Installation / Operation / Maintenance Manual

GASGUARD®

AP11 BSGS eV / BULKGUARD® eV (NA/EU)

Manual Part Number: 481319

Edition: Rev-3

This Installation and Operation Manual is subject to change without notification. For current technical information please call Product Support at (866)624-7677 from continental U.S., or write Versum Materials, Inc., 1919 Vultee Street, Allentown, PA 18103, Attention: Product Support.

Printed in the U.S.A.

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Revision Control Summary

Chapter	Revision	File Name
Chapter 1 – Safety Warnings • Updated Safety Label Pictures	Rev-8	MNL000127.doc
Chapter 2 – Installation • Updated control power specification	Rev-2	MNL000530.doc
Chapter 3 – Module Specifications • Adding in Process Outlet C and D	Rev-1	MNL000531.doc
Chapter 4 – Intentionally Left Blank • Initial Release	Rev-0	MNL000532.doc
Chapter 5 – Intentionally Left Blank • Initial Release	Rev-0	MNL000533.doc
Chapter 6 – Intentionally Left Blank • Initial Release	Rev-0	MNL000534.doc
Chapter 7 – System Description • Adding new optional components	Rev-1	MNL000535.doc
Chapter 8 – Operating Procedures • Software procedure updates	Rev-1	MNL000536.doc
Chapter 9 – Troubleshooting • Initial Release	Rev-0	MNL000537.doc
Chapter 10 – Maintenance • Adding EFS	Rev-1	MNL000538.doc

Appendix A – Installation Drawing Package
Rev-2 MNL000539.doc

- Updated drawings to latest revisions

Appendix B – Spare Parts List
Rev-1 MNL000540.doc

- Updated Electrical Spares

Appendix C – PED Assessment
Rev-2 MNL000140.doc

- Updated Company Name and Logo

Appendix D – Pre-Facilitation Checklist
Rev-0 MNL000541.doc

- Initial Release

Appendix E – Startup and Commissioning Checklist
Rev-1 MNL000542.doc

- Add EFS

Appendix F – ORI Checklist
Rev-0 MNL000543.doc

- Initial Release

Appendix G – UV/IR Detector
Rev-0 MNL000544.doc

- Initial Release

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Rev-0 MNL000545.doc

- Initial Release

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Rev-0 MNL000546.doc

- Initial Release

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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

⚠ DANGER

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

⚠ WARNING

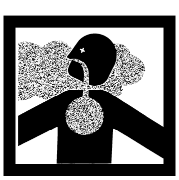
Indicates a potentially hazardous situation, which if not avoided, <u>could</u> result in death or serious injury.

⚠ CAUTION

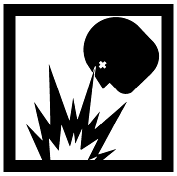
Indicates a potentially hazardous situation, which if not avoided, <u>may</u> result in a minor or moderate injury. It may also be use to alert against unsafe practices.

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.



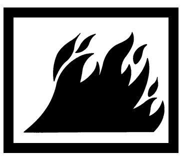
This symbol can represent one or more of the following conditions:

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.

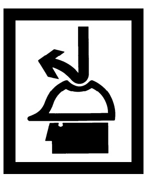
This symbol represents PPE (Personal Protective Equipment). Proper PPE shall be worn when working with this system.

This symbol represents electrical shock hazard.

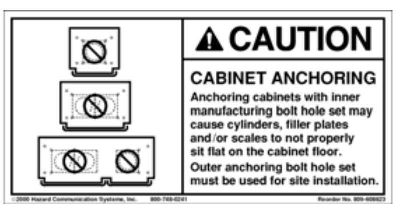
This symbol warns of potential strain or injury when lifting cylinders.

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

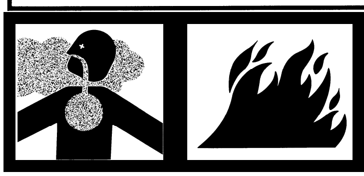
WARNING

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

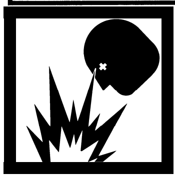


All cylinder storage areas must be continually monitored with an air quality monitor to prevent the danger of a hazardous atmosphere.

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

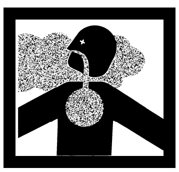


Do not use this device in any manner other than specified in this manual.

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 MUST be used at all times.

Personal Protective Equipment for Pyrophorics

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

Personal Protective Equipment for Flammables

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

Personal Protective Equipment for Inerts

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

1.10 Hazard Warnings

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

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

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

WARNING

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

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

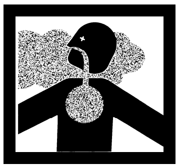
WARNING

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

1.10.1 Toxic Gas Hazards

⚠WARNING

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



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

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

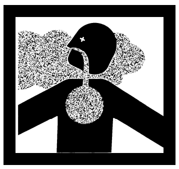
A list of most of the toxic gases used in the GASGUARD® system follows:

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

1.10.2 Corrosive Gas Hazards

⚠ DANGER

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



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

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

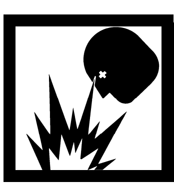
A list of most of the corrosive gases used in the GASGUARD® system follows:

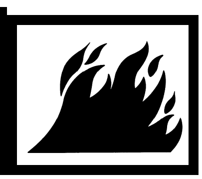
Ammonia	**Hydrogen chloride**
Boron trichloride	**Hydrogen fluoride**
Boron trifluoride	**Hydrogen sulfide**
Chlorine	**Nitrogen dioxide**
Chlorine trifluoride	**Phosphorous pentafluoride**
Dichlorosilane	**Silicon tetrachloride**
Fluorine	**Silicon tetrafluoride**
Hydrogen bromide	**Tungsten hexafluoride**

1.10.3 Flammable and Pyrophoric Gas Hazards

⚠ WARNING

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





Pyrophoric gases will spontaneously ignite in air

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

Flammable mixtures can burn or explode

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

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

Adequate ventilation is necessary

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

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

Continually monitor the atmosphere

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

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

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

Guidelines to avoid forming combustible mixtures

Avoid forming combustible mixtures by adhering to the following:

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

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

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

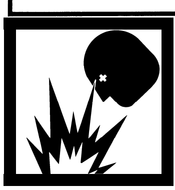
Diborane	**Phosphine**
Disilane	**Silane**

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

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

1.10.4 Oxygen and Other Oxidizer Hazards

⚠WARNING



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

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

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

Use only equipment specifically designed for oxygen or oxidizer service.

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

Maintain oxygen cleanliness at all times.

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

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

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

Do not substitute oxygen for compressed air.

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

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

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

1.10.5 Inert Gas Hazards

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

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

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

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

Symptoms of asphyxia include:

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

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

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

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

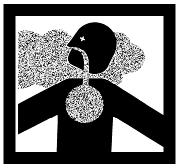
When entering a confined area or area which may contain high inert gas concentrations, a **"Buddy System"** must be used. One person should remain outside the suspect area, but within view of the other person. This method ensures that the other person can respond in the event of an emergency.

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

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

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

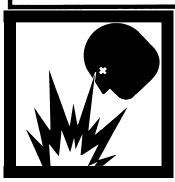
WARNING



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

1.10.6 Pressurized Gases

WARNING



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

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

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

1.10.7 Cylinder Handling Hazards

WARNING

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

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

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

1.10.8 Electrical Hazards

⚠WARNING

Electric shock could cause personal injury or death.

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

1.10.9 Purge Gas Backstream Hazard

⚠WARNING

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

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

1.11 Typical Minimal Lockout or Tagout System Procedures

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

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

General

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

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

Purpose

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

Responsibility

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

Preparation for Lockout or Tagout

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

Sequence of Lockout or Tagout System Procedure

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

⚠CAUTION

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

6. The equipment is now locked or tagged out.

Restoring Machines or Equipment to Normal Production Operations

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

Procedure Involving More Than One Person

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

Basic Rules for Using Lockout or Tagout System Procedure

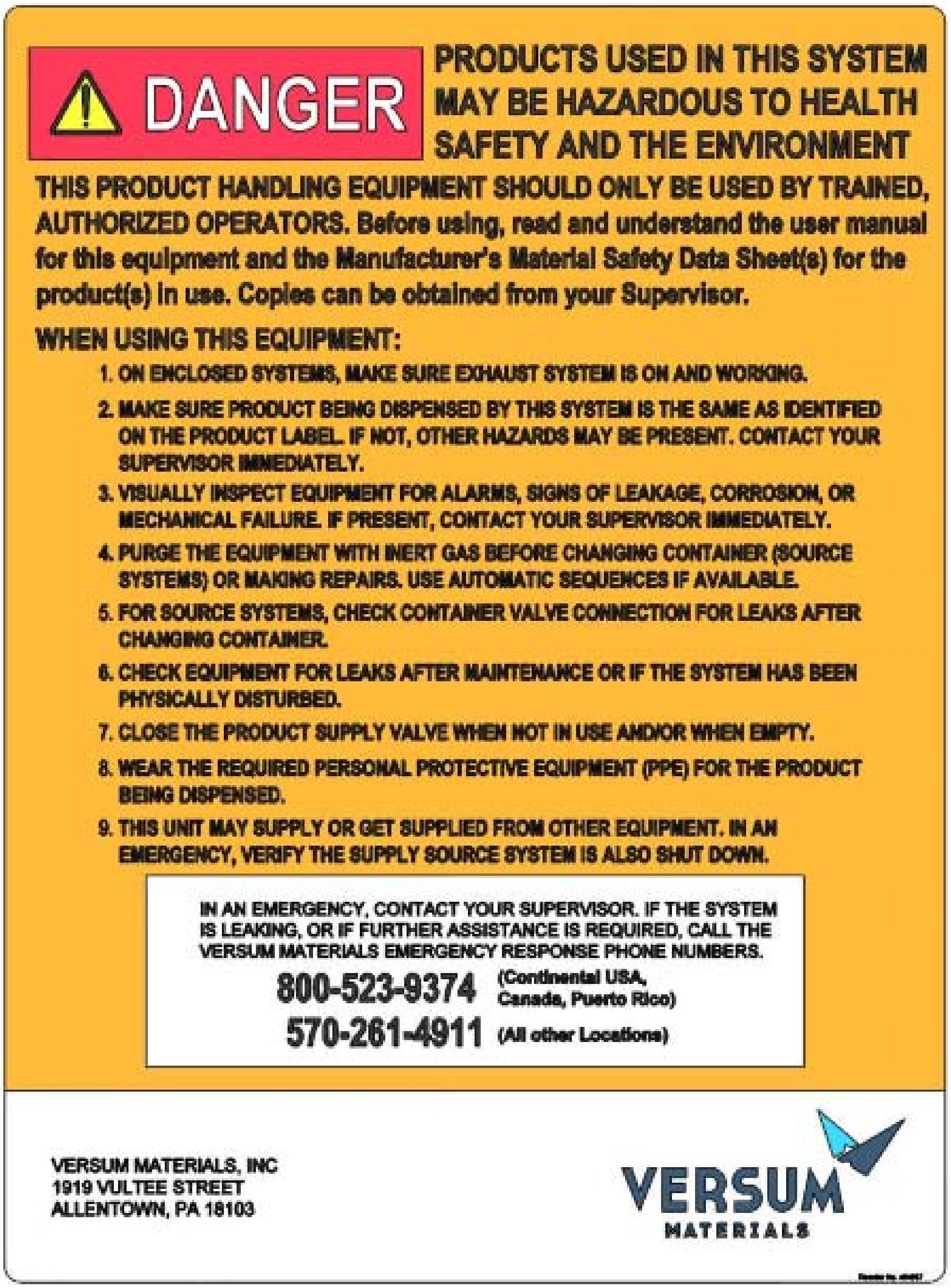
All equipment shall be locked or tagged out to protect against accidental or inadvertent operating when such operation could cause injury to personnel. Do not attempt to operate any switch, valve or other energy isolating device where it is locked or tagged.

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

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

1.12 Safety Signs and Labels

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



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

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

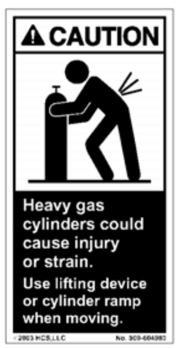
WARNING PRESSURIZED ENCLOSURE

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

WARNING ASPHYXIATION HAZARD

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

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



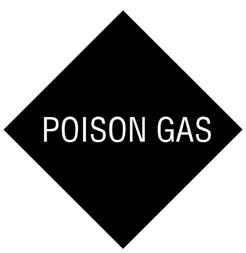
The following label appears inside doors of cabinets.

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

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

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

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



THIS EQUIPMENT IS DESIGNED FOR USE WITH:

Boron trifluoride

Chlorine

Carbon tetrachloride

Nitrogen dioxide

Nitric oxide

Phosphorous pentafluoride

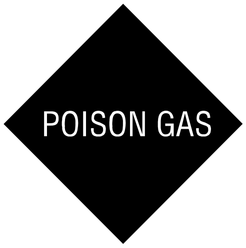
Sulfur dioxide

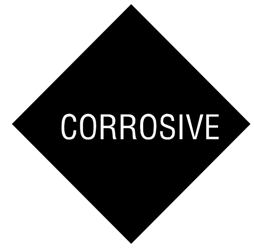
Sulfur tetrafluoride

Tungsten hexafluoride

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

THIS EQUIPMENT IS DESIGNED FOR USE WITH:





Boron trichloride

Hydrogen bromide

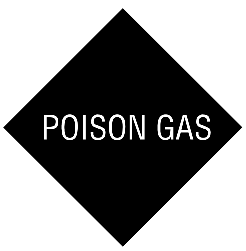
Hydrogen chloride

Hydrogen fluoride

Silicon tetrafluoride

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

THIS EQUIPMENT IS DESIGNED FOR USE WITH:



Fluorine

Fluorine mixtures

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

THIS EQUIPMENT IS DESIGNED FOR USE WITH:

FLAMMABLE GAS

FLAMMABLE GAS

Acetylene

Butane

Disilane

Deuterium

Ethane

Ethanol mixtures

Ethylene

Halocarbon 32

Halocarbon 41

Hydrogen

Hydrogen mixtures

Isobutane

Isobutylene

Methane

Methyl chloride

Methyl silane

Propane

Silane

Silane mixtures

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

THIS EQUIPMENT IS DESIGNED FOR USE WITH:

Arsine mixtures

Carbon monoxide

Diborane mixtures

Dichlorosilane

Diethyl telluride

Germane

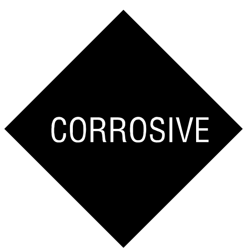
Hydrogen selenide

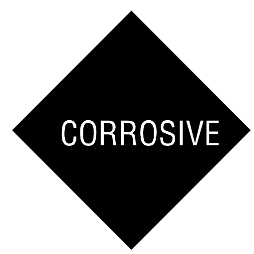
Hydrogen sulfide

Phosphine mixtures

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

THIS EQUIPMENT IS DESIGNED FOR USE WITH:





Silicon tetrachloride

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

Chlorine trifluoride

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

THIS EQUIPMENT IS DESIGNED FOR USE WITH:

Ammonia

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:

THIS EQUIPMENT IS DESIGNED FOR USE WITH:

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

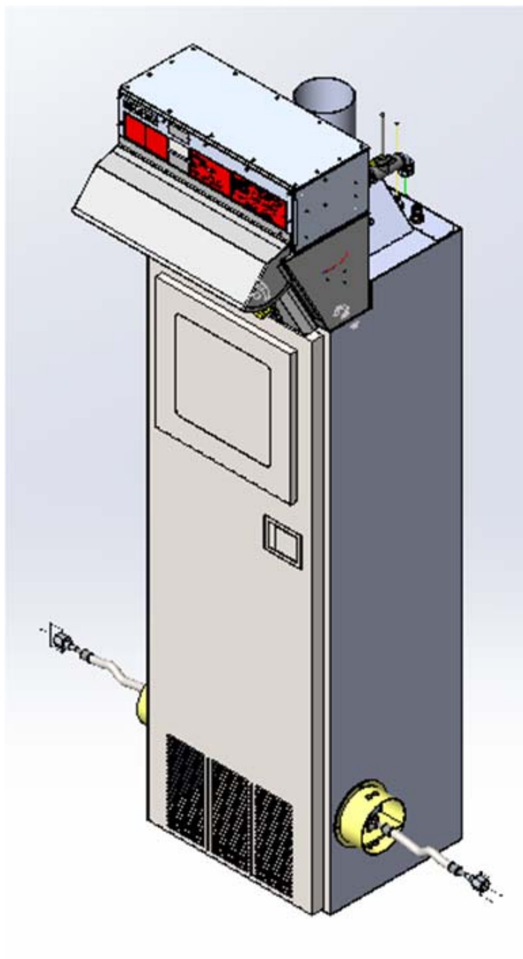
Nitrogen Material Safety Data Sheet (Included as Appendix B)

Chapter 2

Installation

1.0 Receiving Inspection

The BSGS eV / BULKGUARD eV 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 BSGS eV / BULKGUARD eV 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 module is 700 lbs (320 kg).

⚠CAUTION

1. Once the 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 module should be opened and the piping system should be carefully inspected for damage.
- The front door of the AP11 controller and eV ECC 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. Move the unit to its final location.

3.0 Module Installation

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

- BSGS eV / BULKGUARD eV module drawings included in Appendix A – Installation Drawing Package.
- Seismic Codes per ASME, UBC, or applicable local codes.

***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. BSGS eV / BULKGUARD eV 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 siting criteria.

2. An overhead roof or canopy is recommended for source vessels and BSGS eV / BULKGUARD eV equipment. Although the equipment is designed to NEMA 3R, it is recommended that it is 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 eV ECC located on top of the module should 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 applicable local codes.
5. The floor outline dimensions and mounting hole locations are shown in Figure 2-1 below:

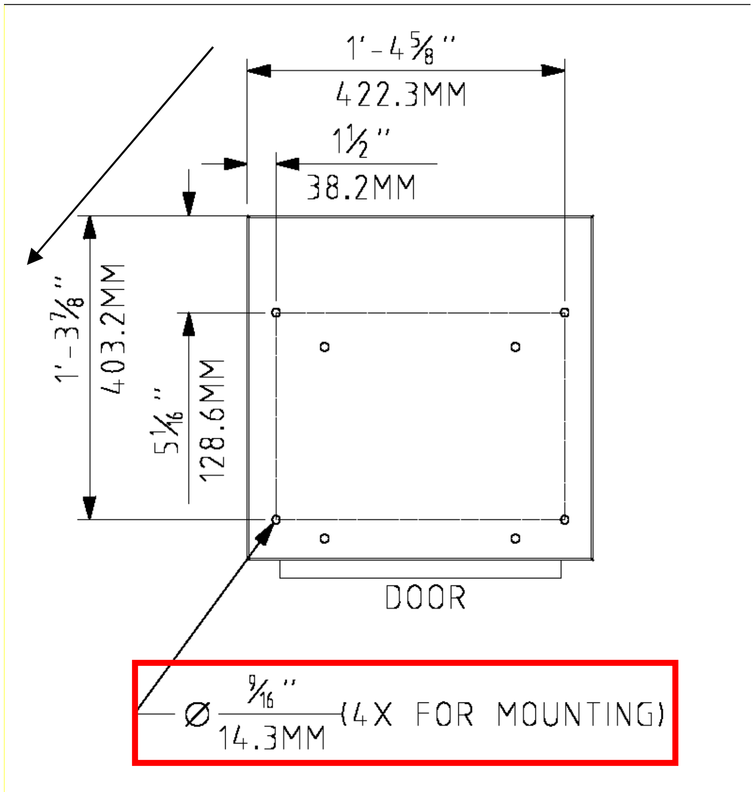


Figure 2-1. Rack Mounting Hole Locations in Floor

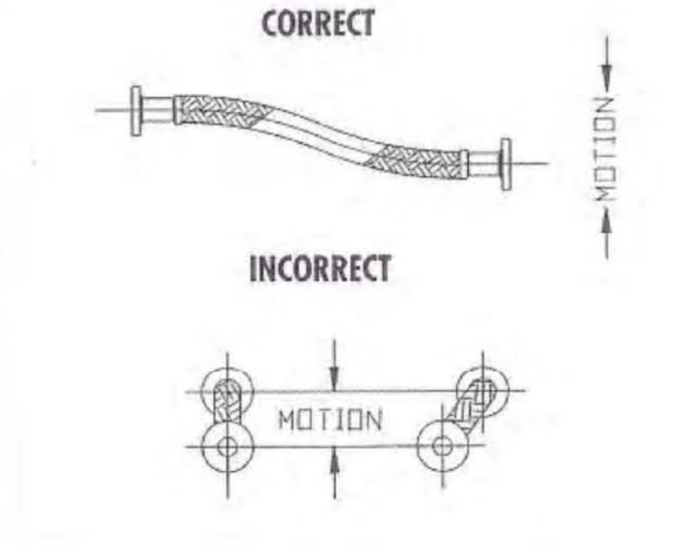
6. There shall be no obstructions in front of any access covers, including controller, electrical enclosures, or piping cabinet.
7. Final equipment layout and mounting locations are the responsibility of the owner. It is recommended that the process gas container be located to the back of the module to allow easy access to the display and piping system components. See Appendix A – Installation Drawing Package, BSGS eV / BULKGUARD eV Pigtail assembly installation drawings.

8. 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 Chapter 3 - Module Specifications.
9. 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 A – Installation Drawing Package, BSGS eV / BULKGUARD eV pigtail installation drawings for general routing and support information.
10. 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 2 pages are a list of those limitations and recommendations for proper installation.

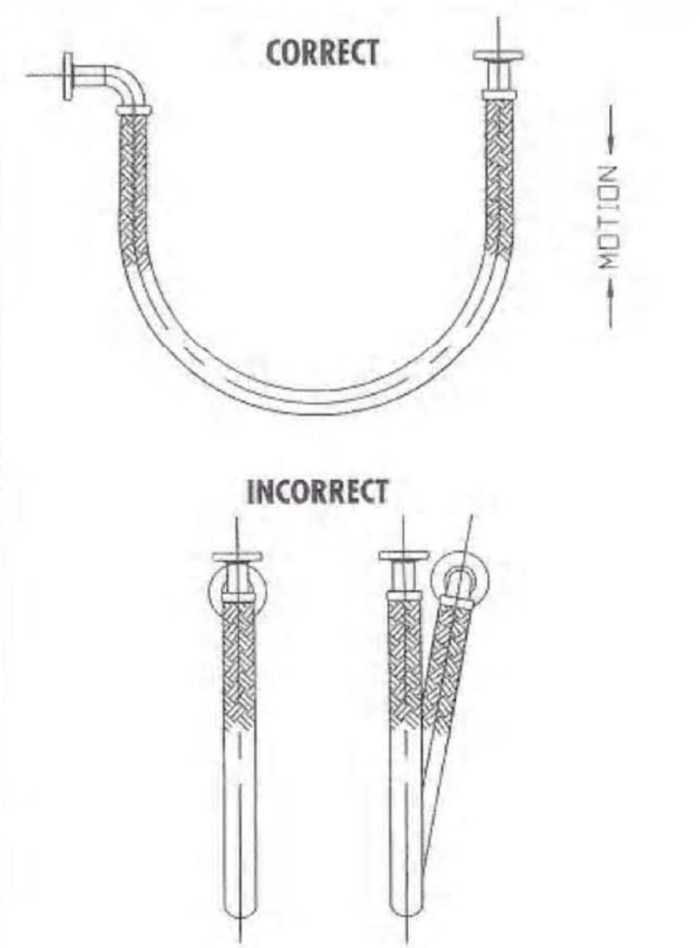
Installation Information

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.

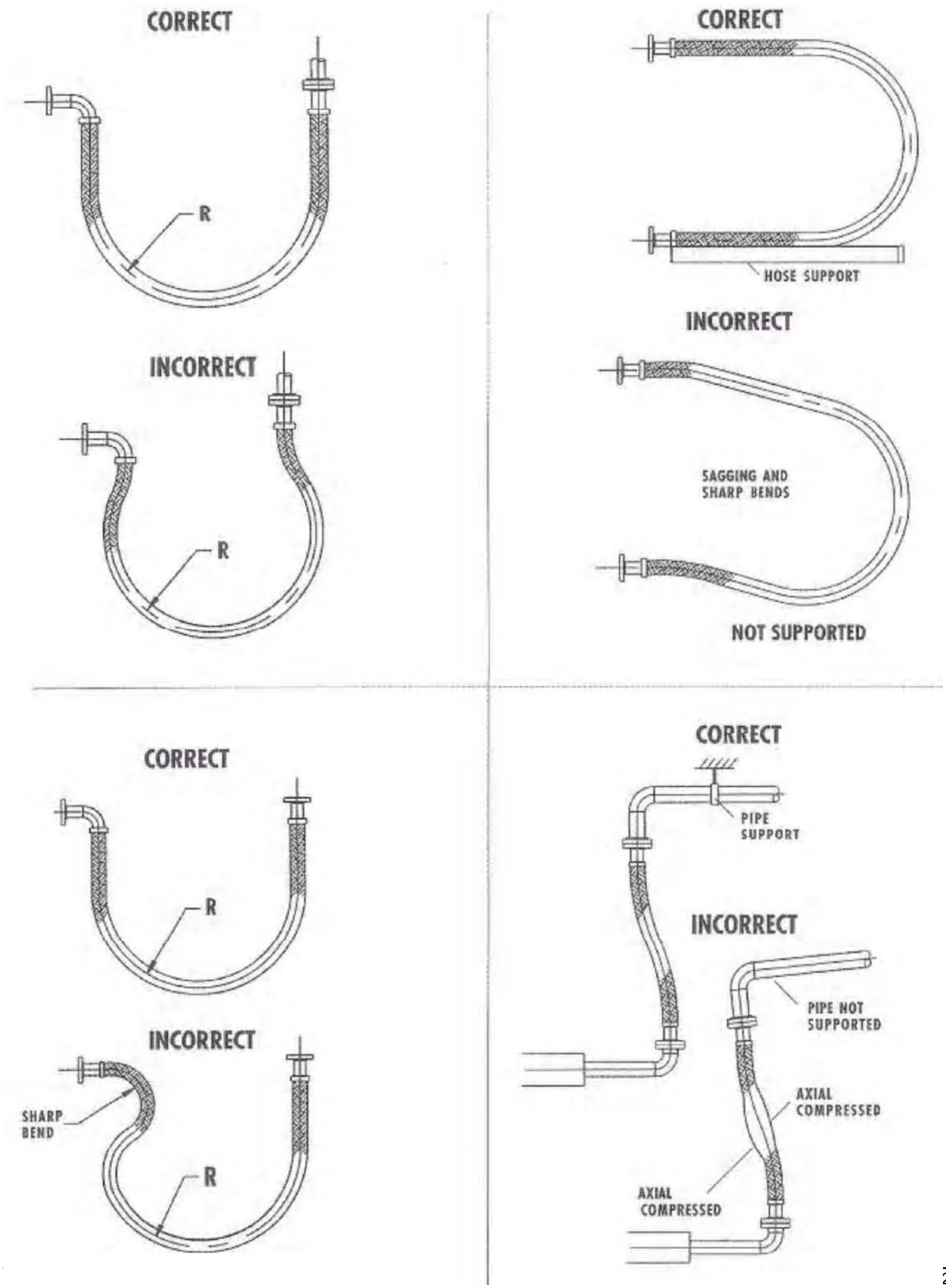


3. Avoid over bending.
The repetitive bending of a hose to a radius smaller than the radius listed in the specification tables for corrugated hose will result in early hose failure. Always provide sufficient length to prevent over-bending and to eliminate strain on the hose.



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.


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

Flex Hose Specifications							
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 module 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) modules.

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

Connection Points

All tubing connections are made at either the top rear of the module or within the source inlet cutouts located on the lower sidewalls of the module. 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 A 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 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/C/D (opt): 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

NOTE – Optional process C and D are shipped with external open-ended piping spools installed to provide stability during shipment. These process lines must be capped if they are not facilitated at the customer site.

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 four 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 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 2-2 shows a standard bulkhead.

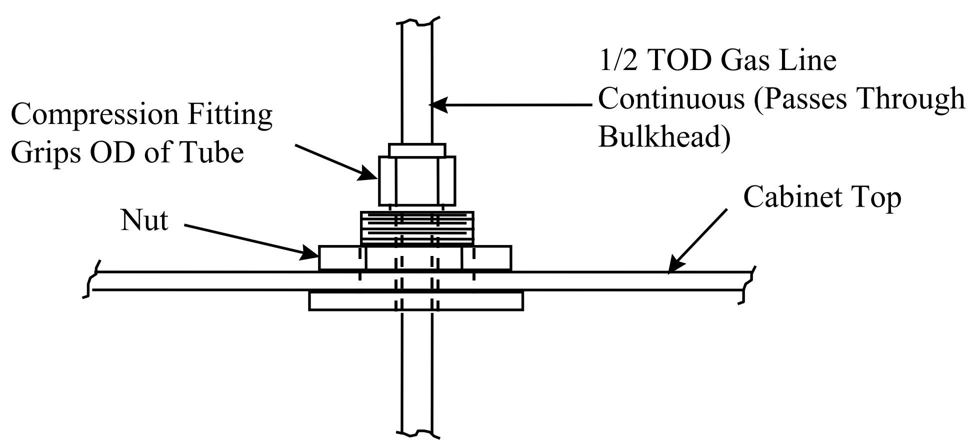


Figure 2-2. Standard Bulkhead

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 2-3 shows a coaxial bulkhead.

⚠CAUTION

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

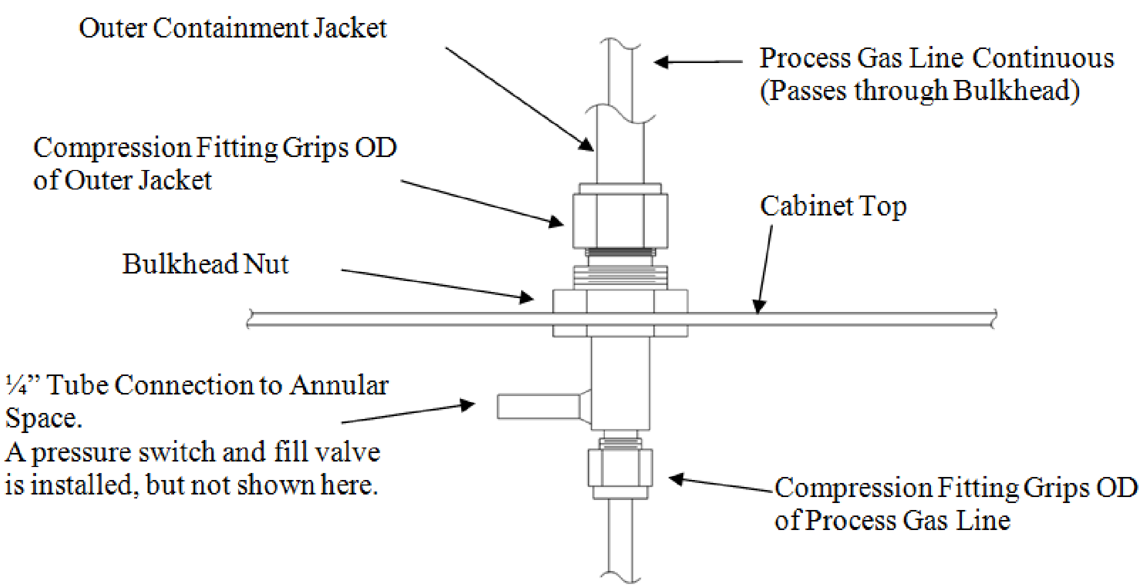


Figure 2-3. Coaxial Bulkhead (optional)

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.

If treatment is required in order to abate the process gas, 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 typically 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 masses of gas will be vented from a BSGS eV / BULKGUARD eV 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

- 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.

- 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.

- 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

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 module employs a vacuum Venturi module that integrates a vacuum Venturi, check valve, and trickle purge valve into a single unit. Figure 2-4 depicts a typical trickle purge assembly that isn't integrated into a module for clarity.

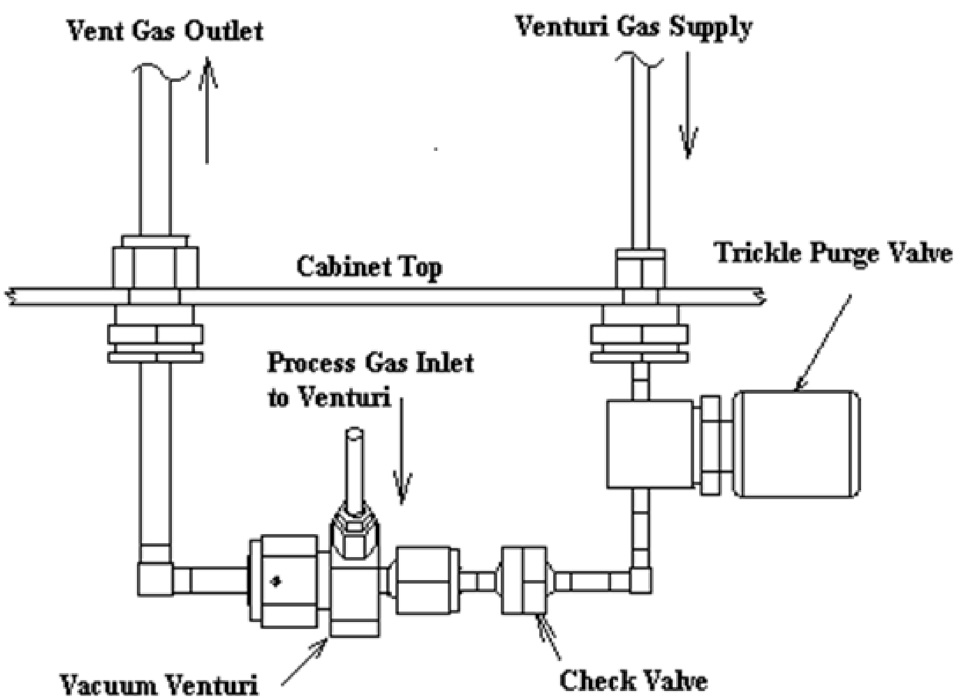


Figure 2-4. Typical Trickle Purge Assembly

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 Venturi line requires 80-90 psig (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 (N_2O), nitrogen trifluoride (NF_3), hydrogen chloride (HCl), and carbon dioxide (CO_2) 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 (N_2O), nitrogen trifluoride (NF_3), hydrogen chloride (HCl), and carbon dioxide (CO_2) 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

Purge gas sources used for the BSGS eV / Bulkguard eV must not be shared with other BSGS eV / Bulkguard eV modules if the gas types are incompatible. 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

Many BSGS eV / BULKGUARD eV modules are supplied with process piping inside an exhausted enclosure. 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.

With the exception of nitrous oxide (N_2O), 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. 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 is recommended 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 O_2 monitoring with local and remote alarms on low O_2 concentration (i.e. less than 19.5% O_2 detected in the room).

Nitrous oxide (N_2O) 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 JT heater.

Silane (SiH_4) 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, tonners, 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 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 BSGS eV / BULKGUARD eV module has been ordered with source heater capability, panel heat trace and insulation will have been partially installed at the factory. The 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.

Depending upon the module configuration, inlet flex hoses may 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 module. The heat trace will be supplied by the factory, coiled at the pigtail inlet to the piping cabinet but acquiring and installing the insulation (as per the installation drawings in Appendix A) will be customer scope.

Heat trace installation details are called out in the electrical installation drawing, located in Appendix A of this manual. Versum Materials, Inc. recommends ½" Buna-N/PVC rubber insulation for all field installed insulation.

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

If additional heat trace is required in the field, the recommended material is Delta-Therm PT3SB Heat Trace Cable. This cable is constant-Watt (12 watts /ft at 240 VAC), so a controller will need to 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 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 module are as follows:

- High pressure process piping, from PT-1 to PCV-1, purge inlet CV-9/CV4 to V-13, and V-13 to MV29.
    - 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): 1300 psig MAWP.
    - Process gases: Ammonia (NH_3): 250 psig MAWP.
    - Other gases: contact your Versum Materials, Inc. representative
- 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. BSGS eV / BULKGUARD eV modules are designed for use in Explosive Atmosphere Directive (ATEX) locations.

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

- "Electrical Details for Typical Installation" located in Appendix A.
- "Installation, BSGS eV / BULKGUARD eV Rack" located in Appendix A.

Sealing hubs and low point drains and other means of providing a watertight seal shall be utilized for outdoor installations. It is also recommended to use poured seals and nitrogen purge for outdoor applications to minimize effects of moisture on the controller. Additional specifications will have to be followed for installation within electrically classified areas.

Grounding Method

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

On the plenum of the gas cabinet there is an additional split bolt terminal for connection hookup to the facilities grounding network. Figure 2.5 shows a suggested grounding method for a typical system. This drawing may not be applicable to your specific system.

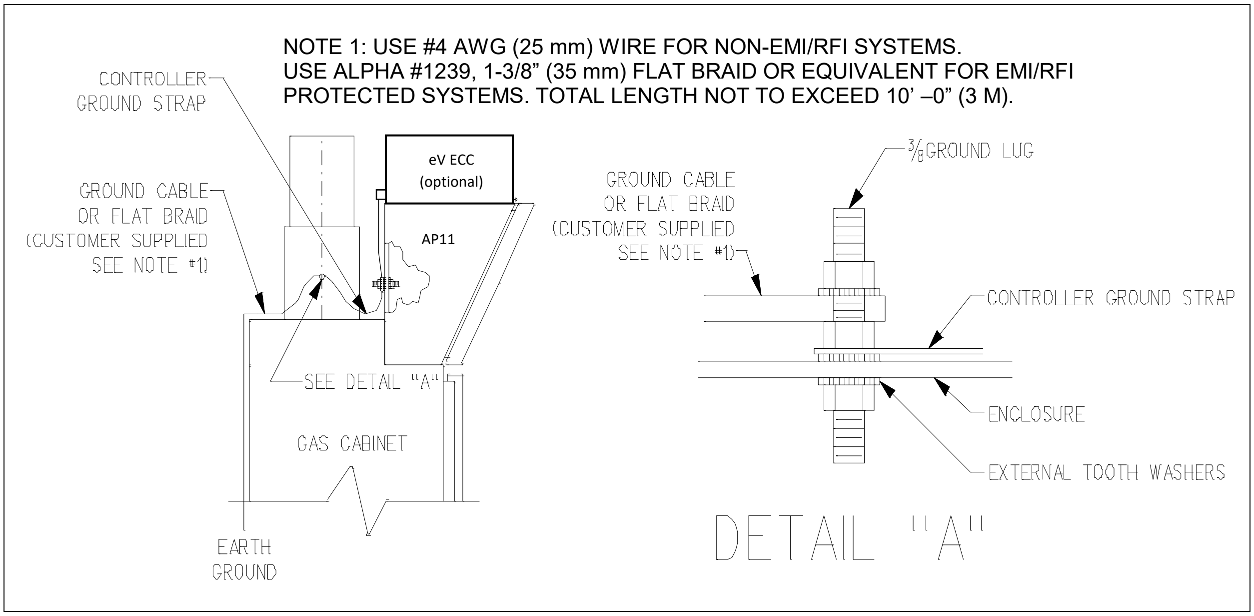


Figure 2.5: Suggested Grounding Method

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

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

Power Supply Connection – AP11 with eV ECC

BSGS eV / BULKGUARD eV modules are normally equipped with an eV ECC located on top of the AP11 controller. When equipped with an eV ECC, the BSGS eV / Bulkguard eV has two power feed options: single feed (both AP11 and eV ECC powered by a single feed) and dual feed (AP11 and eV ECC powered by separate feeds). Details of the termination points are shown in the electrical installation drawing, Appendix A of this manual.

Each BSGS eV / BULKGUARD® eV system should be installed with an independent external circuit interrupting device to remove power from the unit when maintenance on the controller is required and should be Lockout/Tagout capable. This device should be rated as a minimum at 240 volts, 40 amps, 50/60 Hz and 10,000 rms symmetrical ampere interrupting capacity. The device should be accessible to the operators, marked as the disconnecting device for the gas cabinet, and must have the on/off position clearly marked for the operator, and should be near the gas cabinet.

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

Power Requirements: Single Power Feed – JT heater with heat trace
208-240 VAC, 32A, 50/60Hz, 3 wire

Power Requirements: Single Power Feed – Heat trace with no JT heater
208-240 VAC, 7A, 50/60Hz, 3 wire

Power Requirements: Controller Powered Separate – JT heater with heat trace
Heaters: 208-240 VAC, 32A, 50/60Hz, 3 wire
Controller: 100-240 VAC @ 175 VA maximum, 50/60Hz, 3 wire

Power Requirements: Controller Powered Separate – Heat trace with no JT heater
Heaters: 208-240 VAC, 7A, 50/60Hz, 3 wire
Controller: 100-240 VAC @ 175 VA maximum, 50/60Hz, 3 wire

Acceptable wire gauge:
Single power feed: 14-4 AWG
OR
Heater Power: 14-4 AWG
Controller Power: 14-10 AWG

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

Replaceable fuses:
F1, F2, F3, and F4, located on the power board in the top of the AP11 controller, are 4A super quick acting fuses.
FS-405, located in the eV ECC adjacent the DC power supply, is a 2A medium time delay fuse.
FS-406, FS-407, and FS-408 are 500 mA medium time delay fuses.
See the Spare Parts List in Appendix B for Manufacturer and part numbers and specifications.

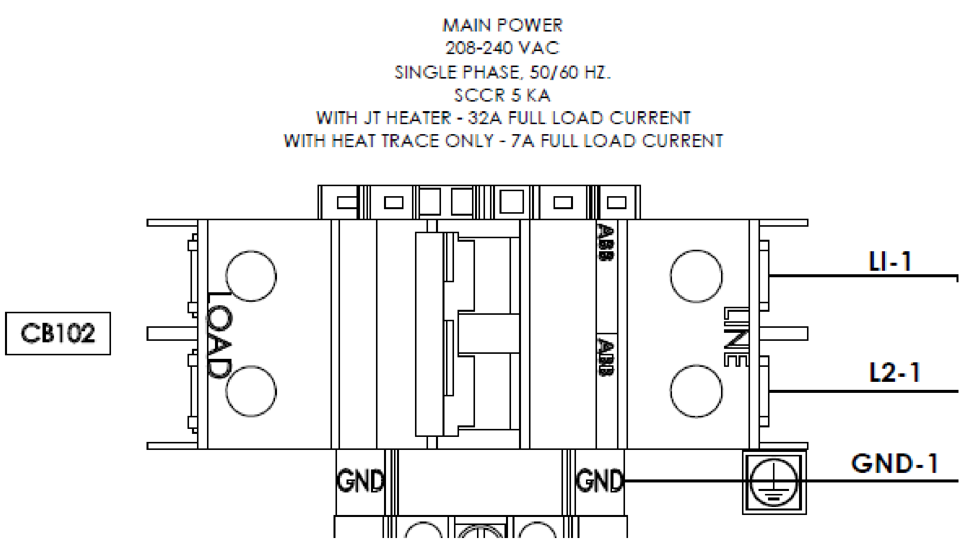


Figure 2-6: Power Connections

Dual Power Supply Connection:

- To supply power for the AP11 controller separate from the heaters complete the following steps: Remove wires between terminal blocks 1031-1121 and 1021-1111 (Figure 2-8).
- Wire heater power feed into the normal connection points (CB-102 and adjacent ground block).
- Wire controller power feed into terminal blocks 1092 (L1), 1102 (L2/N), and adjacent ground block.
- Apply "Danger – Hazardous Voltage Fed by Two Sources" label to controller door as shown (Figure 2-7).

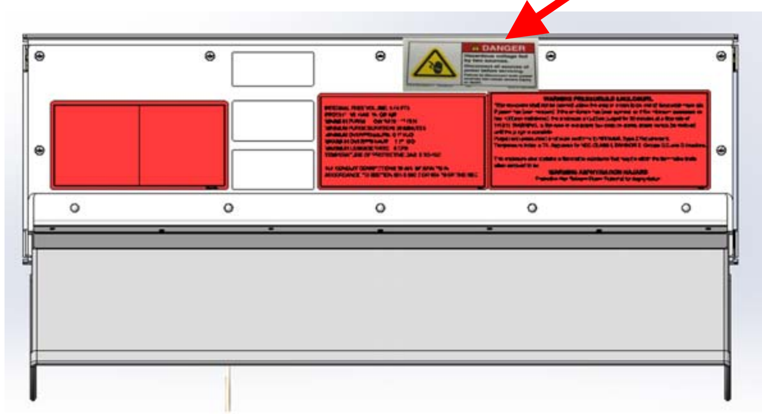


Figure 2-7: Label Placement

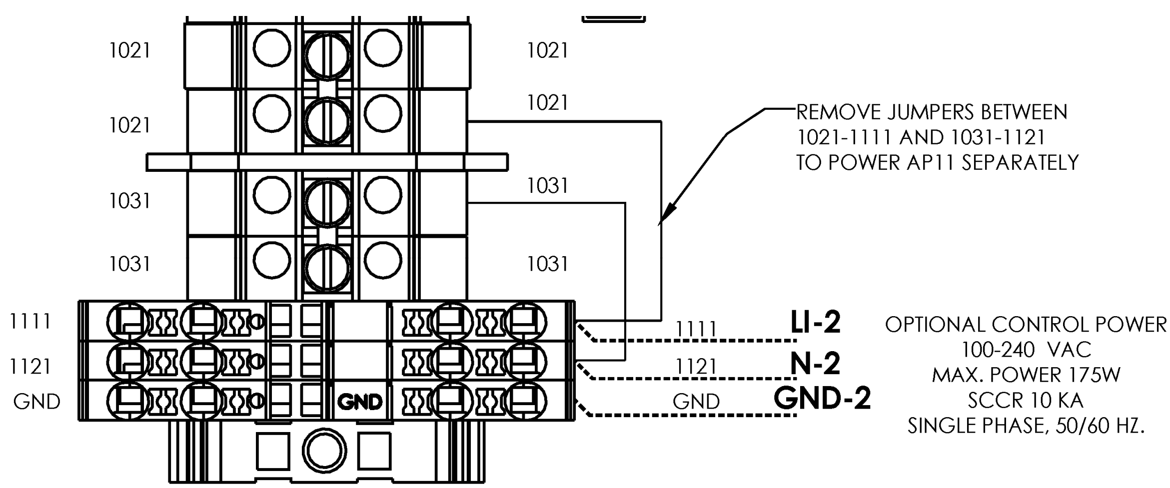


Figure 2-8: Wire Removal

Power Supply Connection – AP11 controller only

There are some cases where the eV ECC will not be installed on the BSGS eV / BULKGUARD eV, such as when neither a JT heater not heat trace are specified. In those cases, there will only be an AP11 controller that requires power.

Each BSGS eV / BULKGUARD® eV system should be installed with an independent external circuit interrupting device to remove power from the unit when maintenance on the controller is required and should be Lockout/Tagout capable. This device should be rated as a minimum at 240 volts, 4 amps, 50/60 Hz and 10,000 rms symmetrical ampere interrupting capacity. The device should be accessible to the operators, marked as the disconnecting device for the gas cabinet, and must have the on/off position clearly marked for the operator, and should be near the gas cabinet.

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

The power input must be wired to the terminals shown below in Figure 2-9.

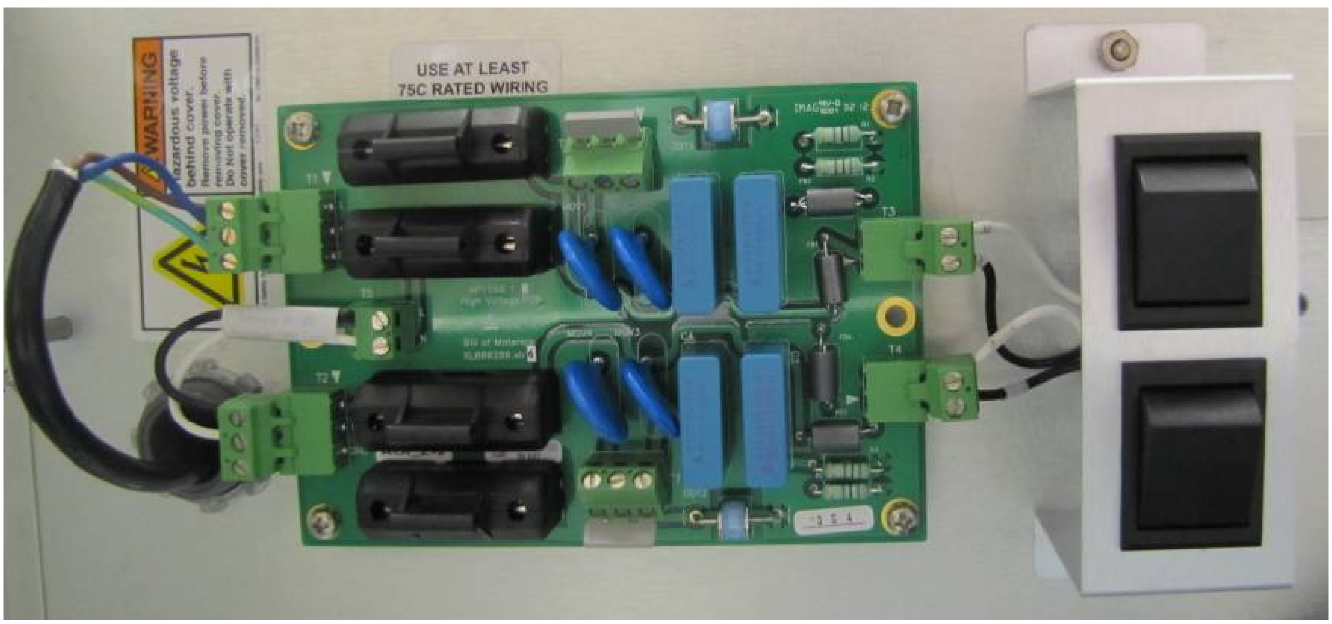


Figure 2-9: Dual Power Supply Terminal Connection

The power requirements are as follows:

100-240 VAC @ 150 VA maximum, 3 wire

Full load current - 4 amps

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

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

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

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

Field Connections

⚠WARNING

In NEC Class I, Division 2 areas (only in the U.S.A.), a conduit seal ("pour fitting") or equivalent must be installed between each electrical connection point on the cabinet and the electrical source. Liquid tight flexible conduit can be installed between the GASGUARD® AP11 connectors and the conduit seals to facilitate these connections. A maximum length of 18" (457 mm) is allowed between the last pour fitting and the cabinet connector. All conduits shall be sealed in accordance to Sections 501-5, 502-5 or 504-70 of the National Electric Code. See Figures 2-10, 2-11, 2-12, and 2-13 for details.

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

⚠WARNING

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

Systems which have been equipped with the eV ECC have conduit holes in the back of the sheet metal. These conduit locations are shown in Figure 2-10 and Figure 2-11.

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

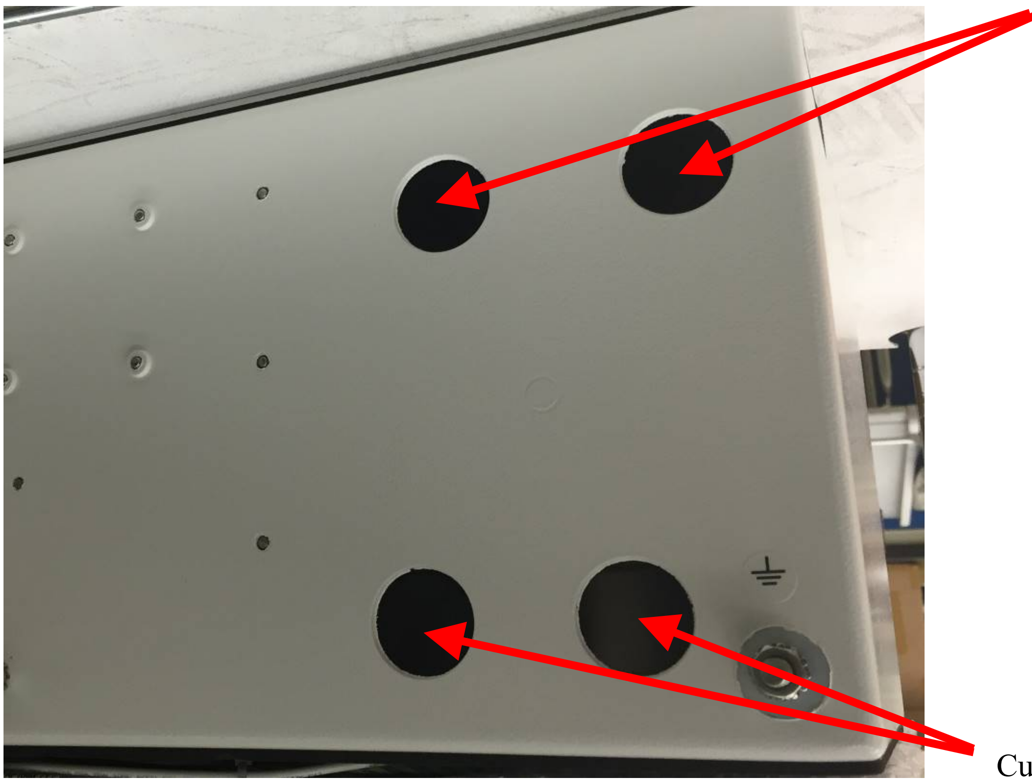


Figure 2-10: Rear View of GASGUARD® eV AP11 Controller

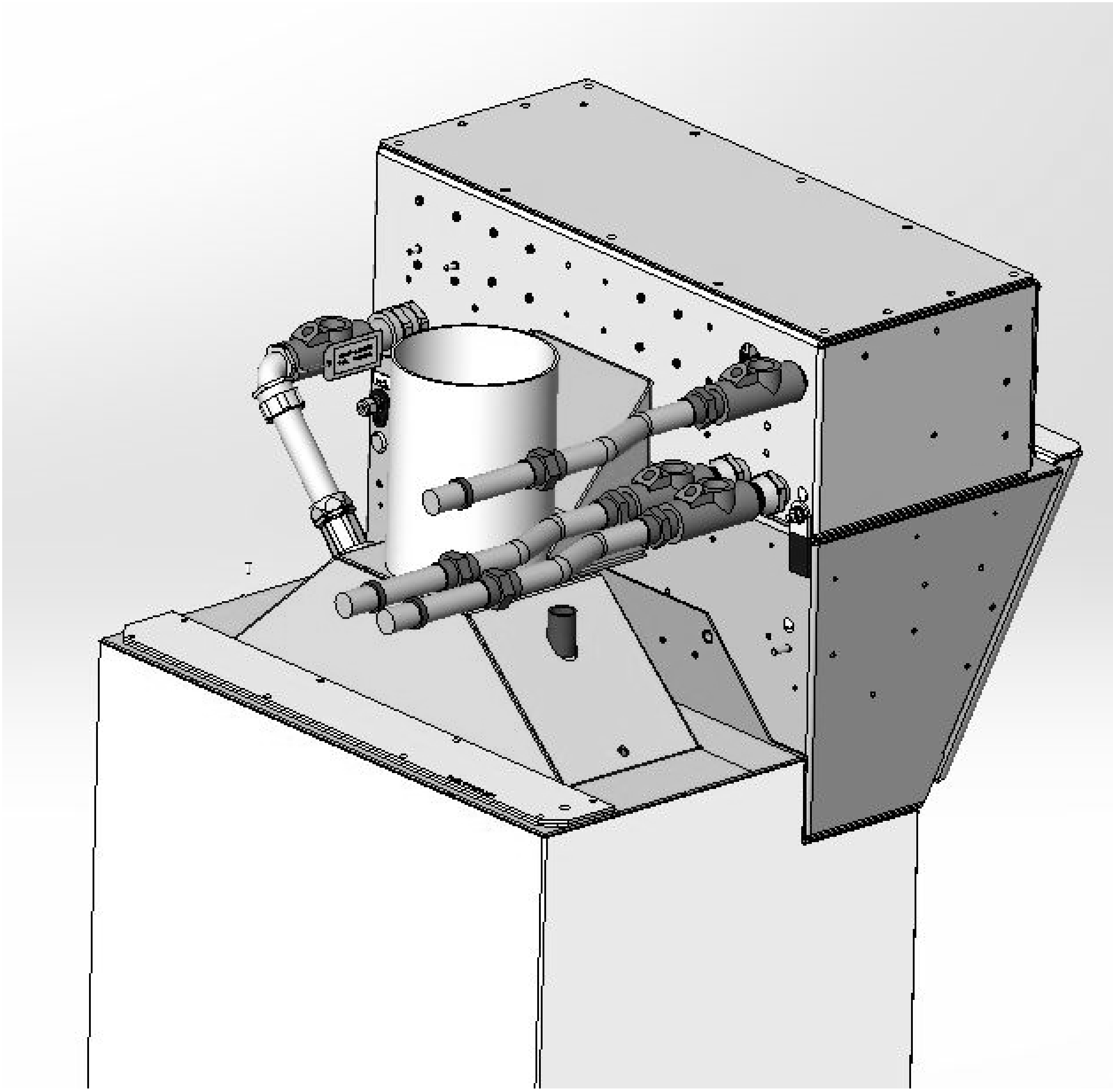


Figure 2-11: BSGS eV / BULKGUARD® eV Conduit and Conduit Seals (with eV ECC)

Systems which do not have the eV ECC installed with have conduit holes located on top of the AP11 controller. These holes would be covered up when the eV ECC is installed. A 1-1/8" (28.6 mm) diameter hole for 3/4" conduit is supplied for connecting the 120/240 VAC power supply to the system. Two additional holes are supplied for customer I/O and/or Ethernet Cable. Figure 2-12 and Figure 2-13.

Figure 2-12: Top View of GASGUARD® AP11 Controller

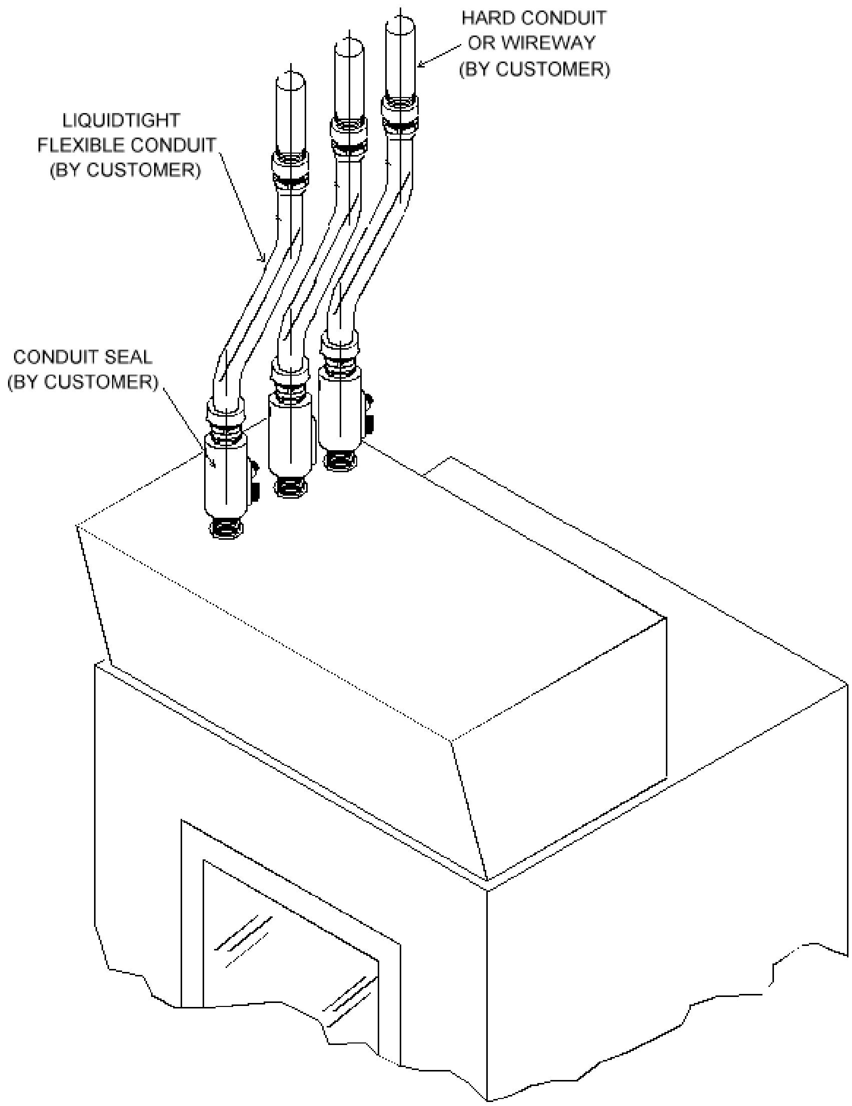


Figure 2-13: Conduit and Conduit Seals (no eV ECC installed)

Field Signal Connections

In the AP11 BSGS eV / BULKGUARD eV 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, and the AP1571 bulk interface board located in the right bulk interface box located on the right side of the piping cabinet.

There are three types of I/O identified for the 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 2-14 and Figure 2-15 show the general locations of these connections. Details of these terminal blocks and termination points are shown in the electrical installation drawing, Appendix A of this manual.

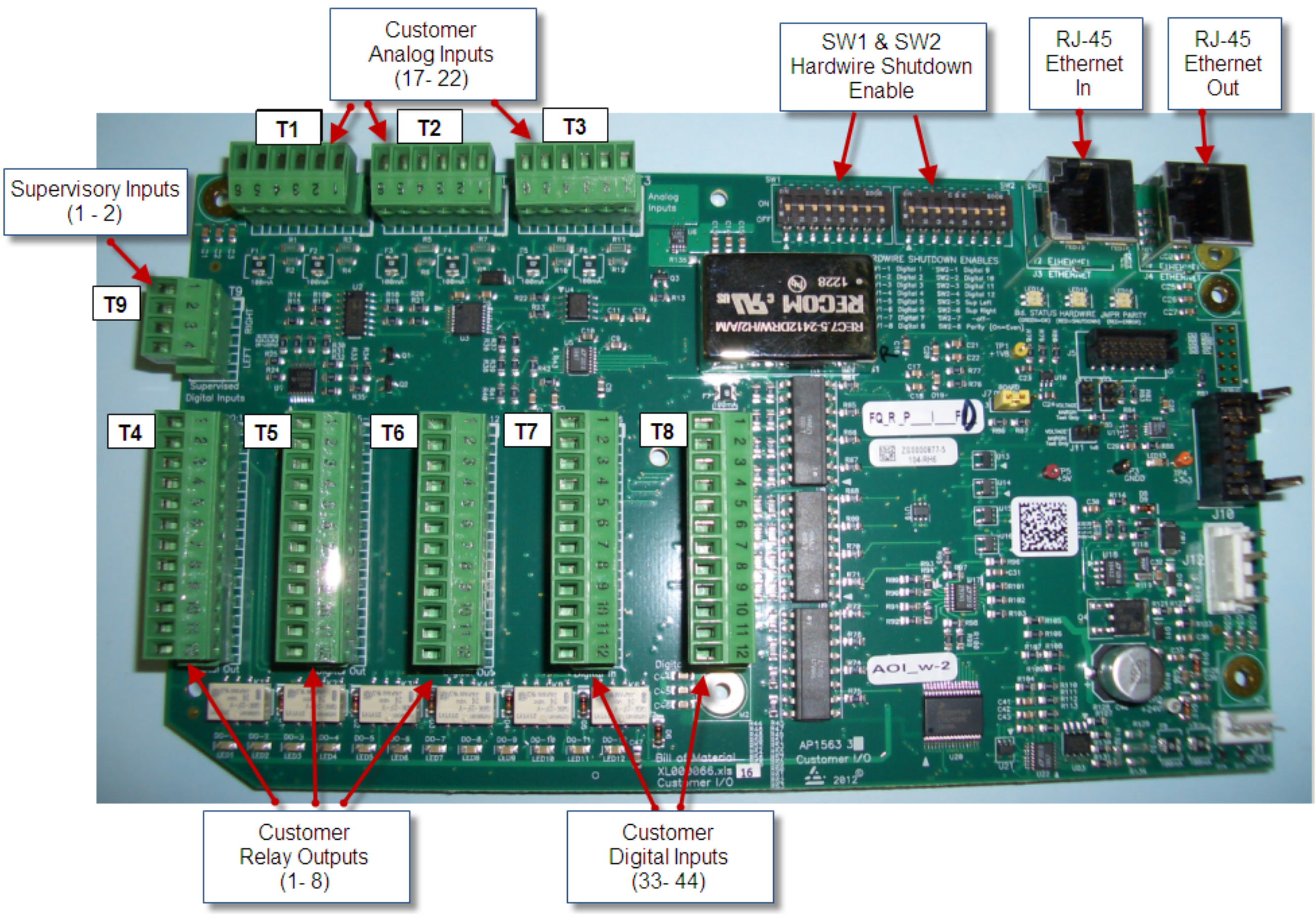


Figure 2-14: AP1563 Customer I/O Terminal Blocks

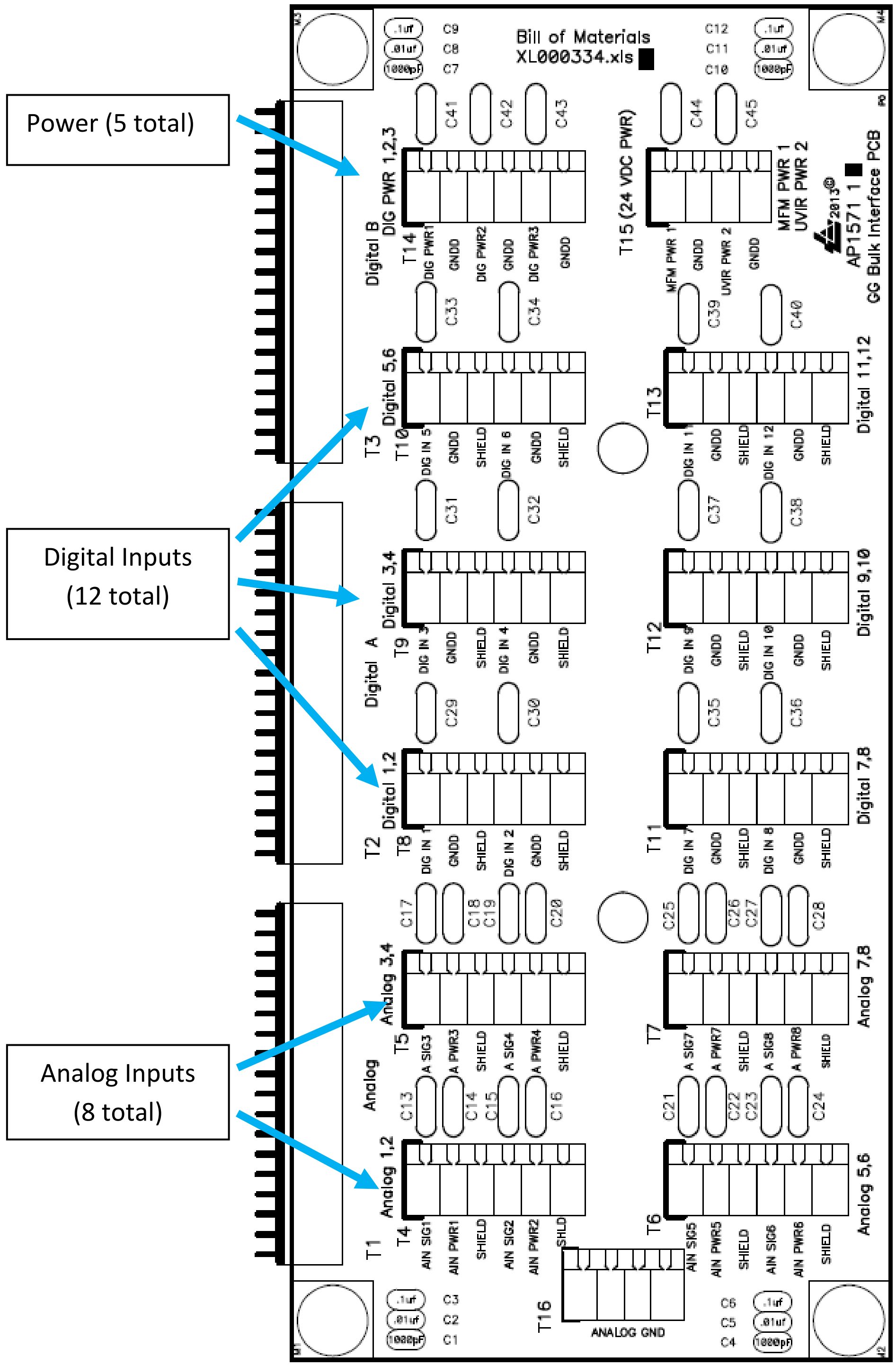


Figure 2-15: Terminal block layout of I/O interface box

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 module, shown on the electrical installation drawing, Appendix A of this manual.

Supervised Inputs

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 2-16 shows the supervisor input wiring for use with the life safety system.

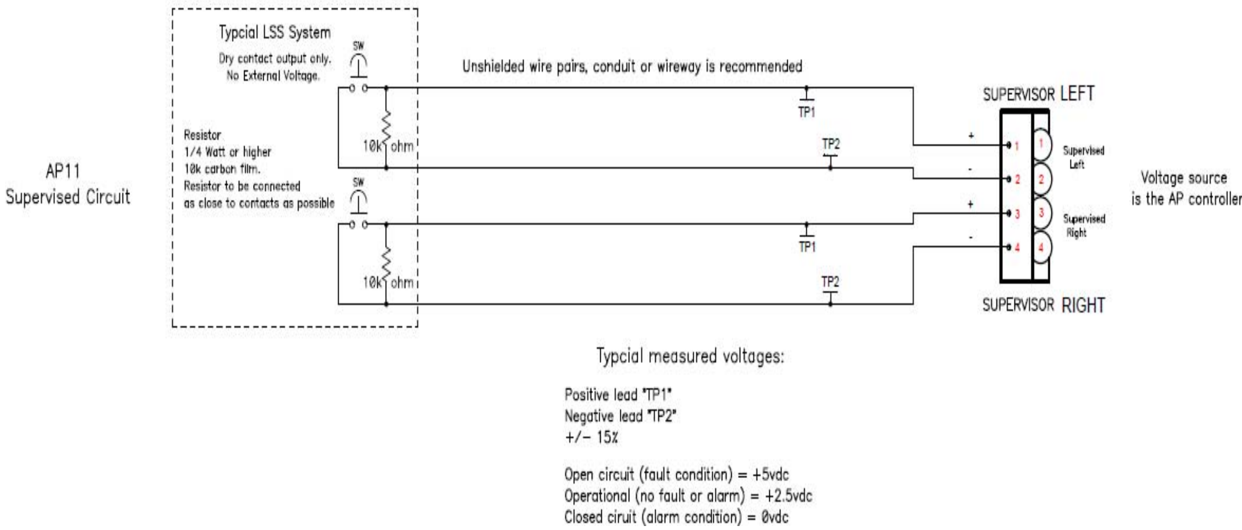


Figure 2-16: Supervisory Input Wiring

Available External I/O Communications

The BSGS eV / BULKGUARD® eV 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 Alarm Matrix included in the drawings section of the operational manual.

Digital Outputs Dry - Customer I/O board AP1563

24 VDC @ 1 Amp maximum

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

Digital Inputs (Customer)

(Customer I/O board AP1563)

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

* Each digital-input can be individually configured to provide a hardwire shutdown alarm function. Figure 2.6 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 Customer I/O board)

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

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

User Power (Customer)
(AP1563 Customer I/O board)

The AP11 customer board supports six Analog-Input (AI) channels, each of which can be independently configured for **0-5V** or **4-20mA** inputs. Three user-connections (per channel) are provided: +24V-power, +24V-gnd, and signal. A common isolated power-supply is used for all channels, however each channel's power is individually fused/current-limited. The combined power-supply loading of all channels must be less than **200mA**. In some configurations, it may be possible to exceed this limit. It is the user's 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 2-17 below. (AP11 connections are shown on the left)

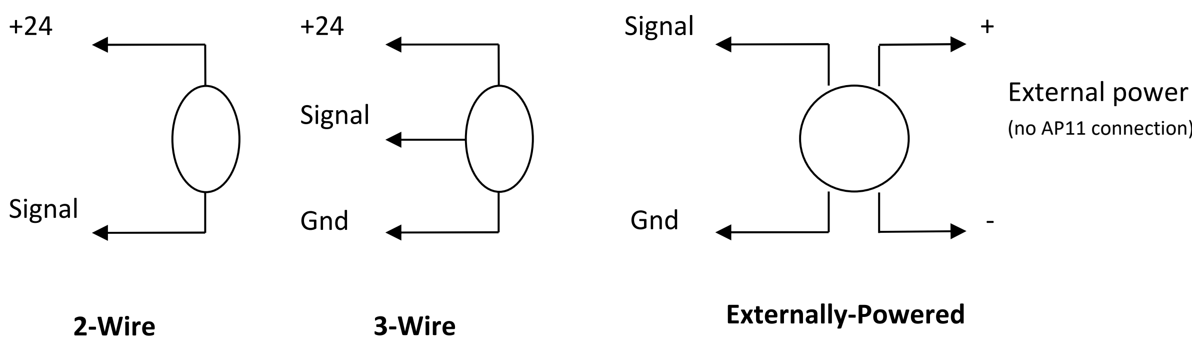


Figure 2-17

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.

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

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.

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

Cable resistance = 0.0527 ohms/meter * 100 meters * 2

(actual) = 10.54 ohms

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

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

The current draw and minimum operating voltage of the device should be included on the manufacturer's data sheet. The voltage seen by the device is reduced by the resistance of the cable going to the device and by a 100-ohm resistor within the AP11. Calculations to determine the maximum cable resistance are shown in Figure 2-18 below:

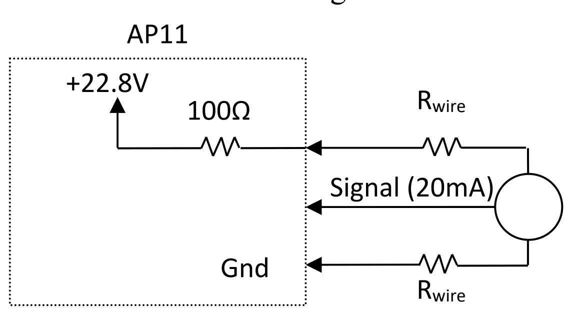


Figure 2-18

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

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

Note: If the manufacturer specifies power consumption in watts instead of current in milliamps, assume that the device is receiving 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 excitation voltage of 15V is at the end of 100 meters of 22/3 cable. The manufacturer specifies that the 22 AWG wire has a resistance of 0.0527 ohms/meter.

$$Max\ Cable\ Resistance = \frac{22.8V - 15 - 100 * 0.064}{0.064 - .01} = 70\ ohms$$

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.

On BSGS eV / BULKGUARD eV modules, jumper J7 is factory set as shown in Figure 2-19 for the Customer I/O board.

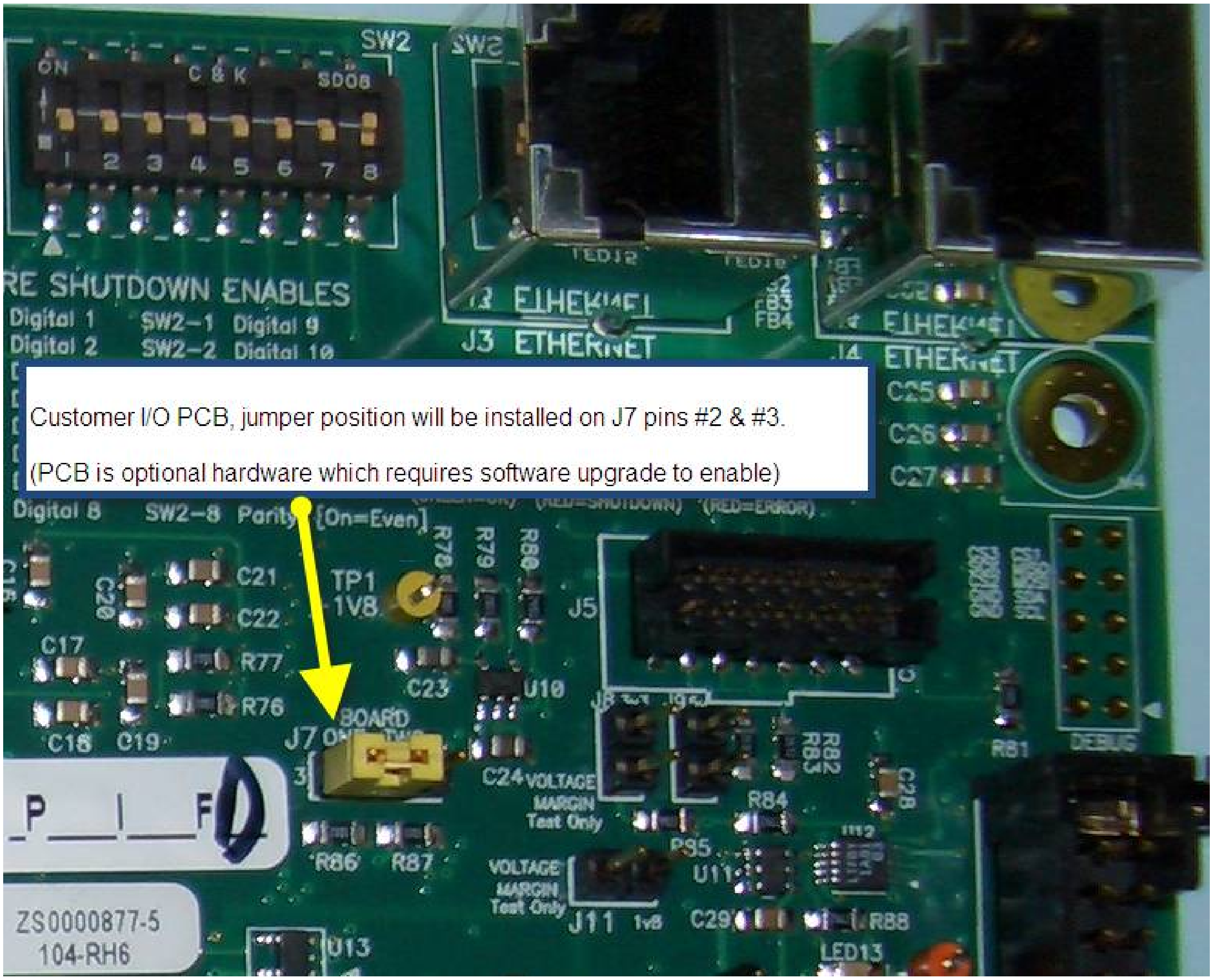


Figure 2-19: GASGUARD® AP11 Customer board "J7" jumper configuration.

USB Connection Port

The 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 2-20) 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 2-21

Figure 2-20: USB Port Warning Label

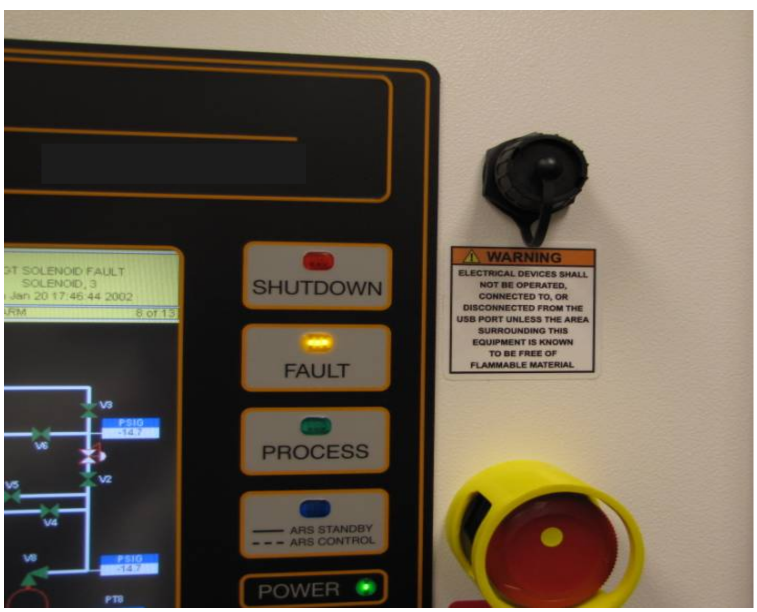


Figure 2-21: AP11 Controller USB Port on the Face of the Controller

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%

Pneumatic Connections

The 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 not use clean dry air for pneumatic supply unless there is a high degree of confidence that it will maintain purity as per ISO 8573-1 Class 2.** Moisture in clean dry air will promote corrosion of electrical components and reduce controller performance and reliability.

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 2-22. 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 BSGS eV / BULKGUARD eV 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 7 lpm/15 CFH for 30 minutes before applying power to the controller, each time any of the three electrical enclosure doors are opened. Do not exceed 7 lpm (15 CFH) during purge of the BSGS eV / BULKGUARD eV.

Z-Purge Procedure

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

1. Close the controller front and tighten both latches completely.
2. Open the needle valve 4 to 5 turns (counter-clockwise). Allow the controller to purge for 30 minutes.
3. Adjust needle valve to satisfy the “Z-Purge” alarm (approximately 2 total turns open).

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

Figure 2-22. Rear View of GASGUARD® AP11 Controller

Source Container Pneumatic Connections

Depending on the BSGS eV / BULKGUARD eV module configuration, the AP11 controller may be configured to supply a single pneumatic signal to the source A1/A2 and B1/B2 container valve, or multiple pneumatic signals to source A container valves and perform tube switching.

If the 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 A of this manual.

GASGUARD® Networking

General Description

Remote monitoring of GASGUARD® systems such as the BSGS eV / BULKGUARD® eV 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. Figure 2-23 shows the location of the Ethernet connection on the AP11 carrier board.

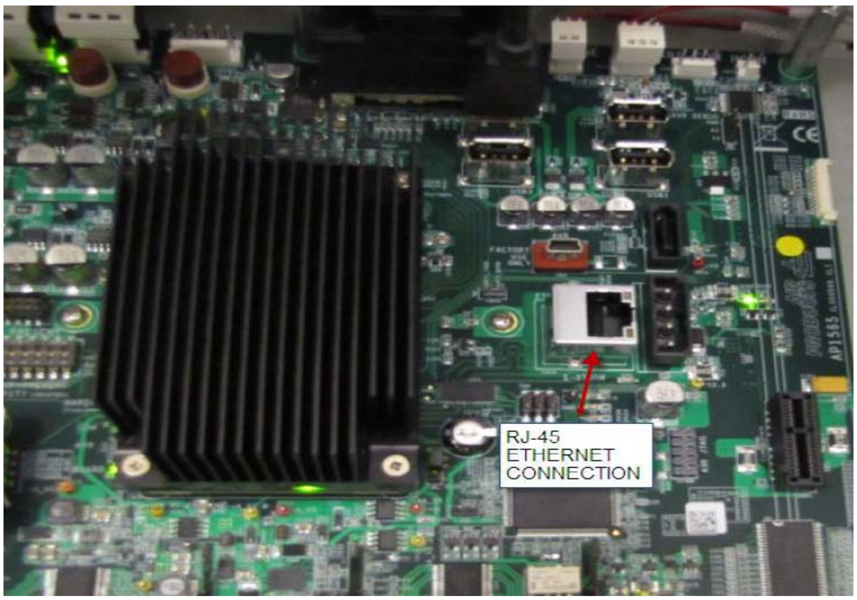


Figure 2-23: AP11 carrier board Ethernet connection

GCS Ethernet Network Wiring Configuration

A GCS is typically integrated into the site's Ethernet network. Figure 2-24 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.

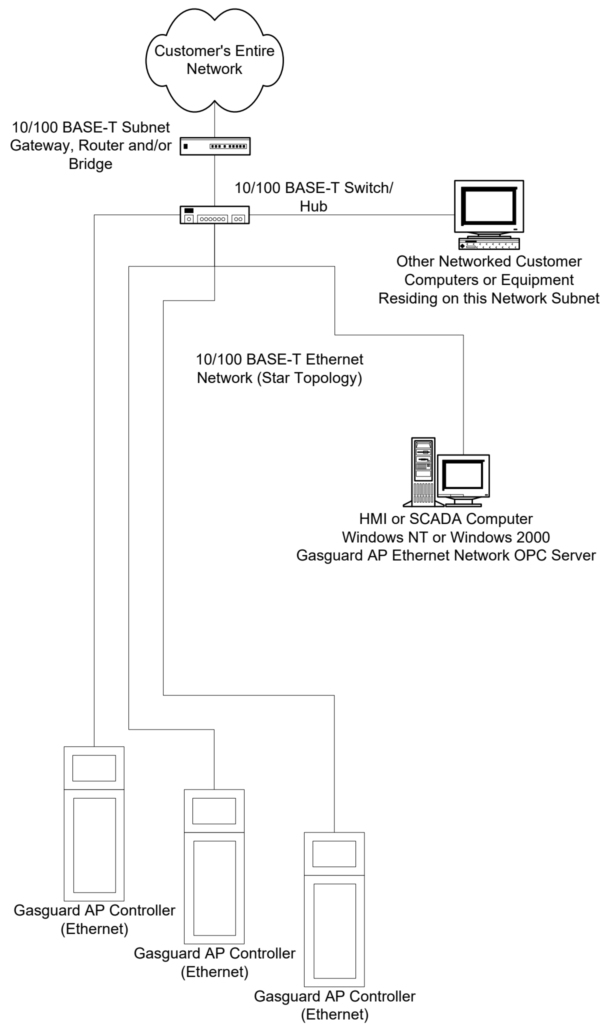


Figure 2-24 Typical GCS Network Architecture

Installation and Pre-Facilitation Checklist

A GASGUARD® BSGS eV / BULKGUARD® eV 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 D of this manual.

Startup and Commissioning Checklist

A GASGUARD® BSGS eV / BULKGUARD® eV 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 E of this manual.

Operational Readiness Inspection

Before a BSGS eV / BULKGUARD eV 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 F of this manual.

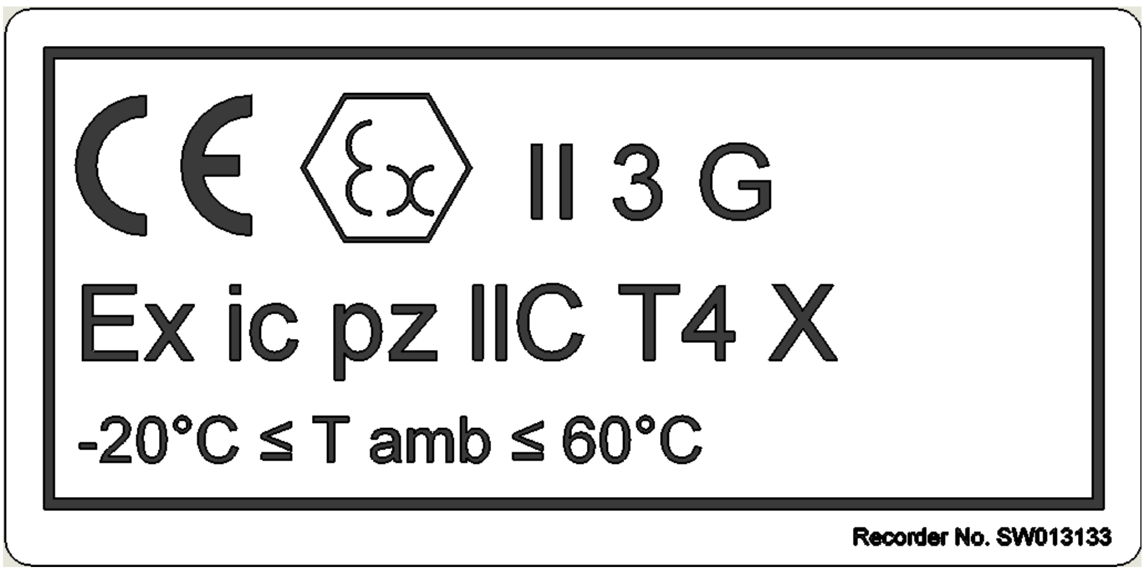
OSHA Process Safety Management (PSM)

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.

6.0 **Explosive Atmosphere (ATEX) Installations**

BSGS eV / BULKGUARD eV controllers that have the label shown in Figure 2-25 has been certified to comply with European Union ATEX Directive 2014/34/EU of the European Parliament and Council when properly installed in accordance with the guidelines and instructions referenced in this section.

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



6.1 Label Markings

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

- The CE Symbol which reflects conformity with the European Directives
- The Hexagonal “Ex” Symbol for Explosive Atmosphere
- The equipment group symbol for the electrical apparatus which is II. All industry gases are classified as Group II gases.
- The equipment category number 3. The equipment category number 3 means the equipment is suitable for an environment where an explosive atmosphere is unlikely to occur, occurs infrequently, or occurs for only a short period of time.
- The atmosphere symbol “G”. “G” means that product is safe in an explosive GAS atmosphere.
- Symbol “Ex”. This symbol stands for the equipment has been tested under the latest European Harmonized Standard for use in Explosive Atmospheres.
- Symbol “ic” for intrinsic safety.
- Symbol “pz” for pressurization. Pressurization prevents the ingress of an explosive atmosphere to a space that may contain a source of ignition. This is used for the controller.
- Symbol “IIC’ for the apparatus gas group.
- The symbol indicating the maximum surface temperature, T4. T4 indicates that the maximum surface temperature does not exceed 135°C.
- The symbol “X” for special conditions of installation and relevant use for safety. The normal ambient temperature range in the ATEX standard is considered to be -20°C to 60°C. Since the temperature range for the AP11 varies from the normal range, an X is included on the label markings.
- The ambient temperature range, Ta.

6.2 Special Conditions for Safe Use (X)

- **Environmental Limits**
  - BSGS eV / BULKGUARD eV controllers are intended for indoor installation. They have been evaluated for installation in locations providing adequate protection against the entry of water.
  - AP11 controllers are intended for use in ambient temperatures in the range of -20°C to +60°C and should not be used outside this range.
  - DO NOT rub the surface of the touch screen with a dry cloth. Electrostatic charge generated by the friction may result. When cleaning the face with a damp cloth, take the measures of an electrostatic discharge such as earth band, ionic shower, etc.
- **Installation Conditions**
  - When installing the equipment, appropriate precautions must be taken to ensure that the equipment has been connected to earth. Refer to Section 5 of this manual for more information.
  - Installation of this equipment shall be carried out in accordance with the installation standards for potentially explosive atmospheres. Installation, startup and maintenance must be carried out only by personnel trained in explosion protection.
- **Power Supply**
  - Input power supply specs must not exceed the maximum values as listed in Section 5 of this manual.
- **Maintenance**
  - Before opening the controller enclosure ensure that there is no danger of explosion in the atmosphere and wait at least 10 minutes after the power has been removed.
  - Before turning the power supply ON, be sure to close the enclosure cover tightly and securely fasten the latch. Ensure that z purge is operating and functional for at least 30 minutes prior to turning the power on.
  - Only qualified Versum Materials personnel should service the controller. Substitution of components (other than those recommended by Versum Materials) may impair its suitability for use in hazardous locations.

Chapter 3

Module Specifications

System Specifications

Range of Environmental Conditions

- -20 to 60° C Operating Temperature Range
- 95% Maximum Relative Humidity
- 2000 Meters Above Sea Level, Maximum

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 module are as follows:

- High pressure process piping, from PT-1 to PCV-1, purge inlet CV-9/CV4 to V-13, and V-13 to MV29.
  - 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): 1300 psig MAWP.
  - Process gases: Ammonia (NH_3): 250 psig MAWP.
  - Other gases: contact your Versum Materials, Inc. representative
- Low pressure process piping from PCV-1 to MV-38.
  - Process gases: All: 250 psig MAWP.

Filtration

High pressure filter (F-1A/B):	5.0 micron
Outlet filter (F-2A/B):	0.003 micron – option (recommended)

Physical Characteristics

Module Weight (estimated):	600 lbs. (270 kg)
Footprint:	2'-10" wide x 3'-2" deep* x 7'-4 1/4" tall
	(864 mm x 966 mm x 2242 mm)
	AP11 controller door fully open
Clearance:	Front: 48 in (1220 mm)
	Back: distance to install the source container
	Sides: 18 in (457 mm)
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 BSGS eV / Bulkguard eV 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/C/D (opt):	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® BSGS eV / BULKGUARD® eV 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 BSGS eV / Bulkguard eV module can be ordered with different options that may impact the flow capacity of the system. Please contact your Versum Materials, Inc. representative for information regarding your specific system.

Venting Criteria

During a container change, it can be expected that the following volumes of gas will be vented from a BSGS eV / Bulkguard eV 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

- 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.

- 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.

- 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

Electrical Requirements

- ± 10% Fluctuation of Nominal Voltage Range
- Short Circuit Current Rating (SCCR) is 10 kA for controller power feed, 5 kA for single power feed or heater power feed

Single Power Feed for Module – with JT Heater:

- 208 – 240 VAC - 50/60 HZ
- Full load current - 32 amps
- 5 kAIC @ 240 VAC, 75 deg. C terminal rating

Single Power Feed for Module – with Heat Trace, no JT Heater:

- 208 – 240 VAC - 50/60 HZ
- Full load current - 7 amps
- 5 kAIC @ 240 VAC, 75 deg. C terminal rating

Single Power Feed for Module – AP11 only, no Heaters:

- 100 – 240 VAC - 50/60 HZ
- Full load current - 4 amps
- 10 kAIC @ 240 VAC, 75 deg. C terminal rating

Dual Power Feed – Critical Power to AP11 Controller, Normal Power to JT Heater/Heat Trace

AP11 Controller:
- 100-240 VAC - 50/60 HZ
- Full load current - 4 A
- 10 KAIC @ 240 VAC, 75 deg. C terminal rating

JT Heater (with or without Heat Trace):
- 208-240 VAC - 50/60 HZ
- Full load current - 32 A
- 5 kAIC @ 240 VAC, 75 deg. C terminal rating

Heat Trace only (no JT Heater):
- 208-240 VAC - Single phase, 50/60 HZ
- Full load current - 7 A
- 5 kAIC @ 240 VAC, 75 deg. C terminal rating

Customer Digital Outputs:

Relay 1, DO9 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.

Relay 2, DO10 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.

Relay 3, DO11 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.

Relay 4, DO12 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 A1 – If no source A2 installed, this will close valves V-1 and V-8 for source A1, and open the valves for sources B1/B2, if they are in standby mode. If the system also has source A2 installed and online, this will close valves V-1 and V-8 on source A1 and the system continue to run on source A2.

DI-26 Remote Shutdown Source A2 - This will close valves V-1 and V-8 on source A2 and the system will continue to run on source A1.

DI-37 Remote Shutdown Source B1 – If no source B2 installed, this will close valves V-1 and V-8 for source B1, and open the valves for sources A1/A2, if they are in standby mode. If the system also has source B2 installed and online, this will close valves V-1 and V-8 on source B1 and the system continue to run on source B2.

DI-28 Remote Shutdown Source B2 - This will close valves V-1 and V-8 on source B2 and the system will continue to run on source B1.

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.

NOTE - Additional digital inputs and outputs beyond the ones described here may be installed in your system. Please contact your Versum Materials, Inc. representative with questions.

Optional Components than can be part of a BSGS eV / Bulkguard eV system

Purge/HPLT Module

Deep Source Purge and Venturi Panels

Generation 2 Y-Cylinder Heater

Compact Y Cylinder Heater

NH3 ISO Container Heater

Scales

On-Board Purifier

Chapter 4

N/A - Intentionally Left Blank

The contents of this chapter do not apply to the system referenced within this manual. For this reason, this chapter has been left intentionally blank.

Chapter 5

N/A - Intentionally Left Blank

The contents of this chapter do not apply to the system referenced within this manual. For this reason, this chapter has been left intentionally blank.

Chapter 6

N/A - Intentionally Left Blank

The contents of this chapter do not apply to the system referenced within this manual. For this reason, this chapter has been left intentionally blank.

Chapter 7

System Description

⚠ WARNING

This equipment is not intended for use by the general public. Only personnel trained in GASGUARD® BSGS eV / BULKGUARD® eV 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 BSGS eV / BULKGUARD eV module, and optional equipment. Up to four source containers can be connected to each module. Other options may be present in a complete bulk installation. These could be a purge module, purifier, 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 module configurations, hardware, and its interface with optional equipment.

BSGS eV / BULKGUARD eV Module

Module Configurations

The GASGUARD® BSGS eV / BULKGUARD® eV is configurable by four option sets:

- Number/type of sources (single, dual, triple, or quad sources in various container types/sizes)
- Purge type (cross purge, deep purge, deep purge with Venturi)
- Process inlets (single or dual, flex hose or hard pipe)
- Number of process trains (single or dual)

The following provides more details about each option set:

Sources:

Single Source (SS) – One process gas container such as a Y, drum, multiple cylinder pack, or ISO trailer connected to a single process inlet. Example: ISO x none

Dual Source (DS) - Two process gas containers such as a Y, drum, multiple cylinder pack, or ISO trailers connected to either a single process inlet (example: 2Y x none) or a dual process inlet (example: Y x Y). Two ISO modules may **not** be installed onto the same process inlet. However, this product line will support one ISO per process inlet with tube switching for an ISO x ISO configuration.

Triple Source (TS) – Three process gas container such as a Y, drum, multiple cylinder pack, or ISO trailer connected to a single module with two sources on one process inlet and a single source on the other inlet. Example: 2Y x ISO

Quad Source (QS) - Four process gas containers such as a Y, drum, or multiple cylinder pack connected two sources per process inlet. Example: 2Y x 2Y

Purge Configurations:

Cross Purge – All purge/vent components (V4, V5, V13) and source pressure monitoring (PT1) are located within the main BSGS eV / BULKGUARD eV cabinet. These systems also have an MV2 on each process inlet to allow for dual isolation of the pigtail from the piping cabinet.

Deep Purge – A separate source deep purge panel is located on the inlet piping outside of the main BSGS eV / BULKGUARD eV cabinet. This panel contains V1, MV1, V13, and PT1. V4/V5 are still located within the main BSGS eV / BULKGUARD eV cabinet, but MV2 no longer exists. Dual isolation of the pigtail from the piping cabinet is performed by MV1 and V1 on the source deep purge panel. Each deep purge panel is dedicated to a single source, so up to two of these panels might be installed on each process side of the system. If equipped with ventilation, the source deep purge panel will be located coaxially within the ventilation duct.

Deep Purge with Dedicated Venturi – This option requires the installation of the source deep purge panel option described above. This additional panel adds vacuum Venturi capability to the deep source purge panel. V4 and V5 are now located on the Venturi panel rather than inside the main BSGS eV / BULKGUARD eV cabinet. There is an additional V7 for the dedicated Venturi and an optional V113TP trickle purge vent valve. One Venturi panel can be attached to up to two deep source purge panels. Additionally, the V13 located on the source deep purge panel now becomes an MV69. If equipped with ventilation, the Venturi shroud will be located coaxially within the ventilation duct.

Please see Appendix A for drawings providing additional details about these different options.

Process Inlets:

Single Inlet – One process inlet only (A side – populated V2 through MV38). This configuration is not available with dual process train option.

Dual Inlet – Two process inlets (A side and B side – populated V2 up to JT Heater)

Flex Hose – Connection from source container to either the main BSGS eV / BULKGUARD eV cabinet (cross purge) OR from the source container to the source deep purge panel (deep purge with or without Venturi) is ½” flexible piping.

- In the case of a dual source process inlet for a cross purge system, the connection from the main BSGS eV / BULKGUARD eV cabinet to the T when the A1/A2 or B1/B2 sources combine is field-installed ½” 316L SS or C22 piping (customer scope). The flex hoses would be field-welded between to T and the source container connection.

- In the case of a deep purge system without Venturi, the connections between the main BSGS eV / BULKGUARD eV cabinet and the source deep purge shroud(s) must be field-installed ½” 316L SS or C22 piping (customer scope).
- In the case of a deep purge system with Venturi, the connections between the main BSGS eV / BULKGUARD eV cabinet and the Venturi shroud AS WELL AS the connection between the Venturi shroud and the source deep purge shroud(s) must be field-installed ½” 316L SS or C22 piping (customer scope).

Hard Pipe – Connections between source containers, source deep purge shrouds, and the main BSGS eV / BULKGUARD eV cabinet are all field-installed ½” 316L SS or C22 piping (customer scope).

Process Trains:

Single Process Train – Inlets from Side A and Side B are combined into a single flow path prior to the JT Heater (which also has a single flow path). Path continues from JT Heater through MV38. This option is mandatory with a single process inlet.

Dual Process Train – Inlets from Side A and Side B have separate, parallel flow paths until after V3. The JT Heater has a dual flow path.

Electrical Devices, Customer Digital Inputs, and Digital Outputs

The following is a list of electrical devices that may be present in the BSGS eV / BULKGUARD eV, 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 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.

The naming convention for these components is *name-#xyz*.

- Name is component type (PT for pressure transducer, MV for manual valve, etc.)
- # is the numerical assignment of the component within the system (PT-1, MV-8, etc.)
- X is the process inlet or process train upon which the component is located (PT-1A is pressure transducer #1 located on the A process inlet, MV-8B is manual valve #8 located on the B process inlet, etc.)
- Y is source container on the process inlet that the component is located (PT-1A1 is located on source A1, V8-B2 is located on source B2, etc.)
- Z is the tube number on an ISO/TT (V-8A-5 is tube #5 on the ISO located on source A)

Please see the installation drawings located in Appendix A for additional information.

PT-1xy Standard for source A1, Optional for Source A2, B1, B2. It monitors pressure at the source container. There could be up to four PT-1s in a module if configured for four source containers. PT-1 performs multiple functions. They are:

PT-1xy 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 module from coming on-line, until the alarm is cleared.

PT-1xy 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 process inlet – PT-1 on the active side will be used to initiate a shutdown.
- Dual source, single process inlet – PT-1 on the active side will be used to initiate a shutdown and crossover to the opposite process side, if 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 process inlet – PT-1 on the active module will be used to initiate a shutdown and crossover to the opposite process line, if available and in standby mode. If associated with the standby side, this alarm will inhibit the standby module from coming on line until it is cleared.
- Dual source, dual process inlet – PT-1xy will close V-1xy (deep purge) or V-2x (cross purge) on the source that empties first, but the second source will continue to flow gas until its PT-1xy signals an empty container. Following the second PT-1 shutdown signal, the controller will initiate a side shutdown and crossover to the opposite process side, if it is in standby mode. If associated with the standby module, this alarm will inhibit the standby side from coming on line until it is cleared.

NOTE: IF BACKUP SIDE IS NOT AVAILABLE: This alarm will cause an interruption of process gas flow to the customer.

PT-1xy 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 runaway source heater controller. It is enabled in both on-line and standby modes.

PT-1xy Low vacuum – This is 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 module to the customer's scrubber, a closed valve or insufficient N2 pressure to drive the vacuum Venturi.

PT-1xy High purge pressure – This is 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-1xy 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-1xy 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-1xy 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-1xy Pigtail trickle vent threshold – Active with V-113TP option, typically installed on SiH_4 systems. Inhibits 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-2x is **Standard – one per process train**. PT2A/B monitors houseline delivery pressure upstream of V-3, and performs multiple functions. They are:

PT-2x 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-2x 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 process train, if it is available and in standby mode. If the opposite process train is not available or has not been installed, this would cause and interruption of process gas flow to the customer.

PT-2x 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-2x 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 process train, if one is available and in standby mode. If the opposite process train is not available or has not been installed, this would cause and interruption of process gas flow to the customer.

PT-4x is **Standard – one per process inlet**. PT4A/B provides the operator with visual indication of purge gas inlet pressure, and is used by the AP11 controller to vent HPLT gas from the purge gas inlet header in preparation for the purge sequence that follows.

PT-5x is **Standard – one per panel Venturi**. PT5A/B monitors vent line vacuum and pressure, and performs multiple functions. They are:

PT-5x 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 module to the customer's scrubber.

PT-5x 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 is Optional - It monitors houseline delivery pressure downstream of the V-3's and is installed for increased reliability in the event V-3 should fail or the optional F-2 filter should clog. 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 module will be used to initiate a shutdown and interrupt the supply of process gas to the customer.

PT-10x is Optional – one per process train. PT-10A/B 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-10x 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.

PT-10x 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. 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-36x is Optional – one per process outlet - PISL-36A/B is the coax monitoring pressure switch, located on the 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-1xy is **Optional – one per source container -** WT-1A1/A2/B1/B2 displays source container weight, and has multiple functions. They are:

WT-1xy 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-1xy WALL - Low-low weight shutdown alarm. This shutdown alarm indicates an empty source container. Shutdown and crossover to the opposite source train if available. If the opposite source train is not available or has not been installed, this will cause a shutdown and interruption of process gas flow to the customer.

WT-1xy WALLL - Low-low-low weight shutdown alarm. This shutdown alarm applies to Versum Materials, Inc. ammonia (NH3) ISO containers only. If the PT-1 WALL shutdown setpoint is reached, the controller checks the status of the opposite source train 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 train isn't available, process gas flow to the customer's houseline will be interrupted.

WT-1xy 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-1xy 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 the opposite process train is available and in standby mode, and will inhibit source heater operation. If the opposite source train isn't available, process gas flow to the customer's houseline will be interrupted.

EFS-2x is **Optional** It is the excess flow switch (EFS). The EFS will be located upstream of F-2x if so equipped. The EFS is a device that is used to provide protection against a high flow condition within the system. This is considered to be a redundant safety feature to the pressure-related alarms associated with PT-2x and PT-9x.

TE-5 is Optional - J-T heater discrete hardwire shutdown (included with J-T Heater 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.

AI49 is **Optional –** This is the analog input dedicated to the JT heater temperature monitoring and control thermocouple. Included with JT Heater option. Its purpose is to regulate J-T heater block temperature, and transmit heater block temperature to the AP11 eV controller. The AP11 will alarm if heater temperature extends outside predetermined operating limits.

TALL-49 - JT heater H-1 low low temperature alarm. Its purpose is to provide the operator with additional warning of a power reduction or power loss to the heater. Causes include failed heater element, tripped GFCB, failed contactor, or failed SSR. A momentary low temperature alarm may also be caused by a drastic increase in flow rate and is considered normal. The AP11 eV controller is a reactionary device, limited in response characteristics, and cannot anticipate the additional demand on the JT heater. The heater can continue to operate temporarily in this state, 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 issues with the process gas.

TAL 49 - JT 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 contactor, or failed SSR. A momentary low temperature alarm may also be caused by a drastic increase in flow rate and is considered normal. The AP11 eV controller is a reactionary device, limited in response characteristics, and cannot anticipate the additional demand on the JT heater.

TAH 49 - JT 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 setpoint temperature, 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 AP11 eV controller is a reactionary device, limited in response characteristics, and cannot anticipate the lack of demand on the JT heater.

TAHH 49 - JT heater H-1 high high temperature fault alarm. Its purpose is to provide additional warning to the operator that the heater is operating above its intended setpoint. The AP11 eV controller will attempt to bring the heater back into the normal operating range. The heater can continue to operate temporarily in this state, 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.

AI-50 is **Optional –** This is the analog input assigned to the Source A inlet heat trace temperature monitoring and control thermocouple. 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-50 – Source A heat trace low-low temperature alarm. This setpoint is lower than TAL-50 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 SSR, or incorrect temperature controller setpoint.

TAL-50 – Source A 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 SSR, or incorrect temperature controller setpoint.

TAH-50 – Source A heat trace high temperature alarm. Its purpose is to detect an increase in power to the heat trace. Causes include a failed SSR, or incorrect temperature controller setpoint.

TAHH-50 – Source A heat trace high-high temperature alarm. This setpoint is higher than TAH-50 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 SSR, or incorrect temperature controller setpoint.

AI-51 is **Optional** – This is the analog input assigned to the Source B inlet heat trace temperature monitoring and control thermocouple. 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-51 -Source B heat trace low-low temperature alarm. This setpoint is lower than TAL-51 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 SSR, or incorrect temperature controller setpoint.

TAL-51 – Source B 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 SSR, or incorrect temperature controller setpoint.

TAH-51 – Source B heat trace high temperature alarm. Its purpose is to detect an increase in power to the heat trace. Causes include a failed SSR, or incorrect temperature controller setpoint.

TAHH-51 – Source B heat trace high-high temperature alarm. This setpoint is higher than TAH-51 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 SSR, or incorrect temperature controller setpoint.

AI-52 is **Optional** – This is the analog input assigned to the panel heat trace temperature monitoring and control thermocouple. 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-52 - Panel heat trace low-low temperature alarm. This setpoint is lower than TAL-52 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 SSR, or incorrect temperature controller setpoint.

TAL-52 - Panel 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 SSR, or incorrect temperature controller setpoint.

TAH-52 - Panel heat trace high temperature alarm. Its purpose is to detect an increase in power to the heat trace. Causes include a failed SSR, or incorrect temperature controller setpoint.

TAHH-52 - Panel heat trace high-high temperature alarm. This setpoint is higher than TAH-52 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 SSR, or incorrect temperature controller setpoint.

AI-55 is **Optional** – This is the analog input assigned to the heat trace temperature setpoints for all three heat trace zones (A, B, Panel). There are no alarms associated with this input. It is accessible through the User Setpoints menu option of the Configuration Menu as “SET PNL HT”.

AI-56 is **Optional** – This is the analog input assigned to the JT Heater temperature setpoints. There are no alarms associated with this input. It is accessible through the User Setpoints menu option of the Configuration Menu as “SET JT HEATER”.

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 module, 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 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-7Ax is **Standard** It is the Customer Remote Shutdown Source A1 or A2 – 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-7Bx is **Standard** It is the Customer Remote Shutdown Source B1 or B2 – 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-8Ax is **Optional -** It is Source A1 or A2 Heater Fault Alarm. This alarm is retransmitted from source heater A to the module. Its purpose is to alert the customer through the module that an alarm has occurred and must be investigated. This contact is powered to 24 VDC, 3mA.

UA-8Bx is **Optional** - It is Source B1 or B2 Heater Fault Alarm. This alarm is retransmitted from source heater A to the module. Its purpose is to alert the customer through the 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 module 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. This would cause and interruption of process gas flow to the customer.

RSHH-15 is Optional It is the UVIR Detector viewing Source A1. 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.

RSHH-15 UVIR flame detect**.** If a flame is detected for more than 5 seconds at source A1, 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. This would cause and interruption of process gas flow to the customer.

RSHH-16 is Optional It is the UVIR Detector viewing Source B1. 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.

RSHH-16 UVIR flame detect. If a flame is detected for more than 5 seconds at source B1, 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. This would cause and interruption of process gas flow to the customer.

RSHH-17 is Optional It is the UVIR Detector viewing the 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 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.

RSHH-17 UVIR flame detect. If a flame is detected for more than 5 seconds at the 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. This would cause and interruption of process gas flow to the customer.

RSHH-18 is Optional It is the UVIR Detector viewing Source A2. 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-18 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.

RSHH-18 UVIR flame detect**.** If a flame is detected for more than 5 seconds at source A2, 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. This would cause and interruption of process gas flow to the customer.

RSHH-19 is Optional It is the UVIR Detector viewing Source B2. 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-19 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.

RSHH-19 UVIR flame detect**.** If a flame is detected for more than 5 seconds at source B2, 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. This would cause and interruption of process gas flow to the customer.

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

AI-23 is Optional It is assigned to the optional analog exhaust monitor inside the module. The exhaust flow sensor monitors pressure differential through the cabinet.

FAL-23 – Low Exhaust is a fault alarm with a factory setpoint at 0.016 in H2O differential pressure. It has a 10 second alarm delay to prevent nuisance alarms due to a temporary drop in exhaust.

FALL-23 – Low Low Exhaust is a fault alarm with a factory setpoint at 0.010 in H2O differential pressure. It has a 10 second alarm delay to prevent nuisance alarms due to a temporary drop in exhaust.

AI-32 is **Standard** A pressure transducer inside the AP11 controller monitors pneumatic pressure to the solenoid valves that send a pneumatic signal to pneumatic valves located throughout the module. There are four alarms associated with pneumatic pressure. Two low alarms and two high alarms. In order to maintain product reliability, all are fault alarms. The specified pneumatic pressure is 85-95psig. Outside of this range solenoids may not operate properly.

PSLL-U14 – Pneumatic Pressure Low-Low Alarm. Pneumatic pressure has fallen below 65psig.

PSL-U14 - Pneumatic Pressure Low Alarm. Pneumatic pressure has fallen below 85psig.

PSH-U14 - Pneumatic Pressure High Alarm. Pneumatic pressure has risen above 102psig.

PSH-U14 - Pneumatic Pressure High-High Alarm. Pneumatic pressure has risen above 110psig.

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. It is strongly advised to <u>not use clean dry air</u> for pneumatic supply unless there is a high degree of confidence that it will maintain purity as per ISO 8573-1 Class 2.

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 24 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 24 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 24 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 24 VDC, 1 Amp, and can be wired normally closed or normally open.

Mechanical Components

MV-8xy is **Optional -** It is the container manual isolation valve for single actuation containers (Y cylinder, drum, tonner, NH3 ISO, etc.) and can be located at source A1, A2, B1, or B2. This option provides the operator with prompts in the correct sequence to open and close the manual valve. See the installation drawings in the appendix of this manual for more details.

V-8xy is **Optional -** It is the container pneumatic isolation valve for single actuation containers (Y cylinder, drum, tonner, NH3 ISO, etc.) and can be located at source A1, A2, B1, or B2. This option provides software and hardware to drive a container pneumatic valve. This valve assignment can also be for the pneumatic manifold isolation valve on ISO/TT. 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.

V8-1xy is **Optional -** It is the container manifold pneumatic isolation valve for dual actuation containers (multiple cylinder packs, ISO/TT without tube switching) and can be located at source A1, A2, B1, or B2. 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.

MV8-1xy is **Optional -** It is the container manifold manual isolation valve for dual actuation containers (multiple cylinder packs, ISO/TT without tube switching) and can be located at source A1, A2, B1, or B2. The operator is prompted in the correct sequence to open and close this valve. See the installation drawings in the appendix of this manual for more details.

V8-2xy is **Optional -** It is the container isolation valves for the cylinders or tubes located in dual actuation containers (multiple cylinder packs, ISO/TT without tube switching). This valve can be located at source A1, A2, B1, or B2. 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.

MV8-2xy is **Optional -** It is the container isolation valves for the cylinders or tubes located in dual actuation containers (multiple cylinder packs, ISO/TT without tube switching). This valve can be located at source A1, A2, B1, or B2. The operator is prompted in the correct sequence to open and close this valve. See the installation drawings in the appendix of this manual for more details.

MV-0x is **Optional -** It is the manual ISO/TT manifold isolation valve and can be located on either process inlet as MV-0A or MV-0B. This option provides software with the correct prompts for this 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.

V8x-z is **Optional** – It is a pneumatic tube valve for ISO/TT used for automated tube switching. Each tube has its own valve which is actuated by a pneumatic line that is routed from AP11 controller. For BSGS eV / BULKGUARD eV, two of these V8x-z valves are tied together into a single solenoid in the AP11 controller, allowing for 2x operation of the automatic tube switching. Single-tube switching is not an option for this product line. 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.

RFO-1xy is **Optional -** It is the pigtail restrictive flow orifice, source A1, A2, B1, or B2. 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-1xy is **Optional -** It is the process dual isolation manual valve for systems with the deep purge option. This valve is located on the source deep purge panel, and is the first valve process gas reaches when so equipped. Its purpose is to isolate process gas in the piping downstream from the operator during source container change outs. The AP11 controller prompts the operator to open and close this valve at the appropriate time to leave a vacuum between MV-1xy and V-1xy during the purge and cylinder change modes.

V-1xy is **Optional -** It is the process isolation pneumatic valve for systems with the deep purge option. This valve is located on the source deep purge panel, immediately downstream of MV-1xy. Its primary purpose is to isolate process gas in the piping downstream from the operator during a source container change out. The AP11 controller actuates this valve at the appropriate time - during a shutdown or when the container is placed on line.

MV-22x is **Optional** It is the weld gas manual isolation valve. This valve is located within the module when so equipped. Its purpose is to isolate the weld gas inlet.

MV-2x is **Optional** It is the process isolation manual valve for systems in the cross purge configuration. This valve is located within the module, and is the first valve process gas reaches when so equipped. Its purpose is to isolate process gas in the piping downstream from the operator during source container change outs. The AP11 controller prompts the operator to open and close this valve at the appropriate time to leave a vacuum between MV-2x and V-2x during the purge and cylinder change modes.

V-2x is **Standard -** It is the process isolation pneumatic valve for located within the module, immediately downstream of MV-2xy, if so equipped. Its primary purpose is to isolate process gas in the piping downstream from the operator during a source container change out. The AP11 controller actuates this valve at the appropriate time - during a shutdown or when the container is placed on line.

F-1x 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 and can contain either a SS or a Ni filter element.

H-1 is **Optional -** It is the J-T heater, located 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. See the AI49 entry for explanation of alarms.

PCV-1x is **Standard -** It is the first stage regulator. The first stage regulator configuration is supplied based on source container pressure and flow rate. Depending on the configuration, PCV-1 adjustments may or may not be made in the field. On a dual-stage regulator system (PCV-1 and 2), PCV-1 will typically be preset to 250 psig delivery at 800 psig source pressure and is non-adjustable. If PCV-1 is in a system with single-stage regulation (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. Product Engineer.

PCV-2x 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 regulator.

RFO-2x 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. This option can be configured to customize the flow-dependent pressure drop that is used to provide excess flow

F-2x 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 can be equipped with either a SS or Ni filter element.

V-3x is **Standard -** It is the houseline pneumatic process isolation valve. This valve is located within the module, downstream of F-2 if so equipped. 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 module components upstream for maintenance. The AP11 controller actuates this valve at the appropriate time - during a shutdown or when the module is placed on line.

MV-9x is **Optional -** It is the houseline manual process dual isolation valve. This valve is located within the module, downstream of V-3. Its primary purpose is to isolate process gas in the houseline from module components upstream for maintenance.

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, C, or D have 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 outlets.

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 B has been purchased. Dual isolation can avoid a planned module shutdown when making a tie-in to process out B after the module has been started up.

MV-38C-1 is **Optional -** It is the process outlet C manual isolation valve. This valve is only supplied when the process out C 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 outlets.

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

MV-38D-1 is **Optional -** It is the process outlet D manual isolation valve. This valve is only supplied when the process out D 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 outlets.

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

V-13xy is **Standard -** It is the purge/vent isolation valve, source A1, A2, B1, or B2. This valve is located either within the main cabinet (cross purge) or out on the source deep purge panel (deep purge option). 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-69xy is **Optional -** It is the manual purge/vent isolation valve, source A1, A2, B1, or B2 for systems equipped with the deep purge with Venturi option. This valve is out on the source deep purge panel. Its purpose is to isolate process gas from the purge and vent piping circuits. The operator is prompted by the software to open and close this valve as needed during purge, change cylinder, and conditioning sequences.

V-4x is **Standard -** It is the purge/HPLT isolation valve. This valve is located in a branch of the purge/vent piping circuit within the main cabinet for cross purge and non-Venturi deep purge configurations. It is located on the Venturi panel when the deep purge with Venturi option has been equipped. Its purpose is to isolate purge and high pressure leak check gas from the vent piping circuit. It is actuated by the AP11 controller during purge and change cylinder sequences.

CV-4 is **Standard -** It is the purge gas back pressure prevention valve. This valve is located upstream of V-11 in the purge 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-11 failure. A 0.0255” RFO is normally installed at the inlet to this component in order to limit purge gas flow.

V-5x is **Standard -** It is the vent isolation valve. This valve is located in a branch of the purge/vent piping circuit cabinet for cross purge and non-Venturi deep purge configurations. It is located on the Venturi panel when the deep purge with Venturi option has been equipped. Its purpose is to isolate the vent piping from purge and high pressure leak check gas. It is actuated by the AP11 controller during purge, change cylinder, and conditioning sequences.

V-6x 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. This valve can only be opened during manual modes and is intended for maintenance purposes only. Only an experienced operator should be allowed to open this valve.

MV-6x is **Optional -** It is the **l**ow pressure vent dual 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. This valve is intended for maintenance purposes only. Only an experienced operator should be allowed to open this valve.

CV-6x is **Standard -** It is the low pressure vent dual isolation check valve. This check valve is located in the low pressure process piping vent circuit, downstream of V-6x. Its purpose is to provide dual isolation between vent piping process gas.

CV-7, V-7TPx, Vacuum Venturi module is **Standard.** This module contains CV-7, V-7TPx, and a vacuum Venturi. It is located in the vent piping circuit immediately downstream of V-6x/CV-6x. In systems with the source deep purge with Venturi option, there are also these components located on the Venturi panel. 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.

CV-9 is **Optional -** It is the HPLT gas back pressure prevention valve. This valve is located upstream of V-10 in the HPLT leak check gas piping circuit. Its purpose is to prevent process gas from backing into the HPLT leak check gas piping circuit or containers in the event of a V-10 failure. A 0.0010" RFO is normally installed at the inlet to this component in order to limit HPLT gas flow.

V-10 is **Optional -** It is the HPLT inlet isolation valve and it is only present when the HPLT option is installed. This valve is located in a branch of the purge/vent piping circuit within the main cabinet. Its purpose is to isolate the high pressure leak check gas from the vent piping circuit. It is actuated by the AP11 controller during and change cylinder sequences. The flow of the HPLT gas is restricted by an 0.010" RFO.

V-11 is **Standard -** It is the purge inlet isolation valve. This valve is located in a branch of the purge/vent piping circuit within the main cabinet. When the Auto HPLT option is selected, its purpose is to isolate the low pressure purge gas from the vent piping circuit only. It is actuated by the AP11 controller during and purge and change cylinder sequences. Unless a V-44 trickle purge valve is installed, a 0.0255" RFO provides a flow restriction during source changes in order to preserve the purge gas supply.

V-44 is **Optional -** It is the HPLT/purge inlet trickle valve. This valve is located in a branch of the purge/vent piping circuit within the main cabinet downstream of V-10 and V-11. Its purpose is to restrict the flow of purge gas during container changes in order to preserve the purge gas supply. It is actuated by the AP11 controller during and change cylinder sequences

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 module.

MV-29 is **Standard -** It is the Venturi 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-29 and the vacuum Venturi. In systems equipped with a source deep purge Venturi, a V-113TPx may also be located on the Venturi panel. 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.

MV-36x is **Optional** It is the coax fill port for process out A/B. This valve is included with the process out coax monitoring option. It is located on a branch of the process out coaxial bulkhead, inside the 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-40x/MV-41x/MV-42x are **Optional** – These are the isolation valves (MV-40/MV-41) and the bypass valve (MV-42) that are installed if the process purifier option is selected. Only qualified personnel should operate these valves.

CF-xy is **Optional –** These are the cylinder flags. The cylinder flags themselves are installed at the customer site. They are activated by the software and are assigned to pneumatic actuators as per the installation drawing in the Pneumatic Assignments section of Appendix A.

Auto HPLT 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 module. One of the purge module outlets must be field piped to the module Purge N2/HPLT inlet leading to V-11. The AP11 controller prompts the operator to switch from purge gas supply to HPLT and back again at the appropriate time. When the Auto HPLT option is selected, the CV9/V10 inlet is added and software is enabled to automatically switch between low pressure purge and HPLT modes without the need for operator action.

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 modules. Analog retransmission of source container heater temperatures can be displayed on the AP11 controller screen.

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 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.

Heat Trace Option

Factory-installed heat trace controlled by the eV ECC is an option. Three zones of heating are offered – panel, source A and source B. A total of 125’ (38m) of 240VAC 12W/ft (40W/m) heat trace line can be supported with ~32’ (10m) of that amount typically being consumed by the panel heat trace. The temperatures of each heat trace zone is displayed on the AP11 controller. Heat trace downstream of the BSGS eV / BULKGUARD eV process outlet is customer scope.

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 module and a weight value will display on the AP11 controller screen.

3000 pound and 5000 pound scales are typically powered from the 24 VDC supply in the ECC. Truck scales draw additional current and the BSGS eV / BULKGUARD eV does not provide power, and only receives the two signal wires. See Chapter 2 for additional information on wiring analog inputs.

Container Tube Switching Option

Tube Switching provides an automated method of systematically actuating ISO container or Tube Trailer air-operated valves on either process inlet A or B or both sides simultaneously without manual intervention. Two ISO/TT tubes are controlled by a single AP11 solenoid, thus enabling 2x tube switching capability. Individual tube switching is not an option. 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.

Process Purifier Option

Low pressure process purifiers can be installed after the PCV-2 regulator outlet. Spools (MV40/MV41/MV42) have been designed to be compatible with Pall PG2400 series purifiers. See the supplier's installation guide for further information. Only qualified personnel should perform any maintenance involving process purifiers.

USB Barcode

Refer to Appendix H for further details on this option.

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

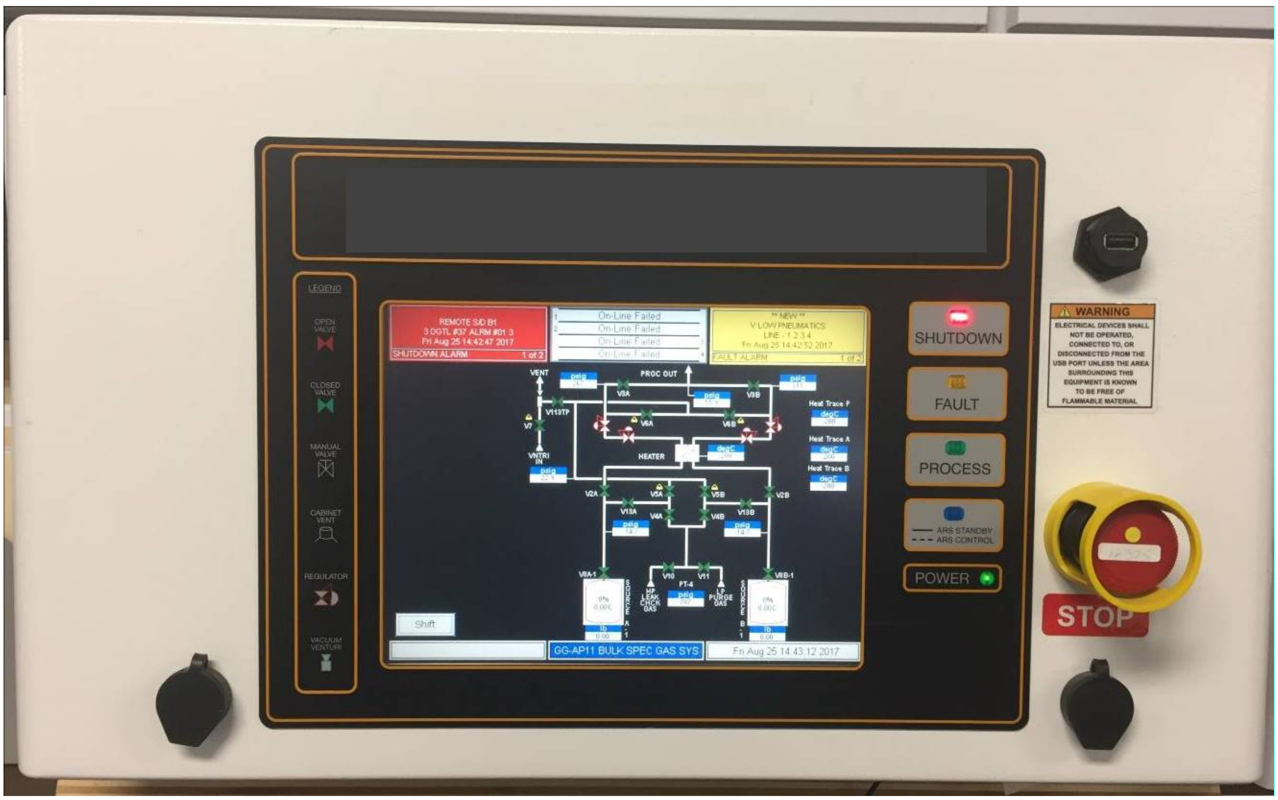


Figure 7-1. GASGUARD® AP11 Controller

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 dual source, dual-process line system (such as a Y x Y).

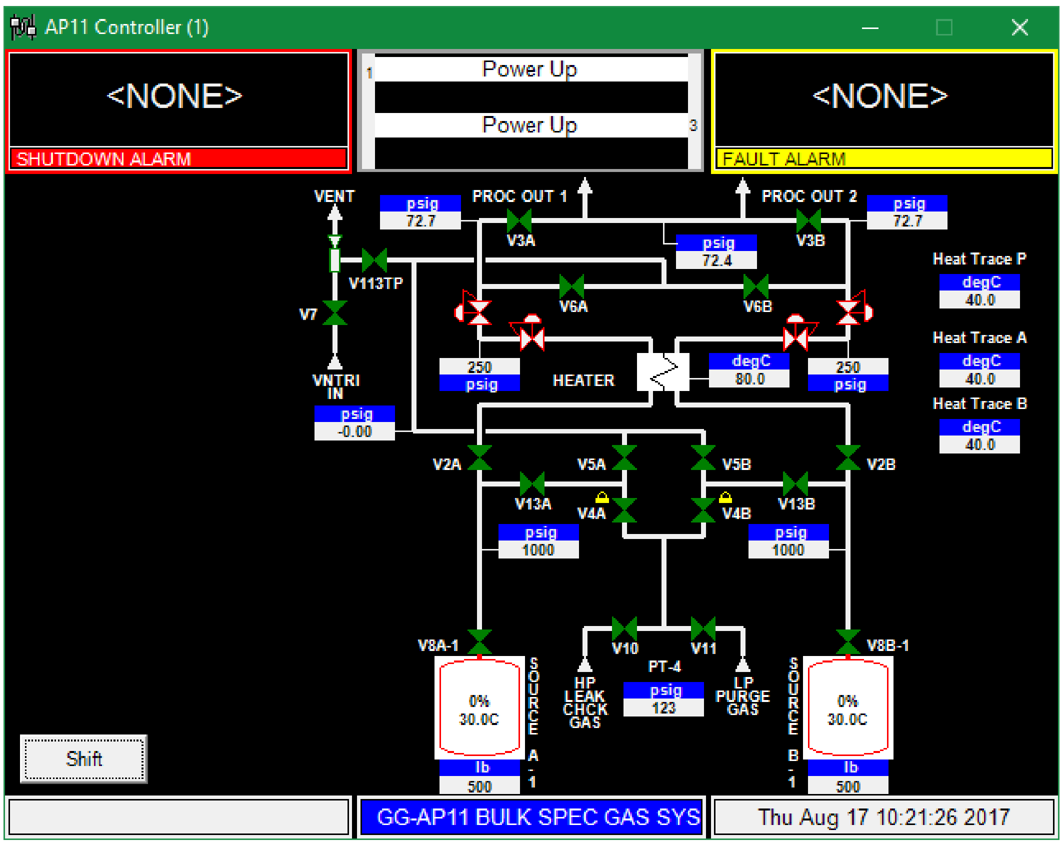


Figure 7-2. BSGS eV / BULKGUARD® eV AP11 Power Up Screen

The Main Menu and Cabinet Configuration Selection Window

The selection window is located to either the left or right side of the screen after successfully entering the password. It presents prompts and menu selections. The Main Menu is shown in Figure 7-3. The Main Menu will remain displayed for a configurable amount of time or until the Logout key is pressed.

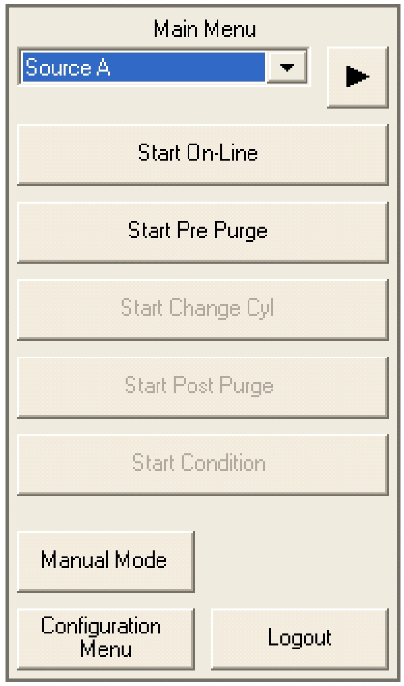


Figure 7-3. GASGUARD® AP11 Controller Main Menu

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 7-4.

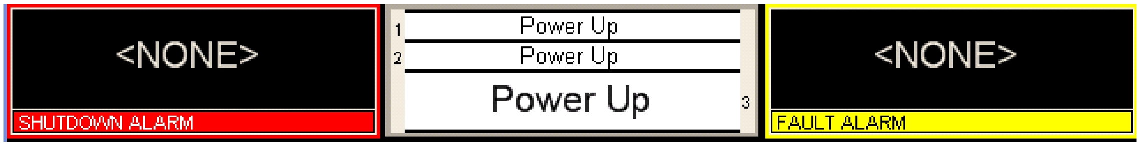


Figure 7-4. Alarm and Controller Status Boxes

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 7-5.

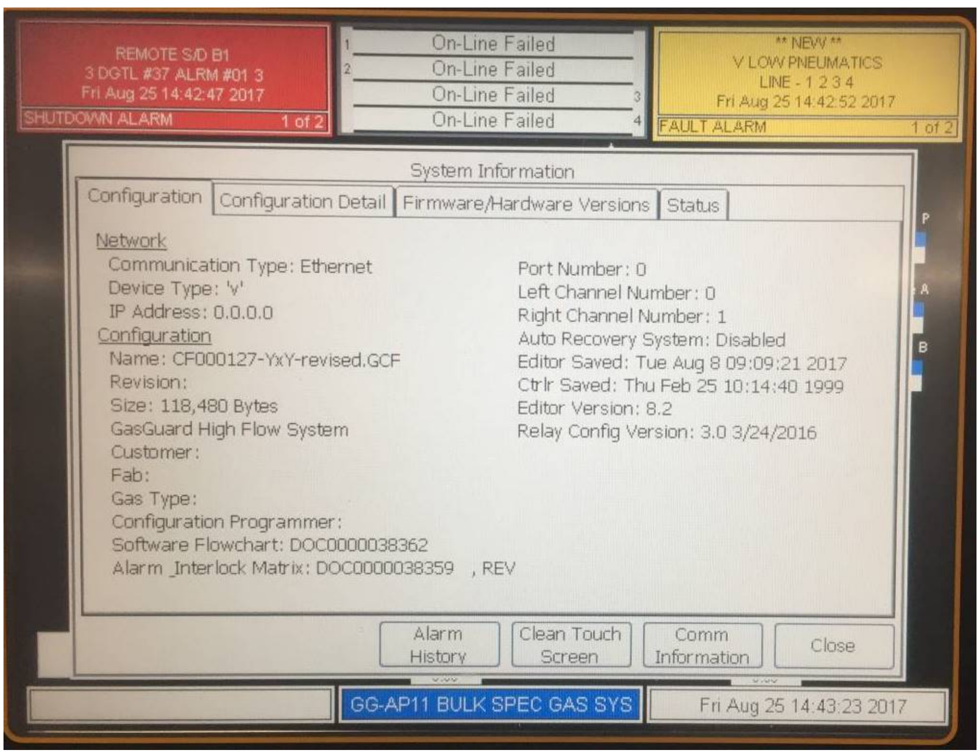


Figure 7-5. System Information Window

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 module.

Emergency Stop

The red, mushroom head push-pull emergency stop button, located on the right side of the cabinet controller (see Figure 7-1), shuts off power to the pilot solenoids, closing all pneumatic valves. Power is maintained to the controller, but it cannot open the valves until the button is pulled out to its normal position and the alarm is reset.

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 7-6 for their location.

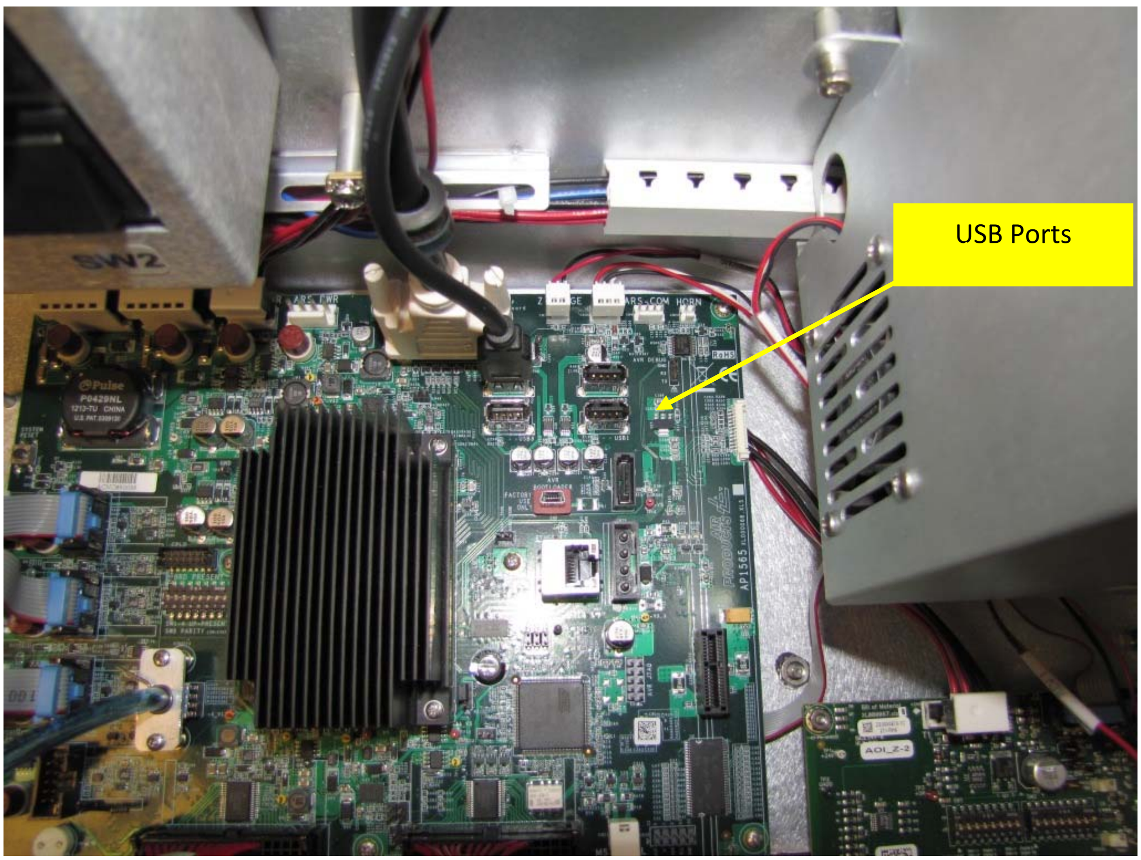


Figure 7-6. USB Ports

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 earlier within this chapter of the operation 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, typically 60-120 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 module in manual mode. Actuating valves in the improper sequence could cause damage to the module, 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.

Start Src(A1/A2/B1/B2) Scan (Optional)

This mode is present when the optional USB barcode scanning feature has been enabled. See Appendix H for instructions for using this feature.

DualPrePrg / DualChngCy / DualPstPrg (Optional)

These modes allow the operator to change out both the x-1 and x-2 source containers at the same time (parallel) rather than one at a time (serial). These modes are only present when there are dual sources and deep source purge panels. These modes can be found under the x-2 Main Menu only. The normal (serial) Pre Purge, Change Cyl, and Post Purge menus will also be present in the x-2 Main Menu.

3.0 Power and I/O Enclosures

The eV Electrical Control Cabinet (ECC) is installed on all modules that have either heat trace or a JT heater. All incoming power terminations are made in the eV ECC when it is present. Otherwise, power is termination within the AP11 controller itself. Power distribution for the J-T heater and heat trace zones is done from an electrical junction box located at the bottom of the piping enclosure. See Chapter 2 and Appendix A for more details and electrical drawings.

All field digital and analog I/O signals are terminated either in the AP11 controller enclosure or in an interface box mounted to either side of the piping enclosure. All modules are factory-equipped with an interface box on the left side of the piping enclosure. If your module has a dual source for either process inlet, then there will be an interface box located on the right side of the piping enclosure. Details of I/O terminations are shown in the electrical installation drawing located in Appendix A.

Figure 7-7 shows where field terminations are made on the AP1563 customer I/O board located on the left side wall inside the AP11 controller. Supervisory inputs are terminated at T9, but all other digital inputs are terminated to T7 and T8. Digital outputs are terminated at T4, T5, and T6. Analog inputs are terminated at T1, T2, and T3.

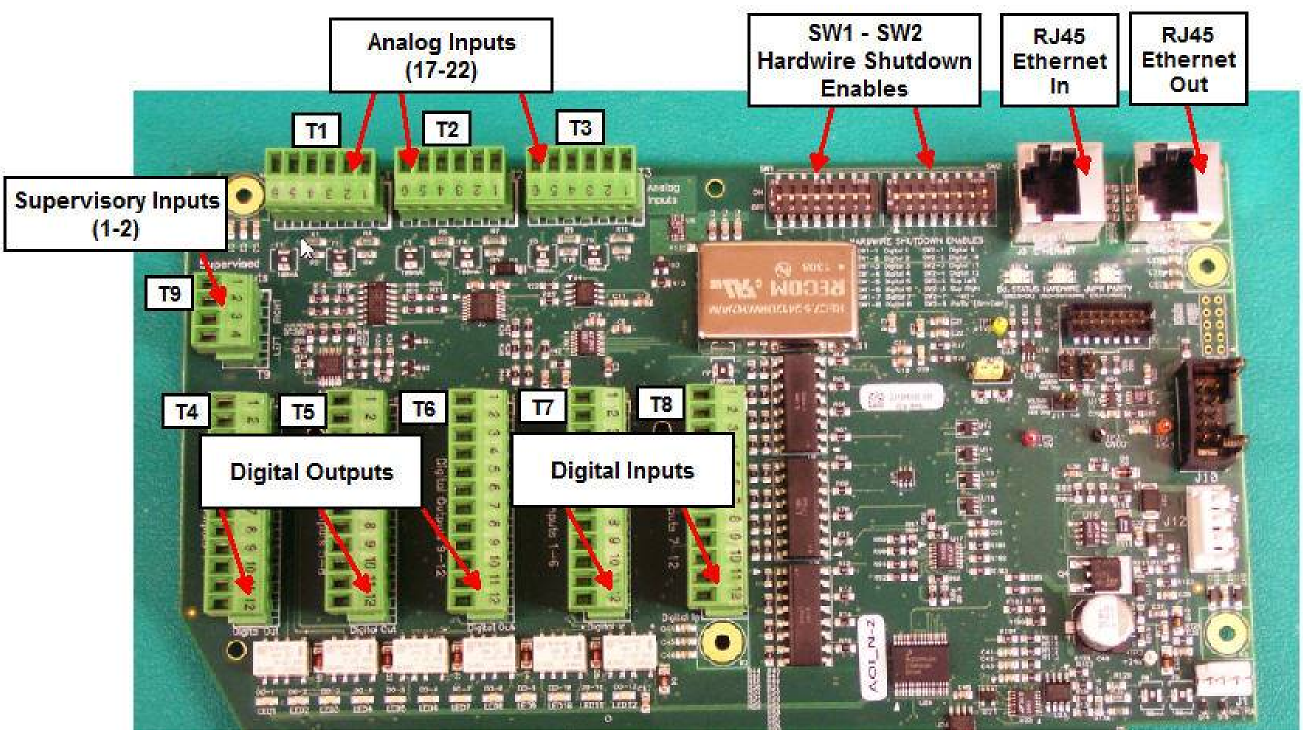


Figure 7.7: AP1563 Expansion Customer I/O Terminal Blocks

Field terminations that need to be made in either of the interface boxes should follow the internal layout of the terminal blocks as shown in Figure 7-8:

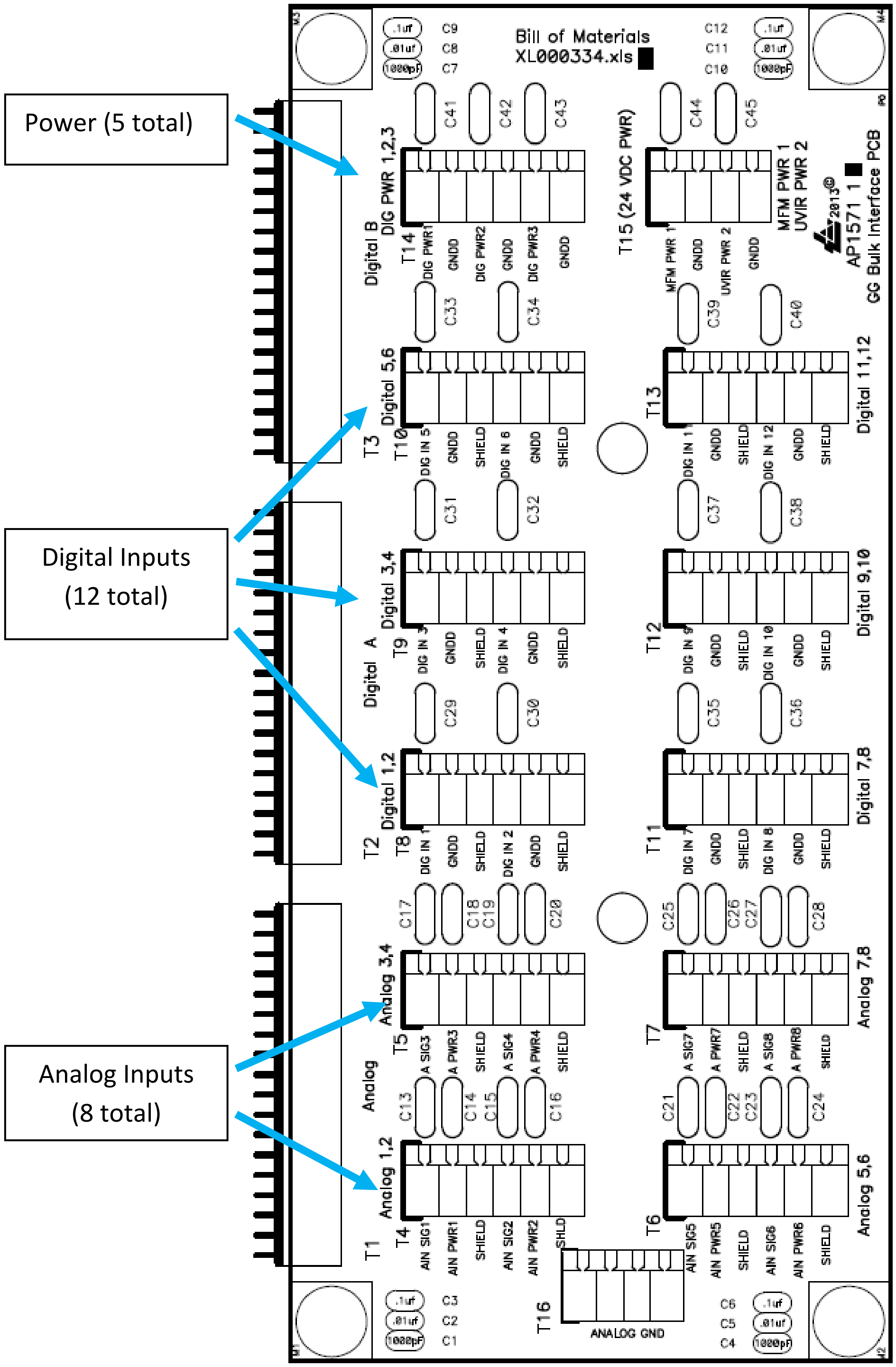


Figure 7-8: Terminal block layout of I/O interface box

The optional J-T heater and heat trace zones are controlled by an AP1602 Thermal Control board via thermocouple inputs and PID control supplied by proprietary onboard PID algorithms on the AP11. The AP11 controller determines if the heater is above or below the operating setpoint, then sends an appropriate digital signal to the SSR located in the eV ECC. Power is applied or removed from the heated component as required via the SSR, and protected by a GFCB. The thermocouple signals are monitored by alarm notifications. Low and high temperature alarms alert the operator to heater temperatures outside normal operating conditions. A discrete hardwire shutdown circuit is provided for the J-T heater that works off an imbedded temperature switch within 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 interrupt power from SSR to not only the J-T heater, but also the heat trace zones.

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. DS&S Product Engineering before making any changes.

Chapter 8

Operating Procedures

1.0 Emergency Stop

1. In the event of an emergency that requires the entire system to be shut down **the remote emergency stop button or the Emergency Off Button at the AP11 controller on the BSGS eV / BULKGUARD eV module should be pushed**. It is strongly recommended that the module 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 shut down the module if any emergency condition is observed.

WARNING

Pressing the Emergency Stop button does not disconnect power to the controller. Heater Power (208-240VAC) and optional Controller Power (100-240VAC) are still live within the Controller. Do not perform maintenance on the Controller without externally disconnecting or switching off power source(s) and following a Lockout and Tagout procedure.

Note: The Emergency Stop (E-Stop) button is located on the AP11 controller which sits above the 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 reachable by 90% of the population.

2.0 Starting a New Module

1. Validate that the Module is ready for startup by verifying all of the following have been completed:
   - Completion of the Startup Checklist and Operational Readiness Inspection (ORI) – See Appendix E and F of this manual for those checklists.
   - Leak checks of field installed piping.
   - Functional testing of 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 the heat trace temperature is set about 10°F (5°C) higher than the heated process gas container to prevent the formation of liquid in the module 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°F (5°C). 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°F (-39°C), houseline heat trace will not be necessary.):
     - 100 psig = -38°F (-39°C)
     - 90 psig = -43°F (-42°C)
     - 80 psig = -48°F (-44°C)
     - 70 psig = -53°F (-47°C)
     - 60 psig = -59°F (-51°C)

     Ammonia (NH3) saturation pressures/temperatures:
     - 100 psig = 63°F (17°C)
     - 90 psig = 58°F (14°C)
     - 80 psig = 53°F (12°C)
     - 70 psig = 47°F (8°C)
     - 60 psig = 41°F (5°C)

Nitrous Oxide (N_2O) saturation pressures/temperatures: (unless ambient temperature is expected to drop below -49°F (-45°C), houseline heat trace will not be necessary.):

- 100 psig = -49°F (-45°C)
- 90 psig = -53°F (-47°C)
- 80 psig = -58°F (-50°C)
- 70 psig = -63°F (-53°C)
- 60 psig = -68°F (-56°C)

- Verify the J-T heater is set to 85°C for silane (SiH_4) and nitrous oxide (N_2O).
- Verify the J-T heater is set to 70°C for nitrogen trifluoride (NF_3), ammonia (NH_3), and hydrogen chloride (HCl)
- Contact your Versum Materials, Inc representative for additional gases

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 before turning on the electrical power main switch.

   IMPORTANT! Care must be taken when introducing Z purge gas into the controller enclosure, as it is rated to a maximum pressure of 1.2"wc (0.3 kPa). 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 8-1 for the valve location.
- Close the controller front and tighten both latches completely.
- Open the needle valve 4 to 5 turns (counter-clockwise). This equates to a flow rate of 7 lpm/15 CFH. Allow the controller to purge for 30 minutes if the area is classified hazardous (Class I, Division 2). 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).

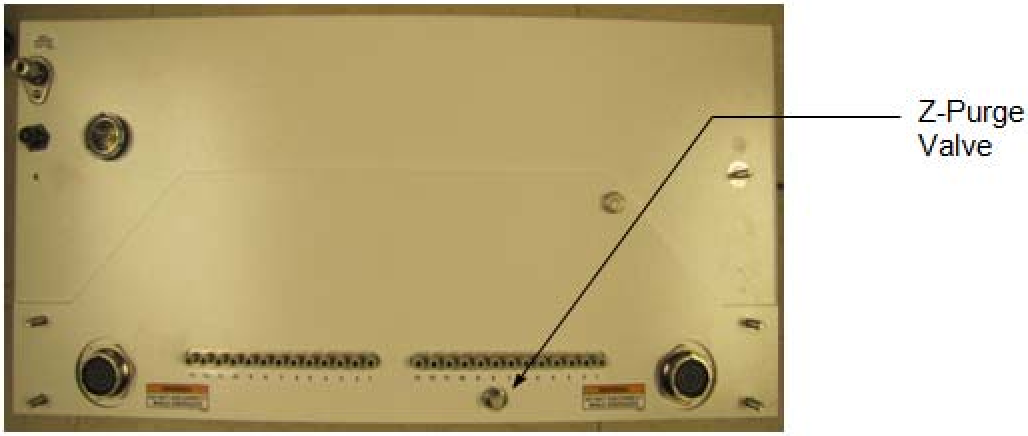
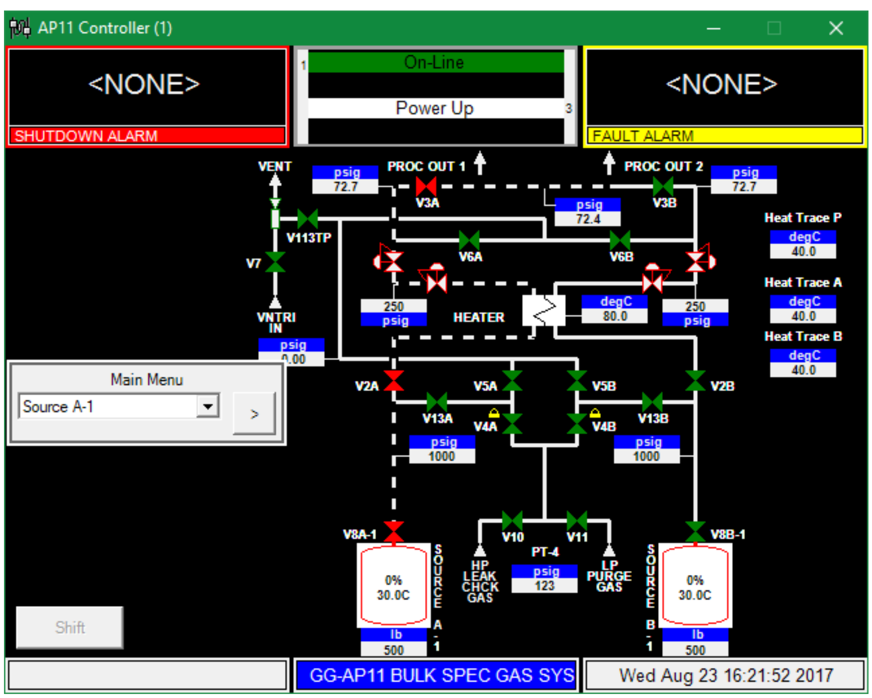
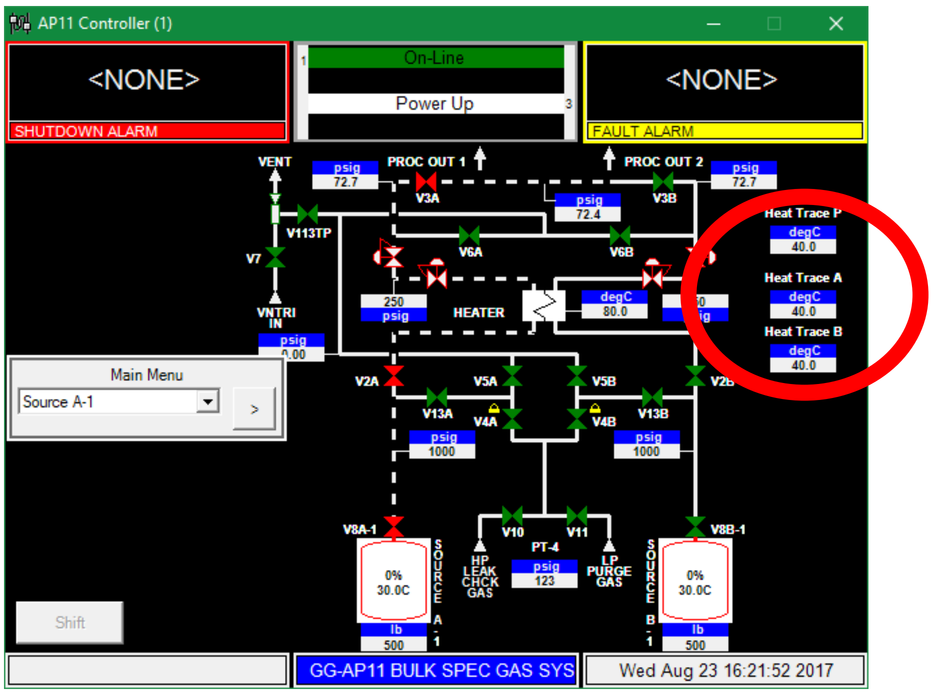


Figure 8-1. Rear View of GASGUARD® AP11 Controller.

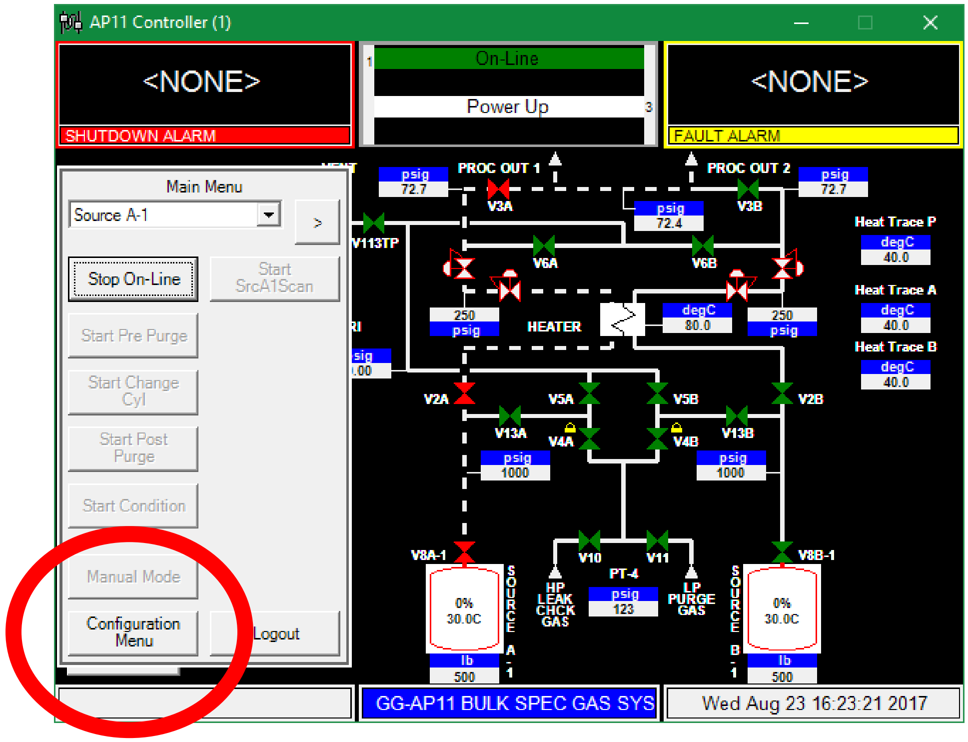
3. On the GASGUARD® AP11 controller, press the shutdown alarm window once to acknowledge any alarms. Press the shutdown alarm window again to reset any alarms. No alarms should be present. If alarms are present, ***do not*** continue. Alarms must be cleared before the controller can be placed in an operating mode.
4. On the GASGUARD® AP11 controller, at the 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 Spec. Sheet included in the gray envelope to determine if this option has been applied.)



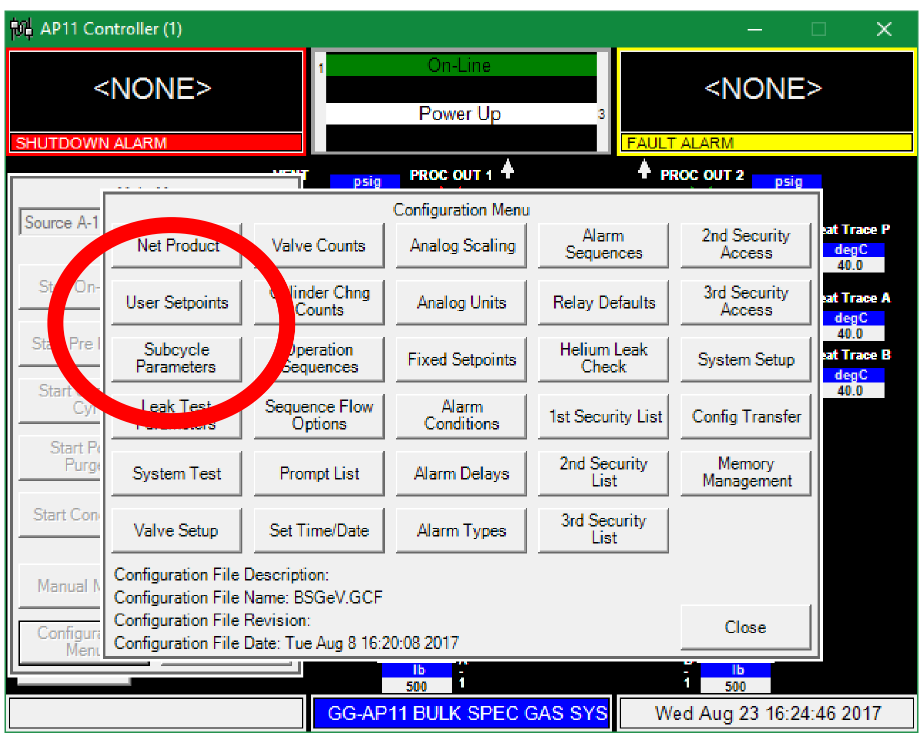
5. In the process piping cabinet verify that the adjustable process regulators are closed (knob rotated fully counterclockwise). Non-adjustable regulators should not be changed since they are factory pre-set.
6. Verify the installation of the HPLT leak check cylinder and purge gas cylinder.
7. Verify that plugs or caps are installed on the process pigtail connections. There should not be supply containers connected at this time.
8. If heat trace has been installed, confirm that the heat trace setpoints are correct by looking at the analog display boxes on the right side of the screen:



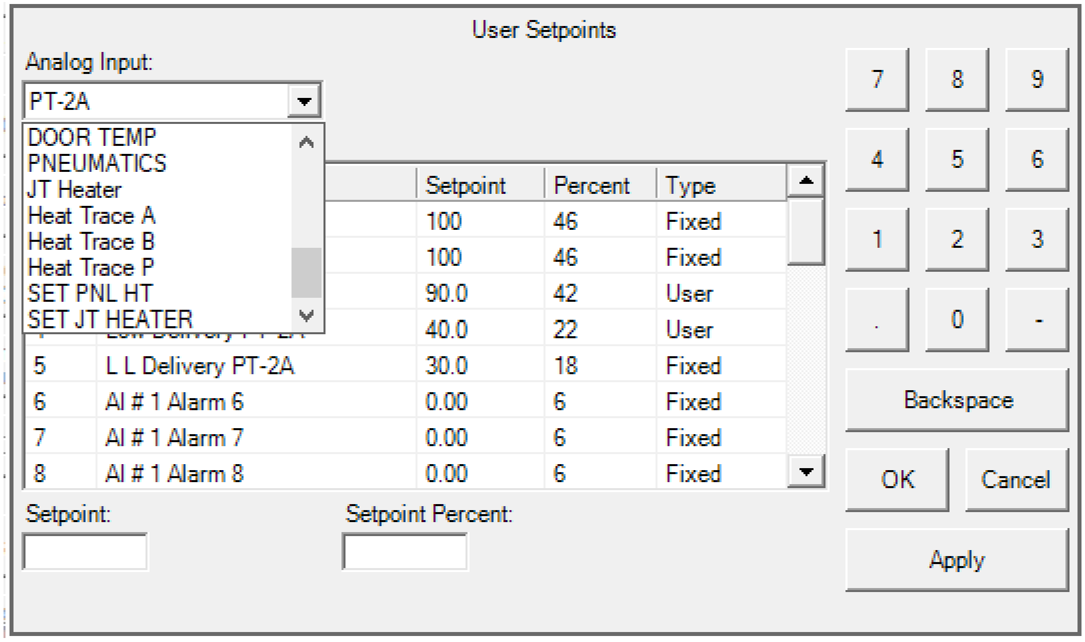
If the heat trace setpoints need to be adjusted, use a 3rd level password to enter into the Configuration Menu:



Enter into the User Setpoints option:



Scroll down to the “SET PNL HT” item on the drop down menu:



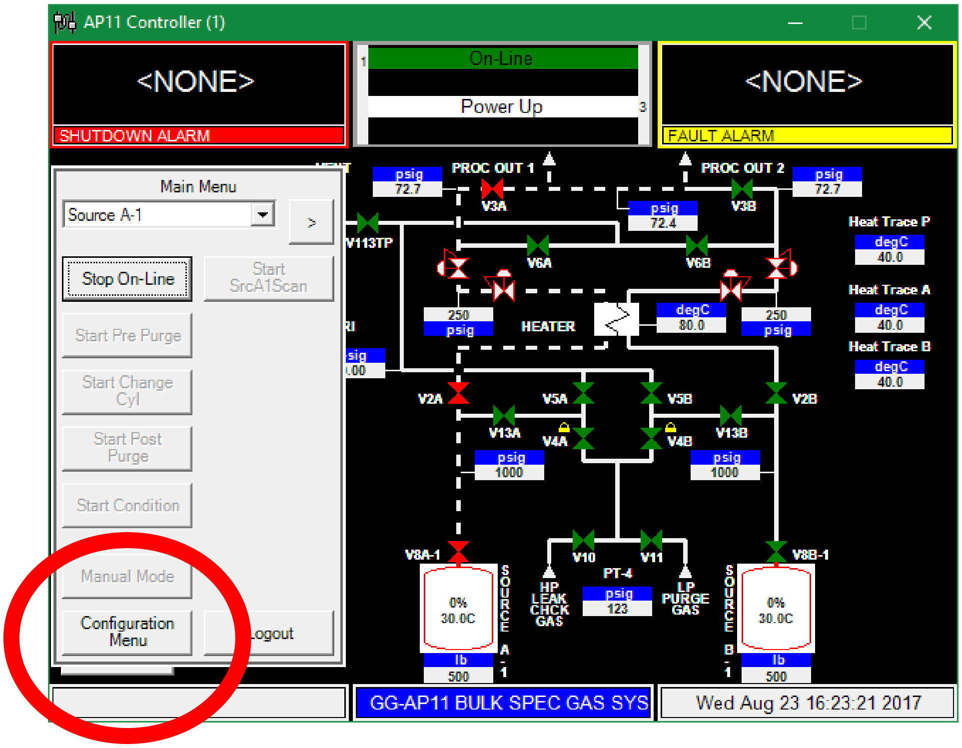
Enter in the desired heat trace setpoint values for each zone.and click on the “Apply” button after each entry. When finished, click on “OK” to exit this menu.

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.

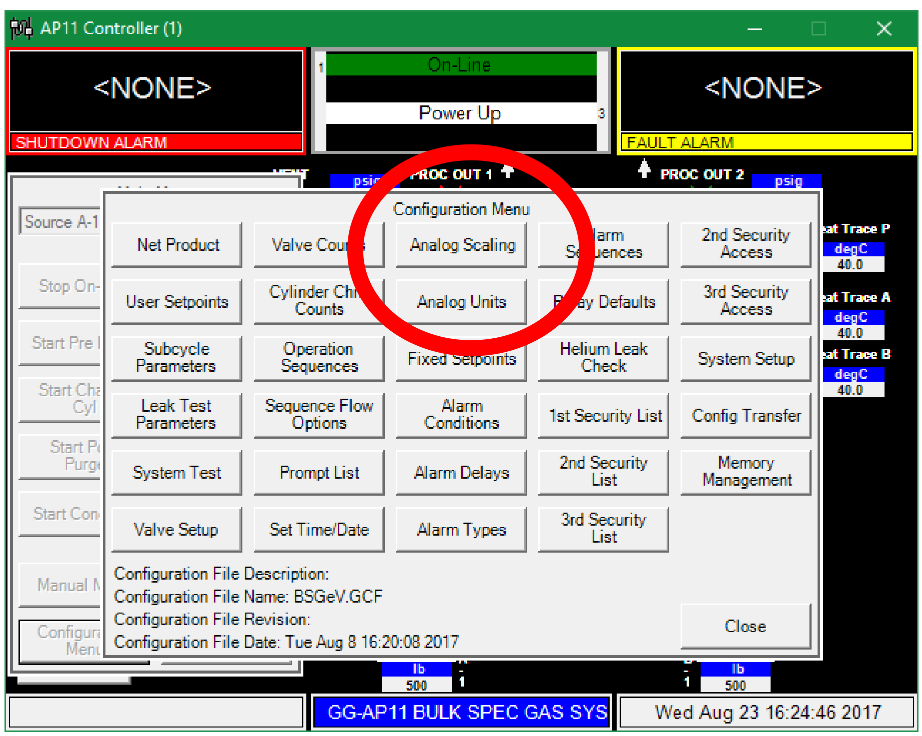
WARNING

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 AP11 controller. See Chapter 8, Section 4 for the log in procedure. Press the “Configuration Menu” button.



Next, press the “Analog Scaling” button.



Scroll down to the appropriate scale analog input. Press on the analog input to highlight the line and then enter in the correct mimium and maximum input values from the scale:

After making the change, press the "Apply" button and "OK" button, then the "Cancel" button to back out of the menu.

10. Begin the Pre Purge program sequence at the module 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 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 / Unplanned.

It is 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.

A Planned Shutdown is defined as the managed removal of electrical power, and pneumatic pressure from the 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 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 decrease 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 module Online, flowing process gas. Failure to do so can result in operational problems and liquefied process gas being delivered to the process tool.

An Unplanned Shutdown is defined as the removal of electrical power, and pneumatic pressure from the system without warning. For this case, it is assumed the AP controller is not fed power by an Uninterruptable Power Supply (UPS). Because it is 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 decrease 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.

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 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 AP11 controller will boot up to the offline mode (On-Line Stopped will be displayed) when power is restored. The 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.

In the unlikely event of an unplanned AP11 controller reboot (during which power to the system is maintained), the AP11 controller's Auto Recovery System (ARS) would maintain existing valve states until the reboot sequence was completed. This normally takes less than 2 minutes. The JT heater would not be receiving power during this bootup time. The Auto Recovery System would put then put the controller back into the operating mode that it was in prior to the reboot. The overall result is that a controller reboot should not impact the flow of process gas to the customer.

4.0 AP11 Controller Operation

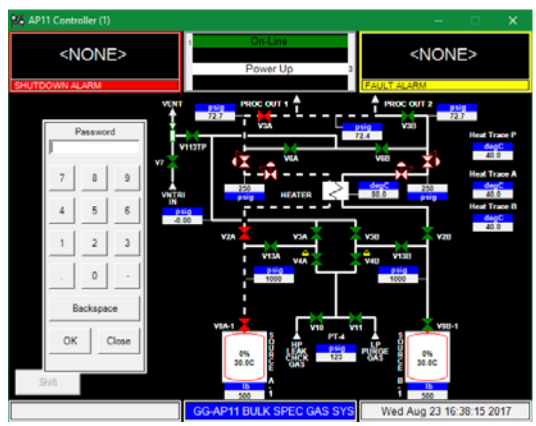
NOTE: Due to the wide variety of available configurations for the BSGS eV / BULKGUARD eV product line, it would be unwieldy to show examples of each within this manual. As such, the controller screens displayed on your system will probably have a different appearance than the examples shown in this manual. The software for your system has been programmed to support the as-built configuration for source containers, purge type, regulators, JT heater, etc. Some of the operator prompts, especially involving manual valves, will also be different than what is shown here.

If you have any questions about the operation of your system, please contact your Versum Materials, Inc. representative.

<u>Entering a Password and Selecting Menu Options</u>

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.

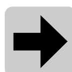


2. Enter the password using the numeric keypad.

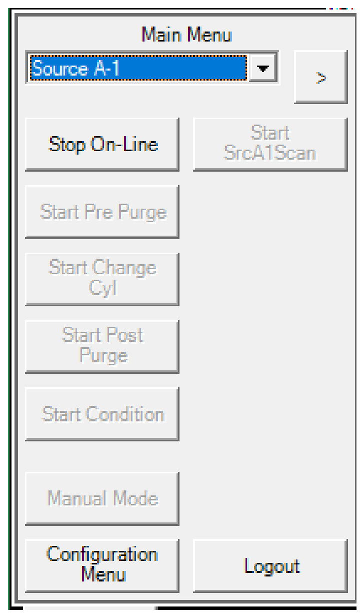
Note: An * (asterisk) will appear instead of a number to prevent the password from being displayed.

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.

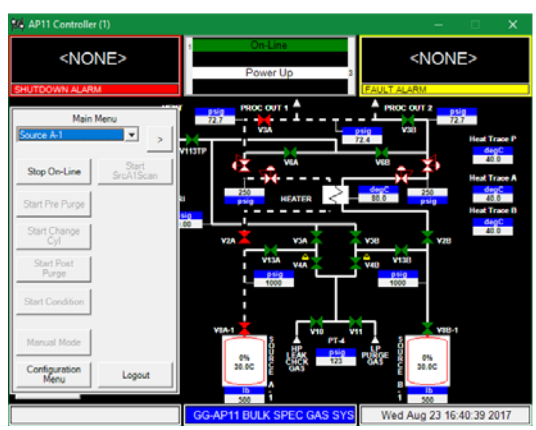
4. Use the  and  keys or the drop-down menu to select the correct source line.

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 Pre-Purge

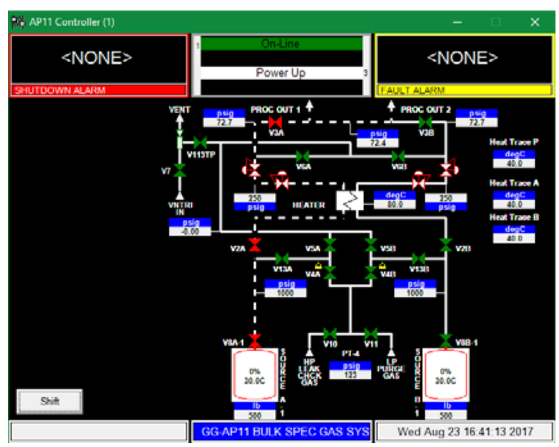
Purpose: This sub-section describes the AP11 Controller program routine that is used to purge and evacuate the process gas from the process pigtail prior to container change or pigtail maintenance. Note that the sources are being referred to generically with ‘x’ meaning which side the component is installed and ‘y’ meaning which source on that side. MV1-B2 would be the second source container on the B side of the equipment.

If the system is in the cross-purge configuration and there are two sources installed on one process side, the Pre-Purge mode will impact both sources (A1 and A2, B1 and B2) when initiated on one side of the system. There is no isolation that allows this mode to be run only on one source at a time without halting flow from the other source.

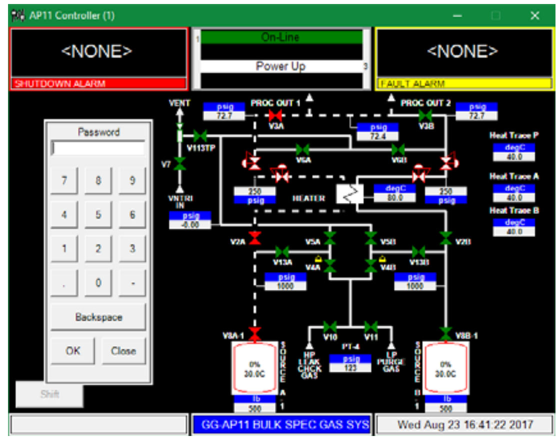
If your system has the deep source purge option (MV-1/V-1 located on a separate panel outside of the gas cabinet), it will allow for individual sources on the same side to be changed without impacting the flow. In other words, you can change out source B-1 while source B-2 is still running.

In addition, a system with dual sources and the deep purge option can change out both sources at the same time. See the notes at the end of sections 4A, 4B, 4C, 4D and 4E for more information on these ‘dual’modes.

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.

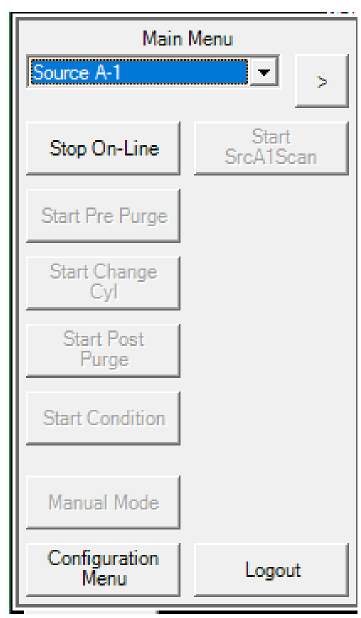
4. Use the  and  keys or the drop-down menu to select the correct source line.

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

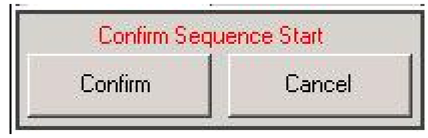
5. Press the START PRE PURGE pushbutton.

If Pre-Purge is running for side A, purge sequences for side B will not be available. Only one side can be changed at a time. If the deep purge option is present, then only one source per module can be in this mode at one time.

If your 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.



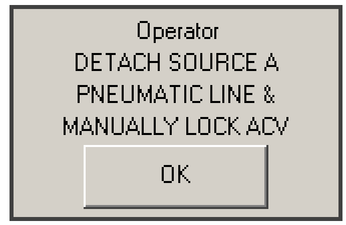
6. The Confirm Sequence Start window will be displayed. Press the CONFIRM pushbutton.



7. !!OPERATOR PROMPT!!

   OPTIONAL with AUTOMATIC source valve, a prompt will appear on the display to “Disconnect Source (xy) 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 module.



8. !!OPERATOR PROMPT!!

   If the system has the deep purge option, a prompt will appear on the display to “Open Manual Valve MV-1xy.” After opening valve, acknowledge prompt by pressing the “OK” key.

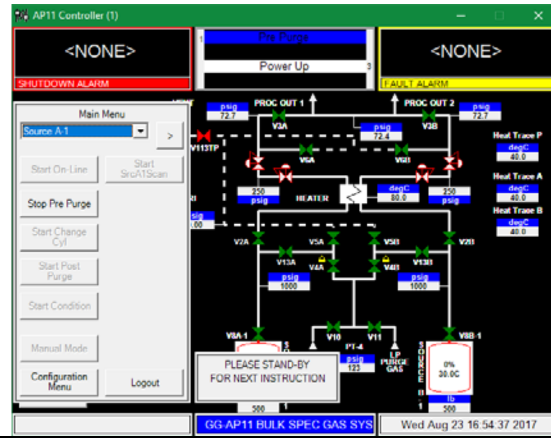
NOTE: If the system has the cross purge option, the prompt will indicate MV-2x, not MV-1xy.

9. !!OPERATOR PROMPT!!

   The panel piping will be evacuated, including the space between manual valve MV-1xy and valve V-1xy (deep purge) or MV.

10. !!OPERATOR PROMPT!!

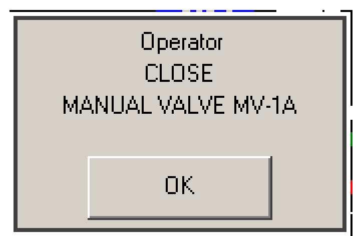
The process gas wetted area from the source container valve V-8 to V-1 (deep purge) or V-2 (cross-purge) will be evacuated of process gas.



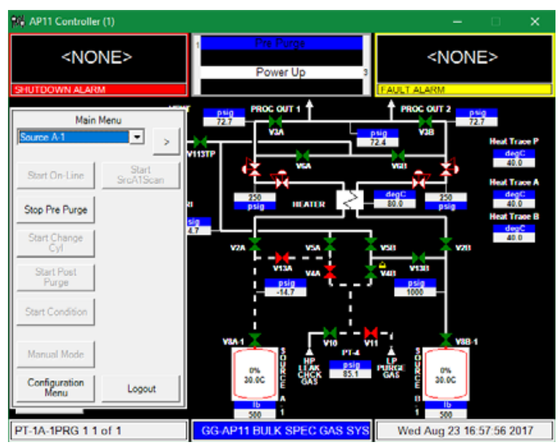
11. !!OPERATOR PROMPT!!

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

NOTE: If the system has the cross purge option, the prompt will indicate MV-2x, not MV-1xy.



12. The process gas wetted area from the source container valve V-8 to MV-1 (deep purge) or MV-2 (cross-purge) will be charged with purge gas.

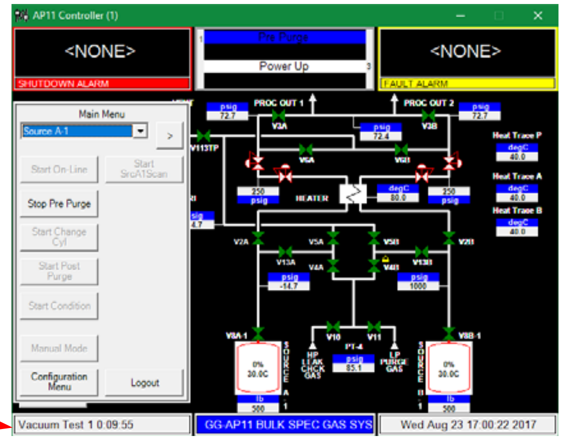


13. !!OPERATOR PROMPT!!

The process gas wetted area from the source container valve V-8 to MV-1 (deep purge) or MV-2 (cross-purge) 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) (2) (3)

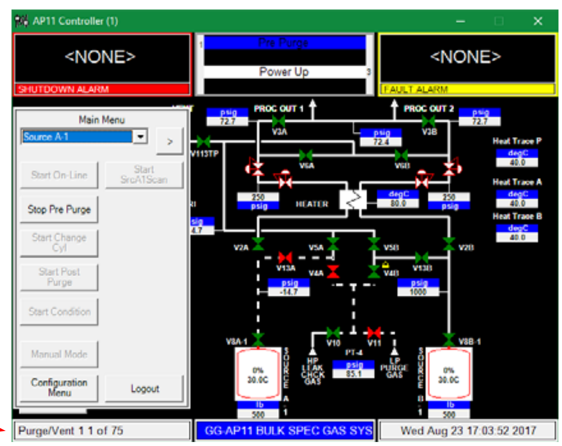
1) The leak test being run.
2) The process line number.

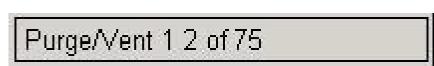
Source A1 = process line 1,
Source A2 = process line 2
Source B1 = process line 3
Source B2 = process line 4

3) The time remaining until the completion of the leak test.

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)

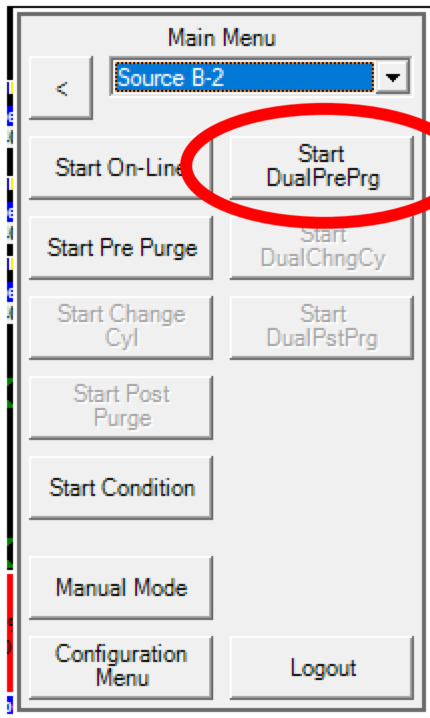
Note: During the cycle purge the status box displays the following:

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".

Dual Pre-Purge Option for Dual Source Systems with Deep Purge:

The Dual Pre Purge Option is only available on the A-2 or B-2 source Main Menu on systems equipped with two sources on one side and the deep source purge option. This 'DualPrePrg' mode runs the Pre-Purge routine on both the x-1 and x-2 sources in parallel. This reduces the time needed to do the purge/vacuum cycles.

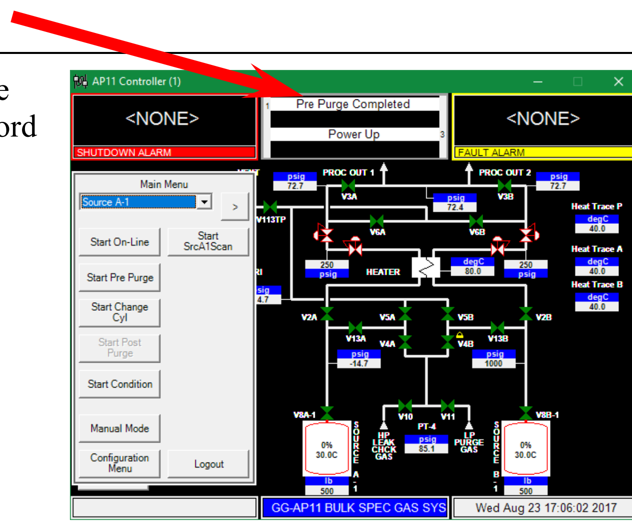


4.B Change Source Container

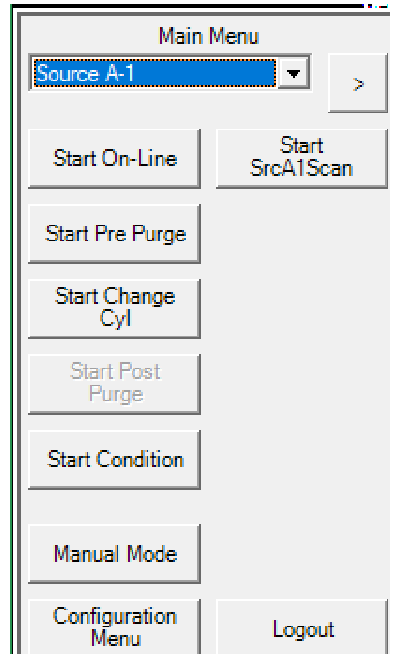
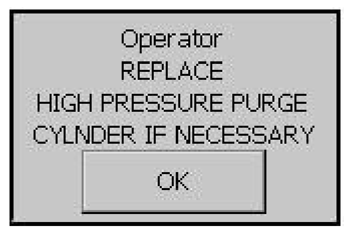
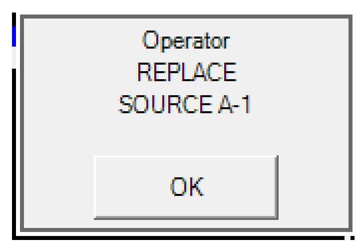
Purpose: This semi-automated Sub-Section describes the AP11 Controller Program Routine that is used to change a source container. Note that the sources are being referred to generically with 'x' meaning which side the component is installed and 'y' meaning which source on that side. MV1-B2 would be the second source container on the B side of the equipment.

If the system is in the cross-purge configuration and there are two sources installed on one process side, the Change Cyl mode will impact both sources (A1 and A2, B1 and B2) when initiated on one side of the system. There is no isolation that allows this mode to be run only on one source at a time without halting flow from the other source.

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

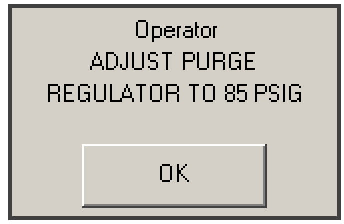
<table>
<tr><td>1. Verify that "Pre-Purge Completed" is displayed in the controller mode box.</td><td></td></tr>
<tr><td>2. Touch anywhere on the graphics portion of the screen. Display will show a request for password input.</td><td>
</td></tr>
<tr><td>3. PASSWORD WINDOW

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 side A, purge sequences for side B will not be available. Only one container can be changed at a time. If the deep purge option is present, then only one source per module can be in this mode at one time.*** ***If your module is equipped with the heat trace option, heat trace on the pigtail being purged will have been 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!!

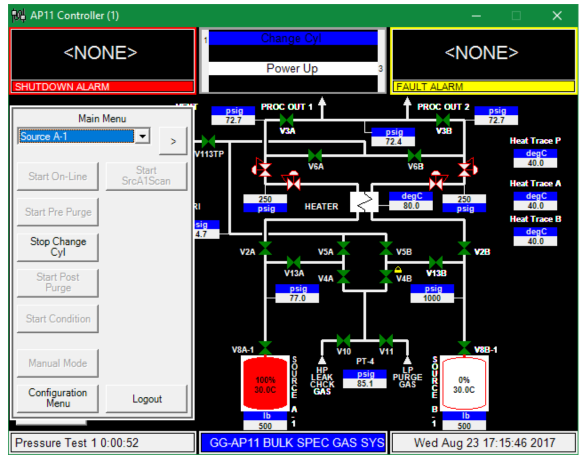
    OPTIONAL when vessel weight scales are used, product weight must be entered to monitor product usage. After completing task, acknowledge prompt by pressing the "OK" Key.

11. !!Operator prompt!!

    OPTIONAL when an ISO container with manual manifold outlet valve is utilized, "Open ISO Manifold Outlet Valve MV-0". Other source containers may have other manual valve prompts. Consult Appendix A for an explanation of the naming convention for source container valves.

    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.

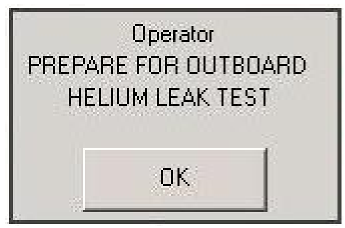


The pressure test status is displayed in the status box in the bottom left corner.

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

(1) (2) (3)

12. !!Operator prompt!!

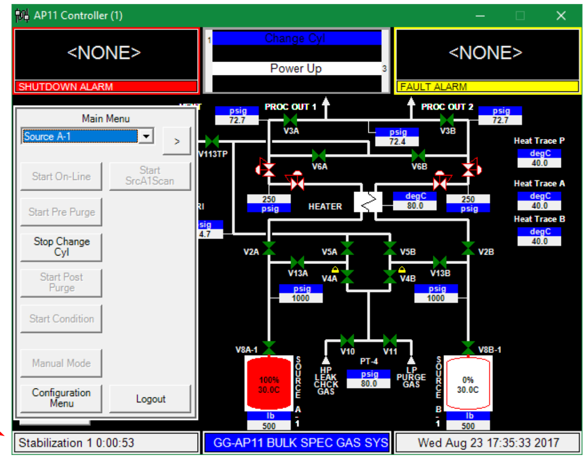


NOTE: HPLT (High Pressure Leak Test) is optional, if hardware present and requiring software option code enabled. It will display Operator prompt as show for the HPLT run routine.

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.



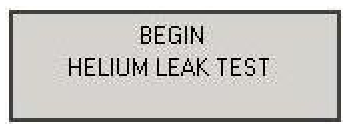
Note: During the leak test the status box displays the following:

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!!

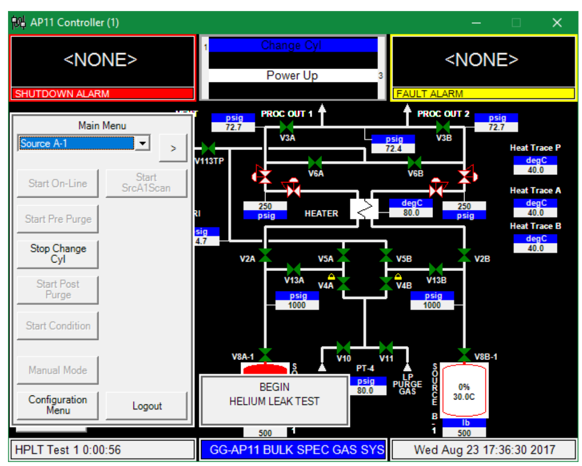
If helium is used for this check, a Mass Spectrometer may be employed for an added level of leak detection. The operator is prompted to “Begin Helium Leak Test” while the controller is running the HPLT. The prompt will automatically be cleared at the completion of the HPLT.



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.

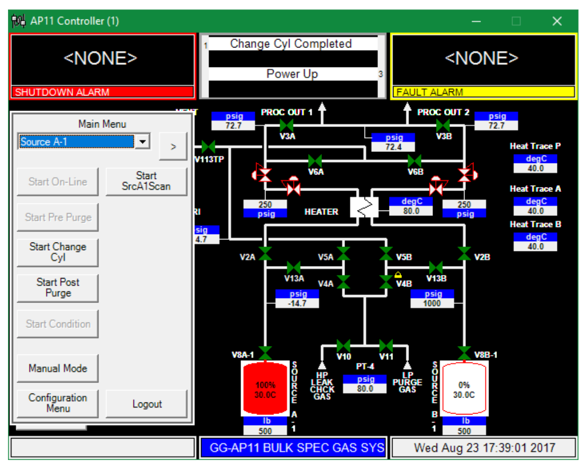
(1) (2) (3)

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.

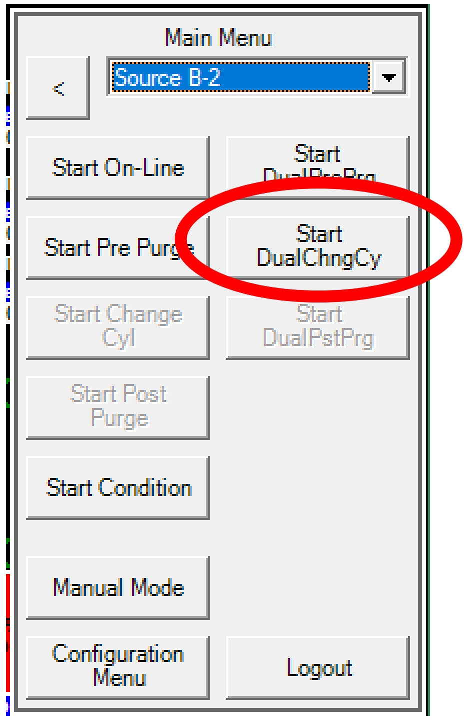
The High Pressure Leak Test has been completed. The operator is given additional time to complete the Outboard Helium Leak Test before the high-pressure leak test gas is evacuated from the pigtail. After completing task, acknowledge prompt by pressing the “OK” Key.

15. CYLINDER CHANGE is now complete.



Dual Change Cylinder Option for Dual Source Systems with Deep Purge:

The Dual Change Cylinder Option is only available on the A-2 or B-2 source Main Menu on systems equipped with two sources on one side and the deep source purge option. This 'DualChgCyl' mode runs the Change Cyl routine on both the x-1 and x-2 sources in parallel. This reduces the time needed to do the source changes. It is only available after the DualPrePrg routine has completed.

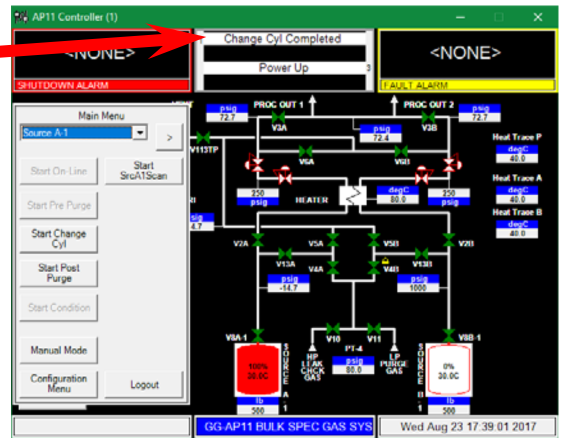


4.C Post Purge

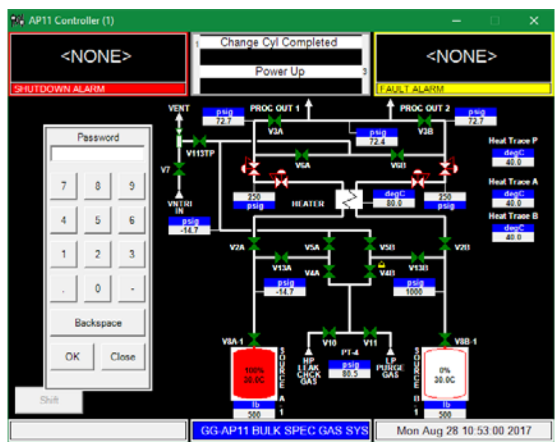
Purpose: This Manual Sub-Section describes the AP11 Controller Program Routine that is used to purge and evacuate all atmospheric contamination from the process pigtail after any container change or pigtail maintenance.

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.

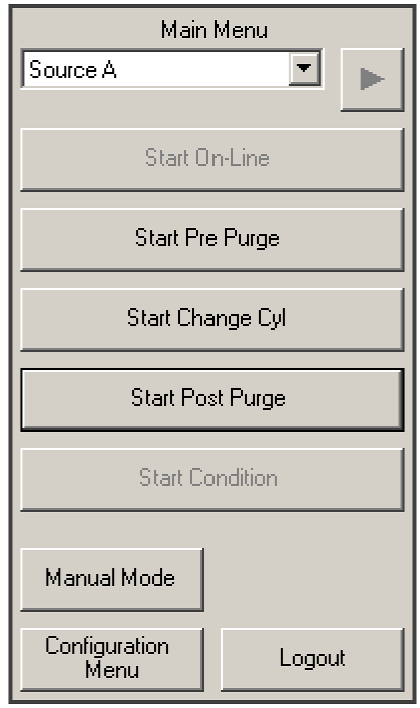
4. Use the  and  keys or the drop down menu to select the correct source line.

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

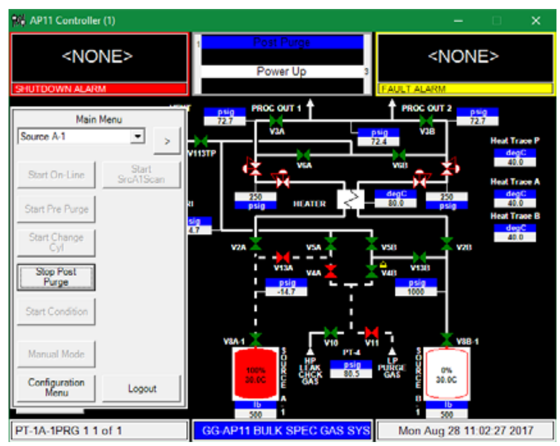
5. Press the START POST PURGE Pushbutton.

If Post-Purge is running for side A, purge sequences for side B will not be available. Only one side can be changed at a time. If the deep purge option is present, then only one source per module can be in this mode at one time.

If your module is equipped with the heat trace option, heat trace on the pigtail being purged will be re-energized at the start of the post-purge sequence.

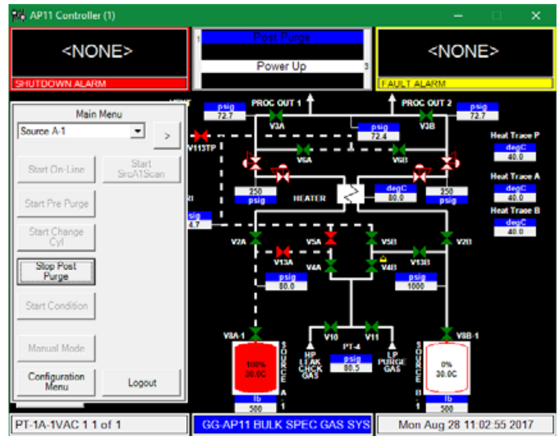


6. The process gas wetted area from the source container valve V-8 to MV-1 (deep purge) or MV-2 (cross purge) will be charged with purge gas.



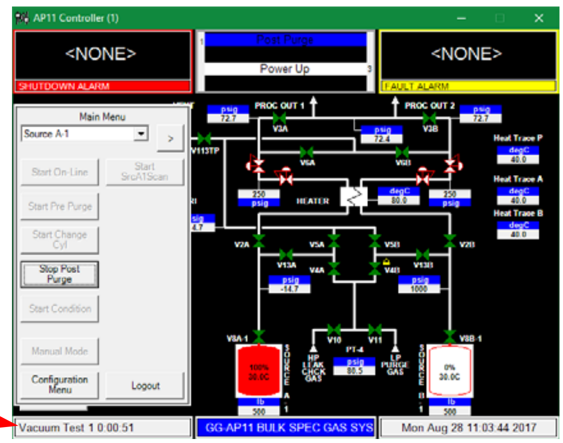
7. !!OPERATOR PROMPT!!

The process gas wetted area from the source container valve V-8 to MV-1 (deep purge) or MV-2 (cross purge) 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.

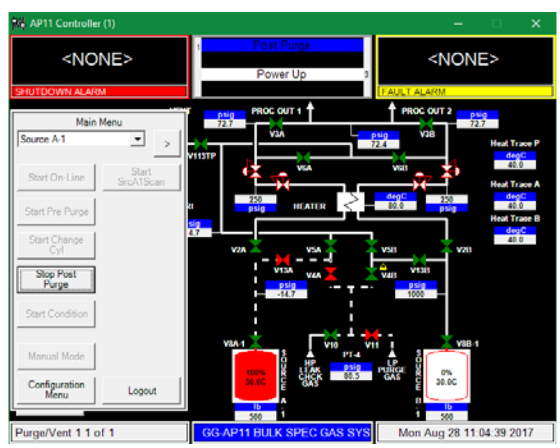


Note: During the leak test the status box displays the following:
1) The leak test being run.
2) The process line number.
3) The time remaining until the completion of the leak test.

(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.

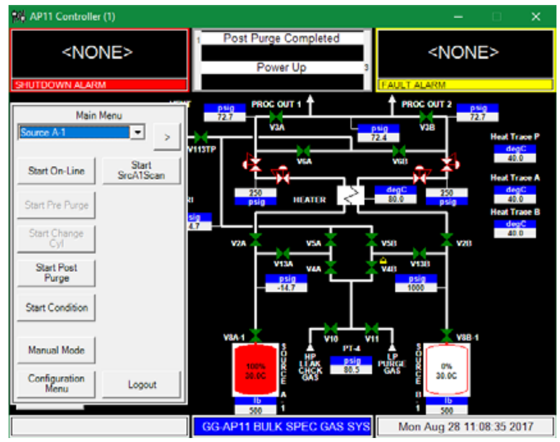


Note: During the cycle purge the status box displays the following:

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.

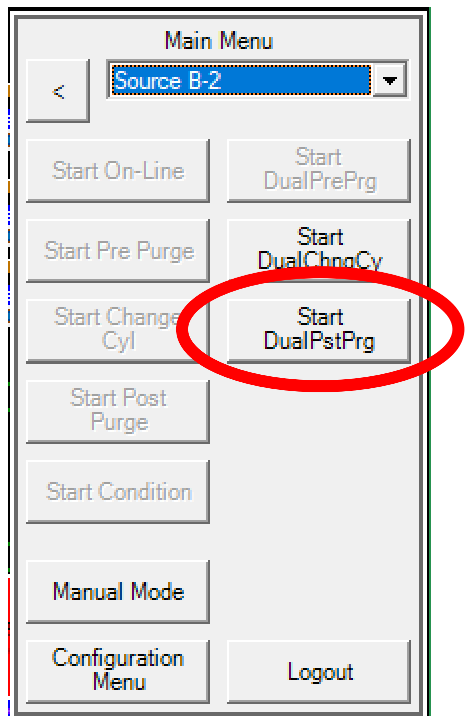
(1) (2) (3)

8. End of POST PURGE



Dual Post Purge Option for Dual Source Systems with Deep Purge:

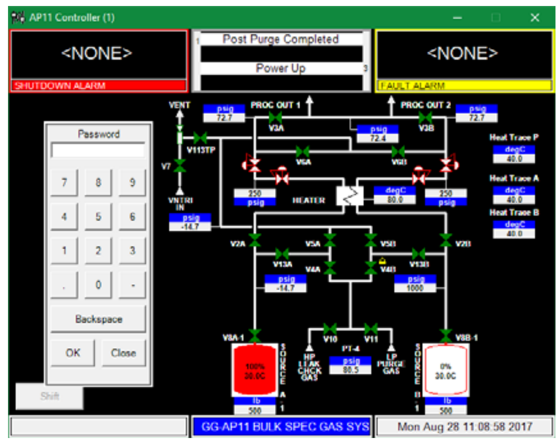
The Dual Post Purge Option is only available on the A-2 or B-2 source Main Menu on systems equipped with two sources on one side and the deep source purge option. This ‘DualPstPrg’ mode runs the Change Cyl routine on both the x-1 and x-2 sources in parallel. This reduces the time needed to do the source changes. It is only available after the DualChgCyl routine has completed. After completion of the DualPstPrg routine, the Start Condition mode for the individual sources becomes available. There is no Dual Condition mode, so the operator must perform the Condition mode on both the x-1 and x-2 sources.



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.

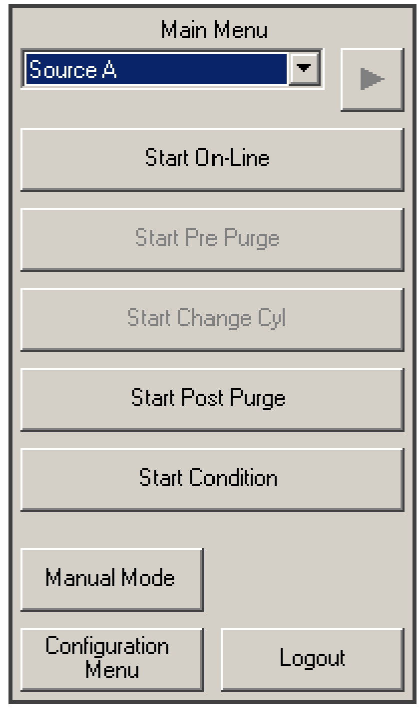
The following table describes the steps to be followed when using the Process Gas Conditioning routine.

1. Touch anywhere on the graphics portion of the screen. Display will show a request for password input.	
2. PASSWORD WINDOW Enter password on keypad and press the "OK" key.	

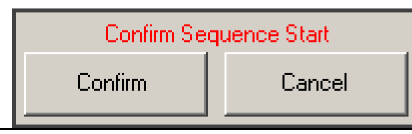
3. Main Menu screen will be displayed. Use the ← and → keys or the drop down menu to select the correct source line.

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

4. Press the START CONDITION pushbutton.



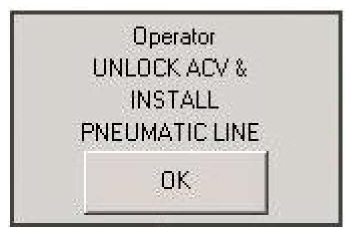
5. The Confirm Sequence Start window will be displayed. Press the CONFIRM pushbutton.



6. !!Operator Prompt!!

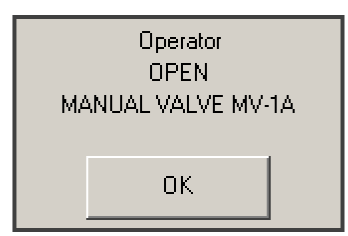
OPTIONAL if source is automated (Y or ISO), install the pneumatic line and unlock the automated valve.

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 module.



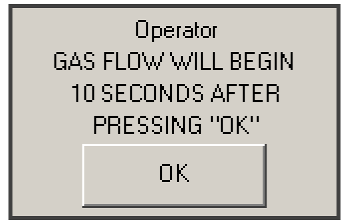
7. !!Operator Prompt!!

A prompt will appear on the display to "Open Manual Valve MV-1xy" if deep purge and "Open Manual Valve MV-2xy" if cross purge. After opening valve, acknowledge prompt by pressing the "OK" key.



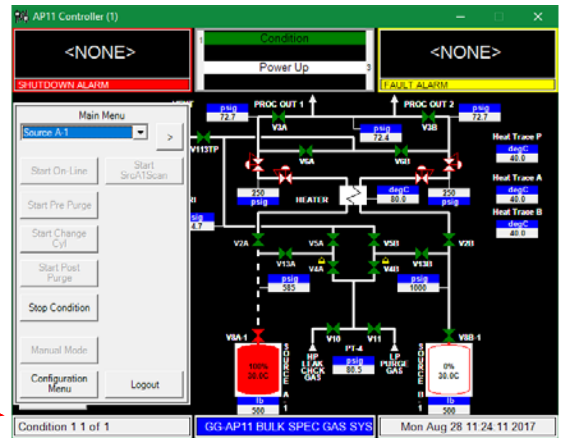
8. !!Operator Prompt!! – ***Optional***

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.

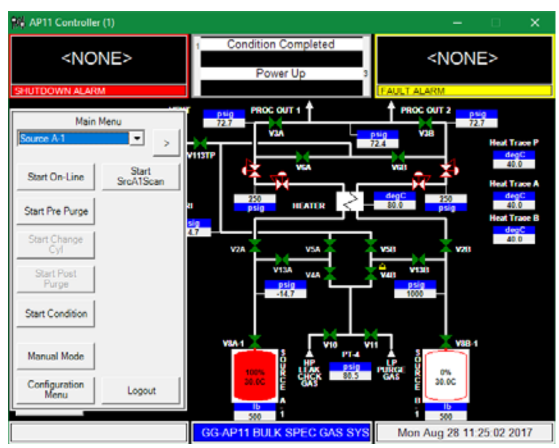
Source A = process line 1,

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.

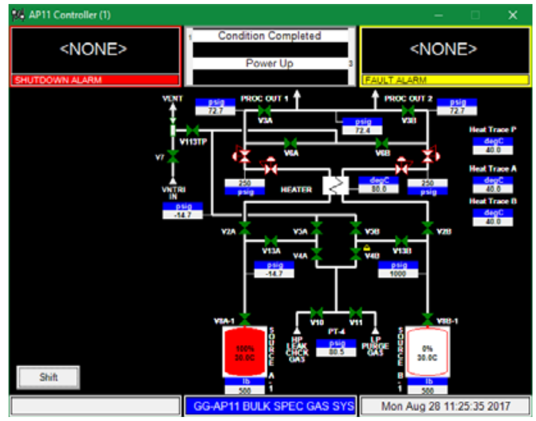
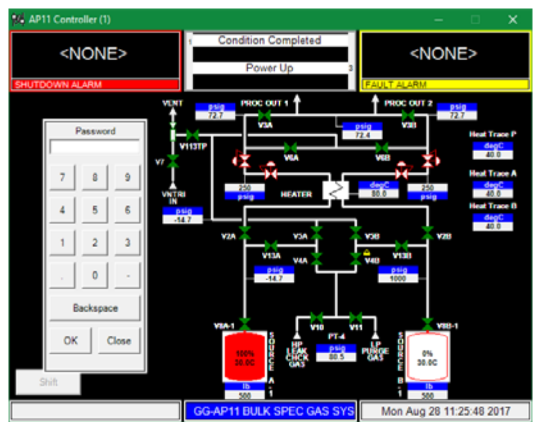


NOTE: There is no Dual Condition mode for systems with dual sources and the deep purge option. Sources must be run through the Condition mode individually upon completion of the 'DualPstPrg' mode.

4.E Process Gas Flow

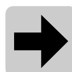
Purpose: This Manual Sub-Section describes the AP11 Controller Program Routine that is used to initiate process gas flow within the module.

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

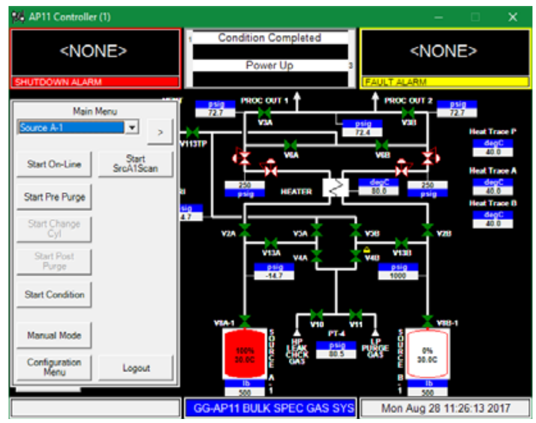
4. PASSWORD WINDOW

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

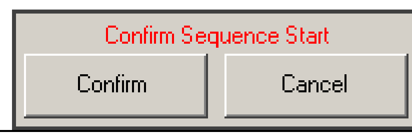
5. Main Menu screen will be displayed. Use the  and  keys or the drop down menu to select the correct source line.

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

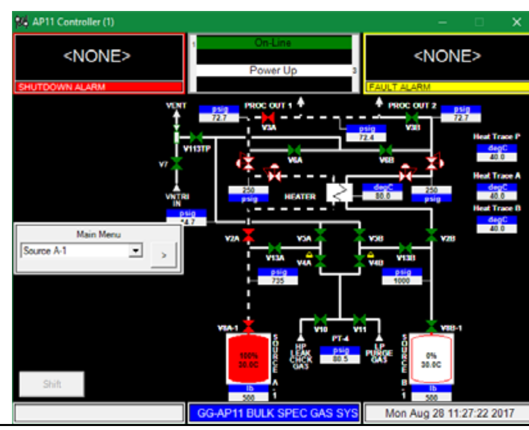
6. Press the START ON-LINE pushbutton.



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.

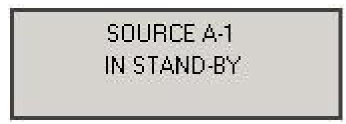


9. The controller opens the source valve V-8 in an automated system.

NOTE: If the tube switcher option has been installed, the operator will be prompted to start the Tube Sw program. See Section 4-I for details about how to operate this feature.

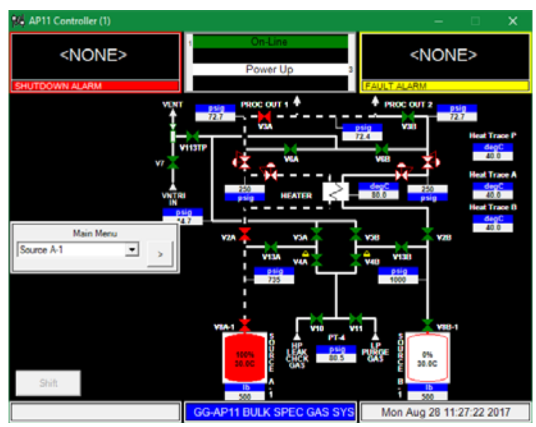
On-Line *Continuation*

10. If the module is configured as a dual process train system and the opposite train is already On-Line, then the controller will wait for the opposite source to go off-line before proceeding to the next step.



11. The "Gas Available" relay is energized.

12. Process gas is now available to flow from the source. The "Gas Flowing" LED will be lit.



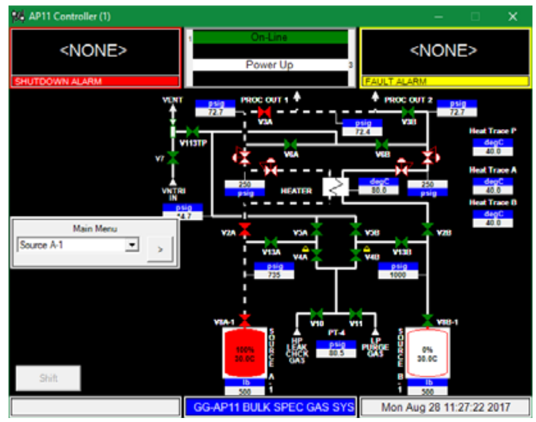
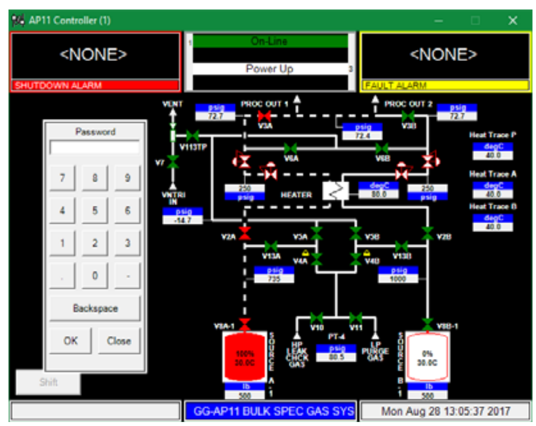
NOTE: There is no Dual Process Gas mode for systems with dual sources and the deep purge option. Sources must be run through the Process Gas mode individually upon completion of the 'DualPstPrg' mode and the individual 'Condition' modes for both sources.

4.F Stop and Restart Process Gas Flow

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

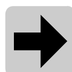
Stop Process Gas Flow

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.

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

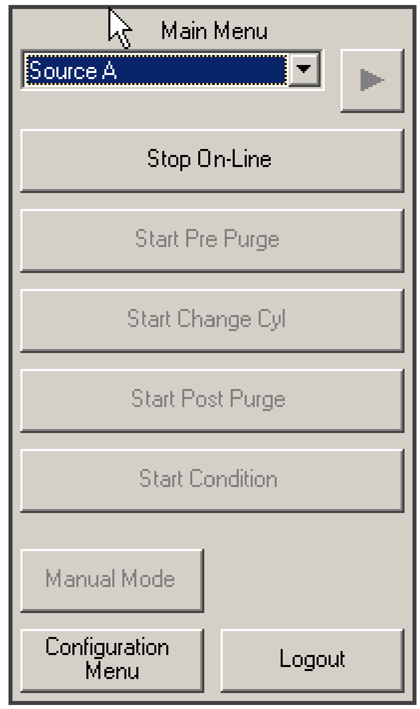
3. PASSWORD WINDOW

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

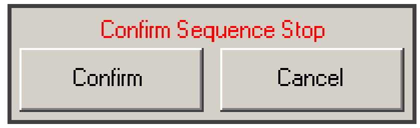
4. Main Menu screen will be displayed. Use the  and  keys or the drop down menu to select the correct source line.

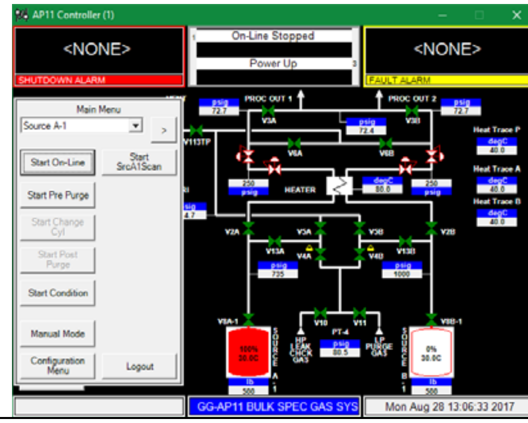
The following instructions are for source A, but the same procedure applies to source B.

5. Press the STOP ON-LINE pushbutton.

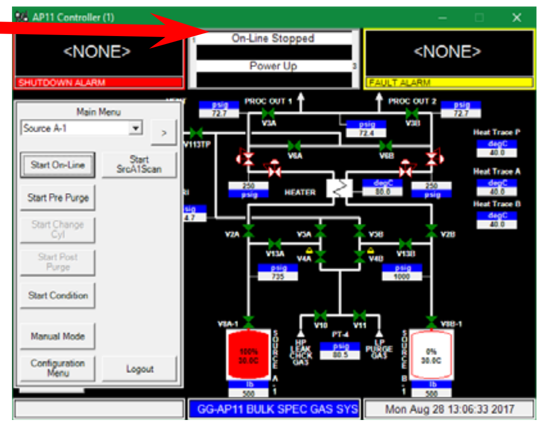


6. The Confirm Sequence **stop** window will be displayed. Press the CONFIRM pushbutton.





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



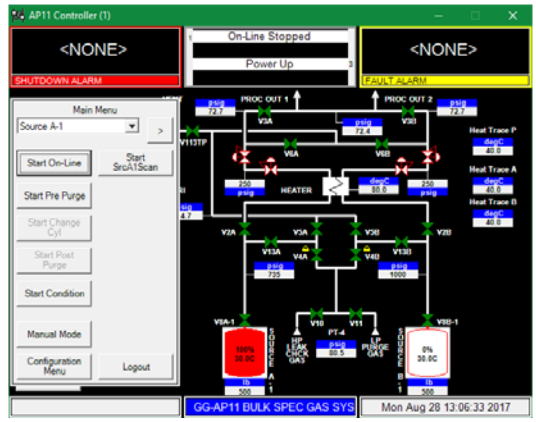
Note: Each source must be individually stopped.

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

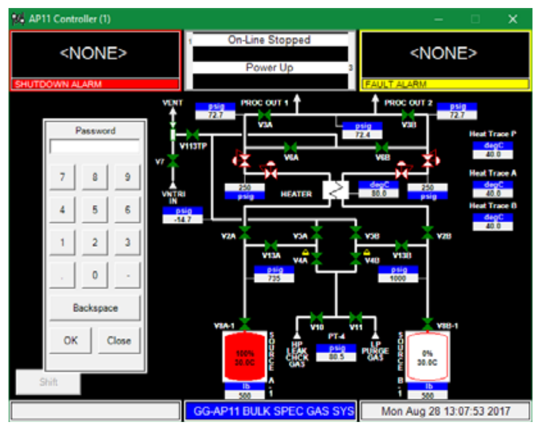
Restart Process Gas Flow

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

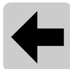
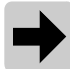


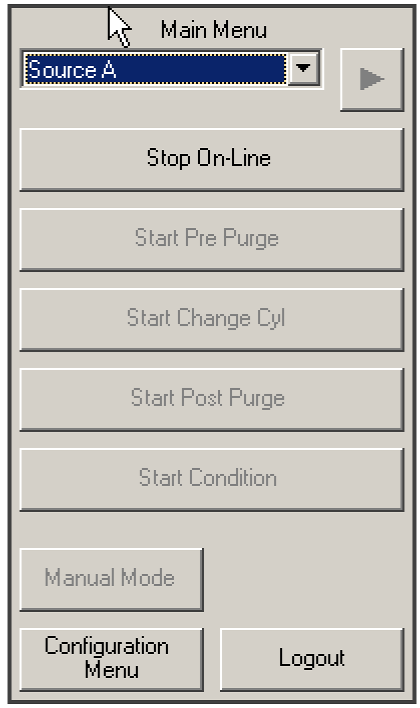
2. Touch anywhere on the graphics portion of the screen. Display will show a request for password input.



3. PASSWORD WINDOW

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

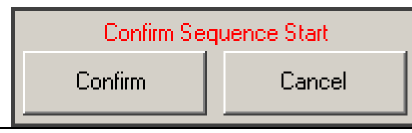
4. Main Menu screen will be displayed. Use the  and  keys or the drop down menu to select the left or right process line.



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

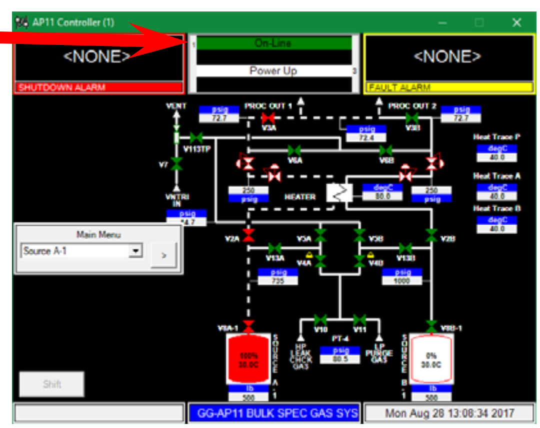
5. Press the START ON-LINE pushbutton.

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.

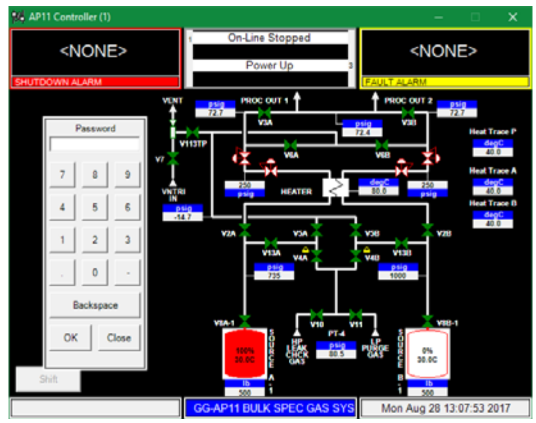
Upon display indicating “On-Line”, process gas will be flowing. The “Gas Flowing” LED on the right side of the controller will be lit.

4.G Idle Mode

Purpose: This Manual Sub-Section describes the 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 BSGS eV / BULKGUARD eV System in Manual Mode. Actuating valves in an improper sequence could potentially cause damage to the 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.

⚠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 (V6A / V6B) 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

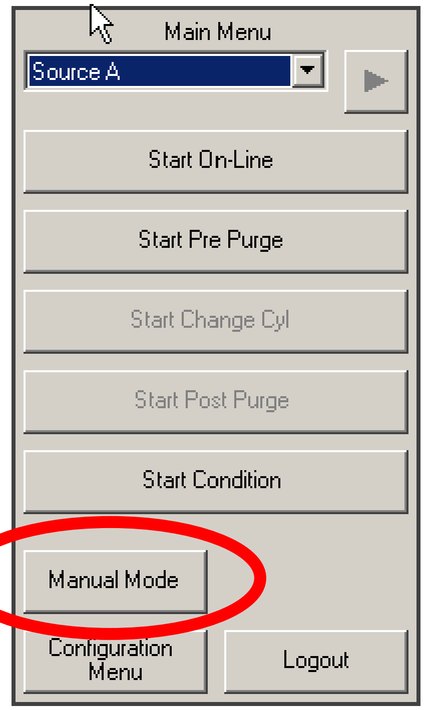
Operating in Manual Mode could cause the following hazards which can result in PERSONNEL INJURY OR DEATH.

- ***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.

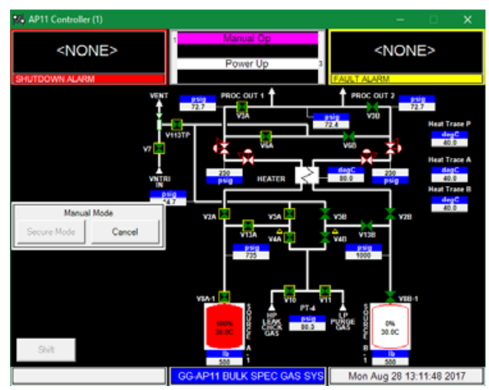
1. Touch anywhere on the graphics portion of the screen and enter the password.
2. Press OK.
3. Use the ← and → keys or the drop down menu to select the correct source line.

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.

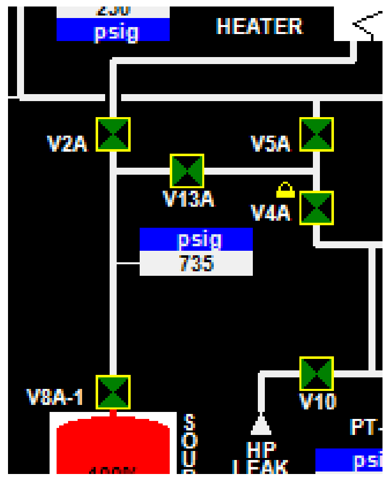
7. To exit MANUAL MODE, press CANCEL.

   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

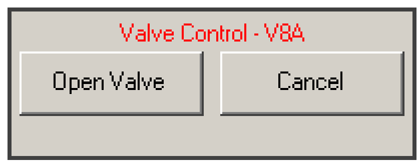
To Open a Valve:

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 once it is 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 the module unattended when Manual Mode is operating.***

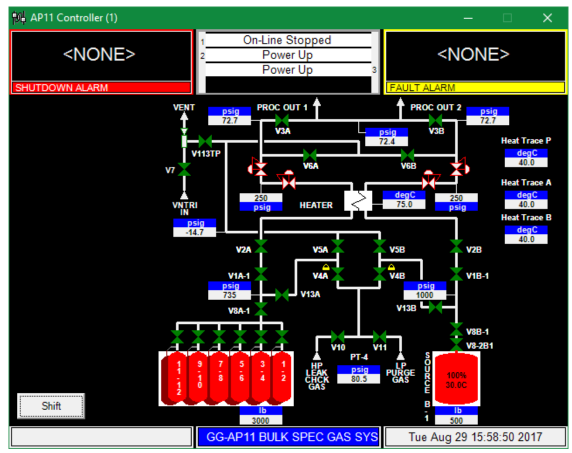
4.I Tube Switching

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, the tube switching program is accessed from the module AP11 controller.

The BSGS eV / BULKGUARD eV system allows for automated tube switching of 2 ISO's with one ISO being located on either process inlet. Due to I/O constraints, the tubes cannot be switched on a one-by-one (also referred to as '1x1') basis. Tubes are instead opened two at a time ('2x2'), actuated by a single pneumatic signal from the AP11 controller which has been split to simultaneously feed two pneumatic tube valves.

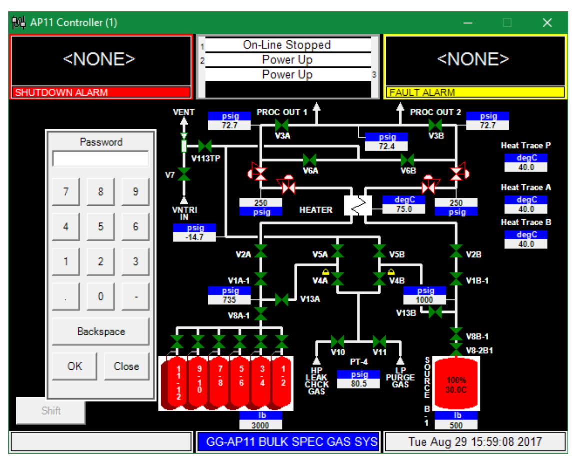
Start Tube Switcher Operation

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



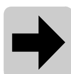
Verify that the manual process flow valves in the system are open.

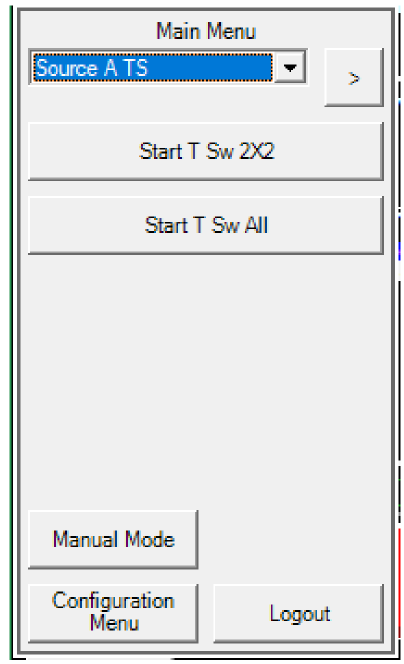
Touch anywhere on the graphics portion of the screen. Display will show a request for password input.



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 one of the Source x TS options.



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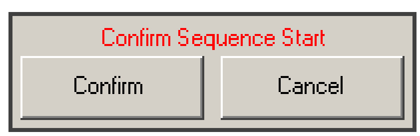
Press the START T SW 2x2 pushbutton to start the Tube Switcher with a dual tube switching. This will enable the switch to the next full pair of tubes as each previous pair of tubes is depleted.

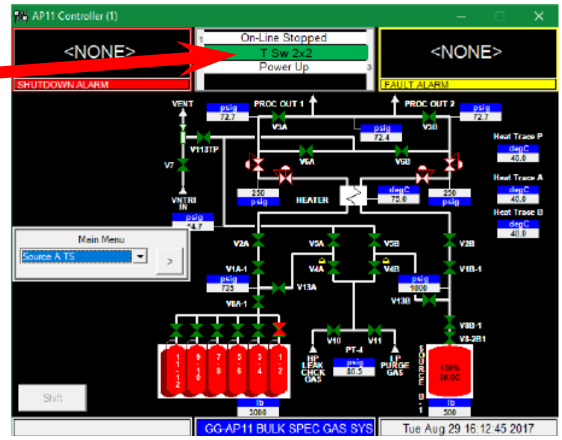
The Confirm Sequence Start window will be displayed. Press the CONFIRM pushbutton.



The "Gas Available" relay is energized.

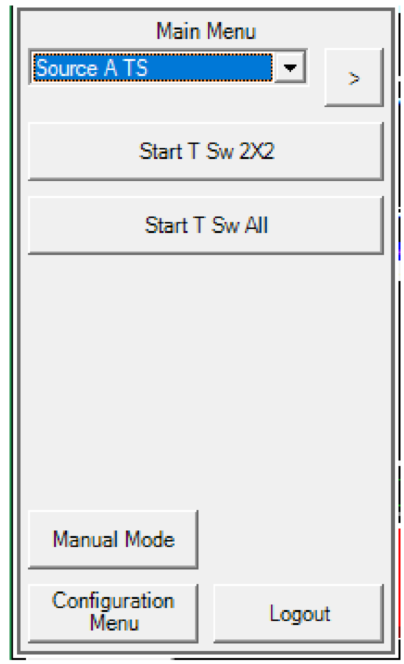
"T Sw 2x2" will be displayed.

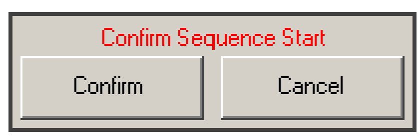
Process gas is now available to flow from the source.



For operating all tubes simultaneously:

Press the START T SW All button to start the Tube Switcher with all source tubes opened simultaneously.



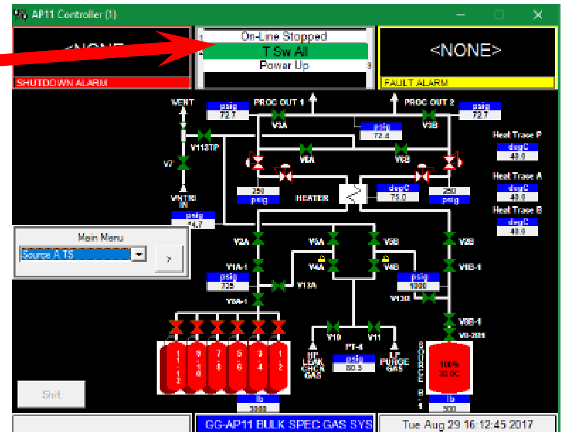


The Confirm Sequence Start window will be displayed. Press the CONFIRM pushbutton.

The “Gas Available” relay is energized.

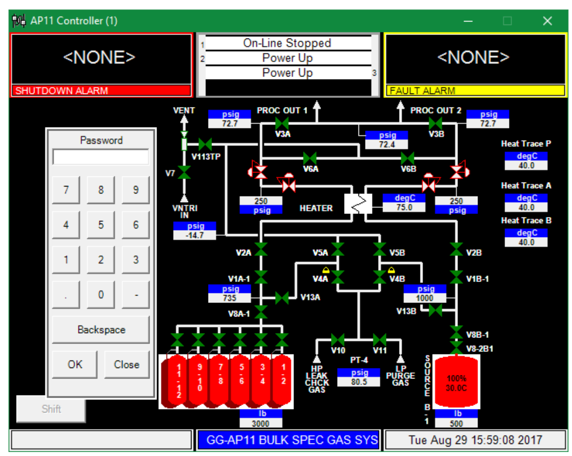
“T SW All” will be displayed.

Process gas is now available to flow from the source.



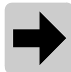
Stop Tube Switcher Operation

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 screenshot will be displayed. Use the  and  keys or the drop down menu to select the correct tube switcher.

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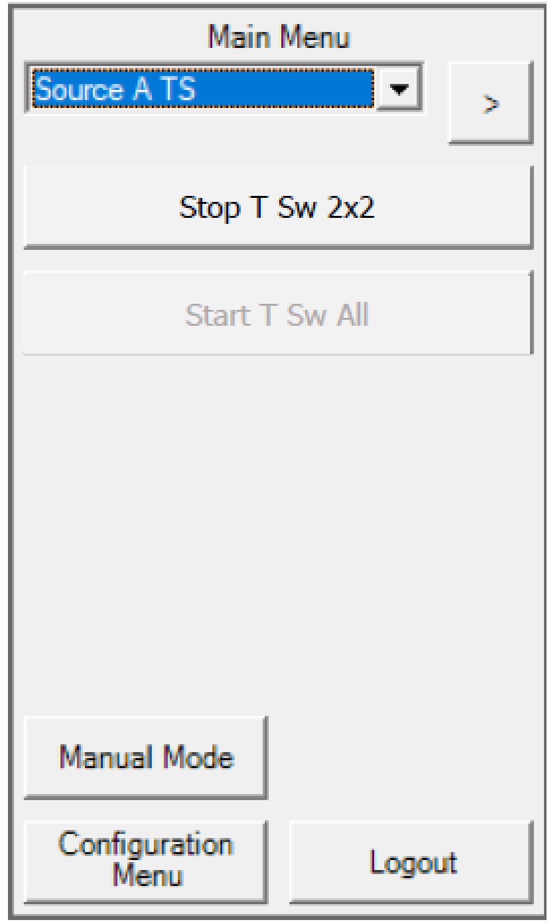
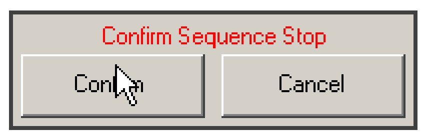
Press the appropriate STOP T SW button to stop the Tube Switcher. Only the active mode will be available for input. Other modes will be 'greyed' out as inactive.



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



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 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® AP11 Controller front panel, may be used at any time to manually shut down the 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

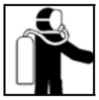
These procedures cover the steps the operator must follow to safely change a Y-container or drum. In the following procedure, "drum" is synonymous with "Y-container".

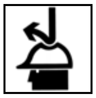
WARNING

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 pin that holds the flexible ventilation duct (if installed) 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.	

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

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 AP11 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.

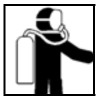
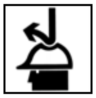
Change ISO Container

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 synonymous 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
Fixed 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 8-1

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® AP11 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 30 setpoints will exist per analog input. The number of user setpoints will be equal to 30 minus the number of Versum 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 are the Versum Materials, Inc. minimum values:

- Purge/Vent = 60 Cycles
- Condition = 0 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 button 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 window. New valve counts will be written to the NV Data File upon exiting and saving the Configuration Menu. To change the valve counts, select the solenoid of your choice by touching the screen. Use the keypad to type in a numeric value. Press Apply to accept the changes. Press the OK button 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 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  button to exit the window.

Fixed Analog Setpoints (VERSUM MATERIALS, INC. Setpoints)

The Fixed Setpoints window will display all analogs used in the system. The operator will be allowed to choose an analog from the drop down menu or exit the window. When the operator chooses an analog, the corresponding setpoints for that analog will be displayed. The Fixed Setpoints window will display the Versum Materials-defined analog alarm data. The window will display the alarm number, alarm label, and current alarm setpoint for each Versum Materials alarm. A total of 30 setpoints will exist per analog input. The number of Versum Materials fixed setpoints will be equal to 30 minus the number of user setpoints. This window will allow the operator to enter a new setpoint value for one or more chosen alarms or exit the window without changes. The Fixed Setpoints window will only be accessible with an Versum Materials-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

This option is not currently used in the BSGS eV / BULKGUARD eV product line.

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-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 manual reset switch.	Reset breaker, input correct temperature into AP11 controller. Reset TSH-5 (*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 manual reset switch.	Reset breaker, input correct temperature into AP11 controller. Reset TSH-5 (*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 BSGS eV / BULKGUARD® eV 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.
Runaway 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°F (43°C). (*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.
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/V-10/V-11 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 J-T Heater 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 J-T Heater 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 212ºF (100ºC). 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 and lock out power prior to opening the J-T heater lid.

TSH-5 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 9-1 for the location of the reset button.

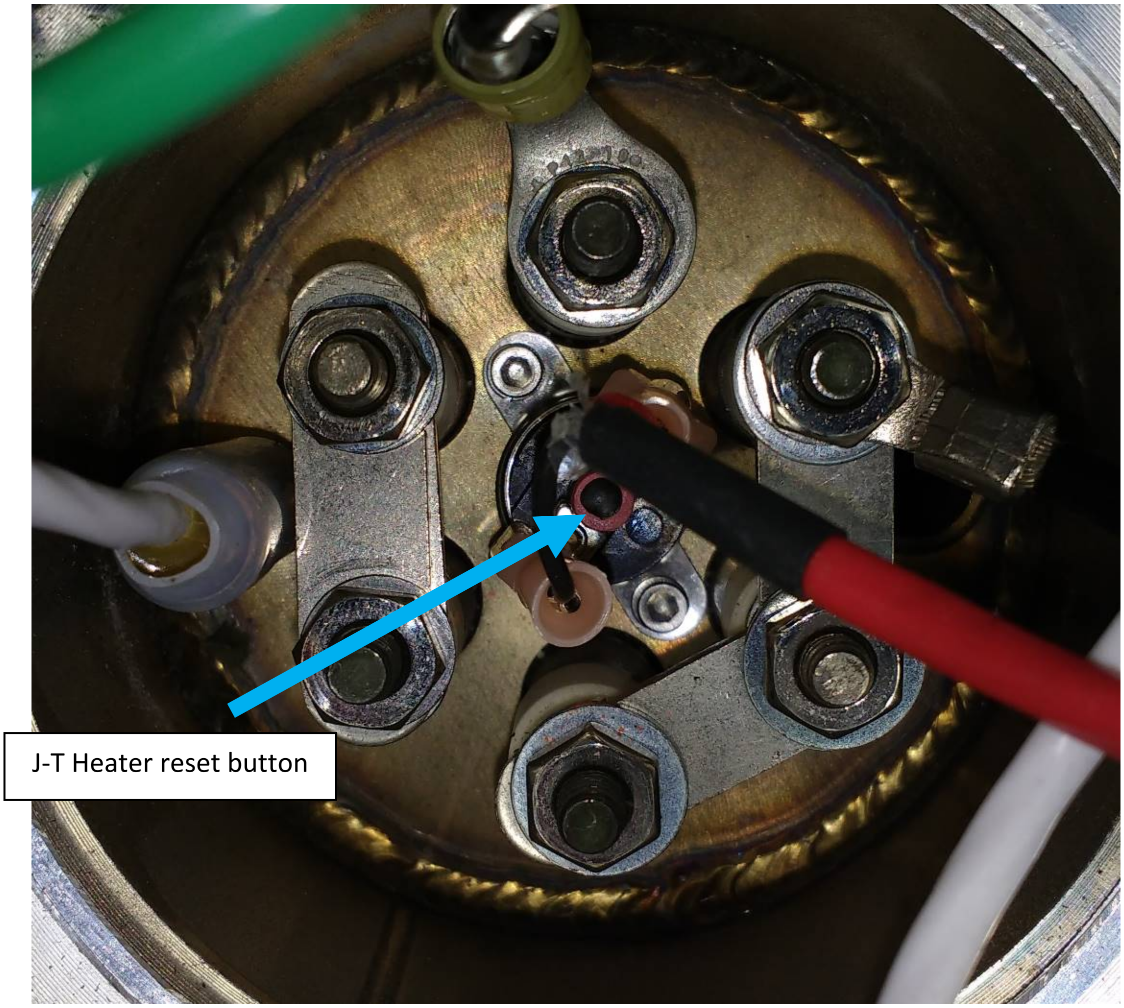


Figure 9-1: J-T Heater Reset Button

CAUTION! ***Before 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 and closing the top of the J-T heater, power can safely be restored. However, the cause of the over temperature situation must be investigated and remedied. Control of the heater 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.
Exhaust / Ventilation	Verify that exhaust is functioning properly, providing negative pressure at source connections.

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
BSGS eV / BULKGUARD eV 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
BSGS eV / BULKGUARD eV 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 interiors. Do not use pressurized water to clean inside or outside of cabinets as serious damage could occur to the electronic components.**
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 system shuts down.
Low- Low Process Source Pressure on all PT-1's.	Verify that process source pressure below the low-low setpoint initiates a process line shutdown.
High-High Process Source Weight on all WT-1's.	Verify that process liquid weight above the high-high setpoint initiates a process line shutdown.
Low-Low Process Source Weight on all WT-1's.	Verify that process liquid weight below the low-low setpoint initiates a process line module shutdown.
High-High Interstage Pressure on all PT-10's.	Verify that interstage pressure above the high-high setpoint initiates a process line shutdown.
High-High Delivery Pressure on PT-2A and PT-2B.	Verify that process delivery pressure above the high- high setpoint initiates a process line shutdown.
Low-Low Delivery Pressure on PT-2A and PT-2B.	Verify that process delivery pressure below the low-low setpoint initiates a process line shutdown.
Low-Low Houseline Pressure on PT-9.	Verify that houseline pressure below the low- low setpoint initiates a process line shutdown.

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.
Excess Flow Switch (EFS)	Verify that the excess flow switch trips on high flow and the system switches to the opposite flow train when it is in stand-by.

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 Z-Purge static pressure.
	Test operation of Ground Fault Circuit Breaker **GFP-102**. 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 Section 3 of this Chapter.***

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 thermocouple utilized on the JT heater assembly.
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:

- BSGS eV / GASGUARD eV Module
- Gas Detection Systems
- Valve Manifold Boxes

MI Maintenance Activities for BSGS eV / BULKGUARD eV Systems

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 – purge/HPLT module	All		
Verify accuracy of transducers activating high pressure shutdown (delivery and cylinder)	All		
Gas Detection System	T, F, P, C		
Inspect PRV – purge/HPLT module	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		

INSPECTION OR TEST	SYSTEM TYPE	ACCEPTABLE (Y/N/NA)	INSPECTED BY (Initial)
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 – purge/HPLT modules	F,P,T		
6 Years Date:			
Flexible hose testing or replacement	I,O		
Test or Replace safety relief valves – purge/HPLT modules	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 BSGS eV / BULKGUARD eV 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 can also result in a hazardous operating condition.

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 Test

Shock Hazard

With the control system energized open the ECC enclosure door. With ground fault circuit breaker **GFP-102** energized heater line voltage should be present on the output terminals (Wires 1022 & 1032). Use a DVM to verify.

Press the **TEST** button on **GFP-102** and verify that the breaker trips. Use a DVM to verify. **Reset GFP-102**.

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
High-High Temperature Switch **TSH-5**	5 yrs
Power Solid-State Relays **SSR-203, SSR-207, SSR-211, and SSR-215**	5 yrs (typical) Life expectancy varies depending on the duty cycle of the heater and the ambient temperature.
Power Contactor **CR-202**	5 yrs (typical) Life expectancy varies depending on the frequency the device is cycled between the on and off state and the ambient temperature.
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

Installation Drawing Package

Process Flow Diagrams

Module - Cross Purge	BSGeV-PFD-0001
Module - Deep Purge	BSGeV-PFD-0002
Module - Deep Purge w/ Venturi	BSGeV-PFD-0003
Deep Purge panel/shroud	BSGeV-PFD-0004
Deep Purge w/ Venturi panel/shroud	BSGeV-PFD-0005

Electrical Drawings

AP11 Alarm Matrix	XL000481
Elementary Wiring Diagram	BNTLY001044
Electrical Installation Drawing	SW019593

Mechanical Drawings

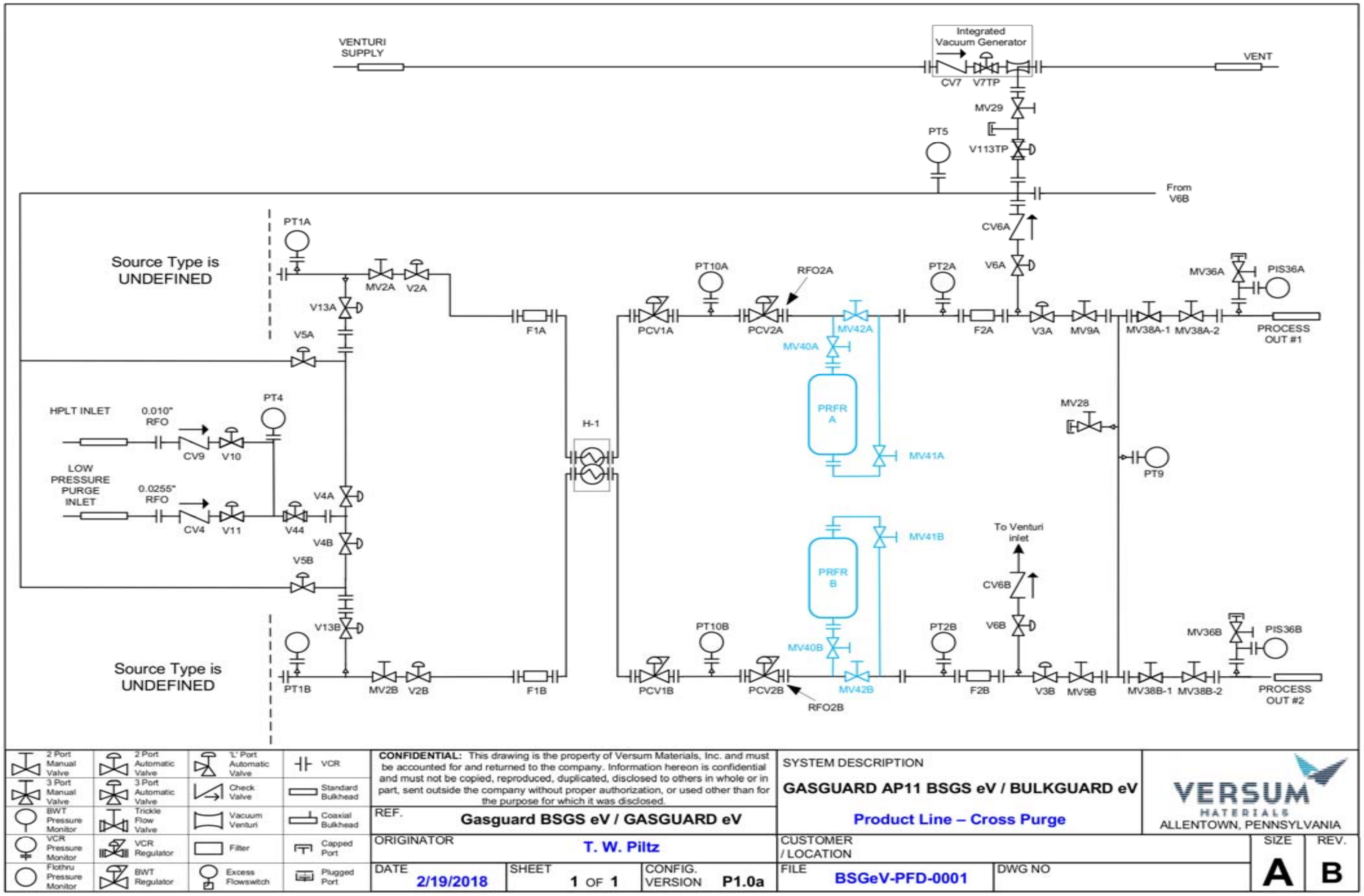
Cabinet	SW019553
Rack	SW019596
Deep Purge/Venturi Panels	SW019824
Ducting for Deep Purge/Venturi	SW019820
PVC End Cap for Source	BSGeV-MECH-0031
Field Details Tube Switcher	BSGeV-MECH-0032
Field Details BSGeV Cylinder Flag	SW020039

Pneumatic Assignments

Pneumatic Installation	SW019819
Single actuation (Y, drum, tonner, NH3 ISO)	BSGeV-MECH-0011
Dual actuation (MCP, ISO w/ 1TP)	BSGeV-MECH-0012
Tube switching - harness with dual tube adapters	BSGeV-MECH-0013
Controller - Cross Purge	BSGeV-MECH-0021
Controller - Deep Purge	BSGeV-MECH-0022
Controller - Deep Purge w/ Venturi	BSGeV-MECH-0023
Cylinder Flags Pneu Assignments	BSGeV-MECH-0024

Heat Trace Documents

Heat trace installation drawing	SW019766
Heat trace installation instruction	DOC000104.doc
Boot installation	WOK-INS1133A.doc
Termination preparation	SW005531


VENTURI SUPPLY
Integrated Vacuum Generator
CV7
V7TP
VENT
MV29
PT5
V113TP
From V6B
CV6A
V6A
PT1A
Source Type is UNDEFINED
MV2A
V2A
V13A
V5A
F1A
PT10A
RFO2A
PCV1A
PCV2A
MV42A
MV40A
PRFR A
MV41A
PT2A
F2A
V3A
MV9A
MV36A
PIS36A
MV38A-1
MV38A-2
PROCESS OUT #1
HPLT INLET
0.010" RFO
CV9
V10
PT4
LOW PRESSURE PURGE INLET
0.0255" RFO
CV4
V11
V44
V4A
V4B
V5B
H-1
MV28
PT9
MV41B
PRFR B
To Venturi inlet
CV6B
V6B
V13B
PT10B
PT2B
MV36B
PIS36B
MV40B
Source Type is UNDEFINED
PT1B
MV2B
V2B
F1B
PCV1B
PCV2B
MV42B
RFO2B
F2B
V3B
MV9B
MV38B-1
MV38B-2
PROCESS OUT #2
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
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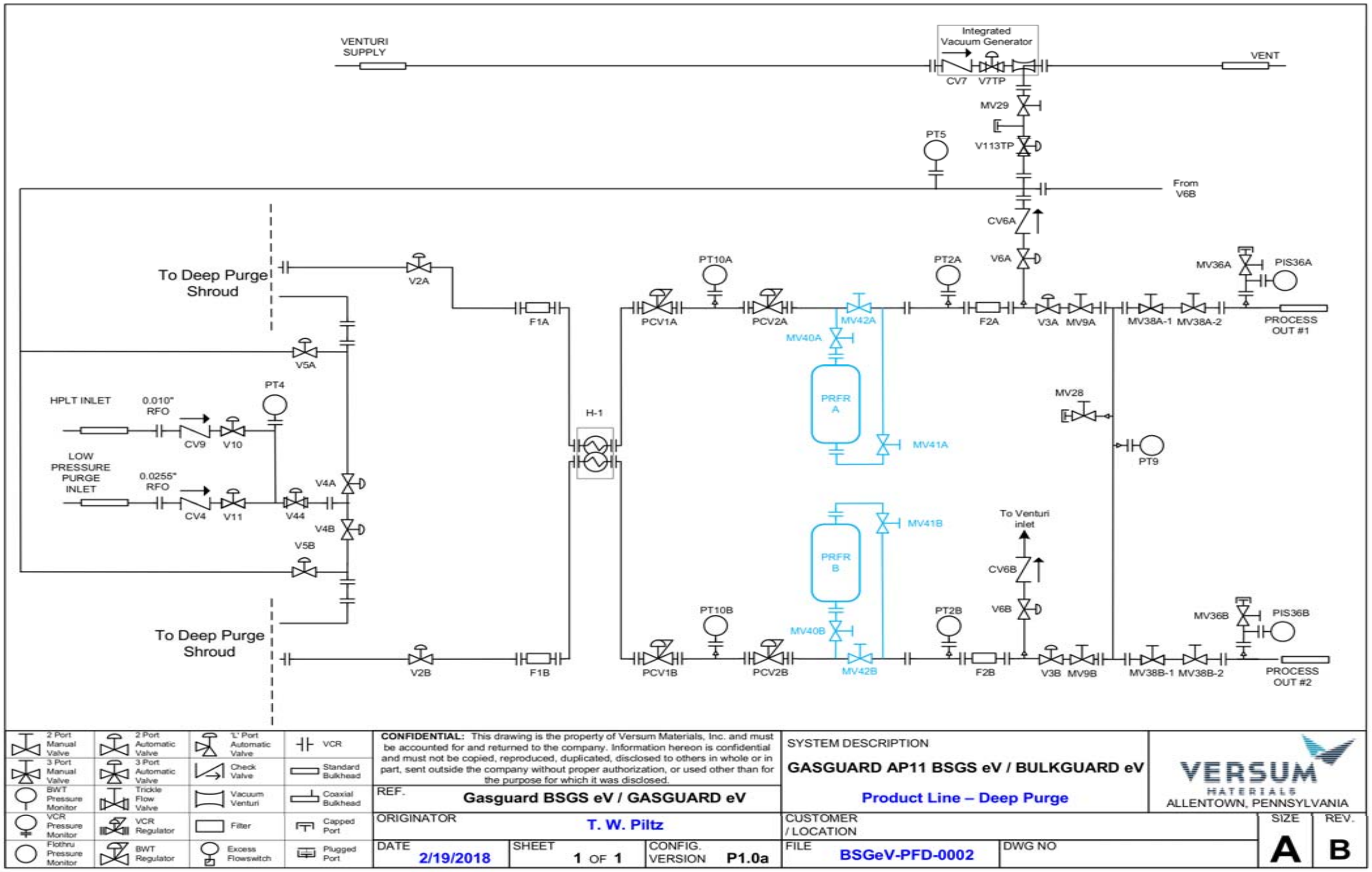
SYSTEM DESCRIPTION
GASGUARD AP11 BSGS eV / BULKGUARD eV
VERSUM MATERIALS
ALLENTOWN, PENNSYLVANIA
REF.
Gasguard BSGS eV / GASGUARD eV
Product Line – Cross Purge
ORIGINATOR
T. W. Piltz
CUSTOMER / LOCATION
SIZE
REV.
DATE
2/19/2018
SHEET
1 OF 1
CONFIG. VERSION
P1.0a
FILE
BSGeV-PFD-0001
DWG NO
A
B


VENTURI SUPPLY
Integrated Vacuum Generator
CV7
V7TP
VENT
MV29
PT5
V113TP
From V6B
CV6A
V6A
PT2A
PT10A
MV36A
PIS36A
To Deep Purge Shroud
V2A
F1A
PCV1A
PCV2A
MV42A
MV40A
F2A
V3A
MV9A
MV38A-1
MV38A-2
PROCESS OUT #1
V5A
PT4
HPLT INLET
0.010" RFO
CV9
V10
H-1
PRFR A
MV28
MV41A
PT9
LOW PRESSURE PURGE INLET
0.0255" RFO
CV4
V11
V44
V4A
V4B
V5B
MV41B
To Venturi inlet
PRFR B
CV6B
V6B
PT10B
PT2B
MV36B
PIS36B
MV40B
To Deep Purge Shroud
V2B
F1B
PCV1B
PCV2B
MV42B
F2B
V3B
MV9B
MV38B-1
MV38B-2
PROCESS OUT #2
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
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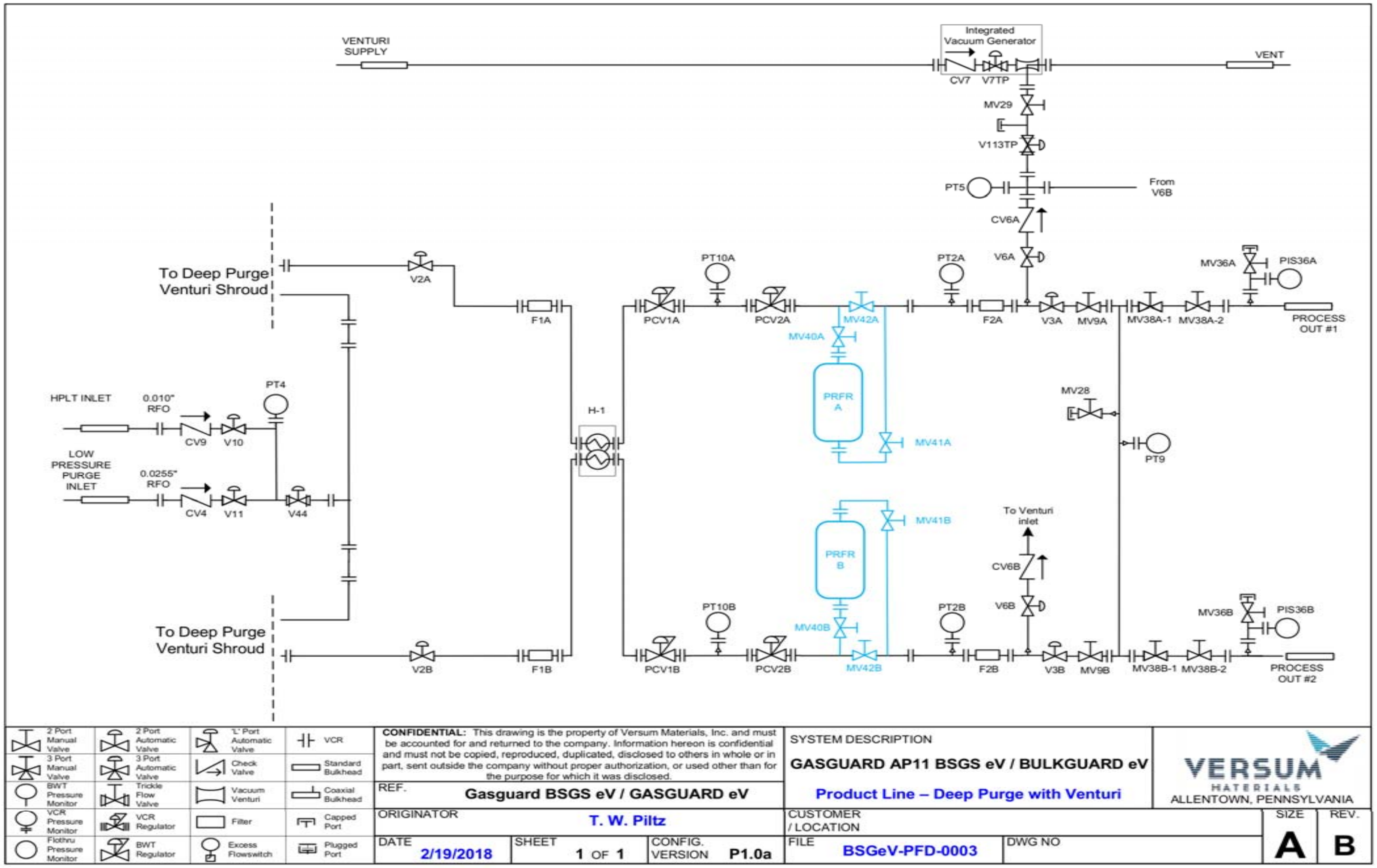
REF.
Gasguard BSGS eV / GASGUARD eV
ORIGINATOR
T. W. Piltz
DATE
2/19/2018
SHEET
1 OF 1
CONFIG. VERSION
P1.0a
SYSTEM DESCRIPTION
GASGUARD AP11 BSGS eV / BULKGUARD eV
Product Line – Deep Purge
VERSUM MATERIALS
ALLENTOWN, PENNSYLVANIA
CUSTOMER / LOCATION
SIZE
REV.
FILE
BSGeV-PFD-0002
DWG NO
A
B


VENTURI SUPPLY
Integrated Vacuum Generator
CV7
V7TP
VENT
MV29
V113TP
PT5
From V6B
CV6A
V6A
PT10A
PT2A
MV36A
PIS36A
To Deep Purge Venturi Shroud
V2A
F1A
PCV1A
PCV2A
MV42A
F2A
V3A
MV9A
MV38A-1
MV38A-2
PROCESS OUT #1
MV40A
PT4
HPLT INLET
0.010" RFO
CV9
V10
H-1
PRFR A
MV41A
MV28
PT9
LOW PRESSURE PURGE INLET
0.0255" RFO
CV4
V11
V44
PRFR B
MV41B
To Venturi inlet
CV6B
PT10B
PT2B
V6B
MV36B
PIS36B
MV40B
To Deep Purge Venturi Shroud
V2B
F1B
PCV1B
PCV2B
MV42B
F2B
V3B
MV9B
MV38B-1
MV38B-2
PROCESS OUT #2
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
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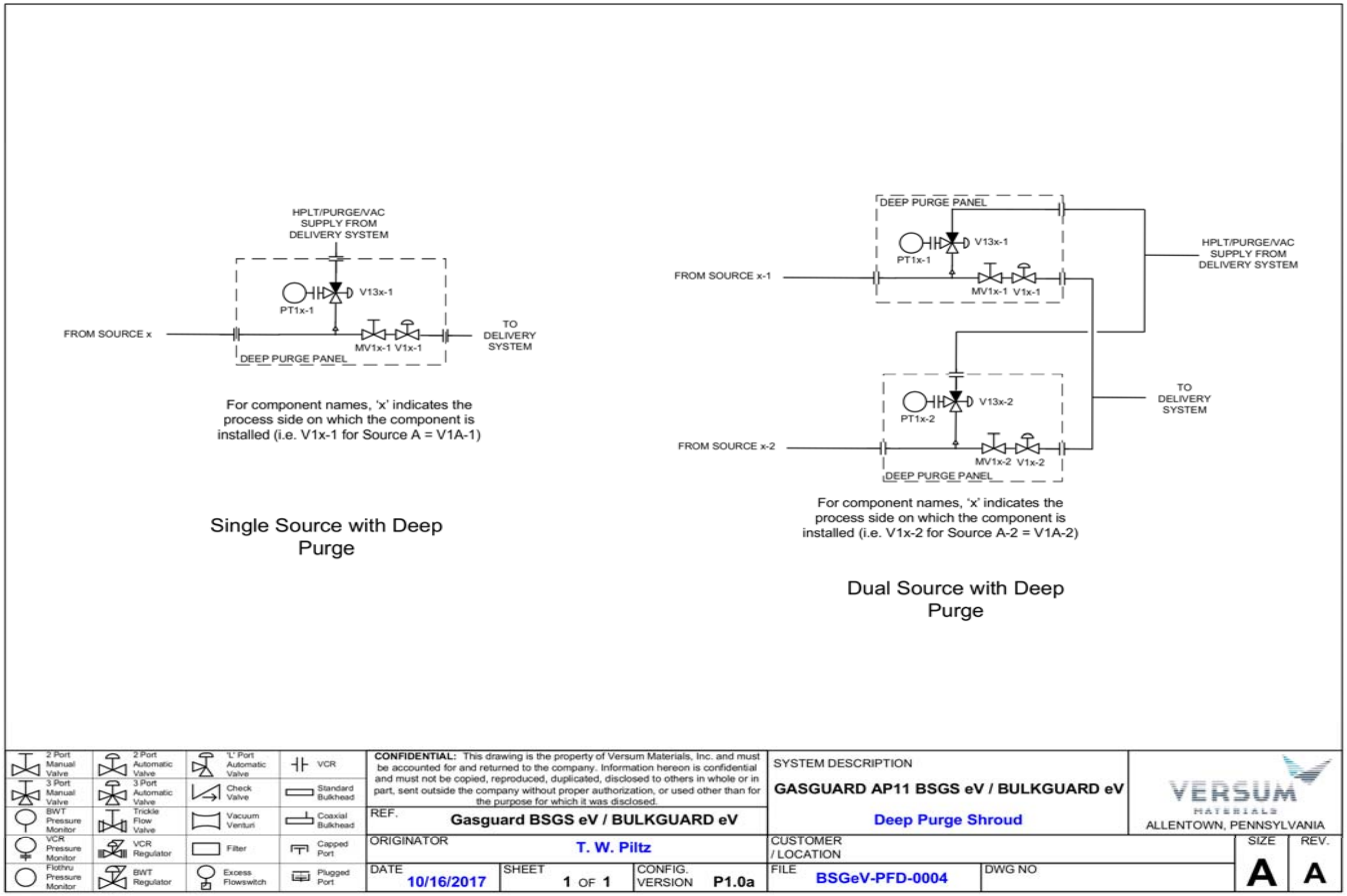
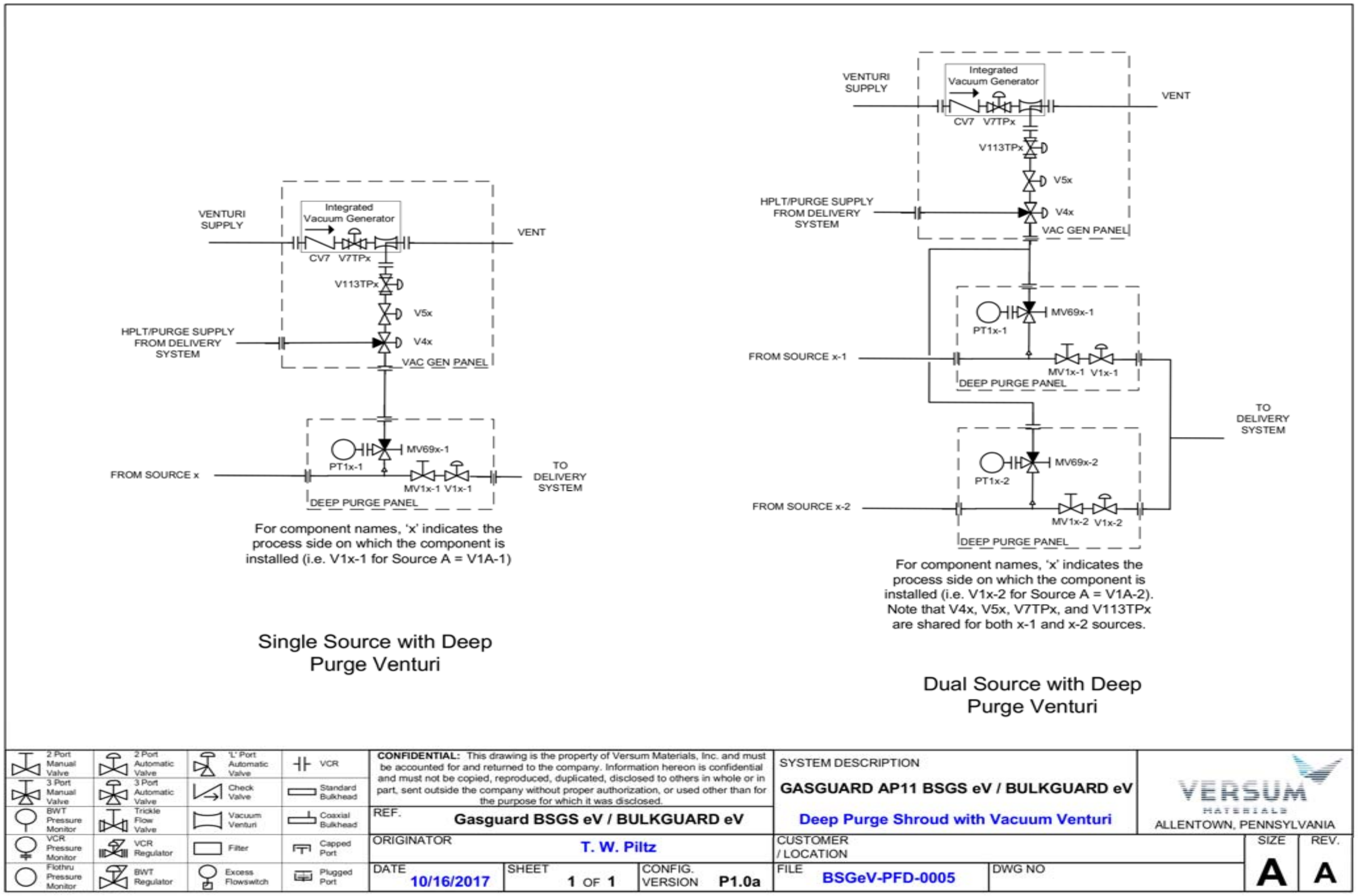
SYSTEM DESCRIPTION
GASGUARD AP11 BSGS eV / BULKGUARD eV
REF.
Gasguard BSGS eV / GASGUARD eV
Product Line – Deep Purge with Venturi
VERSUM MATERIALS
ALLENTOWN, PENNSYLVANIA
ORIGINATOR
T. W. Piltz
CUSTOMER / LOCATION
SIZE
REV.
DATE
2/19/2018
SHEET
1 OF 1
CONFIG. VERSION
P1.0a
FILE
BSGeV-PFD-0003
DWG NO
A
B


HPLT/PURGE/VAC SUPPLY FROM DELIVERY SYSTEM
V13x-1
PT1x-1
FROM SOURCE x
MV1x-1 V1x-1
TO DELIVERY SYSTEM
DEEP PURGE PANEL
For component names, 'x' indicates the process side on which the component is installed (i.e. V1x-1 for Source A = V1A-1)
Single Source with Deep Purge
DEEP PURGE PANEL
V13x-1
PT1x-1
FROM SOURCE x-1
MV1x-1 V1x-1
HPLT/PURGE/VAC SUPPLY FROM DELIVERY SYSTEM
TO DELIVERY SYSTEM
V13x-2
PT1x-2
FROM SOURCE x-2
MV1x-2 V1x-2
DEEP PURGE PANEL
For component names, 'x' indicates the process side on which the component is installed (i.e. V1x-2 for Source A-2 = V1A-2)
Dual Source with Deep Purge
2 Port Manual Valve
3 Port Manual Valve
BWT Pressure Monitor
VCR Pressure Monitor
Flothru Pressure Monitor
2 Port Automatic Valve
3 Port Automatic Valve
Trickle Flow Valve
VCR Regulator
BWT Regulator
'L' Port Automatic Valve
Check Valve
Vacuum Venturi
Filter
Excess Flowswitch
VCR
Standard Bulkhead
Coaxial Bulkhead
Capped Port
Plugged Port
CONFIDENTIAL: This drawing is the property of Versum Materials, 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.
REF. Gasguard BSGS eV / BULKGUARD eV
ORIGINATOR T. W. Piltz
DATE 10/16/2017
SHEET 1 OF 1
CONFIG. VERSION P1.0a
SYSTEM DESCRIPTION
GASGUARD AP11 BSGS eV / BULKGUARD eV
Deep Purge Shroud
VERSUM MATERIALS
ALLENTOWN, PENNSYLVANIA
CUSTOMER / LOCATION
FILE BSGeV-PFD-0004
DWG NO
SIZE A
REV. A


VENTURI SUPPLY
Integrated Vacuum Generator
VENT
CV7 V7TPx
V113TPx
V5x
HPLT/PURGE SUPPLY FROM DELIVERY SYSTEM
V4x
VAC GEN PANEL
MV69x-1
PT1x-1
FROM SOURCE x
MV1x-1 V1x-1
TO DELIVERY SYSTEM
DEEP PURGE PANEL
For component names, 'x' indicates the process side on which the component is installed (i.e. V1x-1 for Source A = V1A-1)
Single Source with Deep Purge Venturi
VENTURI SUPPLY
Integrated Vacuum Generator
VENT
CV7 V7TPx
V113TPx
V5x
HPLT/PURGE SUPPLY FROM DELIVERY SYSTEM
V4x
VAC GEN PANEL
MV69x-1
PT1x-1
FROM SOURCE x-1
MV1x-1 V1x-1
DEEP PURGE PANEL
TO DELIVERY SYSTEM
MV69x-2
PT1x-2
FROM SOURCE x-2
MV1x-2 V1x-2
DEEP PURGE PANEL
For component names, 'x' indicates the process side on which the component is installed (i.e. V1x-2 for Source A = V1A-2). Note that V4x, V5x, V7TPx, and V113TPx are shared for both x-1 and x-2 sources.
Dual Source with Deep Purge Venturi
2 Port Manual Valve
3 Port Manual Valve
BWT Pressure Monitor
VCR Pressure Monitor
Flothru Pressure Monitor
2 Port Automatic Valve
3 Port Automatic Valve
Trickle Flow Valve
VCR Regulator
BWT Regulator
'L' Port Automatic Valve
Check Valve
Vacuum Venturi
Filter
Excess Flowswitch
VCR
Standard Bulkhead
Coaxial Bulkhead
Capped Port
Plugged Port
CONFIDENTIAL: This drawing is the property of Versum Materials, 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
GASGUARD AP11 BSGS eV / BULKGUARD eV
REF. Gasguard BSGS eV / BULKGUARD eV
Deep Purge Shroud with Vacuum Venturi
VERSUM MATERIALS
ALLENTOWN, PENNSYLVANIA
ORIGINATOR T. W. Piltz
CUSTOMER / LOCATION
SIZE A
REV. A
DATE 10/16/2017
SHEET 1 OF 1
CONFIG. VERSION P1.0a
FILE BSGeV-PFD-0005
DWG NO

DELIVERY SYSTEMS & SERVICES

Gasguard BSGS eV / BULKGUARD eV **DIGITAL INPUT** **MASTER ALARM AND INTERLOCK MATRIX** **AP11 Controller**	**Mechanical/Systems** Y. Fatima **Controls:** JP Prego **Check** **Approved:** T.Piltz	Doc. Number XL000481 Revision 2 Date 09/28/2018 MOC: Reference Software Flow Logic

										Operating Mode Alarms										Customer Digital Outputs (Relay Default State)											
Digital Input Number	Alarm Description	Alarm Tag	Alarm Label (Controller)	Comments	Hardwire Jumper	Time Delay (sec)	Alarm Condition (O / C)	Special Condition	Response Sequence	On-Line Mode - Source A1	On-Line Mode - Source A2	On-Line Mode - Source B1	On-Line Mode - Source B2	Online Standby Mode	Pre-Purge Mode	Change Cylinder Mode (and HPLT)	Post-Purge Mode	Conditioning Cycle Mode	Idle Mode	(Relay 1; DO9) Gas Available	(Relay 2; DO10) Module Fault	(Relay 3; DO11) Module Shutdown	(Relay 4; DO12) UVIR / High Temp	(Relay 5; DO13) Src A2 Heater Permissive	(Relay 6; DO14) Src B2 Heater Permissive	(Relay 7; DO15) Src A1 Heater Permissive	(Relay 8; DO16) Src B1 Heater Permissive	(Relay 9: DO17) Open	(Relay 10; DO18) Reset UVIR Source A1	(Relay 11; DO19) Reset UVIR Source B1	(Relay 12: DO20) Open
																				ND	E	E	D	E	E	E	E	E	D	D	E
1	Emergency Stop	UA-1	EMERGENCY STOP			0	O		17	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)			D		D	D	D	D				
2	Low Z-Purge	PIS-206	LOW Z-PURGE			10	O			F	F	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	F	F		D										
4	Power Supply #2 Fault	QA-2	Power Supply #2			0	O			F	F	F	F	F	F	F	F	F	F		D										
5	Supervisory Open		SUPERVISORY OPEN			0	O			F	F	F	F	F	F	F	F	F	F		D										
6	Life Safety System (supervised)	UA-2	LIFE SAFETY SYSTEM			0	O		17	S	S	S	S	S	S	S	S	S	S			D		D	D	D	D				
7	Supervisory Open		SUPERVISORY OPEN			0	O			F	F	F	F	F	F	F	F	F	F		D										
8	Remote Shutdown (supervised)	UA-7	REMOTE SHUTDOWN			0	O		17	S	S	S	S	S	S	S	S	S	S			D		D	D	D	D				
9	Coax Leak 36-1	PIS-36A	COAX LEAK-DELIVERY			0	O			F	F	F	F	F	F	F	F	F	F		D										
10	Coax Leak 36-2	PIS-36B	COAX LEAK-DELIVERY			0	O			F	F	F	F	F	F	F	F	F	F		D										
11	Smoke detector	SD-1	SMOKE DETECT	N1		0	O			F	F	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	F	F		D										
13	Coax Leak 36-3	PIS-36C	COAX LEAK-DELIVERY			0	O			F	F	F	F	F	F	F	F	F	F		D										
14	Coax Leak 36-4	PIS-36D	COAX LEAK-DELIVERY			0	O			F	F	F	F	F	F	F	F	F	F		D										
15	UVIR Fault Alarm - Panel	UA-17	UVIR FAULT			0	O			F	F	F	F	F	F	F	F	F	F		D										
16																															
17	Excess Flow Switch A	EFS2-A	EXCESS FLOW A			3	O			SB	SB											D									
18	Excess Flow Switch B	EFS2-B	EXCESS FLOW B			3	O					SB	SB									D									
19	UVIR Flame Detected - Panel	RSHH-17	UVIR FLAME DETECT			0	O		37	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)			D	E	D	D	D	D				
20	High Temperature Switch	TSHH-1	HIGH TEMP SWITCH			0	O		33	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)			D	E	D	D	D	D				
21	UVIR Flame Verify - Src A2	RSHH-18	UVIR FIRE S-A2			0	O		26	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)			D	E	D							
22	UVIR Flame Verify - Src B2	RSHH-19	UVIR FIRE S-B2			0	O		27	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)			D	E		D						
23	UVIR Fault Alarm - Src A2	UA-18A2	UVIR FAULT S-A2			0	O				F			F	F	F	F	F	F												
24	UVIR Fault Alarm - Src B2	UA-19B2	UVIR FAULT S-B2			0	O						F	F	F	F	F	F	F												
25	Src A2 Htr Fault	UA-8A2	SRC A2 HEATER			0	O				F			F	F	F	F	F	F		D										
26	Src A2 Remote Shutdown	UA-7A2	REMOTE S/D A2			0	O		24		S			S	S	S	S	S	S			D	E	D							
27	Src B2 Htr Fault	UA-8B2	SRC B2 HEATER			0	O				F			F	F	F	F	F	F		D										
28	Src B2 Remote Shutdown	UA-7B2	REMOTE S/D B2			0	O		25				S	S	S	S	S	S	S			D	E		D						
29																															
30																															
31																															
32																															
33	UVIR Flame Verify - Src A1	RSHH-15	UVIR FIRE S-A1			0	O		22	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)			D	E			D			E		
34	UVIR Flame Verify - Src B1	RSHH-16	UVIR FIRE S-B1			0	O		23	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)			D	E				D			E	
35	Life Safety System	UA-2	LIFE SAFETY SYSTEM			0	O		17	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)	S (HW)			D				D	D				
36	Src A1 Remote Shutdown	UA-7A1	REMOTE S/D A1			0	O		22	S				S	S	S	S	S	S			D	E			D			E		
37	Src B1 Remote Shutdown	UA-7B1	REMOTE S/D B1			0	O		23			S		S	S	S	S	S	S			D	E				D			E	
38	Vent/Scrubber Unavailable	UA-14	VENT UNAVAILABLE			0	O		34	N (F)	N (F)	N (F)	N (F)	N (F)	N (S)	N (S)	N (S)	N (S)	N (S)		D	D									
39	Src A1 Heater Fault	UA-8A1	SRC A1 HEATER			0	O			F				F	F	F	F	F	F		D										
40	Src B1 Heater Fault	UA-8B1	SRC B1 HEATER			0	O					F		F	F	F	F	F	F		D										
41	UVIR Fault Alarm - Src A1	UA-15A1	UVIR FAULT S-A1			0	O			F				F	F	F	F	F	F		D										
42	UVIR Fault Alarm - Src B1	UA-16B1	UVIR FAULT S-B1			0	O					F		F	F	F	F	F	F		D										
53	JT Heater Overtemp	TE-5	JT HEATER OVERTEMP			0	O			F	F	F	F	F	F	F	F	F	F		D										

Notes: 1 - Only required when ETO Smoke detector is installed

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	

DELIVERY SYSTEMS & SERVICES

Gasguard BSGS eV / BULKGUARD eV
ANALOG INPUT
MASTER ALARM AND INTERLOCK MATRIX
AP11 Controller

Mechanical/Systems Y. Fatima
Controls: JP Prego
Safety:
Approved: T.Piltz

Doc Number	XL000481
Revision	2
Date	09/28/2018
MOC:	
Reference Software Flow Logic	

Gas / Source							4%H2/N2 MCP or Y	CF4 MCP or Y	Cl2 Y Cyl.	CO2 ISO or TT	CO2 Drum	CO2 Y	HCl ISO or TT	HCl 900 L Drum	HCl Y	NF3 ISO or TT	NF3 Y or Drum	NH3 ISO	NH3 930L Drum	NH3 Y Cyl.	N2O ISO or TT	N2O Drum	N2O Y	SF6 Y Cyl.	SiH4 ISO	SiH4 MCP, Y, or Drum
Analog/Alarm Number	Analog Description	Alarm Description	Alarm Tag	Alarm Label (Controller)	Comments	Time Delay (sec)	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-2A																									
1/2		High High Delivery Pressure PT-2A	PSHH-2A	H H Delivery PT-2A		0	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125
1/3		High Delivery Pressure PT-2A	PAH-2A	High Delivery PT2A		0	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110
1/4		Low Delivery Pressure PT-2A	PAL-2A	Low Delivery PT-2A		1	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-2A	PSLL-2A	L L Delivery PT-2A		1	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
2/1	PT-2B																									
2/2		High High Delivery Pressure PT-2B	PSHH-2B	H H Delivery PT-2B		0	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125
2/3		High Delivery Pressure PT-2B	PAH-2B	High Delivery PT2B		0	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110
2/4		Low Delivery Pressure PT-2B	PAL-2B	Low Delivery PT-2B		1	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65
2/5		Low Low Delivery Pressure PT-2B	PSLL-2B	L L Delivery PT-2B		1	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
3/1	PT-5B	High Vent Pressure B	PAH-5B	High Vent PT5B		10	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 B	PAL-5B	Low Vac PT5B		0	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
3/3		High Pressure PT5B		High PT-5B		255	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
3/4		High Pressure PT5B		High PT-5B		0	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
4/1	PT-5A	High Vent Pressure A	PAH-5A	High Vent PT5A	(N10)	10	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
4/2		Low Vacuum Pressure A	PAL-5A	Low Vac PT5A		0	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
4/3		High Pressure PT5A		High PT-5A		255	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
4/4		High Pressure PT5A		High PT-5A		0	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
5/1	PT-4	High High Purge Delivery Pressure	PAHH-4	H H Purge PT-4		0	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
5/2		High Purge Delivery Pressure	PAH-4	High Purge PT-4		0	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125
5/3		Low Purge Delivery Pressure	PAL-4	Low Purge PT-4		10	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70
5/4		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
5/5		High Pressure PT4		High PT-4	(N12)	255	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
5/6		High Pressure PT4		High PT-4	(N12)	0	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
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
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
7/1	PT-10A	High-High Interstage Pressure A	PSHH-10A	HH Intrstg Pres A	(N11)	0	600	600	N/A	600	600	600	600	600	600	600	600	130	130	130	600	600	600	450	600	600
7/2		High Interstage Pressure A	PAH-10A	Hi Intrstg Pres A	(N11)	0	450	450	N/A	450	450	450	450	450	450	450	450	125	125	125	450	450	450	350	450	450
8/1	PT-10B	High-High Interstage Pressure B	PSHH-10B	HH Intrstg Pres B	(N11)	0	600	600	N/A	600	600	600	600	600	600	600	600	130	130	130	600	600	600	450	600	600
8/2		High Interstage Pressure B	PAH-10B	Hi Intrstg Pres B	(N11)	0	450	450	N/A	450	450	450	450	450	450	450	450	125	125	125	450	450	450	350	450	450
9/1	PT-1A2	High Source Pressure PT-1A2	PAH-1A2	High Source PT1A2		0	2700	2700	160	1900	1900	1900	1300	1300	1300	2060	2060	250	230	230	1600	1600	1600	545	2300	2300
9/2		Low Source Pressure PT-1A2	PAL-1A2	Low Source PT-1A2		1	225	225	70	180	150	150	170	170	170	195	160	125	90	90	180	155	155	90	175	155
9/3		Low Low Source Pressure PT-1A2	PSLL-1A2	L L Source PT-1A2	(N1)	1	175	175	60	130	100	100	120	120	120	145	110	105	80	80	130	105	105	80	125	105
9/4		Low Vacuum PT-1A2		Low Vacuum PT-1A2		0	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
9/5		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
9/6		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
9/7		High Purge PT-1A2		High Purge PT-1A2		0	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125
9/8		Low HP Purge PT-1A2		Low HP Purge PT1A2		0	900	900	170	900	900	900	900	900	900	900	900	170	170	170	900	900	900	170	900	900
9/9		High HP Purge PT-1A2		H HP Purge PT-1A2		0	1050	1050	220	1050	1050	1050	1050	1050	1050	1050	1050	220	220	220	1050	1050	1050	220	1050	1050
9/10		V-4 Lockout		V-4 Lockout PT-1A2		0	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
9/11		Pigtail Trickle Vent Threshold PT-1A2		High PT-1A2		255	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
9/12		Pigtail Trickle Vent Threshold PT-1A2		High PT-1A2		0	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
9/13																										
10/1	WT-1A2	High High Source Weight WT-1A2	WSHH-1A2	H H Source WT-1A2		3	N/A	N/A	1180	TBD	TBD	670	N/A	1287	641	N/A	N/A	N/A	1105	533	N/A	TBD	670	1250	N/A	N/A
10/2		High Source Weight WT-1A2	WAH-1A2	High Source WT1A2		0	N/A	N/A	1170	TBD	TBD	660	N/A	1250	620	N/A	N/A	26000	1090	525	N/A	TBD	660	1200	N/A	N/A
10/3		Low Source Weight WT-1A2	WAL-1A2	Low Source WT-1A2		1	N/A	N/A	150	100	100	100	N/A	125	125	N/A	N/A	4000	80	80	N/A	90	90	100	N/A	N/A
10/4		Low Low Source Weight WT-1A2	WSLL-1A2	LL Source WT-1A2	(N1,4)	3	N/A	N/A	80	60	60	60	N/A	100	100	N/A	N/A	3100	40	40	N/A	45	45	60	N/A	N/A
11/1	PT-1B2	High Source Pressure PT-1B2	PAH-1B2	High Source PT1B2		0	2700	2700	160	1900	1900	1900	1300	1300	1300	2060	2060	250	230	230	1600	1600	1600	545	2300	2300
11/2		Low Source Pressure PT-1B2	PAL-1B2	Low Source PT-1B2		1	225	225	70	180	150	150	170	170	170	195	160	125	90	90	180	155	155	90	175	155
11/3		Low Low Source Pressure PT-1B2	PSLL-1B2	L L Source PT-1B2	(N1)	1	175	175	60	130	100	100	120	120	120	145	110	105	80	80	130	105	105	80	125	105
11/4		Low Vacuum PT-1B2		Low Vacuum PT-1B2		0	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
11/5		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

Analog/Alarm Number	Engineering Units	Alarm Condition (H / L)	User/VM Configurable (U / V)	Response Sequence	Operating Mode Alarms: On-Line Mode - Source A1	On-Line Mode - Source A2	On-Line Mode - Source B1	On-Line Mode - Source B2	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) Src A2 Heater Permissive	(Relay 6; DO14) Src B2 Heater Permissive	(Relay 7; DO15) Src A1 Heater Permissive	(Relay 8; DO16) Src B1 Heater Permissive	(Relay 9: DO17) Open	(Relay 10; DO18) Reset UVIR Source A	(Relay 11; DO19) Reset UVIR Source B	(Relay 12: DO20) Open
															ND	E	E	D	E	E	E	E	E	D	D	E
1/1																										
1/2	PSIG	H	V		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	V	15	S	S			S								D									
2/1																										
2/2	PSIG	H	V				S	S	S								D									
2/3	PSIG	H	U				F	F	F							D										
2/4	PSIG	L	U				F	F	F							D										
2/5	PSIG	L	V	16			S	S	S								D									
3/1	PSIG	H	V				F	F	F	F	F	F	F	F		D										
3/2	PSIG	H	V							F	F	F	F			D										
3/3	PSIG	H	V									S					D									
3/4	PSIG	L	V									N														
4/1	PSIG	H	V		F	F	F	F	F	F	F	F	F	F		D										
4/2	PSIG	H	V							F	F	F	F			D										
4/3	PSIG	H	V									S					D									
4/4	PSIG	L	V									N														
5/1	PSIG	H	V		F	F	F	F		F		F				D										
5/2	PSIG	H	V		F	F	F	F		F		F				D										
5/3	PSIG	L	V		F	F	F	F		F		F				D										
5/4	PSIG	H	V		F	F	F	F			N (F)															
5/5	PSIG	H	V									S					D									
5/6	PSIG	L	V									N														
6/1	PSIG	L	V		F	F	F	F	F							D										
6/2	PSIG	L	V		S	S	S	S	S								D									
7/1	PSIG	H	V		S	S			S								D									
7/2	PSIG	H	U		F	F			F							D										
8/1	PSIG	H	V				S	S	S								D									
8/2	PSIG	H	U				F	F	F							D										
9/1	PSIG	H	V			F			F							D			D							
9/2	PSIG	L	U			F			F							D										
9/3	PSIG	L	U	2		N (S)			N (S)								D									
9/4	PSIG	H	V							S	S	S					D									
9/5	PSIG	L	V							N (S)	N (S)	N (S)					D									
9/6	PSIG	H	V							N (S)	N (S)	N (S)					D									
9/7	PSIG	H	V								S						D									
9/8	PSIG	L	V								S						D									
9/9	PSIG	H	V								S						D									
9/10	PSIG	H	V	48						N (F)		N (F)		N (F)												
9/11	PSIG	H	V							S		S	S				D									
9/12	PSIG	L	V							N		N	N													
9/13																										
10/1	LBS	H	V			S			S								D									
10/2	LBS	H	V			F			F							D										
10/3	LBS	L	U			F			F							D										
10/4	LBS	L	U	6		N (S)			N (S)								D		D							
11/1	PSIG	H	V					F	F							D				D						
11/2	PSIG	L	U					F	F							D										
11/3	PSIG	L	U	4				N (S)	N (S)								D									
11/4	PSIG	H	V							S	S	S					D									
11/5	PSIG	L	V							N (S)	N (S)	N (S)					D									

11/6		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	PSIG	H	V							N (S)	N (S)	N (S)					D									
11/7		High Purge PT-1B2		High Purge PT-1B2		0	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	PSIG	H	V								S						D									
11/8		Low HP Purge PT-1B2		Low HP Purge PT1B2		0	900	900	170	900	900	900	900	900	900	900	900	170	170	170	900	900	900	170	900	900	PSIG	L	V								S						D									
11/9		High HP Purge PT-1B2		H HP Purge PT-1B2		0	1050	1050	220	1050	1050	1050	1050	1050	1050	1050	1050	220	220	220	1050	1050	1050	220	1050	1050	PSIG	H	V								S						D									
11/10		V-4 Lockout		V-4 Lockout PT-1B2		0	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	PSIG	H	V	50						N (F)		N (F)		N (F)												
11/11		Pigtail Trickle Vent Threshold PT-1B2		High PT-1B2		255	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	PSIG	H	V							S		S	S				D									
11/12		Pigtail Trickle Vent Threshold PT-1B2		High PT-1B2		0	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	PSIG	L	V							N		N	N													
11/13																																																				
12/1	WT-1B2	High High Source Weight WT-1B2	WSHH-1B2	H H Source WT-1B2		3	N/A	N/A	1180	TBD	TBD	670	N/A	1287	641	N/A	N/A	N/A	1105	533	N/A	TBD	670	1250	N/A	N/A	LBS	H	V					S	S								D									
12/2		High Source Weight WT-1B2	WAH-1B2	High Source WT1B2		0	N/A	N/A	1170	TBD	TBD	660	N/A	1250	620	N/A	N/A	26000	1090	525	N/A	TBD	660	1200	N/A	N/A	LBS	H	V					F	F							D										
12/3		Low Source Weight WT-1B2	WAL-1B2	Low Source WT-1B2		1	N/A	N/A	150	100	100	100	N/A	125	125	N/A	N/A	4000	80	80	N/A	90	90	100	N/A	N/A	LBS	L	U					F	F							D										
12/4		Low Low Source Weight WT-1B2	WSLL-1B2	LL Source WT-1B2	(N1,4)	3	N/A	N/A	80	60	60	60	N/A	100	100	N/A	N/A	3100	40	40	N/A	45	45	60	N/A	N/A	LBS	L	U	8				N (S)	N (S)								D			D						
13	HTR-A2	Source Heater A2 Temperature Retransmit																																																		
14	HTR-B2	Source Heater B2 Temperature Retransmit																																																		
15																																																				
16																																																				
17/1	PT-1A1	High Source Pressure PT-1A1	PAH-1A1	High Source PT1A1		0	2700	2700	160	1900	1900	1900	1300	1300	1300	2060	2060	250	230	230	1600	1600	1600	545	2300	2300	PSIG	H	V		F				F							D					D					
17/2		Low Source Pressure PT-1A1	PAL-1A1	Low Source PT-1A1		1	225	225	70	180	150	150	170	170	170	195	160	125	90	90	180	155	155	90	175	155	PSIG	L	U		F				F							D										
17/3		Low Low Source Pressure PT-1A1	PSLL-1A1	L L Source PT-1A1	(N1)	1	175	175	60	130	100	100	120	120	120	145	110	105	80	80	130	105	105	80	125	105	PSIG	L	U	1	N (S)				N (S)								D									
17/4		Low Vacuum PT-1A1		Low Vacuum PT-1A1		0	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	PSIG	H	V							S	S	S					D									
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	PSIG	L	V							N (S)	N (S)	N (S)					D									
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	PSIG	H	V							N (S)	N (S)	N (S)					D									
17/7		High Purge PT-1A1		High Purge PT-1A1		0	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	PSIG	H	V								S						D									
17/8		Low HP Purge PT-1A1		Low HP Purge PT1A1		0	900	900	170	900	900	900	900	900	900	900	900	170	170	170	900	900	900	170	900	900	PSIG	L	V								S						D									
17/9		High HP Purge PT-1A1		H HP Purge PT-1A1		0	1050	1050	220	1050	1050	1050	1050	1050	1050	1050	1050	220	220	220	1050	1050	1050	220	1050	1050	PSIG	H	V								S						D									
17/10		V-4 Lockout		V-4 Lockout PT-1A1		0	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	PSIG	H	V	47						N (F)		N (F)		N (F)												
17/11		Pigtail Trickle Vent Threshold PT-1A1		High PT-1A1		255	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	PSIG	H	V							S		S	S				D									
17/12		Pigtail Trickle Vent Threshold PT-1A1		High PT-1A1		0	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	PSIG	L	V							N		N	N													
17/13		Low Tube Pressure PT-1A1 (Tube Switch)		Low Tube PT-1A1		1	N/A	N/A	N/A	N/A	N/A	N/A	180	N/A	N/A	205	N/A	N/A	N/A	N/A	190	N/A	N/A	N/A	185	N/A	PSIG	L	U	13	N																					
17/18		Tube Fault 1-2A		Tube Fault 1-2A		0																					PSIG	L	U		F												D									
17/19		Tube Fault 3-4A		Tube Fault 3-4A		0																					PSIG	L	U		F												D									
17/20		Tube Fault 5-6A		Tube Fault 5-6A		0																					PSIG	L	U		F												D									
17/21		Tube Fault 7-8A		Tube Fault 7-8A		0																					PSIG	L	U		F												D									
17/22		Tube Fault 9-10A		Tube Fault 9-10A		0																					PSIG	L	U		F												D									
17/23		Tube Fault 11-12A		Tube Fault 11-12A		0																					PSIG	L	U		F												D									
18/1	WT-1A1	High High Source Weight WT-1A1	WSHH-1A1	H H Source WT-1A1		3	N/A	N/A	1180	TBD	TBD	670	N/A	1287	641	N/A	N/A	N/A	1105	533	N/A	TBD	670	1250	N/A	N/A	LBS	H	V		S				S								D									
18/2		High Source Weight WT-1A1	WAH-1A1	High Source WT1A1		0	N/A	N/A	1170	TBD	TBD	660	N/A	1250	620	N/A	N/A	26000	1090	525	N/A	TBD	660	1200	N/A	N/A	LBS	H	V		F				F							D										
18/3		Low Source Weight WT-1A1	WAL-1A1	Low Source WT-1A1		1	N/A	N/A	150	100	100	100	N/A	125	125	N/A	N/A	4000	80	80	N/A	90	90	100	N/A	N/A	LBS	L	U		F				F							D										
18/4		Low Low Source Weight WT-1A1	WSLL-1A1	L L Source WT-1A1	(N1,4)	3	N/A	N/A	80	60	60	60	N/A	100	100	N/A	N/A	3100	40	40	N/A	45	45	60	N/A	N/A	LBS	L	U	5	N (S)				N (S)								D				D					
19/1	PT-1B1	High Source Pressure PT-1B1	PAH-1B1	High Source PT1B1		0	2700	2700	160	1900	1900	1900	1300	1300	1300	2060	2060	N/A	230	230	1600	1600	1600	545	2300	2300	PSIG	H	V				F		F							D						D				
19/2		Low Source Pressure PT-1B1	PAL-1B1	Low Source PT-1B1		1	225	225	70	180	150	150	170	170	170	195	160	N/A	90	90	180	155	155	90	175	155	PSIG	L	U				F		F							D										
19/3		Low Low Source Pressure PT-1B1	PSLL-1B1	L L Source PT-1B1	(N1)	1	175	175	60	130	100	100	120	120	120	145	110	N/A	80	80	130	105	105	80	125	105	PSIG	L	U	3			N (S)		N (S)								D									
19/4		Low Vacuum PT-1B1		Low Vacuum PT-1B1		0	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	N/A	-5	-5	-5	-5	-5	-5	-5	-5	PSIG	H	V							S	S	S					D									
19/5		Sufficient Vacuum		Sufficient Vacuum	(N1)	15	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	N/A	-5	-5	-5	-5	-5	-5	-5	-5	PSIG	L	V							N (S)	N (S)	N (S)					D									
19/6		Sufficient Purge		Sufficient Purge	(N1)	3	70	70	70	70	70	70	70	70	70	70	70	N/A	70	70	70	70	70	70	70	70	PSIG	H	V							N (S)	N (S)	N (S)					D									
19/7		High Purge PT-1B1		High Purge PT-1B1		0	125	125	125	125	125	125	125	125	125	125	125	N/A	125	125	125	125	125	125	125	125	PSIG	H	V								S						D									
19/8		Low HP Purge PT-1B1		Low HP Purge PT1B1		0	900	900	170	900	900	900	900	900	900	900	900	N/A	170	170	900	900	900	170	900	900	PSIG	L	V								S						D									
19/9		High HP Purge PT-1B1		H HP Purge PT-1B1		0	1050	1050	220	1050	1050	1050	1050	1050	1050	1050	1050	N/A	220	220	1050	1050	1050	220	1050	1050	PSIG	H	V								S						D									
19/10		V-4 Lockout		V-4 Lockout PT-1B1		0	150	150	150	150	150	150	150	150	150	150	150	N/A	150	150	150	150	150	150	150	150	PSIG	H	V	49						N (F)		N (F)		N (F)												
19/11		Pigtail Trickle Vent Threshold PT-1B1		High PT-1B1		255	75	75	75	75	75	75	75	75	75	75	75	N/A	75	75	75	75	75	75	75	75	PSIG	H	V							S		S	S				D									
19/12		Pigtail Trickle Vent Threshold PT-1B1		High PT-1B1		0	75	75	75	75	75	75	75	75	75	75	75	N/A	75	75	75	75	75	75	75	75	PSIG	L	V							N		N	N													
19/13		Low Tube Pressure PT-1B1 (Tube Switch)		Low Tube PT-1B1		1	N/A	N/A	N/A	N/A	N/A	N/A	180	N/A	N/A	205	N/A	N/A	N/A	N/A	190	N/A	N/A	N/A	185	N/A	PSIG	L	U	14			N																			
19/18		Tube Fault 1-2B		Tube Fault 1-2B		0																					PSIG	L	U				F										D									
19/19		Tube Fault 3-4B		Tube Fault 3-4B		0																					PSIG	L	U				F										D									
19/20		Tube Fault 5-6B		Tube Fault 5-6B		0																					PSIG	L	U				F										D									
19/21		Tube Fault 7-8B		Tube Fault 7-8B		0																					PSIG	L	U				F										D									
19/22		Tube Fault 9-10B		Tube Fault 9-10B		0																					PSIG	L	U				F										D									
19/23		Tube Fault 11-12B		Tube Fault 11-12B		0																					PSIG	L	U				F										D									
20/1	WT-1B1	High High Source Weight WT-1B1	WSHH-1B1	H H Source WT-1B1		3	N/A	N/A	1180	TBD	TBD	670	N/A	1287	641	N/A	N/A	N/A	1105	533	N/A	TBD	670	1250	N/A	N/A	LBS	H	V				S		S								D									
20/2		High Source Weight WT-1B1	WAH-1B1	High Source WT1B1		0	N/A	N/A	1170	TBD	TBD	660	N/A	1250	620	N/A	N/A	N/A	1090	525	N/A	TBD	660	1200	N/A	N/A	LBS	H	V				F		F							D										
20/3		Low Source Weight WT-1B1	WAL-1B1	Low Source WT-1B1		1	N/A	N/A	150	100	100	100	N/A	125	125	N/A	N/A	N/A	80	80	N/A	90	90	100	N/A	N/A	LBS	L	U				F		F							D										
20/4		Low Low Source Weight WT-1B1	WSLL-1B1	L L Source WT-1B1	(N1,6)	3	N/A	N/A	80	60	60	60	N/A	100	100	N/A	N/A	N/A	40	40	N/A	45	45	60	N/A	N/A	LBS	L	U	7			N (S)		N (S)								D					D				
21/1	HTR-A1	Source Heater A1 Temperature Retransmit																																																		
22/1	HTR-B1	Source Heater B1 Temperature Retransmit																																																		
23/1	SETRA	Low Exhaust	FAL-23	Low Exhaust		10	N/A	N/A	0.016	N/A	N/A	N/A	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	N/A	N/A	N/A	in H2O	L	V		F	F	F	F	F	F	F	F	F	F		D										
23/2		Low Low Exhaust	FALL-23	Low Low Exhaust		10	N/A	N/A	0.01	N/A	N/A	N/A	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	N/A	N/A	N/A	in H2O	L	V		F	F	F	F	F	F	F	F	F	F		D										
24																																																				
25																																																				
26																																																				
27																																																				
28																																																				
29																																																				
30	CPU	CPU Temp (VM 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	Deg C	H	V	0	F	F	F	F	F	F	F	F	F	F		D										
31	DOOR	Door Temp (VM Internal)	N/A	N/A																																																	
32/1	U14	Pneumatic Pressure High-High (VM 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	PSIG	H	V	0	F	F	F	F	F	F	F	F	F	F		D										
32/2	U14	Pneumatic Pressure High (VM 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	PSIG	H	U	0	F	F	F	F	F	F	F	F	F	F		D										
32/3	U14	Pneumatic Pressure Low (VM 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	PSIG	L	U	0	F	F	F	F	F	F	F	F	F	F		D										
32/4	U14	Pneumatic Pressure Low-Low (VM 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	PSIG	L	V	0	F	F	F	F	F	F	F	F	F	F		D										
49/1	JT HTR	Low Low JT Temperature	TALL-49	V Low JT HTR		0	50	50	N/A	50	50	50	50	50	50	50	50	N/A	N/A	N/A	65	65	65	N/A	65	65	DEG C	L	U		F	F	F	F	F	F	F	F	F	F		D										
49/2		Low JT Temperature	TAL-49	Low JT HTR		0	60	60	N/A	60	60	60	60	60	60	60	60	N/A	N/A	N/A	75	75	75	N/A	75	75	DEG C	L	U		F	F	F	F	F	F	F	F	F	F		D										
49/3		High JT Temperature	TAH-49	High JT HTR		0	80	80	N/A	80	80	80	80	80	80	80	80	N/A	N/A	N/A	95	95	95	N/A	95	95	DEG C	H	U		F	F	F	F	F	F	F	F	F	F		D										
49/4		High High JT Temperature	TAHH-49	V High JT HTR		0	85	85	N/A	85	85	85	85	85	85	85	85	N/A	N/A	N/A	100	100	100	N/A	100	100	DEG C	H	U		F	F	F	F	F	F	F	F	F	F		D										

49/5		Undertemp Low JT Temperature	TALLL-49	UT Low JT HTR		0	-20	-20	N/A	-20	-20	-20	-20	-20	-20	-20	-20	N/A	N/A	N/A	-20	-20	-20	N/A	-20	-20	DEG C	L	V	18	F	F	F	F	F	F	F	F	F	F		D
49/6		Overtemp High JT Temperature	TAHHH-49	OT High JT HTR		0	90	90	N/A	90	90	90	90	90	90	90	90	N/A	N/A	N/A	105	105	105	N/A	105	105	DEG C	H	V	18	F	F	F	F	F	F	F	F	F	F		D
49/7		Open Thermocouple JT Heater	TAHO-49	Open TC JT HTR		0	1100	1100	N/A	1100	1100	1100	1100	1100	1100	1100	1100	N/A	N/A	N/A	1100	1100	1100	N/A	1100	1100	DEG C	H	V		F	F	F	F	F	F	F	F	F	F		D
50/1	HT A	Low Low Heat Trace A Temperature	TALL-50	V Low HT A		0	N/A	N/A	25	N/A	25	25	N/A	25	25	N/A	N/A	25	25	25	N/A	25	25	25	N/A	N/A	DEG C	L	U		F	F	F	F	F				F	F		D
50/2		Low Heat Trace A Temperature	TAL-50	Low HT A		0	N/A	N/A	30	N/A	30	30	N/A	30	30	N/A	N/A	30	30	30	N/A	30	30	30	N/A	N/A	DEG C	L	U		F	F	F	F	F				F	F		D
50/3		High Heat Trace A Temperature	TAH-50	High HT A		0	N/A	N/A	50	N/A	50	50	N/A	50	50	N/A	N/A	50	50	50	N/A	50	50	50	N/A	N/A	DEG C	H	U		F	F	F	F	F				F	F		D
50/4		High High Heat Trace A Temperature	TAHH-50	V High HT A		0	N/A	N/A	55	N/A	55	55	N/A	55	55	N/A	N/A	55	55	55	N/A	55	55	55	N/A	N/A	DEG C	H	U		F	F	F	F	F				F	F		D
50/5		Undertemp Low Heat Trace A Temperature	TALLL-50	UT Low HT A		0	N/A	N/A	-20	N/A	-20	-20	N/A	-20	-20	N/A	N/A	-20	-20	-20	N/A	-20	-20	-20	N/A	N/A	DEG C	L	V	19	F	F	F	F	F				F	F		D
50/6		Overtemp High Heat Trace A Temperature	TAHHH-50	OT High HT A		0	N/A	N/A	70	N/A	70	70	N/A	70	70	N/A	N/A	70	70	70	N/A	70	70	70	N/A	N/A	DEG C	H	V		F	F	F	F	F				F	F		D
50/7		Open Thermocouple Heat Trace A	TAHO-50	Open TC HT A		0	N/A	N/A	1100	N/A	1100	1100	N/A	1100	1100	N/A	N/A	1100	1100	1100	N/A	1100	1100	1100	N/A	N/A	DEG C	H	V	9	F	F	F	F	F				F	F		D
50/8		Overtemp High Heat Trace A Temperature	TAHHH-50	OT High HT A		255	N/A	N/A	70	N/A	70	70	N/A	70	70	N/A	N/A	70	70	70	N/A	70	70	70	N/A	N/A	DEG C	H	V	9	NL	NL	NL	NL	NL				NL	NL		
51/1	HT B	Low Low Heat Trace B Temperature	TALL-51	V Low HT B		0	N/A	N/A	25	N/A	25	25	N/A	25	25	N/A	N/A	25	25	25	N/A	25	25	25	N/A	N/A	DEG C	L	U		F	F	F	F	F				F	F		D
51/2		Low Heat Trace B Temperature	TAL-51	Low HT B		0	N/A	N/A	30	N/A	30	30	N/A	30	30	N/A	N/A	30	30	30	N/A	30	30	30	N/A	N/A	DEG C	L	U		F	F	F	F	F				F	F		D
51/3		High Heat Trace B Temperature	TAH-51	High HT B		0	N/A	N/A	50	N/A	50	50	N/A	50	50	N/A	N/A	50	50	50	N/A	50	50	50	N/A	N/A	DEG C	H	U		F	F	F	F	F				F	F		D
51/4		High High Heat Trace B Temperature	TAHH-51	V High HT B		0	N/A	N/A	55	N/A	55	55	N/A	55	55	N/A	N/A	55	55	55	N/A	55	55	55	N/A	N/A	DEG C	H	U		F	F	F	F	F				F	F		D
51/5		Undertemp Low Heat Trace B Temperature	TALLL-51	UT Low HT B		0	N/A	N/A	-20	N/A	-20	-20	N/A	-20	-20	N/A	N/A	-20	-20	-20	N/A	-20	-20	-20	N/A	N/A	DEG C	L	V	20	F	F	F	F	F				F	F		D
51/6		Overtemp High Heat Trace B Temperature	TAHHH-51	OT High HT B		0	N/A	N/A	70	N/A	70	70	N/A	70	70	N/A	N/A	70	70	70	N/A	70	70	70	N/A	N/A	DEG C	H	V		F	F	F	F	F				F	F		D
51/7		Open Thermocouple Heat Trace B	TAHO-51	Open TC HT B		0	N/A	N/A	1100	N/A	1100	1100	N/A	1100	1100	N/A	N/A	1100	1100	1100	N/A	1100	1100	1100	N/A	N/A	DEG C	H	V	10	F	F	F	F	F				F	F		D
51/8		Overtemp High Heat Trace B Temperature	TAHHH-51	OT High HT B		255	N/A	N/A	70	N/A	70	70	N/A	70	70	N/A	N/A	70	70	70	N/A	70	70	70	N/A	N/A	DEG C	H	V	10	NL	NL	NL	NL	NL				NL	NL		
52/1	HT P	Low Low Heat Trace P Temperature	TALL-52	V Low HT P		0	N/A	N/A	25	N/A	25	25	N/A	25	25	N/A	N/A	25	25	25	N/A	25	25	25	N/A	N/A	DEG C	L	U		F	F	F	F	F				F	F		D
52/2		Low Heat Trace P Temperature	TAL-52	Low HT P		0	N/A	N/A	30	N/A	30	30	N/A	30	30	N/A	N/A	30	30	30	N/A	30	30	30	N/A	N/A	DEG C	L	U		F	F	F	F	F				F	F		D
52/3		High Heat Trace P Temperature	TAH-52	High HT P		0	N/A	N/A	50	N/A	50	50	N/A	50	50	N/A	N/A	50	50	50	N/A	50	50	50	N/A	N/A	DEG C	H	U		F	F	F	F	F				F	F		D
52/4		High High Heat Trace P Temperature	TAHH-52	V High HT P		0	N/A	N/A	55	N/A	55	55	N/A	55	55	N/A	N/A	55	55	55	N/A	55	55	55	N/A	N/A	DEG C	H	U		F	F	F	F	F				F	F		D
52/5		Undertemp Low Heat Trace P Temperature	TALLL-52	UT Low HT P		0	N/A	N/A	-20	N/A	-20	-20	N/A	-20	-20	N/A	N/A	-20	-20	-20	N/A	-20	-20	-20	N/A	N/A	DEG C	L	V	21	F	F	F	F	F				F	F		D
52/6		Overtemp High Heat Trace P Temperature	TAHHH-52	OT High HT P		0	N/A	N/A	70	N/A	70	70	N/A	70	70	N/A	N/A	70	70	70	N/A	70	70	70	N/A	N/A	DEG C	H	V		F	F	F	F	F				F	F		D
52/7		Open Thermocouple Heat Trace P	TAHO-52	Open TC HT P		0	N/A	N/A	1100	N/A	1100	1100	N/A	1100	1100	N/A	N/A	1100	1100	1100	N/A	1100	1100	1100	N/A	N/A	DEG C	H	V	11	F	F	F	F	F				F	F		D
52/8		Overtemp High Heat Trace P Temperature	TAHHH-51	OT High HT P		255	N/A	N/A	70	N/A	70	70	N/A	70	70	N/A	N/A	70	70	70	N/A	70	70	70	N/A	N/A	DEG C	H	V	11	NL	NL	NL	NL	NL				NL	NL		
55/1		Heat Trace A Setpoint Factory Setting		HT Trace A SET		0	N/A	N/A	40	N/A	40	40	N/A	40	40	N/A	N/A	40	40	40	N/A	40	40	40	N/A	N/A	DEG C		U													
55/2		Heat Trace B Setpoint Factory Setting		HT Trace B SET		0	N/A	N/A	40	N/A	40	40	N/A	40	40	N/A	N/A	40	40	40	N/A	40	40	40	N/A	N/A	DEG C		U													
55/3		Heat Trace P Setpiont Factory Setting		HT Trace P SET		0	N/A	N/A	40	N/A	40	40	N/A	40	40	N/A	N/A	40	40	40	N/A	40	40	40	N/A	N/A	DEG C		U													
56/1		JT Heater Setpoint Factory Setting		JT HEATER SET		0	70	70	N/A	70	70	70	70	70	70	70	N/A	N/A	N/A	N/A	85	85	85	N/A	85	85	DEG C		U													

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

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

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 from CR200.

9- Digital Outputs 9 and 12 are de-energized during their respective source container Change Cylinder sequence.

10 - Source B alarms are not active on PT-5A when PT-5B is present

11- NH3 PT10 setpoints only necessary when ETO PCV-2 second stage regulator is installed.

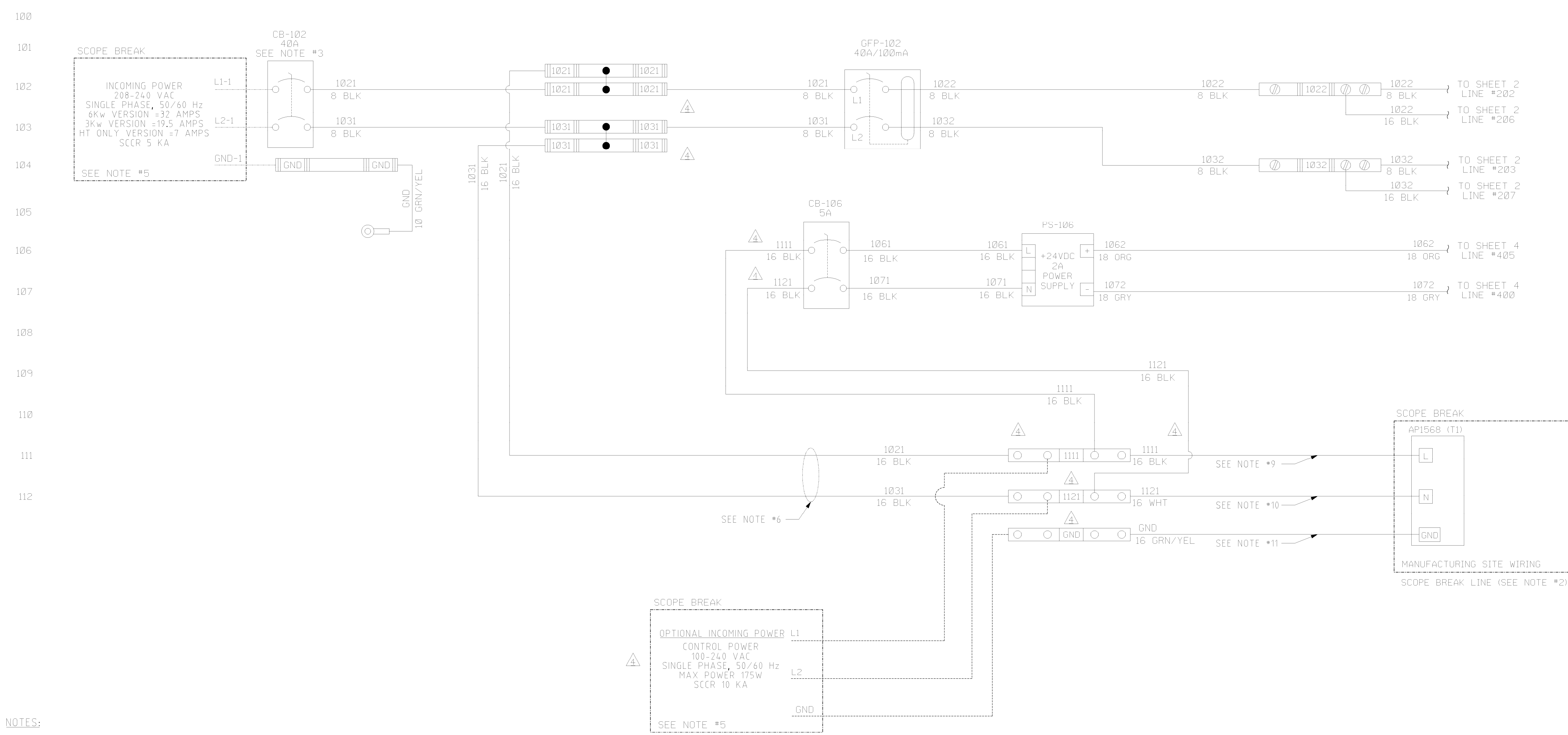
12- These setpoints are only necessary for systems with Dual Cylinder Change mode

Leak Test Parameters			4%H2/ N2	CF4	Cl2	CO2	CO2	CO2	HCl 500 slpm No Purifier	HCl 250 slpm	HCl 250 slpm	NF3 500 slpm	NF3 250 slpm	NH3 800 slpm	NH3 400 slpm 930L Drum	NH3 400 slpm Y Cyl.	N2O 500 slpm	N2O 250 slpm	N2O 250 slpm	SF6	SiH4 500 slpm	SiH4 250 slpm		
#	Label	Type																					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	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	-5.0
3	HPLT Test	Pressure	10(N3)	10(N3)	10(N3)	20(N3)	10(N3)	10(N3)	20(N3)	10(N3)	10(N3)	20(N3)	10(N3)	10(N3)	10(N3)	10(N3)	20(N3)	10(N3)	10(N3)	10(N3)	20(N3)	10(N3)	5	-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	-80.0
5	Vacuum Timer	Pressure	0	0	3	3	3	3	3	0	0	3	0	10	3	3	0	0	0	3	10	3	0	100.0

Sub Sequence Parameters		4%H2/ N2	CF4	Cl2	CO2	CO2	CO2	HCl	HCl	HCl	NF3	NF3	NH3	NH3	NH3	N2O	N2O	N2O	SF6	SiH4	SiH4	
Label	Seq#																					Min. Cycles
Purge/Vent	1	60	60	90	75	75	75	90	90	90	75	75	90	90	90	75	75	75	90	120	120	60
Condition	2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	0
Outboard	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Tube Condition	7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

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)
F = Fault	SB = Shutdown(& Crossover) when backup source is in standby
HW = Hardwire	



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. VERIFY ALL CIRCUIT BREAKER RATINGS; FOR EXAMPLE, CB-102 IS RATED FOR 40AMP.
4. USE FERRULES ON ALL TERMINATIONS. FERRULES SHALL BE SIZED TO MATCH WIRE SIZE AND BE COMPRESSED WITH MANUFACTURER'S APPROVED RATCHETING TYPE CRIMPING TOOL.
5. WIRING INSIDE SCOPE BREAK LINE SHALL BE PERFORMED BY FIELD SITES.
6. MAY BE REMOVED BY FIELD SITE TO FACILITATE DUAL POWER FEEDS.
7. DELETED.
8. WIRES TO BE PTFE RATED FOR 200°C.
9. WIRE TERMINATION WILL BE PERFORMED AT MANUFACTURING SITE. VENDOR SHALL CUT WIRE TO 13½" LONG. PRINT A LABEL WITH "1111 L" TEXT, PLACE LABEL 2" FROM END. COIL AND SESURE INSIDE ELECTRICAL CABINET.
10. WIRE TERMINATION WILL BE PERFORMED AT MANUFACTURING SITE. VENDOR SHALL CUT WIRE TO 13½" LONG. PRINT A LABEL WITH "1121 N" TEXT, PLACE LABEL 2" FROM END. COIL AND SESURE INSIDE ELECTRICAL CABINET.
11. WIRE TERMINATION WILL BE PERFORMED AT MANUFACTURING SITE. VENDOR SHALL CUT WIRE TO 13½" LONG. PRINT A LABEL WITH "GND" TEXT, PLACE LABEL 2" FROM END. COIL AND SESURE INSIDE ELECTRICAL CABINET.

ECN NO.	REV.	ECR NO.	REVISION DESCRIPTION	DATE	BY	CHK'D	APPD.
	4	55183	CHANGED TERMINAL BLOCKS TO QUADS ON PG#1	6/29/18	JCB	SSC	TJS
	3	53724	ADDED SPLICE TO PPS-320 PAGE #3	12/1/17	JCB	SSC	TJS
	2	53287	ADDED CR-206 TO WIRING DIAGRAM	9/19/17	JCB	SSC	TJS

INCHES / MILLIMETERS
INCHES (MILLIMETERS)

UNLESS OTHERWISE SPECIFIED TOLERANCES ARE
FRACTION ± N/A DECIMAL ± N/A ANGLE ± N/A
HOLE LOCATION ± N/A HOLE SIZE + N/A
FILE LOCATION

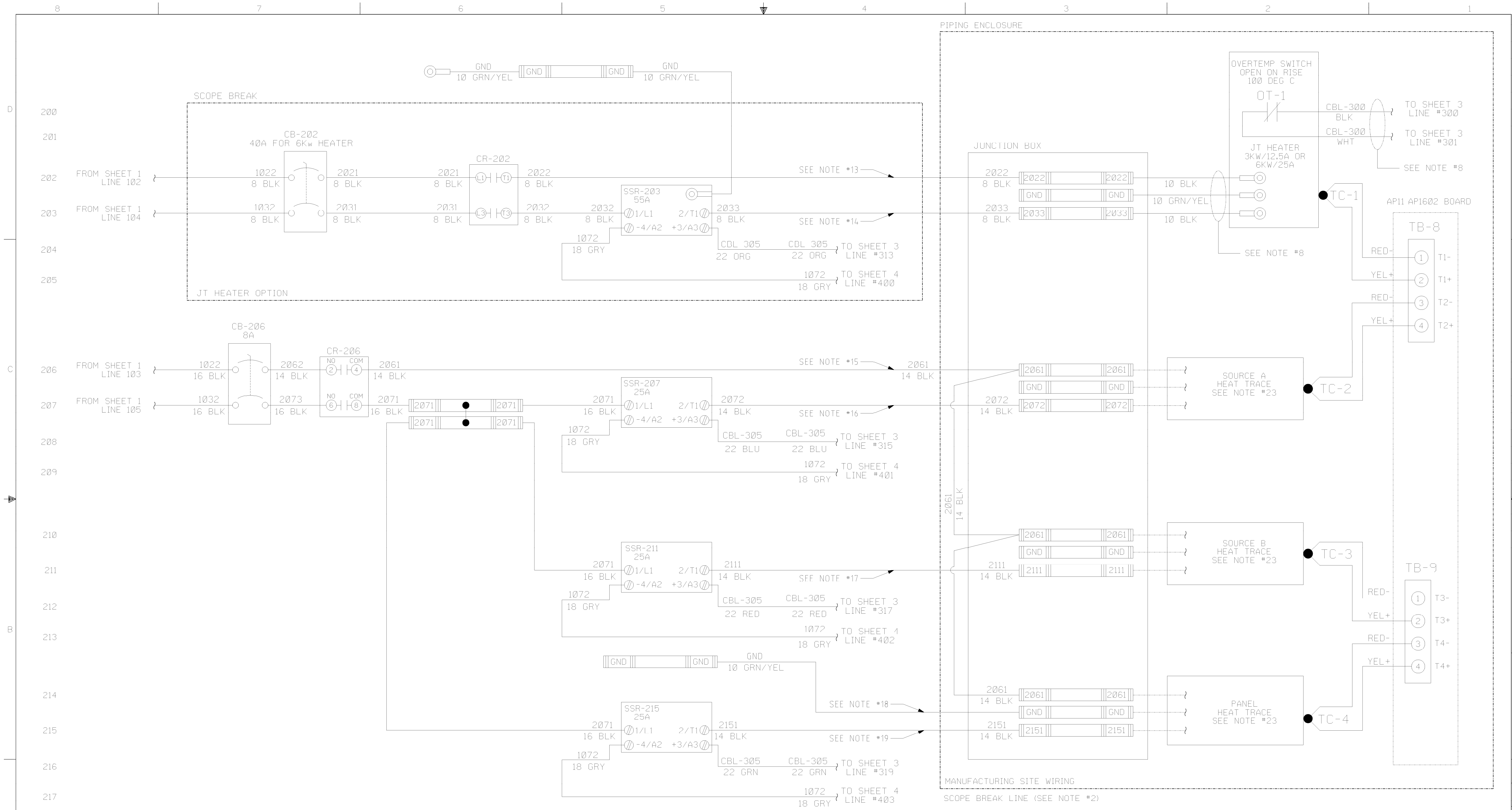
		DATE
J.C. BARTHOLD	DRAWN	3/28/17
S.S. CABLE	CHECKED	3/28/17
	MANUFACTURING	
	ENGINEER	
T.J. SMITH	APPD.	3/28/17

TITLE: ELEMENTARY WIRING DIAGRAM AP11 BSGS eV

VERSUM MATERIALS

FILE | DWG NO. BNTLY01044.DGN | D | REV. 4
SCALE NTS | REF. | SHEET 1 OF 4

DWG NO. BNTLY01044.DGN | SH 1 | REV 4



NOTES CONT.:

12. CABLE TERMINATION WILL BE PERFORMED AT MANUFACTURING SITE. VENDOR SHALL CUT CABLE TO 3'-6" LONG. PRINT A LABEL WITH "CBL-305" TEXT, PLACE LABEL 4" FROM END. COIL AND SESURE INSIDE ELECTRICAL CABINET.

13. WIRE TERMINATION WILL BE PERFORMED AT MANUFACTURING SITE. VENDOR SHALL CUT WIRE TO 9'-0" LONG. PRINT A LABEL WITH "2022" TEXT, PLACE LABEL 2" FROM END. ROUTE WIRE THROUGH POUR SEAL, COIL AND SESURE OUTSIDE ELECTRICAL CABINET.

14. WIRE TERMINATION WILL BE PERFORMED AT MANUFACTURING SITE. VENDOR SHALL CUT WIRE TO 9'-1" LONG. PRINT A LABEL WITH "2033" TEXT, PLACE LABEL 2" FROM END. ROUTE WIRE THROUGH POUR SEAL, COIL AND SESURE OUTSIDE ELECTRICAL CABINET.

15. WIRE TERMINATION WILL BE PERFORMED AT MANUFACTURING SITE. VENDOR SHALL CUT WIRE TO 8'-3" LONG. PRINT A LABEL WITH "2061" TEXT, PLACE LABEL 2" FROM END. ROUTE WIRE THROUGH POUR SEAL, COIL AND SESURE OUTSIDE ELECTRICAL CABINET. DO NOT INSTALL FERRULE ON WIRE END.

ECN NO.	REV.	ECR NO.	REVISION DESCRIPTION	DATE	BY	CHK'D	APPD.
	4	55183	CHANGED TERMINAL BLOCKS TO QUADS ON PG#1	6/29/18	JCB	SSC	TJS
	3	53724	ADDED SPLICE TO PPS-320 PAGE #3	12/1/17	JCB	SSC	TJS
	2	53287	ADDED CR-206 TO WIRING DIAGRAM	9/19/17	JCB	SSC	TJS

INCHES / MILLIMETERS — INCHES (MILLIMETERS)

UNLESS OTHERWISE SPECIFIED TOLERANCES ARE: FRACTION ± N/A, DECIMAL ± N/A, ANGLE ± N/A; HOLE LOCATION ± N/A, HOLE SIZE + N/A

FILE LOCATION

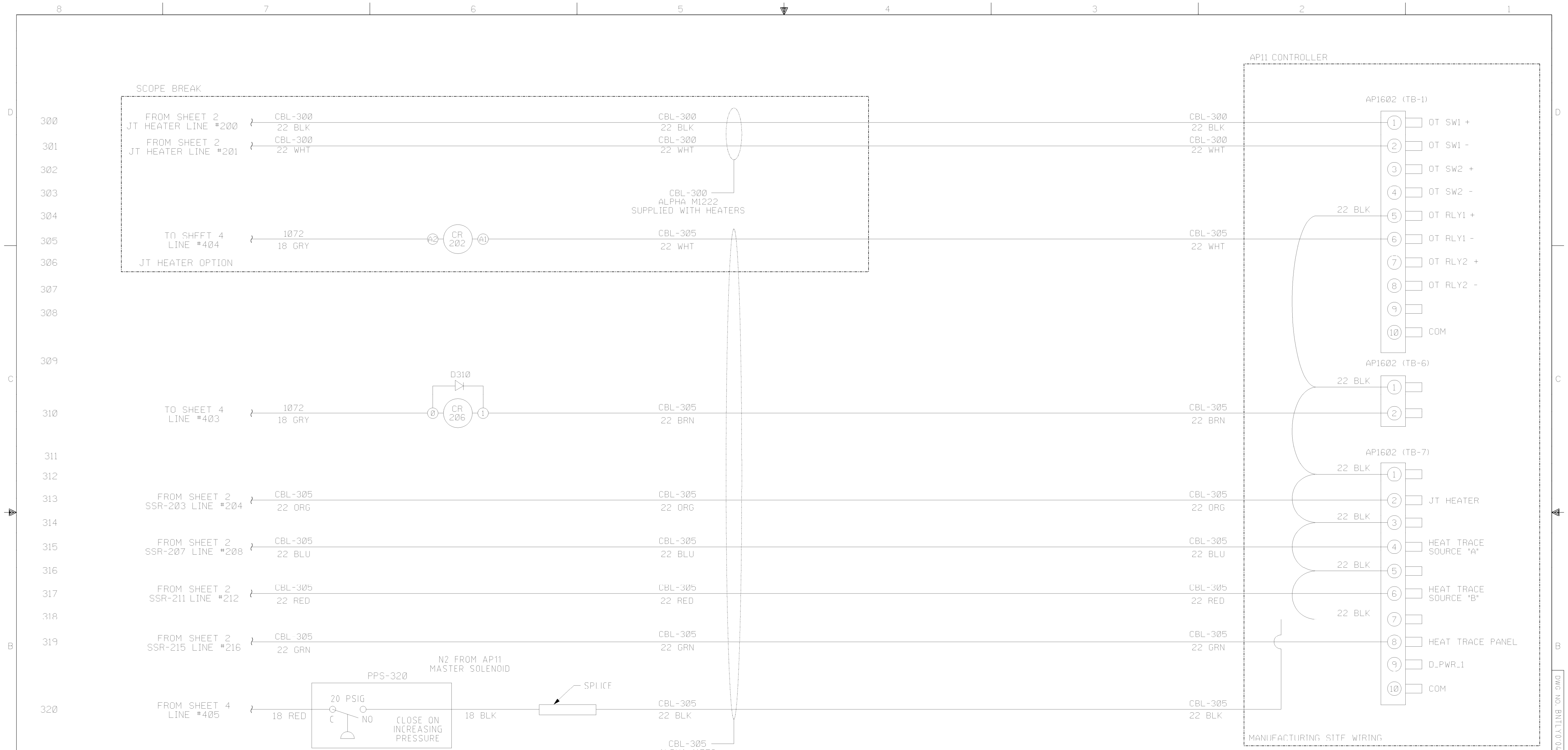
		DATE
DRAWN	J.C. BARTHOLD	3/28/17
CHECKED	S.S. CABLE	3/28/17
MANUFACTURING		
ENGINEER		
APPD.	T.J. SMITH	3/28/17

TITLE: ELEMENTARY WIRING DIAGRAM AP11 BSGS eV

VERSUM MATERIALS

FILE | DWG NO. BNTLY01044.DGN | D | REV. 4

SCALE NTS | REF. | SHEET 2 OF 4



NOTES CONT.:

16. WIRE TERMINATION WILL BE PERFORMED AT MANUFACTURING SITE. VENDOR SHALL CUT WIRE TO 7'-11½" LONG. PRINT A LABEL WITH "2072" TEXT, PLACE LABEL 2" FROM END. ROUTE WIRE THROUGH POUR SEAL, COIL AND SESURE OUTSIDE ELECTRICAL CABINET.

17. WIRE TERMINATION WILL BE PERFORMED AT MANUFACTURING SITE. VENDOR SHALL CUT WIRE TO 7'-9½" LONG. PRINT A LABEL WITH "2111" TEXT, PLACE LABEL 2" FROM END. ROUTE WIRE THROUGH POUR SEAL, COIL AND SESURE OUTSIDE ELECTRICAL CABINET.

18. WIRE TERMINATION WILL BE PERFORMED AT MANUFACTURING SITE. VENDOR SHALL CUT WIRE TO 8'-4" LONG. PRINT A LABEL WITH "GND" TEXT, PLACE LABEL 2" FROM END. ROUTE WIRE THROUGH POUR SEAL, COIL AND SESURE OUTSIDE ELECTRICAL CABINET.

19. WIRE TERMINATION WILL BE PERFORMED AT MANUFACTURING SITE. VENDOR SHALL CUT WIRE TO 7'-8½" LONG. PRINT A LABEL WITH "2151" TEXT, PLACE LABEL 2" FROM END. ROUTE WIRE THROUGH POUR SEAL, COIL AND SESURE OUTSIDE ELECTRICAL CABINET.

20. WIRE TERMINATION WILL BE PERFORMED AT MANUFACTURING SITE. VENDOR SHALL CUT WIRE TO 1'-9½" LONG. PRINT A LABEL WITH "1072" TEXT, PLACE LABEL 2" FROM END. COIL AND SESURE INSIDE ELECTRICAL CABINET.

21. WIRE TERMINATION WILL BE PERFORMED AT MANUFACTURING SITE. VENDOR SHALL CUT WIRE TO 2'-6½" LONG. PRINT A LABEL WITH "4082" TEXT, PLACE LABEL 2" FROM END. COIL AND SESURE INSIDE ELECTRICAL CABINET.

22. WIRE TERMINATION WILL BE PERFORMED AT MANUFACTURING SITE. VENDOR SHALL CUT WIRE TO 2'-7" LONG. PRINT A LABEL WITH "4091" TEXT, PLACE LABEL 2" FROM END. COIL AND SESURE INSIDE ELECTRICAL CABINET.

23. HEAT TRACE TYPE: PT-3-SB, 12W/ft. @ 240VAC. TOTAL HEAT TRACE LENGTH NOT TO EXCEED (1500W) 125ft.

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INCHES / MILLIMETERS
INCHES (MILLIMETERS)

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UNLESS OTHERWISE SPECIFIED TOLERANCES ARE
FRACTION ± N/A DECIMAL ± N/A ANGLE ± N/A
HOLE LOCATION ± N/A HOLE SIZE + N/A
FILE LOCATION

	DATE
J.C. BARTHOLD DRAWN	3/28/17
S.S. CABLE CHECKED	3/28/17
MANUFACTURING	
ENGINEER	
T.J. SMITH APPD.	3/28/17

TITLE: ELEMENTARY WIRING DIAGRAM AP11 BSGS eV

VERSUM MATERIALS
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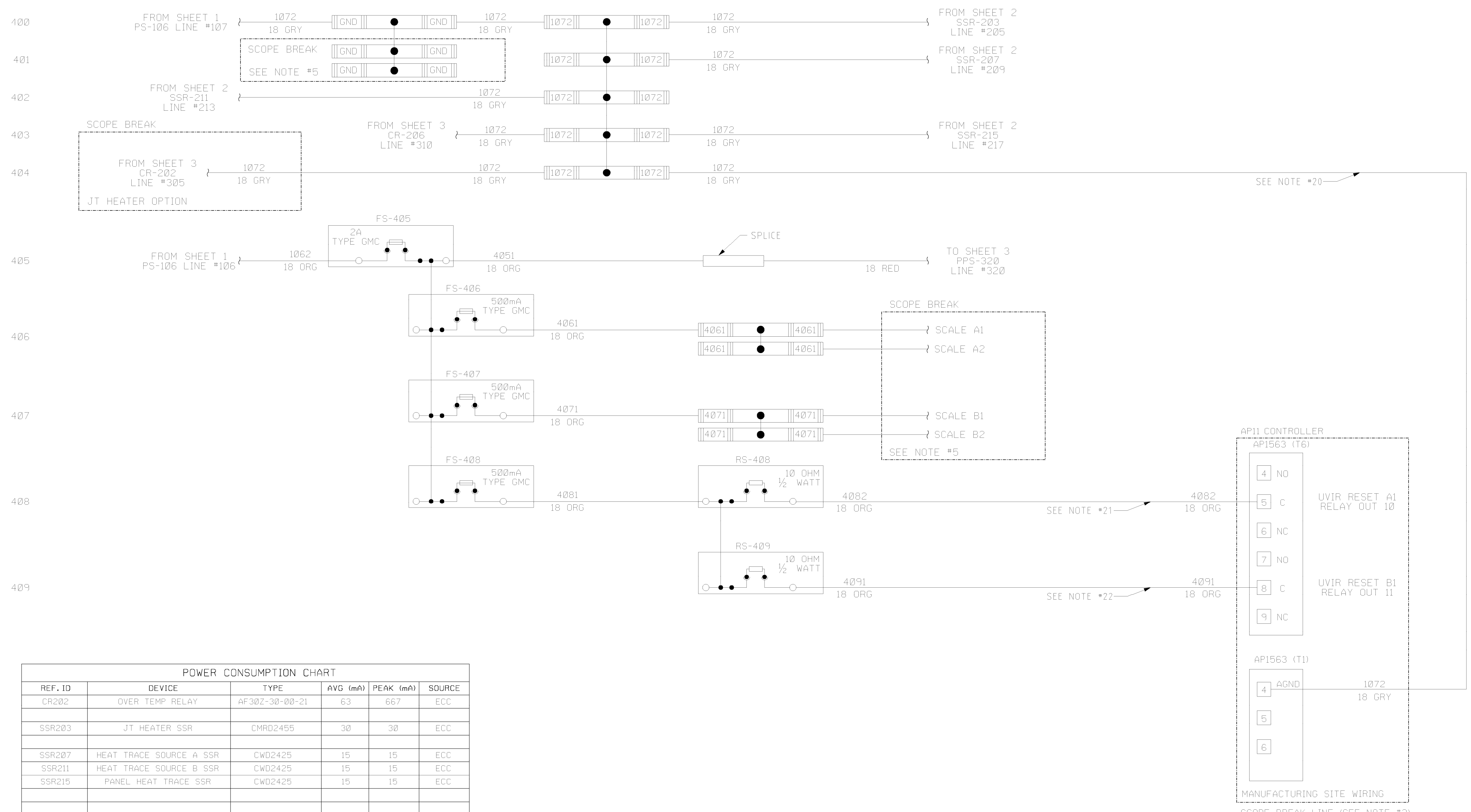
FILE | DWG NO. BNTLY01044.DGN | D | REV. 4
SCALE NTS | REF. | SHEET 3 OF 4

DWG NO. BNTLY01044.DGN | SH 1 | REV 4



POWER CONSUMPTION CHART					
REF. ID	DEVICE	TYPE	AVG (mA)	PEAK (mA)	SOURCE
CR202	OVER TEMP RELAY	AF30Z-30-00-21	63	667	ECC
SSR203	JT HEATER SSR	CMRD2455	30	30	ECC
SSR207	HEAT TRACE SOURCE A SSR	CWD2425	15	15	ECC
SSR211	HEAT TRACE SOURCE B SSR	CWD2425	15	15	ECC
SSR215	PANEL HEAT TRACE SSR	CWD2425	15	15	ECC
UVIR PNL	UVIR PANEL POWER	SS4A	75	300	L-PANEL
UVIR A1	UVIR SOURCE A1 POWER	SS4A	75	300	ECC
UVIR B1	UVIR SOURCE B1 POWER	SS4A	75	300	ECC
UVIR A2	UVIR SOURCE A2 POWER (ETO)	SS4A	75	300	R-PANEL
UVIR B2	UVIR SOURCE B2 POWER (ETO)	SS4A	75	300	R-PANEL
SCL A1	ARLYN 3000# SCALE	5-3403-SS-A0-AP3	75		ECC
SCL B1	ARLYN 5000# SCALE	5-3403-SS-A0-AP3	75		ECC
SCL A2	ARLYN 3000# SCALE	5-3403-SS-A0-AP3	75		ECC
SCL B2	ARLYN 5000# SCALE	5-3403-SS-A0-AP3	75		ECC

ECN NO.	REV.	ECR NO.	REVISION DESCRIPTION	DATE	BY	CHK'D	APPD.
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INCHES / MILLIMETERS
INCHES (MILLIMETERS)

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UNLESS OTHERWISE SPECIFIED TOLERANCES ARE
FRACTION ± N/A DECIMAL ± N/A ANGLE ± N/A
HOLE LOCATION ± N/A HOLE SIZE + N/A
FILE LOCATION

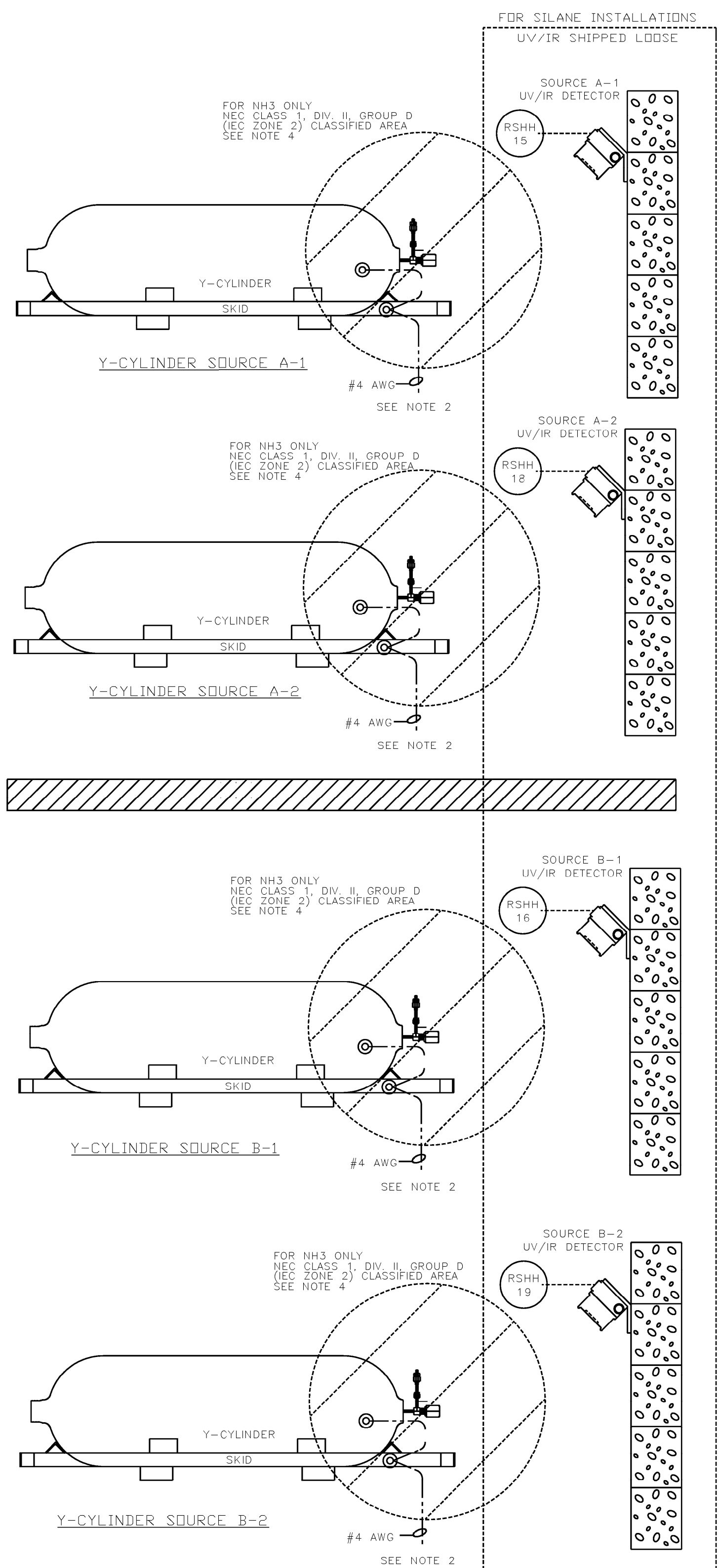
DRAWN: J.C. BARTHOLD — DATE 3/28/17
CHECKED: S.S. CABLE — 3/28/17
MANUFACTURING
ENGINEER
APPD.: T.J. SMITH — 3/28/17

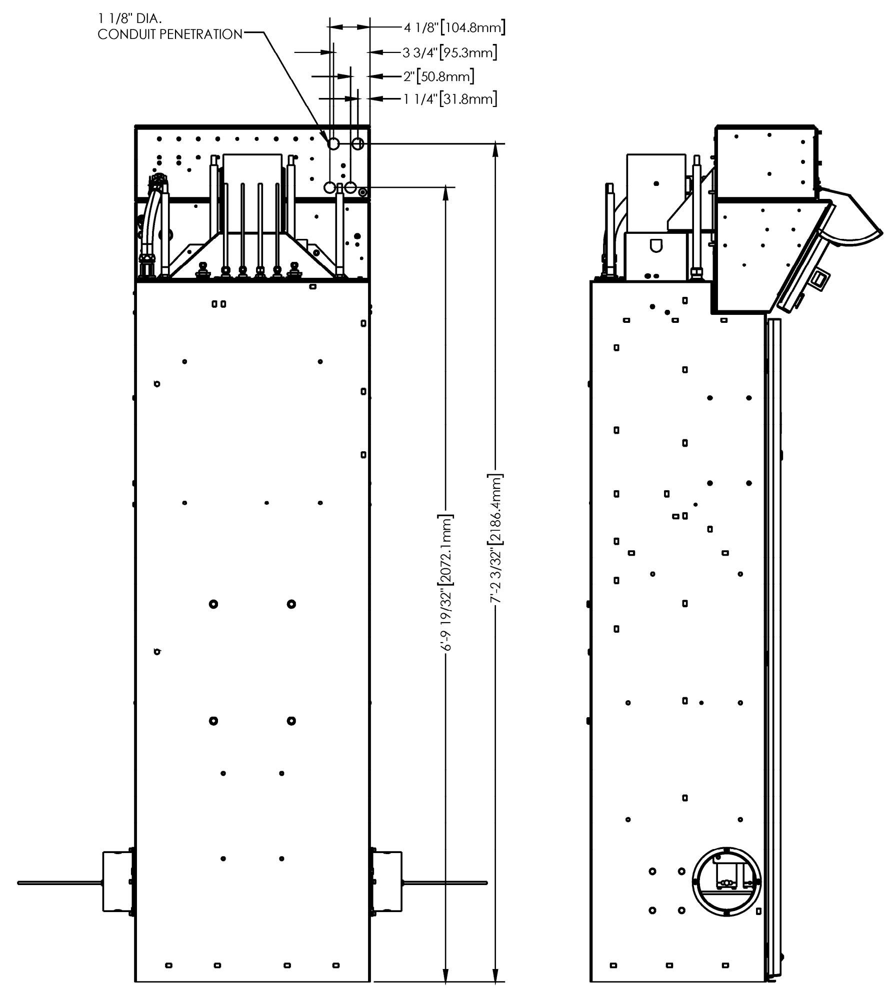
TITLE: ELEMENTARY WIRING DIAGRAM AP11 BSGS eV

VERSUM MATERIALS

FILE
DWG NO. BNTLY01044.DGN — D — REV. 4
SCALE NTS — REF. — SHEET 4 OF 4

DWG NO. BNTLY01044.DGN SH 1 REV4





REAR VIEW

LEFT SIDE VIEW

NOTES:

1. TYPICAL ELECTRICAL INSTALLATION FOR ONE BSGS eV / BULKGUARD eV 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 4 FOR BSGS eV / BULKGUARD eV GROUNDING REQUIREMENTS.
3. ALL CONDUIT ENTRIES MUST ONLY BE INSTALLED INTO REAR 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.
   FOR OTHER FLAMMABLE GASES, THE HAZARDOUS RADIUS MAY VARY.
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 BSGS eV / BULKGUARD eV 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. BSGS eV / BULKGUARD eV 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
    WE = WEIGHT ELEMENT
    WT = WEIGHT TRANSDUCER
    JB = JUNCTION BOX
    EX = EXPLOSION PROOF FITTING
    RSHH = UV/IR DETECTION

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
56970	3	UPDATE OPTIONAL POWER DETAILS	10/25/2018	JRB	SSC	AJS	XXX

Part no.

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

MATERIAL

FINISH

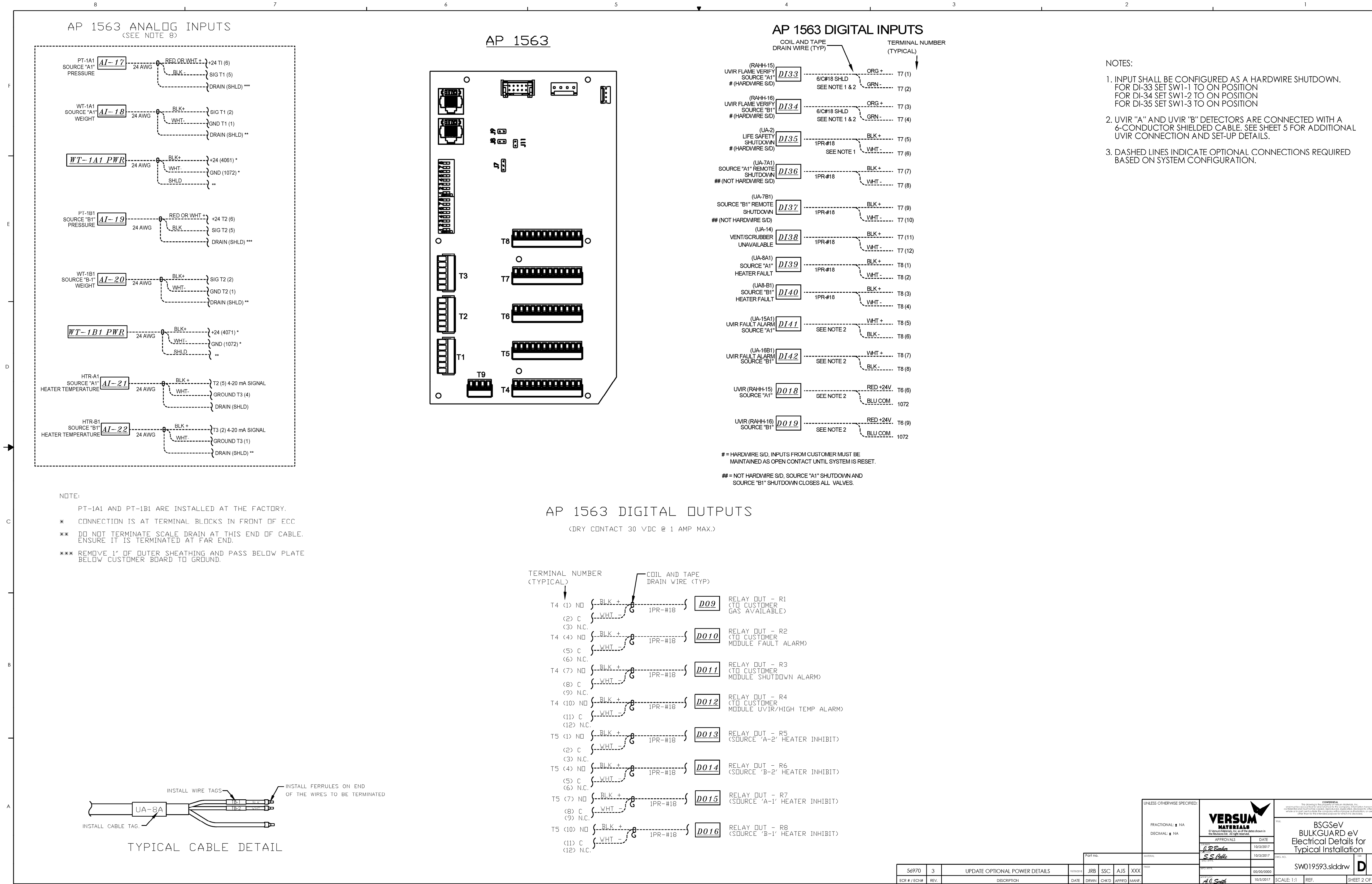
VERSUM MATERIALS

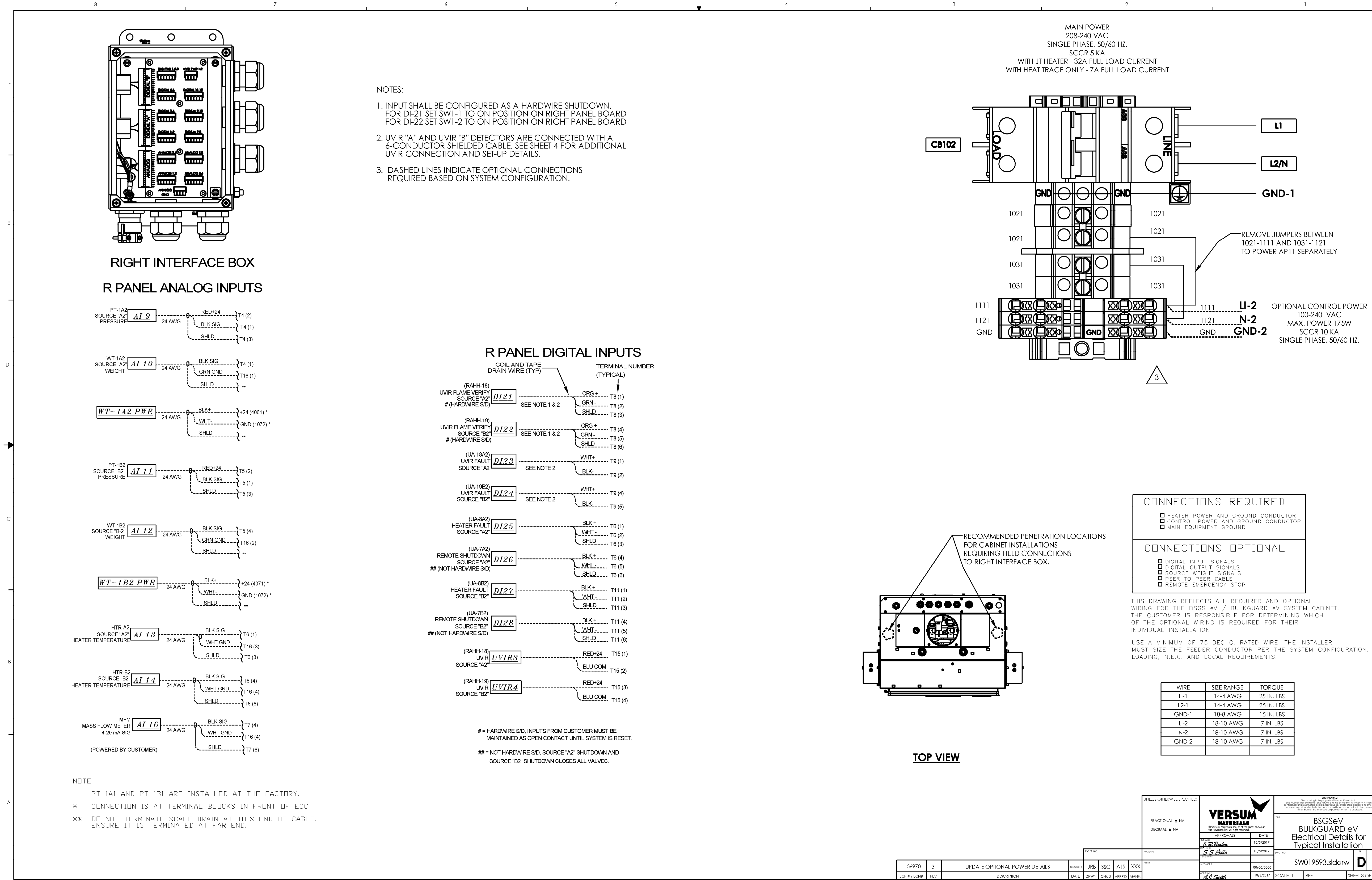
APPROVALS	DATE
DRAWN J.R.Barber	10/3/2017
CHECKED S.S.Cable	10/3/2017
ENG APPR.	
MFG APPR.	00/00/0000
APPROVED A.J.Smith	10/3/2017

TITLE: BSGSeV BULKGUARD eV Electrical Details for Typical Installation

DWG. NO. SW019593.slddrw SIZE D REV 3

SCALE: 1:1 REF. SHEET 1 OF 6


AP 1563 ANALOG INPUTS
(SEE NOTE 8)
AP 1563
AP 1563 DIGITAL INPUTS
COIL AND TAPE DRAIN WIRE (TYP)
TERMINAL NUMBER (TYPICAL)
NOTES:
1. 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
2. UVIR "A" AND UVIR "B" DETECTORS ARE CONNECTED WITH A 6-CONDUCTOR SHIELDED CABLE. SEE SHEET 5 FOR ADDITIONAL UVIR CONNECTION AND SET-UP DETAILS.
3. DASHED LINES INDICATE OPTIONAL CONNECTIONS REQUIRED BASED ON SYSTEM CONFIGURATION.
= HARDWIRE S/D, INPUTS FROM CUSTOMER MUST BE MAINTAINED AS OPEN CONTACT UNTIL SYSTEM IS RESET.
= NOT HARDWIRE S/D, SOURCE "A1" SHUTDOWN AND SOURCE "B1" SHUTDOWN CLOSES ALL VALVES.
NOTE:
PT-1A1 AND PT-1B1 ARE INSTALLED AT THE FACTORY.
* CONNECTION IS AT TERMINAL BLOCKS IN FRONT OF ECC
** DO NOT TERMINATE SCALE DRAIN AT THIS END OF CABLE. ENSURE IT IS TERMINATED AT FAR END.
*** REMOVE 1" OF OUTER SHEATHING AND PASS BELOW PLATE BELOW CUSTOMER BOARD TO GROUND.
AP 1563 DIGITAL OUTPUTS
(DRY CONTACT 30 VDC @ 1 AMP MAX.)
TERMINAL NUMBER (TYPICAL)
COIL AND TAPE DRAIN WIRE (TYP)
RELAY OUT - R1 (TO CUSTOMER GAS AVAILABLE)
RELAY OUT - R2 (TO CUSTOMER MODULE FAULT ALARM)
RELAY OUT - R3 (TO CUSTOMER MODULE SHUTDOWN ALARM)
RELAY OUT - R4 (TO CUSTOMER MODULE UVIR/HIGH TEMP ALARM)
RELAY OUT - R5 (SOURCE "A-2" HEATER INHIBIT)
RELAY OUT - R6 (SOURCE "B-2" HEATER INHIBIT)
RELAY OUT - R7 (SOURCE "A-1" HEATER INHIBIT)
RELAY OUT - R8 (SOURCE "B-1" HEATER INHIBIT)
INSTALL WIRE TAGS
INSTALL FERRULES ON END OF THE WIRES TO BE TERMINATED
INSTALL CABLE TAG
UA-8A
TYPICAL CABLE DETAIL
56970 3 UPDATE OPTIONAL POWER DETAILS JRB SSC AJS XXX
VERSUM MATERIALS
BSGSeV
BULKGUARD eV
Electrical Details for Typical Installation
SW019593.slddrw D 3
SHEET 2 OF 6



RIGHT INTERFACE BOX
R PANEL ANALOG INPUTS
NOTES:
1. INPUT SHALL BE CONFIGURED AS A HARDWIRE SHUTDOWN. FOR DI-21 SET SW1-1 TO ON POSITION ON RIGHT PANEL BOARD FOR DI-22 SET SW1-2 TO ON POSITION ON RIGHT PANEL BOARD
2. 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.
3. DASHED LINES INDICATE OPTIONAL CONNECTIONS REQUIRED BASED ON SYSTEM CONFIGURATION.
R PANEL DIGITAL INPUTS
COIL AND TAPE DRAIN WIRE (TYP)
TERMINAL NUMBER (TYPICAL)
= HARDWIRE S/D, INPUTS FROM CUSTOMER MUST BE MAINTAINED AS OPEN CONTACT UNTIL SYSTEM IS RESET.
= NOT HARDWIRE S/D, SOURCE "A2" SHUTDOWN AND SOURCE "B2" SHUTDOWN CLOSES ALL VALVES.
NOTE:
PT-1A1 AND PT-1B1 ARE INSTALLED AT THE FACTORY.
* CONNECTION IS AT TERMINAL BLOCKS IN FRONT OF ECC
** DO NOT TERMINATE SCALE DRAIN AT THIS END OF CABLE. ENSURE IT IS TERMINATED AT FAR END.
MAIN POWER
208-240 VAC
SINGLE PHASE, 50/60 HZ.
SCCR 5 KA
WITH JT HEATER - 32A FULL LOAD CURRENT
WITH HEAT TRACE ONLY - 7A FULL LOAD CURRENT
CB102
LOAD
LINE
L1
L2/N
GND-1
REMOVE JUMPERS BETWEEN 1021-1111 AND 1031-1121 TO POWER AP11 SEPARATELY
LI-2
N-2
GND-2
OPTIONAL CONTROL POWER
100-240 VAC
MAX. POWER 175W
SCCR 10 KA
SINGLE PHASE, 50/60 HZ.
RECOMMENDED PENETRATION LOCATIONS FOR CABINET INSTALLATIONS REQUIRING FIELD CONNECTIONS TO RIGHT INTERFACE BOX.
TOP VIEW
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 BSGS eV / BULKGUARD eV SYSTEM CABINET. THE CUSTOMER IS RESPONSIBLE FOR DETERMINING WHICH OF THE OPTIONAL WIRING IS REQUIRED FOR THEIR INDIVIDUAL INSTALLATION.
USE A MINIMUM OF 75 DEG C. RATED WIRE. THE INSTALLER MUST SIZE THE FEEDER CONDUCTOR PER THE SYSTEM CONFIGURATION, LOADING, N.E.C. AND LOCAL REQUIREMENTS.
WIRE | SIZE RANGE | TORQUE
LI-1 | 14-4 AWG | 25 IN. LBS
L2-1 | 14-4 AWG | 25 IN. LBS
GND-1 | 18-8 AWG | 15 IN. LBS
LI-2 | 18-10 AWG | 7 IN. LBS
N-2 | 18-10 AWG | 7 IN. LBS
GND-2 | 18-10 AWG | 7 IN. LBS
56970 | 3 | UPDATE OPTIONAL POWER DETAILS | JRB | SSC | AJS | XXX
UNLESS OTHERWISE SPECIFIED:
FRACTIONAL: ± NA
DECIMAL: ± NA
VERSUM MATERIALS
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APPROVALS | DATE
DRAWN J.R.Barker 10/3/2017
CHECKED S.S.Cable 10/3/2017
MFG APPR. 00/00/0000
APPROVED A.J.Smith 10/3/2017
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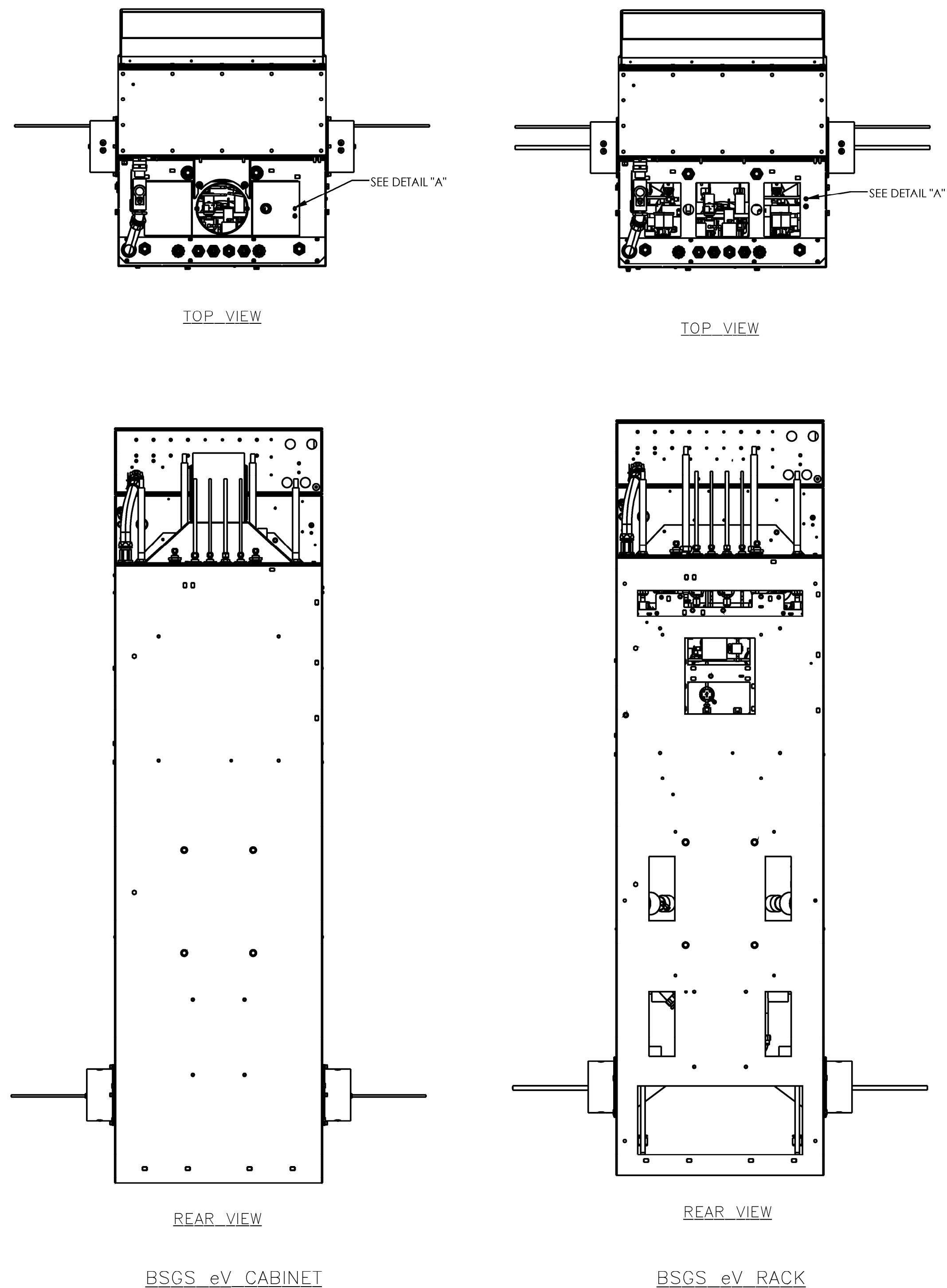
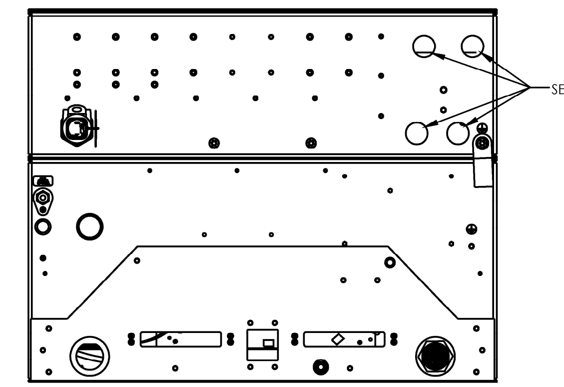
TITLE: BSGSeV BULKGUARD eV Electrical Details for Typical Installation
DWG. NO. SW019593.slddrw
SIZE D
REV 3
SCALE: 1:1
SHEET 3 OF 6

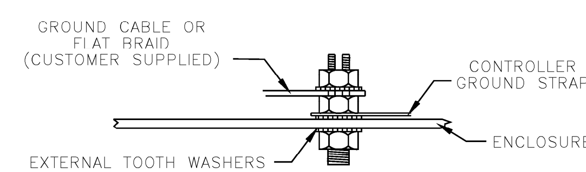


NOTES

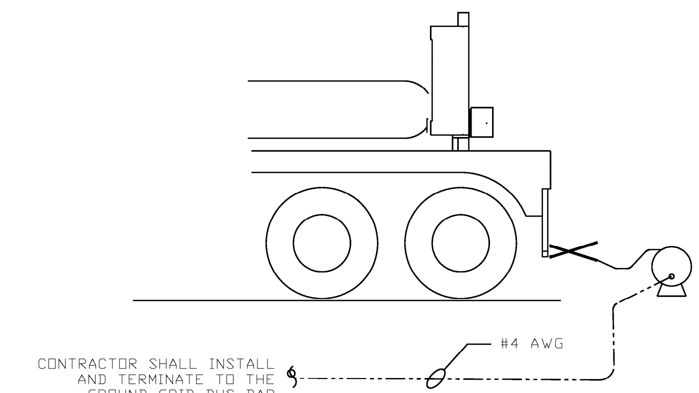
1. THE EQUIPMENT MUST BE GROUNDED IN ACCORDANCE WITH ARTICLE 250 - GROUNDING IN THE NATIONAL ELECTRIC CODE, IF INSTALLED IN THE UNITED STATES. THE CUSTOMER IS RESPONSIBLE FOR CONNECRTIONS TO EARTH GROUND. A GROUND CONECTION IS SUPPLIED ON THE CABINETY FOR THIS PURPOSE.
2. USE OF #4 AWG GROUND WIRE WILL NOT MAINTAIN CE MARKING. USE ALPHA #1239, 1-3/8" FLAT BRAID OR EQUIVALENT FOR CE MARKED SYSTEMS (TOTAL LENGTH NOT TO EXCEED 10 FET OR 3 METERS).
3. GROUNDING CONDUCTOR FROM BSGS eV / BULKGUARD eV 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.
4. 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.
5. INSTALLATION OF CONDUITS AND LOW POINT DRAINS BY COSTOMER (TYPICAL).
6. VERIFY THAT ALL UNUSED CONTROLLER PENETRATIONS ARE WATERTIGHT AND PLUGGED WITH NEMA TYPE 4 HOLE SEALS (HOFFMAN OR EQUAL).
7. 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.
8. CONTRACTOR SHALL TERMINATE #4 AWG GROUND CONDUCTOR TO GROUNDING REEL, AND THEN CLAMP ASSEMBLY TO ISO CONTAINER TRAILER.
9. 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.



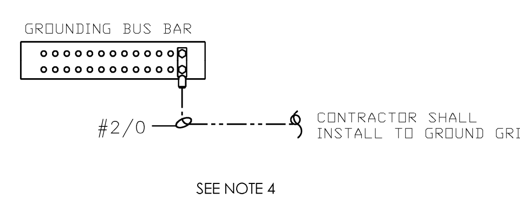
CONTROLLER REAR VIEW



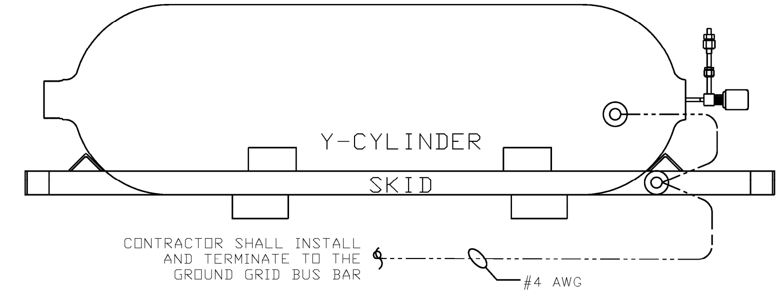
DETAIL "A"



TRAILER GROUNDING DETAIL



SEE NOTE 4



Y-CYLINDER GROUNDING DETAIL

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

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TITLE: BSGSeV BULKGUARD eV Electrical Details for Typical Installation

APPROVALS		DATE
DRAWN	J.R.Barber	10/3/2017
CHECKED	S.S.Cable	10/3/2017
ENG APPR.		
MFG APPR.		00/00/0000
APPROVED	A.J.Smith	10/3/2017

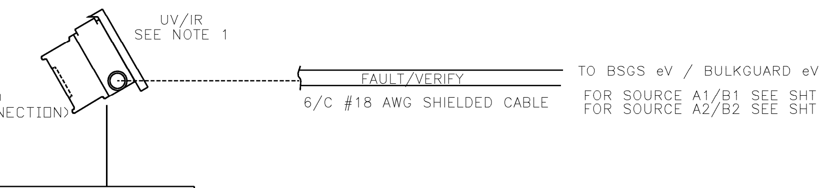
Part no.
MATERIAL
FINISH

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
56970	3	UPDATE OPTIONAL POWER DETAILS	10/25/2018	JRB	SSC	AJS	XXX

DWG. NO. SW019593.slddrw SIZE D REV 3
SCALE: 1:1 REF. SHEET 4 OF 6

UV/IR-15/16, 18/19 DETECTOR WIRING AND SETTINGS

OPTIONAL



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

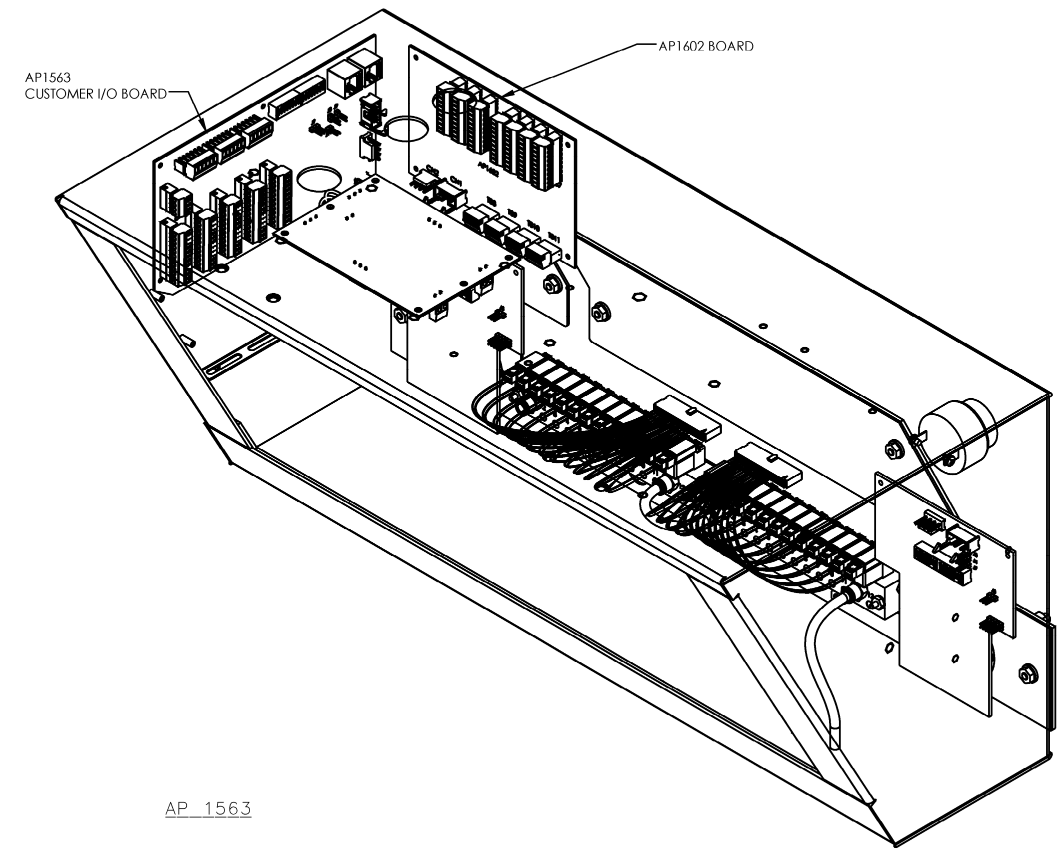
DETECTOR WIRING

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:

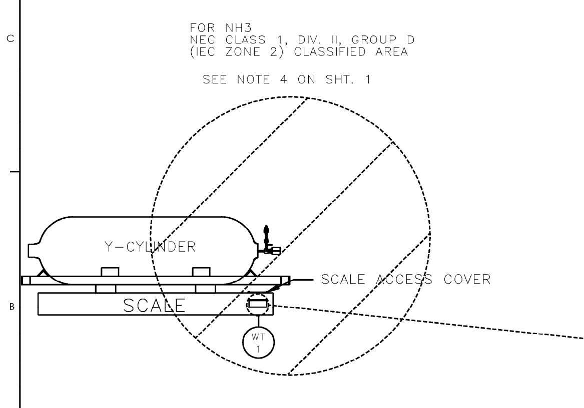
1. UP TO 4 ADDITIONAL UV/IR DETECTORS (UV/IR-15,16,18,19) ARE SHIPPED LOOSE WITH THE BSGS eV / BULKGUARD eV AND SHALL BE MOUNTEDAT THE SOURCE (AS SHOWN ON SHEET 1) AND WIRED BY THE CONTRACTOR DIRECTLY TO THE BSGS eV / BULKGUARD eV. THE UV/IR FAULT AND VERIFY SIGNALS SHALL BE WIRED TO DIGITAL INPUTS AS 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 BSGS eV / BULKGUARD eV 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 BSGS eV / BULKGUARD eV.

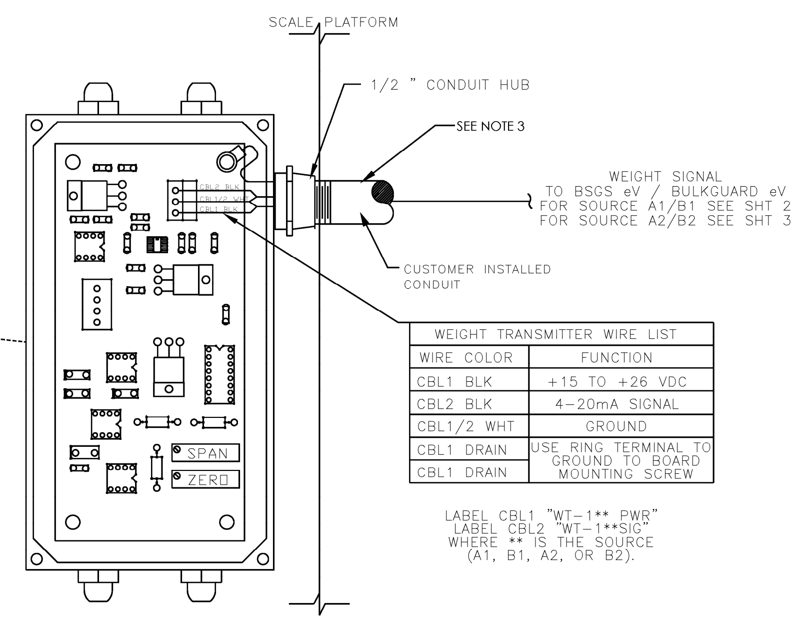


AP 1563

SOURCE WEIGHT DETAILS

OPTIONAL

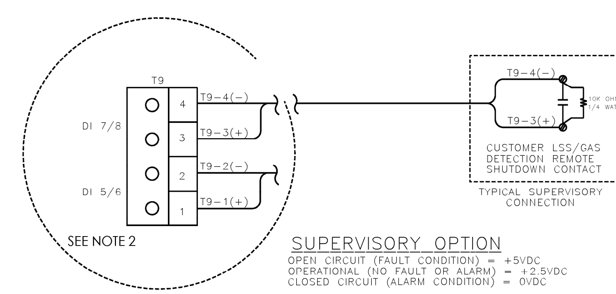




WEIGHT TRANSMITTER WIRE LIST	
WIRE COLOR	FUNCTION
CBL1 BLK	+15 TO +26 VDC
CBL2 BLK	4-20mA SIGNAL
CBL1/2 WHT	GROUND
CBL1 DRAIN	USE RING TERMINAL TO GROUND TO BOARD MOUNTING SCREW
CBL1 DRAIN	

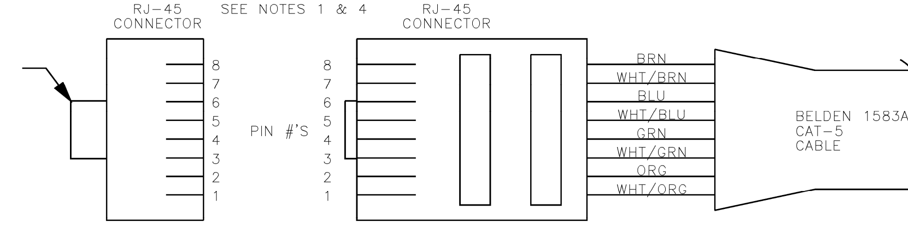
LABEL CBL1 "WT-1** PWR"
LABEL CBL2 "WT-1**SIG"
WHERE ** IS THE SOURCE
(A1, B1, A2, OR B2).

WEIGHT TRANSMITTER



SUPERVISORY OPTION

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



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.
4. RJ-45 CONNECTOR TO BE INSTALLED TO J3 ON AP1563 CUSTOMER I/O BOARD.

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
56970	3	UPDATE OPTIONAL POWER DETAILS	10/25/2018	JRB	SSC	AJS	XXX

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

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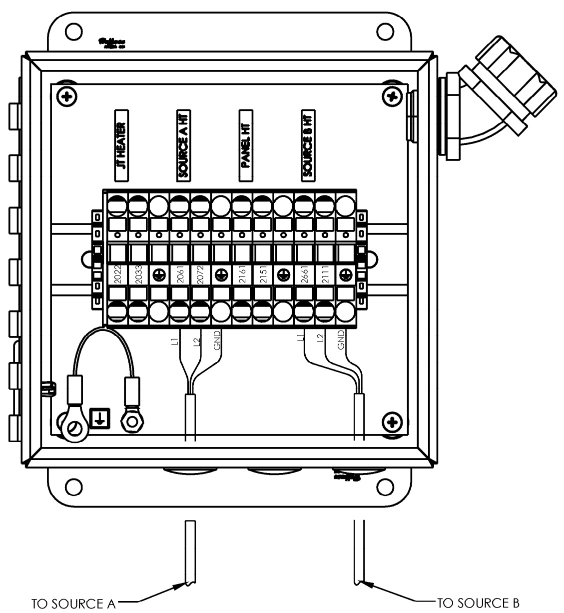
APPROVALS	DATE
DRAWN J.R.Barker	10/3/2017
CHECKED S.S.Cable	10/3/2017
MFG APPR.	00/00/0000
APPROVED A.J.Smith	10/3/2017

TITLE: BSGSeV BULKGUARD eV Electrical Details for Typical Installation

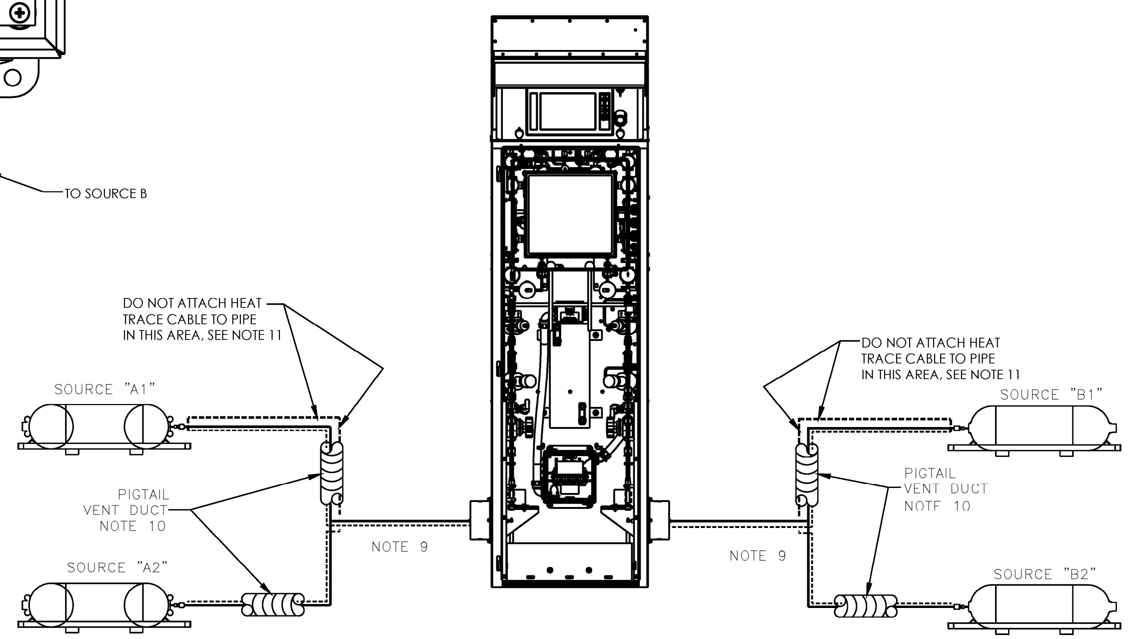
DWG. NO. SW019593.slddrw — SIZE D — REV 3 — SCALE: 1:1 — REF. — SHEET 5 OF 6

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	PIPE INSULATION 5/8" I.D. x 6 FT LONG	44745K21	AS REQ.	MCMASTER-CARR
5	SILICON FOAM TAPE INSULATION 1/8" THKL x 30 FFT.	C1-125SNS100S	AS REQ.	SAINT GOBAIN
6	SILICON TAPE GREY .030" THK x 60 FT	C4032SNS440S	AS REQ.	SAINT GOBAIN
7				
8				
9				

ITEM 1: SEE NOTES 3 & 4   ITEM 2: SEE NOTE 5   ITEM 3: SEE NOTE 6   ITEMS 5 & 6: SEE NOTE 11



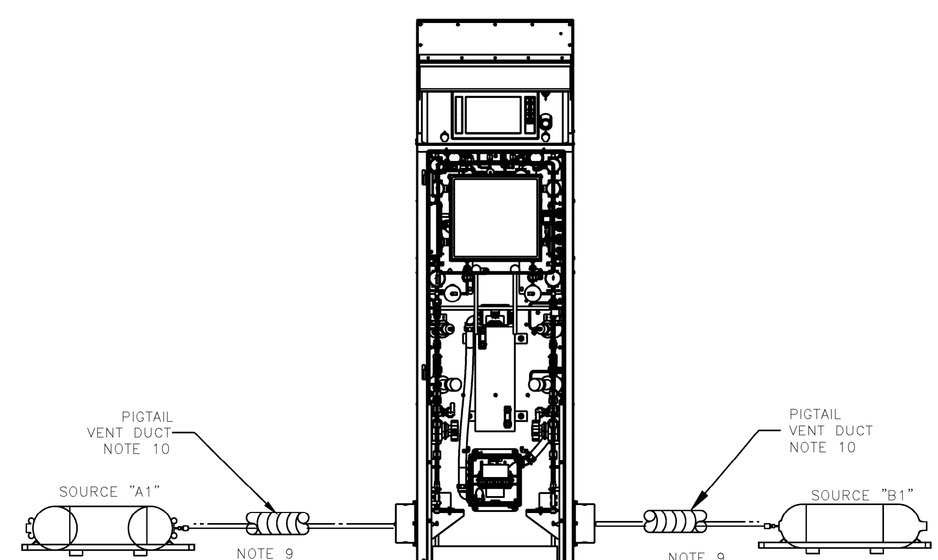
JUNCTION BOX



HEAT TRACE INSTALLATION DIAGRAM

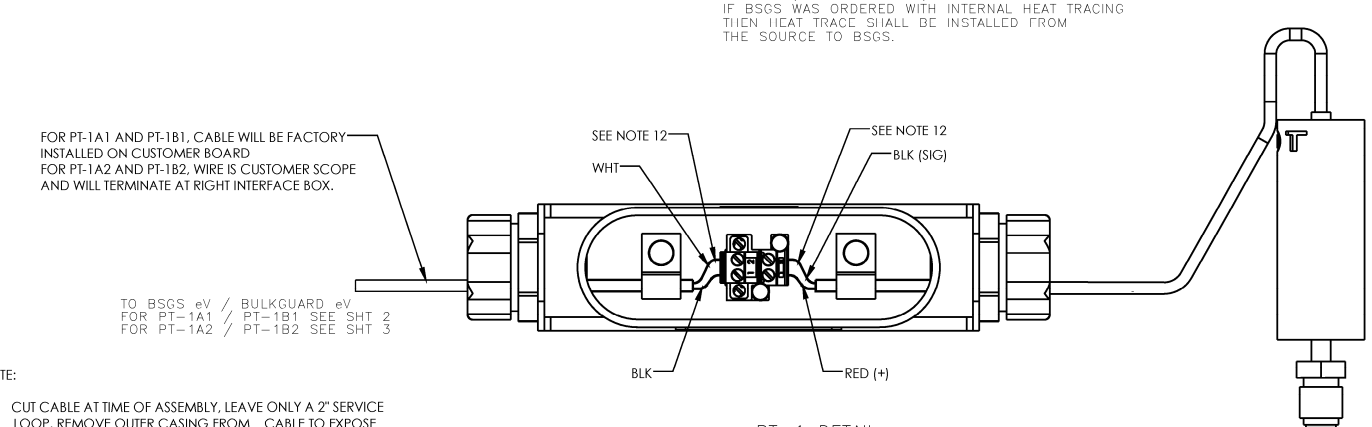
HEAT TRACE REQUIREMENTS ARE BASE ON:
GAS TYPE, EQUIPMENT SET, AND SCOPE DOCUMENT.
IF BSGS WAS ORDERED WITH INTERNAL HEAT TRACING
THEN HEAT TRACE SHALL BE INSTALLED FROM
THE SOURCE TO BSGS.

HEAT TRACE DETAILS
Y x Y



HEAT TRACE 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. THERMOCOUPLES FOR HEAT TRACE ARE FACTORY INSTALLED.
9. 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. SEE MANUAL FOR HEAT TRACE SETTING INSTRUCTIONS.
10. WHEN HEAT TRACE IS REQURED BETWEEN THE SOURCE AND BSGS MODULE, THE HEAT TRACE IS SUPPLIED AND POWERED FROM THE BSGS MODULE.
11. FOR HEAT TRACE RETURN TO SOURCE A2 OR B2 PIPING, DO NOT ATTACH HEAT TRACE CABLE TO PIPING, INSULATE HEAT TRACE CABLE INDEPENDANTLY, SPIRAL WRAP USING INSULATION (ITEM 5) AND OVERWRAP (ITEM 6)



PT-1 DETAIL
USED WITH DEEP PURGE OPTION

PT-1**

NOTE:

12. CUT CABLE AT TIME OF ASSEMBLY, LEAVE ONLY A 2" SERVICE LOOP. REMOVE OUTER CASING FROM CABLE TO EXPOSE SHIELD BRAID. ROUTE CABLE UNDER GROUNDING CLAMP AND ENSURE EXPOSED BRAID IS MAKING CONTACT WITH GROUNDING CLAMP BEFORE SECURING.

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
56970	3	UPDATE OPTIONAL POWER DETAILS	10/25/2018	JRB	SSC	AJS	XXX

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

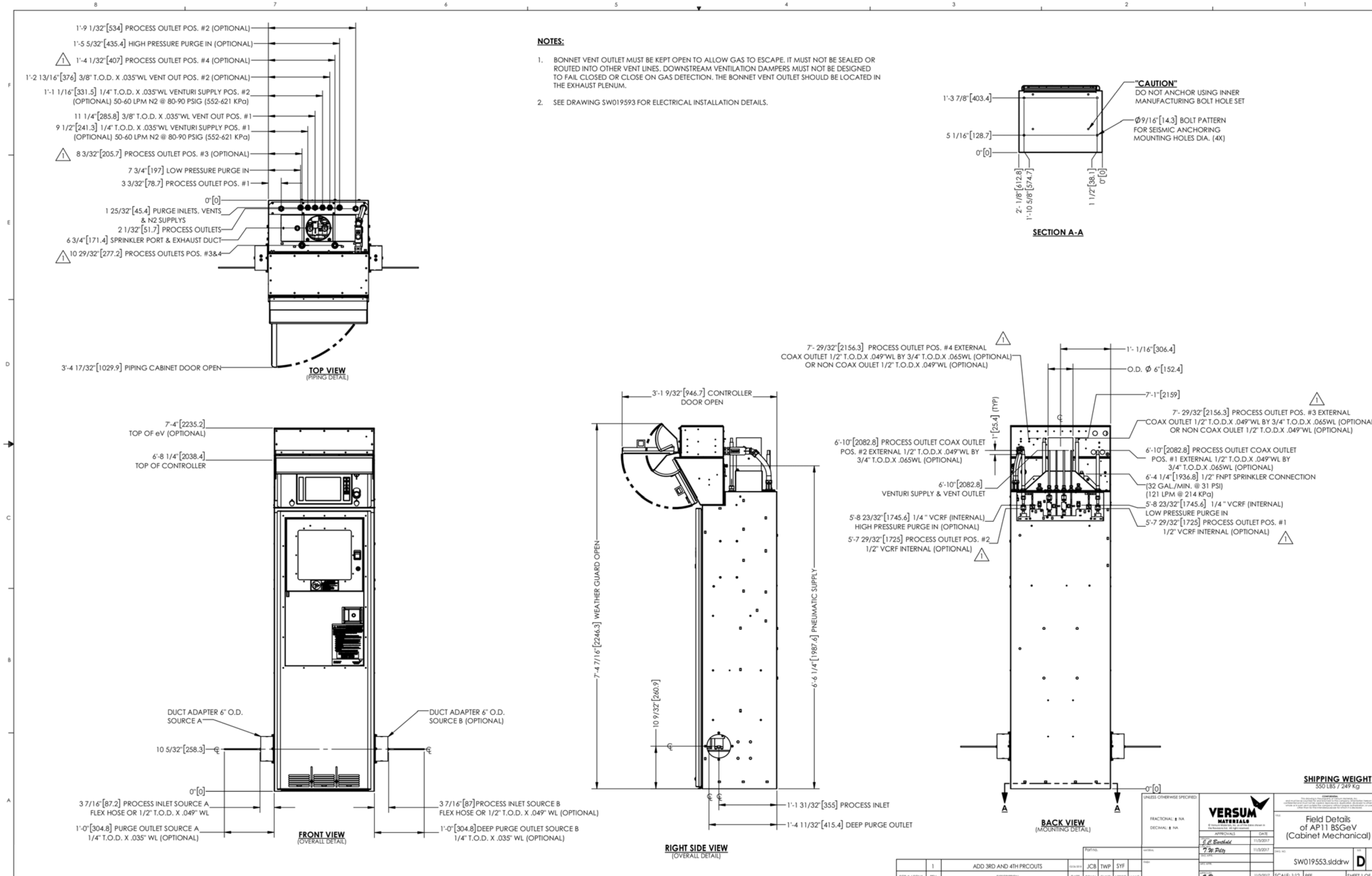
Part no.
MATERIAL
FINISH

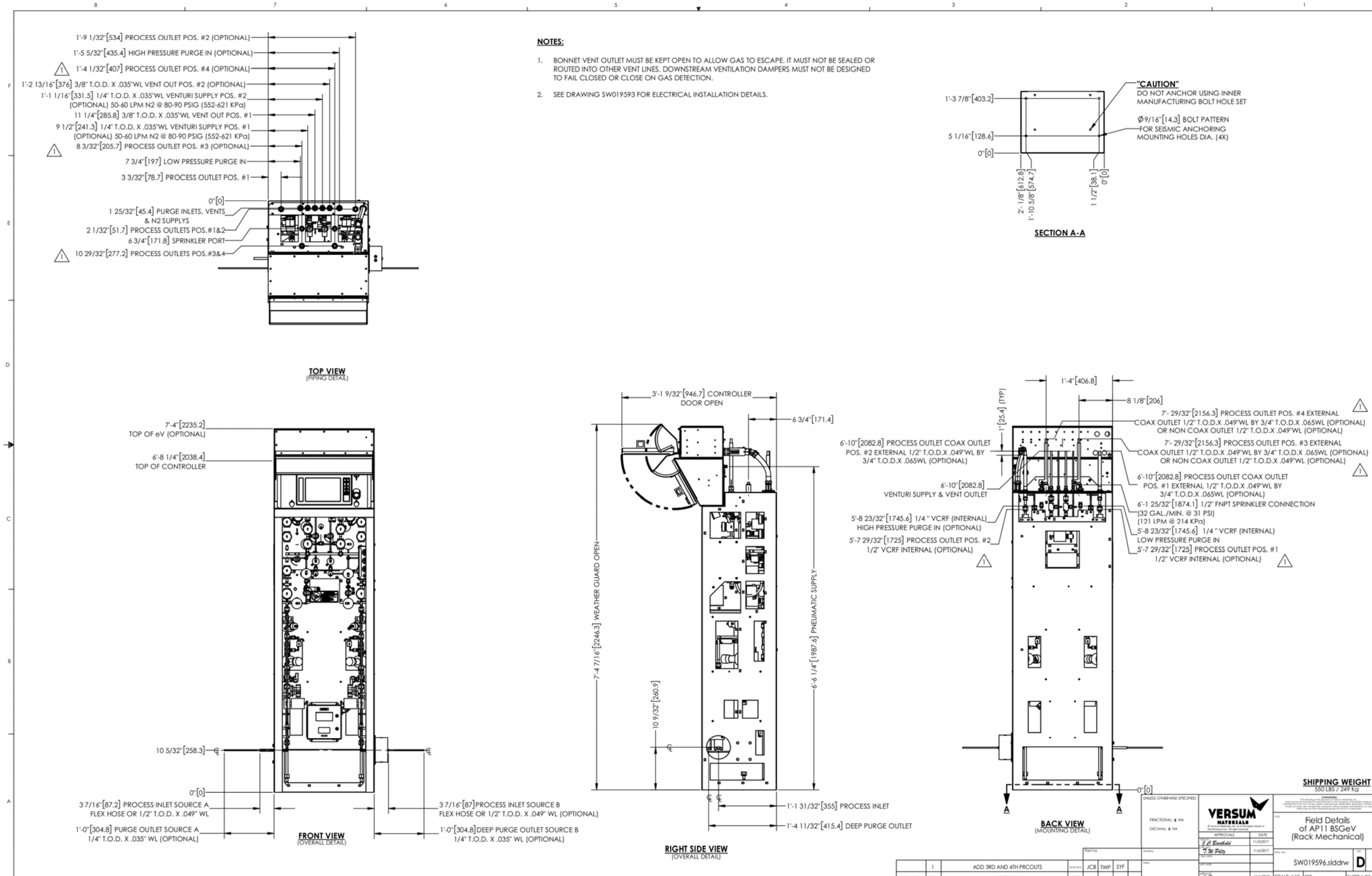
VERSUM MATERIALS

APPROVALS	DATE
DRAWN J.R.Barber	10/3/2017
CHECKED S.S.Cable	10/3/2017
ENG APPR.	
MFG APPR.	00/00/0000
APPROVED A.J.Smith	10/3/2017

TITLE: BSGSeV BULKGUARD eV Electrical Details for Typical Installation

DWG. NO. SW019593.slddrw SIZE D REV 3
SCALE: 1:1 REF. SHEET 6 OF 6


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. DOWNSTREAM VENTILATION DAMPERS MUST NOT BE DESIGNED TO FAIL CLOSED OR CLOSE ON GAS DETECTION. THE BONNET VENT OUTLET SHOULD BE LOCATED IN THE EXHAUST PLENUM.
2. SEE DRAWING SW019593 FOR ELECTRICAL INSTALLATION DETAILS.
1'-9 1/32"[534] PROCESS OUTLET POS. #2 (OPTIONAL)
1'-5 5/32"[435.4] HIGH PRESSURE PURGE IN (OPTIONAL)
1'-4 1/32"[407] PROCESS OUTLET POS. #4 (OPTIONAL)
1'-2 13/16"[376] 3/8" T.O.D. X .035"WL VENT OUT POS. #2 (OPTIONAL)
1'-1 1/16"[331.5] 1/4" T.O.D. X .035"WL VENTURI SUPPLY POS. #2 (OPTIONAL) 50-60 LPM N2 @ 80-90 PSIG (552-621 KPa)
11 1/4"[285.8] 3/8" T.O.D. X .035"WL VENT OUT POS. #1
9 1/2"[241.3] 1/4" T.O.D. X .035"WL VENTURI SUPPLY POS. #1 (OPTIONAL) 50-60 LPM N2 @ 80-90 PSIG (552-621 KPa)
8 3/32"[205.7] PROCESS OUTLET POS. #3 (OPTIONAL)
7 3/4"[197] LOW PRESSURE PURGE IN
3 3/32"[78.7] PROCESS OUTLET POS. #1
0"[0]
1 25/32"[45.4] PURGE INLETS, VENTS & N2 SUPPLYS
2 1/32"[51.7] PROCESS OUTLETS
6 3/4"[171.4] SPRINKLER PORT & EXHAUST DUCT
10 29/32"[277.2] PROCESS OUTLETS POS. #3&4
3'-4 17/32"[1029.9] PIPING CABINET DOOR OPEN
TOP VIEW
(PIPING DETAIL)
1'-3 7/8"[403.4]
5 1/16"[128.7]
0"[0]
"CAUTION"
DO NOT ANCHOR USING INNER MANUFACTURING BOLT HOLE SET
Ø9/16"[14.3] BOLT PATTERN FOR SEISMIC ANCHORING MOUNTING HOLES DIA. (4X)
2'- 1/8"[612.8]
1'-10 5/8"[574.7]
1 1/2"[38.1]
0"[0]
SECTION A-A
7'-4"[2235.2] TOP OF eV (OPTIONAL)
6'-8 1/4"[2038.4] TOP OF CONTROLLER
DUCT ADAPTER 6" O.D. SOURCE A
DUCT ADAPTER 6" O.D. SOURCE B (OPTIONAL)
10 5/32"[258.3]
0"[0]
3 7/16"[87.2] PROCESS INLET SOURCE A FLEX HOSE OR 1/2" T.O.D. X .049" WL
1'-0"[304.8] PURGE OUTLET SOURCE A 1/4" T.O.D. X .035" WL (OPTIONAL)
3 7/16"[87] PROCESS INLET SOURCE B FLEX HOSE OR 1/2" T.O.D. X .049" WL (OPTIONAL)
1'-0"[304.8] DEEP PURGE OUTLET SOURCE B 1/4" T.O.D. X .035" WL (OPTIONAL)
FRONT VIEW
(OVERALL DETAIL)
3'-1 9/32"[946.7] CONTROLLER DOOR OPEN
7'-4 7/16"[2246.3] WEATHER GUARD OPEN
6'-6 1/4"[1987.6] PNEUMATIC SUPPLY
10 9/32"[260.9]
1'-1 31/32"[355] PROCESS INLET
1'-4 11/32"[415.4] DEEP PURGE OUTLET
RIGHT SIDE VIEW
(OVERALL DETAIL)
7'- 29/32"[2156.3] PROCESS OUTLET POS. #4 EXTERNAL COAX OUTLET 1/2" T.O.D.X .049"WL BY 3/4" T.O.D.X .065WL (OPTIONAL) OR NON COAX OULET 1/2" T.O.D.X .049"WL (OPTIONAL)
1'- 1/16"[306.4]
O.D. Ø 6"[152.4]
7'-1"[2159]
1"[25.4] (TYP)
7'- 29/32"[2156.3] PROCESS OUTLET POS. #3 EXTERNAL COAX OUTLET 1/2" T.O.D.X .049"WL BY 3/4" T.O.D.X .065WL (OPTIONAL) OR NON COAX OULET 1/2" T.O.D.X .049"WL (OPTIONAL)
6'-10"[2082.8] PROCESS OUTLET COAX OUTLET POS. #2 EXTERNAL 1/2" T.O.D.X .049"WL BY 3/4" T.O.D.X .065WL (OPTIONAL)
6'-10"[2082.8] VENTURI SUPPLY & VENT OUTLET
5'-8 23/32"[1745.6] 1/4" VCRF (INTERNAL) HIGH PRESSURE PURGE IN (OPTIONAL)
5'-7 29/32"[1725] PROCESS OUTLET POS. #2 1/2" VCRF INTERNAL (OPTIONAL)
6'-10"[2082.8] PROCESS OUTLET COAX OUTLET POS. #1 EXTERNAL 1/2" T.O.D.X .049"WL BY 3/4" T.O.D.X .065WL (OPTIONAL)
6'-4 1/4"[1936.8] 1/2" FNPT SPRINKLER CONNECTION (32 GAL./MIN. @ 31 PSI) (121 LPM @ 214 KPa)
5'-8 23/32"[1745.6] 1/4" VCRF (INTERNAL) LOW PRESSURE PURGE IN
5'-7 29/32"[1725] PROCESS OUTLET POS. #1 1/2" VCRF INTERNAL (OPTIONAL)
0"[0]
BACK VIEW
(MOUNTING DETAIL)
SHIPPING WEIGHT
550 LBS / 249 Kg
VERSUM MATERIALS
Field Details of AP11 BSGeV (Cabinet Mechanical)
SW019553.slddrw D 1
SCALE: 1:12
SHEET 1 OF 1
1 ADD 3RD AND 4TH PROCOUTS JCB TWP SYF


NOTES:
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1'-1 1/16"[331.5] 1/4" T.O.D. X .035"WL VENTURI SUPPLY POS. #2 (OPTIONAL) 50-60 LPM N2 @ 80-90 PSIG (552-621 KPa)
11 1/4"[285.8] 3/8" T.O.D. X .035"WL VENT OUT POS. #1
9 1/2"[241.3] 1/4" T.O.D. X .035"WL VENTURI SUPPLY POS. #1 (OPTIONAL) 50-60 LPM N2 @ 80-90 PSIG (552-621 KPa)
8 3/32"[205.7] PROCESS OUTLET POS. #3 (OPTIONAL)
7 3/4"[197] LOW PRESSURE PURGE IN
3 3/32"[78.7] PROCESS OUTLET POS. #1
0"[0]
1 25/32"[45.4] PURGE INLETS, VENTS & N2 SUPPLYS
2 1/32"[51.7] PROCESS OUTLETS POS.#1&2
6 3/4"[171.8] SPRINKLER PORT
10 29/32"[277.2] PROCESS OUTLETS POS.#3&4
TOP VIEW
(PIPING DETAIL)
1'-3 7/8"[403.2]
5 1/16"[128.6]
0"[0]
"CAUTION"
DO NOT ANCHOR USING INNER MANUFACTURING BOLT HOLE SET
Ø9/16"[14.3] BOLT PATTERN FOR SEISMIC ANCHORING MOUNTING HOLES DIA. (4X)
2'- 1/8"[612.8]
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1 1/2"[38.1]
0"[0]
SECTION A-A
7'-4"[2235.2] TOP OF eV (OPTIONAL)
6'-8 1/4"[2038.4] TOP OF CONTROLLER
10 5/32"[258.3]
0"[0]
3 7/16"[87.2] PROCESS INLET SOURCE A FLEX HOSE OR 1/2" T.O.D. X .049" WL
1'-0"[304.8] PURGE OUTLET SOURCE A 1/4" T.O.D. X .035" WL (OPTIONAL)
3 7/16"[87] PROCESS INLET SOURCE B FLEX HOSE OR 1/2" T.O.D. X .049" WL (OPTIONAL)
1'-0"[304.8] DEEP PURGE OUTLET SOURCE B 1/4" T.O.D. X .035" WL (OPTIONAL)
FRONT VIEW
(OVERALL DETAIL)
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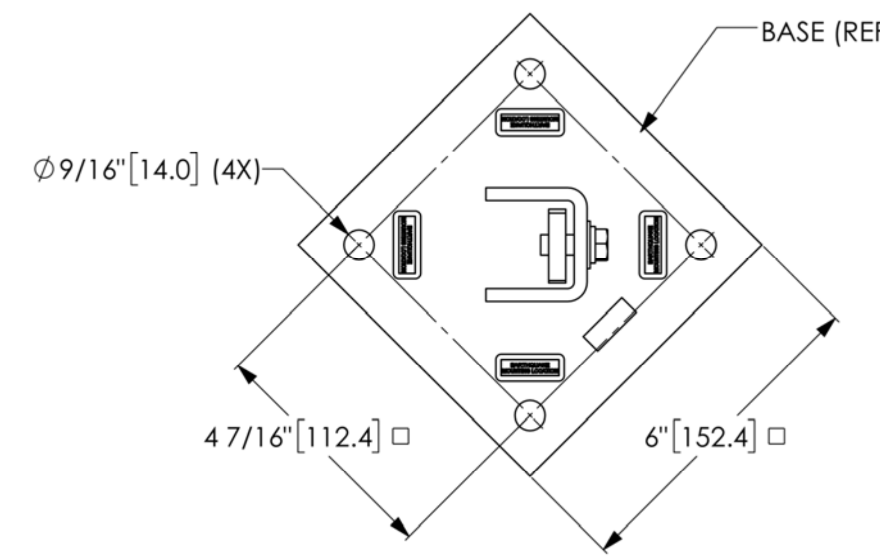
10 9/32"[260.9]
1'-1 31/32"[355] PROCESS INLET
1'-4 11/32"[415.4] DEEP PURGE OUTLET
RIGHT SIDE VIEW
(OVERALL DETAIL)
1'-4"[406.8]
8 1/8"[206]
1"[25.4] (TYP)
7'- 29/32"[2156.3] PROCESS OUTLET POS. #4 EXTERNAL COAX OUTLET 1/2" T.O.D.X .049"WL BY 3/4" T.O.D.X .065WL (OPTIONAL) OR NON COAX OUTLET 1/2" T.O.D.X .049"WL (OPTIONAL)
7'- 29/32"[2156.3] PROCESS OUTLET POS. #3 EXTERNAL COAX OUTLET 1/2" T.O.D.X .049"WL BY 3/4" T.O.D.X .065WL (OPTIONAL) OR NON COAX OUTLET 1/2" T.O.D.X .049"WL (OPTIONAL)
6'-10"[2082.8] PROCESS OUTLET COAX OUTLET POS. #2 EXTERNAL 1/2" T.O.D.X .049"WL BY 3/4" T.O.D.X .065WL (OPTIONAL)
6'-10"[2082.8] VENTURI SUPPLY & VENT OUTLET
5'-8 23/32"[1745.6] 1/4" VCRF (INTERNAL) HIGH PRESSURE PURGE IN (OPTIONAL)
5'-7 29/32"[1725] PROCESS OUTLET POS. #2 1/2" VCRF INTERNAL (OPTIONAL)
6'-10"[2082.8] PROCESS OUTLET COAX OUTLET POS. #1 EXTERNAL 1/2" T.O.D.X .049"WL BY 3/4" T.O.D.X .065WL (OPTIONAL)
6'-1 25/32"[1874.1] 1/2" FNPT SPRINKLER CONNECTION (32 GAL./MIN. @ 31 PSI) (121 LPM @ 214 KPa)
5'-8 23/32"[1745.6] 1/4" VCRF (INTERNAL) LOW PRESSURE PURGE IN
5'-7 29/32"[1725] PROCESS OUTLET POS. #1 1/2" VCRF INTERNAL (OPTIONAL)
0"[0]
BACK VIEW
(MOUNTING DETAIL)
SHIPPING WEIGHT
550 LBS / 249 Kg
VERSUM MATERIALS
Field Details of AP11 BSGeV (Rack Mechanical)
SW019596.slddrw
D 1
SCALE: 1:12
SHEET 1 OF 1
ADD 3RD AND 4TH PRCOUTS
JCB TWP SYF

TABLE OF CONTENT



TOP VIEW
ANCHORING PATTERN

NOTES:

1. SOME ITEMS HAVE BEEN HIDDEN FOR CLARITY.
2. SPOOLS ARE FOR REFERENCE ONLY, YOUR EXACT BUILD WILL VARY FROM DETAILS SHOWN ON DRAWING.
3. IF EQUIPMENT REQUIRES DUCTING, YOU SHOULD CONSIDER ASSEMBLING DUCT AS YOU WELD PIPING TOGETHER.
4. SOURCE B SIDE SHOULD FOLLOW SAME INSTRUCTIONS AS SOURCE A.
5. HARDWARE TORQUE SPEC: 7-9 IN/LBS UNLESS OTHERWISE NOTED
6. REMOVE BURRS AND SHARP EDGES, APPLY TOUCH UP PAINT IF NECESSARY.

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
	0	INITIAL RELEASE	11/09/2017	JCB	TWP	CDF	

UNLESS OTHERWISE SPECIFIED:
FRACTIONAL ± 1/64" [.4]
DECIMAL:
.XX [.X] ± .00 [.0]
.XXX [.XX] ± .005 [.13]
ANGULAR: MACH ± .5
BEND ± .5

Weld Station: NA

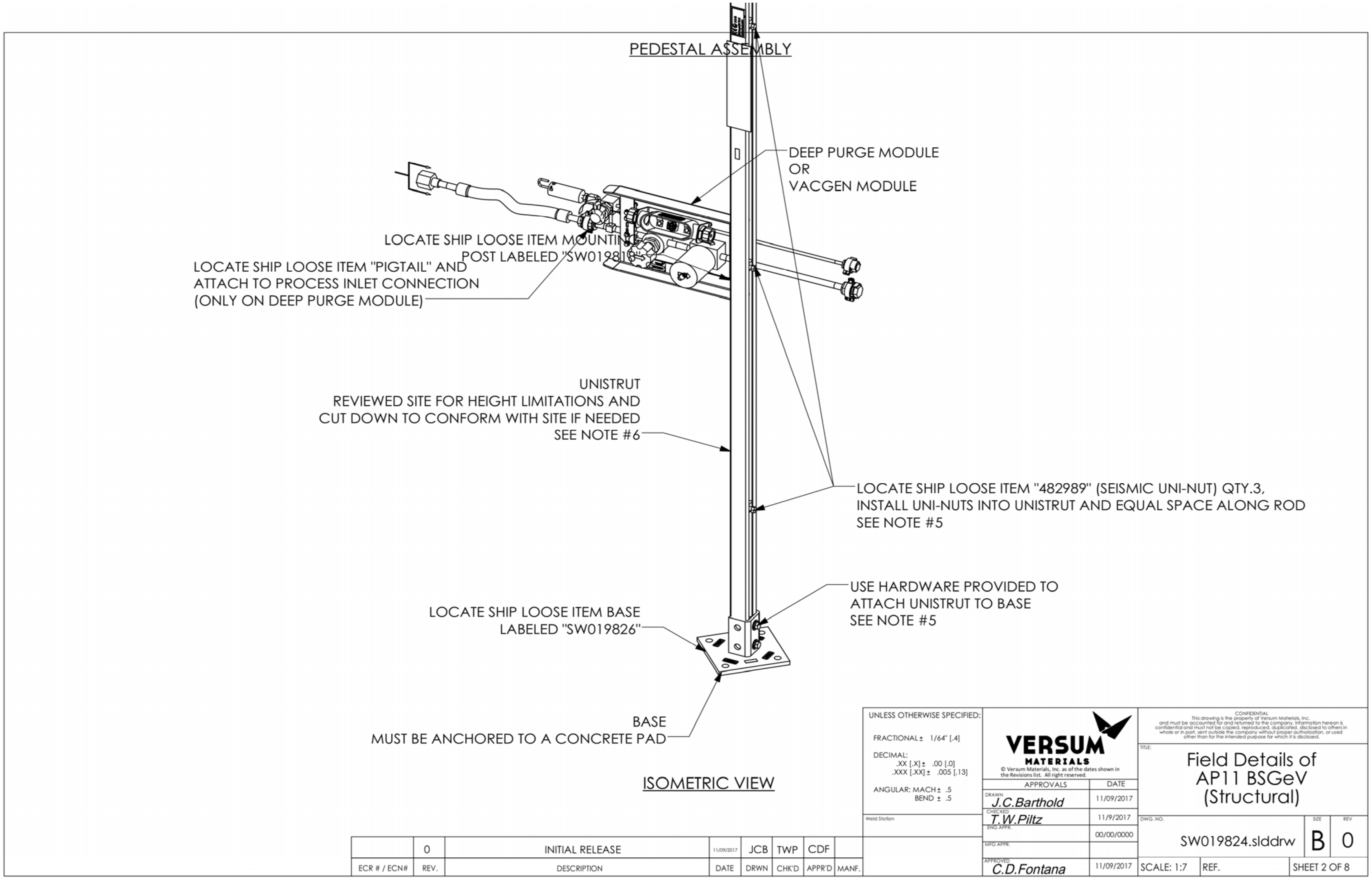
VERSUM MATERIALS

APPROVALS		DATE
DRAWN	J.C.Barthold	11/09/2017
CHECKED	T.W.Piltz	11/9/2017
ENG APPR.		00/00/0000
MFG APPR.		
APPROVED	C.D.Fontana	11/09/2017

TITLE: Field Details of AP11 BSGeV (Structural)

DWG. NO.: SW019824.slddrw | SIZE: B | REV: 0

SCALE: 1:9 | REF. | SHEET 1 OF 8


PEDESTAL ASSEMBLY
DEEP PURGE MODULE
OR
VACGEN MODULE
LOCATE SHIP LOOSE ITEM MOUNTING POST LABELED "SW019819"
LOCATE SHIP LOOSE ITEM "PIGTAIL" AND ATTACH TO PROCESS INLET CONNECTION (ONLY ON DEEP PURGE MODULE)
UNISTRUT
REVIEWED SITE FOR HEIGHT LIMITATIONS AND CUT DOWN TO CONFORM WITH SITE IF NEEDED
SEE NOTE #6
LOCATE SHIP LOOSE ITEM "482989" (SEISMIC UNI-NUT) QTY.3, INSTALL UNI-NUTS INTO UNISTRUT AND EQUAL SPACE ALONG ROD
SEE NOTE #5
USE HARDWARE PROVIDED TO ATTACH UNISTRUT TO BASE
SEE NOTE #5
LOCATE SHIP LOOSE ITEM BASE LABELED "SW019826"
BASE
MUST BE ANCHORED TO A CONCRETE PAD
ISOMETRIC VIEW
UNLESS OTHERWISE SPECIFIED:
FRACTIONAL ± 1/64" [.4]
DECIMAL:
.XX [.X] ± .00 [.0]
.XXX [.XX] ± .005 [.13]
ANGULAR: MACH ± .5
BEND ± .5
Weld Station
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APPROVALS
DATE
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CHECKED T.W.Piltz 11/9/2017
ENG APPR. 00/00/0000
MFG APPR.
APPROVED C.D.Fontana 11/09/2017
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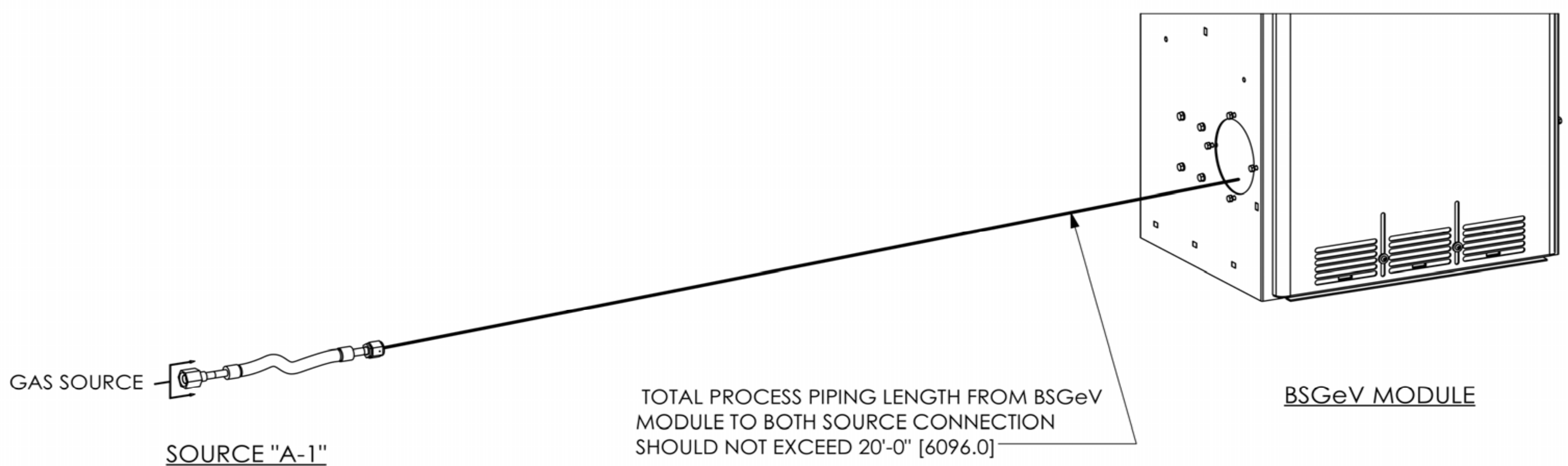
TITLE:
Field Details of AP11 BSGeV (Structural)
DWG. NO.
SW019824.slddrw
SIZE B
REV 0
SCALE: 1:7
REF.
SHEET 2 OF 8
ECR # / ECN# | REV. | DESCRIPTION | DATE | DRWN | CHK'D | APPR'D | MANF.
0 | INITIAL RELEASE | 11/09/2017 | JCB | TWP | CDF

SINGLE SOURCE CROSS PURGE



UNLESS OTHERWISE SPECIFIED:
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DECIMAL:
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.XXX [.XX] ± .005 [.13]
ANGULAR: MACH ± .5
BEND ± .5

Weld Station: NA

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ENG APPR.		00/00/0000
MFG APPR.		
APPROVED	C.D.Fontana	11/09/2017

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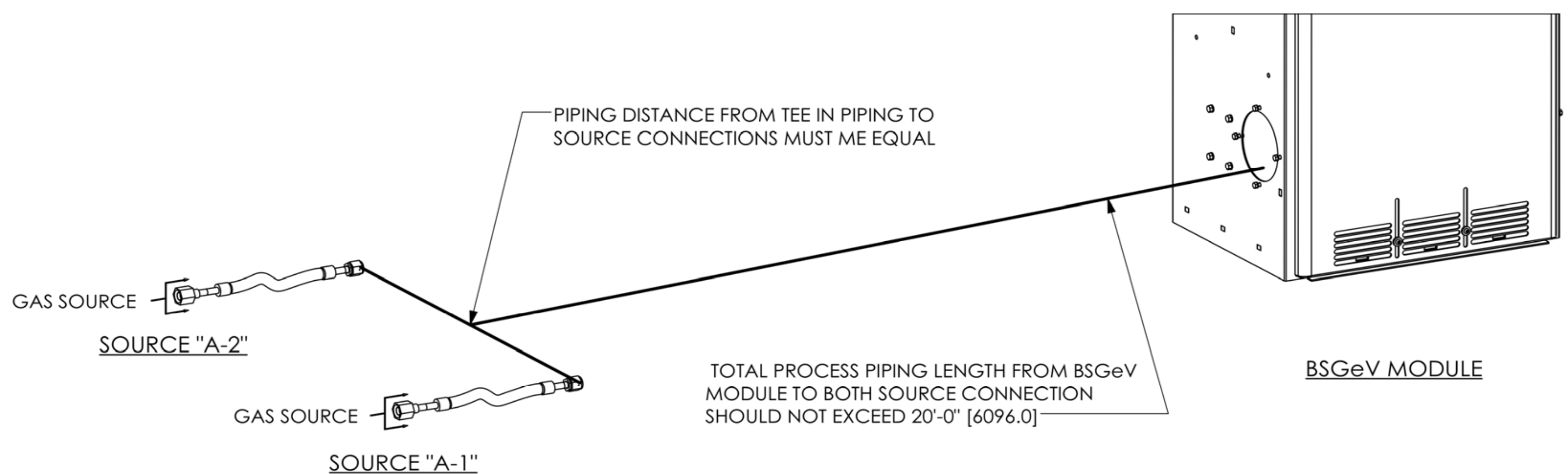
TITLE: Field Details of AP11 BSGeV (Structural)

DWG. NO.: SW019824.slddrw | SIZE: B | REV: 0
SCALE: 1:9 | REF. | SHEET 3 OF 8

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
	0	INITIAL RELEASE	11/09/2017	JCB	TWP	CDF	

DUAL SOURCE CROSS PURGE



ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
	0	INITIAL RELEASE	11/09/2017	JCB	TWP	CDF	

UNLESS OTHERWISE SPECIFIED:
FRACTIONAL ± 1/64" [.4]
DECIMAL:
.XX [.X] ± .00 [.0]
.XXX [.XX] ± .005 [.13]
ANGULAR: MACH ± .5
BEND ± .5

Weld Station
NA

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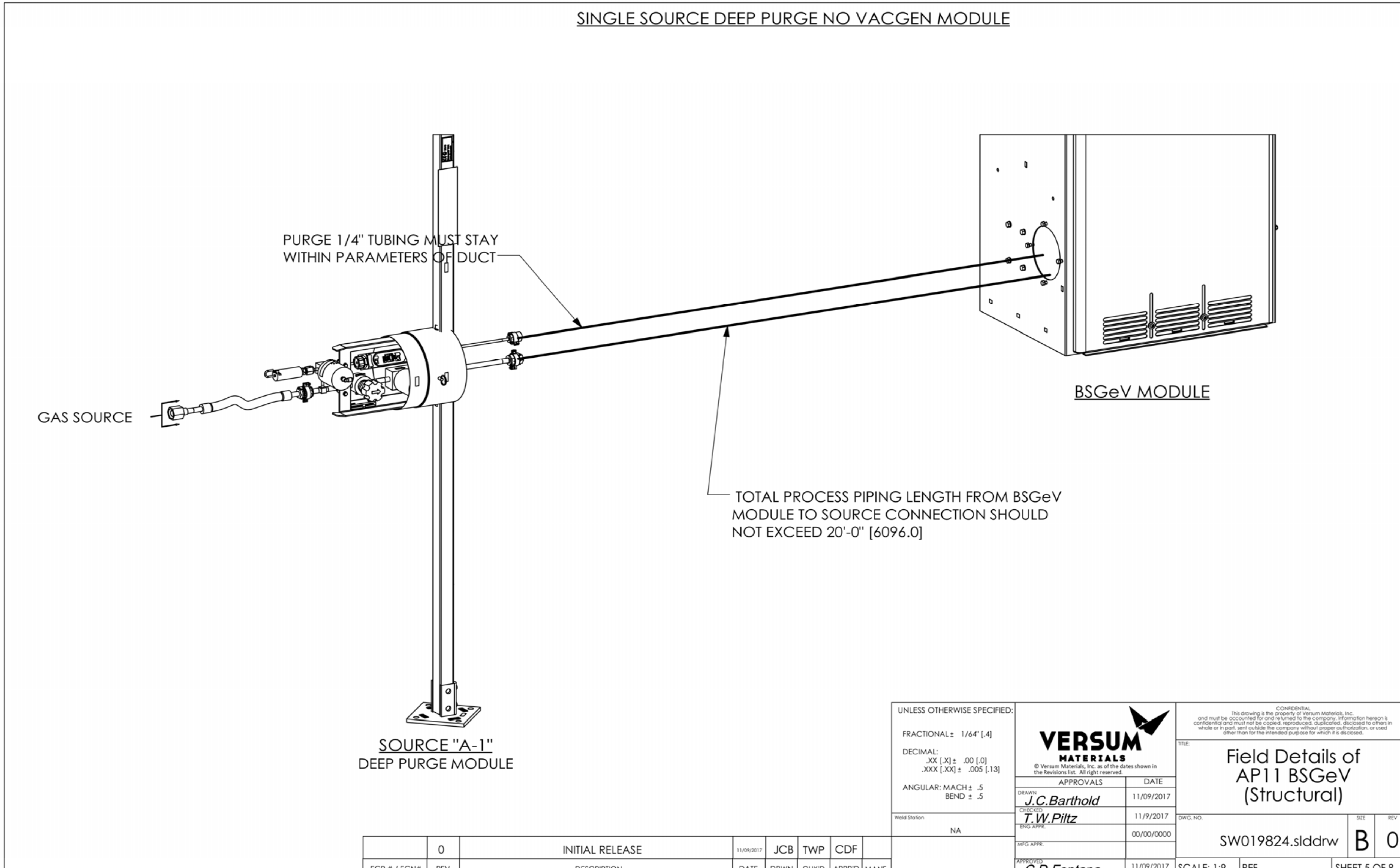
ENG APPR.		00/00/0000
MFG APPR.		
APPROVED	C.D.Fontana	11/09/2017

TITLE: Field Details of AP11 BSGeV (Structural)

DWG. NO.	SIZE	REV
SW019824.slddrw	B	0

SCALE: 1:9 | REF. | SHEET 4 OF 8


SINGLE SOURCE DEEP PURGE NO VACGEN MODULE
PURGE 1/4" TUBING MUST STAY WITHIN PARAMETERS OF DUCT
GAS SOURCE
BSGeV MODULE
TOTAL PROCESS PIPING LENGTH FROM BSGeV MODULE TO SOURCE CONNECTION SHOULD NOT EXCEED 20'-0" [6096.0]
SOURCE "A-1"
DEEP PURGE MODULE
0
INITIAL RELEASE
11/09/2017
JCB
TWP
CDF
ECR # / ECN#
REV.
DESCRIPTION
DATE
DRWN
CHK'D
APPR'D
MANF.
UNLESS OTHERWISE SPECIFIED:
FRACTIONAL ± 1/64" [.4]
DECIMAL:
.XX [.X] ± .00 [.0]
.XXX [.XX] ± .005 [.13]
ANGULAR: MACH ± .5
BEND ± .5
Weld Station
NA
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DATE
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ENG APPR.
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MFG APPR.
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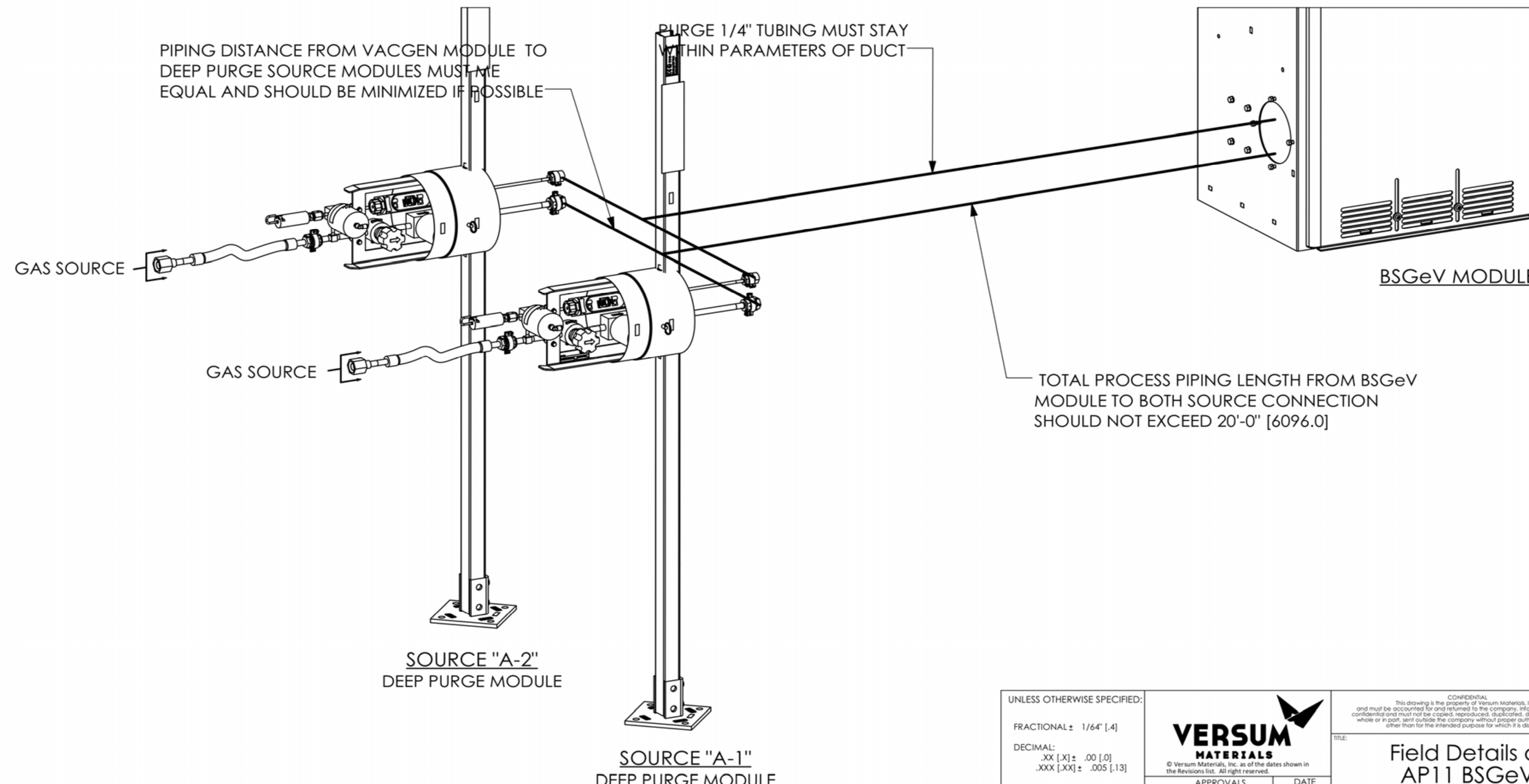
TITLE:
Field Details of AP11 BSGeV (Structural)
DWG. NO.
SW019824.slddrw
SIZE
B
REV
0
SCALE: 1:9
REF.
SHEET 5 OF 8

DUAL SOURCE DEEP PURGE NO VACGEN MODULE



ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
	0	INITIAL RELEASE	11/09/2017	JCB	TWP	CDF	

UNLESS OTHERWISE SPECIFIED:
FRACTIONAL ± 1/64" [.4]
DECIMAL:
.XX [.X] ± .00 [.0]
.XXX [.XX] ± .005 [.13]
ANGULAR: MACH ± .5
BEND ± .5

Weld Station: NA

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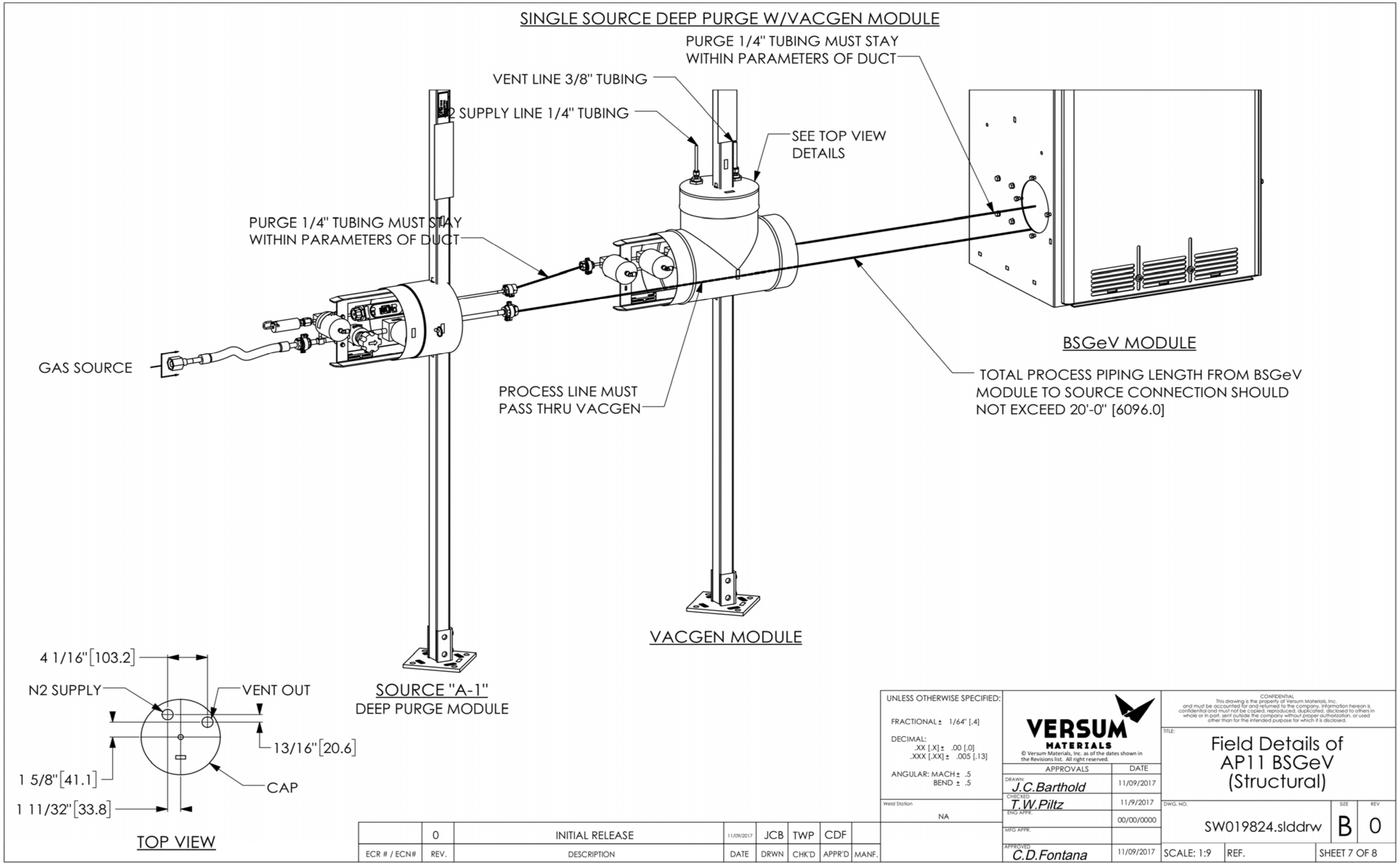
ENG APPR.		00/00/0000
MFG APPR.		
APPROVED	C.D.Fontana	11/09/2017

TITLE: Field Details of AP11 BSGeV (Structural)

DWG. NO. SW019824.slddrw | SIZE B | REV 0

SCALE: 1:9 | REF. | SHEET 6 OF 8


SINGLE SOURCE DEEP PURGE W/VACGEN MODULE
PURGE 1/4" TUBING MUST STAY WITHIN PARAMETERS OF DUCT
VENT LINE 3/8" TUBING
N2 SUPPLY LINE 1/4" TUBING
SEE TOP VIEW DETAILS
PURGE 1/4" TUBING MUST STAY WITHIN PARAMETERS OF DUCT
GAS SOURCE
PROCESS LINE MUST PASS THRU VACGEN
BSGeV MODULE
TOTAL PROCESS PIPING LENGTH FROM BSGeV MODULE TO SOURCE CONNECTION SHOULD NOT EXCEED 20'-0" [6096.0]
VACGEN MODULE
4 1/16"[103.2]
N2 SUPPLY
VENT OUT
13/16"[20.6]
1 5/8"[41.1]
CAP
1 11/32"[33.8]
TOP VIEW
SOURCE "A-1"
DEEP PURGE MODULE
UNLESS OTHERWISE SPECIFIED:
FRACTIONAL ± 1/64" [.4]
DECIMAL:
.XX [.X] ± .00 [.0]
.XXX [.XX] ± .005 [.13]
ANGULAR: MACH ± .5
BEND ± .5
Weld Station
NA
0
INITIAL RELEASE
11/09/2017
JCB
TWP
CDF
ECR # / ECN#
REV.
DESCRIPTION
DATE
DRWN
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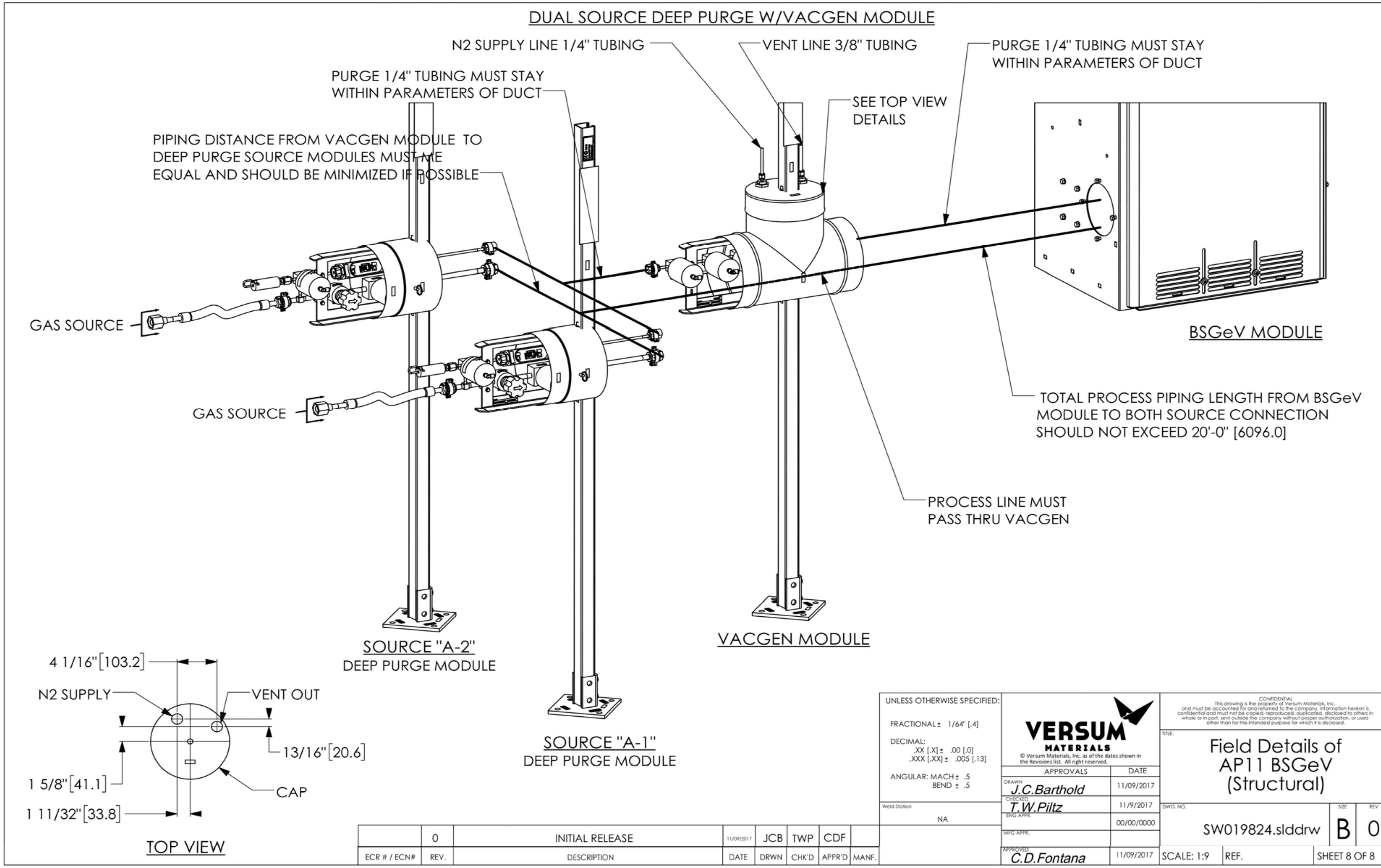
TITLE:
Field Details of AP11 BSGeV (Structural)
DWG. NO.
SW019824.slddrw
SIZE
B
REV
0
SCALE: 1:9
REF.
SHEET 7 OF 8


DUAL SOURCE DEEP PURGE W/VACGEN MODULE
N2 SUPPLY LINE 1/4" TUBING
VENT LINE 3/8" TUBING
PURGE 1/4" TUBING MUST STAY WITHIN PARAMETERS OF DUCT
PURGE 1/4" TUBING MUST STAY WITHIN PARAMETERS OF DUCT
SEE TOP VIEW DETAILS
PIPING DISTANCE FROM VACGEN MODULE TO DEEP PURGE SOURCE MODULES MUST ME EQUAL AND SHOULD BE MINIMIZED IF POSSIBLE
GAS SOURCE
GAS SOURCE
BSGeV MODULE
TOTAL PROCESS PIPING LENGTH FROM BSGeV MODULE TO BOTH SOURCE CONNECTION SHOULD NOT EXCEED 20'-0" [6096.0]
PROCESS LINE MUST PASS THRU VACGEN
SOURCE "A-2"
DEEP PURGE MODULE
VACGEN MODULE
SOURCE "A-1"
DEEP PURGE MODULE
4 1/16"[103.2]
N2 SUPPLY
VENT OUT
13/16"[20.6]
1 5/8"[41.1]
CAP
1 11/32"[33.8]
TOP VIEW
0
INITIAL RELEASE
11/09/2017
JCB
TWP
CDF
ECR # / ECN#
REV.
DESCRIPTION
DATE
DRWN
CHK'D
APPR'D
MANF.
UNLESS OTHERWISE SPECIFIED:
FRACTIONAL ± 1/64" [.4]
DECIMAL:
.XX [.X] ± .00 [.0]
.XXX [.XX] ± .005 [.13]
ANGULAR: MACH ± .5
BEND ± .5
Weld Station
NA
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DATE
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ENG APPR. 00/00/0000
MFG APPR.
APPROVED C.D.Fontana 11/09/2017
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TITLE:
Field Details of AP11 BSGeV (Structural)
DWG. NO.
SW019824.slddrw
SIZE
B
REV
0
SCALE: 1:9
REF.
SHEET 8 OF 8

TABLE OF CONTENT

NOTES:

1. SOME ITEMS HAVE BEEN HIDDEN FOR CLARITY.
2. SPOOLS ARE FOR REFERENCE ONLY, YOUR EXACT BUILD WILL VARY FROM DETAILS SHOWN ON DRAWING.
3. SOURCE B SIDE SHOULD FOLLOW SAME INSTRUCTIONS AS SOURCE A.
4. THICK DASHED LINES INDICATE FLEX DUCT, CUT TO FIT AT FIELD.

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
	0	INITIAL RELEASE	11/03/2017	JCB	TWP	ZR	

UNLESS OTHERWISE SPECIFIED:
FRACTIONAL ± 1/64" [.4]
DECIMAL:
.XX [.X] ± .00 [.0]
.XXX [.XX] ± .005 [.13]
ANGULAR: MACH ± .5
BEND ± .5

Weld Station

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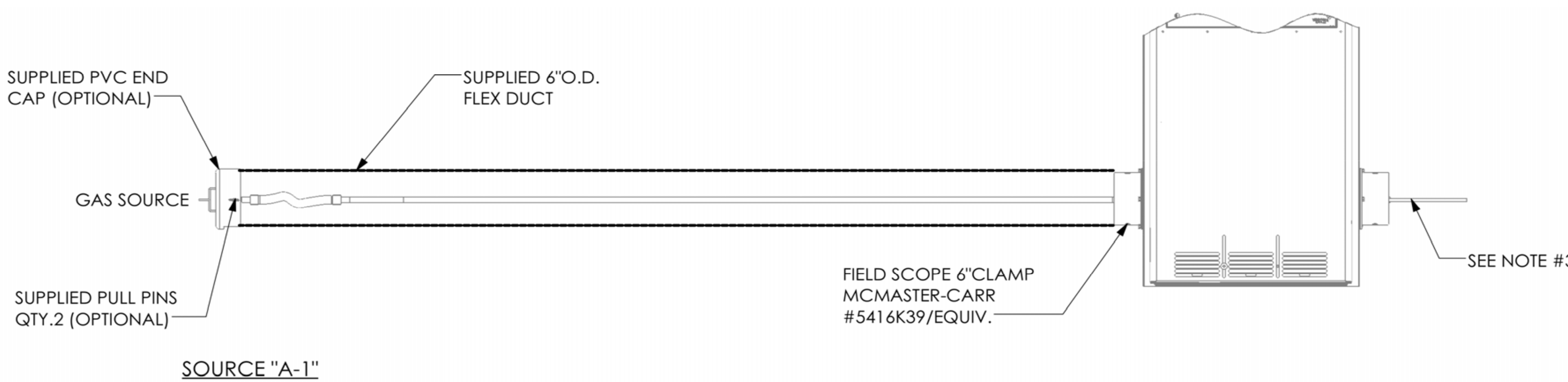
ENG APPR.		
MFG APPR.		
APPROVED	Z.Ren	11/03/2017

TITLE: Field Details of AP11 BSGeV (Ducted)

DWG. NO. SW019820.slddrw | SIZE B | REV 0

SCALE: 2:1 | REF. | SHEET 1 OF 7

SINGLE SOURCE CROSS PURGE



UNLESS OTHERWISE SPECIFIED:
FRACTIONAL ± 1/64" [.4]
DECIMAL:
.XX [.X] ± .00 [.0]
.XXX [.XX] ± .005 [.13]
ANGULAR: MACH ± .5
BEND ± .5

Weld Station: NA

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
	0	INITIAL RELEASE	11/03/2017	JCB	TWP	ZR	

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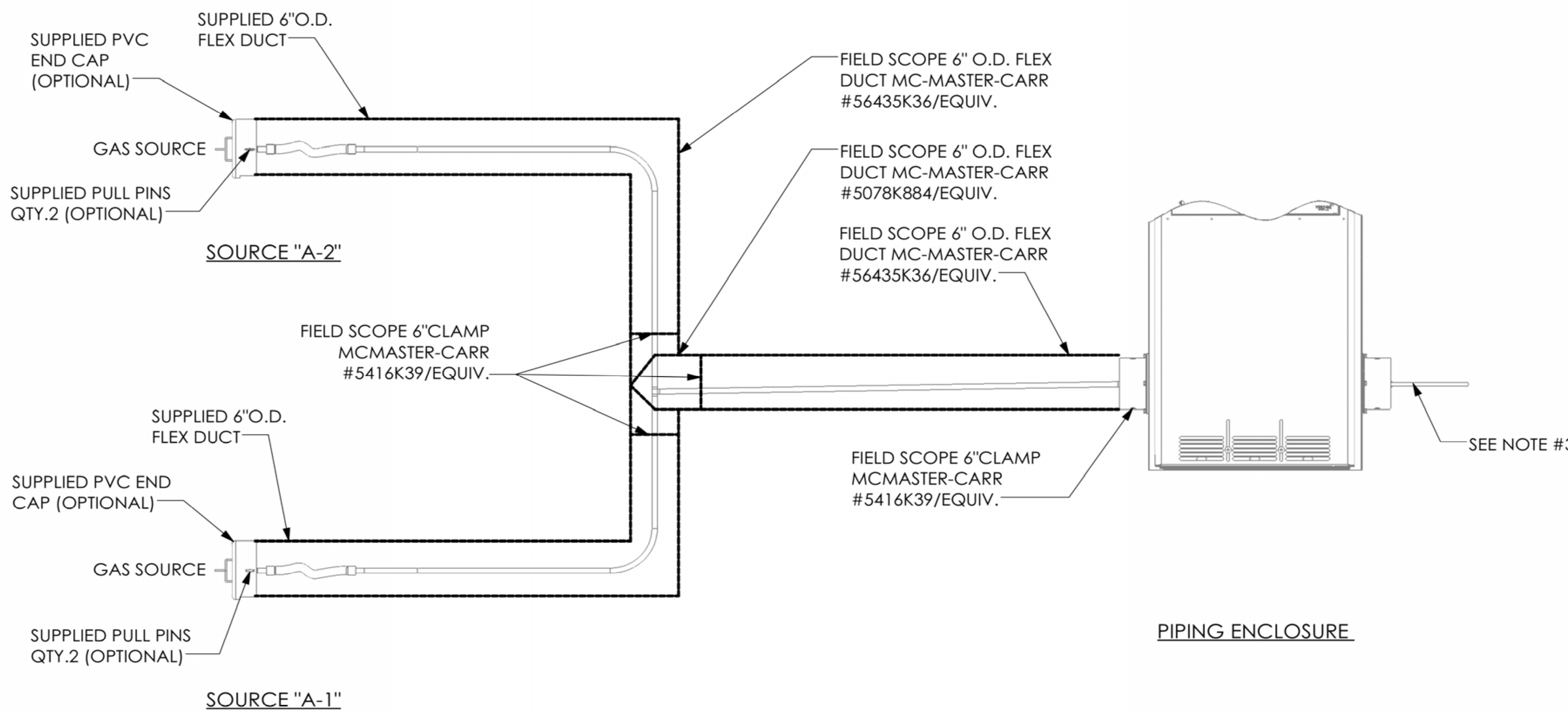
CHECKED	T.W.Piltz	11/3/2017
ENG APPR.		
MFG APPR.		
APPROVED	Z.Ren	11/03/2017

TITLE: Field Details of AP11 BSGeV (Ducted)

DWG. NO. SW019820.slddrw | SIZE B | REV 0

SCALE: 2:1 | REF. | SHEET 2 OF 7

DUAL SOURCE CROSS PURGE



UNLESS OTHERWISE SPECIFIED:
FRACTIONAL ± 1/64" [.4]
DECIMAL:
.XX [.X] ± .00 [.0]
.XXX [.XX] ± .005 [.13]
ANGULAR: MACH ± .5
BEND ± .5
Weld Station
NA

VERSUM MATERIALS

APPROVALS	DATE
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ENG APPR.	
MFG APPR.	
APPROVED Z.Ren	11/03/2017

TITLE: Field Details of AP11 BSGeV (Ducted)

DWG. NO. SW019820.slddrw | SIZE B | REV 0
SCALE: 2:1 | REF. | SHEET 3 OF 7

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
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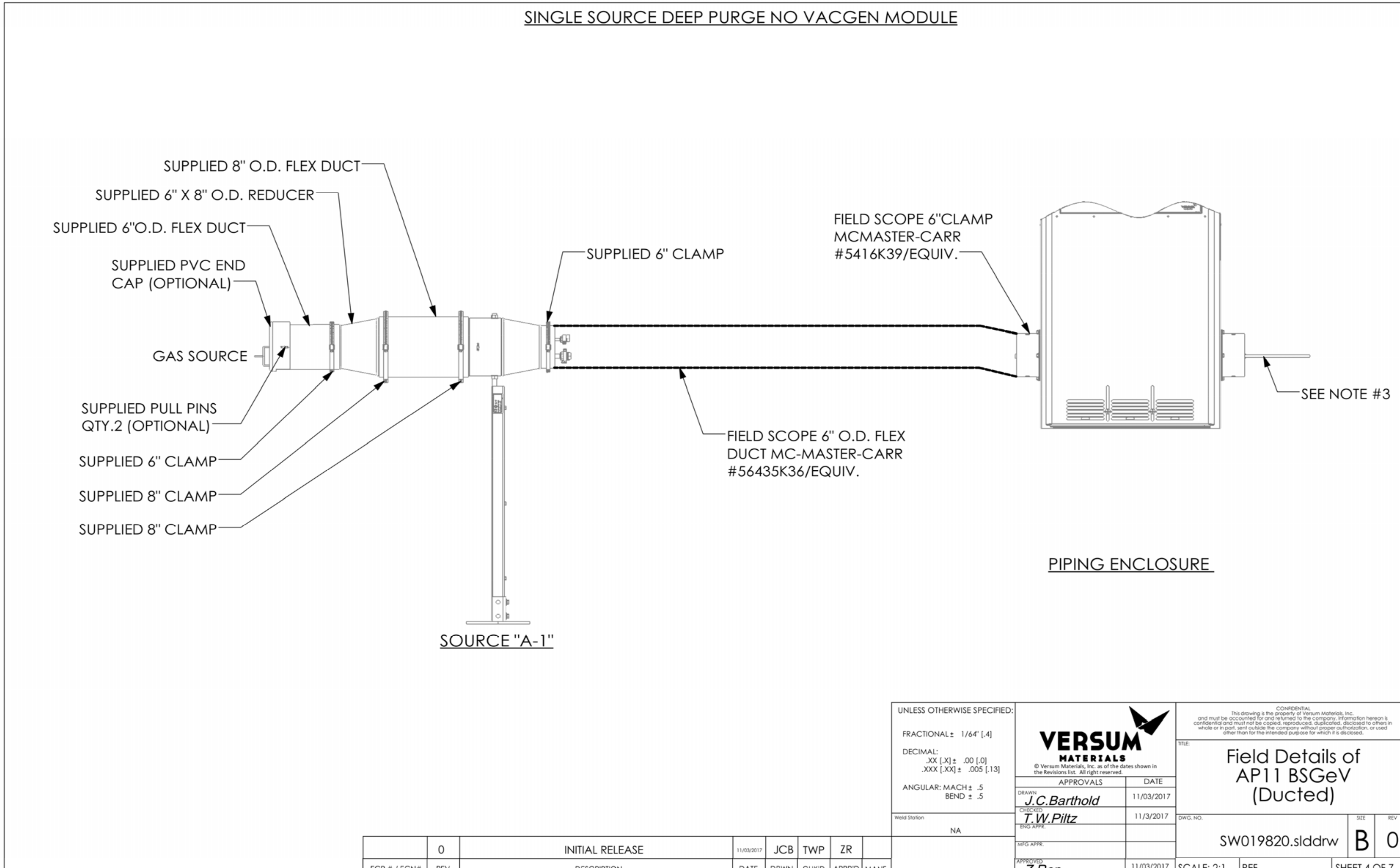
SINGLE SOURCE DEEP PURGE NO VACGEN MODULE
SUPPLIED 8" O.D. FLEX DUCT
SUPPLIED 6" X 8" O.D. REDUCER
SUPPLIED 6"O.D. FLEX DUCT
SUPPLIED PVC END CAP (OPTIONAL)
GAS SOURCE
SUPPLIED PULL PINS QTY.2 (OPTIONAL)
SUPPLIED 6" CLAMP
SUPPLIED 8" CLAMP
SUPPLIED 8" CLAMP
SUPPLIED 6" CLAMP
FIELD SCOPE 6"CLAMP MCMASTER-CARR #5416K39/EQUIV.
FIELD SCOPE 6" O.D. FLEX DUCT MC-MASTER-CARR #56435K36/EQUIV.
SEE NOTE #3
PIPING ENCLOSURE
SOURCE "A-1"
UNLESS OTHERWISE SPECIFIED:
FRACTIONAL ± 1/64" [.4]
DECIMAL:
.XX [.X] ± .00 [.0]
.XXX [.XX] ± .005 [.13]
ANGULAR: MACH ± .5
BEND ± .5
Weld Station
NA
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MFG APPR.
APPROVED Z.Ren 11/03/2017
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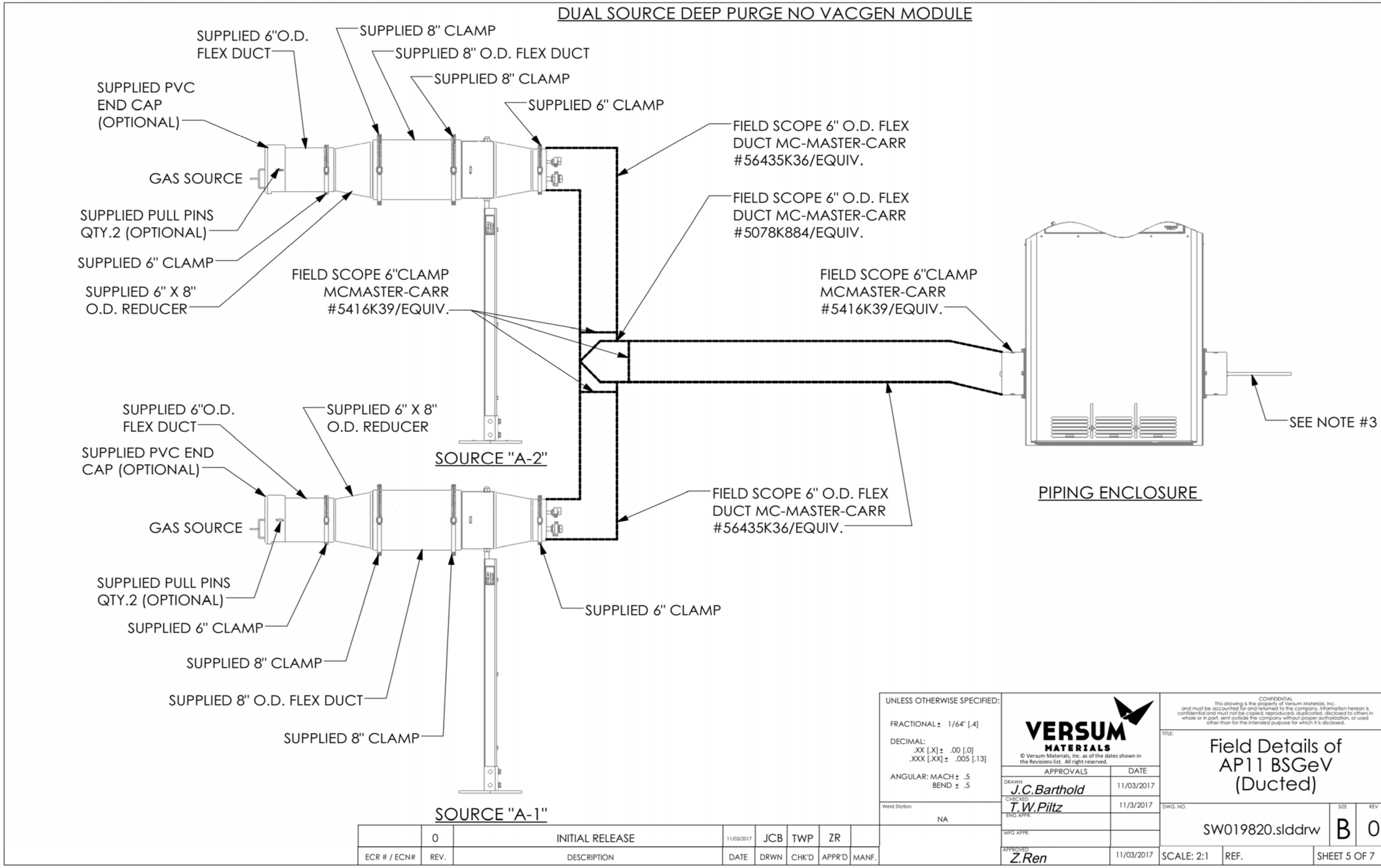
TITLE: Field Details of AP11 BSGeV (Ducted)
DWG. NO. SW019820.slddrw
SIZE B
REV 0
SCALE: 2:1
REF.
SHEET 4 OF 7
0 INITIAL RELEASE 11/03/2017 JCB TWP ZR
ECR # / ECN# REV. DESCRIPTION DATE DRWN CHK'D APPR'D MANF.


DUAL SOURCE DEEP PURGE NO VACGEN MODULE
SUPPLIED 6"O.D. FLEX DUCT
SUPPLIED 8" CLAMP
SUPPLIED 8" O.D. FLEX DUCT
SUPPLIED 8" CLAMP
SUPPLIED 6" CLAMP
SUPPLIED PVC END CAP (OPTIONAL)
GAS SOURCE
SUPPLIED PULL PINS QTY.2 (OPTIONAL)
SUPPLIED 6" CLAMP
SUPPLIED 6" X 8" O.D. REDUCER
FIELD SCOPE 6" O.D. FLEX DUCT MC-MASTER-CARR #56435K36/EQUIV.
FIELD SCOPE 6" O.D. FLEX DUCT MC-MASTER-CARR #5078K884/EQUIV.
FIELD SCOPE 6"CLAMP MCMASTER-CARR #5416K39/EQUIV.
FIELD SCOPE 6"CLAMP MCMASTER-CARR #5416K39/EQUIV.
SUPPLIED 6"O.D. FLEX DUCT
SUPPLIED 6" X 8" O.D. REDUCER
SUPPLIED PVC END CAP (OPTIONAL)
SOURCE "A-2"
SEE NOTE #3
PIPING ENCLOSURE
FIELD SCOPE 6" O.D. FLEX DUCT MC-MASTER-CARR #56435K36/EQUIV.
GAS SOURCE
SUPPLIED PULL PINS QTY.2 (OPTIONAL)
SUPPLIED 6" CLAMP
SUPPLIED 6" CLAMP
SUPPLIED 8" CLAMP
SUPPLIED 8" O.D. FLEX DUCT
SUPPLIED 8" CLAMP
SOURCE "A-1"
UNLESS OTHERWISE SPECIFIED:
FRACTIONAL ± 1/64" [.4]
DECIMAL:
.XX [.X] ± .00 [.0]
.XXX [.XX] ± .005 [.13]
ANGULAR: MACH ± .5
BEND ± .5
Weld Station
NA
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APPROVALS
DATE
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CHECKED T.W.Piltz 11/3/2017
ENG APPR.
MFG APPR.
APPROVED Z.Ren 11/03/2017
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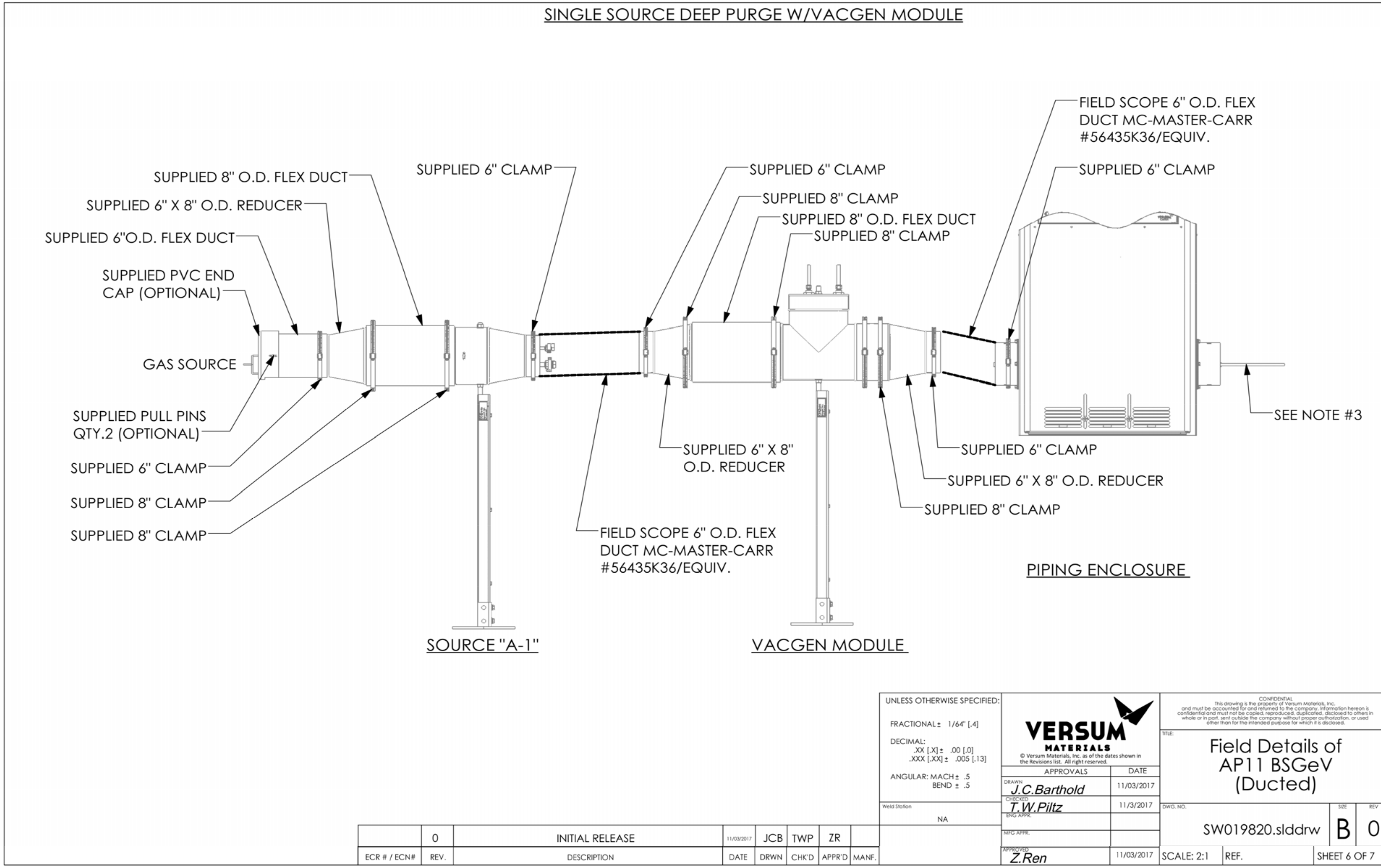
TITLE:
Field Details of AP11 BSGeV (Ducted)
DWG. NO. SW019820.slddrw
SIZE B
REV 0
SCALE: 2:1
REF.
SHEET 5 OF 7
0
INITIAL RELEASE
11/03/2017
JCB
TWP
ZR
ECR # / ECN#
REV.
DESCRIPTION
DATE
DRWN
CHK'D
APPR'D
MANF.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SUPPLIED 6"O.D. FLEX DUCT
SUPPLIED PVC END CAP (OPTIONAL)
GAS SOURCE
SUPPLIED PULL PINS QTY.2 (OPTIONAL)
SUPPLIED 6" CLAMP
SUPPLIED 8" CLAMP
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SUPPLIED 8" CLAMP
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SUPPLIED 6" CLAMP
SUPPLIED 6" X 8" O.D. REDUCER
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SEE NOTE #3
PIPING ENCLOSURE
SOURCE "A-1"
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UNLESS OTHERWISE SPECIFIED:
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DECIMAL:
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ANGULAR: MACH ± .5
BEND ± .5
Weld Station
NA
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TITLE:
Field Details of AP11 BSGeV (Ducted)
DWG. NO.
SW019820.slddrw
SIZE B
REV 0
SCALE: 2:1
REF.
SHEET 6 OF 7
0
INITIAL RELEASE
11/03/2017
JCB
TWP
ZR
ECR # / ECN#
REV.
DESCRIPTION
DATE
DRWN
CHK'D
APPR'D
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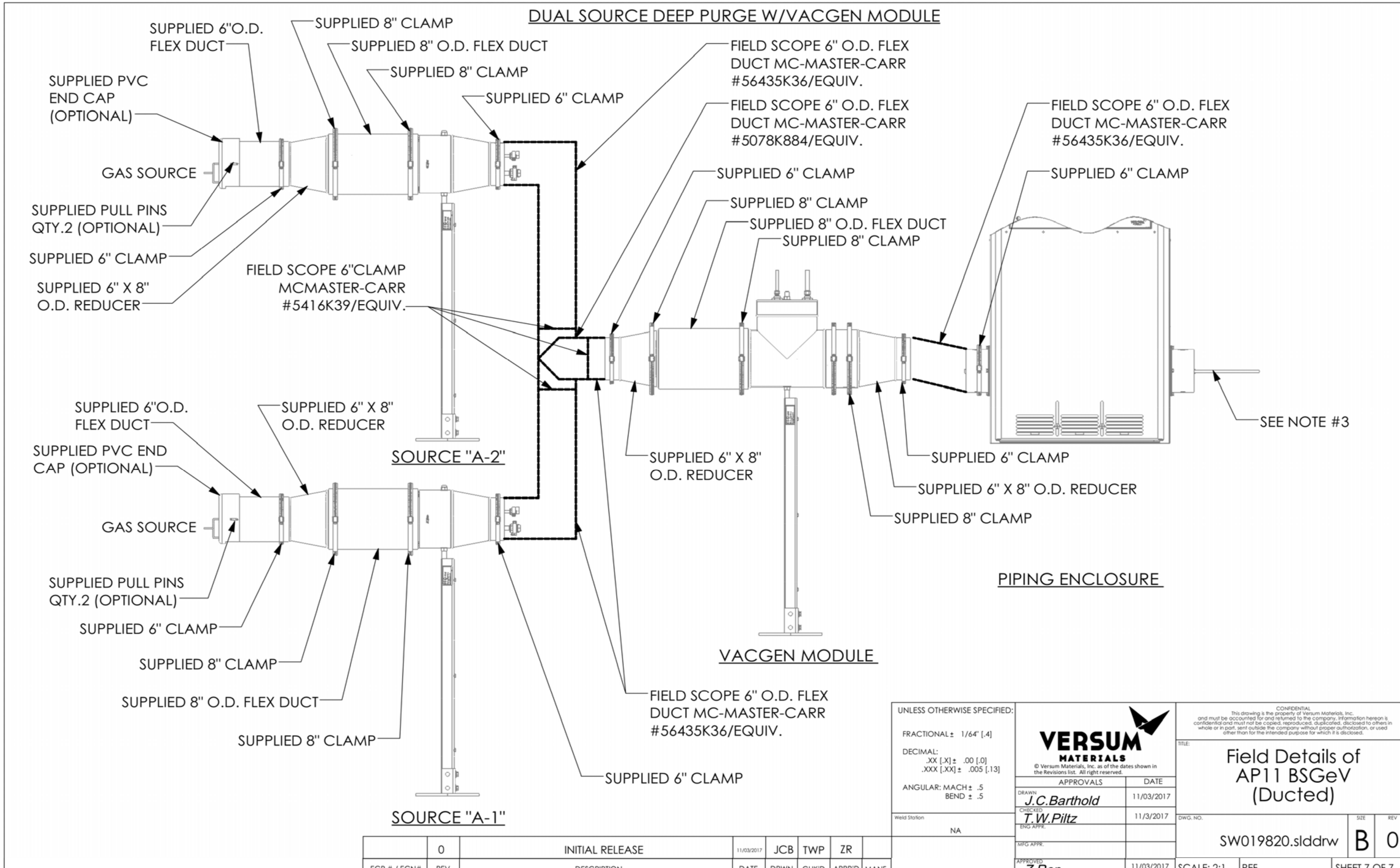
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SHEET 7 OF 7
0 INITIAL RELEASE 11/03/2017 JCB TWP ZR
ECR # / ECN# REV. DESCRIPTION DATE DRWN CHK'D APPR'D MANF.

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.

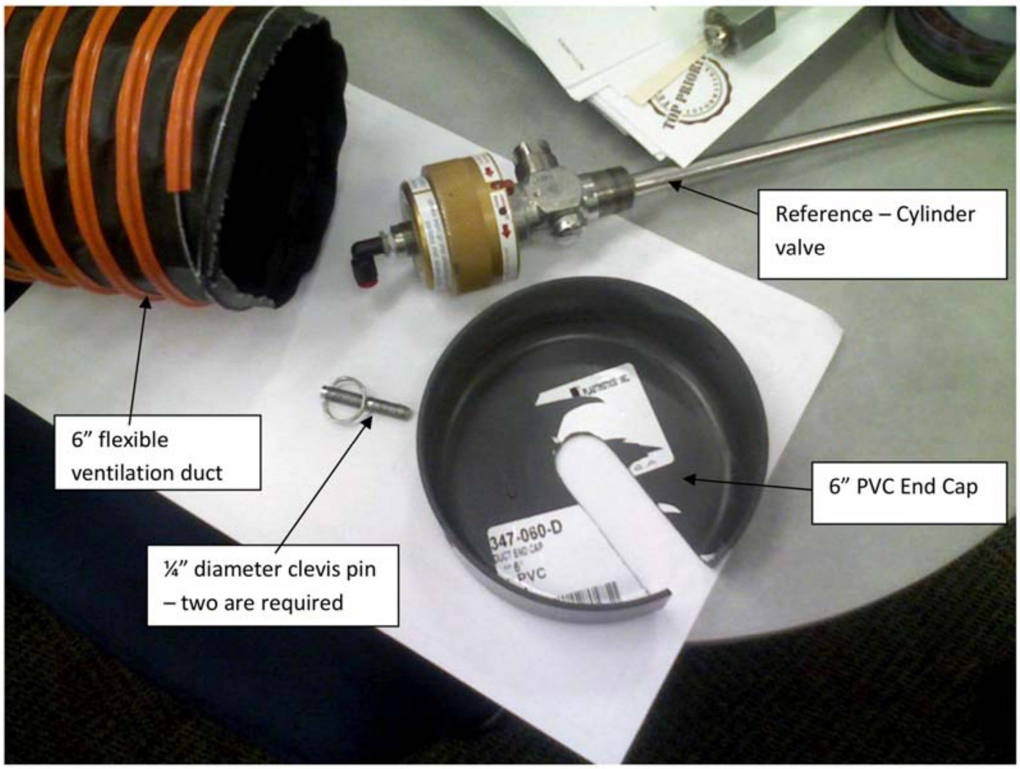


Figure 1 - Flexible ventilation duct, and PVC end cap

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.

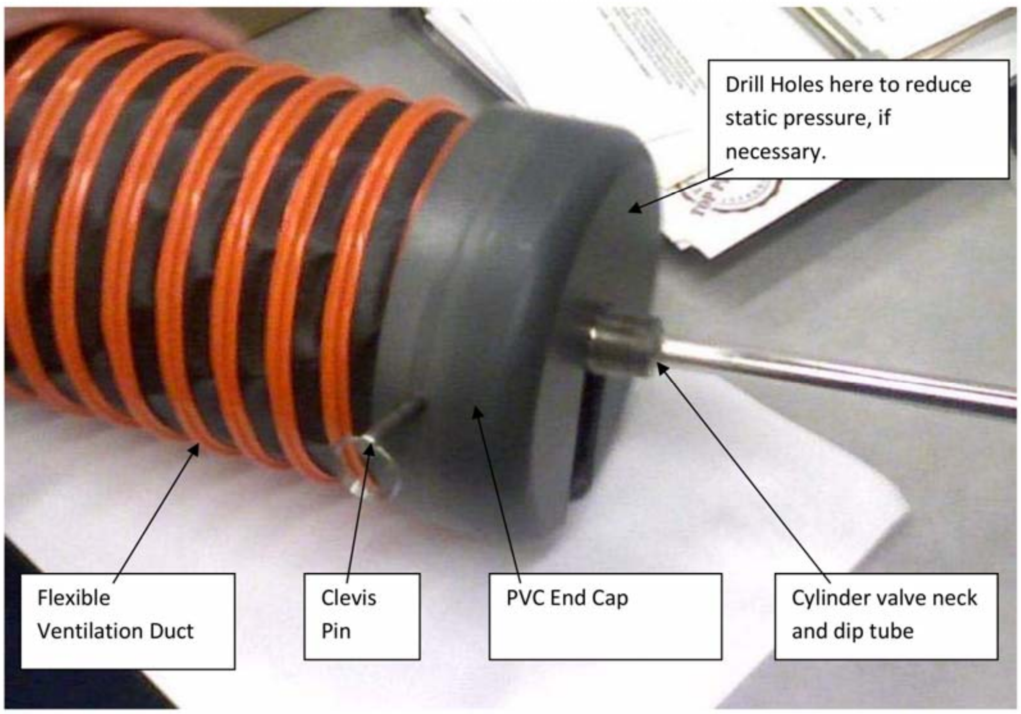
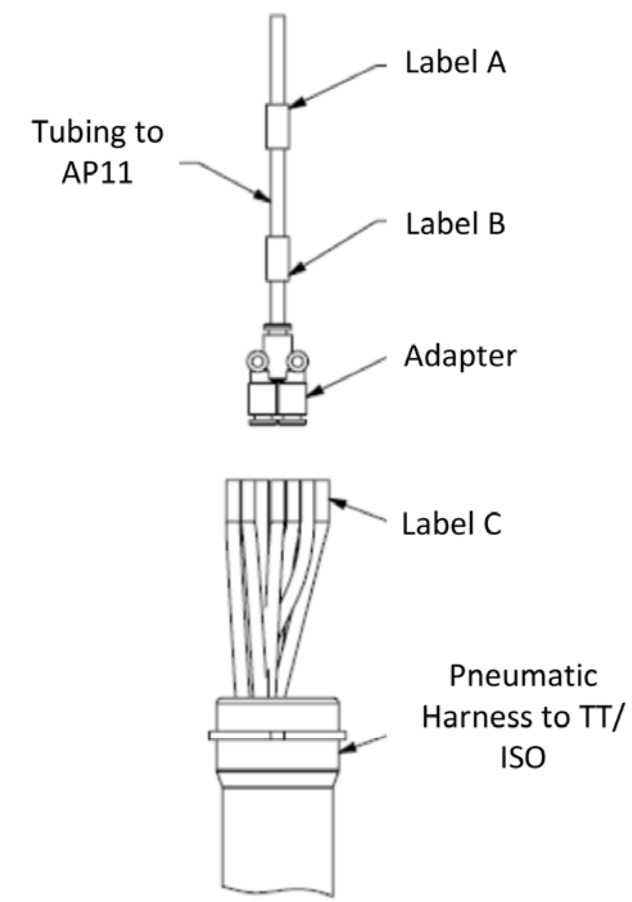


Figure 2 - Flexible Ventilation Duct and PVC End Cap Assembled

BSGeV MECH 0031 Rev. 0

Label A TS Side A	Label A TS Side B	Tubing Label B	Pneu Harness Label C	ISO/TT Location
R4	R11	V8-1/V8-2	R1-V-8-1 R2-V-8-2	Tubes 1/2
R5	R12	V8-3/V8-4	R3-V-8-3 R4-V-8-4	Tubes 3/4
R6	R13	V8-5/V8-6	R5-V-8-5 R6-V-8-6	Tubes 5/6
R7	R14	V8-7/V8-8	R7-V-8-7 R8-V-8-8	Tubes 7/8
R8	R15	V8-9/V8-10	R9-V-8-9 R10-V-8-10	Tubes 9/10
R9	R16	V8-11/V8-12	R11-V-8-11 R12-V-8-12	Tubes 11/12
L8	R10	V8	L8-V-8	Manifold V8

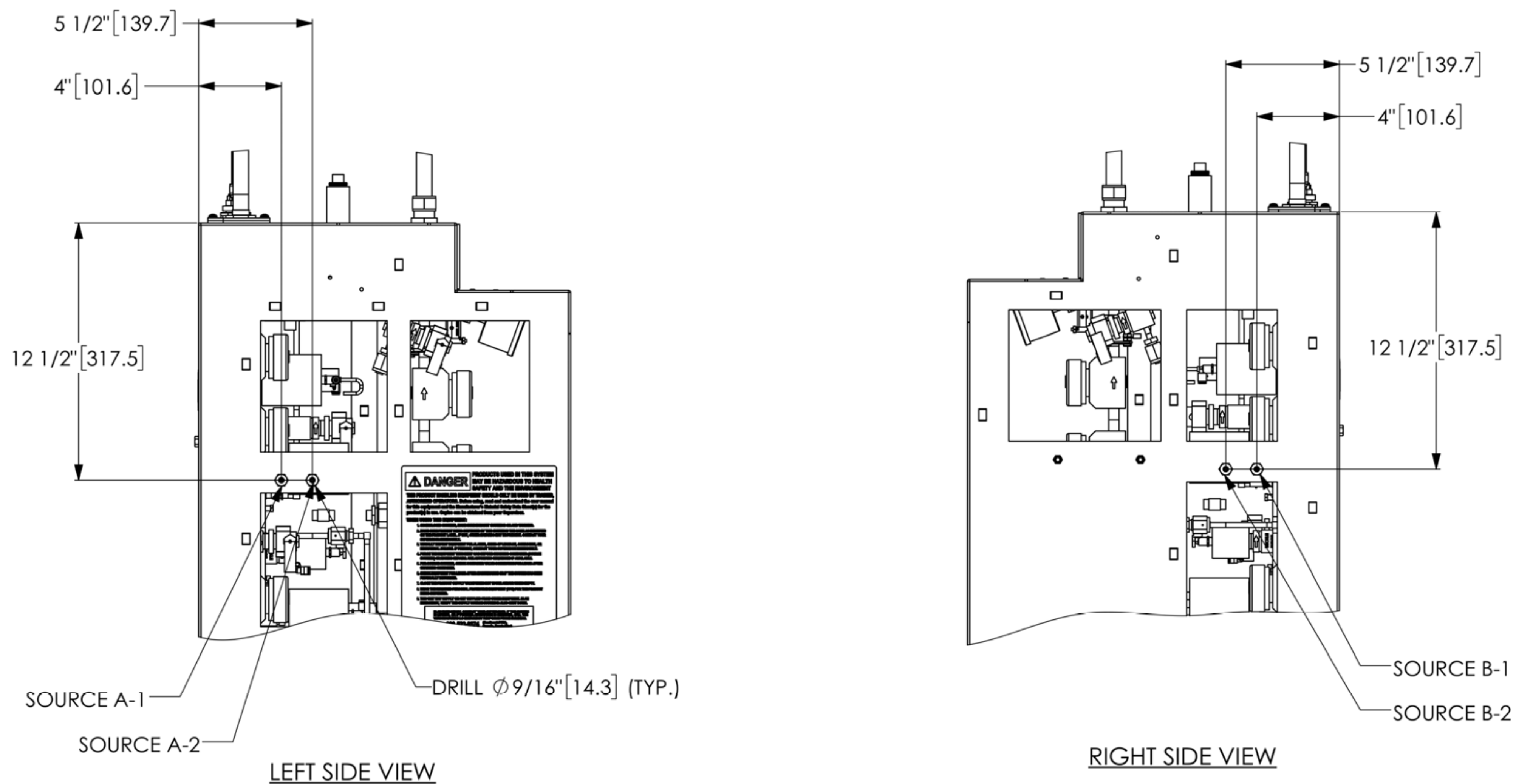
- Label A indicates the pneumatic bank side (right or left) and solenoid assignment on the AP11
- Label B indicates which tubes will be controlled by the solenoid indicated by Label A
- Label C indicates what valve on the ISO/TT will be actuated through the TwinTec fitting that connects onto the ISO/TT
- The number of tubes within a pneumatic harness will vary depending upon gas type and source container supplier



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. Gasguard BSGS eV / GASGUARD eV	SYSTEM DESCRIPTION **GASGUARD AP11 BSGS eV / BULKGUARD eV** Field Details Tube Switching	VERSUM MATERIALS ALLENTOWN, PENNSYLVANIA	
ORIGINATOR T. W. Piltz	CUSTOMER / LOCATION	SIZE A	REV. A
DATE 2/19/2018	SHEET 1 OF 1	CONFIG. VERSION P1.0a	FILE BSGeV-MECH-0032
DWG NO			

DRILLING DETAILS



FIELD NOTES:

1. ALL DIMENSIONS TAKEN FROM EDGE OF ENCLOSURE METAL.
2. ONLY DRILL THE LOCATION YOU NEED FOR YOUR SYSTEM REQUIRMENTS.
3. REMOVE BURRS AND SHARP EDGES AND TOUCH UP PAINT IF NECESSARY AFTER DRILLING WORK IS COMPLETED.
4. CREATE A LABEL AND WRAP AROUND POLYURETHANE TUBING. SEE DRAWING BSGeV-MECH-0024 FOR PNEUMATIC ASSIGNMENT AND PROPER TEXT FOR LABEL. THIS WILL VARY DEPENDING ON SYSTEM REQUIRMENTS. PLACE LABEL 1"[25.4] FROM END OF TUBING.

MANUFACTURING NOTES:

1. NO PREP OR ASSEMBLY WORK IS REQUIRED.
2. BAG ALL ITEMS BEING CALLED OUT ON DRAWING AND SHIP ALONG WITH SYSTEM FOR FIELD TO INSTALL.

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
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DECIMAL:
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ANGULAR: MACH ± .5
BEND ± .5

Weld Station: NA

VERSUM MATERIALS

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MFG APPR.		
APPROVED	Z.Ren	12/22/2017

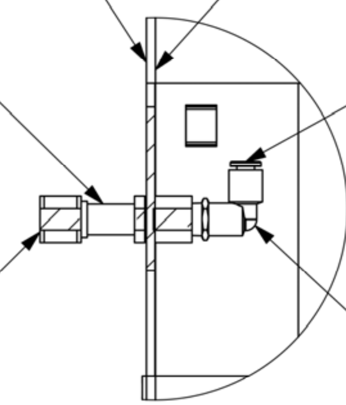
TITLE: Field Details BSGeV Cylinder Flag

DWG. NO. SW020039.slddrw | SIZE B | REV 0

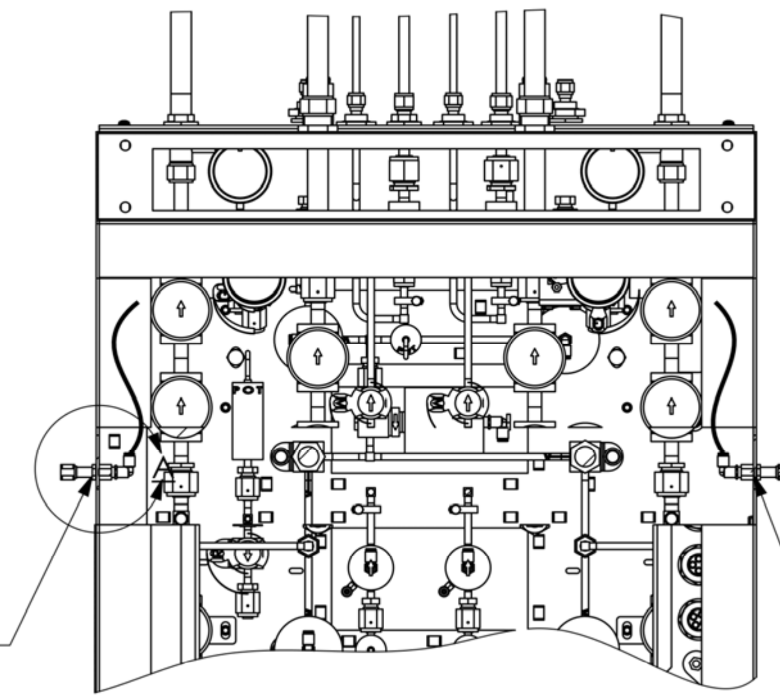
SCALE: 1:6 | REF. | SHEET 1 OF 2

MNL0C
BSGS

ASSEMBLY DETAILS



DETAIL A
SCALE 1 : 2



FRONT VIEW

	0	INTIIAL RELEASE	12/22/2017	JCB	TWP	ZR	
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Weld Station: NA

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APPROVED Z.Ren	12/22/2017

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DWG. NO. SW020039.slddrw | SIZE B | REV 0

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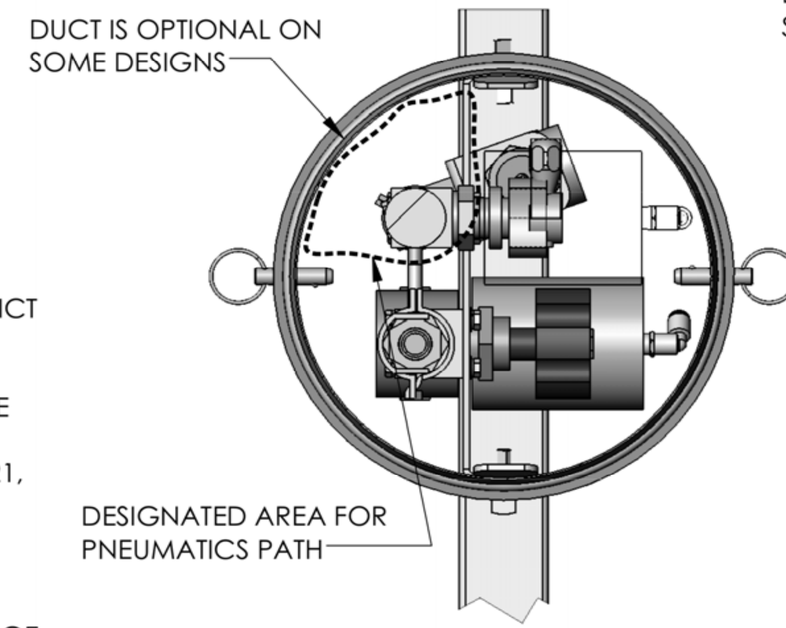
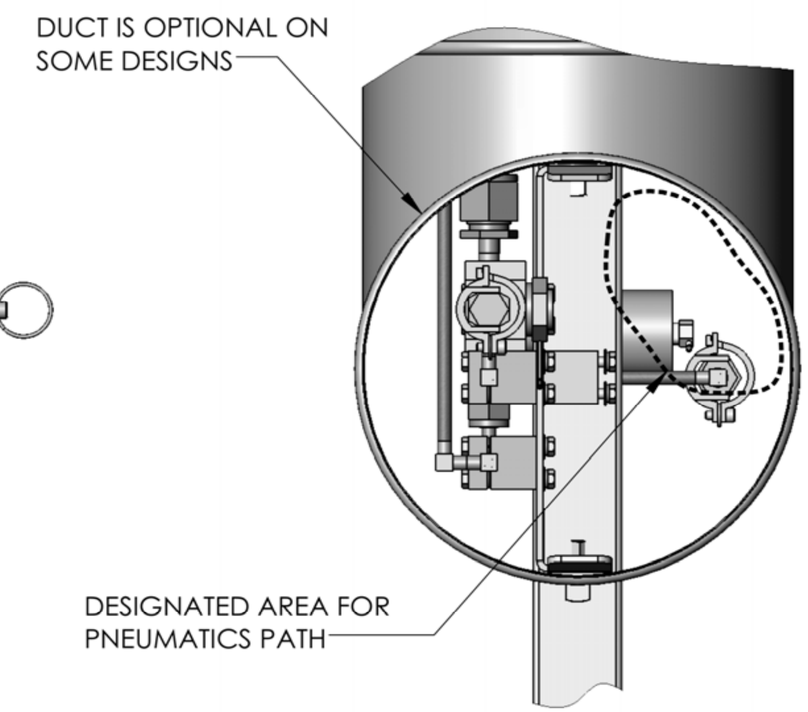
3	DUAL SOURCE CROSS PURGE
4	SINGLE SOURCE DEEP PURGE NO VACGEN MODULE
5	DUAL SOURCE DEEP PURGE NO VACGEN MODULE
6	SINGLE SOURCE DEEP PURGE W/VACGEN MODULE
7	DUAL SOURCE DEEP PURGE W/VACGEN MODULE

NOTES:

1. SOME ITEMS HAVE BEEN HIDDEN FOR CLARITY.
2. SPOOLS ARE FOR REFERENCE ONLY, YOUR EXACT BUILD WILL VARY FROM DETAILS SHOWN ON DRAWING.
3. DO NOT CUT PNEUMATIC LINES/HARNESS, USE ENTIRE LENGTHS PROVIDED.
4. WHEN SECURING PNEUMATIC LINES/HARNESS ENSURE NOT TO RESTRICT THE FLOW PATH OF PNEUMATIC LINES/HARNESS.
5. ROUTE PNEUMATIC LINES/HARNESS ALONG INSIDE WALLS, CONTINUE ROUTING UNTIL CONNECTIONS ARE MADE ON BACK OF AP11 CONTROLLER. SECURE AS NEEDED. SEE DRAWING BSGeV-MECH-0021, BSGeV-MECH-0022 OR BSGeV-MECH-0023 FOR AP11 CONTROLLER PNEUMATIC TERMINATIONS.
6. FOLLOW THICK DASHED LINE PROVIDED, THIS IS THE PATH FOR INSTALLING PNEUMATIC LINES/HARNESS. SECURE AS NEEDED TO PURGE PIPING.
7. KEEP PNEUMATIC LINES/HARNESS WITH IN THE BOUNDRIES OF THE BACKPLATE. THIS WILL ENSURE DUCT WORK WILL FIT OVER PIPING WHEN REQUIRED.
8. SEE DRAWING BSGeV-MECH-0011, BSGeV-MECH-0012 OR BSGeV-MECH-0013 FOR SOURCE PNEUMATIC TERMINATIONS.
9. SOURCE B SIDE SHOULD FOLLOW SAME INSTRUCTIONS AS SOURCE A.
10. FOLLOW THICK DASHED LINE PROVIDED, THIS IS THE PATH FOR INSTALLING PNEUMATIC LINES/HARNESS. SECURE AS NEEDED TO PROCESS PIPING.





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Weld Station

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TITLE: Field Details of AP11 BSGeV (Pneumatics)

DWG. NO. SW019819.slddrw | SIZE B | REV 0

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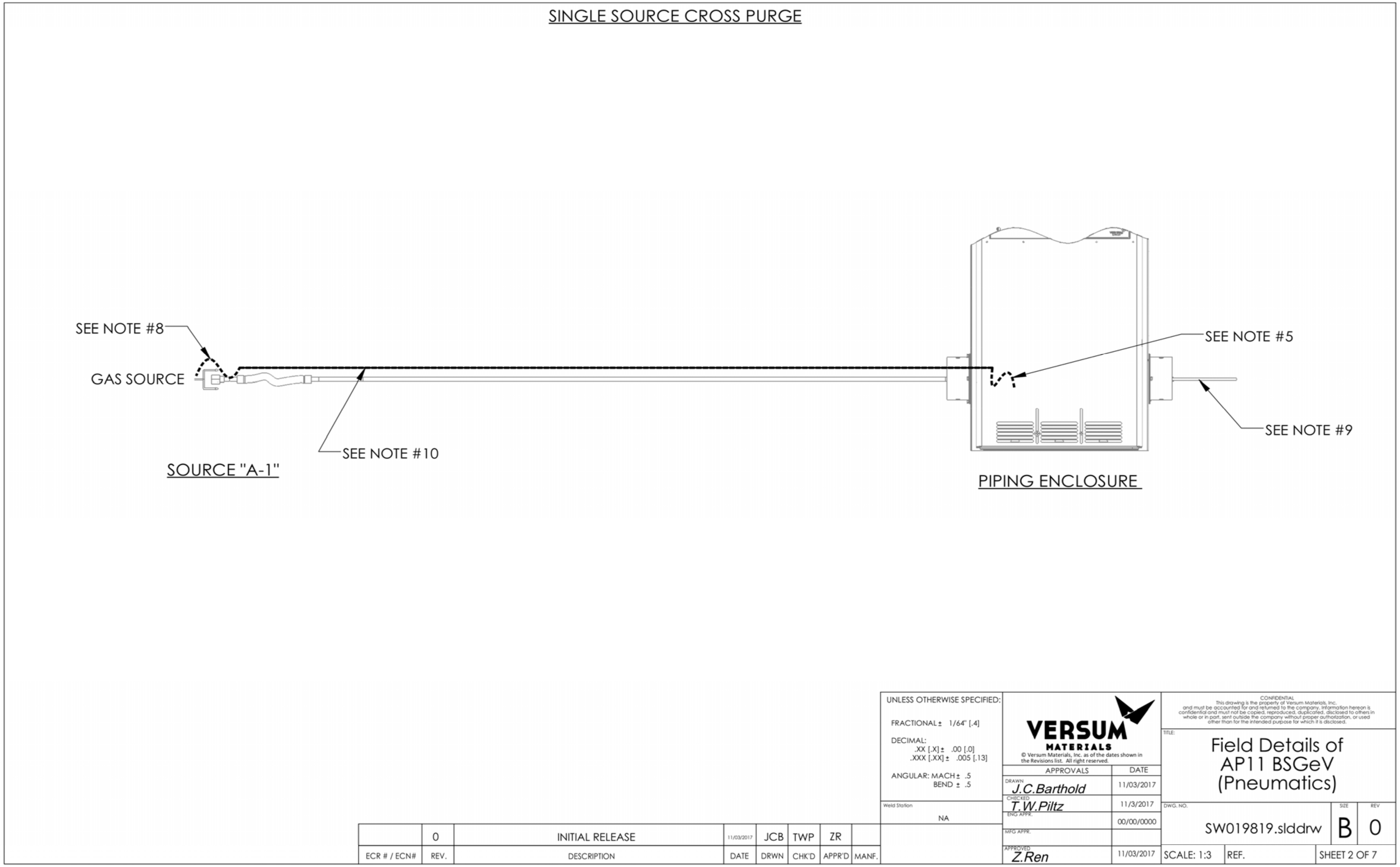
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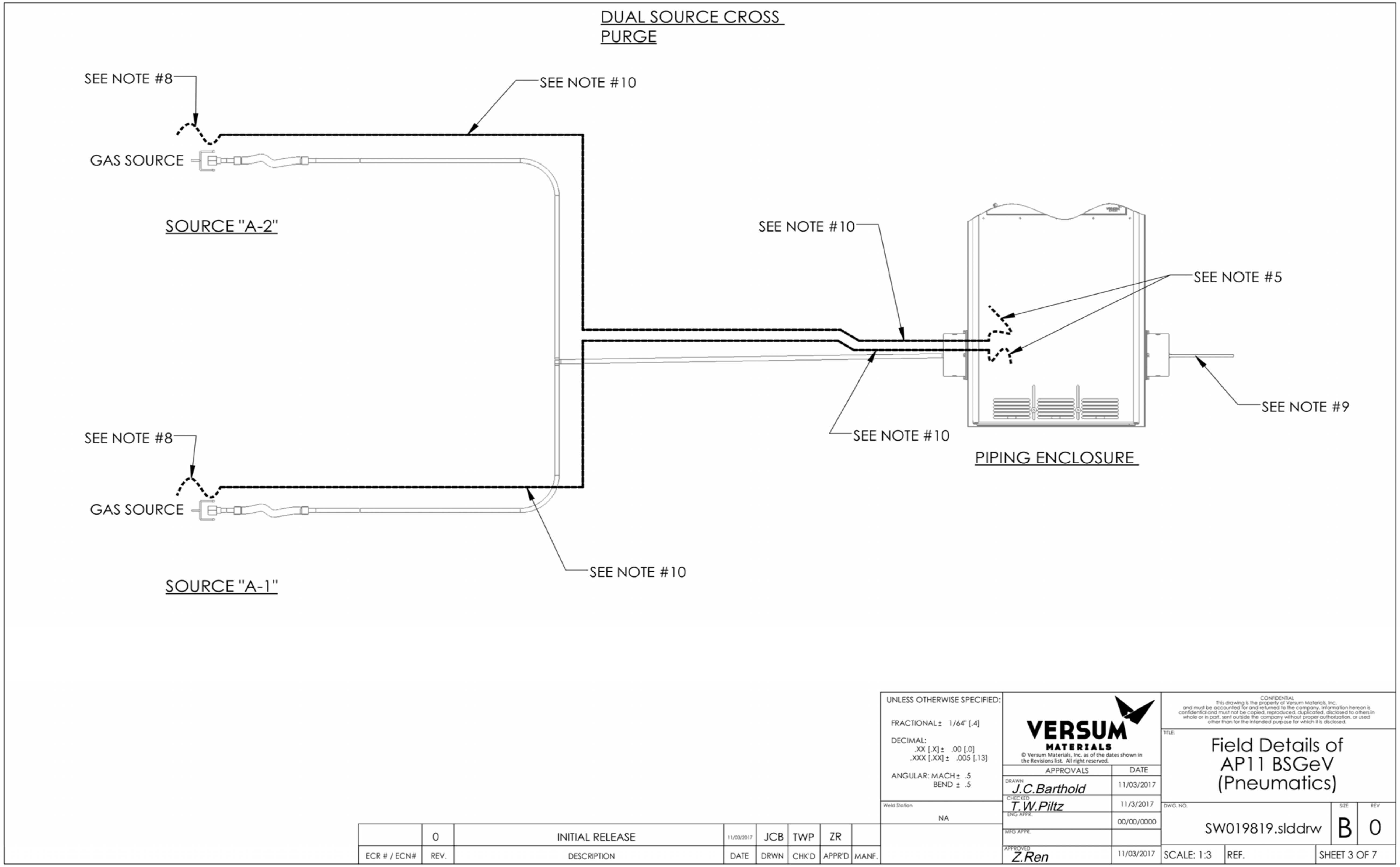
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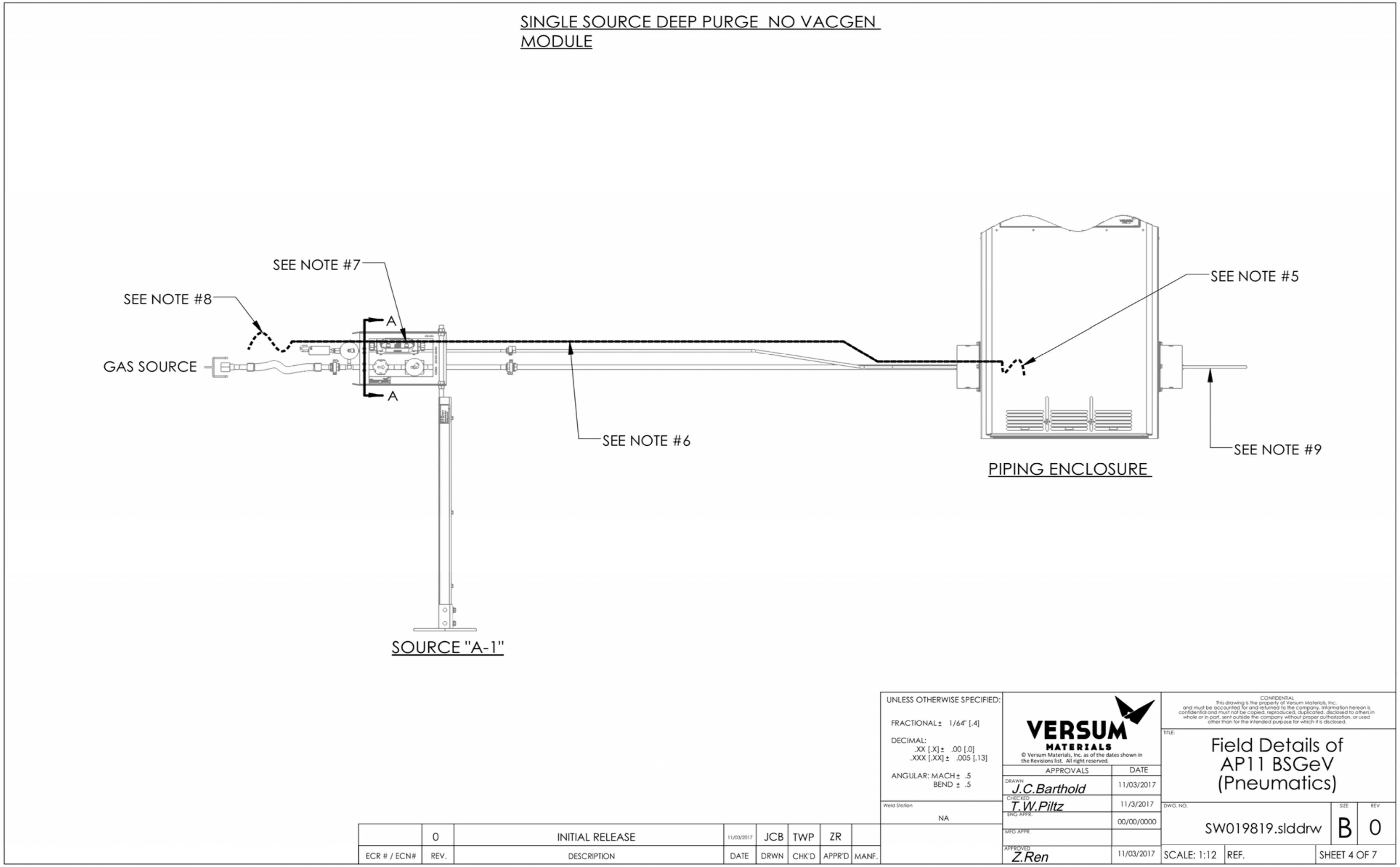
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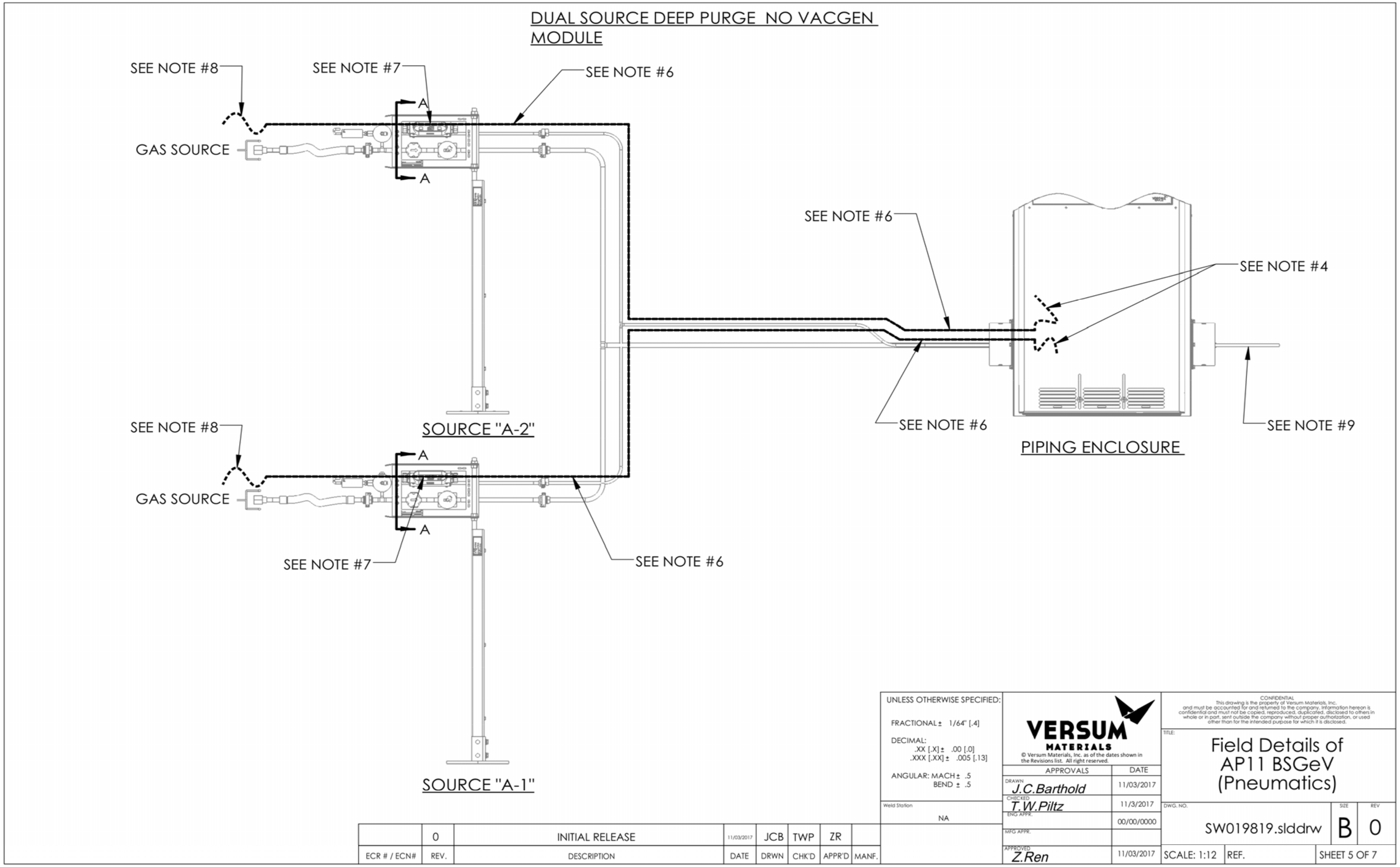
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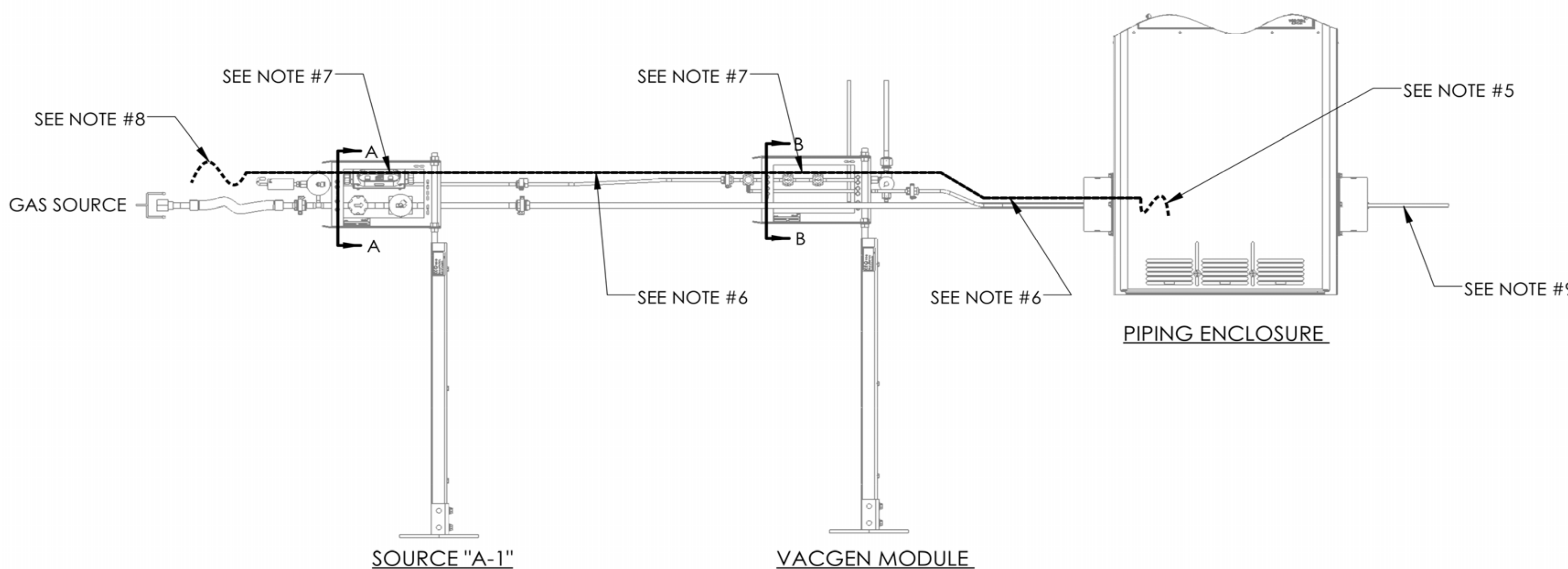

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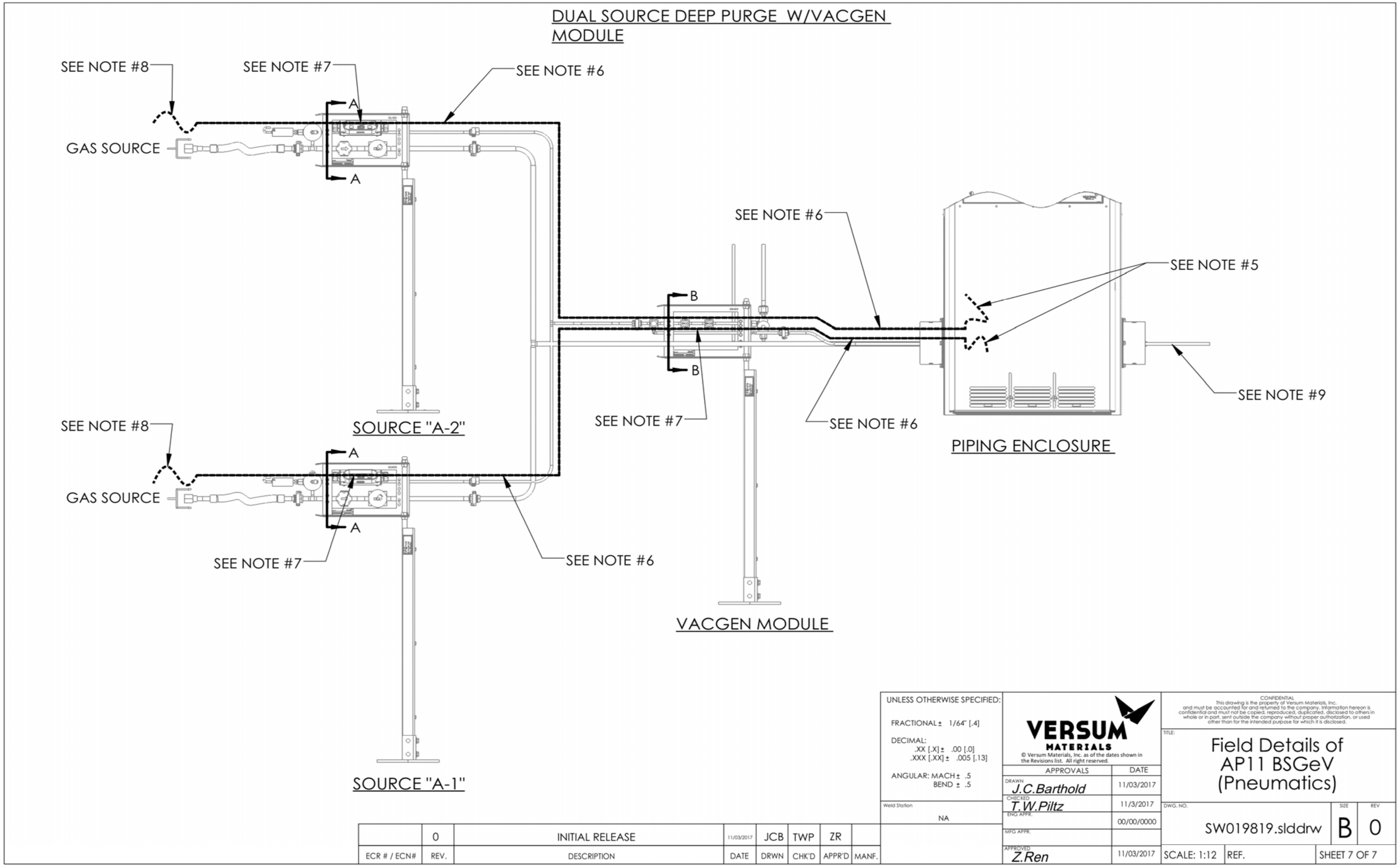
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FRACTIONAL ± 1/64" [.4]
DECIMAL:
.XX [.X] ± .00 [.0]
.XXX [.XX] ± .005 [.13]
ANGULAR: MACH ± .5
BEND ± .5
Weld Station
NA
VERSUM MATERIALS
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APPROVALS
DATE
DRAWN J.C.Barthold 11/03/2017
CHECKED T.W.Piltz 11/3/2017
ENG APPR. 00/00/0000
MFG APPR.
APPROVED Z.Ren 11/03/2017
CONFIDENTIAL
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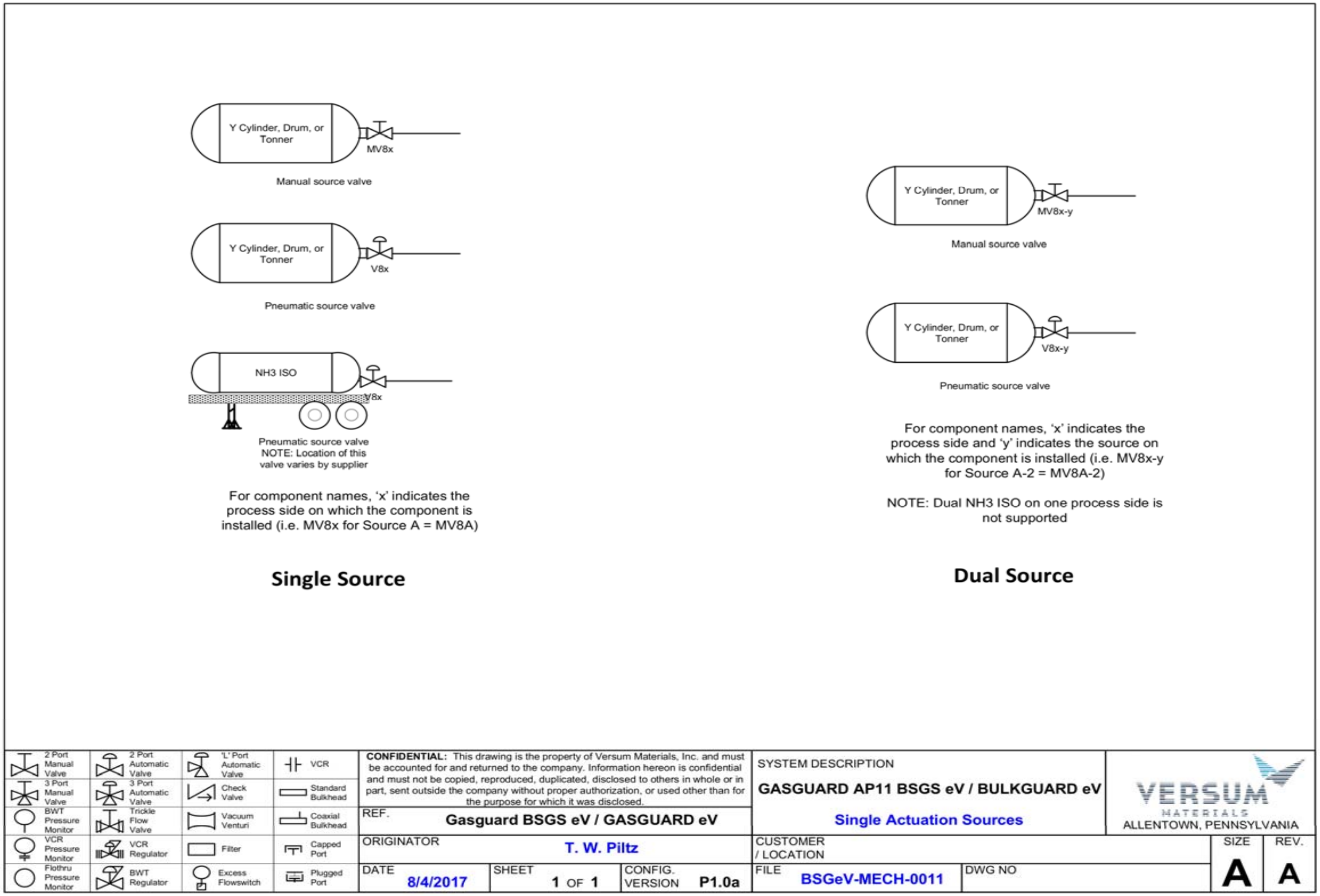
TITLE:
Field Details of AP11 BSGeV (Pneumatics)
DWG. NO.
SW019819.slddrw
SIZE B
REV 0
SCALE: 1:12
REF.
SHEET 7 OF 7
ECR # / ECN#
REV.
DESCRIPTION
DATE
DRWN
CHK'D
APPR'D
MANF.
0
INITIAL RELEASE
11/03/2017
JCB
TWP
ZR


Y Cylinder, Drum, or Tonner
MV8x
Manual source valve
Y Cylinder, Drum, or Tonner
V8x
Pneumatic source valve
NH3 ISO
V8x
Pneumatic source valve
NOTE: Location of this valve varies by supplier
For component names, 'x' indicates the process side on which the component is installed (i.e. MV8x for Source A = MV8A)
Single Source
Y Cylinder, Drum, or Tonner
MV8x-y
Manual source valve
Y Cylinder, Drum, or Tonner
V8x-y
Pneumatic source valve
For component names, 'x' indicates the process side and 'y' indicates the source on which the component is installed (i.e. MV8x-y for Source A-2 = MV8A-2)
NOTE: Dual NH3 ISO on one process side is not supported
Dual Source
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
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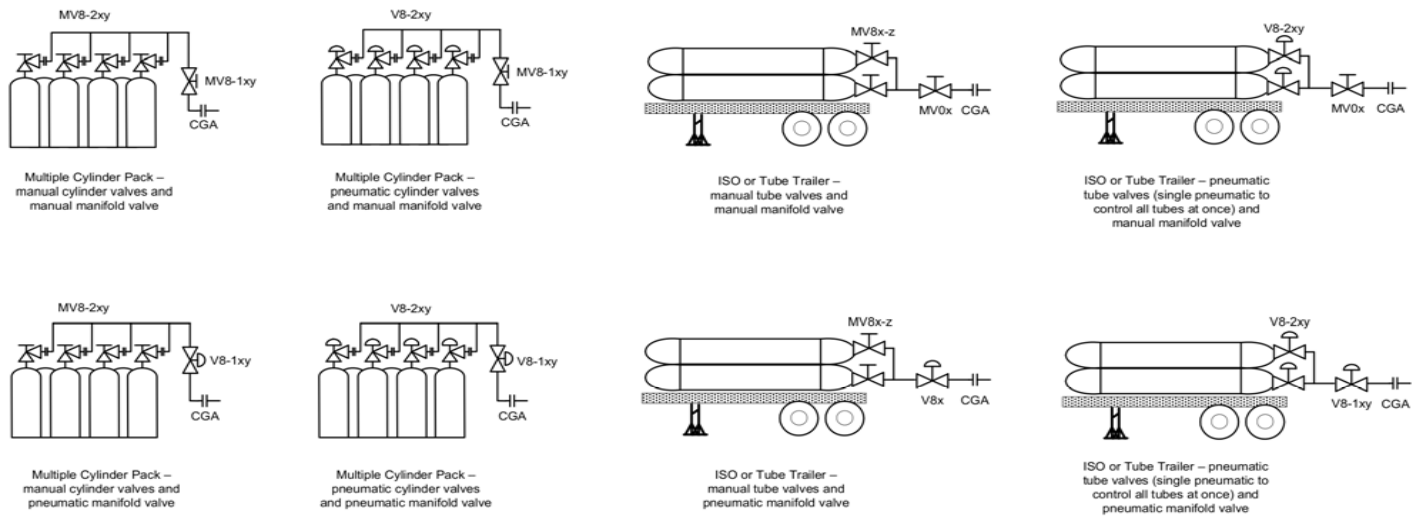
REF. Gasguard BSGS eV / GASGUARD eV
ORIGINATOR T. W. Piltz
DATE 8/4/2017
SHEET 1 OF 1
CONFIG. VERSION P1.0a
SYSTEM DESCRIPTION
GASGUARD AP11 BSGS eV / BULKGUARD eV
Single Actuation Sources
VERSUM MATERIALS
ALLENTOWN, PENNSYLVANIA
CUSTOMER / LOCATION
SIZE A
REV. A
FILE BSGeV-MECH-0011
DWG NO



Dual actuation sources include:

- Multiple Cylinder Packs (MCP) with manual or pneumatic cylinder valves and manual or pneumatic manifold outlet valves
- ISO Modules/Tube Trailers that have manual tube valves and manifold outlet valves
- ISO Modules/Tube Trailers that have single-pneumatic actuation of all tubes (no tube switching, but pneumatic valves on tubes) and either a manual or pneumatic manifold outlet valve

For valve names, 'x' indicates the process side (A or B), 'y' indicates the source (1 or 2 if dual source, does not apply to single source), and 'z' indicates the ISO tube number on which the valve is installed. MCP cylinders/cylinder valves are not individually labelled.

Examples:
- MV8-2xy for MCP tube valves on Source B-2 = MV8-2B2
- V8-1xy for MCP manifold valve MCP on Source A-2 = V8-1A2
- MV8x-z for tube 4 of ISO on Source B = MV8B-4
- V8x for ISO manifold valve on Source A = V8A

NOTE: ISO/TT are single source per process side ONLY (no A-2 or B-2).

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

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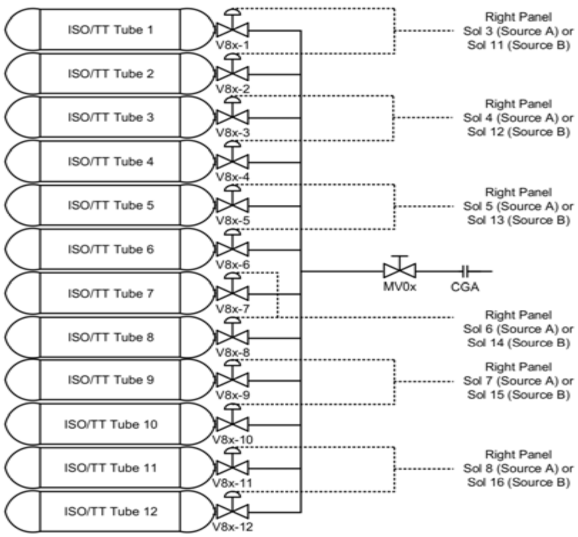
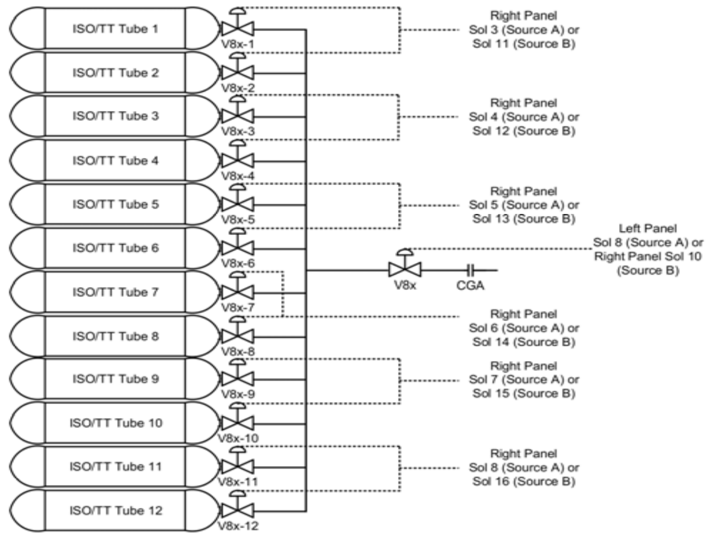
SYSTEM DESCRIPTION: **GASGUARD AP11 BSGS eV / BULKGUARD eV** — **Dual Actuation Sources**		VERSUM MATERIALS ALLENTOWN, PENNSYLVANIA	
REF. **Gasguard BSGS eV / GASGUARD eV**			
ORIGINATOR **T. W. Piltz**		CUSTOMER / LOCATION	
DATE **8/4/2017**	SHEET **1** OF **1**	CONFIG. VERSION **P1.0a**	
FILE **BSGeV-MECH-0012**	DWG NO	SIZE **A**	REV. **A**



Manual manifold outlet valve



Pneumatic manifold outlet valve

This system supports 2x and All Tubes Open functionality for automated tube switching. Individual tube switching is not available in order to provide tube switching to 2 ISO/TT's (Source A and Source B) with a single controller. Paired tubes (1 and 2, 3 and 4, etc.) will open with a single pneumatic signal from the AP11 located at the solenoid assignment shown in this drawing. The pneumatic manifold outlet valve (V8x in the drawing on the right) operates on its own dedicated solenoid.

The two pneumatic lines for paired tubes are joined together in a 'T' fitting at the AP11 controller. No further modifications are necessary for either the pneumatic harness that is connected to the back of the ISO/TT nor any of the pneumatic lines on the ISO/TT itself.

For valve names, 'x' indicates the process side (A or B) and 'z' indicates the ISO/TT tube number on which the valve is installed.

Examples:
- MV0x manual ISO manifold valve for Source A = MV0A
- V8x pneumatic ISO manifold valve on Source B = V8B
- V8x-z for ISO tube 8 on Source A = V8A-8

NOTE: Only one ISO/TT supported per source side (no Source A-2/B-2)

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

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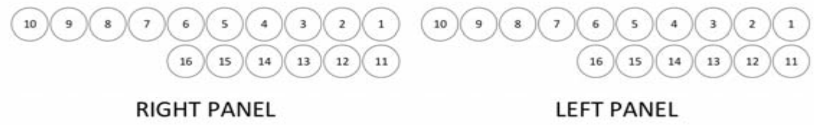
SYSTEM DESCRIPTION	**GASGUARD AP11 BSGS eV / BULKGUARD eV** — ISO/TT with Tube Switching
	VERSUM MATERIALS, ALLENTOWN, PENNSYLVANIA
REF.	Gasguard BSGS eV / GASGUARD eV
ORIGINATOR	T. W. Piltz
CUSTOMER / LOCATION	
DATE	8/4/2017
SHEET	1 OF 1
CONFIG. VERSION	P1.0a
FILE	BSGeV-MECH-0013
DWG NO	
SIZE	A
REV.	A

Pneu Location

Left	Right	Y/Drum cross purge (XP)	TS-A with Dual Y XP	TS-B with Dual Y XP	Pneu MCP XP	TS-A with Dual Pneu MCP XP	TS-B with Dual Pneu MCP XP	Dual TS with XP
Sol 1		*OPEN*	*OPEN*	*OPEN*	*OPEN*	*OPEN*	*OPEN*	*OPEN*
Sol 2		V2A	V2A	V2A	V2A	V2A	V2A	V2A
Sol 3		V3A	V3A	V3A	V3A	V3A	V3A	V3A
Sol 4		V4A	V4A	V4A	V4A	V4A	V4A	V4A
Sol 5		V5A	V5A	V5A	V5A	V5A	V5A	V5A
Sol 6		V6A	V6A	V6A	V6A	V6A	V6A	V6A
Sol 7		V7	V7	V7	V7	V7	V7	V7
Sol 8		V8A-1	V8A	V8A-1	V8-1A1	V8A	V8-1A1	V8A
Sol 9		V113TP	V113TP	V113TP	V113TP	V113TP	V113TP	V113TP
Sol 10		V10	V10	V10	V10	V10	V10	V10
Sol 11		V11	V11	V11	V11	V11	V11	V11
Sol 12		V13A-1	V13A	V13A-1	V13A-1	V13A	V13A-1	V13A
Sol 13		V13B-1	V13B-1	V13B	V13B-1	V13B-1	V13B	V13B
Sol 14		*OPEN*	*OPEN*	*OPEN*	*OPEN*	*OPEN*	*OPEN*	*OPEN*
Sol 15		V2B	V2B	V2B	V2B	V2B	V2B	V2B
Sol 16		V3B	V3B	V3B	V3B	V3B	V3B	V3B
	Sol 1	V4B	V4B	V4B	V4B	V4B	V4B	V4B
	Sol 2	V5B	V5B	V5B	V5B	V5B	V5B	V5B
	Sol 3	V6B	V6B	V6B	V6B	V6B	V6B	V6B
	Sol 4	V8A-2	V8-1/2A	V8A-2	V8-1A2	V8-1/2A	V8-1A2	V8-1/2A
	Sol 5	CFA1	V8-3/4A	*OPEN*	V8-2A1	V8-3/4A	V8-2A1	V8-3/4A
	Sol 6	CFA2	V8-5/6A	*OPEN*	V8-2A2	V8-5/6A	V8-2A2	V8-5/6A
	Sol 7	*OPEN*	V8-7/8A	*OPEN*	*OPEN*	V8-7/8A	*OPEN*	V8-7/8A
	Sol 8	*OPEN*	V8-9/10A	*OPEN*	V1B-2	V8-9/10A	*OPEN*	V8-9/10A
	Sol 9	*OPEN*	V8-11/12A	*OPEN*	CFA1	V8-11/12A	*OPEN*	V8-11/12A
	Sol 10	V8B-1	V8B-1	V8B	V8-1B1	V8-1B1	V8B	V8B
	Sol 11	V8B-2	V8B-2	V8-1/2B	V8-1B2	V8-1B2	V8-1/2B	V8-1/2B
	Sol 12	CFB1	*OPEN*	V8-3/4B	V8-2B1	V8-2B1	V8-3/4B	V8-3/4B
	Sol 13	CFB2	*OPEN*	V8-5/6B	V8-2B2	V8-2B2	V8-5/6B	V8-5/6B
	Sol 14	V44	*OPEN*	V8-7/8B	CFB1	*OPEN*	V8-7/8B	V8-7/8B
	Sol 15	*OPEN*	*OPEN*	V8-9/10B	CFA2	*OPEN*	V8-9/10B	V8-9/10B
	Sol 16	*OPEN*	*OPEN*	V8-11/12B	CFB2	*OPEN*	V8-11/12B	V8-11/12B

OPEN (dark grey)	- Not assigned
(blue)	- Located within main cabinet
(white)	- Located on source

Looking at Back Panel of AP11 Controller

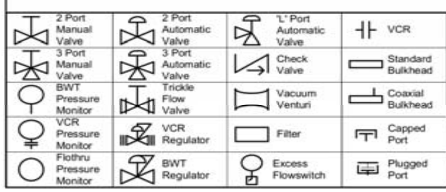


See the following drawings for pneumatic locations on different container types:

BSGeV-MECH-0011
Y Cylinder
Drum
Tonner
NH3 ISO

BSGeV-MECH-0012
Multi-Cylinder Pack/Bundle
ISO/TT with no tube switching

BSGeV-MECH-0013
ISO/TT with tube switching



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REF. **Gasguard BSGS eV / GASGUARD eV**

SYSTEM DESCRIPTION
GASGUARD AP11 BSGS eV / BULKGUARD eV
Cross Purge Pneumatic Assignments

VERSUM MATERIALS
ALLENTOWN, PENNSYLVANIA

ORIGINATOR **T. W. Piltz**

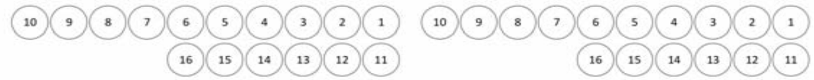
CUSTOMER / LOCATION

DATE **2/16/2018** | SHEET **1** OF **1** | CONFIG. VERSION **P1.0a** | FILE **BSGeV-MECH-0021** | DWG NO | SIZE **A** | REV. **B**

Pneu Location								
Left	Right	Y/Drum deep purge (DP)	TS-A with Dual Y DP	TS-B with Dual Y DP	Pneu MCP DP	TS-A with Dual Pneu MCP DP	TS-B with Dual Pneu MCP DP	Dual TS with DP
Sol 1		V1A-1	V1A	V1A-1	V1A-1	V1A	V1A-1	V1A
Sol 2		V2A	V2A	V2A	V2A	V2A	V2A	V2A
Sol 3		V3A	V3A	V3A	V3A	V3A	V3A	V3A
Sol 4		V4A	V4A	V4A	V4A	V4A	V4A	V4A
Sol 5		V5A	V5A	V5A	V5A	V5A	V5A	V5A
Sol 6		V6A	V6A	V6A	V6A	V6A	V6A	V6A
Sol 7		V7	V7	V7	V7	V7	V7	V7
Sol 8		V8A-1	V8A	V8A-1	V8-1A1	V8A	V8-1A1	V8A
Sol 9		V113TP	V113TP	V113TP	V113TP	V113TP	V113TP	V113TP
Sol 10		V10	V10	V10	V10	V10	V10	V10
Sol 11		V11	V11	V11	V11	V11	V11	V11
Sol 12		V13A-1	V13A	V13A-1	V13A-1	V13A	V13A-1	V13A
Sol 13		V13B-1	V13B-1	V13B	V13B-1	V13B-1	V13B	V13B
Sol 14		V1B-1	V1B-1	V1B-1	V1B-1	V1B-1	V1B	V1B
Sol 15		V2B	V2B	V2B	V2B	V2B	V2B	V2B
Sol 16		V3B	V3B	V3B	V3B	V3B	V3B	V3B
	Sol 1	V4B	V4B	V4B	V4B	V4B	V4B	V4B
	Sol 2	V5B	V5B	V5B	V5B	V5B	V5B	V5B
	Sol 3	V6B	V6B	V6B	V6B	V6B	V6B	V6B
	Sol 4	V8A-2	V8-1/2A	V8A-2	V8-1A2	V8-1/2A	V8-1A2	V8-1/2A
	Sol 5	CFA1	V8-3/4A	*OPEN*	V8-2A1	V8-3/4A	V8-2A1	V8-3/4A
	Sol 6	CFA2	V8-5/6A	*OPEN*	V8-2A2	V8-5/6A	V8-2A2	V8-5/6A
	Sol 7	V1A-2	V8-7/8A	V1A-2	V1A-2	V8-7/8A	V1A-2	V8-7/8A
	Sol 8	V1B-2	V8-9/10A	*OPEN*	V1B-2	V8-9/10A	*OPEN*	V8-9/10A
	Sol 9	*OPEN*	V8-11/12A	V13A-2	*OPEN*	V8-11/12A	V13A-2	V8-11/12A
	Sol 10	V8B-1	V8B-1	V8B	V8-1B1	V8-1B1	V8B	V8B
	Sol 11	V8B-2	V8B-2	V8-1/2B	V8-1B2	V8-1B2	V8-1/2B	V8-1/2B
	Sol 12	CFB1	*OPEN*	V8-3/4B	V8-2B1	V8-2B1	V8-3/4B	V8-3/4B
	Sol 13	CFB2	*OPEN*	V8-5/6B	V8-2B2	V8-2B2	V8-5/6B	V8-5/6B
	Sol 14	V44	V1B-2	V8-7/8B	*OPEN*	V1B-2	V8-7/8B	V8-7/8B
	Sol 15	V13A-2	*OPEN*	V8-9/10B	V13A-2	*OPEN*	V8-9/10B	V8-9/10B
	Sol 16	V13B-2	V13B-2	V8-11/12B	V13B-2	V13B-2	V8-11/12B	V8-11/12B

OPEN	- Not assigned
(blue)	- Located within main cabinet
(red corner mark)	- Located on deep purge panel
(blank)	- Located on source

Looking at Back Panel of AP11 Controller



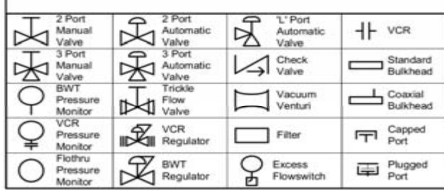
RIGHT PANEL LEFT PANEL

See the following drawings for pneumatic locations on different container types:

BSGeV-MECH-0011
Y Cylinder
Drum
Tonner
NH3 ISO

BSGeV-MECH-0012
Multi-Cylinder Pack/Bundle
ISO/TT with no tube switching

BSGeV-MECH-0013
ISO/TT with tube switching



SYSTEM DESCRIPTION: **GASGUARD AP11 BSGS eV / BULKGUARD eV**
Deep Purge Pneumatic Assignments

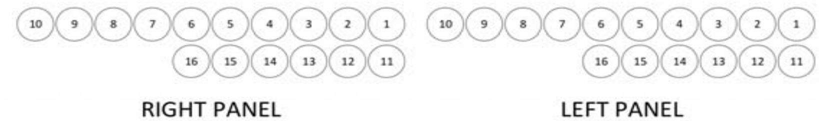
VERSUM MATERIALS, ALLENTOWN, PENNSYLVANIA

REF.: Gasguard BSGS eV / GASGUARD eV
ORIGINATOR: T. W. Piltz
CUSTOMER / LOCATION:
DATE: 2/16/2018 | SHEET: 1 OF 1 | CONFIG. VERSION: P1.0a
FILE: BSGeV-MECH-0022 | DWG NO
SIZE: A | REV.: B

Pneu Location								
Left	Right	Y/Drum Deep Purge w/ Venturi (DPV)	TS-A + Dual Y DPV	TS-B + Dual Y DPV	Pneu MCP DPV	TS-A + Pneu MCP DPV	TS-B + Pneu MCP DPV	Dual TS DPV
Sol 1		V1A-1	V1A	V1A-1	V1A-1	V1A	V1A-1	V1A
Sol 2		V2A	V2A	V2A	V2A	V2A	V2A	V2A
Sol 3		V3A	V3A	V3A	V3A	V3A	V3A	V3A
Sol 4		V4A	V4A	V4A	V4A	V4A	V4A	V4A
Sol 5		V5A	V5A	V5A	V5A	V5A	V5A	V5A
Sol 6		V6A	V6A	V6A	V6A	V6A	V6A	V6A
Sol 7		V7	V7	V7	V7	V7	V7	V7
Sol 8		V8-1A1	V8A	V8A-1	V8-1A1	V8A	V8-1A1	V8A
Sol 9		V113TP	V113TP	V113TP	V113TP	V113TP	V113TP	V113TP
Sol 10		V10	V10	V10	V10	V10	V10	V10
Sol 11		V11	V11	V11	V11	V11	V11	V11
Sol 12		V113TPA	V113TPA	V113TPA	V113TPA	V113TPA	V113TPA	V113TPA
Sol 13		V113TPB	V113TPB	V113TPB	V113TPB	V113TPB	V113TPB	V113TPB
Sol 14		V1B-1	V1B-1	V1B-1	V1B-1	V1B-1	V1B	V1B
Sol 15		V2B	V2B	V2B	V2B	V2B	V2B	V2B
Sol 16		V3B	V3B	V3B	V3B	V3B	V3B	V3B
	Sol 1	V4B	V4B	V4B	V4B	V4B	V4B	V4B
	Sol 2	V5B	V5B	V5B	V5B	V5B	V5B	V5B
	Sol 3	V6B	V6B	V6B	V6B	V6B	V6B	V6B
	Sol 4	V8A-2	V8-1/2A	V8-1A2	V8-1A2	V8-1/2A	V8-1A2	V8-1/2A
	Sol 5	*OPEN*	V8-3/4A	*OPEN*	V8-2A1	V8-3/4A	V8-2A1	V8-3/4A
	Sol 6	*OPEN*	V8-5/6A	*OPEN*	V8-2A2	V8-5/6A	V8-2A2	V8-5/6A
	Sol 7	V1A-2	V8-7/8A	V1A-2	V1A-2	V8-7/8A	V1A-2	V8-7/8A
	Sol 8	V1B-2	V8-9/10A	*OPEN*	V1B-2	V8-9/10A	*OPEN*	V8-9/10A
	Sol 9	V7A	V7A	V7A	V7A	V7A	V7A	V7A
	Sol 10	V8B-1	V8B-1	V8B	V8-1B1	V8-1B1	V8B	V8B
	Sol 11	V8B-2	V8B-2	V8-1/2B	V8-1B2	V8-1B2	V8-1/2B	V8-1/2B
	Sol 12	*OPEN*	*OPEN*	V8-3/4B	V8-2B1	V8-2B1	V8-3/4B	V8-3/4B
	Sol 13	*OPEN*	*OPEN*	V8-5/6B	V8-2B2	V8-2B2	V8-5/6B	V8-5/6B
	Sol 14	*OPEN*	V1B-2	V8-7/8B	*OPEN*	V1B-2	V8-7/8B	V8-7/8B
	Sol 15	*OPEN*	*OPEN*	V8-9/10B	*OPEN*	*OPEN*	V8-9/10B	V8-9/10B
	Sol 16	V7B	V7B	V7B	V7B	V7B	V7B	V7B

OPEN - Not assigned
- Located within main cabinet
- Located on deep purge panel
- Located on source

Looking at Back Panel of AP11 Controller

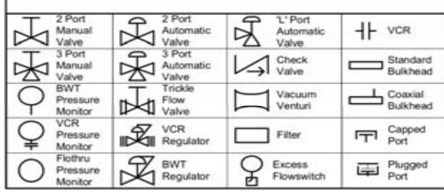


See the following drawings for pneumatic locations on different container types:

BSGeV-MECH-0011
Y Cylinder
Drum
Tonner
NH3 ISO

BSGeV-MECH-0012
Multi-Cylinder Pack/Bundle
ISO/TT with no tube switching

BSGeV-MECH-0013
ISO/TT with tube switching



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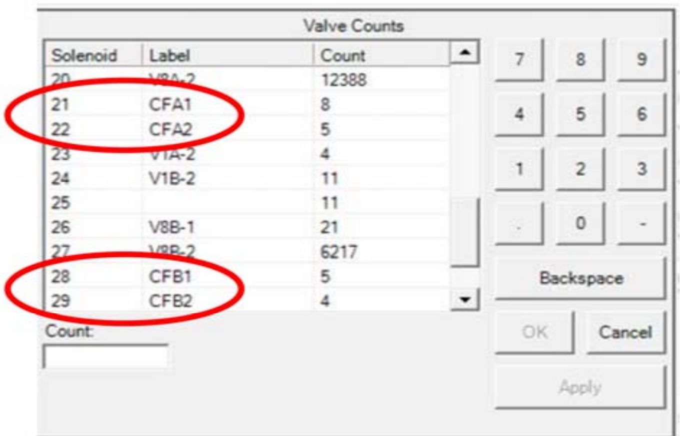
REF. Gasguard BSGS eV / GASGUARD eV		SYSTEM DESCRIPTION **GASGUARD AP11 BSGS eV / BULKGUARD eV** **Deep Purge with Venturi Pneumatic Assignments**	VERSUM MATERIALS ALLENTOWN, PENNSYLVANIA
ORIGINATOR **T. W. Piltz**		CUSTOMER / LOCATION	SIZE **A** REV. **B**
DATE **2/16/2018**	SHEET **1** OF **1** CONFIG. VERSION **P1.0a**	FILE **BSGeV-MECH-0023**	DWG NO

Installation of the cylinder flag pneumatic tubing within the BSGeV is field scope. Refer to drawing SW020039 for cylinder flag hardware field installation details.

Cylinder flag pneumatic assignments will vary depending upon the option set that is on the BSGeV system. The installer needs to check on the controller screen for the valve assignments. Using a Level-2 or higher password, log into the Configuration Menu and open the 'Valve Counts' menu.

The cylinder flags will always be assigned to solenoids on the right side panel, which are numbered 17-32. To determine which solenoid should be used on the right panel, subtract 16 from the solenoid number.

In the example on the right, the cylinder flag for source A-1 (CFA1) is assigned to solenoid 21, which is right panel solenoid 5 (21-16 = 5). CFA2 is on right solenoid 6, CFB1 is on right solenoid 12, and CFB2 is on right solenoid 13.



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

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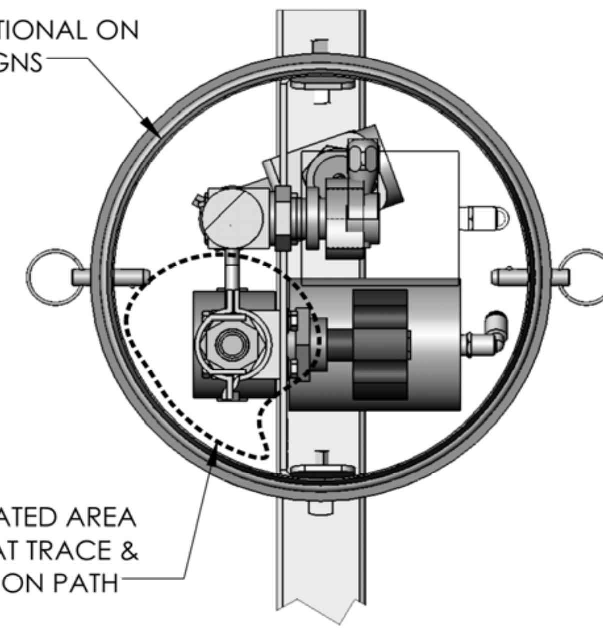
SYSTEM DESCRIPTION	GASGUARD AP11 BSGS eV / BULKGUARD eV
	Cylinder Flag Pneu Assignments
REF.	Gasguard BSGS eV / GASGUARD eV
ORIGINATOR	T. W. Piltz
CUSTOMER / LOCATION	
DATE	2/19/2018
SHEET	1 OF 1
CONFIG. VERSION	P1.0a
FILE	BSGeV-MECH-0024
DWG NO	
SIZE	A
REV.	A

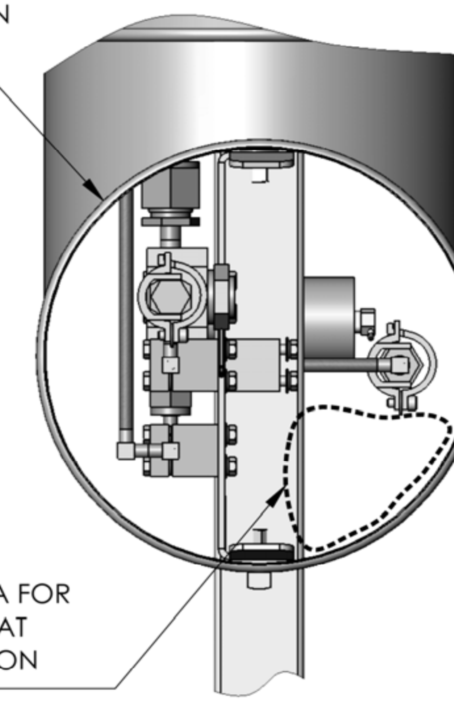
VERSUM MATERIALS
ALLENTOWN, PENNSYLVANIA

NOTES:

1. SOME ITEMS HAVE BEEN HIDDEN FOR CLARITY.
2. SPOOLS ARE FOR REFERENCE ONLY, YOUR EXACT BUILD WILL VARY FROM DETAILS SHOWN ON DRAWING.
3. REFER TO DOC0000104.DOC FOR GENERAL NOTES TO PROPERLY INSTALL HEAT TRACE CABLE.
4. REFER TO WOK-INS1133A.DOC FOR DETAIL OF BOOT END ON HEAT TRACE CABLE.
5. REFER TO SW005531.SLDDRW FOR DETAIL OF HEAT TRACE CABLE END TERMINATION PREPARATION.
6. FOLLOW THICK DASHED LINE PROVIDED, THIS IS THE PATH FOR INSTALLING HEAT TRACE CABLE. SECURE AS NEEDED TO PROCESS PIPING.
7. STARTING WITH BOOT END OF HEAT TRACE CABLE, ATTACH TO CGA OR DISS CONENCTION. DO NOT AFFIX BOOT END OF HEAT TRACE CABLE TO CGA OR DISS CONNECTION, ONLY BRAIDED AREA SHOULD TOUCH PIPING/ COMPONENTS.
8. DO NOT CUT HEAT TRACE CABLE, ROUTE HEAT TRACE CABLE TO "TERMINAL BOX". SEE TERMINAL BOX DETAILS FOR HEAT TRACE CABLE PASS THRU DETAILS. SEE DRAWING BNTLY01044.DGN FOR WIRING TERMINATIONS FOR "SOURCE A OR B HEAT TRACE". KEEP DISTANCE SHORT AS POSSIBLE.
9. HEAT TRACE CABLE IS NOT ATTACHED TO PIPING IN THIS AREA. KEEP DISTANCE AS SHORT AS POSSIBLE. SEE SW019593.SLDDRW FOR INSULATION DETAILS.
10. KEEP HEAT TRACE CABLE WITH IN THE BOUNDRIES OF THE BACKPLATE. THIS WILL ENSURE DUCT WORK WILL FIT OVER PIPING WHEN REQUIRED. SEE DETAIL A.
11. ROUTE AND ATTACH HEAT TRACE CABLE UP TO INLET PORT OF V2 VALVE ON PROCESS INLET SPOOL.
12. MAXIMUM LENGTH OF HEAT TRACE CABLE CAN NOT EXCEED 45'-0".
13. MAXIMUM LENGTH OF HEAT TRACE CABLE CAN NOT EXCEED 24'-0".
14. SOURCE B SHOULD FOLLOW SAME REQUIREMENTS AS SOURCE A DETAILS.

TABLE OF CONTENT





	0	INITIAL RELEASE	11/03/2017	JCB	TWP	ZR	
ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.

UNLESS OTHERWISE SPECIFIED:

FRACTIONAL ± 1/64" [.4]

DECIMAL:
.XX [.X] ± .00 [.0]
.XXX [.XX] ± .005 [.13]

ANGULAR: MACH ± .5
BEND ± .5

Weld Station

VERSUM MATERIALS

APPROVALS	DATE
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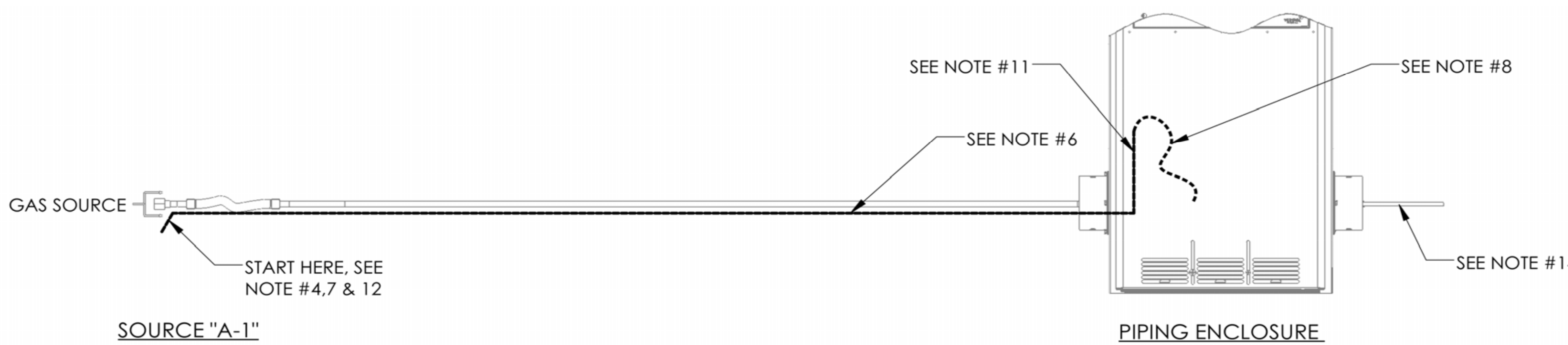
CHECKED T.W.Piltz	11/3/2017
ENG APPR.	
MFG APPR.	
APPROVED Z.Ren	11/03/2017

TITLE: Field Details of AP11 BSGeV (Heat Trace)

DWG. NO. SW019766.slddrw | SIZE B | REV 0

SCALE: 1:4 | REF. | SHEET 1 OF 8

SINGLE SOURCE CROSS PURGE



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	0	INITIAL RELEASE	11/03/2017	JCB	TWP	ZR	

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.XXX [.XX] ± .005 [.13]
ANGULAR: MACH ± .5
BEND ± .5

Weld Station: NA

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APPROVALS		DATE
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CHECKED	T.W.Piltz	11/3/2017
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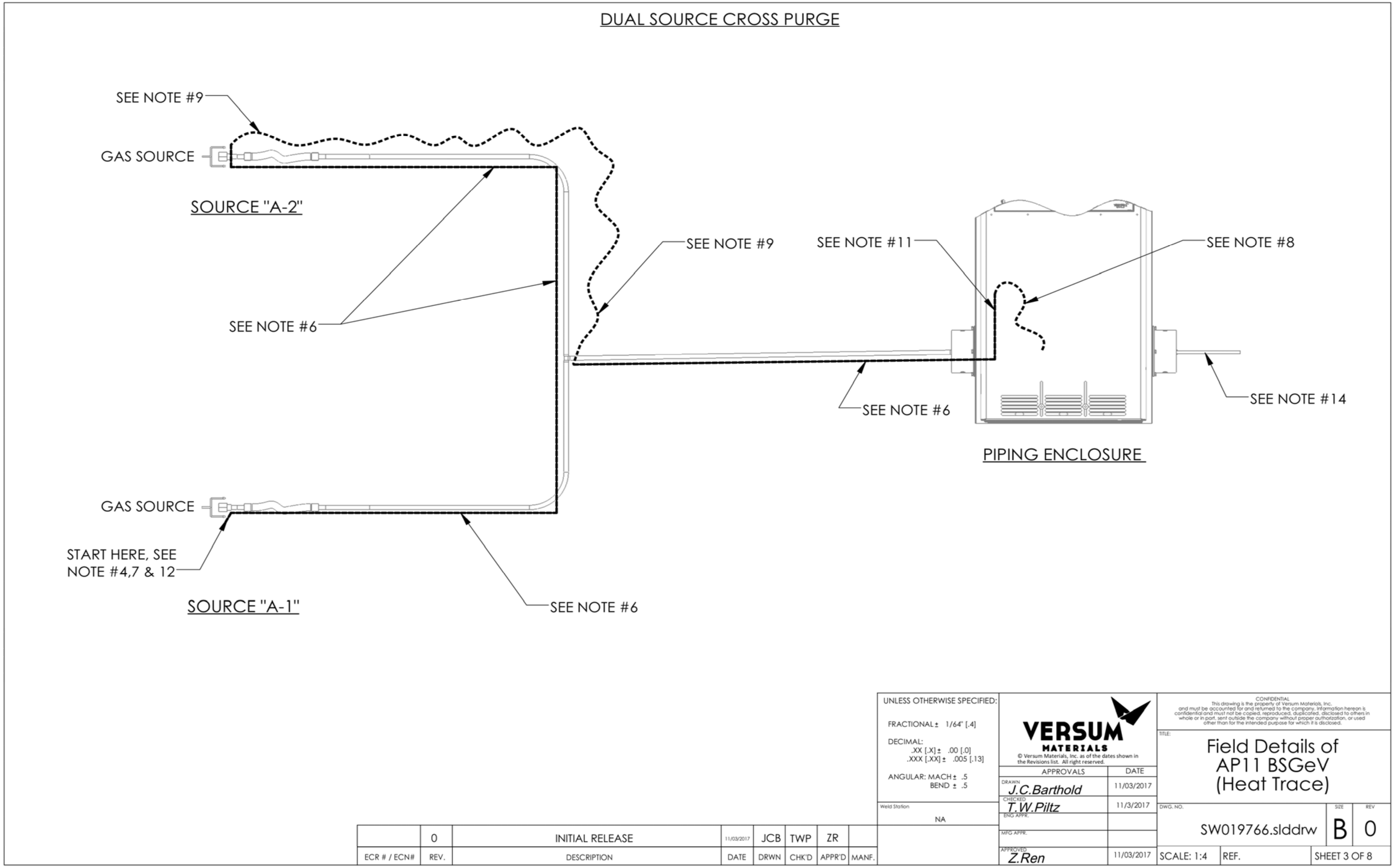
MFG APPR.		
APPROVED	Z.Ren	11/03/2017

TITLE: Field Details of AP11 BSGeV (Heat Trace)

DWG. NO. SW019766.slddrw | SIZE B | REV 0

SCALE: 1:4 | REF. | SHEET 2 OF 8


DUAL SOURCE CROSS PURGE
SEE NOTE #9
GAS SOURCE
SOURCE "A-2"
SEE NOTE #9
SEE NOTE #11
SEE NOTE #8
SEE NOTE #6
SEE NOTE #6
SEE NOTE #14
PIPING ENCLOSURE
GAS SOURCE
START HERE, SEE NOTE #4,7 & 12
SOURCE "A-1"
SEE NOTE #6
UNLESS OTHERWISE SPECIFIED:
FRACTIONAL ± 1/64" [.4]
DECIMAL: .XX [.X] ± .00 [.0] .XXX [.XX] ± .005 [.13]
ANGULAR: MACH ± .5 BEND ± .5
Weld Station
NA
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TITLE:
Field Details of AP11 BSGeV (Heat Trace)
DWG. NO.
SW019766.slddrw
SIZE B
REV 0
SCALE: 1:4
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0
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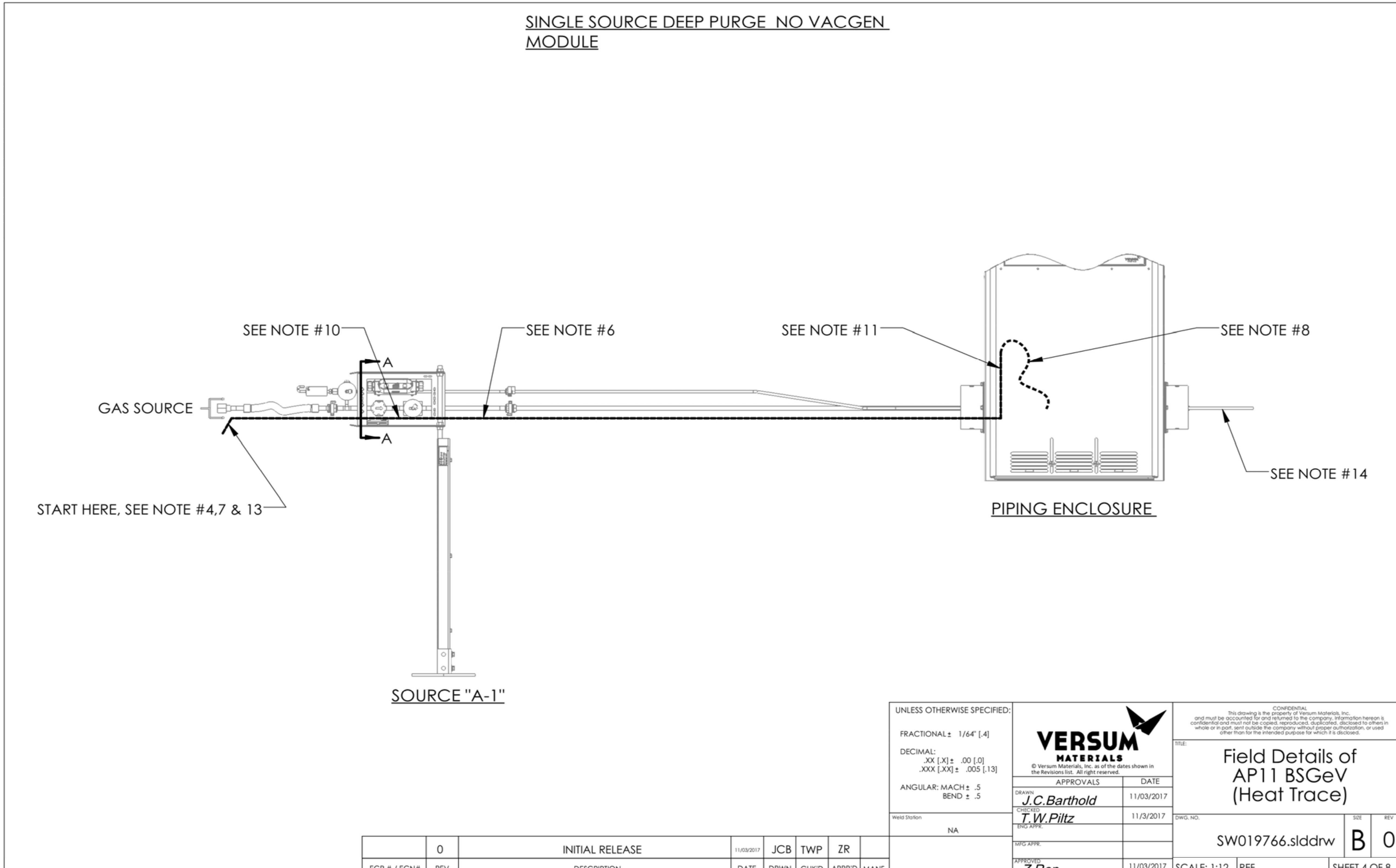
JCB
TWP
ZR
ECR # / ECN#
REV.
DESCRIPTION
DATE
DRWN
CHK'D
APPR'D
MANF.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SEE NOTE #10
SEE NOTE #6
SEE NOTE #11
SEE NOTE #8
A
A
GAS SOURCE
SEE NOTE #14
START HERE, SEE NOTE #4,7 & 13
PIPING ENCLOSURE
SOURCE "A-1"
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TITLE:
Field Details of AP11 BSGeV (Heat Trace)
DWG. NO.
SW019766.slddrw
SIZE B
REV 0
SCALE: 1:12
REF.
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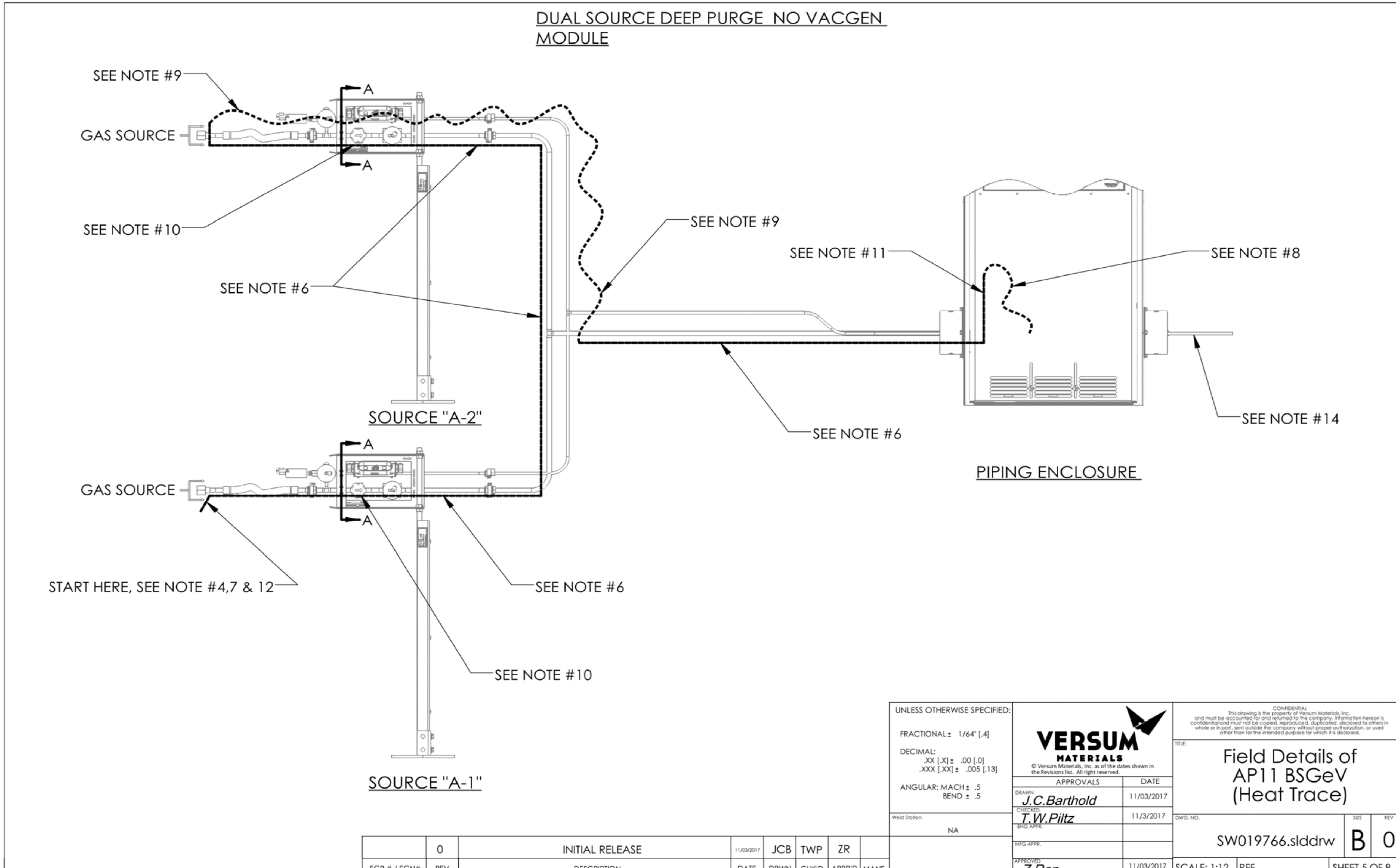
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SEE NOTE #9
GAS SOURCE
A
A
SEE NOTE #10
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SOURCE "A-2"
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START HERE, SEE NOTE #4,7 & 12
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UNLESS OTHERWISE SPECIFIED:
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DWG. NO.
SW019766.slddrw
SIZE B
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SCALE: 1:12
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SHEET 5 OF 8
0
INITIAL RELEASE
11/03/2017
JCB
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ECR # / ECN#
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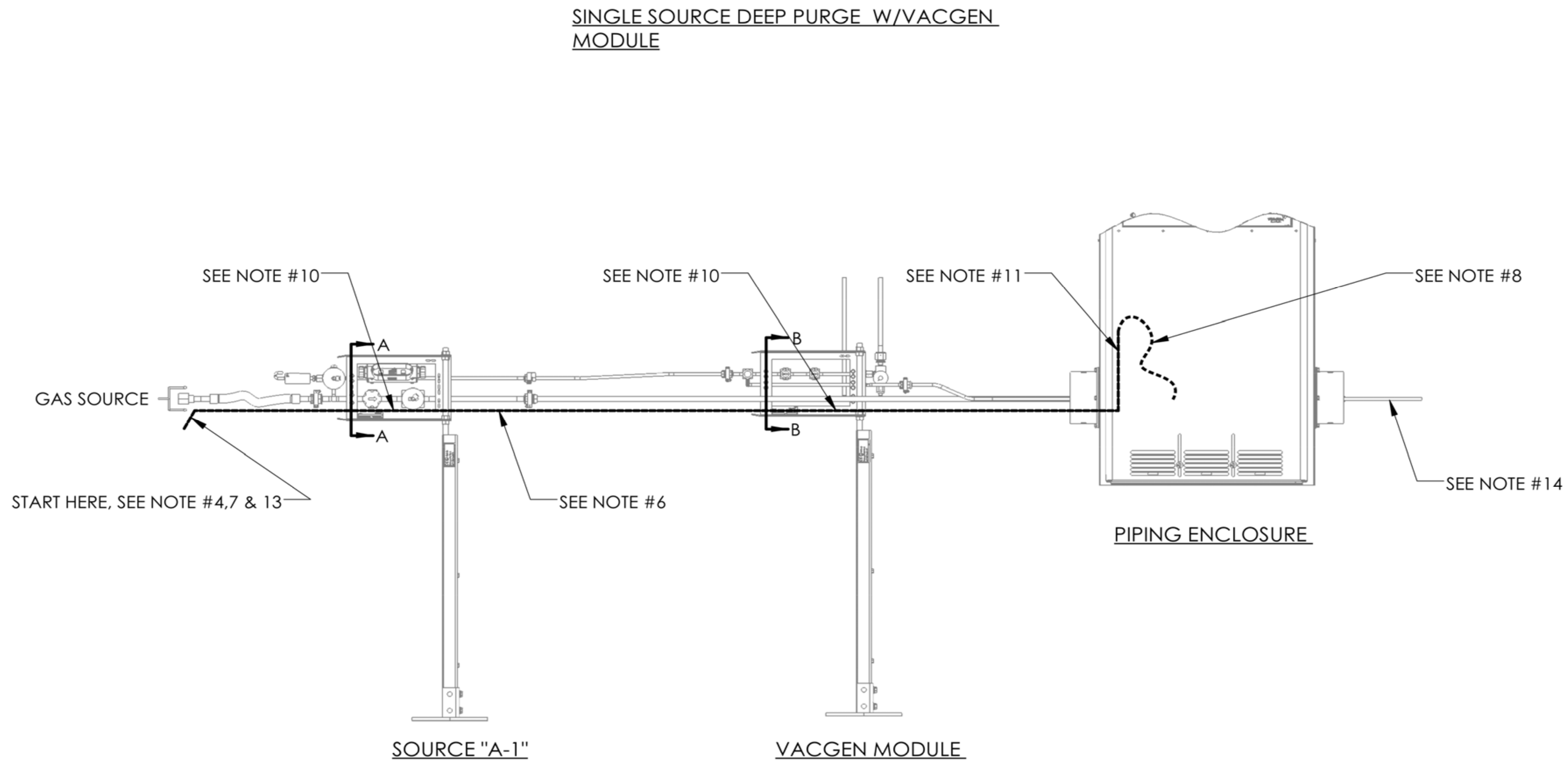

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ANGULAR: MACH ± .5
BEND ± .5

Weld Station
NA

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Field Details of AP11 BSGeV (Heat Trace)

DWG. NO.	SIZE	REV
SW019766.slddrw	B	0

SCALE: 1:12 | REF. | SHEET 6 OF 8

ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.
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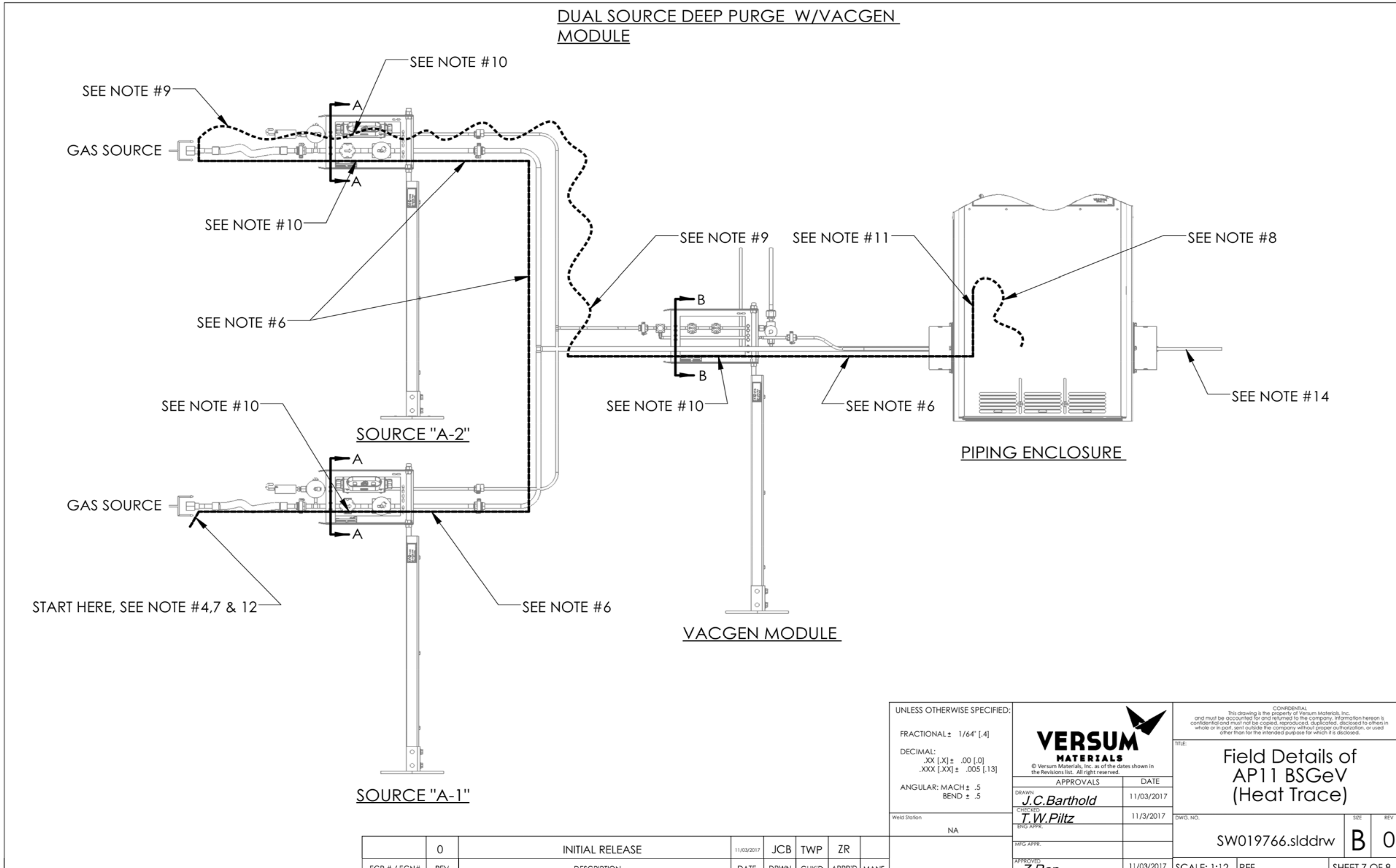
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SEE NOTE #10
SEE NOTE #9
GAS SOURCE
A
A
SEE NOTE #10
SEE NOTE #6
SEE NOTE #9
SEE NOTE #11
SEE NOTE #8
B
B
SEE NOTE #10
SEE NOTE #10
SEE NOTE #6
SEE NOTE #14
SOURCE "A-2"
PIPING ENCLOSURE
A
GAS SOURCE
A
START HERE, SEE NOTE #4,7 & 12
SEE NOTE #6
VACGEN MODULE
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VERSUM MATERIALS
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SW019766.slddrw
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DRWN
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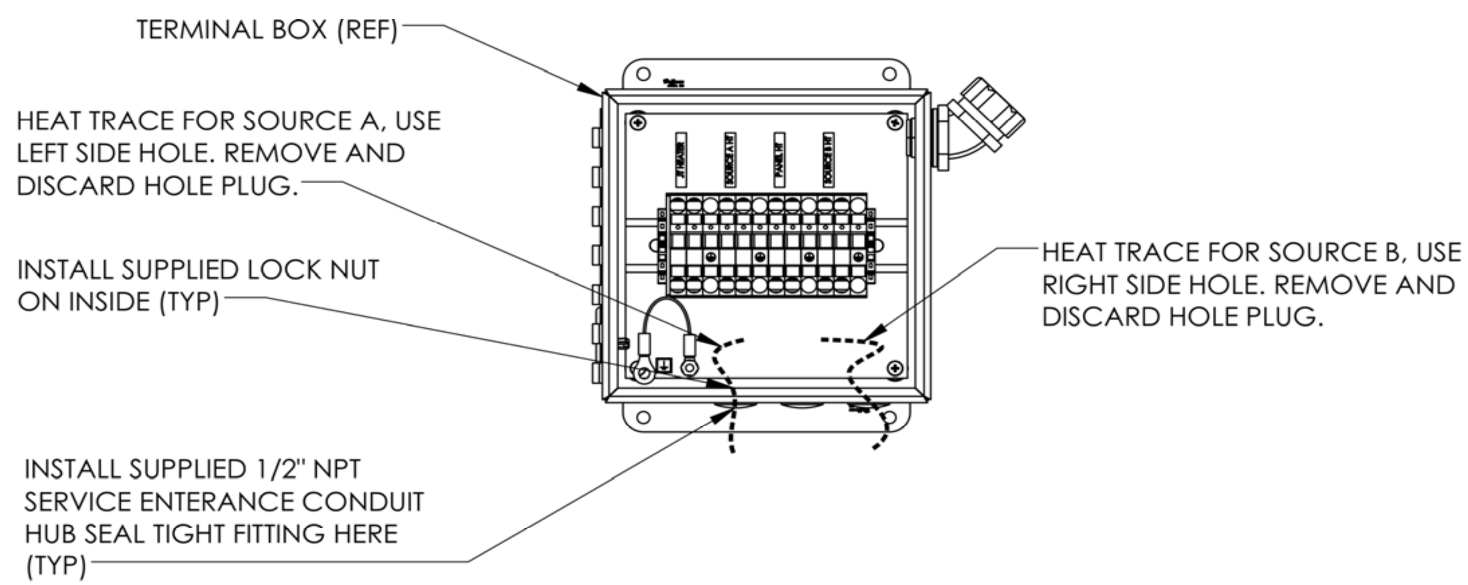
APPR'D
MANF.

TERMINAL BOX DETAILS



FRONT VIEW
LID REMOVED

	0	INITIAL RELEASE	11/03/2017	JCB	TWP	ZR	
ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.

UNLESS OTHERWISE SPECIFIED:
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ANGULAR: MACH ± .5
BEND ± .5

Weld Station: NA

VERSUM MATERIALS

APPROVALS		DATE
DRAWN	J.C.Barthold	11/03/2017
CHECKED	T.W.Piltz	11/3/2017
ENG APPR.		
MFG APPR.		
APPROVED	Z.Ren	11/03/2017

TITLE: Field Details of AP11 BSGeV (Heat Trace)

DWG. NO.	SIZE	REV
SW019766.slddrw	B	0

SCALE: 1:4 | REF. | SHEET 8 OF 8

GENERIC HEAT TRACE INSTRUCTIONS:

1. Refer to engineering documents, to understand path of heat trace cable, location of capillary bulb and or thermocouple. **(*BULKGUARD* eV & BSGS eV units do not require a capillary bulb)**
2. Portions of the heat trace assembly may be installed with piping spools/panels removed from enclosure to ease the heat trace installation process. Manufacturing is to decide if step is necessary.
3. Refer to the following documents depending on your system needs:
   a. See DOC000011.doc for details on installation of capillary bulb **(*BULKGUARD* eV & BSGS eV units do not require a capillary bulb).**
   b. See SW011286.slddrw for details on installation of thermocouple.
4. Heat trace is only required to touch one side of components, unless otherwise noted.
5. Heat trace should coil one time around regulator bodies.
6. Do not coil heat trace around valves, excess flow switches, mass flow meters, transducers, filters & purifiers. Heat trace should be running along the axis of the piping.
7. Do not coil heat trace around piping circumference.
8. Allow heat trace to contact the top of piping standoffs.
9. No service loops around mechanical points such as VCR's & threaded connections are required.
10. Do not cover any weep holes on valves or regulators.
11. Do not apply aluminum tape to areas where the heat trace does not contact the piping or components **(example: service loops).**
12. Precut foam insulation pieces should be in a relaxed state when applying to components, pulling on precut pieces while applying will cause stress cracks in material.
13. Precut pieces may be trimmed down to fit around components necessary.
14. Remove paper backing from adhesive faces before attaching foam to objects.
15. Foam tubes should be cut to fit.

16. Foam tubes can be mitered to create 90 degree corners; this is done by cutting a V-shape out of foam.

HEAT TRACE INSTRUCTIONS:

1. Do a preliminary cable routing test to verify heat trace cable is correct length before proceeding to next step.
2. Install heat trace boot on end of cable using instructions found on WOK-INS1133A.DOC.
3. Affix the heat trace parallel to piping, components & standoffs with fiberglass banding tape (171861) as needed. **Note: it is not necessary to remove the fiberglass banding tape.**
4. If system has a flex hose refer to engineering documents for further instructions and details.
5. Apply aluminum tape (889-609636) to areas where the heat trace contacts the piping, components & standoffs. Apply the aluminum tape around the circumference of the piping. Excess flow switches equipped with a mechanical indicator may be wrapped with aluminum tape, but the mechanical indicator portion of the switch shall remain exposed. If a braided flex hose is present, apply aluminum tape (889-609636) in a spiral path around steel braiding.
6. If heat trace cable is not attached to piping, apply the insulating tape (889-606433) around the circumference of the piping. Overlap the insulating tape approximately 3/8". Wrap the insulating tape in a spiral manner over the heat trace cable.
7. Terminate heat trace cable using instructions found on SW005531.slddrw

PIPING INSULATION KIT INSTRUCTIONS:

(All content in piping insulation kits have been labeled with item numbers.)

1. Use item 1's in kit and attach to valve bodies that are in the path of heat trace cable.
2. Use item 5's in kit and attach to Regulator bodies that are in the path of heat trace cable.
3. Use item 6's in kit and attach to only AP9000 Regulator bodies that are in the path of heat trace cable.
4. Use item 7's in kit and attach to Filter/Purifier bodies that are in the path of heat trace cable. You may need to cut to fit since filter/purifier bodies vary.
5. Use item 8's in kit and attach to Filter/Purifier ends that are in the path of heat trace cable. You may need to cut to fit since filter/purifier bodies vary.
6. Use item 3's in kit and attach to piping that is in the path of heat trace cable.
7. Use item 2's in kit and place inside enclosure so they can be shipped with equipment. Do not install.
8. All remaining items not used in kit should be trashed.
9. Use item 9 Black self-fusing tape in kit when necessary to secure insulation.
10. Use item 10 Bonding Adhesive in kit for mitered seams.

HARWARE PARTS:

1. RA_Tape_FbrGlss Bndng 1/2"W x 180 FT MM# 171861
2. RB_Tape_1 SILICON SLD .030" THK X 60 FT MM# 889-606433
3. RC_TapeInsltn_Alum 25FT MM# 889-609636

ELECTRONICS ENGINEERING WORK INSTRUCTION

Heat Trace Boot End Installation

1. Purpose:

1.1. To outline in detail the proper installation of heat trace boot ends.
1.2. This document supersedes documents DOC000010.doc and APCISEMC-52508.doc.

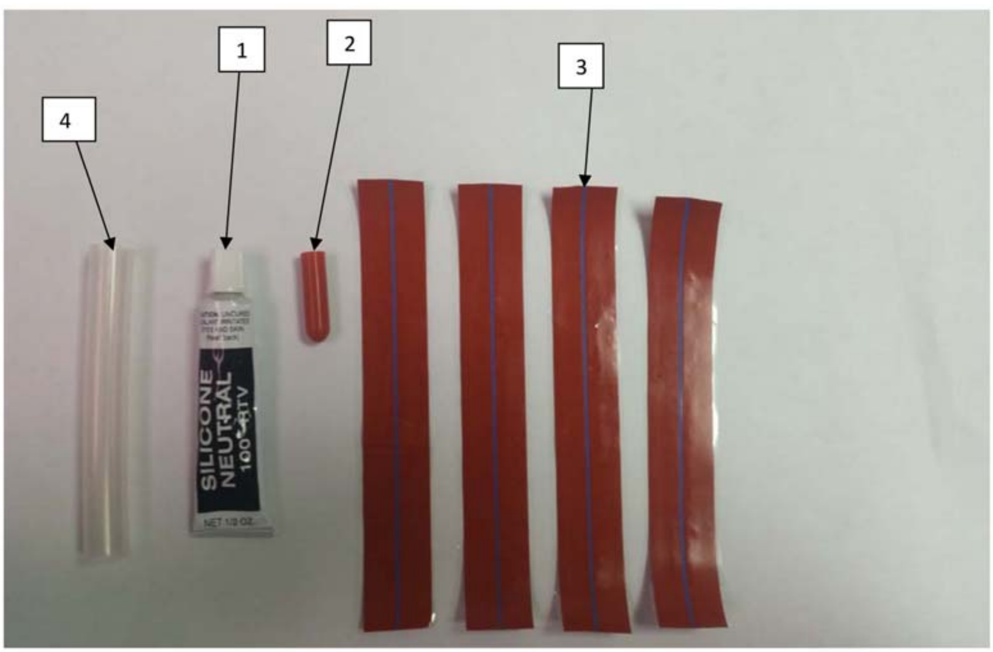
2. Scope:

2.1. This procedure applies to all equipment using delta therm PT series heat trace.

3. Parts Required:

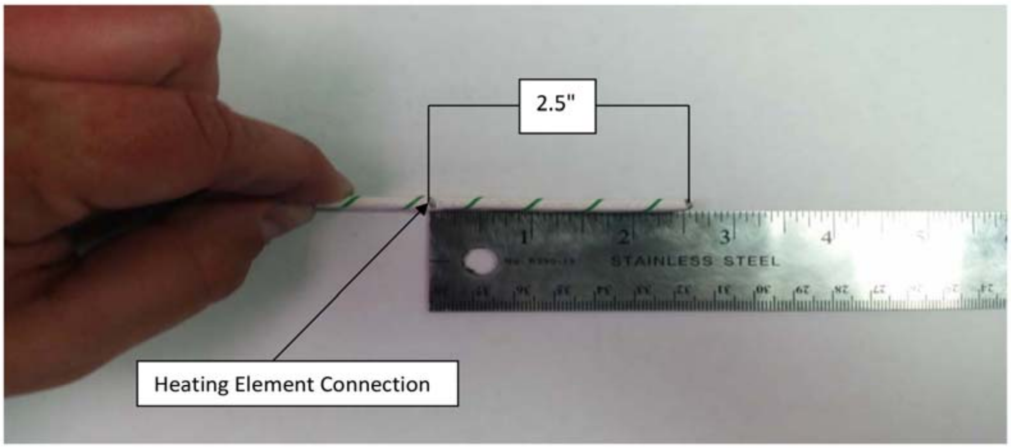
3.1. The following should be included in heat trace kit 809-609664:

1) Qty(1) – ½ oz. tube silicon sealant
2) Qty(1) – silicon end cap
3) Qty(4) – 6” silicon self-fusing tape
4) Qty(1) – 4” clear silicon tube
5) Qty(1) -- WOK-INS113A.doc

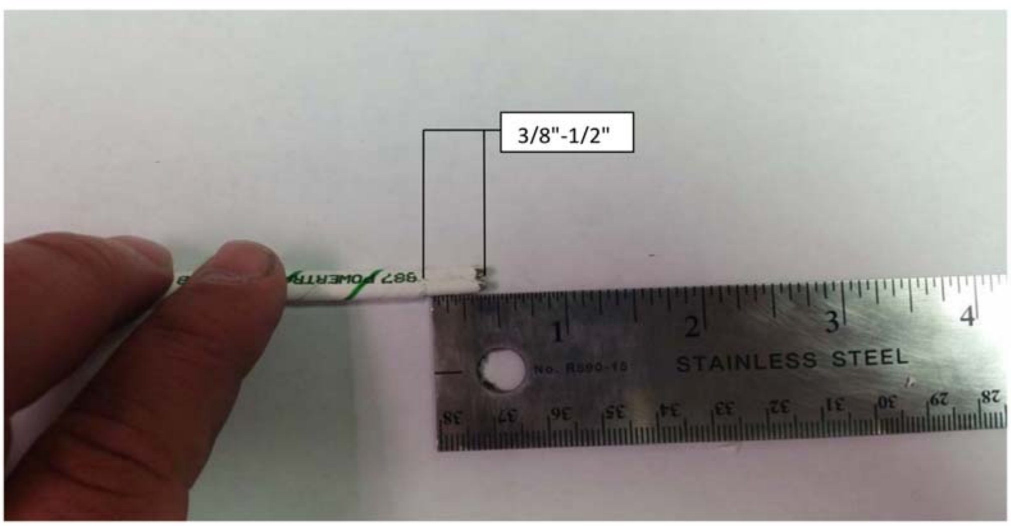


4. Procedure:

4.1. Pull outer braided layer of cable back to expose the inner wires. Locate the nichrome heating element connection which shows as a bump and is located every 2'. Cut the cable 2.5" after the bump as shown below.



4.2. Remove the outer layer of wrapping on the cable as well as the surrounding nichrome wire. Remove no less than 3/8" and no more than 1/2" from the end of the cable. Ensure that all nichrome wire is removed. Nichrome wire is the thickness of human hair; thus a close thorough inspection is required.



4.3. Cut between the two wires and separate slightly as shown below.
NOTE: Ensure there are no bare spots in the wires after they have been separated.

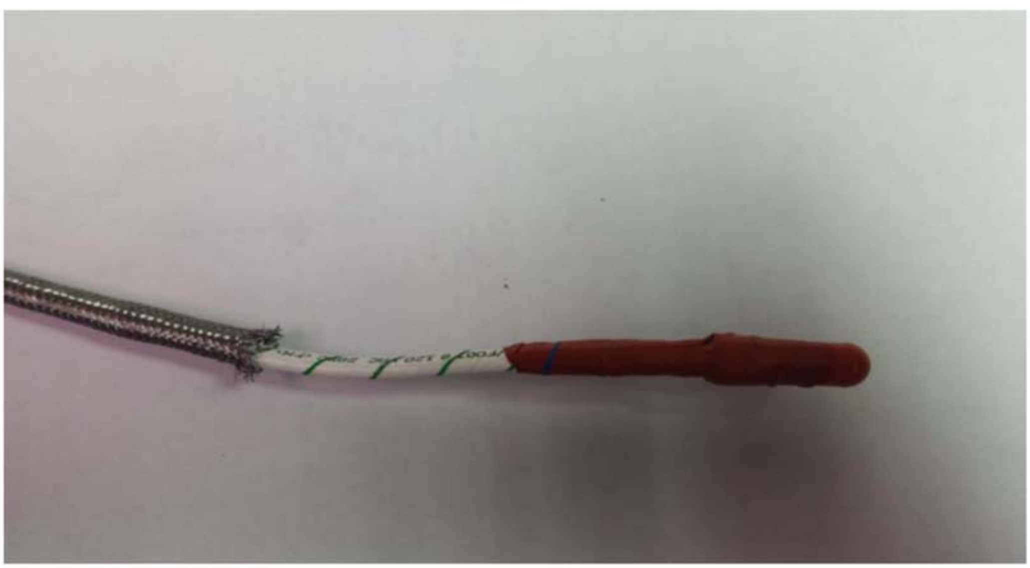
4.4. Trim one wire halfway down to help prevent the wires from touching each other. If any bare wire is present at the end of the wires, trim it off and straighten the wires as shown below.

4.5. Fill end cap with silicon sealant.

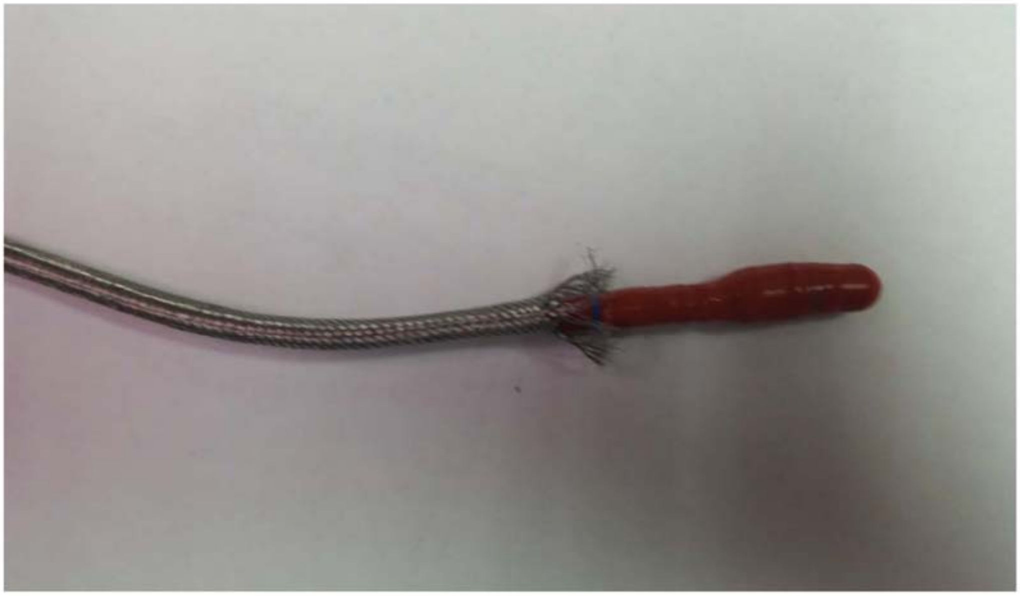
4.6. Slide braid out of way and cover end of cable with silicon sealant as shown below. Allow silicon sealant to harden before proceeding.

4.7. Install end cap onto cable using a twist and push motion to force out any air bubbles and to ensure silicon fills the end cap entirely. Smooth excess silicon with a wet finger. Allow sealant to harden before proceeding to step 4.8.

4.8. Starting at the end of the cap, wrap the end of the assembly with silicon self fusing tape. Use the line on the tape as a guide to half lap the tape. Pull and stretch tape as you wrap.

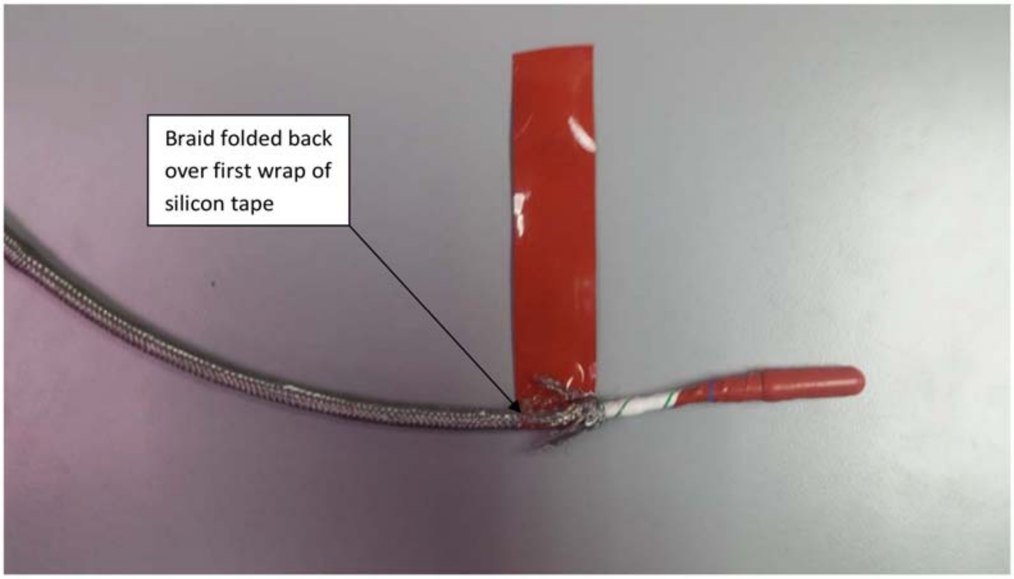


4.9. Pull braid back in place and splay apart for 1/2" as shown below



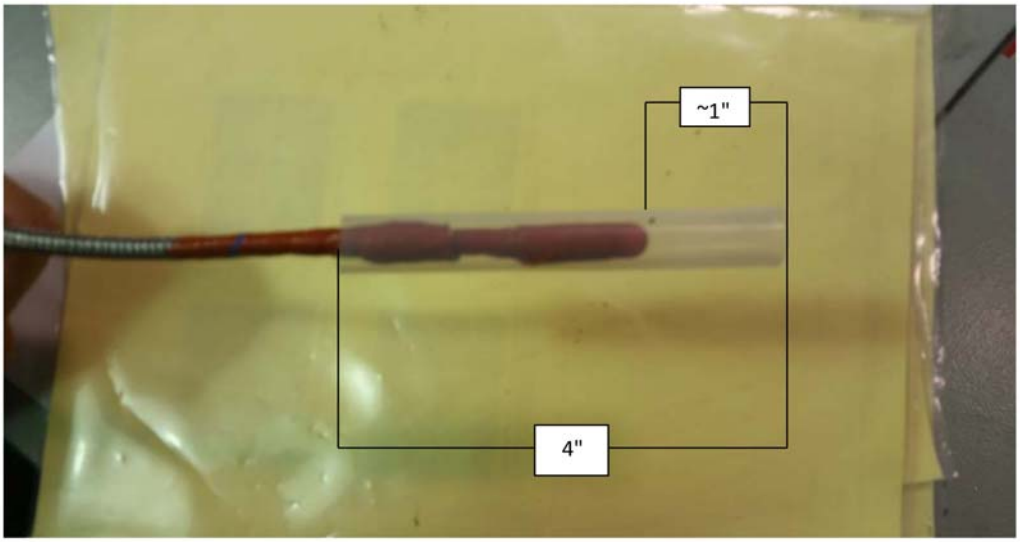
4.10. Wrap cable as shown below, pulling and stretching the silicon tape. Only make 1 complete wrap around the braided wire before proceeding to step 4.11

4.11. After the first wrap of tape has been applied, fold the splayed section of braided wire over the tape as shown below.



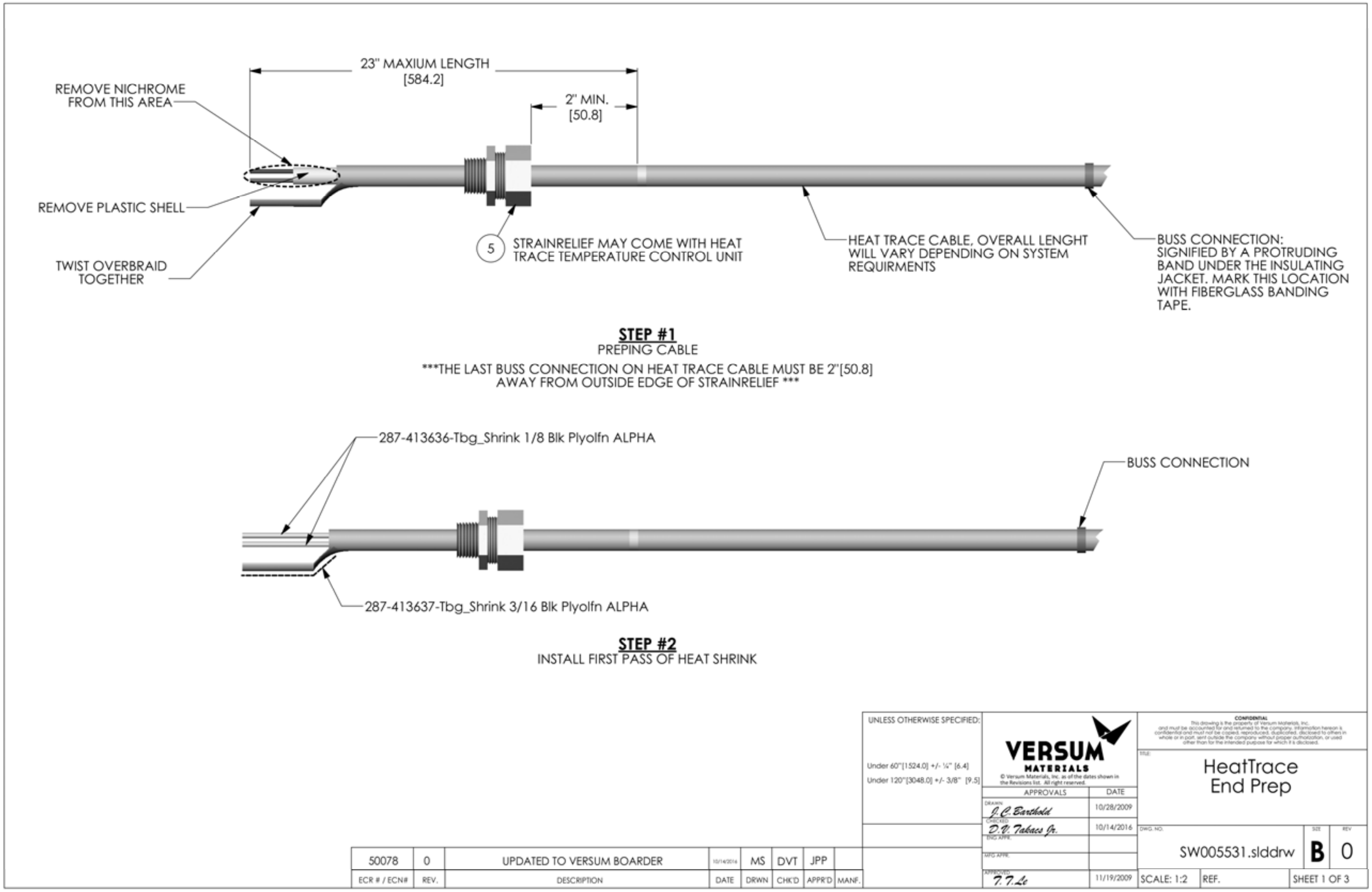
4.12. Continue to wrap the tape down the cable. Once tape is installed, slide the braid up to the end cap as shown below. Braid should be snug but able to slide to accommodate cable expansion when heated.

4.13. Take the clear silicon tubing and slide it over the existing boot end termination leaving approximately 1" of tubing past the end of the existing termination.



4.14. Fold over the excess silicon tubing and secure it with a piece of 6" silicon self fusing tape.

4.15. Seal the silicon tubing by completely taping over the silicon tubing with a piece of 6" silicon self-fusing tape as shown below.


23" MAXIUM LENGTH
[584.2]
2" MIN.
[50.8]
REMOVE NICHROME FROM THIS AREA
REMOVE PLASTIC SHELL
TWIST OVERBRAID TOGETHER
5
STRAINRELIEF MAY COME WITH HEAT TRACE TEMPERATURE CONTROL UNIT
HEAT TRACE CABLE, OVERALL LENGHT WILL VARY DEPENDING ON SYSTEM REQUIRMENTS
BUSS CONNECTION: SIGNIFIED BY A PROTRUDING BAND UNDER THE INSULATING JACKET. MARK THIS LOCATION WITH FIBERGLASS BANDING TAPE.
STEP #1
PREPING CABLE
***THE LAST BUSS CONNECTION ON HEAT TRACE CABLE MUST BE 2"[50.8] AWAY FROM OUTSIDE EDGE OF STRAINRELIEF ***
287-413636-Tbg_Shrink 1/8 Blk Plyolfn ALPHA
BUSS CONNECTION
287-413637-Tbg_Shrink 3/16 Blk Plyolfn ALPHA
STEP #2
INSTALL FIRST PASS OF HEAT SHRINK
UNLESS OTHERWISE SPECIFIED:
Under 60"[1524.0] +/- ¼" [6.4]
Under 120"[3048.0] +/- 3/8" [9.5]
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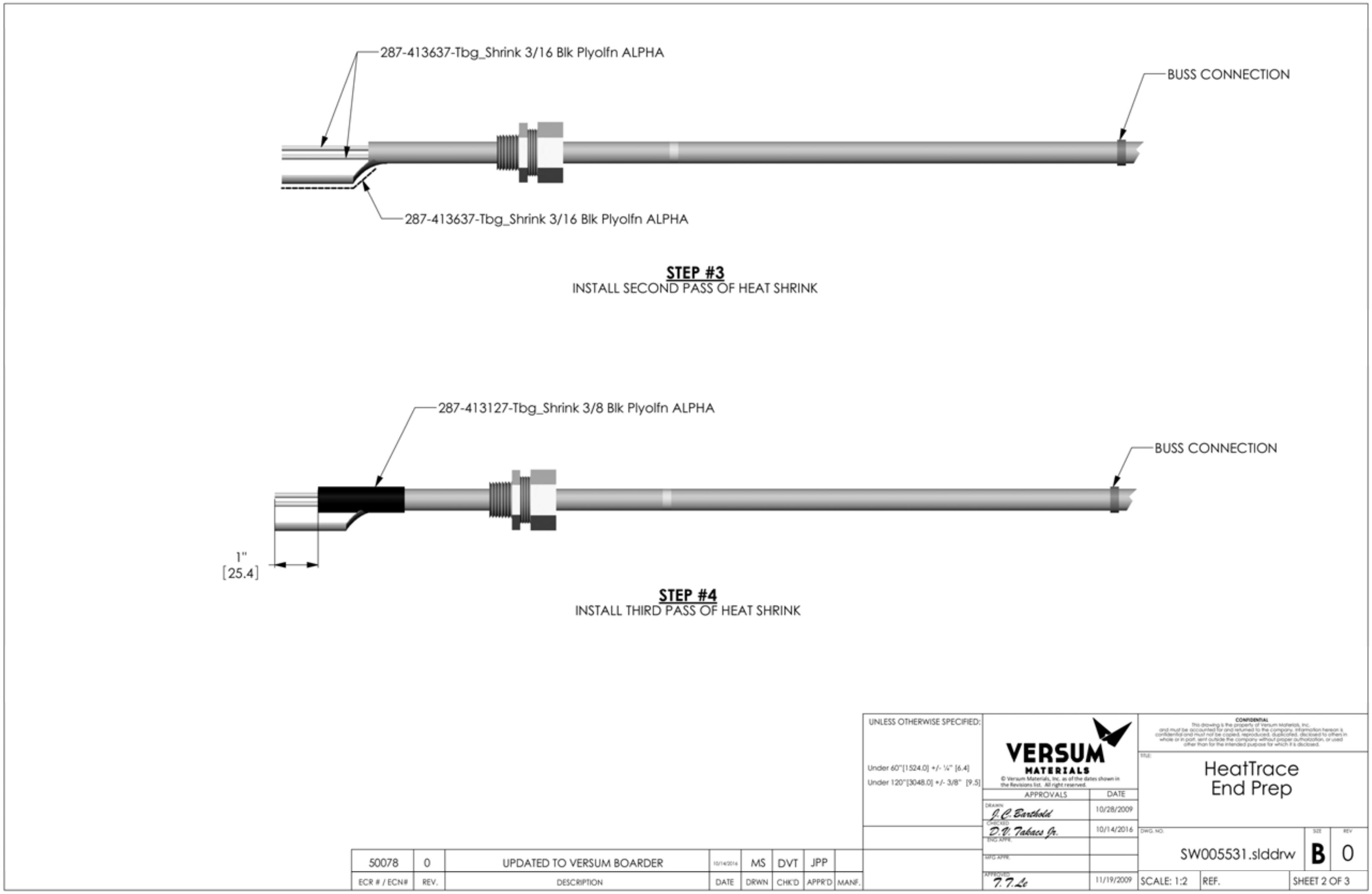
APPROVALS
DATE
DRAWN J.C.Barthold 10/28/2009
CHECKED D.V. Takacs Jr. 10/14/2016
ENG APPR.
MFG APPR.
APPROVED T.T.Le 11/19/2009
CONFIDENTIAL
This drawing is the property of Versum Materials, Inc. and must be accounted for and returned to the company. Information hereon is confidential and must not be copied, reproduced, duplicated, disclosed to others in whole or in part, sent outside the company without proper authorization, or used other than for the intended purpose for which it is disclosed.
TITLE:
HeatTrace End Prep
DWG. NO.
SW005531.slddrw
SIZE B
REV 0
SCALE: 1:2
REF.
SHEET 1 OF 3
50078
0
UPDATED TO VERSUM BOARDER
10/14/2016
MS
DVT
JPP
ECR # / ECN#
REV.
DESCRIPTION
DATE
DRWN
CHK'D
APPR'D
MANF.


287-413637-Tbg_Shrink 3/16 Blk Plyolfn ALPHA
BUSS CONNECTION
287-413637-Tbg_Shrink 3/16 Blk Plyolfn ALPHA
STEP #3
INSTALL SECOND PASS OF HEAT SHRINK
287-413127-Tbg_Shrink 3/8 Blk Plyolfn ALPHA
BUSS CONNECTION
1"
[25.4]
STEP #4
INSTALL THIRD PASS OF HEAT SHRINK
UNLESS OTHERWISE SPECIFIED:
Under 60"[1524.0] +/- ¼" [6.4]
Under 120"[3048.0] +/- 3/8" [9.5]
VERSUM MATERIALS
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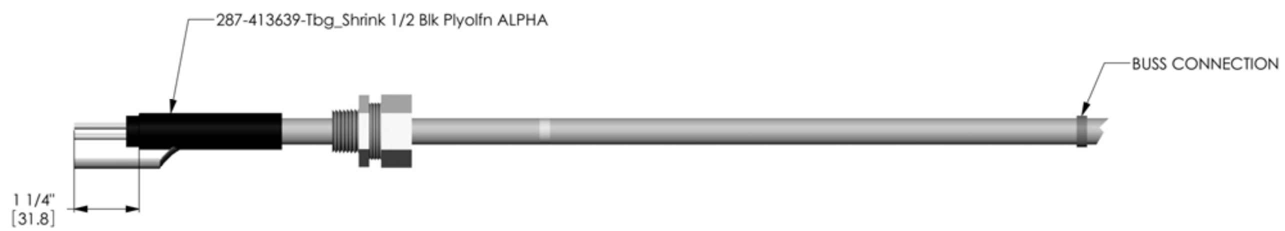
APPROVALS
DATE
DRAWN
J.C.Barthold
10/28/2009
CHECKED
D.V. Takacs Jr.
10/14/2016
ENG APPR.
MFG APPR.
APPROVED
T.T.Le
11/19/2009
CONFIDENTIAL
TITLE:
HeatTrace
End Prep
DWG. NO.
SW005531.slddrw
SIZE
B
REV
0
SCALE: 1:2
REF.
SHEET 2 OF 3
50078
0
UPDATED TO VERSUM BOARDER
10/14/2016
MS
DVT
JPP
ECR # / ECN#
REV.
DESCRIPTION
DATE
DRWN
CHK'D
APPR'D
MANF.



STEP #5
INSTALL FINAL PASS OF HEAT SHRINK

50078	0	UPDATED TO VERSUM BOARDER	10/14/2016	MS	DVT	JPP	
ECR # / ECN#	REV.	DESCRIPTION	DATE	DRWN	CHK'D	APPR'D	MANF.

UNLESS OTHERWISE SPECIFIED:
Under 60"[1524.0] +/- ¼" [6.4]
Under 120"[3048.0] +/- 3/8" [9.5]

VERSUM MATERIALS

APPROVALS		DATE
DRAWN	J.C. Barthold	10/28/2009
CHECKED	D.V. Takacs Jr.	10/14/2016
ENG APPR.		
MFG APPR.		
APPROVED	T.T. Le	11/19/2009

TITLE: HeatTrace End Prep

DWG. NO.	SIZE	REV
SW005531.slddrw	B	0
SCALE: 1:2	REF.	SHEET 3 OF 3

Appendix B

Spare Parts List

Section 1	**Mechanical Spares**
Section 2	**Electrical Spares**

1.0 Mechanical Spares

Due to the wide variety of product line options and configurations available for BSGS eV / BULKGUARD eV, it is difficult to have a list of standard mechanical spare parts that would be applicable to all systems. Please contact your Versum Materials representative for spare parts service. It is recommended that your equipment set is analyzed in order to produce a specific list of mechanical spare parts for your site. The modular design of the system should allow for common spares supporting multiple systems depending upon the gas types in service.

Critical spare components:

Regulators:	One PCV1A/B and one PCV2A/B for each type (pressure rating, 316 SS/C22, PCTFE/Vespel seats) found within the equipment set.
RFO:	One for each orifice size found within the equipment set (HPLT, purge, source, etc.)
PT's:	One for each pressure range found within the equipment set (250 / 1000 / 3000 psia)
JT Heater:	One for each configuration (single/dual process train, 316 SS/C22) found within the equipment set
Purifiers:	One for each purifier type found within the equipment set
Vacuum:	One Venturi vacuum generator per equipment set

Recommended spare components:

Piping/valve spools:	Piping spools are impacted by the purge type (cross, deep source, deep source with Venturi) and gas type (single/dual pressure regulation, JT heater, soft goods) as well as other options. A quote would need to be generated in order to ensure that there would be no duplication of common spare spools within an equipment set.
Filters:	One F1 and one F2 for each type (316SS / Ni media) found within the equipment set
EFS:	One excess flow switch for each type found within the equipment set

2.0 Electrical Spare Parts

AP11 Controller Spare Parts

Item	Category	Critical Spare Part (Qty)	Recommended Spare Part (Qty)	Manufacturer	GASGUARD® Part #	Description
1	Carrier Board	1	0	VERSUM MATERIALS	**407410**	Carrier Board w/SOM, Heat sink, & firmware. Part # AP1565
2	Carrier Board	0	1	VERSUM MATERIALS	**414763**	Carrier Board w/ firmware. Part # AP1565
3	Carrier Board	0	1	VERSUM MATERIALS	**414897**	SOM w/Heat sink & firmware. Part # AP1565
4	Panel Board	1	0	VERSUM MATERIALS	**407356**	Panel Board, part # AP1564
5	Customer Board	1	0	VERSUM MATERIALS	**440969**	Customer Board **STD**, part # AP1563 (replacement board only, see item 6 for complete kit)
6	Customer Board	0	1	VERSUM MATERIALS	**440776**	Customer Board **STD** Kit (includes AP1563 board & cables to add customer input/output alarm function)
7	Door Board	1	0	VERSUM MATERIALS	**407726**	Door Board, part # AP1562
8	Display	1	0	NEC	**409057**	Display (CCFL BACKLIGHT TYPE)
9	Display	1	0	NEC	**436466**	Display (LED BACKLIGHT TYPE)
10	Display	1	0	NEC	**409058**	Inverter Board
11	Display	1	0	NEC	**436908**	CCFL Replacement Backlight for GASGUARD® Part #409057
12	Display	1	0	Quadrangle	**439367**	Display Cable
13	Fuse	5	0	Littlefuse	**409610**	Fuse 250MA radial, (37002500410)
14	Fuse	5	0	Littlefuse	**409611**	Fuse 500MA radial, (37005000410)
15	Fuse	5	0	Littlefuse	**409608**	Fuse 1A radial, (37011000410)
16	Fuse	5	0	Littlefuse	**418758**	Fuse 4A radial, (37014000410)
17	Graphics	1	0	VERSUM MATERIALS	**415647**	Graphic Overlay/Touch Screen Assembly
18	Pressure Switch	1	0	Micro Pneumatic Logic	**809-418802**	Differential Pressure Switch, For Z-Purge, 0.1" H2O, N.O., 1/16" Barbed Special.

Item	Category	Critical Spare Part (Qty)	Recommended Spare Part (Qty)	Manufacturer	GASGUARD® Part #	Description
19	Solenoid	1	0	SMC	**420179**	Master Solenoid Valve (L Style, 24V, w/base)
20	Power Supply	1	0	Phoenix Contact	**409506**	Power Supply, 24 VDC, 4A
21	Power Supply	1	0	VERSUM MATERIALS	**414764**	AP11 Power Cooling Fan (SW008286.SLDDRW)
22	Power Supply	1	0	VERSUM MATERIALS	**414762**	PCB High Voltage AP11, AP1568
23	Power Supply	1	0	VERSUM MATERIALS	**436467**	10Awg Power Wire Modification Kit
24	Misc.	0	1	VERSUM MATERIALS	**400509**	SETRA Exhaust sensor cable (SW008106.SLDDRW)
25	Misc.	0	1	Allen Bradley	**409501**	Push Button - Mushroom Head - Red - Maintained Push/Pull Twist to Release.
26	Misc.	0	1	Mallory / Sonalert	**171538**	Mallory Sonalert Horn
27	Graphics	0	1	VERSUM MATERIALS	**199117**	AP11 Logo w/ Z Purge Warning
28	Graphics	0	1	VERSUM MATERIALS	**199116**	AP11 Graphic Overlay Optional Valve Legend
29	Fuse	4	0	Schurter or SIBA	**416974**	Fuse 4A, super quick acting (Schurter 7022.0660 or SIBA 189020.4)
30	Misc.	0	1	Honeywell	**418571**	Pressure-sensor, 150psi, 2%
31	Misc.	0	1	Lindy	**435058**	USB Type-A Port Blocker
32	Customer Board	1	0	VERSUM MATERIALS	**469624**	Customer Board with **Analog-Out**, part # AP1580 (replacement board only, see item 40 for complete kit)
33	Customer Board	0	1	VERSUM MATERIALS	**468487**	Customer Board with **Analog-Out** Kit (includes AP1580 board & cables to add customer input/output alarm function)
34	Heater Board	1	0	VERSUM MATERIALS	**467662**	Heater Control Board, part # AP1602 (replacement board only, see item 35 for complete kit)

Item	Category	Critical Spare Part (Qty)	Recommended Spare Part (Qty)	Manufacturer	GASGUARD® Part #	Description
35	Heater Board	0	1	VERSUM MATERIALS	**459769**	Heater Control Board Kit (includes AP1602 board & cables to add customer input/output alarm function)
54	Display	0	1	VERSUM MATERIALS	**457266**	Epoxy Coated LED Light Bar

BSGS eV / BULKGUARD eV Specific Parts

Item	Category	Critical Spare Part (Qty)	Recommended Spare Part (Qty)	Manufacturer	GASGUARD® Part #	Description
100	Power Supply	1	0	Phoenix Contact	**9-688-79-2761**	Power Supply, 24VDC, 2A
101	Heat Trace	1	0	Omega Engineering	**183573**	Thermocouple, (for heat trace)
102	Heat Trace	0	1	Delta Therm	**481533**	Heat Trace, 240VAC, 12W/ft
103	SSR	1	0	Crydom	**483908**	Solid State Relay, 25A, 3-32VDC input.
104	SSR	1	0	Crydom	**483909**	Solid State Relay, 55A, 3-32VDC input.
105	Relay	1	0	ABB	**483910**	Relay, 50A, 24VDC coil
106	Relay	1	0	Potter Brumfield	**466815**	Relay, 30A, 24VDC Coil
107	Fuse	2	0	Bussman	**180021**	Fuse, 2A (GMC-2-R)
108	Fuse	2	0	Bussman	**484286**	Fuse, 500mA (GMC-500-R)
109	Solenoid	1	0	VERSUM MATERIALS	**483799**	AP11 10V Solenoid Bank, High Density
110	Solenoid	1	0	VERSUM MATERIALS	**483800**	AP11 6V Solenoid Bank, High Density
111	UVIR	0	1	Honeywell	**809-609122**	UVIR Fire Detector

Appendix C

PED Assessment

PED Assessment

in accordance with the Pressure Equipment Directive 97/23/EC

Versum Materials, Inc., Kanaalweg 15, P.O. Box 3193, 3502 GD Utrecht, Netherlands

Equipment Description: **GASGUARD® UHP Delivery Systems**

Fluid state:	All
Fluid group:	All
Design Pressure:	All
Piping nominal size (DN):	Less than DN25 [Less than one inch nominal diameter]
Classification according to Table 7:	SEP

This equipment has been classified as SEP in accordance with Article 3, Section 1.3 of the Pressure Equipment Directive 97/23/EC on the basis that all components contained herein are less than DN25. The equipment has been designed and manufactured following 'Sound Engineering Practice' and Versum Materials' Engineering Standards. Instructions for its safe use and installation are documented in the accompanying Operation and Installation Manual.

Appendix D

Pre-Facilitation Checklist

This document provides an installation review checklist for proper connections, utilities, and system requirements. This will assure the BSGS eV / BULKGUARD® eV 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 installation.

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 from the customer site and re-schedule the facilitation activity, or the team may wait onsite until the system is ready for facilitation. Either option may result in additional cost impact to the customer.

Definitions

BSGeV – BSGS eV or BULKGUARD® eV

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 BSGeV 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 BSGeV installation. Since there are many configurations and source arrangements, this section shall serve to show the site-specific information for this BSGeV installation. Check the boxes and fill in the quantity of each equipment module for this BSGeV installation. Please include Versum Materials Commodity Code Numbers and Serial Numbers for each piece of equipment.

BSGS eV / BULKGUARD® eV 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 =)

Purifier ☐ (Qty =)

Purge Module ☐ (Qty =)

1. **Visual Inspection and General Condition**	**Initial / Date**	**N/A or Task Responsibility**	**VERSUM 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 BSGeV area is available. No other work is being performed in the area.			

2. Mechanical Installation	Initial / Date	N/A or Task Responsibility	VERSUM FSS Initial / Date
A. All BSGeV equipment properly mounted and installed. Record Physical Layout drawing number & revision. Dwg # ________________, Rev. ___.			
B. All BSGeV piping has been verified as accurate against the BSGeV Mechanical 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. ___.			
D. Verify VCR locks or Glyptol installed where required.			
E. 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.			
F. All source container pneumatic tubing is installed and have been verified as accurate against the installation drawing.			
G. 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. ___.			
H. Verify vacuum venturi / utility pneumatic N2 lines installed, leak tested, and 85-95 psig of nitrogen available.			
I. Verify Z-purge installed & labeled and that fittings are tight. Verify 85-95 psig of pneumatic nitrogen is available.			
J. 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. ___.			
K. Verify internal piping is helium leak tested.			
L. Verify restrictive flow orifice installed (if applicable).			
M. Verify heat trace is installed (if applicable) on BSGeV process lines from source equipment to inlet.			
N. Verify heat trace on process houseline from BSGeV outlet to Fab is installed (if applicable) and tested.			

3. **Purge System**	**Initial / Date**	**N/A or Task Responsibility**	**VERSUM 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 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 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 BSGeV 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 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 BSGeV 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**	Inboard ($x10^{-9}$) / Outboard ($x10^{-6}$)	**Initial / Date**	**N/A or Task Responsibility**	**VERSUM FSS Initial / Date**
A. Interconnecting Piping	______________			
B. BSGeV 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 FSS Initial / Date
Date / Time	____ / ____			
Temperature (°F)	________			
Inlet Pressure (psig)	________			
Outlet Pressure (psig)	________			

	H_2O / O_2	Initial / Date	N/A or Task Responsibility	VERSUM FSS Initial / Date
A. Baseline (ppb)	____ / ____			
B. Final Readings (ppb)	____ / ____			

This BSGS eV / BULKGUARD® eV 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 E

Startup and Commissioning Checklist

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.

Definitions

BSGeV – BSGS eV / BULKGUARD eV
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 BSGeV is properly installed, commissioned, and functionally tested. All tasks identified in this document must be completed prior to the BSGeV 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:**	
BSGeV Model Number:		**Side "A" Source(s):**	
BSGeV Serial Number:		**Side "B" Source(s):**	
Commodity Description:			

1. Pre-Facilitation Checklist Review and Visual Inspection

		Initials or N/A	Date
A.	Review the Pre-Facilitation Checklist (Appendix D) 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 BSGeV installation. Review the Pre-Facilitation Checklist and verify each equipment module is identified and the 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 BSGeV 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 BSGeV 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 BSGeV 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

Item	Description	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. Confirm balancing damper on cabinet is closed if using exhaust ducts. Record Exhaust Duct Field Piping installation drawing number and revision. Dwg # ______________, Rev. ___. Verify exhaust flow tell tails are installed.		
C.	Customer Life Safety System (LSS) I/O for BSGeV 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.	Complete the VERSUM MATERIALS, INC. Operational Readiness 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

Item	Description	Initials or N/A	Date
A.	Obtain copy of BSGeV Elementary Wiring Diagram used to manufacture this BSGeV. 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 BSGeV 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 BSGeV equipment is installed within an electrically rated Hazardous / Classified area, list the Hazardous Classification of the area: Class: ___, Division: ___, Group: ___. List each piece of BSGeV 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 BSGeV.

M. Verify seating of fuses, ribbon cables, etc. before applying any power.

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. Verify incoming power wiring is the proper size and rating and it is labeled and terminated correctly. Ground conductors must be terminated to ground terminal block. 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 BSGeV, verify that the electrical contractor has increased the feeder conductor size to ensure less than 3% voltage drop at the BSGeV 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:______VAC, L2-1 to GND:______VAC, Freq:______Hz

Control Power if dual power feed (fed from: ______________________________________)

1111 to 1121:______VAC, 1111 to GND:______VAC, 1121 to GND:______VAC, 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. ___. BSGeV: _______ Ohms

V.	Perform & record the 500 VDC Megger Test of heaters. Ensure power to the system is de-energized and locked out prior to performing Megger Tests. Open the power distribution junction box located below the JT heater (if installed). J-T Heater: Wire # 2022 – Gnd: _______ Ohms, Heat Trace: Wire # 2061 - Gnd: _______ Ohms		
W.	Perform & record the Resistance of heating elements. JT Heater: Wire # 2022 – Wire # 2033:_______ Ohms Source A Heat Trace: Wire # 2061 – Wire # 2072:_______ Ohms Source B Heat Trace: Wire # 2061 – Wire # 2111:_______ Ohms Panel Heat Trace: Wire # 2061 – Wire # 2151:_______ Ohms		
X.	Obtain a copy of the City Inspection (or applicable Authority Having Jurisdiction – AHJ) from the Customer/Electrical Contractor.		
Y.	Verify all required safety approvals /checks (SL1) are complete and signed off, energize incoming Control Power to BSGEV 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.**		
Z.	Test and record incoming power feeds at BSGeV Main Circuit Breaker CB-102 and adjacent terminal blocks if control power fed separately. **Heater Power** (fed from: ____) L1-1 to L2-1:______VAC, L1-1 to GND:______VAC, L2-1 to GND:______VAC, Freq:______Hz **Control Power** if dual power feed (fed from: ____) 1111 to 1121:______VAC, 1111 to GND:______VAC, 1121 to GND:______VAC, Freq:______Hz		
AA.	Place **CB-102 and CB-106** in the Closed / On position. Verify that the 24VDC Power Supply PS-106 is now energized and has an output of 24.1VDC (+/-0.05V). Verify 24VDC is present between ECC wires 4051 and 1072. Record PS-106 output voltage: ______ VDC.		
BB.	Open AP11 controller door and turn on both power switches.		
CC.	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: ____________________________________.		
DD.	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 #:_______________		
EE.	Verify the AP controller touch panel display is in good condition.		
FF.	Verify the AP controller touch panel is calibrated correctly and functions.		
GG.	Verify that the **“Emergency Stop”** Shutdown alarm can be cleared. Verify CR-202 (optional) is 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. - "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. With the controller door open, locate the optional Right Panel I/O board in the bottom left side of the AP11 enclosure. On the board, locate SW1 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 #21: SW1-1 must be set to ON, only if this input has been enabled in the software. Digital Input #22: SW1-2 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. - "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. 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. - "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. 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. In the analog setpoints screen, confirm/record the JT heater control setpoint _______°C

The normal operating setpoint for the JT Heater is 70°C (Kel-F valve seats) or 85 °C (Vespel valve seats)

G. In the analog setpoints screen, set/record the Heat trace control setpoints

Source A Heat Trace _______°C

Source B Heat Trace _______°C

Panel Heat Trace _______°C

The default setpoint for heat trace is 40°C and should be set at least 5°C above the source heater temperature.

H. In the analog setpoints screen, confirm the JT Heater temperature alarm setpoints:

Low-Low (control setpoint minus 20°C): ______°C

Low (control setpoint minus 10°C): ______°C

High (control setpoint plus 10°C): ______°C

High-High (control setpoint plus 15°C): ______°C

I. In the analog setpoints screen, confirm the Heat Trace temperature alarm setpoints for all three heat trace zones.

	Source A	Source B	Panel
Low-Low (control setpoint minus 15°C):	______°C	______°C	______°C
Low (control setpoint minus 10°C):	______°C	______°C	______°C
High (control setpoint plus 10°C):	______°C	______°C	______°C
High-High (control setpoint plus 15°C):	______°C	______°C	______°C

J. Place CB-202 and GFP-102 into the CLOSED/ON position.

K. Verify the JT Process Gas Heater #1 is properly connected & functioning by observing the temperature displayed on the AP11 controller. It should reach it's setpoint and stabilize within 5 minutes at no flow.

Record the temperature once it stabilizes. _______°C

L. Place a Clamp-On Ammeter on the JT Process Gas Heater #1 power wiring (wire # 2022) and record the current of the JT Process Gas Heater. Note: This may be easiest to access in the junction box below the JT heater. Read peak current. Current will either 0 Amps or full current as the heater cycles.

JT Process Gas Heater full-load current: ______ Amps.

JT Process Gas Heater ground current: ______ Amps. (Ground wire to junction box)

M. Trip GFP-102 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.

N.	Place CB-206 into the CLOSED/ON position. Verify that the Heat Trace is properly connected & functioning by observing the temperature displayed on the AP11 controller. All 3 zones should reach their setpoint and stabilize within 15 minutes at no flow.		
O.	Place a Clamp-On Ammeter on the Source A Heat Trace power wiring (wire # 2072) and record the current of the Heat Trace. Source A Heat Trace full-load current: ______ Amps.		
P.	Place a Clamp-On Ammeter on the Source B Heat Trace power wiring (wire # 2111) and record the current of the Heat Trace. Source B Heat Trace full-load current: ______ Amps.		
Q.	Place a Clamp-On Ammeter on the Panel Heat Trace power wiring (wire # 2151) and record the current of the Heat Trace. Panel Heat Trace full-load current: ______ Amps.		
R.	Place a Clamp-On Ammeter on the ground wire going to the heater power junction box. Heater ground current: ______ Amps.		
S.	Once the heat trace temperature stabilizes, record the temperatures: Source A Heat Trace Temperature _______°C Source B Heat Trace Temperature _______°C Panel Heat Trace Temperature _______°C		
T.	Trip GFP-102 using the Push-to-Test button on the circuit breaker and verify loss of voltage to the Heat Trace circuits. Reset circuit breaker.		
U.	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.		
V.	**(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.		
W.	**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.		
X.	**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		
Y.	**UV/IR Flame Detector Relay (UVIR-17) Panel**: 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 optional JT Heater contactor CR-202 is 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 ____.		

Z. **UV/IR Flame Detector Relay (UVIR-15) Source A-1**: 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 optional JT Heater contactor CR-202 is 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 ____________________.		
AA. **UV/IR Flame Detector Relay (UVIR-18) Source A-2**: 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 optional JT Heater contactor CR-202 is 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-16) Source B-1**: 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 optional JT Heater contactor CR-202 is 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-19) Source B-2**: 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 optional JT Heater contactor CR-202 is 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. **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.)		
EE. **Excess Flow Switch Side A:** Verify that the "**EXCESS FLOW"** Shutdown alarm activates on the AP controller when the excess flow switch is tripped (3 sec time delay is used). Reset the excess flow switch and verify that the alarm can be cleared. Record the Excess Flow Switch Trip Setting: _______ scfh		
FF. **Excess Flow Switch Side B:** Verify that the "**EXCESS FLOW"** Shutdown alarm activates on the AP controller when the excess flow switch is tripped (3 sec time delay is used). Reset the excess flow switch and verify that the alarm can be cleared. Record the Excess Flow Switch Trip Setting: _______ scfh		
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 BSGEV. 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 optional JT Heater contactor is 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-A1 Remote Shutdown (Customer Remote Shutdown) Signal**: Verify that the **"REMOTE SHUTDOWN A1"** 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-A2 Remote Shutdown (Customer Remote Shutdown) Signal**: Verify that the **"REMOTE SHUTDOWN A2"** 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-26 on the alarm matrix.

LL. **Source-B1 Remote Shutdown (Customer Remote Shutdown) Signal**: Verify that the **"REMOTE SHUTDOWN B1"** 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.

MM. **Source-B2 Remote Shutdown (Customer Remote Shutdown) Signal**: Verify that the **"REMOTE SHUTDOWN B2"** 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-28 on the alarm matrix.

NN. **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.

OO. **Source A1 Heater Fault (UA-8A1)**: Verify that the **"SOURCE A1 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.

PP. **Source A2 Heater Fault (UA-8A2)**: Verify that the **"SOURCE A2 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-25 on the alarm matrix.

QQ. **Source B1 Heater Fault (UA-8B1)**: Verify that the **"SOURCE B1 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.

RR. **Source B2 Heater Fault (UA-8B2)**: Verify that the **"SOURCE B2 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-27 on the alarm matrix.

SS. 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 Common 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 board AP1563 (24 VDC @ 1 Amp maximum)

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

TT.	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.		
UU.	Verify the GASGUARD® Monitoring Network wiring is installed and terminated on both ends. Verify site network matrix is updated with this BSGeV equipment.		
VV.	Verify the BSGeV is configured on the host network computer system. Ensure that the network communications mode is set to Ethernet and appropriate channel numbers and IP address are set.		
WW.	Verify AP controller Screen Saver Delay is set to 35 minutes.		
XX.	Verify AP controller Key Press Feedback is set to Enabled.		
YY.	Verify the site network matrix is updated with this BSGeV equipment.		
ZZ.	Verify Password Protected Reset is Enabled or Disabled, per Customer's site requirements.		
AAA.	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
BSGeV Source Pressure						
1. PT-1A1						
2. PT-1A2						
3. PT-1B1						
4. PT-1B2						
BSGeV Interstage Pressure						
1. PT-10A						
2. PT-10B						
BSGeV Regulated Pressure						
1. PT-2A						
2. PT-2B						
Houseline Delivery Pressure						
1. PT-9						
Delivery Purge and Vacuum Pressure						
1. PT-4A						
2. PT-5A						
3. PT-5B						
Exhaust Flow						
1. FT-1						
Source Weight Scales						
1. WT-1A1						
2. WT-1A2						
3. WT-1B1						
4. WT-1B2						

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 BSGeV 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 2x2_______ 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 personnel.		
C.	Copy (hard or soft) of this document shall be given to Customer / local Versum. 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 BSGS eV / BULKGUARD eV 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)
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8)
9)
10)

Appendix F

Operational Readiness Inspection Checklist

Rev	ITEM #	BSGS eV / BULKGUARD eV 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 bulk cabinets or delivery racks containing source containers with a combined internal volume greater than 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 Flow Check**					
	A00.01	Flow check against P&ID's performed.					
	A00.02	Reconcile any differences identified by flow checking.					
	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.					
	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.					

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	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 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					

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	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.					
	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)					

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	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)**					
	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**					

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	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.					
	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.					
Rev	ITEM #	BSGS eV / BULKGUARD eV ORI ACTION ITEM	TIMING REQ'T	STATUS	RESPON-SIBLE PERSON	DATE COMPL'D	CLOSEOUT STATEMENT / ACTIONS REQUIRED FOR

							CLOSEOUT/ COMMENTS
	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 #**	**BSGS eV / BULKGUARD eV ORI ACTION ITEM**	**TIMING REQ'T**	**STATUS**	**RESPON-SIBLE PERSON**	**DATE COMPL'D**	**CLOSEOUT STATEMENT / ACTIONS REQUIRED FOR CLOSEOUT/ COMMENTS**

Rev	ITEM #	BSGS eV / BULKGUARD eV 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 a 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 are complete.					
	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 transition from construction site to 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 startup of any unit.					

	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 startup of any unit.					
	C02.02	Verify documentation exists to confirm all Mandatory Before Start-up hazard review recommendations have been closed 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					

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	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**					
	G01	**Establishment of a Mechanical Integrity Program**					
	G01.01	For Versum 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 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 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 required					

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							COMMENTS
	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.					

Appendix G

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.

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.

1.8 Testing/Maintenance of the SS4-A/-A2 Flame Detector

1.8.1 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.

1.8.2 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.

Appendix H

USB Barcode Reader

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

USB Barcode Feature

Note: All AP11 controllers 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. 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.

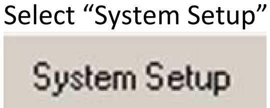
Before connecting the USB Barcode Reader device, the Technician must be aware of the equipment to ensure no gas safety alarm and flammable atmosphere are present.

Enabling the Barcode

How to enable barcode feature:

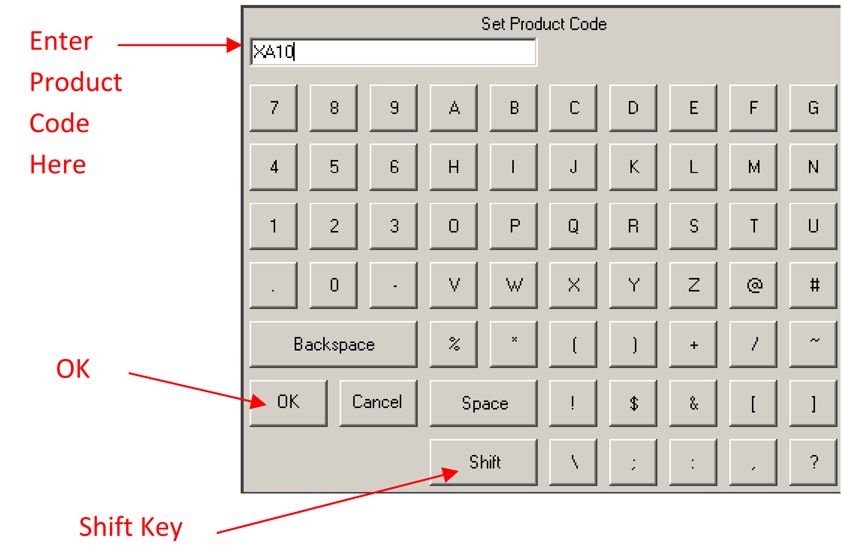
1) From the Configuration Menu:

   a. Log-in to controller.
   b. Select “Configuration Menu”.
   c. Select “System Setup”.



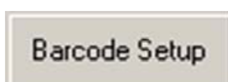
   d. Select “Set Product Code” from the System Setup menu.

   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.

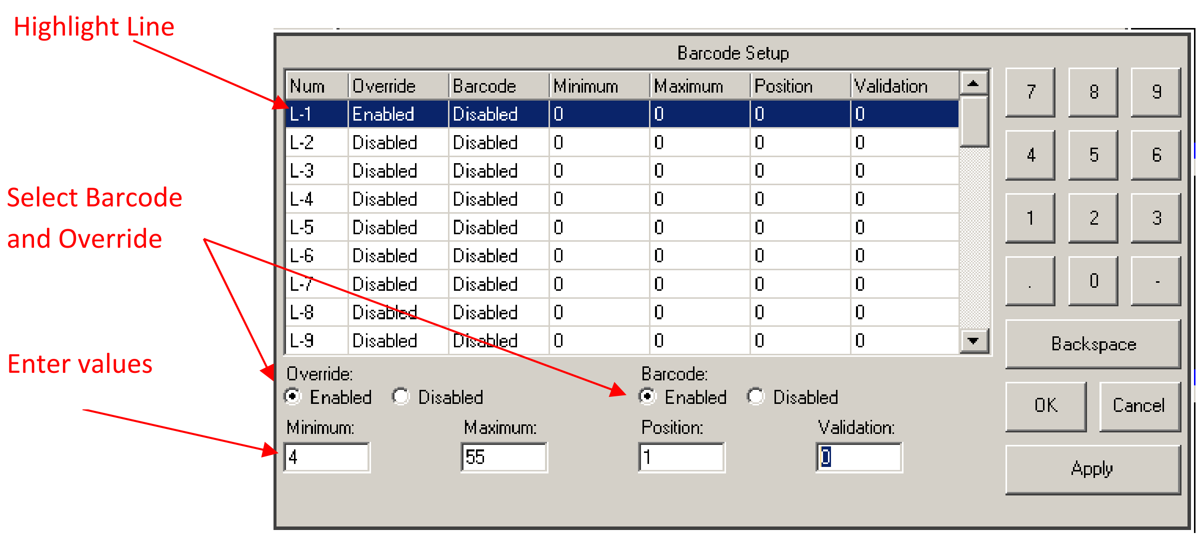


Note: Barcode strings are case sensitive. Be sure to use the proper case when entering letters. The case can be toggled between uppercase and lowercase by pressing the shift key.

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 XA10 in the following:
ABC346XA10ZZ123 starting position is 7.
XA10ABC346ZZ123 starting position is 1.

m) Enter the validation code:
  i) “0” – No other restrictions. The only check is to verify that barcode contains the product code.
  ii) “1” – In addition to verifying the product code, this validation method verifies that the Barcode is not the same any previously installed cylinder.
  iii) “2” – In addition to verifying the product code, this validation method verifies that the Barcode is not the same as the most recently installed cylinder on that process side.
  iv) “3” – This selection should not be used. This option causes the system to ignore the barcode command. It is only used in development testing.
n) Enter “Apply” if editing multiple barcode lines and return to step g).
o) Enter “Ok” when complete.

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) Remove USB port blocker (if present)
2) Plug the USB barcode reader into the system Controller USB port.
3) System is ready for scanning the cylinder barcode label.
4) Always scan the barcode label on the cyclinder before removing and/or opening the cylinder cap or valves.
5) After the barcode is scaned and confirmed, disconect USB Barcode Reader device before resuming the cylinder change sequence.
6) Replace USB port blocker if removed in step 1.

How to disable the barcode feature:

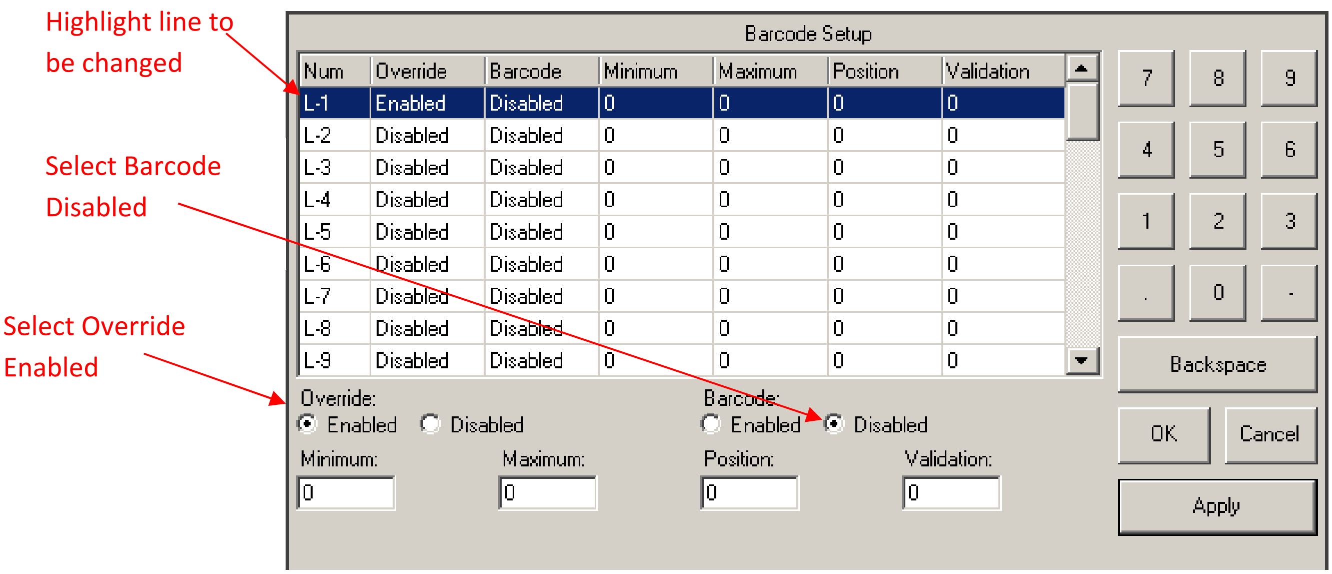
a. Highlight the input line.

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



Appendix I

Y-Cylinder Heaters Description

Use of the Gen II or Compact Y-Cylinder Heater with a BSGS eV / BULKGUARD eV 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 BSGS eV / BULKGUARD eV.

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.