	L	A		F	F	F	F	F	F	F	F		D										
5/3	DEG C	H	A	25	N (S)	N (S)	N (S)	N (S)	N (S)	N (S)	N (S)	N (S)		D				D						
6/1	PSIG	L	A		F	F	F							D										
6/2	PSIG	L	A		S	S									D									
7/1	PSIG	H	A		S	S	S								D									
7/2	PSIG	H	U		F	F	F							D										
17/1	PSIG	H	A	32	F		F							D					D					
17/2	PSIG	L	U		F		F							D										
17/3	PSIG	L	U	17	N (S)		N (S)								D									
17/4	PSIG	H	A					S	S	S					D									
17/5	PSIG	L	A					N (S)	N (S)	N (S)					D									
17/6	PSIG	L	A					N (S)	N (S)	N (S)					D									
17/7	PSIG	H	A						S						D									
17/8	PSIG	L	A						S						D									
17/9	PSIG	H	A						S						D									
17/10	PSIG	H	A	30				N (F)		N (F)		N (F)												
17/11	PSIG	H	A					S		S	S				D									
17/12	PSIG	L	A					N		N	N													
17/13	PSIG	L	U		N																			
19/1	PSIG	H	A	33		F	F							D						D				
19/2	PSIG	L	U			F	F							D										
19/3	PSIG	L	U	18		N (S)	N (S)								D									
19/4	PSIG	H	A					S	S	S					D									
19/5	PSIG	L	A					N (S)	N (S)	N (S)					D									
19/6	PSIG	H	A					N (S)	N (S)	N (S)					D									
19/7	PSIG	H	A						S						D									
19/8	PSIG	L	A						S						D									
19/9	PSIG	H	A						S						D									
19/10	PSIG	H	A	30				N (F)		N (F)		N (F)												
19/11	PSIG	H	A					S		S	S				D									
19/12	PSIG	L	A					N		N	N													
19/13	PSIG	L	U	22		N																		
21/1	LBS	H	A		S		S								D									
21/2	LBS	H	A		F		F							D										
21/3	LBS	L	U		F		F							D										
21/4	LBS	L	U	19	N (S)		N (S)								D				D					
21/5	LBS	L	U		S		S								D				D					
21/10	mA	L	U	4	N																			
22/1	LBS	H	A			S	S								D									
22/2	LBS	H	A			F	F							D										
22/3	LBS	L	U			F	F							D										
22/4	LBS	L	U	20		N (S)	N (S)								D					D				
22/5	LBS	L	U		S		S								D					D				
22/10	mA	L	A	6	N																			
23	SLPM																							
30	Deg C	H	A	0	F	F	F	F	F	F	F	F												
32/1	PSIG	H	A	0	F	F	F	F	F	F	F	F												
32/2	PSIG	H	U	0	F	F	F	F	F	F	F	F												
32/3	PSIG	L	U	0	F	F	F	F	F	F	F	F												
32/4	PSIG	L	A	0	F	F	F	F	F	F	F	F												
33/1	DEG C	L	U		F	F	F					F		D										
33/2	DEG C	H	U		F	F	F					F		D										

	TSH	All values in deg C Operating	overshoot	delta	Existing	new alarm	delta
VHF H-1	vespel	88	96.6	8.6	93	100	12
VHF H-2	PCTFE	27	33.4	6.4	38	n/a	
GG250 H-1	PCTFE	75	not tested	?	85		

Notes:
1 - Configured as "non-latching" will always result as Shutdown.
2 - Configured as "non-latching" will always result as Fault.
3 - 10 minutes for Y-Cylinders and 20 minutes for ISO trailers

Leak Test Parameters #	Label	Type	HCl	HCl	HCl	HCl	HCl	HCl	NF3	NF3	NF3	NH3	NH3	NH3	NH3	N2O	N2O	N2O	N2O	SiH4	SiH4	SiH4	CO2	CO2	CO2	CO2	NO	Minimum	Delta
1	Vacuum Test	Pressure	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	5	5.0
2	Pressure Test	Pressure	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	-5.0
3	HPLT Test	Pressure	10(N3)	10(N3)	10(N3)	10(N3)	10(N3)	10(N3)	10(N3)	10(N3)	10(N3)	10(N3)	10(N3)	10(N3)	10(N3)	10(N3)	10(N3)	10(N3)	10(N3)	10(N3)	10(N3)	10(N3)	10(N3)	10(N3)	10(N3)	10(N3)	10(N3)	10	-5.0
4	Stabilization	Pressure	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	-80.0
5	Vacuum Timer	Pressure	3	3	3	3	0	0	3	3	0	10	10	3	3	0	0	0	0	10	10	3	3	3	3	3	3	0	100.0

Legend

AD = Autodialer	
O = Alarm On Open Contacts	I = Inhibit from open/start
C = Alarm On Closed Contacts	N = Non-Latching
CL = Close and lock	ND = No default / Not configured
D = De-energize	Nx = Note number "x"
E = Energize	S = Shutdown (& Crossover)

4- Shutdown and crossover to opposite source.
If unavailable, energize DO7, continue to flow until LLL setpoint is reached. If analog signal drops below 4 mA and last logged weight is >3100 lbs, energize DO7 and continue to flow for 6 hr. and 30 minutes., else shutdown.

5 - Shutdown and crossover.

6 - Shutdown and crossover to opposite source.
If unavailable, energize DO8, continue to flow until LLL setpoint is reached. If analog signal drops below 4 mA and last logged weight is >3100 lbs, energize DO8 and continue to flow for 6 hr. and 30 minutes, else shutdown.

7 - Turn off power to heater until temperature drops below setpoint, maintain flow, do not shutdown or crossover.

8 - JT heater and heat trace hardwire shutdown is controlled by AP11 pneumatics and PPS-1. When a shutdown occurs, pneumatic pressure is removed, PPS-1 contacts open and remove power form CR200.

9- Digital Outputs 9 and 12 are de-energized during their respective source container Pre-Purge and Change Cylinder sequences.

Sub Sequence Parameters

#	Label	Seq#	HCl 1000 slpm No Purifier	HCl 1000 slpm with Purifier	HCl 500 slpm No Purifier	HCl 500 slpm with Purifier	HCl 250 slpm	HCl 250 slpm	NF_3 1000 slpm	NF_3 500 slpm	NF_3 250 slpm	NH_3 1600 slpm	NH_3 800 slpm
1	Purge/Vent	1	90	90	90	90	90	90	75	75	75	90	90
2	Condition	2	5	5	5	5	5	5	5	5	5	5	5
4	Outboard	4	1	1	1	1	1	1	1	1	1	1	1
7	Tube Condition	7	1	1	1	1	1	1	1	1	1	1	1

#	Label	NH_3 400 slpm 930L Drum	NH_3 400 slpm Y Cyl.	N_2O 1000 slpm	N_2O 500 slpm	N_2O 250 slpm	N_2O 250 slpm	SiH_4 1000 slpm	SiH_4 500 slpm	SiH_4 250 slpm	CO_2 500 slpm	CO_2 500 slpm	CO_2 500 slpm	CO_2 500 slpm	NO 250 slpm	Min. Cycles
1	Purge/Vent	90	90	75	75	75	75	120	120	120	75	75	75	75	120	60
2	Condition	5	5	5	5	5	5	5	5	5	5	5	5	5	5	0
4	Outboard	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	Tube Condition	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

F = Fault
HW = Hardwire

SB = Shutdown(& Crossover) when backup source is in standby

NOTES:

1. ALL WIRING SHALL BE INSTALLED BY THE PANEL FABRICATOR, UNLESS OTHERWISE NOTED.
2. EQUIPMENT INSIDE SCOPE BREAK LINE SHALL BE WIRED BY MANUFACTURING SITES
3. WIRING FOR TEMPERATURE SWITCHES ARE SHOWN ON SHEET 4 OF 4 THIS DRAWING, RTD WIRING IS SHOWN ON LOOP DRAWINGS.
4. VERIFY ALL CIRCUIT BREAKER RATINGS; FOR EXAMPLE, GFCB103, IS RATED FOR 35AMP
5. WIRE TERMINATION WILL BE PERFORMED AT MANUFACTURING SITE. VENDOR SHALL CUT WIRE TO 5'-0" LONG AND COIL INSIDE ELECTRICAL CABINET.
6. WIRE TERMINATION WILL BE PERFORMED AT MANUFACTURING SITE. VENDOR SHALL CUT WIRE TO 12'-0" LONG AND COIL INSIDE ELECTRICAL CABINET.
7. JT HEATER POWER WIRES TO BE RATED FOR HIGH TEMPERATURE TYPE "TFE" TELON & UL LISTED.
8. USE FERRULES ON ALL TERMINATIONS. FERRULES SHALL BE SIZED TO MATCH WIRE SIZE AND BE COMPRESSED WITH MANUFACTURER'S APPROVED RATCHETING TYPE CRIMPING TOOL.
9. MAIN CIRCUIT BREAKER WILL CHANGE DEPENDING ON THE ORDERED VHFS CONFIGURATION:
   10 AMP BREAKER - WITH NO JT HEAT
   40 AMP BREAKER - WITH 1ST JT HEAT OPTION
   60 AMP BREAKER - WITH 1ST AND 2ND JT HEAT OPTION.
10. USE TWISTED PAIR WIRES.
11. BLACK WIRE FROM TWISTED PAIR SHALL NOT BE USED. CUT EXCESS WIRE AND TERMINATE ACCORDINGLY.
12. COIL INSIDE ELECTRICAL CABINET.

REV.	ECR NO.	REVISION DESCRIPTION	DATE	BY	CHK'D	APPD.
5	35654	GFP was GFCB	2/12/14	JRB	JCB	DLH
4	35210	ADDED NOTE #12	12/11/13	ACS	PO	DLH
3	34841	NO CHANGE TO THIS SHEET	11/06/13	ACS	PO	DLH

UNLESS OTHERWISE SPECIFIED TOLERANCES ARE
FRACTION ± N/A DECIMAL ± N/A ANGLE ± N/A
HOLE LOCATION ± N/A HOLE SIZE ± N/A

INCHES
MILLIMETERS
INCHES (MILLIMETERS)

		DATE
DRAWN	A. SWOYER	4/1/13
CHECKED	J. BARTHOLD	7/15/13
MANUFACTURING		
ENGINEER		
APPD.	D. HOCKENBERRY	7/15/13

TITLE
VHF ELEMENTARY
WIRING DIAGRAM
AP11 CONTROLLER

AIR PRODUCTS
ALLENTOWN, PENNSYLVANIA

DWG NO. BNTLY00837.DGN D REV. 5
SCALE NTS REF. SHEET 1 OF 4

ECN NO.	REV.	ECR NO.	REVISION DESCRIPTION	DATE	BY	CHK'D	APPD.
	5	35654	NO CHANGE TO THIS SHEET	2/12/14	JRB	JCB	DLH
	4	35210	NO CHANGE TO THIS SHEET	12/11/13	ACS	PO	DLH
	3	34841	ADD GND-3	11/06/13	ACS	PO	DLH

UNLESS OTHERWISE SPECIFIED TOLERANCES ARE
FRACTION ± N/A DECIMAL ± N/A ANGLE ± N/A
HOLE LOCATION ± N/A HOLE SIZE + N/A

INCHES / MILLIMETERS
INCHES (MILLIMETERS)

	DATE
A. SWOYER DRAWN	4/1/13
J. BARTHOLD CHECKED	7/15/13
MANUFACTURING	
ENGINEER	
D. HOCKENBERRY APPD.	7/15/13

TITLE
VHF ELEMENTARY
WIRING DIAGRAM
AP11 CONTROLLER

AIR PRODUCTS
ALLENTOWN, PENNSYLVANIA

DWG NO. BNTLY00837.DGN D REV. 5
SCALE NTS REF. SHEET 2 OF 4

ECN NO.	REV.	ECR NO.	REVISION DESCRIPTION	DATE	BY	CHK'D	APPD.
	5	35654	RELAY 9 WAS 7, 12 WAS 8, NOTE 6 WAS NOTE 5	2/12/14	JRB	JCB	DLH
	4	35210	CHANGED WIRE COLOR FROM 20 GRY TO 20 ORG	12/11/13	ACS	PO	DLH
	3	34841	CHANGE 16 ORG TO 20 ORG & 16 GRY TO 20 GRY	11/06/13	ACS	PO	DLH

UNLESS OTHERWISE SPECIFIED TOLERANCES ARE
FRACTION ± N/A DECIMAL ± N/A ANGLE ± N/A
HOLE LOCATION ± N/A HOLE SIZE ± N/A

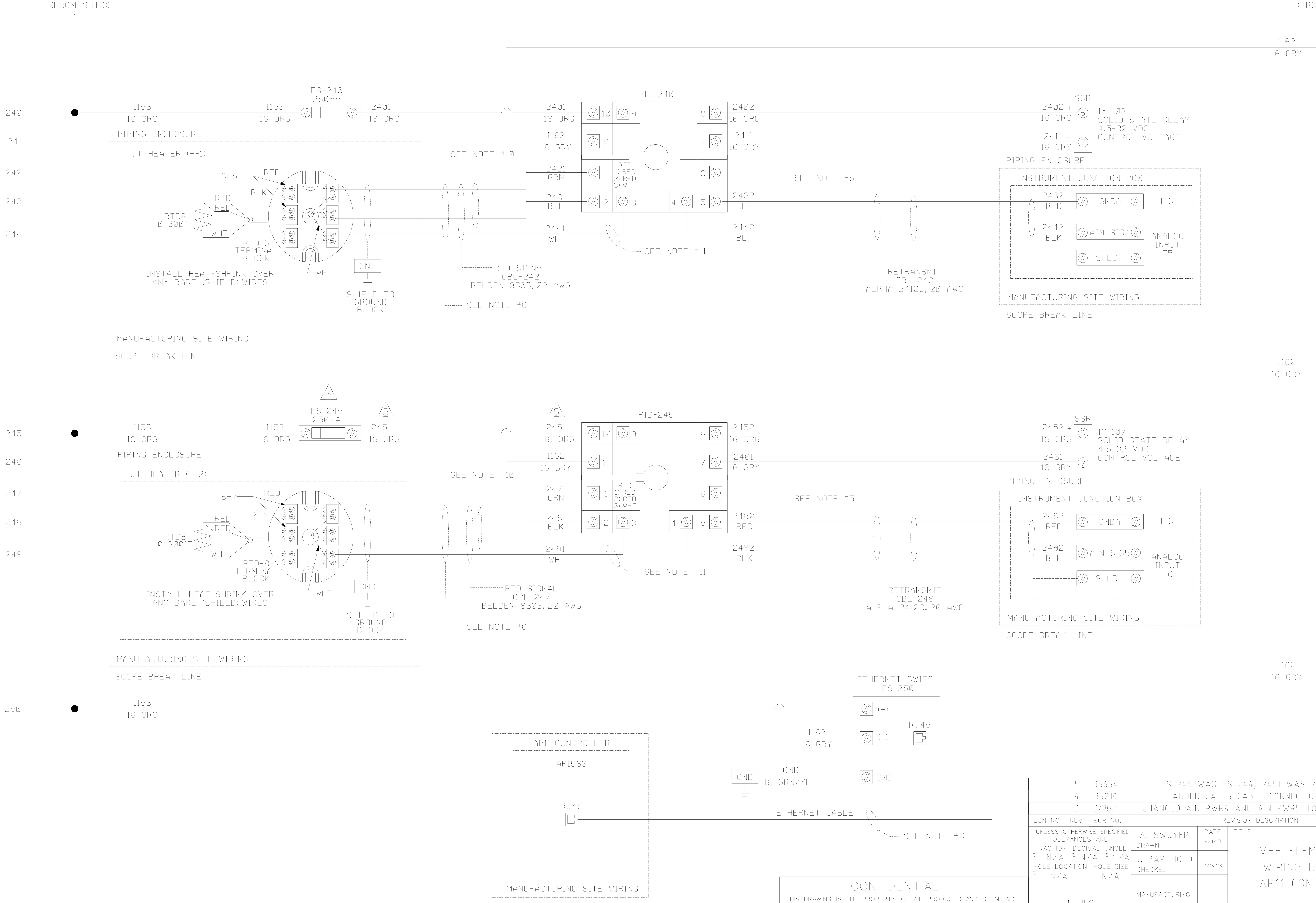
INCHES
MILLIMETERS
INCHES (MILLIMETERS)

DRAWN: A. SWOYER — 4/1/13
CHECKED: J. BARTHOLD — 7/15/13
MANUFACTURING
ENGINEER
APPD.: D. HOCKENBERRY — 7/15/13

TITLE
VHF ELEMENTARY
WIRING DIAGRAM
AP11 CONTROLLER

AIR PRODUCTS
ALLENTOWN, PENNSYLVANIA

DWG NO. BNTLY00837.DGN
D
REV. 5
SCALE NTS
REF.
SHEET 3 OF 4



ECN NO.	REV.	ECR NO.	REVISION DESCRIPTION	DATE	BY	CHK'D	APPD.
	5	35654	FS-245 WAS FS-244, 2451 WAS 2441	2/12/14	JRB	JCB	DLH
	4	35210	ADDED CAT-5 CABLE CONNECTION	12/11/13	ACS	PO	DLH
	3	34841	CHANGED AIN PWR4 AND AIN PWR5 TO GND D	11/06/13	ACS	PO	DLH

UNLESS OTHERWISE SPECIFIED TOLERANCES ARE
FRACTION DECIMAL ANGLE
± N/A ± N/A ± N/A
HOLE LOCATION HOLE SIZE
± N/A ± N/A

INCHES
MILLIMETERS
INCHES (MILLIMETERS)

A. SWOYER — DRAWN — DATE 6/1/13
J. BARTHOLD — CHECKED — 7/15/13
MANUFACTURING
ENGINEER
D. HOCKENBERRY — APPD. — 7/15/13

TITLE
VHF ELEMENTARY
WIRING DIAGRAM
AP11 CONTROLLER

AIR PRODUCTS
ALLENTOWN, PENNSYLVANIA

DWG NO. BNTLY00837.DGN — D — REV. 5
SCALE NTS — REF. — SHEET 4 OF 4

CONFIDENTIAL

Installation Drawing Package

Very High Flow Module Installation Package

Thank you for purchasing the GASGUARD® Very High Flow module, one of the finest gas delivery systems available to the electronics industry. This installation package contains all the drawings necessary to help facilitate the VHF module and optional components.

Note: The pre-installation package contains all the drawings for all options. It's the responsibility of the user to determine which drawings apply using the scope sheet as a reference.

Included with the equipment module is the VHF Scope Sheet which lists the options purchased for your module. Using the mechanical options PFD (BKA004 MECH 0021), identify and highlight the options listed in your scope sheet. This will allow the installer to understand what piping connections must be made to the VHF module.

Again, reviewing the VHF Scope Sheet, identify which software logic option the VHF module was built to. Select the appropriate software logic PFD (BKA004 PFD 0001, 3, 8, or 9). This will provide the correct module-to-module process piping interconnect diagram. Software logic options 1 and 2, require no process piping interconnections.

Consult the VHF electrical installation drawing (SW10145.slddrw) for power, I/O, and Ethernet connections. The electrical installation drawing contains all available options, so the VHF Scope Sheet will need to be reviewed to determine which options are applicable to your VHF module.

Source container piping configuration varies with process gas and container type. Using the VHF Scope Sheet, identify the process gas and source container. Then choose the appropriate VHF Pigtail Assembly drawing (BKA004 MECH 0010 through 0020).

Optional tube switching is available for source A trailers and ISO containers. If the tube switching option is called out on the VHF Scope sheet, the appropriate installation drawing must be identified. Using the software logic option, source container type and process gas identified earlier, choose the appropriate Pneumatic Assembly Installation drawing. Tube switching is not available for source B with the AP11 controller.

The appropriate VHF module installation drawing can be identified by process gas, and in the case of HCl only, the container type. Identify the correct drawing using the process gas and container listed in the VHF Scope Sheet.

Optional Equipment may have been purchased, that will interface with the VHF module. High level installation drawings are included with this drawing set, but, the installation information provided with each optional module should be used. The exception to this rule is the Versum Materials, Inc. purge module (WREDV1805 MECH 0014).

All installation work should be performed by qualified trade personnel necessary to perform the installation tasks properly. The GASGUARD® VHF module must be installed in accordance with all applicable site requirements, local, state, and federal regulations.

REV.

VHF PFDs

Individual module piping, source containers, and utilities:

VHF Mechanical Options PFD	BKA004 MECH 0021
VHF Mechanical Options PFD Legend	BKA004 MECH 0022

Module to module interface:

VHF Software Logic Option 1 , Single Source-Single Module	BKA004 PFD 0001
VHF Software Logic Option 2 AP11 , Dual Source-Single Module	BKA004 PFD 0008
VHF Software Logic Option 3 , Single Source-Dual Module	BKA004 PFD 0003
VHF Software Logic Option 4 AP11, Dual Source-Dual Module	BKA004 PFD 0009

VHF Electrical Installation

VHF Electrical Details for Typical Installation	SW013145.SLDDRW

VHF Mechanical Installation

Source Assemblies:

VHF Pigtail Assembly, Y or Drum, SiH4	BKA004 MECH 0010
VHF Pigtail Assembly, ISO Container, SiH4	BKA004 MECH 0011
VHF Pigtail Assembly, Y or Drum, N2O	BKA004 MECH 0012
VHF Pigtail Assembly, Tube Trailer, N2O	BKA004 MECH 0013
VHF Pigtail Assembly, Y or Drum, NH3	BKA004 MECH 0014
VHF Pigtail Assembly, ISO Container, NH3	BKA004 MECH 0015
VHF Pigtail Assembly, Y or Drum, NF3	BKA004 MECH 0016
VHF Pigtail Assembly, ISO Container, NF3	BKA004 MECH 0017
VHF Pigtail Assembly, Y or Drum, HCl	BKA004 MECH 0018
VHF Pigtail Assembly, 7 Tube Trailer, HCl	BKA004 MECH 0019
VHF Pigtail Assembly, 10 Tube ISO Container, HCl	BKA004 MECH 0020

PVC End Cap/Flexible Ventilation Duct Installation	BKA004 MECH 0024
VHF Pigtail Assembly, Y or Drum, NO	BKA004 MECH 0025
VHF Pigtail Assembly, Y or Drum, CO2	BKA004 MECH 0026
VHF Pigtail Assembly, Trailer, CO2	BNTLY00434

Tube Switching, Source A:

Pneumatic Assembly Installation, Source A only, SiH4 8 tube ISO only	SW012922.SLDDRW
Pneumatic Assembly Installation, Source A only, NF3 8 tube ISO only	BNTLY00827
Pneumatic Assembly Installation, Source A only, HCl 7 Tube Trailer only	SW012928.SLDDRW
Pneumatic Assembly Installation, Source A only, HCl 10 tube ISO only	SW012931.SLDDRW

VHF Modules:

VHF Module Installation, SiH4/CO2 Rack	INS10554.SLDDRW
VHF Module Installation, N2O/NH3/NF3/NO/HCl 10 Tube ISO	INS003730.SLDDRW
VHF Module Installation, HCl, 7 Tube Trailer	INS003821.SLDDRW

Optional Equipment Modules:

Purge Module with HPLT (High Pressure Leak Test) Gas	WREDV1805 MECH 0014
3000 lb. Weight Scale	BBA001 MECH 0002
HCl Purifier Module	BBH001 MECH 0001

VHF Controls: (maintenance and troubleshooting only)

VHF Shutdown Tables	XL000356
VHF Alarm Matrix	XL000355
VHF Elementary Wiring Diagram	BNTLY00837

Appendix C

Pressure Equipment Directive Statement

PED Assessment

in accordance with the Pressure Equipment Directive 97/23/EC

Versum Materials, 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 Air Products Engineering Standards. Instructions for its safe use and installation are documented in the accompanying Operation and Installation Manual.

Appendix D

Process Heater PID Controller Setup

DIGITAL INDICATING CONTROLLER

RKC SA100

OPERATIONAL AND

CONFIGURATION INFORMATION

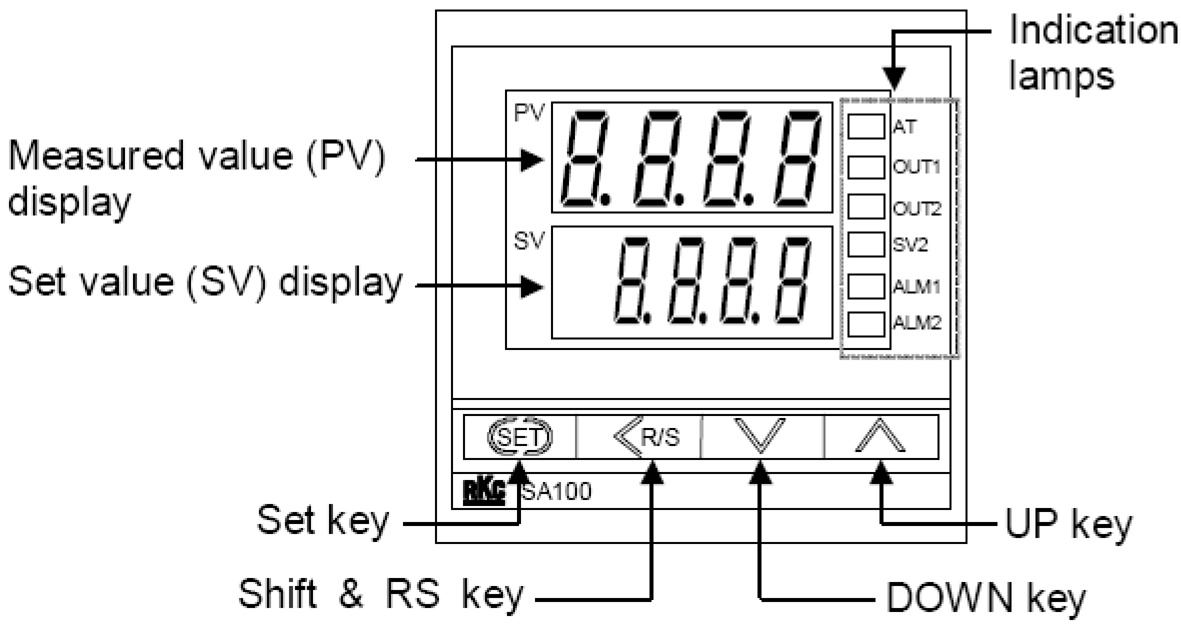
VHF Module Heater Controls

Controller TAG Number

PID-240, 244

JT Temperature Controller

RKC SA100


Indication lamps
Measured value (PV) display
Set value (SV) display
PV
SV
AT
OUT1
OUT2
SV2
ALM1
ALM2
SET
R/S
RKC
SA100
Set key
UP key
Shift & RS key
DOWN key

Measured value (PV) display [Green]
Displays PV or various parameter symbols.

Set value (SV) display [Orange]
Displays SV or STEP set value (SV1, SV2).
Displays various parameter set values.

Indication lamps:
Autotuning (AT) lamp [Green]
Flashes during autotuning execution.

Output lamps (OUT1, OUT2) [Green]
OUT1: Lights when output1 is turned on.
OUT2: Lights when output2 is turned on.

STEP set value (SV2) lamp [Orange]
Lights when the SV2 of STEP function is selected.

Alarm lamps (ALM1, ALM2) [Orange]
ALM1: Lights when alarm1 is turned on.
ALM2: Lights when alarm2 is turned on.

Set key
Used for parameter calling up and set value registration.

Shift & R/S key
Shift digits when settings are changed.
Selects the RUN/STOP function.

DOWN key
Decrease numerals.

UP key
Increase numerals.

****TO AVOID DAMAGE TO THE INSTRUMENT, NEVER USE A SHARP OBJECT TO PRESS KEYS. ****

I. GENERAL OVERVIEW OF THIS SET-UP DOCUMENT

a) Use fuse switch to power on/off the PID controller.
b) Unlock the PID controller.
c) Change the PID controller from the RUN mode to STOP mode.
d) Set the initial parameters.
e) Revise the PID controller operational parameters.
f) Change the PID controller from the STOP mode to the RUN mode.
g) Enter the Process Set Value (SV) temperature.

II. INITIALIZATION SETUP PARAMETERS CONFIGURATION

a. To Power the PID Controller, Close the Fuse Switch (display should be on).

b. Unlock the Controller to enter the engineering configuration

To verify the mode (Press [SET] key for 2 seconds) the unit should display (ATU)
Continue to press the [SET] key to display (LCK) function
If the set value indicated (1000 = Unlock) then proceed to step (c) otherwise;
Press the [<R/S] key to flash the most significant digit of the set value (SV)
Press the [↓DOWN] key to change the “1” to “0” and “0” to “1”, displaying the value (1000).
Press the [SET] key for 2 seconds to change to the PV/SV display mode

c. Change from RUN to STOP

Press the [<R/S] key for 1 second. This changes the operation mode from RUN mode to STOP mode.

**** [STOP] NEEDS TO BE DISPLAYED AT THIS POINT OR YOU WILL <u>NOT</u>**

BE ABLE TO CONFIGURE THE FUNCTION BLOCKS. **

d. Setting Initial Parameters Setting

Press the [<R/S] and [SET] keys together for 2 seconds

This will enter the engineering mode and display changes to the function block “F10”

Press the [↑ **UP**] Key to proceed to next function block.

Press the [SET] Key to proceed to the next input

F 10.	[SET]	SPCH	[SET]	dCHG	[SET]	MVd	[SET]
		0000		0000		0000	

Press the [↑ **UP**] Key to proceed to next function block.

F 21	[SET]	InP	[SET]	UnIT	[SET]	PGdP	[SET]	SLH	[SET]	SLL	[SET]
		0012		0000		0001		150.0		0.0	

Press the [↑ **UP**] Key

F 30.	[SET]	LoGC	[SET]
		0012	

Press the [↑ **UP**] Key

F 41.	[SET]	AS1	[SET]	AHo1	[SET]	AH1	[SET]	AEo1	[SET]
		0000		0000		2.0		0000	

Press the [↑ **UP**] Key

F 42.	[SET]	AS2	[SET]	AHo2	[SET]	AH2	[SET]	AEo2	[SET]
		0000		0000		2.0		0000	

Press the [↑ **UP**] Key

F 51.	[SET]	oS1	[SET]	oH	[SET]
		0001		2.0	

Press the [↑ **UP**] Key

F 61.	[SET]	CMPS	[SET]
		0000	

Press the [↑ **UP**] Key

F 71.	[SET]	SVrS	[SET]	SVrT	[SET]
		0000		0060	

Press the [↑ **UP**] Key

F 91.	[SET]	E227	[SET]	WT	[SET]	TCJ	[SET]
		Leave Setting		Leave Setting		Leave Setting	

Press the [↑ **UP**] Key to return to the function block F10.

Press the [**SET** and <R/S**]** keys for two seconds.

PID Controller should still be in the **STOP** mode, (STOP) displayed.

e. <u>Revise the Operation Parameters per the following Table</u>:

The unit should display **ATU**. Reference the table below for the settings required for each parameter. Press the [**SET]** to advance to the next parameter. Use the ↑↓ keys to change the operating parameter value. The [**SET]** key must be pressed to store the new value.

Note: Operating parameter changes may be performed with the system in operation.

Log all program modifications.

CODE	DEFINITION	VALUE	DESCRIPTION / RANGE
ATU	Auto-tuning	**OFF**	ON or OFF Factory Set Value: OFF When the AT function is activated, ST function can not be turned on.
STU	Self-tuning	***OFF***	ON or OFF Factory Set Value: OFF To activate the ST function, the following parameters must not be set to zero: P, I, D and ARW.
P	Heat-Side Proportional Band	**20.8**	0 to SPAN (0 or 0.0: ON/OFF action) Factory Set Value: Temperature (30.0)
I	Integral Time	**81**	0 to 3600 sec (0:PD action) Factory Set Value: Temperature (240)
d	Derivative Time	**20**	0 to 3600 sec (0:PI action) Factory Set Value: Temperature (60)
Ar	Anti-Reset Windup	**100%**	0 to 100% (0:Integral action OFF) Factory Set Value: 100%

r	Heat-Side Proportioning Cycle Time	**1**	1 to 100 sec (voltage pulse output) Factory Set Value: 2
Pb	PV Bias	**0.0**	-span to +span (temperature input) Factory Set Value: 0 (0.0)
dF	Digital Filter	**0**	0 to 100 sec (0:OFF) Factory Set Value: 0
Ao	Analog Output Specification	**PV**	Analog output specification: <u>PV</u>: Measured Value, <u>SV</u>: Set Value <u>dEV</u>: Deviation, <u>mV</u>: Manipulated output
AHS	Analog Output Scale High	**150**	Measured value (PV): Same as input range Factory Set Value: Input Range (high limit)
ALS	Analog Output Scale Low	**0**	Measured value (PV): Same as input range Factory Set Value: Input Range (low limit)
LCY	Set Data Lock	**0011**	0011: Only SV can be set.

The last table entry (LCY) will **“Lock the controller”** and only allow the SV parameter to be changed during operation – The controller setting should be locked to prevent any accidental changes.

f. Press the [**R/S]** key for one second to exit the STOP Mode.

g. Temperature Set-point

To change the temperature set-point in the controller use the ↑↓ keys to change the set-point value. When the desired value is displayed, press the [**SET]** key to store the new value. The controller will now operate with the new reference set-point.

Press [**SET]** key to enter the SV Setting Mode

- The blinking digit on the SV display indicates which digit can be set.
- Press the [<**R/S]** key to shift digit to the right and use the ↑↓ keys to change the value.
- Pressing the [**SET]** key stores the value setting and the display will automatically return to the PV/SV display mode.

Use the following specific set-point values:

Process Heater H-1:

- **88° C** (190.4 ° F) for **SiH4** and **N2O** systems
- **71° C** (159.8 °F) for all other gases

Process Heater H-2:

- **27° C** (80.6 °F) for all gases

III. OPERATIONAL INFORMATION

AUTO-TUNING (AT) OPERATION

The controller has the ability to automatically adjust the PID tuning parameters to optimize controller operation. Slow responding process variables, such as temperature, are well suited for auto-tuning controllers.

The AT function automatically measures, computes and set the optimum PID and LBA constants by allowing the controller to drift above the set-point and below the set-point by two seconds for a period of time.

If the AT function is cancelled (when the RUN/STOP is changed to STOP mode) the controller changes to PID control, the PID and LBA constants will be the same as before AT was activated.

When the AT function is completed, the controller changes to PID control.

To Start Auto-Tuning:

Unlock the PID Controller

Change from RUN to STOP Mode. Press the [<R/S] key for 1 second.

Press the [SET] key for 2 seconds and the unit should display **ATU**

Change the ATU from “OFF” to “ON”

Press the [**R/S]** key for one second exit the STOP Mode.

ANALOG RETRANSMISSION:

The RKC-SA100 temperature controller has the capacity to retransmit the process variable (temperature) to another device or system as a 4-20 mA signal. This signal can be utilized provide trending or data acquisition of system temperature, or remote monitoring if desired. This analog output is prewired to terminal blocks of the AP-10 analog input within the Instrument Terminal Box. For this application the 4-20mA signal is equal to 0 to 150° C (32 to 302° F). Any range can be inputted, but keeping the range small will kept the transmitted signal more accurate.

Appendix E

Pre-Facilitation Checklist

This document provides an installation review checklist for proper connections, utilities, and system requirements. This will assure the GASGUARD® Very High Flow Module is not damaged by any incorrect or missing connections and that the installation is ready to proceed to the commissioning phase (final test and first time charging of Hazardous Gas). This document must be completed for each GASGUARD® Very High Flow System gas type.

Versum Materials, Inc. may be providing startup resources to the Customer Site. Completing the activities shown on this checklist prior to the arrival of the Versum Materials, Inc.' Equipment Startup Team personnel will avoid unnecessary delays and costs to the project and customer. With an accurately completed checklist, the Versum Materials, Inc.' Equipment Startup Team commissioning and startup activity should require less time and proceed in a more efficient and safe manner.

When the Versum Materials, Inc. startup service is requested, the Equipment Startup Team will use this checklist to review the installation. If the installation does not satisfy the requirements for facilitation and startup, the team will provide a list of the discrepancies to the designated site representative. Depending on the scope of discrepancies, the Versum Materials, Inc. Equipment Startup Team may decide to return to VERSUM MATERIALS, INC. and re-schedule the facilitation activity, or the team may wait onsite until the GASGUARD® Very High Flow system is ready for facilitation. Either option may result in additional cost impact to the Customer.

Definitions

VHF –GASGUARD® Very High Flow System.

LSS - Life Safety Systems (Facility gas detection or hazardous monitoring systems.)

SL1 (Safety Level 1) - Equipment is OK to power up and pressurize with inert gas for testing.

SL2 (Safety Level 2) - Equipment is OK to install process gas cylinder and pressurize with process gas.

SL3 (Safety Level 3) - Equipment is qualified with the fab process.

Acceptance - the process of verifying the incoming equipment to site specifications and properly mounting the equipment in the correct location and orientation prior to facilitation.

Facilitation - the process of installing all utilities and piping to support the equipment and verifying the operation and safety of the gas delivery equipment. This includes electrical testing / checkout and alarm functional testing. This includes Safety Level 1 & Safety Level 2, which must be completed prior to commissioning the system with process gas.

Commissioning - the process of verifying operational safety followed by the first time charging of process gas. This includes purifier conditioning, fluorine passivation, etc.

Instructions Complete the checklist as follows:

1. Initial and Date each line item when the individual task is complete.
   Note- DO NOT check the shaded blocks in the VERSUM MATERIALS, INC. FSS column. These blocks will be initialed by the Versum Materials, Inc. Equipment Startup Team when the task is verified as complete.

2. Assign Task Responsibility of each task to Customer, Supplier, or Contractor (list their name) or complete as N/A, if the individual task is not applicable to this VHF installation.
3. Read and sign the Customer Certification on the last page.
4. Fax the completed checklist to the attention of the VERSUM MATERIALS, INC. Project Engineer of record.

Customer Name:		**Date:**	
Customer Location:		**Gas Type:**	
Commodity Code:		**Source(s) A:**	
Serial Number:		**Source(s) B:**	
Commodity Description:			

Equipment Inventory

This section shall be used to identify all the equipment modules that make up this entire VHF installation. Since there are many configurations and source arrangements, this section shall serve to show the site-specific information for this VHF installation. Check the boxes and fill in the quantity of each equipment module for this VHF installation. Please include SEMC Commodity Code Numbers and Serial Numbers for each piece of equipment.

GASGUARD® Very High Flow System Cabinet/Rack ☐ (Qty =) ISO Heater Controller ☐ (Qty =)

Source Connection/ Flexible Ventilation Duct/PVC End Cap ☐ (Qty =) Y-Cylinder Heater Controller ☐ (Qty =)

ISO Container Source ☐ (Qty =) Source Scale ☐ (Qty =)

Y-Cylinder Source ☐ (Qty =) Tube Trailer Source ☐ (Qty =)

Drum Source ☐ (Qty =) HCL Purifier Module ☐ (Qty =)

Purge Module ☐ (Qty =)

1. **Visual Inspection and General Condition**	**Initial / Date**	**N/A or Task Responsibility**	**VERSUM MATERIALS, INC. FSS Initial / Date**

A. All component / equipment conditions OK.			
B. Bag containing: VCR insulation, enclosure air inlet sheet metal for the bottom of the enclosure, DISS/RFO spool, flexible ventilation duct and clamps, tube switching pneumatic tube bundles, etc. shipped with the equipment is in an identified location / individual's possession.			
C. All mechanical (VCR and/or Swagelok) connections are tight.			
D. All equipment and scales (if applicable) installed. Local scale supplier identified and contacted for scheduling of technician and weights for scale calibration.			
E. Forklift & operator available for scale calibration.			
F. Proper regulators, pressure transducers, and safety relief valves are installed, properly rated and set. Materials of construction are proper for gas type. Components that are difficult to see due to insulating material can be verified by reviewing the QAF595B document shipped with the unit.			
G. Roof / canopy installed and complete.			
H. Unhindered, complete access to VHF area is available. No other work is being performed in the area.			

2. Mechanical Installation	**Initial / Date**	**N/A or Task Responsibility**	**VERSUM MATERIALS, INC. FSS Initial / Date**
A. All VHF equipment properly mounted and installed. Record Physical Layout drawing number & revision. Dwg # __________________, Rev. ___.			
B. All VHF piping has been verified as accurate against the VHF Mechanical VHF SKM in the equipment documentation envelope. Record SKM drawing number & revision. Dwg # _________________, Rev. ___.			
C. Process lines installed, helium leak tested, and qualified. Record Field Piping Installation drawing number & revision. Dwg # _________________, Rev. ___. Verify VCR locks installed or Glyptol installed where required.			
D. Vent lines installed, pressure tested, and qualified (if applicable). Verify vent lines are complete and installed into			

appropriate header and all fittings are tight. If vent header is purged, ensure purge source is connected and available.			
E. All source container pneumatic tubing is installed and have been verified as accurate against the installation drawing.			
F. Pneumatic supply connected to each piece of equipment and 85-95 psig of nitrogen is available. Record Pneumatic Installation drawing number and revision. Dwg # _______________, Rev. ___.			
G. Verify vacuum venturi / utility pneumatic N2 lines installed, leak tested, and 85-95 psig of nitrogen available.			
H. Verify Z-purge installed & labeled and that fittings are tight. Verify 85-95 psig of pneumatic nitrogen is available.			
I. Verify exhaust duct / scrubber exhaust lines are complete, flowing, and balanced (if applicable). Record Exhaust Duct Field Piping installation drawing number and revision. Dwg # ______________________, Rev. ___.			
J. Verify internal piping is helium leak tested.			
K. Verify restrictive flow orifice installed (if applicable).			
L. Verify heat trace is installed (if applicable) on VHF process lines from source equipment to inlet.			
M. Verify heat trace on process houseline from VHF outlet to Fab is installed (if applicable) and tested.			

3. Purge System	**Initial / Date**	**N/A or Task Responsibility**	**VERSUM MATERIALS, INC. FSS Initial / Date**
A. Verify purge lines installed, helium leak tested, and qualified. Record Purge Piping Installation drawing number and revision. Dwg # ________________, Rev. ___. Verify all connections are tight.			
B. Purge and He leak check cylinders available and connected.			
C. Purge gas purifiers installed (if applicable) and tagged with nameplate.			
D. Verify He Leak Check is installed (if applicable) and leak tested. In a high pressure system the Leak check should be regulated to 950 psig and have a safety relief valve set at 1200			

	Initial / Date	N/A or Task Responsibility	VERSUM MATERIALS, INC. FSS Initial / Date
psig. For a low pressure system the Leak Check should be regulated to 200 psig and the safety relief valve set at 250 psig. The line should be leak tested.			

4. Electrical Installation	**Initial / Date**	**N/A or Task Responsibility**	**VERSUM MATERIALS, INC. FSS Initial / Date**
A. All equipment grounding conductors installed and connected to each piece of equipment. Record Grounding drawing number and revision. Dwg # ________________, Rev. ___.			
B. Electrical power connected to each piece of equipment. Record Field Interconnect drawing number & revision. Dwg # _____________, Rev. ___.			
C. Power wiring Megger tests completed by installer and test results turned over to customer for their records. (needed for trouble shooting)			
D. All interconnecting conduit and wire installed, labeled, and terminated at both ends.			
E. Customer I/O wiring / signals installed. Record drawing number and revision of electrical drawing that shows all Customer I/O. Dwg # _______________, Rev. ___.			
F. Verify Network wiring (Ethernet) installed and terminated at VHF equipment (if applicable).			
G. Conduit seals installed (if applicable), but not poured.			
H. Verify VERSUM MATERIALS, INC.-supplied conduit hubs were not removed during conduit installation. All outdoor conduits must be weather-tight and provide low-point water drainage.			

5. Safety Level Inspections and Safety Equipment	**Initial / Date**	**N/A or Task Responsibility**	**VERSUM MATERIALS, INC. FSS Initial / Date**

Item	Initial / Date	N/A or Task Responsibility	VERSUM MATERIALS, INC. FSS Initial / Date
A. Safety Level 1 completed and approved for Inert Gas and Power. Customer safety protocols and checks / signoffs complete and all power is ready and authorized to energize.			
B. Equipment has tags / nameplates showing voltage level, amps, frequency, and where source of electrical power originates.			
C. Safety Level 2 approvals for Hazardous Gas in process of being complete.			
D. Hazardous gas monitoring / leak detection is installed, wired, calibrated, and operational (if applicable).			
E. For indoor installations, O2 monitors installed and tested (if applicable).			
F. Customer Life Safety System (LSS) I/O for VHF installed, wired, labeled, and point-to-point checks by Customer or installer have been completed.			
G. Danger / warning stickers installed on each piece of equipment as required by Customer and VERSUM MATERIALS, INC. safety protocols.			

6. Pressure Tests and Helium Leak Tests

Inbound ($x10^{-9}$)

Outboard ($x10^{-6}$)

Item		Initial / Date	N/A or Task Responsibility	VERSUM MATERIALS, INC. FSS Initial / Date
A. Interconnecting Piping	______________			
B. VHF Piping	______________			
C. Source module Piping	______________			
D. Purge Piping	______________			
E. Houseline Piping	______________			
F. Vent Lines / Header	______________			

7. Moisture & Oxygen Analysis

Initial / Date	N/A or Task Responsibility	VERSUM MATERIALS, INC.

				FSS Initial / Date
Date / Time	______ / ___			
Temperature (°F)	______			
Inlet Pressure (psig)	______			
Outlet Pressure (psig)	______			

		H_2O	O_2			
A.	Baseline (ppb)	______				
B.	Final Readings (ppb)	______				

This GASGUARD® **Very High Flow System equipment was installed in accordance with applicable Versum Materials, Inc. Engineering Standards and Practices. By signature, this site is ready for facilitation, commissioning, and startup. Any further work required by Versum Materials, Inc. to meet these pre-facilitation expectations will be considered a scope change.**

Signature	Date
Customer / Site Gas Eng. Representative	**Date**
Versum Materials, Inc. Representative	**Date**
Customer / Site EHS Representative	**Date**
Customer / Site LSS Representative	**Date**
Customer / Site Contractor Manager	**Date**

Appendix F

Startup and Commissioning

Equipment Facilitation and Commissioning can only be performed by trained personnel who understand the hazards of the system. Personal injury or death may result if the personnel performing these tasks are not properly trained and qualified to work on pressurized systems and electrical apparatus and wearing proper personal protective equipment (PPE) when required.

⚠WARNING

Definitions

VHF – Very High Flow

LSS - Life Safety Systems (Facility gas detection or hazardous monitoring systems.)

SL1 (Safety Level 1) - Equipment is OK to power up and pressurize with inert gas for testing.

SL2 (Safety Level 2) - Equipment is OK to install process gas cylinder and pressurize with process gas.

SL3 (Safety Level 3) - Equipment is qualified with the fab process.

Acceptance - the process of verifying the incoming equipment to site specifications and properly mounting the equipment in the correct location and orientation prior to facilitation.

Facilitation - the process of installing all utilities and piping to support the equipment and verifying the operation and safety of the gas delivery equipment. This includes electrical testing / checkout and alarm functional testing. This includes Safety Level 1 & Safety Level 2, which must be completed prior to commissioning the system with process gas.

Commissioning - the process of verifying operational safety followed by the first time charging of process gas. This includes purifier conditioning, fluorine passivation, etc.

This document provides a checklist for use at the Customer Site by the VERSUM MATERIALS, INC. Commissioning and Startup Team personnel. Completing this checklist and following this procedure will help ensure the VHF is properly installed, commissioned, and functionally tested. All tasks identified in this document must be completed prior to the VHF equipment being placed into full operational service to the Customer.

Instructions Complete the checklist as follows:

1. Make sure all required task are completed.
2. Initial and Date each applicable line item or complete as N/A, if the individual task is not applicable.
3. Read and sign the Certification on the last page.
4. Fax the completed checklist to the attention of the VERSUM MATERIALS, INC. Project Engineer of record.

Customer Name:		**Dates:**	
Customer Location:		**Gas:**	
VHF Model Number:		**Side "A" Source(s):**	

VHF Serial Number:		**Side "B" Source(s):**	
Commodity Description:			

1. Pre-Facilitation Checklist Review and Visual Inspection

		Initials or N/A	**Date**
A.	Review the "GASGUARD® Very High Flow Pre-Facilitation Checklist" and verify that each activity is completed, initialed, and dated.		
B.	Review equipment Source Inspection (QAF) / Factory Acceptance Testing (FAT) documents and address any open items.		
C.	An individual VERSUM MATERIALS, INC. Facilitation and Commissioning Checklist must be completed for each individual equipment module that makes up this complete VHF installation. Review the "GASGUARD® Very High Flow Pre-Facilitation Checklist" and verify each equipment module is identified and the SEMC Model, Equipment and Serial numbers are recorded.		
D.	General appearance of all equipment is satisfactory.		

2. Mechanical Checklist

		Initials or N/A	**Date**
A.	Verify all piping (process, purge, Venturi, pneumatic, vent, etc.) is flow checked per VHF SKM in the equipment documentation envelope. Record SKM drawing number and revision: Dwg # ________________, Rev. ___.		
B.	Verify all equipment properly mounted and secure to concrete pad (anchor bolts), supports, or walls. Verify seismic bracing installed, if required.		
C.	Verify all piping and devices properly mounted and supported. Verify all piping clamps are tightened.		
D.	Verify all bulkhead fittings on piping into the VHF are tight.		
E.	Verify all unistrut and supports have no sharp edges or are capped to prevent injury.		
F.	Verify all doors close and latch properly, check alignment, Verify seals/gaskets OK.		
G.	Verify all door locks function and gather all keys-will turn over all to Customer. (Keys are shipped tie wrapped to the door closer.)		
H.	Verify canopy / roof (for weather protection) is completed.		
I.	Verify all equipment is weather-tight and all seals/gaskets are in proper condition. Any exterior openings in equipment must be sealed. Ensure all covers are installed and tight.		
J.	Verify RFO's are installed, if required. Record RFO Size: ________________________		
K.	Verify proper DISS connection orifice size per the VHF Manufacturing BOM Specification Text "DISS Spool RFO-1".		
L.	Verify all product containers have proper safety relief devices installed		
M.	Verify heat trace and line insulation is complete, if required.		
N.	Verify quick disconnect for Source cylinder valve pneumatics are installed.		
O.	Verify equipment/cabinet labeling – gas labels on equipment, VERSUM MATERIALS, INC. emergency label, valve labels, equipment nameplates, equipment model/serial numbers, D.O.T. labels, safety warnings, electrical information, safety inspection tags, etc.		
P.	Verify Analytical and Qualification tests have been properly completed for all piping. Verify customer has copy of all tests and documentation for Helium Leak Tests, Pressure Tests, Moisture and Oxygen Tests, Particle Tests, etc.		

Q. Verify Purge Gas Cylinders are connected and available to flow purge gas. Verify correct CGA or DISS to match cylinder(s). Verify that any purge gas purifiers are installed, conditioned/activated and tagged with nameplate.

3. Safety Protocols / Equipment Checks

		Initials or N/A	Date
A.	Hazardous gas monitors / leak detection for process gas installed, wired, and tested by Customer or Customer's installation contractor (if applicable).		
B.	Verify exhaust duct / scrubber exhaust lines (if applicable) are complete, flowing, and balanced. Record Exhaust Duct Field Piping installation drawing number and revision. Dwg # ________________, Rev. ___. Verify exhaust flow Tel tails are installed.		
C.	Customer Life Safety System (LSS) I/O for VHF installed, wired, labeled, and point-to-point tested by Customer or installer.		
D.	Customer safety protocols and checks / signoffs complete and all power is ready and authorized to energize. Equipment has tags / nameplates showing where source of electrical power originates.		
E.	Conduit seals installed, packed, and poured once electrical checkout complete and all wiring verified. Paint conduit seal red once poured.		
F.	Danger / warning stickers installed on each piece of equipment as required by Customer and VERSUM MATERIALS, INC. safety protocols.		
G.	Voltage level warning stickers installed on each piece of equipment as required by Customer and VERSUM MATERIALS, INC. safety protocols.		
H.	Comple the VERSUM MATERIALS, INC. Operational Rediness Inspection (ORI) and verify the ORI is signed off by Customer representatives.		
I.	Verify Customer Safety Level 2 (SL2) approval for Hazardous Gas is complete.		

4. Electrical Commissioning and Checkout

		Initials or N/A	Date
A.	Obtain copy of VHF Elementary Wiring Diagram used to manufacture this VHF. Record drawing number and revision. Dwg # _______________, Rev. ___.		
B.	Verify Third Party Certification from a Nationally Recognized Testing Laboratory (NRTL) is complete. Record NRTL listing number for each VHF module: __________________.		
C.	Verify all equipment is properly installed in a General Purpose area or properly equipped and rated for installation within a Hazardous / Classified area.		
D.	If any VHF equipment is installed within an electrically rated Hazardous / Classified area, list the Hazardous Classification of the area: Class: ___, Division: ___, Group: ___. List each piece of VHF equipment that is installed within this Hazardous Area: ___________________ ____. Verify that each piece of electrical equipment (devices, conduit, fittings, reducers, etc.) is properly rated (or properly equipped) for installation within this Hazardous Area.		
E.	Verify all field conduit and wiring installed per design package. Record drawing number and revision		

of electrical installation drawing. Dwg # ____________________, Rev.___.

F.	Verify conduit installed properly-all outdoor conduit is RGS (Rigid Galvanized Steel), electrically approved thread compound on all threads, all conduit properly supported, conduit seals (if required), low-point drains, fittings have covers & gaskets, Myers/bullet hub with o-ring gasket installed on all outdoor penetrations, no splice in any wire, cable tag on both ends of each cable, wire tag on both ends of each wire/conductor, wire supported properly with ty-wraps, etc.		
G.	Verify all unused openings in all equipment are sealed with o-ring gasket plugs and are weather / rain tight.		
H.	Verify the **(Optional)** Y or Drum container weight scale is properly mounted, including seismic braces, if required.		
I.	Verify the **(Optional)** weight scale is properly wired and scale terminal box is weather-tight.		
J.	Verify the **(Optional)** Y or Drum container weight scale load cell bolts are screwed down from their locked shipping position. Verify the weight scale is properly leveled using the four screw-down feet.		
K.	Verify Customer-supplied conduit hubs and auto-drains are INSTALLED. All outdoor conduits must be weather-tight and o-ring gasketed and provide low-point water drainage.		
L.	Verify electrical contractor has cleaned out and vacuumed all debris out of the VHF.		
M.	Verify seating of AP controller EPROMS, fuses, ribbon cables, etc. before applying any power to these devices.		
N.	Verify all internal wiring is tight and properly connected / terminated. Ensure all circuit breakers and switches are in the Open / Off position.		
O.	Verify incoming power feeds with installation electricians. VHF has two (2) forms of power: Heater Power shall terminate on DISC-103-1L1 and 3L2, Control Power shall terminate on DISC-103-5L3 and 7L4. Verify incoming power wiring is the proper size and rating and it is labeled and terminated correctly. Ground conductors must be terminated to ground post LUG-103 in right side of the high voltage enclosure. Verify customer's power is Locked and Tagged Open / Off.		
P.	If incoming power feeds are long in length from the source power panel to the VHF, verify that the electrical contractor has increased the feeder conductor size to ensure less than 3% voltage drop at the VHF equipment. Reference latest edition of NFPA 70 – National Electrical Code.		
Q.	Customer electricians must provide Megger Test Results of all power circuits. Review electrician's Megger test results for incoming power feeds. Proceed only if these test results show that all wires/cables are in good condition.		
R.	Verify that equipment is labeled with nameplate that indicates Source of incoming power feeds, voltage level, current, and frequency.		
S.	Test and record incoming power feeds with electricians at Customer's power panel(s). **Heater Power** (fed from: ____) L1-1 to L2-1:______VAC, L1-1 to Gnd-1:______VAC, L2-1 to Gnd-1:______VAC, Freq:______Hz **Control Power** (fed from: ____) L1-2 to N1-2:______VAC, L1-2 to Gnd-2:______VAC, N1-2 to Gnd-2:______mVAC, Freq:______Hz		
T.	Verify that equipment and canopy structure have lightning protection, if located outdoors.		
U.	Verify that equipment grounding conductors / pigtails are connected to each piece of equipment. Perform Ground Resistance Test (3-Point Fall-of-Potential test or equivalent) for each grounding conductor and record test results of ground resistance with reference to ground grid. Record Grounding drawing number and revision. Dwg # ____________, Rev. ___. VHF: _______ Ohms		

V. Verify the **(Optional)** Heat Trace Temperature Switch is set 10 degrees C. above the Source Heater operating temperature.

W. Perform & record the 500 VDC Megger Test of the H-1 Process Gas Heater. Ensure power is de-energized to the JT Heater prior to performing Megger Tests by ensuring the Contactor CON-103 and Ground Fault Circuit Breaker GFCB-103 are **OPEN** before beginning this test. **Remove each wire from load side of IY-103 before performing Megger Test and reconnect wires once completed.**

Wire # 1035 – Gnd: _______ Ohms, Wire # 1045 - Gnd: _______ Ohms

X. Perform & record the Resistance Tests of the H-1 Process Gas Heater.

Wire # 1035 – Wire # 1045:_______ Ohms

Y. Perform & record the 500 VDC Megger Test of the H-2 Process Gas Heater. Ensure power is de-energized to the JT Heater prior to performing Megger Tests by ensuring the Contactor CON-107 and Ground Fault Circuit Breaker GFCB-107 are **OPEN** before beginning this test. **Remove each wire from load side of IY-107 before performing Megger Test and reconnect wires once completed.**

Wire # 1073 – Gnd: _______ Ohms, Wire # 1083 - Gnd: _______ Ohms

Z. Perform & record the Resistance Tests of the H-2 Process Gas Heater.

Wire # 1073 – Wire # 1083:_______ Ohms

AA. Perform & record the Resistance Test of the **(Optional)** Heat Trace. Open terminal box and disconnect wires from terminals, perform test from the connectors to the Heat Trace elements.

Wire # 1114 – Wire # 1123:_______ Ohms

Wire # 1115 – Wire # 1124:_______ Ohms

Wire # 1113 – Wire # 1122:_______ Ohms

BB. Obtain a copy of the City Inspection (or applicable Authority Having Jurisdiction – AHJ) from the Customer/Electrical Contractor.

CC. Verify all required safety approvals /checks (SL1) are complete and signed off, energize incoming Control Power to VHF unit. Verify proper voltage / frequency at DISC-103. **DO NOT proceed until SL1 sign off has been completed as no power or inert gas may be started until Customer Safety Level 1 is complete.**

DD. Test and record incoming power feeds at VHF Main Disconnect DISC-103.

Heater Power (fed from: ____)

L1-1 to L2-1:______VAC, L1-1 to Gnd-1:______VAC, L2-1 to Gnd-1:______VAC, Freq:______Hz

Control Power (fed from: ____)

L1-2 to N1-2:______VAC, L1-2 to Gnd-2:______VAC, N1-2 to Gnd-2:______mVAC, Freq:______Hz

EE. Place the Main Disconnect Switch (DISC-103) into the Closed / On position.

FF. Place **CB-122** in the Closed / On position. Verify that the 24VDC Power Supply PS-115 is now energized and has an output of 24.1VDC (+/-0.05V). Place CB-1151 in the Closed/On Position. Verify 24VDC is present at distribution block TB-2. Record PS-115 output voltage: ______ VDC.

GG. Download the AP controller Configuration software into the AP controller. Contact your local VERSUM MATERIALS, INC. representative for a copy of these files. Record Name, Revision, and Date of Configuration software: ____.

HH. Navigate to the AP controller System Information screen and record the following data:

Controller EXE Version:___________, DLL Version:___________
Startup EXE Version:___________, OS Image Version:___________
Editor Version:___________, Site Description:________________________________
AP Controller Model #:________________, AP Controller Serial #:_______________

II. Verify the AP controller touch panel display is in good condition.

JJ. Verify the AP controller touch panel is calibrated correctly and functions.

KK. Verify that the **"Emergency Stop"** Shutdown alarm can be cleared. Verify CON-103, CON-107 and (**optional**) CON-111are energized.

5.0 Alarm Matrix / Functional Tests for Digital Inputs and Outputs

Initials or N/A **Date**

A. Record drawing number and revision of Alarm Matrix. Dwg # ____________, Rev. ___.

B. Verify the AP11 controller Hardwire Shutdowns are set as follows.

With the controller door open, locate the Left Panel I/O board in the bottom left side of the AP11 enclosure. On the board, locate SW2 near the upper right side of the board, to the right of SW1 (SW1 and SW2 are stenciled on the board adjacent to their respective switch banks). There are 8 switches per bank numbered 1 though 8 starting from left to right.

Digital Input #19: SW2-3 must be set to ON, only if this input has been enabled in the software.

Digital Input #20: SW2-4 must be set to ON, only if this input has been enabled in the software.

Parity: at the end of the switch bank is SW2-8, the Parity switch. If digital input #19 or #20 has been set to on, the Parity switch must be set to OFF. If both digital inputs #19 and #20 have been set to on, the Parity switch must be set to ON. Verify the Jumper Parity LED on the upper right of the circuit board is green. If not, the parity switch must be switched to the opposite position.

With the controller door open, locate the Customer I/O board on the left side wall of the AP11 enclosure. On the board, locate SW1 near the upper right side of the board, to the left of SW2 (SW1 and SW2 are stenciled on the board adjacent to their respective switch banks). There are 8 switches per bank numbered 1 though 8 starting from left to right.

Digital Input #33: SW1-1 must be set to ON, only if this input has been enabled in the software.

Digital Input #34: SW1-2 must be set to ON, only if this input has been enabled in the software.

Digital Input #35: SW1-3 must be set to ON, only if this input has been enabled in the software.

Parity: at the end of the switch bank is SW2-8, the Parity switch. If one or three of the digital inputs #33, #34 or #35 have been set to on, the Parity switch must be set to OFF. If two of the digital inputs #33,#34, or #35 have been set to on, the Parity switch must be set to ON. Verify the Jumper Parity LED on the upper right of the circuit board is green. If not, the parity switch must be switched to the opposite position.

Note that when the hardwired switches are set, the hardwire jumper LED will turn red unless the circuit is satisfied (wired and continuity exists). The LED will remain red until all of the hardwired circuits are satisfied.

C. As each Fault Alarm or Shutdown Alarm is activated on the AP controller, verify the Relay Outputs are

properly causing the appropriate response. Each response must be tested. Also, verify the Outputs to the Customer.		
D. Using the AP controller, manually actuate each automatic valve individually. Perform point-to-point checks on all pneumatic tubing/lines. Verify that each pneumatic line opens the proper valve. Verify operation of each valve by listening for valve venting and verify graphic change on the AP controller screen for both sides.		
E. Acknowledge and Reset the AP controller.		
F. Place CB-103 and GFCB-103 into the CLOSED/ON position. Verify that the Heater Power is energized through CON-103.		
G. Verify the JT Process Gas Heater #1 RTD (TE-6) is properly connected & functioning. Assuming the VHF unit has not been powered or run, the JT Heater should be at ambient temperature.		
H. Place a Clamp-On Ammeter on the JT Process Gas Heater #1 power wiring (wire # 1035) and record the current of the JT Process Gas Heater. Note: Controller Output must be 100% for Full Load. JT Process Gas Heater full-load current: ______ Amps.		
JT Process Gas Heater ground current: ______ Amps.		
I. Trip GFCB-103 using the Push-to-Test button on the circuit breaker and verify loss of voltage to the JT Process Gas Heater#1. Reset circuit breaker.		
J. Place GFCB-107 into the CLOSED/ON position. Verify that the Heater Power is energized through CON-107.		
K. Verify the JT Process Gas Heater #2 RTD (TE-8) is properly connected & functioning. Assuming the VHF unit has not been powered or run, the JT Heater should be at ambient temperature.		
L. Place a Clamp-On Ammeter on the JT Process Gas Heater #2 power wiring (wire # 1073) and record the current of the JT Process Gas Heater. Note: Controller Output must be 100% for Full Load. JT Process Gas Heater full-load current: ______ Amps.		
M. Place a Clamp-On Ammeter on the JT Process Gas Heater #2 ground wiring and record the ground current of the JT Process Gas Heater. JT Process Gas Heater ground current: ______ Amps.		
N. Trip GFCB-107 using the Push-to-Test button on the circuit breaker and verify loss of voltage to the JT Process Gas Heater#2. Reset circuit breaker.		
O. Place GFCB-111 into the CLOSED ON position. Verify that the Heat Trace power is energized through CON-111. Verify that the optional Heat Trace is energized.		
P. Place a Clamp-On Ammeter on the Heat Trace power wiring (wire # 1113) and record the current of the Heat Trace. Heat Trace full-load current: ______ Amps.		
Q. Place a Clamp-On Ammeter on the Heat Trace ground wiring and record the ground current of the Heat Trace. Heat Trace ground current: ______ Amps.		
R. Trip GFCB-111 using the Push-to-Test button on the circuit breaker and verify loss of voltage to the Heat Trace circuits. Reset circuit breaker.		
S. Connect a 4-20ma simulator to analog input 4 (TT-6/TE-6) in the interface enclosure of the VHF. Simulate 4-20ma and verify all of the following: JT Process Gas Heater#1 controller PID240 (TT-6/TE-6) functionality, -17.8 to 93.3 deg C on PID 240 and Controller screen depending on milliamp input. "LOW TEMP TT-6" Fault alarm-AP controller (verify Fault alarm set point using the Alarm Matrix) "HIGH TEMP TT-6" Fault alarm-AP controller (verify Fault alarm set point using the Alarm Matrix)		

"HIGH-HIGH TEMP TT-6" Shutdown alarm-AP controller (verify Shutdown alarm set point using the Alarm Matrix)

T. Re-connect signal cable TE-6 to analog input 4 in the interface enclosure of the VHF. Acknowledge and Reset the AP controller. Verify TE-6 is functioning properly. The normal operating setpoint for the JT Process Gas Heater #1 is 71deg C (Kel-F valve seats) or 88 deg C (Vespal valve seats). Once a stable temp has been established record value: ____° C

U. Connect a 4-20ma simulator to analog input 5 (TT-8/TE-8) in the interface enclosure of the VHF. Simulate 4-20ma and verify all of the following: JT Process Gas Heater#1 controller PID245 (TT-6/TE-6) functionality, 0-150 deg C on PID 245 and Controller screen depending on milliamp input.

"LOW TEMP TT-8" Fault alarm-AP controller (verify Fault alarm set point using the Alarm Matrix)

"HIGH TEMP TT-8" Fault alarm-AP controller (verify Fault alarm set point using the Alarm Matrix)

"HIGH-HIGH TEMP TT-8" Shutdown alarm-AP controller (verify Shutdown alarm set point using the Alarm Matrix)

V. Re-connect signal cable TE-8 to analog input 5 in the interface enclosure of the VHF. Acknowledge and Reset the AP controller. Verify TE-8 is functioning properly. The normal operating setpoint for the JT Process Gas Heater#2 is 27 deg C (Kel-F valve seats) or 27 deg C (Vespel valve seats). Once a stable temp has been established record value: ____° C

W. Press the **Emergency Stop** push button on the controller and verify the "EMERGENCY STOP" Shutdown Alarm is displayed on the AP controller. Pull out the Emergency Stop push button to reset it and press Reset. Verify the Emergency Stop is labeled and its guard is in place.

X. **(Optional) Z-Purge Pressure Switch (PSL-206)**: Verify incoming Z-purge nitrogen gas is 85 – 95 PSIG. Set Z-purge needle valve and verify flow. Verify the **"LOW Z-PURGE"** Fault alarm activates on the AP controller when the Z-purge is lost (10 sec. time delay is used). Re-establish Z-purge and verify the alarm can be cleared. Verify the controller is sealed by achieving and maintaining Z-purge pressure within the enclosure.

Y. **Pneumatics Pressure Transducer (U-14)**: Verify incoming pneumatic nitrogen gas is 85 – 95 PSIG. Verify the **"High-High", "High", "Low" and "Low-Low" Pneumatic** alarms**,** analog input 32, activate on the AP controller when the pneumatic pressure goes above/below the setpoints shown in the Alarm Matrix. Return pneumatic pressure to normal, and verify the alarm can be cleared.

Z. **Enclosure High Temperature Switch (TSHH-1)**: Verify that the **"HIGH TEMP SWITCH"** Shutdown alarm activates on the AP controller when temperature switch is activated. Reset the temperature switch and verify the alarm can be cleared

AA. **UV/IR Flame Detector Relay (UVIR-17)**: Verify that UV/IR Flame Detector is properly configured and setup for the appropriate gas type. Verify that the **"UVIR FAULT"** Fault alarm activates on the AP controller when the UV/IR Detector is in a Fault condition. Verify that the **"UVIR FLAME VERIFY"** shutdown alarm activates on the AP controller when the UV/IR Detector is in a shutdown condition and JT Heater contactors, (**optional 1st Stage JT Heater**) CON-103, (**optional 2nd Stage JT Heater**) CON-107 and (**optional Heat Trace**) CON-111are de-energized during a flame detect. Verify JT Heater contactors continue de-energized until UVIR Detector is manually reset and Alarm is cleared. Reset the UV/IR Detector fault relay and verify the alarm can be cleared. Record the settings of the UVIR Detector ____.

BB. **UV/IR Flame Detector Relay (UVIR-15) Source A**: Verify that UV/IR Flame Detector is properly configured and setup for the appropriate gas type. Verify that the **"UVIR FAULT"** Fault alarm activates on the AP controller when the UV/IR Detector is in a Fault condition. Verify that the **"UVIR FLAME**

VERIFY" shutdown alarm activates on the AP controller when the UV/IR Detector is in a shutdown condition and JT Heater contactors, (**optional 1st Stage JT Heater**) CON-103, (**optional 2nd Stage JT Heater**) CON-107 and (**optional Heat Trace**) CON-111are de-energized during a flame detect. Verify JT Heater contactors continue de-energized until UVIR Detector is manually reset and Alarm is cleared. Reset the UV/IR Detector fault relay and verify the alarm can be cleared. Record the settings of the UVIR Detector ____.

CC. **UV/IR Flame Detector Relay (UVIR-16) Source B**: Verify that UV/IR Flame Detector is properly configured and setup for the appropriate gas type. Verify that the **"UVIR FAULT"** Fault alarm activates on the AP controller when the UV/IR Detector is in a Fault condition. Verify that the **"UVIR FLAME VERIFY"** shutdown alarm activates on the AP controller when the UV/IR Detector is in a shutdown condition and JT Heater contactors, (**optional 1st Stage JT Heater**) CON-103, (**optional 2nd Stage JT Heater**) CON-107 and (**optional Heat Trace**) CON-111are de-energized during a flame detect. Verify JT Heater contactors continue de-energized until UVIR Detector is manually reset and Alarm is cleared. Reset the UV/IR Detector fault relay and verify the alarm can be cleared. Record the settings of the UVIR Detector ____.

DD. **HCL Purifier Supply Coax Pressure Switch (PISL-35A)**: Verify that PISL-35A is properly set to VERSUM MATERIALS, INC./Customer's requirements. Verify that the **"COAX LEAK-SIDE A"** Fault alarm activates on the AP controller when the coax pressure on Side "A" is lost. Re-establish coax pressure and verify the alarm can be cleared. **NOTE**: Coax lines are typically pressurized or evacuated prior to VERSUM MATERIALS, INC. personnel arriving on site. Therefore, varying line pressure may not be possible. If not, use a small magnet to force the indicating needle on the switch/gauge up or down to cause actuation of the alarm. This note applies to all coax pressure switches in the VHF system. Record the setting of PISL-35A:______ PSIG.

EE. **HCL Purifier Supply Coax Pressure Switch (PISL-35B)**: Verify that PISL-35B is properly set to VERSUM MATERIALS, INC./Customer's requirements. Verify that the **"COAX LEAK-SIDE B"** Fault alarm activates on the AP controller when the coax pressure on Side "B" is lost. Re-establish coax pressure and verify the alarm can be cleared. **NOTE**: Coax lines are typically pressurized or evacuated prior to VERSUM MATERIALS, INC. personnel arriving on site. Therefore, varying line pressure may not be possible. If not, use a small magnet to force the indicating needle on the switch/gauge up or down to cause actuation of the alarm. This note applies to all coax pressure switches in the VHF system. Record the setting of PISL-35B:______ PSIG.

FF. **Houseline Low Coax Pressure Switch (PISL-36A)**: Verify that PISL-36A is properly set to VERSUM MATERIALS, INC./Customer's requirements. Verify that the **"COAX LEAK-DELIVERY"** Fault alarm activates on the AP controller when the Delivery piping coax pressure goes Low. Re-establish coax pressure & verify the alarm can be cleared. Record the Low setting of PISL-36A:______ PSIG. (Alarm on Pressure Decrease.)

GG. **Houseline Low Coax Pressure Switch (PISL-36B)**: Verify that PISL-36B is properly set to VERSUM MATERIALS, INC./Customer's requirements. Verify that the **"COAX LEAK-DELIVERY"** Fault alarm activates on the AP controller when the Delivery piping coax pressure goes Low. Re-establish coax pressure & verify the alarm can be cleared. Record the Low setting of PISL-36B:_____ PSIG. (Alarm on Pressure Decrease.)

HH. **Exhaust Flow Switch (FSL-1):** Verify that FSL-1 is properly set to VERSUM MATERIALS, INC./Customer's requirements. Verify the **"LOW EXHAUST"** Fault alarm activates on the AP controller when the Exhaust Flow goes Low. Re-establish Exhaust & verify the alarm can be cleared. Record balanced exhaust flow values for the VHF. Flow:______ scfh & Static Pressure:_____inches H2O

II. **Gas Leak Detector (Customer Life Safety System) Shutdown Signal**: Verify that the **"LIFE SAFETY SYSTEM"** Shutdown alarm activates on the AP controller when Customer's LSS signal is de-energized. Verify JT Heater contactors, (**optional 1st Stage JT Heater**) CON-103, (**optional 2nd Stage JT Heater**) CON-107 and (**optional Heat Trace**) CON-111are de-energized during an LSS shutdown. Reset the LSS signal and verify the alarm can be cleared. Reference DI-35 on the alarm matrix.

JJ. **Source-A Remote Shutdown (Customer Remote Shutdown) Signal**: Verify that the **"REMOTE SHUTDOWN A"** alarm activates on the AP controller when Customer's Source a Remote Shutdown A signal is de-energized. Reset the signal and verify the alarm can be cleared. Reference DI-36 on the alarm matrix.		
KK. **Source-B Remote Shutdown (Customer Remote Shutdown) Signal**: Verify that the **"REMOTE SHUTDOWN B"** alarm activates on the AP controller when Customer's Source a Remote Shutdown A signal is de-energized. Reset the signal and verify the alarm can be cleared. Reference DI-37 on the alarm matrix.		
LL. **Vent/Scrubber Unavailable (UA-14)**: Verify that the **"VENT UNAVAILABLE"** Shutdown alarm activates on the AP controller when the signal is de-energized. Reset the signal and verify the alarm can be cleared. Reference DI-38 on the alarm matrix.		
MM. **Source A Heater Fault (UA-8A)**: Verify that the **"SOURCE A HEATER"** Fault alarm activates on the AP controller when the signal is de-energized. Reset the signal and verify the alarm can be cleared. Reference DI-39 on the alarm matrix.		
NN. **Source B Heater Fault (UA-8B)**: Verify that the **"SOURCE B HEATER"** Fault alarm activates on the AP controller when the signal is de-energized. Reset the signal and verify the alarm can be cleared. Reference DI-40 on the alarm matrix.		

OO. With a DVM set to measure either resistance or continuity, test customer I/O board Relay Outputs 1 through 4, 7 and 8, 10 and 11 – see the chart below. Connect the leads and test Normally Open (NO) to Common, and Common to Normally Closed (NC). Verify there is no continuity between the NO and Common terminals, and that continuity exists between the Commom and NC terminals. Enable the Relay Output from the controller. To do this go to the MENU on the AP controller, select CONFIG MENU, then SYSTEM TEST, then select TEST DIGITAL OUT. Scroll down to the output labeled **"GAS AVAILABLE"** and press ENERGIZE on screen then ENTER to manually toggle the state of the output relay. Verify continuity exists between the NO and Common terminals, and that there is no continuity between the Common and NC terminals. Press DE-ENERGIZE on screen then ENTER to toggle the state of the output relay. Remove the DVM.

Digital Outputs Dry - Customer I/O boards AP1563 and AP1574

Relay Output #	NO	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	Factory use only	Factory use only	Factory use only
6	Factory use only	Factory use only	Factory use only
7	T5-7	T5-8	T5-9
8	T5-10	T5-11	T5-12
9	Factory use only	Factory use only	Factory use only
10	T6-4	T6-5	T6-6
11	T6-7	T6-8	T6- 9
12	Factory use only	Factory use only	Factory use only

PP. If Supervisory Circuits shall be utilized, verify the proper alarm numbers are being used and the wiring is terminated in the proper terminal blocks. Verify functionality of the supervisory circuits with the Customer.

QQ. Verify the GASGUARD® Monitoring Network wiring is installed and terminated on both ends. Verify site network matrix is updated with this VHF equipment.

RR. **(Optional) Peer-to-Peer Communication.** Verify the GASGUARD® Ethernet Network wiring is installed into each AP controller. Ensure that CAT-5 cable is terminated in the AP controller using the T-568B wire map standard. Ensure the Ethernet Network wiring is terminated at the Ethernet switch side and plugged into an active port. In order to verify the network link is active, a green and yellow LED will be lit on the AP11 controller Carrier Board (AP1565) Ethernet connector and a green LED will be lit on the Ethernet switch port located inside the ECC low voltage enclosure. On the AP1565 board, the LED's are located on the right side of the Ethernet connector. On the Ethernet switch port the LED's are located on the front. Verify the green and yellow LED's are lit on the AP1565 board and green LED's lit on the Ethernet switch port.

Ensure Remote Controllers IP settings screens contain the correct IP address of each AP controller in the system. This screen must be identical for each controller. Record the IP addresses (maximum of 16 controllers) and identify the equipment assigned to that address. There are typically two VHF modules that communicate via Peer to Peer, but there may be as many as four.

	IP ADDRESS		EQUIPMENT DESCRIPTION/NAME
1-	______________________________	=	____.
2-	______________________________	=	____.
3-	______________________________	=	____.
4-	______________________________	=	____.

SS. Verify the VHF is configured on the host network computer system. Ensure that the controller peer-to-peer network is cascaded to the network that the network monitoring system is residing. Ensure that the network communications mode is set to ENET. If RS-485 communications is used, then run additional cables to the controller in the architecture of a daisy chain from the remote serial port device (GIN box or Device Master). In this case, all terminations will be RJ-45 crimps in the T-568B wire map. Plug these connections into the serial RJ-45 network ports located at the far end of the AP network card. Make sure that the communications setting in the controller is RS-485. Give the controller a unique channel for the port (to which it has been wired). The port does not need to be set (it is determined by the number of the remote serial port device). Set up the device on the network monitoring system and test the network communications & paging system for functionality.

TT. Verify AP controller Screen Saver Delay is set to 35 minutes.

UU. Verify AP controller Key Press Feedback is set to Enabled.

VV. Verify the site network matrix is updated with this VHF equipment.

WW. Verify Password Protected Reset is Enabled or Disabled, per Customer's site requirements.

XX. Verify Site Passwords are loaded into AP controller.

6. Alarm Matrix / Shutdown Function Tests for Analog Inputs

Initials or N/A **Date**

A. Each device must be calibrated /verified for calibration using calibrated test equipment. Zero and Full Scale must be checked. Once three (3) sets of zero and full scale have been completed with no adjustments to the device, check one final time at 75%, 50%, and 25% of full scale (Ex. 0 - 3,000 pound scale must be calibrated using 0 – 3,000 pounds of calibrated weight).

B. Record device Make, Model, and Range for each unit being calibrated (Ex. MKS Pressure Transducer, Model 870, Range: 0 – 250 PSIA).

	Make, Model, Range, Units	Initial Zero	Calibrated Zero	Span High Range	Initial Span	Calibrated Span
VHF Source Pressure						
1. PT-1A						
2. PT-1B						
VHF Interstage Pressure						
1. PT-10						
VHF Regulated Pressure						
1. PT-2						
Houseline Delivery Pressure						
1. PT-9						
Delivery Purge and Vacuum Pressure						
1. PT-4						
2. PT-5						
Exhaust Flow						
1. FT-1						
Source Weight Scales						
1. WT-1A						
2. WT-1B						

7. Alarm Matrix / Shutdown Function Tests for Analog Inputs

	Initials or N/A	Date
A. Verify the User setpoints in the AP controller match those shown on the Alarm Matrix.		
B. Verify the VERSUM MATERIALS, INC. setpoints in the AP controller match those shown on the Alarm Matrix.		
C. Verify the Purge Parameters and Leak Check setpoints in the AP controller match those shown on the Alarm Matrix.		
D. Verify the Alarm Responses, Alarm Conditions, and Alarm Delays in the AP controller match those shown on the Alarm Matrix.		
E. Using the Alarm Matrix and Purge Gas, verify each pressure alarm listed on the Alarm Matrix - Low-Low level Shutdowns, Low level Faults, High level Faults, and High-High level Shutdowns. As each Fault Alarm or Shutdown Alarm is activated on the AP controller, verify the Relay Outputs are properly causing the appropriate response. Each response must be tested. Verify the Outputs to the Customer.		
F. Verify that each program sequence runs properly for each VHF Module. Start Online _____ Start Pre-Purge ____ Start Cyl. Change ____ Start Post Purge ____ Start Conditioning ____		

8. Tube Switching (Optional)

	Initials or N/A	Date
A. Perform point-to-point checks on all pneumatic tubing/lines. Using the AP11 controller, manually exercise each Valve and verify that each pneumatic line opens the proper valve. Verify operation of each valve by listening for valve venting and verify graphic change on the AP controller screen.		
B. Verify Tube Switching software. Run Tube Switching program sequences/combinations. NOTE: Depending on the number of tubes, some sequences/combinations will not be available. (initial each sequence mode as it is completed): Start T SW 1x1_______ Start T SW 2x2_______ Start T SW 3x3x4_______ Start T SW 4x4_______ Start T SW All_______		

9. Closeout Section

	Initials or N/A	Date
A. As-Built /redlined drawings have been put into Customer's Operating Manual.		
B. Copies (hard or soft) of all documents shall be given to Customer / local VERSUM MATERIALS, INC. personnel.		
C. Copy (hard or soft) of this document shall be given to Customer / local VERSUM MATERIALS, INC. personnel.		
D. Verify that all Operating Manuals, keys, safety documentation, and extra commissioning spare parts are handed over to Customer or VERSUM MATERIALS, INC. Megasys Operations.		

E. Record all **Calibration Information** for all test equipment used. Record Make, Model Number, Calibration Date, and Calibration Company for all equipment.
Digital Volt Meter:
Clamp-On Ammeter:
Insulation Resistance Tester (Megger):
4-20mA Calibrator:
Pressure PT Calibrator:
PT Modules:

F. Document all changes or discrepancies from this procedure/checklist in the Notes Section on the last page. Include as much detail as possible.

This VHF equipment was installed in accordance with applicable Versum Materials, Inc. Engineering Standards and Practices. By signature, this site is ready for final commissioning and startup by the VERSUM MATERIALS, INC. Operations / Customer Operations Startup Team. The Operational Readiness Inspection (ORI) must be performed as a next step.

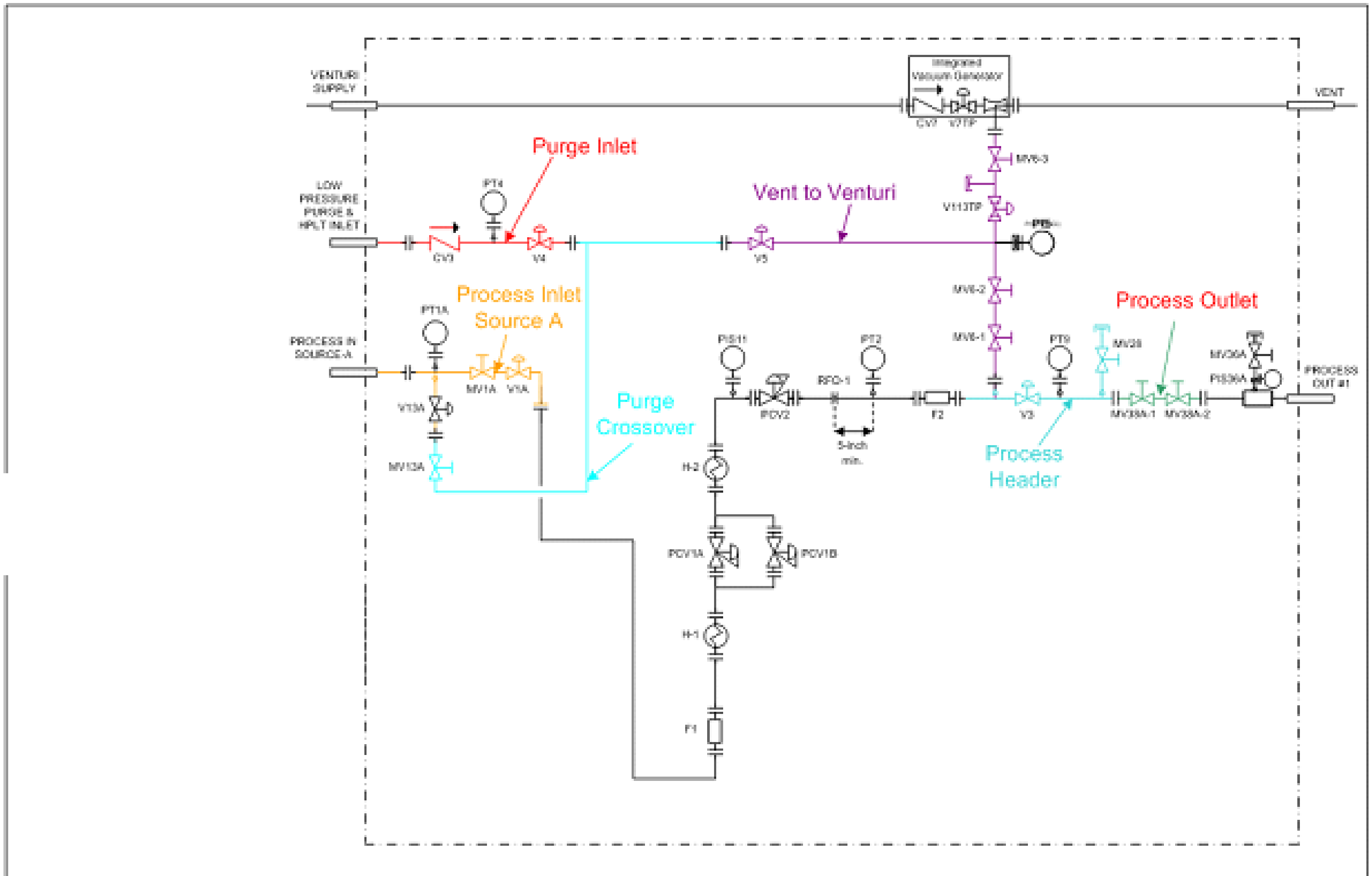
Versum Materials, Inc. Representative	**Date**
Customer / Site Gas Eng. Representative	**Date**
Customer / Site EHS Representative	**Date**
Customer / Site LSS Representative	**Date**
Customer / Site Contractor Manager	**Date**

Notes Section
1)
2)
3)
4)
5)
6)

7)
8)
9)
10)

Appendix G

Spare Parts List



2 Port Manual Valve	2 Port Automatic Valve	"L" Port Automatic Valve	VCR
3 Port Manual Valve	3 Port Automatic Valve	Check Valve	Standard Bulkhead
BNT Pressure Monitor	Trickle Flow Valve	Vacuum Venturi	Coaxial Bulkhead
VCR Pressure Monitor	VCR Regulator	Filter	Capped Port
Positive Pressure Monitor	BNT Regulator	Excess Flowswitch	Plugged Port

CONFIDENTIAL: This drawing is the property of Air Products and Chemicals, Inc. and must be accounted for and returned to the company. Information hereon is confidential and must not be copied, reproduced, duplicated, disclosed to others in whole or in part, sent outside the company without proper authorization, or used other than for the purpose for which it was disclosed.

SYSTEM DESCRIPTION: **VHF System Spares**

REF.: **Beth Zakeosian**

ORIGINATOR

CUSTOMER / LOCATION

DATE	SHEET	CONFIG. VERSION	FILE	DWG NO	SIZE	REV.
02/16/2009	1 OF 1		VHF Spares.vsd	SKM-VHF	A	A

Spools Assemblies

Description	Qty
DISS Spool (SiH4 or HCl only)	
Process In - Source A	1
Process In - Source B	1
Process Header	1
Process Out	1
Prg Crossover	1
Purge Inlet	1
Vent to Venturi	1
Coax Monitoring Assembly without PIS-35/36 -	1

Note: When ordering spare parts, the part number is:
Cabinet Commodity Code / Serial No. / Description
where;
Cabinet Commodity Code = 2XXXXX
Serial No. = Axxxx-xxxx or 200xxxxxx-x
Description = Description of Spool Piece from chart above
Example:
213456 / 2000123456-1 / Process Header

Components

Mechanical Components

Description	Qty.	SiH4			N2O			NH3			NF3			HCl		
		1000 slpm	500 slpm	250 slpm	1000 slpm	500 slpm	250 slpm	1600 slpm	800 slpm	400 slpm	1000 slpm	500 slpm	250 slpm	1000 slpm	500 slpm	250 slpm
Heater - H1 or H-2 - 150582	1	X	X	X	X	X	X				X	X	X			
Heater - H1 or H-2 - 155187	1													X	X	X
Filter - F2 - 889-607432	1	X	X		X	X		X	X		X	X		X	X	
Filter - F2 - 889-604831	1			X			X			X			X			X
Filter - F1 - 889-604832	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Regulator, Preset - PCV1A or 1B -149991	1	X	X	X	X	X	X									
Regulator, Adjustable PCV-1 - previously supplied mm#181663 on systems built prior to August 2012. This regulator is no longer used - contact SEMC for a conversion quote to *AP 9010 mm#155086	1							X								
Regulator, Adjustable - 155082	1								X	X						
Regulator, Preset - PCV1A or 1B -413737	1										X	X	X			
Regulator, Adjustable, use when PCV-2 isn't present - PCV1A or B - 418897	1										X	X	X			
Regulator, Preset - PCV1A or 1B - 413738	1													X	X	X
Regulator - PCV2 - 149926	1	X			X											
Regulator - PCV2 - 155086	1										X			X		
Regulator - PCV2 - 155083	1		X	X		X	X									
Regulator - PCV2 - 155082	1											X	X			
Regulator - PCV2 - 155084	1														X	X
RFO1A or 1B - 889-605884		X	X													
RFO1A or 1B - 889-606009	1			X												X
RFO-2 - 889-605886	1												X			

Mechanical Components		SiH4			N2O			NH3			NF3			HCl		
RFO-2 - 889-605884	1									X						
Description	**Qty.**	1000 slpm	500 slpm	250 slpm	1000 slpm	500 slpm	250 slpm	1600 slpm	800 slpm	400 slpm	1000 slpm	500 slpm	250 slpm	1000 slpm	500 slpm	250 slpm
Pressure Transducer - PT1A or PT-1B - 170236	1	X	X	X	X	X	X				X	X	X	X	X	X
Pressure Transducer - PT1A or PT-1B - 170235	1							X	X							
Pressure Transducer - PT1A or PT-1B - 170234	1									X						
Pressure Transducer - PT2 - 170234	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Pressure Transducer - PT4 - 170236	1	X	X	X	X	X	X				X	X	X	X	X	X
Pressure Transducer - PT4 - 170234	1							X	X	X						
Pressure Transducer - PT5 - 170236	1	X	X	X	X	X	X				X	X	X	X	X	X
Pressure Transducer - PT5 - 170234	1							X	X	X						
Pressure Transducer - PT9 - 170234	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Pressure Transducer - PT10 - 170236	1	X	X	X	X	X	X				X	X	X	X	X	X
Pressure Transducer - PT10 - 170235	1							X	X							
Pressure Transducer - PT10 - 170234	1									X						
Pressure Switch - PIS35A or 35B - 809-606753	1													X	X	X
Pressure Switch - PIS36A or 36B - 809-606753	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Vacuum Generator - 150068	1															

* NH3 VHF modules built prior to August 2012 can be converted to use this regulator, but a change to the inlet piping spool is required.

Electrical Components

Description	Qty
DISC-103 80A NON-FUSIBLE MAIN DISCONNECT SWITCH, DIN MOUNTED	1
CB-103 CIRCUIT BREAKER - THERMAL MAGNETIC TYPE - (10 AMPS) - DOUBLE POLE - (240 VAC) - DIN RAIL MOUNT - (No JT Heater Option)	1
CB-122 CIRCUIT BREAKER - (3 AMPS) - SINGLE POLE - (240 VAC) - DIN RAIL MOUNT	1
CB-1151 CIRCUIT BREAKER- (2 AMPS) - SINGLE POLE - (277 VAC) - DIN RAIL MOUNT	1
CR-200 CONTROL RELAY, 24 VDC COIL, 4-POLE	1
CR-208, 209 CONTROL RELAY - 24 VDC COIL	1
CR-216,217 CONTROL RELAY - 24 VDC COIL	1
PS-115 DC POWER SUPPLY - 24 VDC - 100 TO 240 VAC	1
AP1563 Customer I/O Board - for systems without heat trace	1
AP1574 Customer I/O Board - for systems <u>with</u> heat trace	1

<u>Options</u>

Single JT Heater

Description	Qty
PID240 PID Controller, RKC	1
CB-103 CIRCUIT BREAKER- 40 AMPS - DOUBLE POLE - 240 VAC - DIN RAIL MOUNT	1
GFCB-103 GROUND LEAKAGE CIRCUIT BREAKER, HYDRAULIC-MAGNETIC TYPE, 35A, 100MA LEAKAGE TRIP, 2 POLE, DIN RAIL MOUNT	1
CON-103 CONTACTOR, 30A, 24VDC	1
IY-103 SOLID STATE POWER CONROLLER	1
PPS1 PNEUMATIC PRESSURE SWITCH	1
TSH5 SNAP ACTION SWITCH, 212 DEG F SETPOINT	1
FS-240 250mA FUSE	5

Dual JT Heater Option

Description	Qty
CB-103 CIRCUIT BREAKER- 40 AMPS - DOUBLE POLE - 240 VAC - DIN RAIL MOUNT	1
GFCB-107 GROUND LEAKAGE CIRCUIT BREAKER, HYDRAULIC-MAGNETIC TYPE, 25A, 100MA LEAKAGE TRIP, 2 POLE, DIN RAIL MOUNT	1
CON-107 CONTACTOR, 30A, 24VDC	1
IY-107 SOLID STATE POWER CONROLLER	1
GFCB-103 GROUND LEAKAGE CIRCUIT BREAKER, HYDRAULIC-MAGNETIC TYPE, 35A, 100MA LEAKAGE TRIP, 2 POLE, DIN RAIL MOUNT	1
CON-103 CONTACTOR, 30A, 24VDC	1
IY-103 SOLID STATE POWER CONROLLER	1
PID240,245 PID Controller, RKC	1

FS-240, 245 250mA FUSE	5
PPS1 PNEUMATIC PRESSURE SWITCH	1
TSH5, 7 SNAP ACTION SWITCH, 212 DEG F SETPOINT	1

Heat Trace

Description	Qty
TS-111 TEMPERATURE SWITCH 8 AMP RELAY, DIN RAIL MOUNT, K-TYPE T/C, HEAT CONTROL, SHOW PROCESS TEMP.	1
HEAT TRACE, WITH OVER-BRAID, CLASS 1 DIV 2, 12 WATTS/FT AT 240VAC, 9 WATTS/FT AT 208VAC; p/n 172729	50'
Aluminum Heat Transfer Tape	AS REQ
FIBERGLASS BANDING TAPE	AS REQ
BLACK FOAM RUBBER PIPE INSULATION	AS REQ
BLACK FOAM RUBBER VALVE, REGULATOR COMPONENT INSULATION.	AS REQ
GFCB-111 GROUND LEAKAGE CIRCUIT BREAKER, HYDRAULIC-MAGNETIC TYPE, 5A, 100MA LEAKAGE TRIP, DIN RAIL MOUNT	1
CON-111 CONTACTOR, 5A, 24VDC COIL W/INTEGRATED DIODE	
End Termination Kit; p/n 171086	1
Tube-Slit-Foam insolator (1 in. thick, 6 ft length, 3.375 in. OD); p/n 172235	1
PPS1 PNEUMATIC PRESSURE SWITCH	
CR211, 212 CONTROL RELAY 24 VDC HAZARDOUS AREA	

UVIR

Description	Qty
CR-216, 217 CONTROL RELAY - DPDT - (24 VDC COIL) - (8 AMP CONTACTS) - DIN RAIL MOUNT - INCLUDES SOCKET W/ LED INDICATOR AND EJECTOR MECHANISM	1

Peer to Peer Ethernet Switch

Description	Qty
ES-250 SPIDER 5TX INDUSTRIAL ETHERNET UNMANAGED 10/100 BASE T SWITCH, 5 RJ45 PORTS, 24VDC	1

Appendix H

UVIR Detector

UVIR Detector

VERSUM MATERIALS, INC.' RECOMMENDATIONS FOR FLAME DETECTION

1.1 For flame detection, Versum Materials, Inc. uses a Fire Sentry/Honeywell SS4-A or SS4-A2 UV/IR in GG500, APx, TEx, and Chemguard cabinets, racks, wall-mounts, VMBs, VMPs, HFS's, VHF and BSGS's. Versum Materials, Inc. strongly recommends the use of a UV/IR detector over any other type of flame detection device.

1.1.1 The Model No. SS4-A/-A2 Detector is a microprocessor based Electro-Optical Fire/Flame Detector that "sees" the ultraviolet (UV), visible, and wide band infrared (IR) spectral bands of optical spectra. This fast reacting, digital, configurable, Fire Detector will alarm to Type A, B, and C flaming fires (Table 1).

Table 1: Fire Types

Class of Fire	Fuel Source
A	Ordinary combustibles (i.e., trash, wood, paper, cloth)
B	Flammable Liquids (i.e., oils, grease, tar, gasoline, paint, thinners)
C	Electricity (i.e., live electrical equipment)

1.1.2 "The Fire Sentry UV/IR model SS4-A features algorithms that process multiple spectrums to determine if a fire exists while also rejecting false alarm signals. UV/IR monitors are tuned to respond to both UV and IR emissions (as well as other variables such as visible light, flicker frequency, etc) that algorithms use to declare a flame or reject as a false alarm. The SS4-A detector analyzes ultraviolet (UV), visible (VIS), and wideband infrared (IR) energy before declaring a fire. Generally, flames have little VIS but significant UV and IR allowing the VIS signal to assist in false alarm rejection logic. In the case of non-hydrocarbon fires, and Silane fires in particular, the spectrum that is emitted results from the interaction of oxygen and hydrogen that forms water vapor (H_20) as well as oxygen-hydrogen (OH) radicals. OH emits strongly in the 306 nanometer UV spectral band and additional emission peaks within the UV spectral band between 180 – 240 nanometers. It also emits IR radiant energy in the Near IR band with several peaks within the 1 – 3 micron spectral IR band. Water (H_20) emits mainly in the near IR band with a strong peak at 2.7 microns. Detecting the emitted radiation from a Silane flame simultaneously at both these spectral bands (UV and IR) enables fast and reliable Electro-Optical fire detection with high immunity to false alarms. Note that this Silane flame detection does not rely on IR absorbance associated with CO_2 (4.3 microns) evolution from hydrocarbon fires." (Excerpt from Matthew H. MacConnell's "UVIR Flame Detection", Rev 1, 30 May 03)

1.2 **Field of View:** The UVIR can detect a fire within a 120 degree cone. The detector is pointed at the largest fire threat area for the fastest response times to the smallest size fire. In Versum Materials, Inc.' equipment the UVIR will be positioned to see all VCR connections.

1.3 **Certifications:**

Class I, Div. 1 & 2, Groups B, C, & D

Class II, Div. 1 & 2, Groups E, F, G

Class III

1.4 **Versum Materials, Inc. Configuration Settings**

The configuration of the SS4-A/-A2 UV/IR Detector is set using DIP switches located on the middle circuit board of the detector. Configuration options and Versum Materials, Inc. settings are discussed below.

1.4.1 **Verification Time:** The verification time is the amount of time the detector will wait until it declares a fire. If a fire is detected, the detector will use the specified amount of time to confirm the existence of a fire. If at the end of the time period the detector no longer detects a flame, the detector will not alarm. If at the end of the time period the detector still detects a flame, the detector will alarm. Verification time helps in reducing the number of false detections. Versum Materials, Inc. sets the verification time to 5 seconds and the verification time is always enabled. Therefore, if the detector detects a flame for 5 continuous seconds, the detector will declare a Fire Verify. Verification time is controlled by the settings of dip switches 1, 2, and 3.

1.4.2 **Latching:** In the SS4-A/-A2 Latching mode, the Fire or Verify Relay will energize and Red LEDs will remain illuminated until the detector power is cycled (power is turned off and on). If Verify is enabled when the Verify Relay energizes it will remain energized until the detector is reset. Latching is determined through the setting of dip switch 4.

1.4.3 **IR-Only Enable:** The IR-only setting allows the detector to declare a fire in situations where UV is not present or is obscured. For Silane systems, the detector must detect both UV and IR to declare a fire. This is done to reduce false detections, since silane systems are sometimes sited outdoors. These detectors are labeled with “Configured for Silane”. For all other gas systems, the detector will declare a fire if UV and IR are present, but can declare a fire with only the presence of IR. False detections have not occurred on systems using the IR only mode. When the detector detects only IR in this IR only mode, it begins a UV self test. During this test, the internal UV source is turned on, UV reflects off the metal lens guard, and should be sensed by the UV sensor. If the detector does not sense the internally generated UV, it assumes that the lens is blocked, and will declare a fire based only on IR. If the internally generated UV is sensed, the detector assumes that it is working properly, and that IR is present without UV (and therefore, no fire exists). The detector will not declare a fire in this condition. IR-Only Enable is controlled by the dip switch 5 setting.

1.4.4 **Test Cycle:** Testing of the UV sensor occurs every 30 minutes. The detector has an internal UV source and performs a self-test every 30 minutes. During the self-test, the UV source is turned on, and UV is reflected off of the metal lens guard. The UV should be sensed by the UV sensor. If the detector does not sense the UV, a fault alarm will be set off. The test cycle frequency is controlled by the dip switch 6 setting.

1.4.5 **Fire Range/Sensitivity:** The fire range/sensitivity setting is measured by the distance between the sensor and the fire (15, 30, 45, or 60 ft). The sensitivity setting refers to the distance that the detector is guaranteed to detect a burning 1 square foot puddle of gasoline. Versum Materials, Inc. sets the UV/IR so it will detect a 1 square foot gasoline fire at a distance of 60 feet. Since a leaking low pressure VCR connection would produce a significantly smaller flame than a puddle of gasoline, the sensitivity is set to a much higher distance than the actual distance of the potential leak. The fire range/sensitivity is controlled by the dip switches 7 and 8 settings.

1.4.6 Dip Switch Settings (GG500, APx, TEx)

The SS4-A/-A2 is configured at the Versum Materials, Inc. Factory as listed in Table 2.

Table 2: Versum Materials, Inc.' SS4-A/-A2 Dip Switch Setting

Switch	State	Description
1	Closed	Verify is enabled and the verify time is 5 seconds
2	Open	
3	Open	
4	Closed	Latching mode (LEDs stay on until reset)
5	Open	Used for silane only. UVIR must detect both UV and IR to declare a fire. This is done to reduce false detections, since Silane systems are sited outdoors. These detectors are labeled with "Configured for Silane".
5	Closed	Used for all other gases. The detector will declare a fire if UV and IR are present, but can declare a fire with only the presence of IR.
6	Open	Testing of the UV sensor occurs every 30 minutes.
7	Closed	The UVIR is set to detect a 1 square foot gasoline fire at a distance of 60 feet.
8	Closed	

1.5 SS4-A/-A2 Detector System Relays

1.5.1 Fault Relay: The fault relay checks for normal operation of the UV/IR Detector. The detector issues a fault condition by de-energizing its Fault Relay and the controller will show a UV/IR Fault alarm on its screen. If there is a fault, the detector will illuminate one LED to visually indicate the fault. The list of Detector Faults include temperature fault, excessive input voltage fault, no power fault, detector fault, relay fault, self-checking fault, and analog '0' current. The LED will not light if the fault is "no power". If the fault condition is eliminated, the detector will return to normal operation and the LEDs will return to blinking every 10 seconds. Faults requiring factory recertification will be indicated with the LEDs rapidly blinking.

Temperature Fault: The detector will fault due to temperature if during operation the internal temperature rises about 85°C or falls below -40°C. This will cause both LEDs to blink rapidly. The corrective action for this type of fault is to return the UV/IR for factory re-certification.

Excessive Input Voltage Fault: The detector will fault due to excessive input voltage if the input voltage becomes greater than 45 Volts. This will also cause both LEDs to blink rapidly, and the corrective action requires returning the detector for factory re-certification.

Low Input Voltage Fault: The detector will fault due to low input voltage if the input voltage becomes too low. In this cause, one LED is illuminated until the fault is corrected.

No Power Fault: The detector will fault if there is no power and/or the input voltage is interrupted or turned off. The LEDs will not be lit in this case.

Detector Fault: The detector will fault if the Optical Sensors fail the automatic built-in lens test. In this case one LED is on until the fault is corrected. The user should clean the inside and outside of the lens, then the exposed surface of the UV sensors, and the protective grill mounted on the outside of the housing cover. Testing of the UV sensor (automatic built-in lens test) occurs every 30 minutes (Versum Materials, Inc. setting) and the testing frequency is controlled by dip switch 6.

Relay Fault: The detector will fault if one of its relay circuits fails. This fault will be indicated by one LED being lit continuously.

Self-Checking Fault: The detector will fault if its internal microprocessor finds a failure during its self-check of the hardware and software. One LED will be lit until the fault is corrected.

Analog "0" Current: All of the faults described will produce an output current loss with the 4-20 mA module option.

1.5.2 Fire Relay: If the detector senses a fire, the fire relay will energize and the detector will fault. The detector fault will cause the controller to issue a shutdown alarm. The detector will monitor the same x/y coordinates for a specified duration of time to verify the existence of a fire. Versum Materials, Inc. specifies the verification time to be 5 seconds. The fire relay and verification time is enabled by dip switches 1, 2, and 3.

1.5.3 Verify Relay: The verify relay signals the existence of a fire. For Versum Materials, Inc. applications, the Fire Verify Relay is always enabled. In the case of a fire, the Verify Relay will energize and the Fire Relay will de-energize if the fire conditions are still present at the end of the Verify Time period of five seconds. Therefore, if the sensor detects a fire (through the use of the fire relay), the Fire Verify Relay will energize and if it continues to detect a fire in the exact x/y coordinates for five seconds, the detector will declare a fire in the cabinet. The verify relay is controlled by dip switches 1, 2, and 3.

1.6 Controller Alarms Associated with the SS4-A/-A2 UV/IR Detector

1.6.1 **UV/IR Fault –** If the detector's fault relay deenergizes, the controller's UV/IR fault alarm will be initialized. The UV/IR Fault alarm is a fault alarm and indicates that the UV/IR detector is not functioning properly (possible detector faults are described in section 1.5.1).

1.6.2 **Flame Detect –** If the detector's fire relay energizes, the controller's flame detect alarm will be initialized. The flame detect alarm is a shutdown alarm and will close all the valves on the side of the system that detected a fire. On VMBs, this alarm is a hardwire alarm

1.6.3 **Flame Verify –** If the detector's verify relay energizes, the controller's flame verify alarm will be initialized. The flame verify alarm is a shutdown alarm, and the alarm will close all valves throughout the system and stop the flow of gas. Power will also be turned off to the UV/IR detector. This alarm is initiated when the detector senses a steady flame or fire for five seconds. Flame verify is a hardwire alarm. The alarm is not used on VMBs since only two inputs are used, UV/IR Fault and Flame Detect (which is hardwired).

1.7 Operation of the Fire Sentry SS4-A UV/IR (excerpt taken from PTB071, Jan 22, 2004)

There are two LEDs on the SS4-A UV/IR that indicate the state of the detector. During normal operation without an alarm condition, the LED's on the face of the UV/IR will blink every 10 seconds. Every 30 minutes, as defined by switch 6, the detector performs a self-test. The detector tests itself by turning on a UV source inside the housing. This UV is transmitted through the lens, reflects off the metal lens guard, and is detected by the UV sensor. If the detector fails to sense the self generated UV, it will go into fault, and the controller will declare a UV/IR fault.

If the UV/IR detects a fire during testing or operation, both LED's will remain on continuously. The controller will alarm with UV/IR Fire VHF (a shutdown alarm), closing all valves and turning power off to the process heaters. If a second module is available and in online standby mode, it will begin to flow process gas. If the detector continues to detect a flame for 5 continuous seconds, as defined by switches 1 through 3, the detector will declare a Fire Verify. The controller will alarm with the hardwired shutdown UV/IR Flame Verify, closing all system valves and turning off the JT heaters.

The controller turns off UV/IR power when the UV/IR Flame Verify occurs. Power is restored to the UV/IR when the operator presses the controller's reset button. This causes the UV/IR to reset and un-latch.

1.8 **Version SS4-A2:** "The operation of this unit is identical to the SS4-A, except the fire alarm LEDs turn off once the fire threat is eliminated, without power cycling of the device." Excerpt from Installation and Operating Manual, Model SS4-A/-A2, Rev A, July 2014.

Since Versum Materials, Inc. controllers use the relay outputs not the LEDs for detection, the SS4-A and SS4-A2 are considered identical and interchangeable in Versum Materials, Inc. equipment.

1.9 Testing/Maintenance of the SS4-A/-A2 Flame Detector

1.9.1 The SS4-A/-A2 can be manually tested to verify proper operation and should be done at least yearly. Testing the SS4-A/-A2 will require a shutdown of the equipment. A UV/IR Fault can be simulated by placing a non-reflective surface (i.e. black paper) in front of the UV/IR metal lens protector for at least 30 minutes. This causes the UV/IR to fail its self-test, and generate a fault.

A UV/IR Flame Detect can be simulated by generating UV and IR in front of the lens. This can be done with an actual flame (NOTE: This method is dependent upon the hazard location of the UV/IR and should not be done in an area considered to be hazardous), or with a UVIR test source. It must be done continuously for at least 5 seconds. Any interruption in the UV/IR source during the 5 seconds will cause the UV/IR to restart the 5 second period.

1.9.2 Automatic testing of the detector is performed during detector operation. Versum Materials, Inc. specifies that the detector will self test every 30 minutes. A red LED on the detector will remain illuminated to indicate contamination of the window lens, missing the protective self-test grill, or when removing the enclosure.

1.8.3 The housing glass or lens should be cleaned at least every 6 months if the device is located indoors. If located outdoors, the lens should be cleaned at least monthly. To clean the housing glass, a blast of an air hose or an oil-free cloth (oil degrades the performance of UV detectors) can be used. The use of a solvent, such as alcohol, is acceptable in some cases.

2.0 RELATED DOCUMENTS

2.1 Visit honeywellanalytics.com for Product Description, Specifications, Data Sheets, and FAQs.

2.2 See attached Fire Sentry SS4-A/-A2 Operating Manual.

Appendix I

Peer-to-Peer Communications

Peer-To-Peer Communications

Peer-to-Peer Status Exchange Network Overview

The Versum Materials, Inc. (AP) Peer-to-Peer Status Exchange Network (P2PSE) allows Very High Flow AP Controllers to exchange a predefined amount of controller status amongst a network of Ethernet equipped AP Controllers.

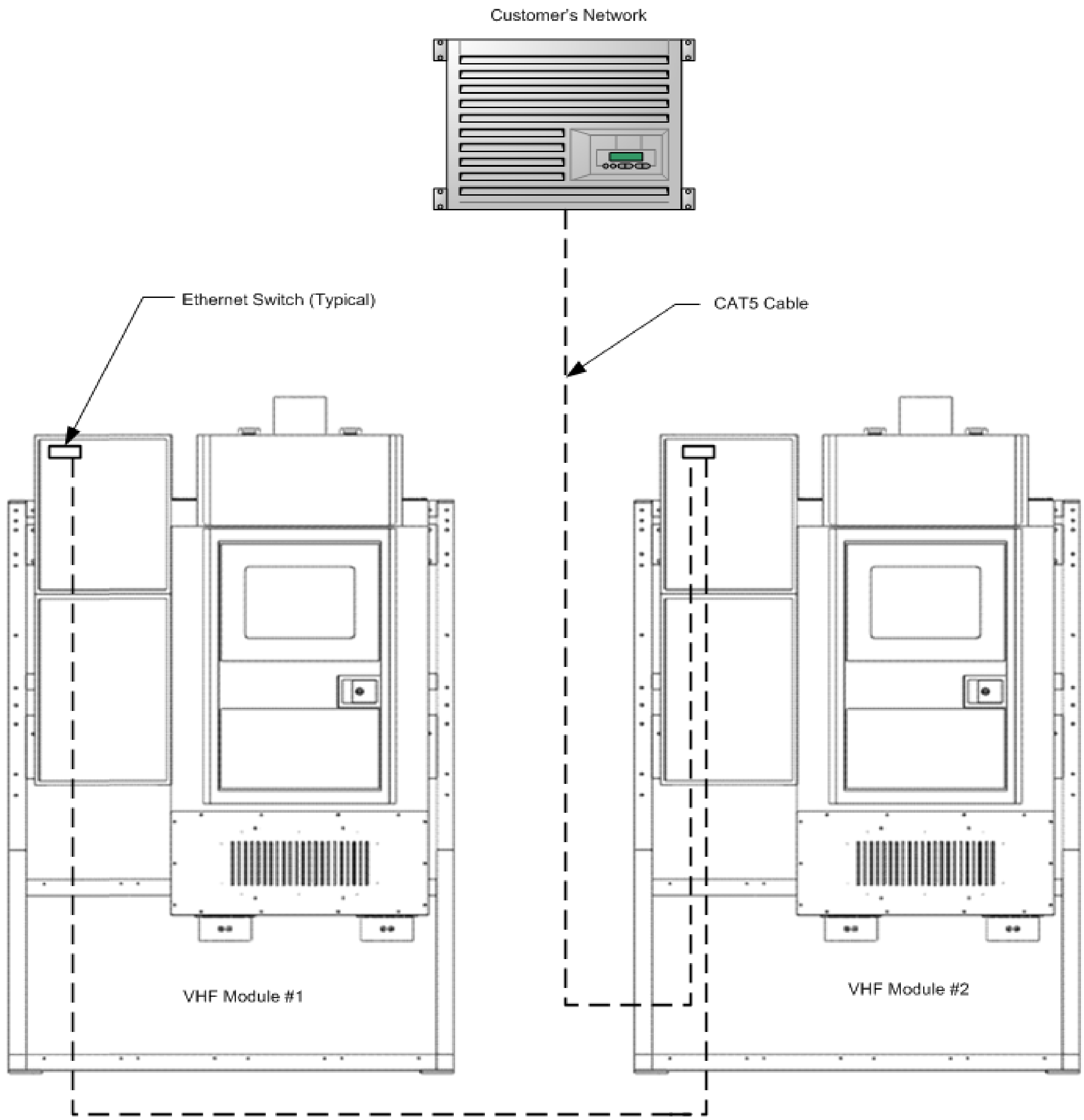


Figure J-1 Network Overview.

Within this networked system, each AP Controller considers itself the "local" controller and the other AP Controllers as the "remote" controllers. The "local" AP Controller receives controller status information from one or more "remote" AP Controllers on the same Ethernet based P2PSE Network. All of the Very High Flow AP Controllers will be both a "local" and "remote" controller, but the designation is based on the perspective from where the controller status originates. All controller status resides on the "local" controller, but the "local" controller's status can be shared via the P2PSE Network with the other Very High Flow AP Controllers. The P2PSE Network allows a system of Very High Flow AP Controllers to share information and function as a single entity, and offers enhanced system functionality, flexibility and overall reliability with minimal hardware and interconnect wiring.

In order to maximize Very High Flow system robustness, each AP Controller of a Very High Flow Control System will not shutdown due to a brief loss of the P2PSE Network, but will continue to operate in a "local status only" mode. Upon the loss of P2PSE Network communications between VHF modules operating in a Dual Module software configuration, the on line module will continue to dispense process gas, and the standby VHF module will begin to dispense process gas. The responding operator must restore the communication loss and put one of the modules back in standby mode.

The P2PSE Network is meant to allow the Very High Flow AP Controllers within the Very High Flow Control System to exchange controller status and function as a single entity without the cumbersome (and limited) I/O interconnect wiring traditionally used for sharing information.

Peer-to-Peer Status

Figure J-2. Peer-To-Peer Status Indicator.

The peer-to-peer status that appears on the main window of the AP Controller indicates the overall status of each of the AP Controllers within the P2PSE Network. A green **Up Arrow** indicates good communication with the controller; a red **Down Arrow** indicates no communication with the controller; a white **Circled Number** indicates the local controller; and **No Arrow** indicates no Remote Status Inputs designated for the controller. If the communication from a remote controller is configured as being critical to the local controller and communication is down to the remote controller for longer than the 24 hour Communication Down Error Timeout, then the Down Arrow will display alternately with the hour and minute countdown until the “P2PSE CRITICAL COMM ERROR” Internal Shutdown Alarm occurs. This communication error shutdown alarm will occur if peer to peer communications has not been re-established within the 24 hour countdown. This shutdown alarm is latching, and can only be manually reset after all the VHF AP controllers are communicating.

The maximum number of peer-to-peer status indicators is 16, which represents the maximum number of AP Controllers that can participate in the P2PSE Network.

Peer to Peer IP Settings (Submenu of the System Setup Submenu of the Configuration Menu)

The Remote Controllers IP Settings window provides the operator with the ability to configure the Ethernet IP addresses of the other VHF modules within the P2PSE Network. This window also shows the three Network Communication Down Timeout values. Figure J-4 shows a typical VHF Peer to Peer IP Setting screen. This screen should be identical on both VHF modules, paying particular attention to the IP address and Port number. IP address is assigned by the site network administrator.

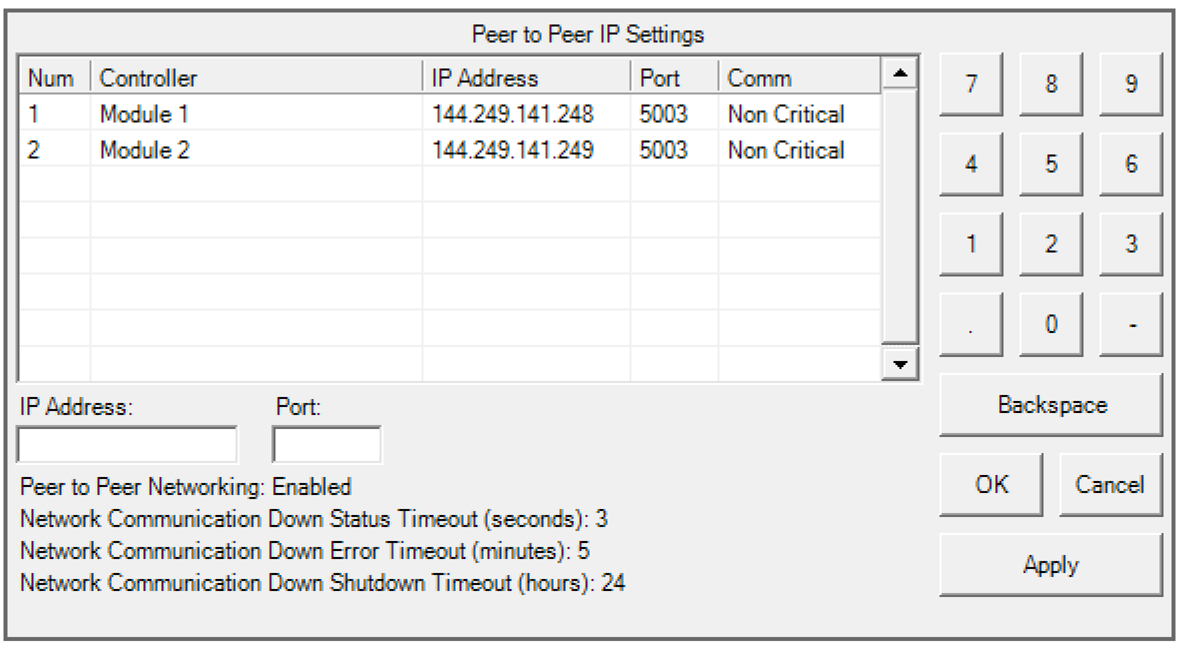


Figure J-4 Peer to Peer IP Settings Submenu.

PEER TO PEER Ethernet IP Addresses

This window allows an operator to configure the Ethernet IP Addresses of the VHF AP Controllers within the P2PSE Network. The window will allow the operator to input IP Address, Subnet Mask, and Default Gateway information in this screen. These values must be assigned by the person in charge of the Ethernet network (the network administrator). It is important that these addresses are correct; otherwise P2PSE Network communication with other AP Controllers will fail.

The Ethernet IP addresses are used to distinguish between the various devices connected to the Ethernet network. The address is a 32-bit value expressed with four values (0 to 255), each separated by a period as in the default value of 0.0.0.0. The default value of 0.0.0.0 indicates that P2PSE Network communication to the remote AP Controller is disabled. It is important that each device connected to the Ethernet network be assigned a unique Ethernet IP address. Highlight the window, then input the IP Address using the number pad to the reight. Follow the same procedure to input Subnet Mask and Default Gateway information in this screen. These values must be assigned by the person in charge of the Ethernet network (the network administrator).

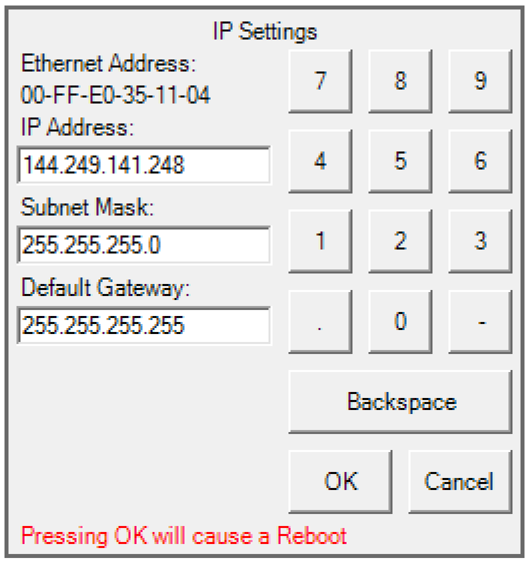


Figure J-5 Peer to Peer IP Settings

Appendix J

Y Cylinder Heaters Description

Use of the Gen II or Compact Y-Cylinder Heater with a Very High Flow (VHF) Module

Introduction

The GEN II and Compact Controller Y-Cylinder Heater Systems are designed to regulate the heat energy input into a fixed volume, horizontally mounted cylinder containing a liquefied gas product for increased product flow. The system contains three main assemblies which include:

- Control System (Figure L-1)
- Heating Blanket (Figure L-2)
- Insulation Cover (Figure L-3)
-

After the cylinder and shipping skid are in the desired position to facilitate connection to the supply piping, the heater blanket and insulation cover are attached to the cylinder. The system is also designed to maximize commonality of control components with the AP11 based VHF.

The resistive heater element, with integral temperature measurement elements, is designed to be easily removable from the gas cylinder without the use of specialized tools. The Compact Heater Controller heater blanket is hard wired to the control system through the use of cable assemblies. The cable assembly is 25 feet long for easy disconnection and connection of the heating blankets. The Gen II Heater Controller design is similar, with the exception of a thermocouple disconnect assembly and power disconnect assembly at the end of the 25 foot long cables. Power and thermocouple wiring from the disconnect boxes to the heater controller is field supplied and installed allowing the Gen II heater controller to be remotely located.

Figure L-1. Control System

Figure L-2. Heating Blanket

Figure L-3. Insulation Cover

Control System Overview

The addition of heat energy to a compressed gas cylinder must be managed with multiple layers of controls to eliminate the possibility of over-pressurizing the cylinder due to the application of excessive heat. Therefore, independent temperature control and over-temperature protective layers are integrated into the design to provide isolation of functionality and eliminate the possibility of a common mode failure between the two layers.

PID feedback control is used to provide accurate regulation of the surface temperature of the cylinder. Additional operational safeguards are also incorporated into the system.

Each heater system utilizes the following control devices:

- 1 each, resistive heater element.
- 1 each, temperature indicating controller.
- 1 each, over-temperature limit controller.
- 1 each, Silicone Controlled Rectifier (SCR) power controller.
- 1 each, electro-mechanical contactor.
- 1 each, over-current device with integral ground leakage detection.
- 4 each, temperature elements, Type “K” thermocouple, integral to the resistive heater assembly. (2 elements are not used in the compact controller Y heater)

Temperature indication on the system is in degrees Celsius (°C), but throughout this manual the temperature will also be provided in degrees Fahrenheit (°F).

To provide alarm management, a small Programmable Logic Controller (PLC) is integrated into the control system. Failure of the PLC again does not inhibit operation of the system. All interlocks are hard-wired and do not require operation of the PLC.

The Y-Cylinder Heater system incorporates the following alarms:

- Low cylinder temperature fault alarm
- High cylinder temperature fault alarm
- High-High cylinder temperature shutdown alarm
- Ground fault activated shutdown alarm
- Emergency-Stop activated shutdown alarm
- 24 Volt power supply failure fault alarm
- Enclosure high temperature fault alarm
- PLC failure fault alarm

Layout Details

The system layout varies based on the process gas, source container type and size, and owner's site constraints. The site layout can be designed to accommodate any desired arrangement.

For further details, see the Installation, Operation, and Maintenance Manual for the Gasguard® Gen II or Compact Y Cylinder Heater.

Appendix K

Operational Readiness Inspection (ORI)

Rev	ITEM #	High Flow System & VHS ORI ACTION ITEM	TIMING REQ'T	STATUS	RESPON-SIBLE PERSON	DATE COMPL'D	CLOSEOUT STATEMENT / ACTIONS REQUIRED FOR CLOSEOUT/ COMMENTS
	Scope	This Operational Readiness Inspection (ORI) checklist is to be used during the installation of high flow cabinets or delivery racks containing source containers with a combined internal volume greater than 8.8.3 cu ft (250 liters). Each system may consist of single or multiple cylinders connected to a distribution panel (s). Typically the scope will include the placement, connection to all required utilities, verification of operability, startup and eventual commissioning of the system.	**MBS or MAS**				
	A	**Design, Construction, Commissioning, Pre-Operational Verifications**					
	A00	**P&ID Flowcheck**					
	A00.01	Flow check against P&ID's performed.					
	A00.02	Reconcile any differences identified by flowchecking.					
	A00.04	Confirm the generation of design and construction punch lists and the preparation of STC & STO certificates per EH&S standard 01.17.03					
	A01	**Fire Protection Systems**					
	A01.06.01	Verify that facility fire suppression system has been connected for required gases					
	A02	**Atmospheric Monitoring Systems (includes toxic, flammable and asphyxiating gas monitors)**					
	A02.05	Confirm that all appropriate locations for each type of gas monitoring were included in the design (O2, UVIR, gas detectors)					
	A03	**Nitrogen Purge Systems**					
	A03.05	Verify design pressure of nitrogen supply for venturi operation, pneumatics and cabinet purging. Establish nitrogen purge has proper pressure regulation, pressure indication, overpressure protection and backflow prevention.					

Rev	ITEM #	High Flow System & VHS ORI ACTION ITEM	TIMING REQ'T	STATUS	RESPON-SIBLE PERSON	DATE COMPL'D	CLOSEOUT STATEMENT / ACTIONS REQUIRED FOR CLOSEOUT/ COMMENTS
	A03.06	Verify design pressure of inert process purge supply. Establish inert purge system has proper pressure regulation, pressure indication, overpressure protection and backflow prevention and is a dedicated source where required.					
	A03.07	Verify design pressure of inert process leak check supply. Establish inert high pressure leak check system has proper pressure regulation, pressure indication, overpressure protection and backflow prevention and is a dedicated source where required.					
	A04	**Other Protective Systems**					
		Verify area and separation distance requirements by code have been met					
	A06	**Environmental Protection**					
-	A06.09	Verify all equipment exhausts are connected to appropriate exhaust systems as designed (i.e., process scrubbed exhaust, solvent exhaust, ammonia exhaust, etc.)	-				
	A06.11	Verify all equipment process gas vents are connected to appropriate exhaust or abatement systems					
	A07	**Safety Relief Devices and Vent Locations**					
	A07.01	Perform a 100% audit that pressure relief device (relief valves and rupture discs) set points, orifice designation/size and nameplate stamp are consistent with the P&ID's and the individual device specifications.					
	A07.05	Verify relief device vent stacks are secured for reaction force and exhaust directed away from walkways, structures and buildings.					
	A07.09	Check that hazardous vents do not discharge toward personnel areas					
	A07.10	Verify documentation exists to confirm vent stack heights and locations have been defined based on dispersion analysis that considered heat radiation, asphyxiant and toxic gas dispersion.					
	A07.12	Verify restricted areas associated with radiation and dispersion analysis from flares and vents have been					

Rev	ITEM #	High Flow System & VHS ORI ACTION ITEM	TIMING REQ'T	STATUS	RESPON-SIBLE PERSON	DATE COMPL'D	CLOSEOUT STATEMENT / ACTIONS REQUIRED FOR CLOSEOUT/ COMMENTS
		identified and have warning signs posted.					
	A07.13	Verify vertical relief device vent stacks have low point drains to prevent rainwater accumulation and freezing in cold climates.					
	A07.15	Verify all silane/pyrophoric pressure regulator bonnet vents are captured and routed to required location					
	A07.16	Verify all relief device vent stacks are routed to the appropriate exhaust or abatement system					
	A07.17	Verify areas around flares and flammable gas vents are clear of combustible materials.					
	A08	**Mechanical Equipment and Piping Systems**					
	A08.01	**Corrosion and Erosion**					
	A08.01.06	Verify that all piping and tubing used are compatible with gas service and standard 3EQ95009					
	A08.03	**Vessels, Exchangers, Tanks**					
	A08.03.04	Verify process equipment has been labeled with tag number (and/or name).					
	A08.03.06	Check and verify all cabinets and panels have been bolted down and/or secured per design.					
	A08.07	**Packaged / Miscellaneous Equipment - Specific Checks**					
	A08.07.04	Verify lifting devices (hoists, cranes, etc) have been inspected, tested, and (labeled with maximum capacity etc.) as required. Where appropriate verify travel stops have been set.					
	A08.07.05	Verify checks were made to assure that all temporary shipping supports have been removed from equipment. Check against list provided by fabricator/designer if available.					
	A09	**Piping Systems - Fabrication, Erection, and Testing**					
	A09.01	**General Piping System Checks**					
	A09.01.08	Check that all piping and tubing has been labeled with proper gas type and hazard labels.					

Rev	ITEM #	High Flow System & VHS ORI ACTION ITEM	TIMING REQ'T	STATUS	RESPON-SIBLE PERSON	DATE COMPL'D	CLOSEOUT STATEMENT / ACTIONS REQUIRED FOR CLOSEOUT/ COMMENTS
	A09.01.09	Check that all piping and tubing have proper sizing and material breaks as per specified on P&ID					
	A09.06	**Piping QA /QC / Pressure Testing**					
	A09.06.02	Confirm weld procedures and welder qualification records are onsite and have been reviewed by a qualified engineer. Confirm that there is documentation that welding procedures have been followed. (See Construction Engineering Procedure "Audit-7" for details)					
	A09.06.05	Ensure witnessed pressure or service tests of entire systems are complete and documented.					
	A09.07	**Pipes and Vessels Flushed for Removal of Construction Debris**					
	A09.07.07	Verify that all piping has been cleaned for electronic grade service per 4WPI-FWSE01					
	A09.07.08	Verify that all piping has been O2 cleaned for electronic grade service per 4WPI-SW70003					
	A10	**Insulated & Heat Trace Systems**					
	A10.08	Verify that all face seal fittings (VCR joints) have been insulated following pressure and leak testing.					
	A10.09	If the container (Y, Drum, or ISO) is heated, verify piping from the container connection to the outlet of the piping cabinet is heat traced and insulated. Depending on ambient temperature, process gas type and delivery pressure, verify the houseline is also heat traced and insulated.					
	A10.10	Verify that all heat trace has been installed per design documentation					
	A14	**Electrical / Instrument Construction**					
	A14.01	**Instrument tubing installation**					
	A14.01.04	Verify all instrument tubing and pneumatic supply to equipment has been connected per installation and construction documentation					
	A14.02	**Grounding (Earthing)**					

Rev	ITEM #	High Flow System & VHS ORI ACTION ITEM	TIMING REQ'T	STATUS	RESPON-SIBLE PERSON	DATE COMPL'D	CLOSEOUT STATEMENT / ACTIONS REQUIRED FOR CLOSEOUT/ COMMENTS
	A14.02.02	Verify equipment grounding has been inspected for installation per design, has been tested and that tests have been documented.					
	A14.03	**Electrical Equipment Checks**					
	A14.03.02	Verify documentation exists to confirm all electrical equipment alarm and trips have been function tested and passed the tests.					
	A14.03.03	Verify all electrical equipment has been tested per VERSUM MATERIALS, INC. electrical construction / commissioning procedures.					
	A14.03.11	Verify Electrical power and controls were installed per installation and construction documentation					
	A14.05	**Electrical Classification of Hazardous Areas**					
	A14.05.01	Conduct field verification review of electrical hazardous classification drawing and update if required.					
	A14.05.02	Conduct inspection to verify that all required panel purges have been installed (from the correct purge gas source).					
	A14.05.03	Inspect to confirm that all conduit seals are installed at hazardous area boundaries; and at conduit entries to electrical devices, panels, and boxes within classified areas.					
	A14.05.04	Verify conduit seals have been poured following validation, loop checks.					
	A14.05.10	Verify to confirm that all inert purge sources are properly connected to control panels per installation documents (Z-Purge)					
	A14.08	**Emergency Power / UPS / Emergency Lighting**					
	A14.08.03	Verify testing documentation confirms that UPS has sufficient capacity (KVA, specified duration) for as-installed loads.					
	A14.08.06	Verify that all emergency power supplies have been connected to equipment as per installation documentation					
	A14.10	**Segregation of Wiring**					
	A14.10.01	Obtain confirmation that wiring system was checked for proper segregation of cables by voltage level.					

Rev	ITEM #	High Flow System & VHS ORI ACTION ITEM	TIMING REQ'T	STATUS	RESPON-SIBLE PERSON	DATE COMPL'D	CLOSEOUT STATEMENT / ACTIONS REQUIRED FOR CLOSEOUT/ COMMENTS
	A15	**Construction - General**					
	A15.01	**General Site Cleanliness**					
	A15.01.04	Conduct inspection prior to commencing start-up to ensure all equipment related debris is removed from area.					
	A15.02	**Safe Locations and Egress**					
	A15.02.03	Verify all cylinders are chained and secured in cabinets and cylinder racks.					
	A15.02.03	Verify for seismic zones cylinders are properly secured					
	A15.03	**Construction Records**					
	A15.03.02	Verify orbital welding procedures have been turned over to plant staff.					
	A15.03.03	Verify that a final set of pressure and service test records have been turned over to project team.					
	A15.03.04	Verify that oxygen cleaning records have been turned over to project team					
	A15.03.05	Verify that all welding, cleaning and purity certification records have been turned over to operations					
	A16	**Instrumented Systems Pre Operational Inspection and Testing**					
	A16.01	**Testing of Critical Safety Systems (IL-3)**					
	A16.01.01	Verify function test procedure philosophies and specifics for each Critical Safety System are documented.					
	A16.01.02	Verify all critical safety systems have been functionally proof tested and that documentation exists to confirm that all the tests have been passed. Include verification of successful testing of any hardwired emergency shutdown system.					
	A16.01.04	For programmable electronic system (PES) based IL3 protection systems confirm there is a manual means of placing the process in a safe condition external to the PES that is readily accessible in an emergency situation. (See Global BEP 2S113)					

	A16.01.05	If the manual means for placing the process in a safe condition involves operator closure of manual valves, confirm there is a documented procedure that defines the valve closure requirements.					
	A16.02	**Testing and Documentation of Software Control System (Level 1 alarms & controls / Level 2 shutdowns)**					
	A16.02.01	Verify that function test procedure philosophies and specifics for Software Control System (Level 1 alarms & controls / Level 2 shutdowns) are documented.					
	A16.02.02	Verify Level 1 alarms & controls / Level 2 shutdowns have been functionally proof tested and that documentation exists to confirm that the tests have been passed. Spot check documentation).					
	A16.02.03	Verify software control configurations have been tested (i.e. staged) to assure proper operation prior to the start of validation.					
Rev	**ITEM #**	**High Flow System & VHS ORI ACTION ITEM**	**TIMING REQ'T**	**STATUS**	**RESPON-SIBLE PERSON**	**DATE COMPL'D**	**CLOSEOUT STATEMENT / ACTIONS REQUIRED FOR CLOSEOUT/ COMMENTS**
	A16.02.04	If project includes a new programmable electronic system (PES) or modification to an existing PES, verify documentation exists to confirm that a site acceptance test (SAT) has been completed. (See Global EH&S Standard 01.20.24)					
	A16.03	**Additional Control and Shutdown System Checks**					
	A16.03.09	Verify system alarm matrix and shutdown tables match equipment requirements and document any differences					
	A16.05	**Electrical and Software Jumper Log**					
	A16.05.01	Verify an administrative procedure is in place governing the practice of using electrical and software jumpers and that the procedure is communicated to the start-up / commissioning team. The procedure must include the requirement for maintaining a log of jumpers installed and removed, locations, dates, times and responsible person.					
	A16.05.02	Ensure any jumpers that were installed during construction or commissioning are either all removed or noted on the Jumper Log as still being in place					

	A18	**Punch lists**					
	A18.01	Verify documentation exists to confirm all safety-related punch list items have been completed.					
	B	**Organization and Staffing**					
	B02	**Safety During Startup/Commissioning with Construction**					
	B02.01	Verify documentation exists to confirm specific safety coordination meeting (s) with Construction Management, Contractors, Start-up/Commissioning and permanent plant staff have been held to ensure that the transition from construction site to an operating					
	B03	**Commissioning**					
	B03.01	Confirm there is a system in place to notify all contractors or visitors that will remain onsite following startup of a unit about the hazards and emergency procedures associated with that unit.					
	B03.02	Confirm there is a documented assignment of EH&S responsibilities between the onsite operating group and any contractors that may remain onsite following start up of any unit.					
Rev	**ITEM #**	**High Flow System & VHS ORI ACTION ITEM**	**TIMING REQ'T**	**STATUS**	**RESPON-SIBLE PERSON**	**DATE COMPL'D**	**CLOSEOUT STATEMENT / ACTIONS REQUIRED FOR CLOSEOUT/ COMMENTS**
	C	**Hazard Review Resolution and Implementation**					
	C01	Confirm that a hazard review has been performed and documented for the project including all vendor supplied packages (required for all projects per SP 804).					
	C02	Confirm there is a documented assignment of EH&S responsibilities between the onsite operating group and any contractors that may remain onsite following start up of any unit.					
	C02.02	Verify documentation exists to confirm all Mandatory Before Start-up hazard review recommendations have been closed					

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		out.					
	C02.03	Verify documentation exists to confirm all Mandatory After Start-up hazard review recommendations have been closed out.					
	C03	Confirm a system is in place to ensure changes that occur during commissioning and start up that require modifications to the process safety information receive a hazard review.					
	D	**Process Safety Documentation**					
	D01	**Chemicals Information**					
	D01.01	Verify by inspection that an MSDS is available onsite for each hazardous chemical used or produced in the process.					
	D03	**Equipment Information**					
	D03.14	Verify Own & Operation manual exists onsite which describes materials of construction, utility requirements, operation instructions, safety information and as-built P&ID of all equipment					
	D03.15	Verify that all non-VERSUM MATERIALS, INC. equipment meets VERSUM MATERIALS, INC. minimum functional requirements per 3EQ94041					
	D03.16	Verify proper construction material compatibility per 3EQ95009					
	D03.17	Verify all panel mounted and field installed pigtails are properly supported					
	D03.18	Verify all non panel mounted mechanical fittings have anti-rotation devices					
	D03.20	Verify that all non-VERSUM MATERIALS, INC. Silane equipment meets VERSUM MATERIALS, INC. requirements per 3EQ94060					
	D03.21	Verify System located per Code and VERSUM MATERIALS, INC. criteria away from fire sources					

	E	**Procedures for Operation, Emergencies, and Safe Work Practices**					
	E01.06	Confirm the availability of documented normal start-up, operation, and shutdown procedures.					
	E01.07	Confirm the availability of documented procedures for emergency operation / action or shutdown, including start-up following an emergency shutdown as well as a troubleshooting guide for operators to quickly follow during an emergency.					
	E03	**Site Specific EH&S Procedures**					
	E03.01	Confirm that work permit systems (including hot work) are in place and are coordinated with the system turnover from Project/Construction.					
	E03.02	Confirm that the lockout/tagout system is in place and that there is clear definition of where the lock-out / tagout system is in effect for plants still under construction.					
	E03.05	Verify that a documented Management of Change procedure is on site.					
	E03.06	Verify that new operations checklist per "Volume 10 New TCM/TGM Site Assessment Checklist 10.02.202" is complete					
	E03.07	Verify that operation procedures are in place per "Volume 10 Total Chemicals Management Audit Sheet 10.02.203"					
	E03.08	Verify that new handling procedures are in place per "Volume 10 Total Chemicals Management Audit Sheet 10.02.203"					
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	E03.09	Verify that new analytical services are in place per "Volume 10 Total Chemicals Management Audit Sheet 10.02.203"					
	E04	**Maintenance Procedures**					
	E04.03	Confirm the availability of documented maintenance procedures as contained within Operation manuals					
	G	**Mechanical Integrity Program / Maintenance**					

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	G01	**Establishment of a Mechanical Integrity Program**					
	G01.01	For VERSUM MATERIALS, INC. owned/operated sites confirm that documentation exists that defines the method, test frequency, and acceptance criteria for testing (i.e. Mechanical Integrity Program) of the following:					
	G01.01.01	IL-3 Critical Safety Circuits (See Global EH&S Procedure 01.20.24)					
	G01.01.02	Stationary equipment/piping (See Global EH&S Procedure 01.20.13)					
	G01.01.04	UPS systems (See Global EH&S Procedure 01.20.14)					
	G01.01.05	Relief Devices (See Global EH&S Procedure 01.20.06)					
	G04	**Maintenance Systems Ready for Operation**					
	G04.04	Confirm spare parts, part of VERSUM MATERIALS, INC. scope have been turned over to operation team or customer if purchased.					
	H	**Safety Equipment and Industrial Hygiene Systems**					
	H01	**Personal Protective Equipment**					
	H01.01	Verify documentation exists to confirm that a workplace risk assessment has been performed or modified to identify potential hazards and the minimum PPE required. (Ref. Global EH&S Standard 01.05.06 and 01.05.06 A.M.)					
	H01.02	Verify by inspection that the PPE required to be on-site by the workplace risk assessment is available for employee use.					
	H07	**Warning Signs/Labeling**					
	H07.13	Verify by inspection that equipment and piping containing hazardous materials have been labeled with the hazard warnings and identification of the hazardous material contained.					

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	J	**Regulatory Compliance**					
	J01	Verify that a written plan is in place for "Right to Know" requirements.					

	J14	Verify that all HFS/VHFS OSHA Process Safety Management (PSM) documentation has been turned over to the site owner for inclusion into the site OSHA PSM program. (USA)					
	J	**Regulatory Compliance**					
	J01	Verify that a written plan is in place for "Right to Know" requirements.					
	K09	**Site Security Systems**					
	K09.01	Verify that the operations/construction team has conducted planning meetings to address security issues related to the transition of site from construction to operation or customer.					
	K09.02	Verify that systems are in place to provide control of visitor access to plant for security purposes.					
	K09.03	Verify that front gate security access is completed: card reader or other security system (as applicable)					
	-	-					
	K10	**Site Security Vulnerability Assessment (SVA)**					
	K10.01	Verify the site has been tiered for security risk and added to the corporate database, maintained by Global Process Safety. (reference Global EH&S Standard 01.21.04)					
	K10.02	Confirm that an SVA has been performed for this site.					
	K10.03	Confirm that recommendations from the SVA have been implemented and the implementation verified by a third party (local police or LEPC, etc.) NOTE: This 3rd party verification is only to confirm we did what the SVA said we were going to do and is require					

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	K10.04	Verify the security systems have been function tested and commissioned and documentation exists to confirm.					
	K10.05	Verify that site security work processes and reporting procedures are in place.					

	K10.06	Verify documentation exists to confirm all site personnel have been trained in the site security work processes and reporting procedures and actions to take in the event of a security alert.					
	K10.07	Verify the site security systems have been added to the site PM program.					
	K10.08	Verify Corporate Security and Global Process Safety have been notified of plant turnover.					

Addendum Z

USB Barcode Setup 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 or Liquid System. All operating and maintenance personnel must complete the Gas or Liquid 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 Gas and Chemical System are:

- **Health Hazard Chemical**
- **Reactive Chemical**
- **Flammable Chemical**
- **Oxidizing Chemical**
- **Oxygen-Deficient Atmosphere**
- **Pressurized Chemical Hazards**
- **Cylinder Handling Hazards**
- **Electrical Hazards**

WARNING

Equipment Changes

Do not make any changes to the System without authorization from an Versum Materials, Inc.' Representative. Death or serious injury may result from unauthorized System changes.

Emergency Response – 24-Hour Service

If a chemical release emergency occurs that cannot be alleviated by a trained operator or supervisor, call Versum Materials, Inc. at one of the following telephone numbers.

North America:

United States, Canada and Puerto Rico — (800) 523-9374 (toll free)
(610) 481-3772 (FAX)

VERSUM MATERIALS, INC. Operator — (610) 481-4911

European Community / Middle East: (32) 2-752-39-40

All Other Locations: (US Country Code) (610) 481-7711

Material Safety Data Sheet (MSDS)

Fax-On-Demand Service: (800) 245-2746 (toll free)

Internet www.airproducts.com

Addendum – USB Barcode

Overview

Controllers have been equipped with an external USB port for barcode scanning. It is important to note the following before using the port or the USB barcode reader.

1) The barcode reader is not approved for Class I Division 2 locations (US) or a Group II Category 3 Zone 2 (Europe) area, but can be used in a flammable area if the area is known to be non-hazardous. It is up to the customer to determine how they determine if the area is non-hazardous (through gas monitoring, detection, etc).
2) The barcode reader or any other USB device is not intended to be permanently connected to the external USB port. The external USB port is intended for intermittent use and USB devices connected to it should be used for as short a time as possible.
3) If a customer desires to keep a device permanently connected to the external USB port, the customer must ensure that the USB device has the appropriate certifications for permanent use in a Class I Division 2 location or a Group II Category 3 Zone 2 area.

USB Connection Port

A controller may be equipped with an external USB port. The external 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. All controllers with a USB port on the controller will also have a warning label (Figure A) for operation in a flammable area. The USB port has a cap that can be used to cover the port when not in use.

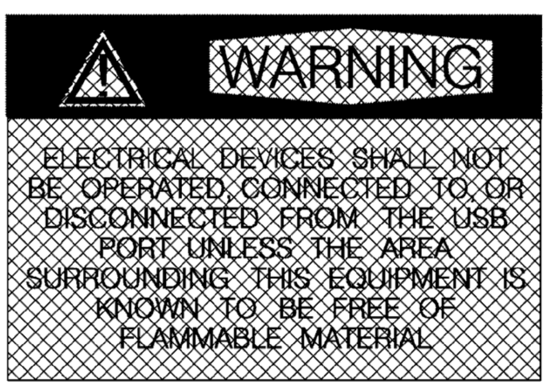


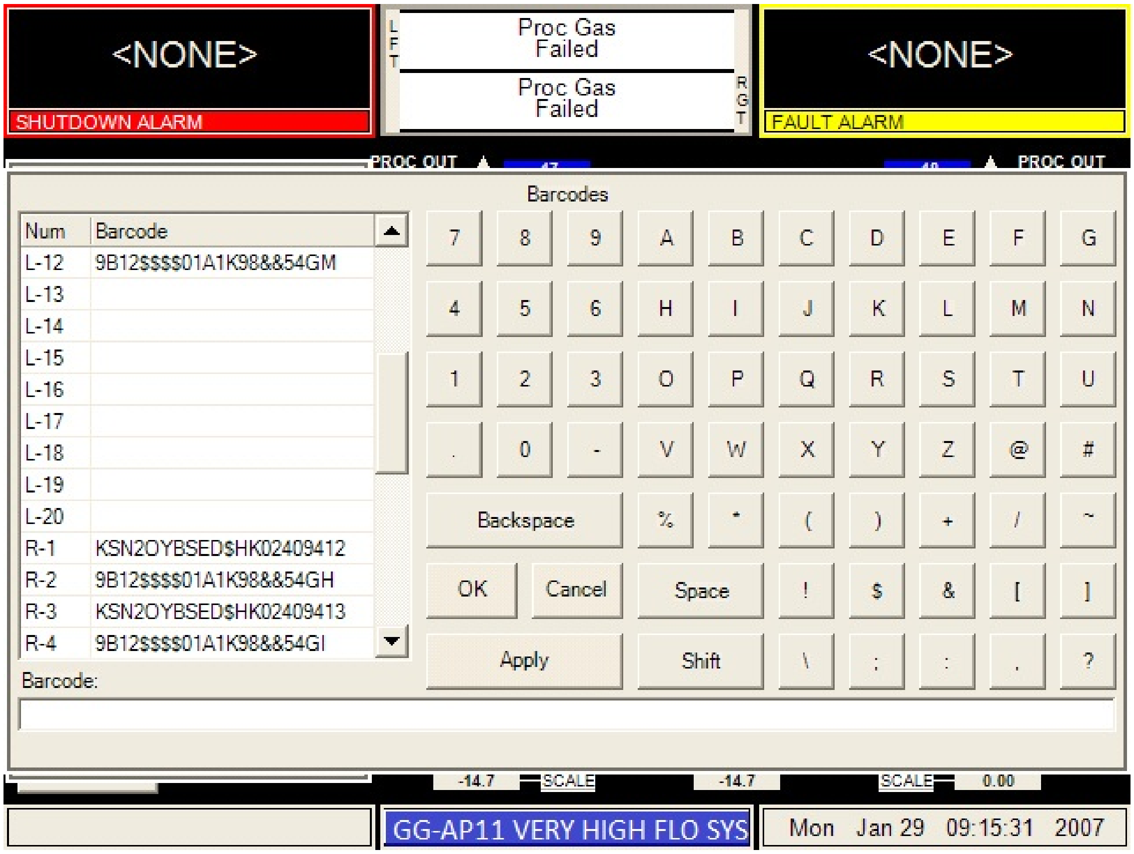
Figure A: USB Port Warning Label

AP10/AP11/ChemGuard® Gen II USB Barcode Feature

Note: All AP11controllers contain the external USB port. Unless the Barcode feature was included in the factory scope, this feature will be disabled. However, it can be enabled in the field through the controller face. Please see the "Barcode Setup" procedure below.

Barcode Data Window

On the controller, a window accessed via the System Setup menu of the Configuration Menu will allow the viewing and modification of the barcode data. This window will show all the barcodes stored in the controller in a 2 column list. The columns will be the Barcode Number, which is a combination of the process line character and the barcode number, and Barcode String. The Barcode Number will be a number from 1 to the maximum number of barcodes for the process line. The process line character will be L or R, A to H, 1 to 8, or B for ChemGuard®. This window will allow each barcode to be selected and modified, and contains a full set of keyboard characters accessible via a Shift button. The Shift button will toggle the case of all the alphabetic characters, and allows access to all the different symbols.



Barcode Setup

The 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.

Before connecting the USB Barcode Reader device, the Technician must be aware of the equipment to ensure no gas safety alarm and flammable atmosphere are present.

Enabling the Barcode Feature on AP10/ChemGuard® Gen IIB Based Products

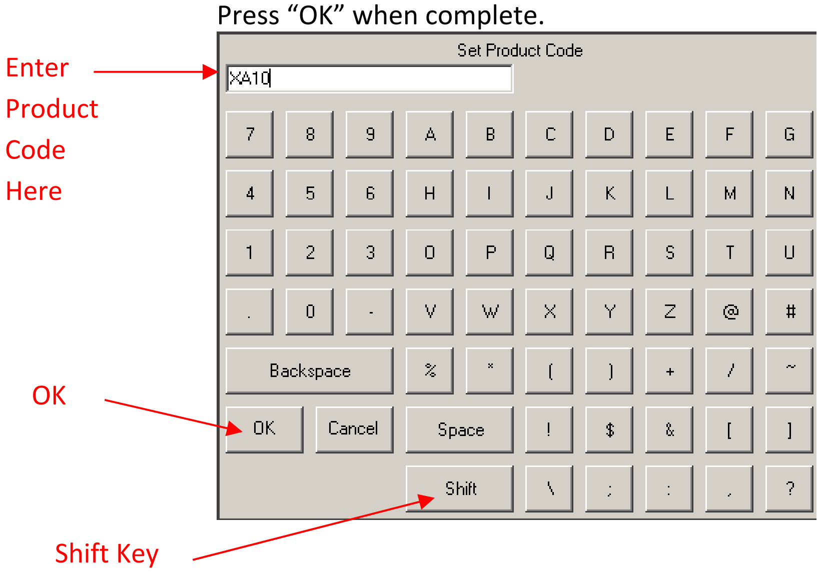
How to enable barcode feature:

1) From the Configuration Menu:

   a. Log-in to controller.
   b. Select "Configuration Menu".
   c. Select "System Setup".

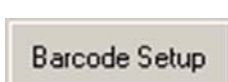
   d. Select "Set Product Code" from the System Setup menu.

   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.

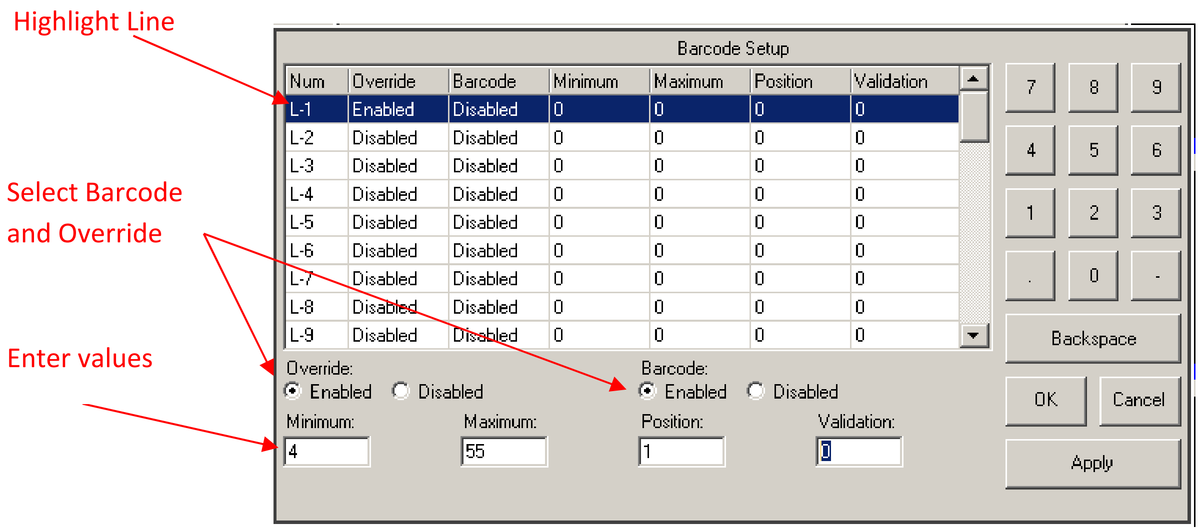


Note: Barcode strings are case sensitive. Be sure to use the proper case when entering letters. The case can be toggled between uppercase and lowercase by pressing the shift key.

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 <u>XA10</u> in the following:
      ABC346<u>XA10</u>ZZ123 starting position is 7.
      <u>XA10</u>ABC346ZZ123 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.

Connecting and Disconnecting USB barcode reader

Before connecting the USB Barcode Reader device, the Technician must be aware of the equipment to ensure no gas safety alarm and flammable atmosphere are present.

1) Plug the USB barcode reader into the system Controller USB port.
2) System is ready for scanning the cylinder barcode label.
3) Always scan the barcode label on the cyclinder before removing and/or opening the cylinder cap or valves.
4) After the barcode is scaned and confirmed, disconect USB Barcode Reader device before resuming the cylinder change sequence.

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