VERSUM MATERIALS

Installation / Operation / Maintenance Manual

BSH eV

Bulk Source Heater eV

Edition: Rev- 0

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Revision Control Summary

Chapter	Revision	File Name
Chapter 1 – Safety	Rev-0	MNL000620.doc
• Initial Release		
Chapter 2 – Installation	Rev-0	MNL000609.doc
• Initial Release		
Chapter 3 – System Description	Rev-0	MNL000610.doc
• Initial Release		
Chapter 4 – Operation	Rev-0	MNL000611.doc
• Initial Release		
Chapter 5 – Troubleshooting	Rev-0	MNL000612.doc
• Initial Release		
Chapter 6 – Maintenance	Rev-0	MNL000613.doc
• Initial Release		
Chapter 7 – Drawings	Rev-0	MNL000614.doc
• Initial Release		
Chapter 8 – Spare Parts	Rev-0	MNL000615.doc
• Initial Release		
Chapter 9 – Facilitation and Startup Checklist	Rev-0	MNL000616.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, will result in death or serious injury.

⚠ WARNING

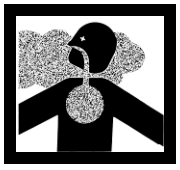
Indicates a potentially hazardous situation, which if not avoided, could result in death or serious injury.

⚠ CAUTION

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

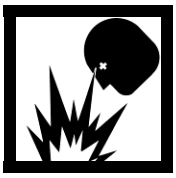
1.1.2 Hazard Types (Symbols)

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.

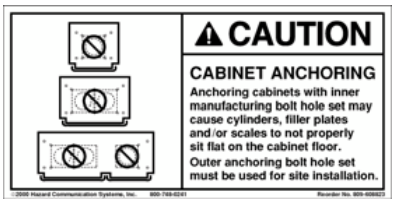
This symbol represents flammable gases. Gases used with the GASGUARD® can cause flammable atmospheres.

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 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

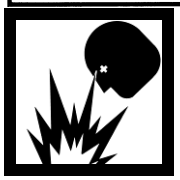
⚠WARNING

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

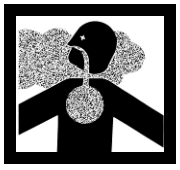


Do not use this device in any manner other than specified in this manual.

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:

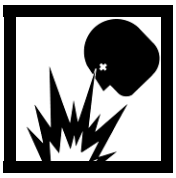
- Rapid breathing
- Nausea
- Vomiting
- Inability to move
- Convulsive movements
- Collapse
- Abnormal pulse
- Rapid fatigue
- Faulty judgment
- Insensitivity to pain
- Abnormal emotions

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 (7+ 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.

Power circuits for the system use up to 240 VAC. 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 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.

Live electrical work and dead checks following lock out tagout require use of electrical PPE. Electrical PPE shall be rated to provide protection for the available incident energy at the cabinet being worked on. Only qualified and electrically trained personnel should perform this work. Onsite and Versum Materials procedures must be followed.

1.8 Ergonomic Hazard

Lifting during installation of heating blanket may result in injury or strain. Avoid unnecessary bending and use proper tools and methods as described in chapter 4.

1.9 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

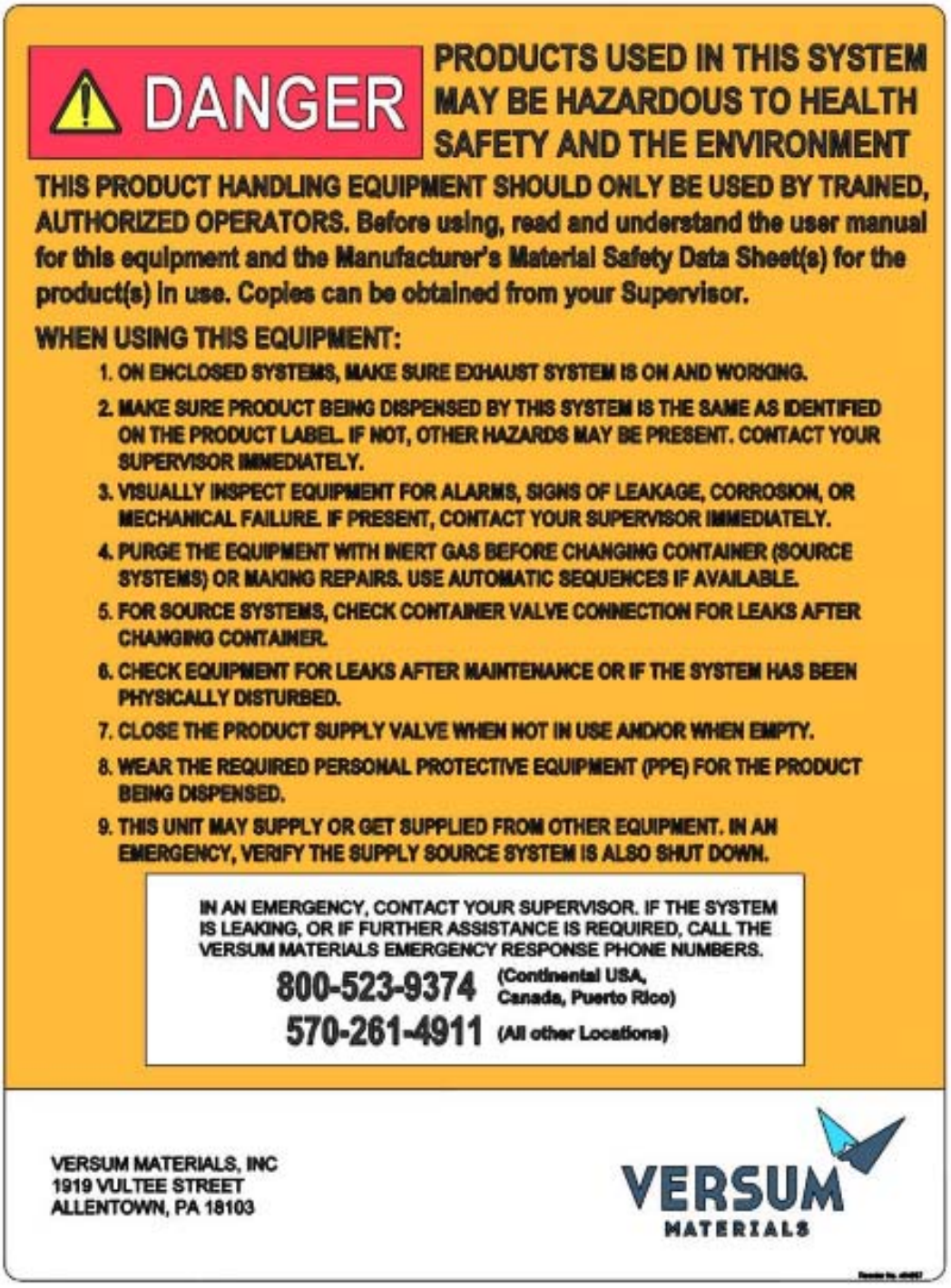
All equipment shall be locked or tagged out to protect against accidental or inadvertent operating when such operation could cause injury to personnel. Do not attempt to operate any switch, valve or other energy isolating device where it is locked or tagged.

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)

1.10 Safety Signs and Labels

The following sign is located on the interior of the BSH eV cabinet below ECC-2.

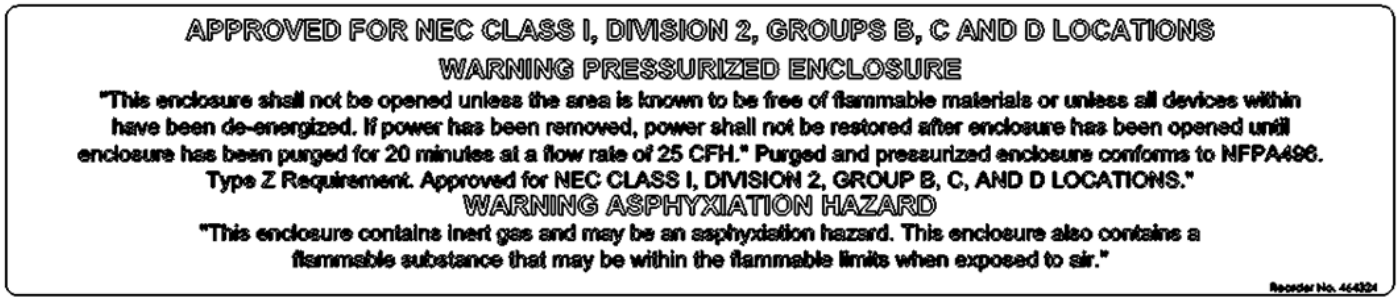


The following labels are located inside the GASGUARD® AP11 controller on guards covering areas with hazardous voltage. Do not remove guards without locking out electrical power.

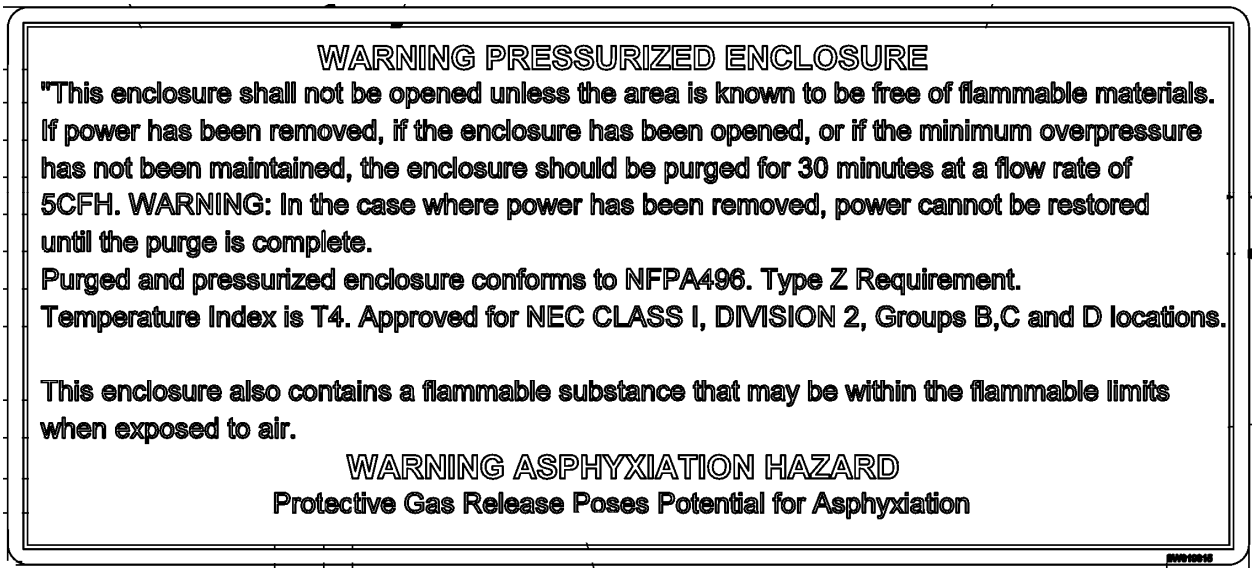
The following label is located on the front of the GASGUARD® AP11 controller adjacent to the USB port. Do not connect to the USB port unless the area is known free of flammable material.

The following label is placed on the bottom of ECC-1 and ECC-2 adjacent to the pressure relief valve.

The following label is located on the GASGUARD® AP11 controller. This label is required if the GASGUARD® BSH eV System is located in a Class I, Division II rated area (United States) or in a Group 2, Category 3 ATEX rated area (Europe).



The following label is located on the front of ECC-1 and ECC-2. This label is required if the GASGUARD® BSH eV System is located in a Class I, Division II rated area (United States) or in a Group 2, Category 3 ATEX rated area (Europe).



The following labels appear on the doors of ECC-1, ECC-2, J-Box-1, and J-Box-2. They indicate that there is hazardous voltage inside that may result arc flash. Do not open door without locking out electrical power or wearing appropriate electrical PPE.

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

The following label located on the floor of the cabinet.

The following label is located on the inside of the cabinet below ECC-1.

1.11 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.
- 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 stop all heating.
- 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.

1.12 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 BSH eV module and Y-cylinder/drum heater blankets are shipped in large wooden crates. When crates are 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 BSH eV module and Y-cylinder/drum heater blankets are shipped inside large boxes designed to protect the units from minor shipping damage. Extreme care should be taken in handling the large BSH eV 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 BSH eV module is 400 lbs (180 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 damage.
- The doors of the AP11 controller, ECC, and junction box 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.

- BSH eV module drawings included in Chapter 7 of this manual.
- 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. BSH 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 BSH 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 ECC located inside 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:

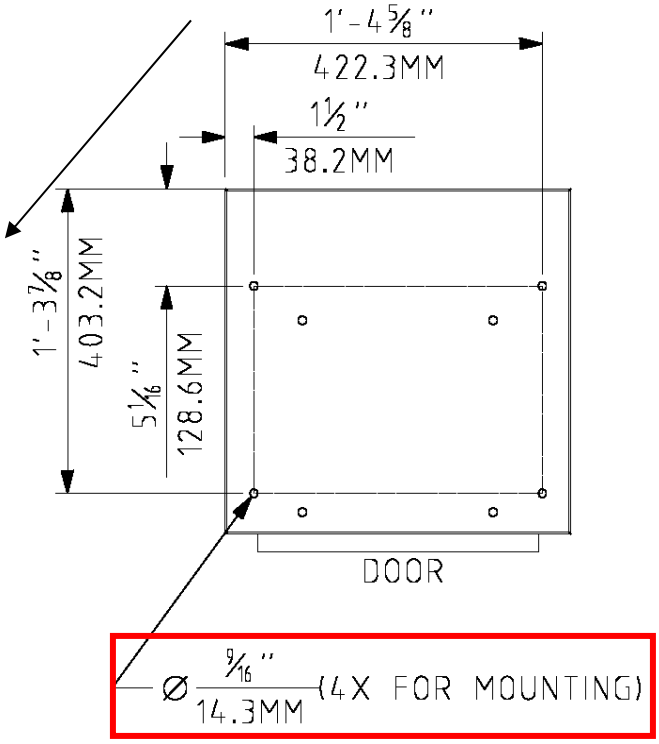


Figure 2-1: Rack Mounting Hole Locations in Floor

6. Four 1/2 inch, Kwik Bolt-II stainless steel anchors, without special inspection, and an anchor depth of 4 inches, in 3,000 psi concrete will meet the requirements for seismic loading as specified in SEMI S2.

7. There shall be no obstructions in front of any access covers.

8. Final equipment layout and mounting locations are the responsibility of the owner.

9. If the painted surfaces of the enclosure cabinets are nicked or scratched during handling and installation, they must be painted to prevent rust from forming. Touch up paint is not provided with the equipment. Touch up paint must be purchased from a local paint supplier. The Paint Specification is included in Chapter 3 - Module Specifications.

4.0 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. BSH 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 installation drawings that are in Chapter 7.

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.

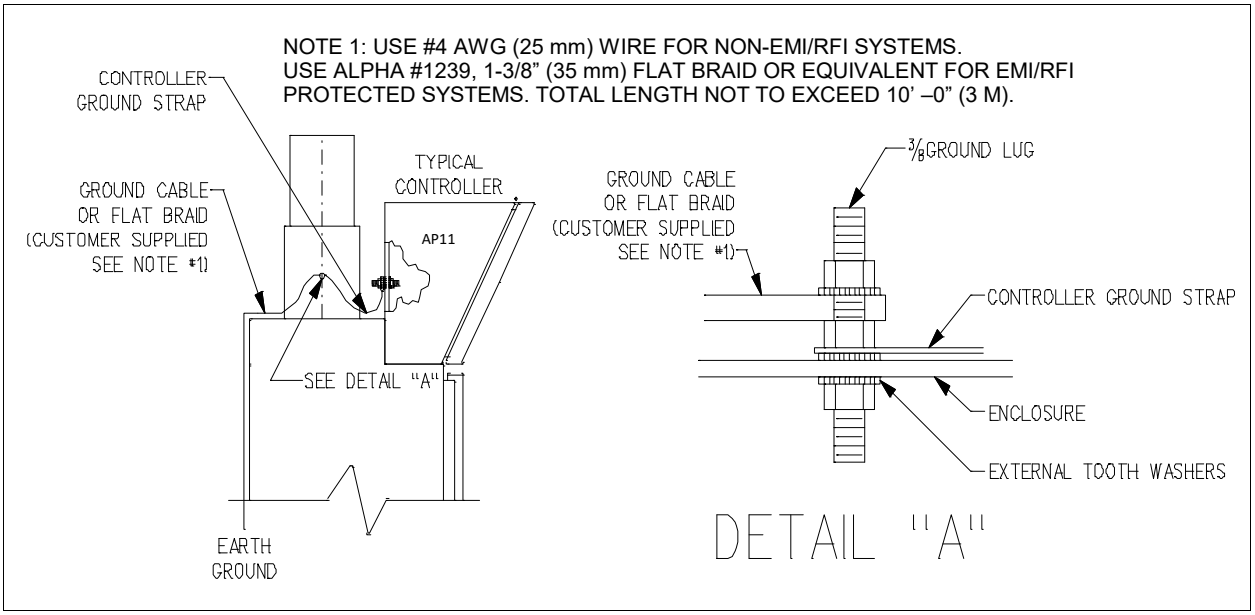


Figure 2-2: Suggested Grounding Method

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

BSH eV modules are equipped an AP11 controller and either one or two ECC's located within the equipment rack. Details of the termination points are shown in the electrical installation drawing, Chapter 7 of this manual.

Each BSH eV system should be installed with independent external circuit interrupting devices to remove power from the unit when maintenance on the controller is required and should be Lockout/Tagout capable. The disconnects for the heater power feed(s) should be rated as a minimum at 240 volts, 50 amps, 50/60 Hz and 100,000 rms symmetrical ampere interrupting capacity. The disconnect for the control power feed should be rated as a minimum at 240 volts, 3 amps, 50/60 Hz and 10,000 rms symmetrical ampere interrupting capacity. The device should be accessible to the operators, marked as the disconnecting device for the heater, 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: AP11 Controller (recommend connecting to Critical power with UPS backup)
100-240 VAC @ 150 VA maximum, 50/60Hz, 3 wire

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

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

Power Requirements: Single ECC/Blanket (Recommend connecting to normal power, no UPS backup)
208-240 VAC, 38 Full Load Amps, 50/60Hz, 3 wire

Power Requirements: Dual ECC/Blankets (Recommend connecting to normal power, no UPS backup)
Qty-2 - 208-240 VAC, 38 Full Load Amps, 50/60Hz, 3 wire

Acceptable wire gauge:
ECC Power: 6-3 AWG
ECC GND: 10-6 AWG
Controller Power/GND: 14-12 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-100, located in the ECC at the incoming AC power, is a 50A Class J time lag fuse.
FS-104, located prior to the PS-104 DC power supply, is a 5A Class CC fast acting fuse.
FS-1041, located immediate after the PS-104 DC power supply, is a 2A Type GMC fuse.
See the Spare Parts List in Chapter 8 for Manufacturer and part numbers and specifications.

Field Connections

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 2-3 and 2-4 for details.

NOTE: For Systems approved for installation and use in Explosive Atmospheres (Europe), refer to section 5 of this chapter for additional instructions.

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

A 1-1/8" (28.6 mm) diameter hole for 3/4" conduit is supplied for connecting the 120/240 VAC power supply to the system. The conduit hole is located on the top of the controller enclosure. Two additional holes are supplied for customer I/O and/or Ethernet Cable. See Figures 2-3 and 2-3a.

Figure 2-3: Top View of GASGUARD® AP11 Controller

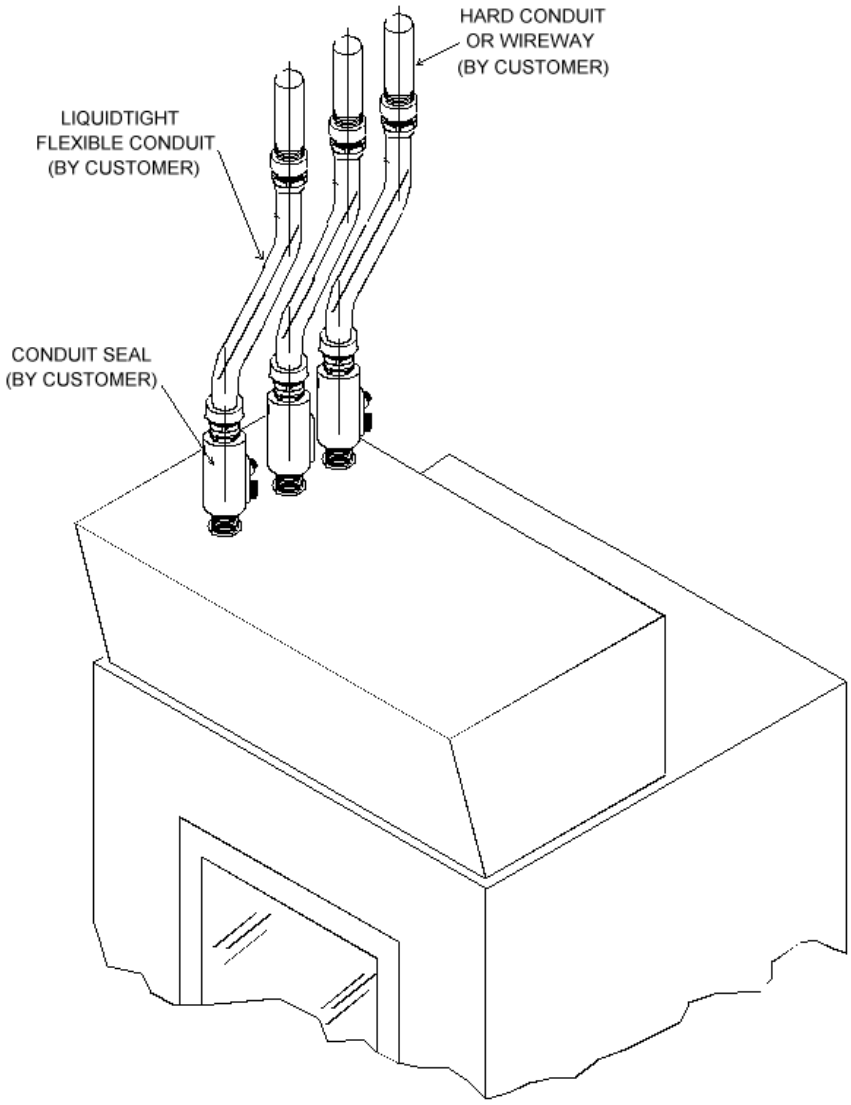


Figure 2-3a: Conduit and Conduit Seals

Each ECC is supplied with a ¾ NPT conduit fitting for connection to heater power inlets as shown in Figure 2-4.

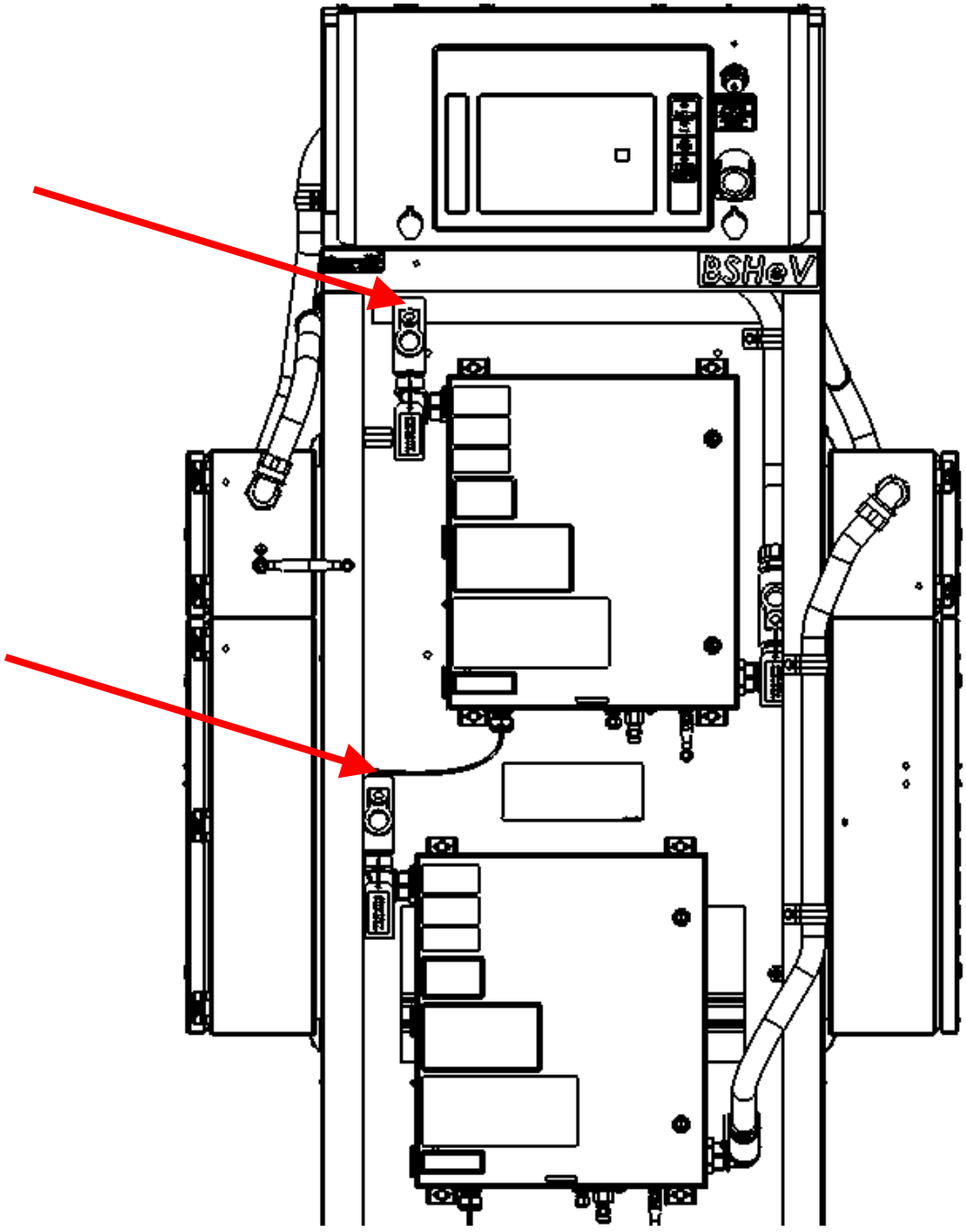


Figure 2-4: Heater Power Conduit connections

Field Signal Connections

In the AP11 controller on the BSH eV module, all field I/O wiring connections are made to the AP1580 customer I/O board located inside the left wall of the AP11 enclosure.

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 2-5 shows the general locations of these connections. Details of these terminal blocks and termination points are shown in the electrical installation drawing.

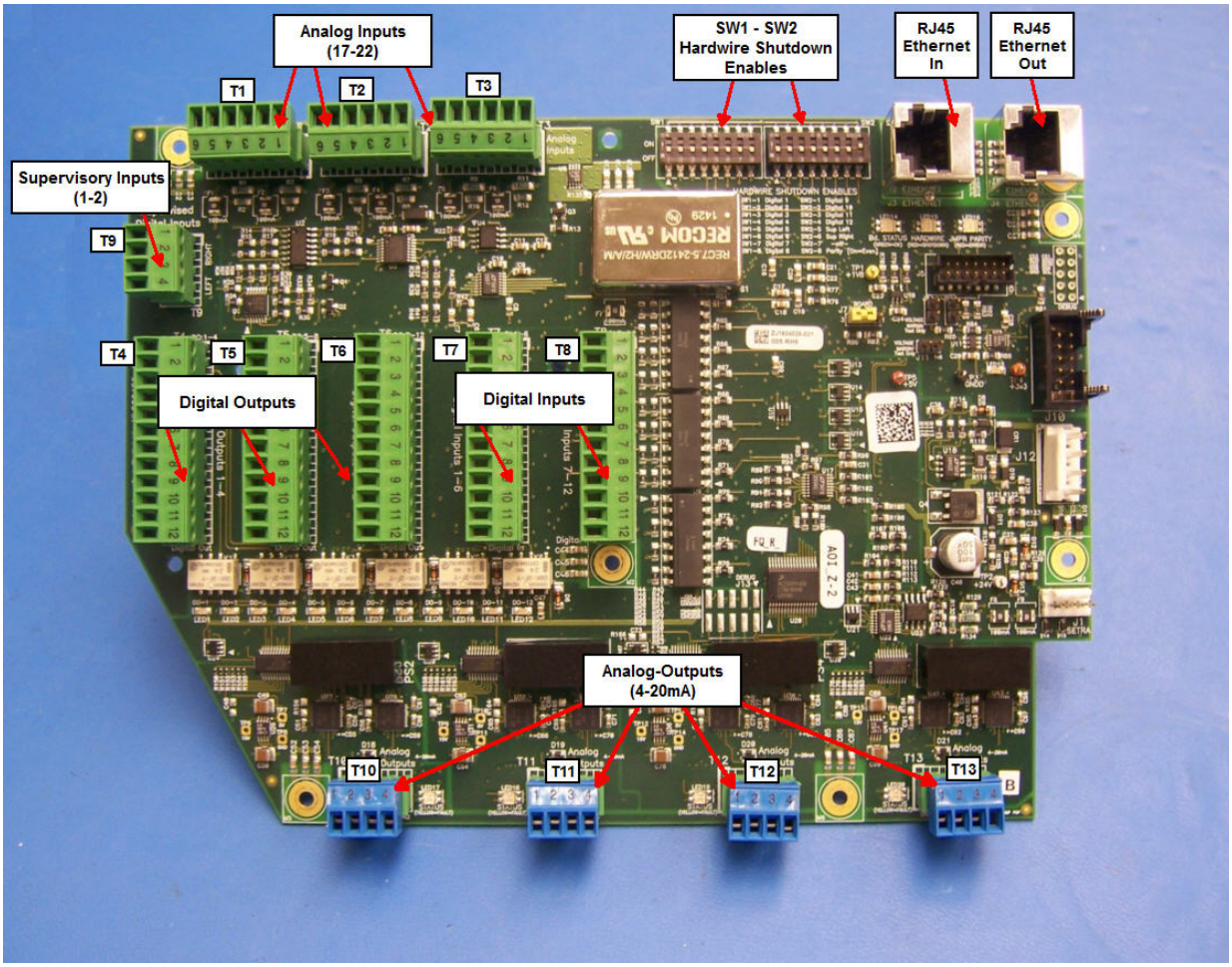


Figure 2-5: AP1580 Customer I/O Terminal Blocks

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.

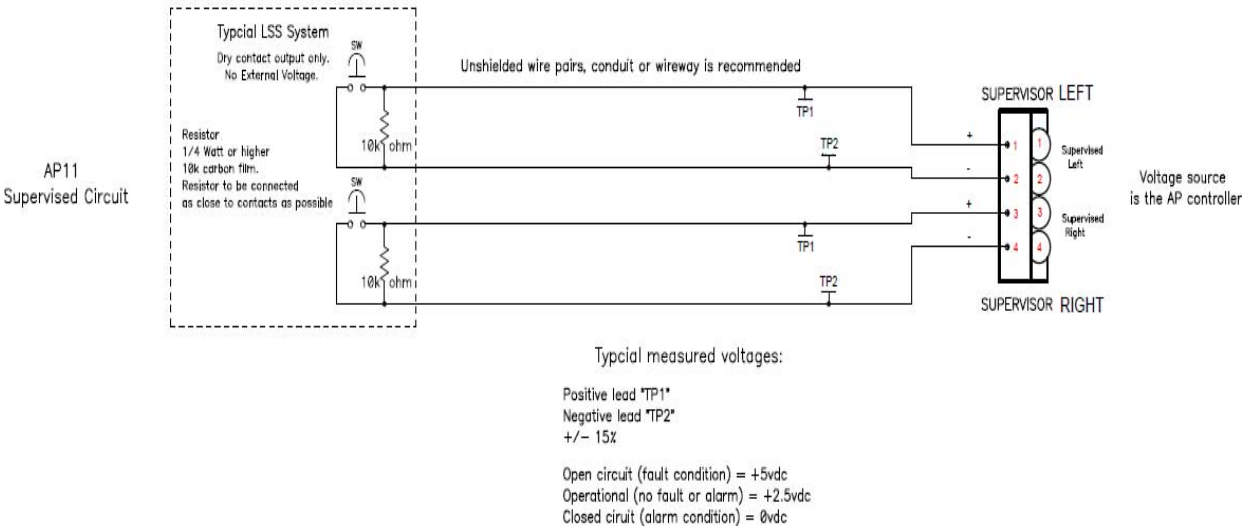


Figure 2-6: Supervisory Input Wiring

Available External I/O Communications

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 AP1580

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	T6-4	T6-5	T6-6
11	T6-7	T6-8	T6-9
12	T6-10	T6-11	T6-12

Digital Inputs (Customer)

(Customer I/O board AP1580)

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

* Each digital-input can be individually configured to provide a hardwire shutdown alarm function. 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 Outputs (Customer)

(AP1580 Customer I/O board)

Analog Output #	Customer Brd Signal (+)	Customer Brd Rtn (-)
1	T10 - 1	T10 - 2
2	T10 - 3	T10 - 4
3	T11 - 1	T11 - 2
4	T11 - 3	T11 - 4
5	T12 - 1	T12 - 2
6	T12 - 3	T12 - 4
7	T13 - 1	T13 - 2
8	T13 - 3	T13 - 4

Analog Inputs (Customer)

(AP1580 Customer I/O board)

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

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

User Power (Customer)
(AP1580 Customer I/O board)

The AP11 customer board supports six Analog-Input (AI) channels, each of which can be independently configured for **0-5V** or **4-20mA** inputs. Three user-connections (per channel) are provided: +24V-power, +24V-gnd, and signal. A common isolated power-supply is used for all channels. However, each channel's power is individually fused/current-limited. The combined power-supply loading of all channels must be less than **200mA**. In some configurations, it may be possible to exceed this limit. It is the 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 2-7 below. (AP11 connections are shown on the left)

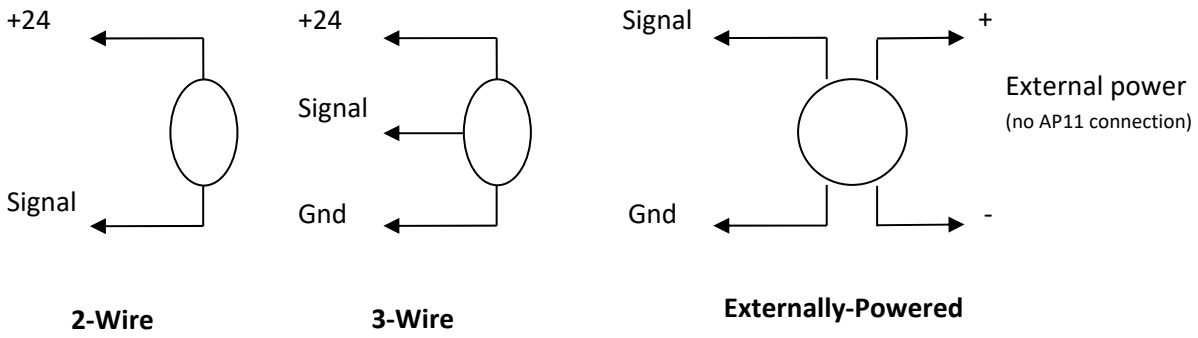


Figure 2-7

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

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

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

There are two calculations that must be performed when connecting Analog devices to an AP11.

1. The total current-consumption calculation of AP11-powered devices
2. The cable-resistance calculation for each device connection

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

Current-Consumption Calculations for AP11-powered devices:

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

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

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

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

EXAMPLE:

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

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

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

Cable-Resistance Calculation:

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

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

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

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

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

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

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

EXAMPLE:

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

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

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

(actual) = 10.54 ohms

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

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

The current draw and minimum operating voltage of the device should be included on the manufacturer's data sheet. The voltage seen by the device is reduced by the resistance of the cable going to the device and by a 100-ohm resistor within the AP11. Calculations to determine the maximum cable resistance are shown in Figure 2-8 below:

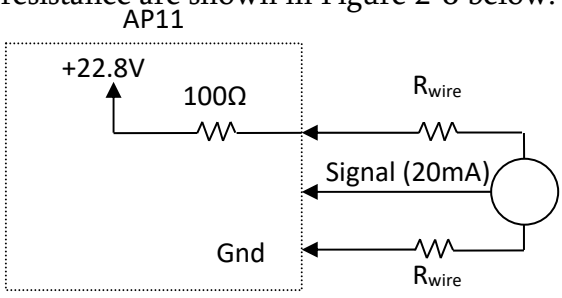


Figure 2-8

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.

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

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

(actual) = 10.54 ohms

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

On BSH eV modules, jumper J7 is factory set as shown in Figure 2-9 for the Customer I/O board.

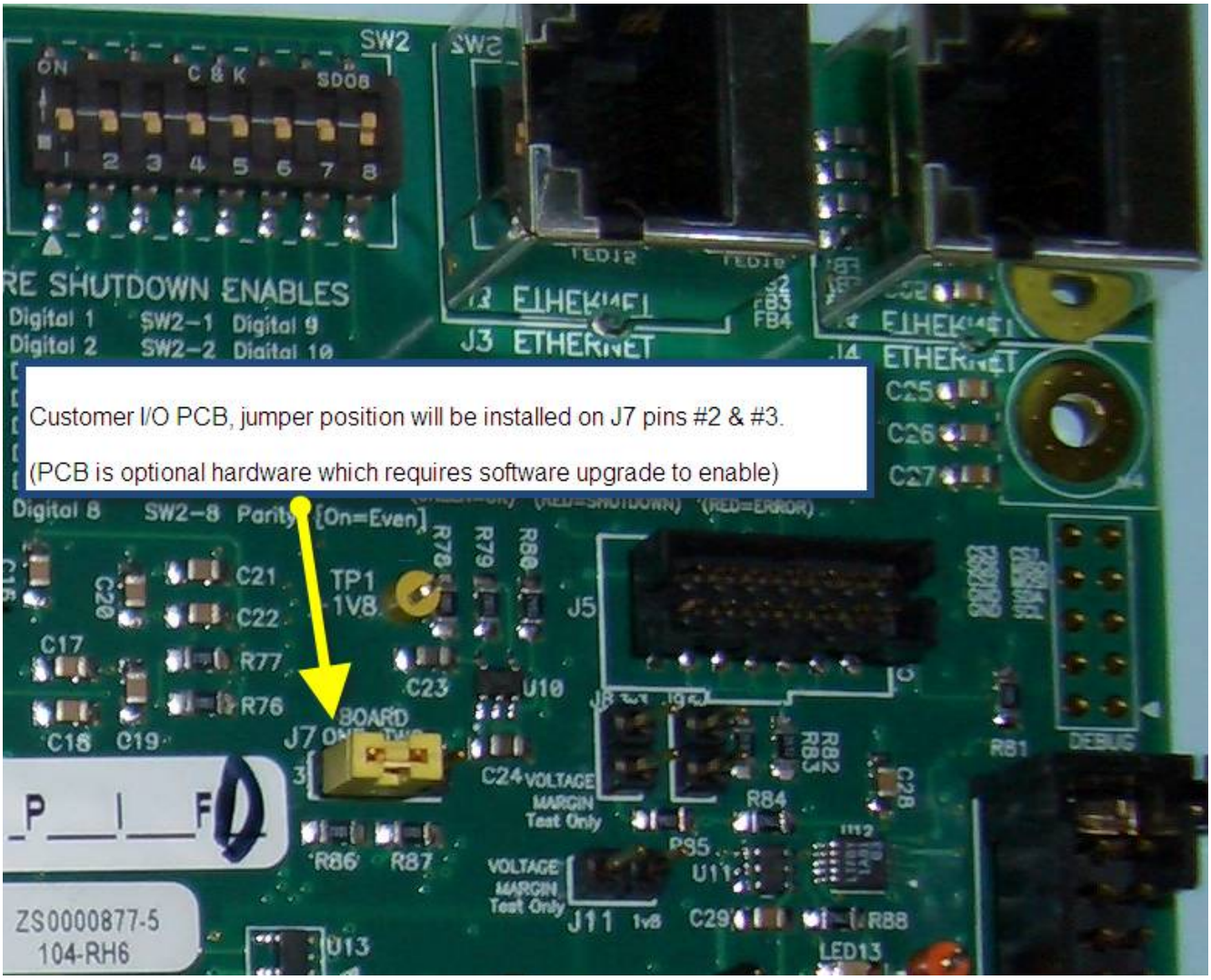


Figure 2-9: GASGUARD® AP11 Customer board "J7" jumper configuration.

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 2-10) 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 2-11

Figure 2-10: USB Port Warning Label

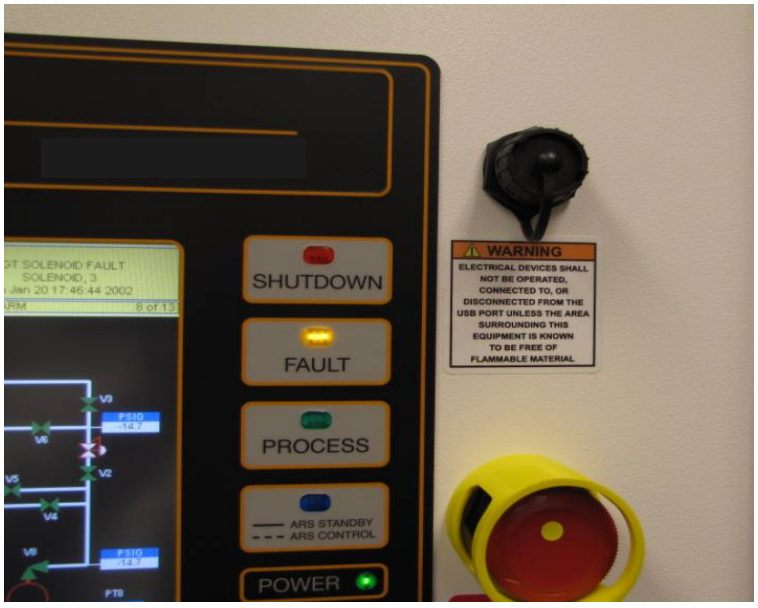


Figure 2-11: AP11 Controller USB Port on the Face of the Controller

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%

⚠CAUTION

To prevent overpressurization of enclosure, do not exceed 100psig.

Pneumatic Connections

The AP11 controller requires a pneumatic supply for Z-purge and pneumatic master solenoid 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. If compressed air is used as the pneumatic source, the compressor shall be located in a non-classified area. If the air intake line for the compressor passes through a classified location, the line shall be made of a non-combustible material designed to prevent leakage and protect against mechanical damage. If electrical power for the purge air is required, this power shall be on a separate disconnect or before the BSH system disconnects.

Z-purge is enabled on all BSH eV module controllers because a clean, dry nitrogen purge will promote controller longevity and guard against water intrusion when installed outdoors.

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 components.

In NEC Class I, Division 2 applications (in U.S.A.) and in ATEX Zone (Group) 2, Category 3 (in Europe) this supply is also used for Type Z purge of the electrical enclosure. The Type Z purge is required to maintain a positive pressure at or above 0.1" H_2O (24.9 Pa) as dictated by the National Fire Protection Agency (NFPA) and the European directives (ATEX). In applications where Type Z purge is required, the controller will be equipped with a pressure switch to monitor the pressure.

The ECC is also equipped with Z-purge capability with the same purge gas recommendations.

For the AP11 controller:

The Type Z purge will require a flow rate of up to 7 LPM (15 CFH).
Do not exceed 7 LPM (15 CFH) during purge of the AP11.

A 1/4" Swagelok® connection at the back of the controller is provided for the pneumatic supply inlet connection as shown in Figure 2-12. Piping for the pneumatic supply must be protected from mechanical damage. Maximum allowable working pressure is 100 psig (6.9 barg). Over-pressurization protection, such as a safety relief valve, must be provided for the protection of internal components.

For the ECC:

The Type Z purge will require a flow rate of up to 2.4 LPM (5 CFH).

A 1/4" Swagelok® connection at the bottom of the controller is provided for the pneumatic supply inlet connection as shown in Figure 2-13. Piping for the pneumatic supply must be protected from mechanical damage. Maximum allowable working pressure is 100 psig (6.9 barg). Over-pressurization protection, such as a safety relief valve, must be provided to prevent overpressurization of the enclosure.

AP11 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 or ECC to purge for 20 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. BSH eV will require 7 LPM (15CFH). Flowrates should be monitored during Type Z purge. Do not exceed 7 LPM (15 CFH) during purge of BSH eV.

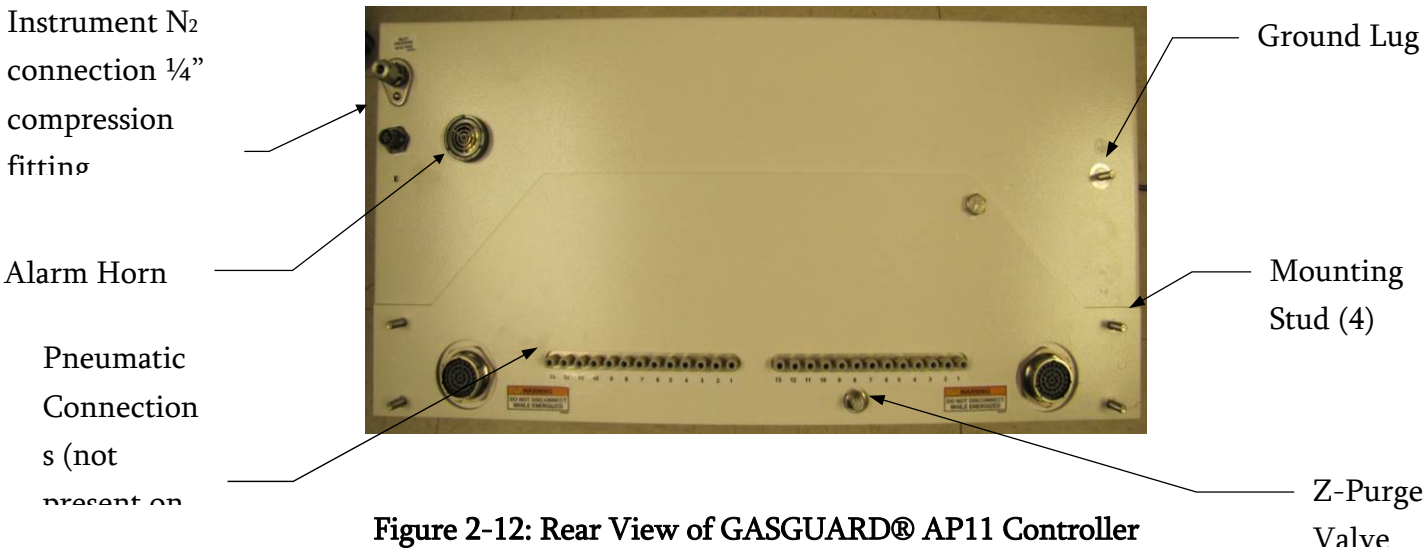


Figure 2-12: Rear View of GASGUARD® AP11 Controller

ECC Z-Purge Procedure

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

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

Flow during purge will reach 2.4 LPM (5 CFH). Flow requirements to satisfy Z-Purge are typically very low and is dependent on the tightness of the individual controller and the installation.

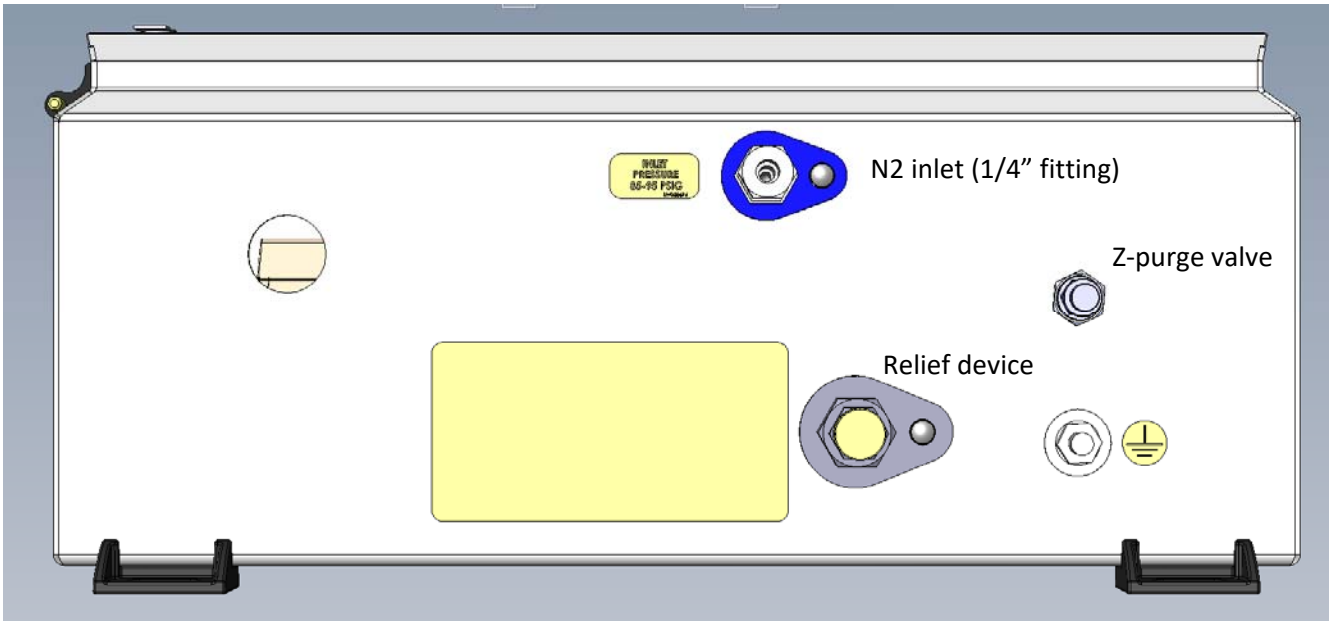


Figure 2-13: Underside View of BSH eV ECC

GASGUARD® Networking

General Description

Remote monitoring of GASGUARD® systems such as the BSH 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 2-14 shows the location of the Ethernet connection on the AP11 carrier board.

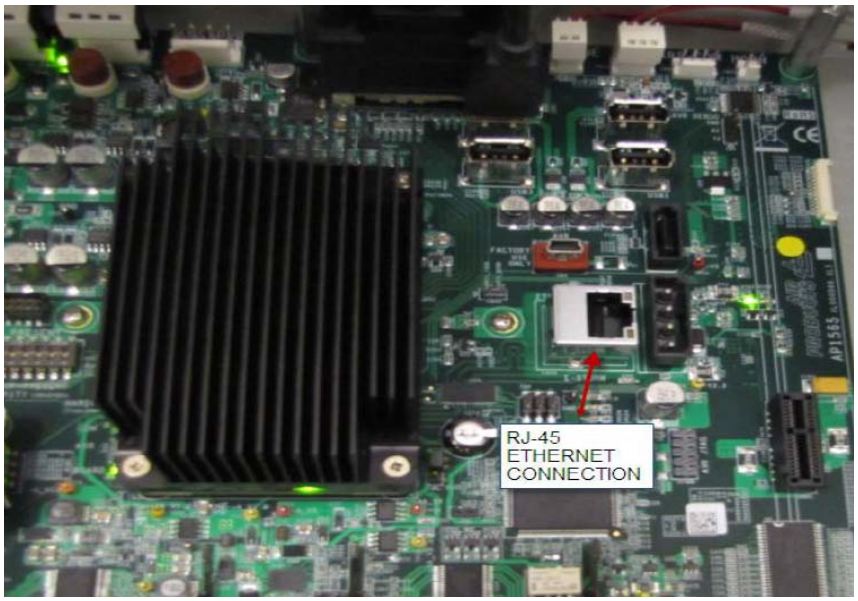


Figure 2-14: AP11 carrier board Ethernet connection

GCS Ethernet Network Wiring Configuration

A GCS is typically integrated into the site's Ethernet network. Figure 2-15 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.

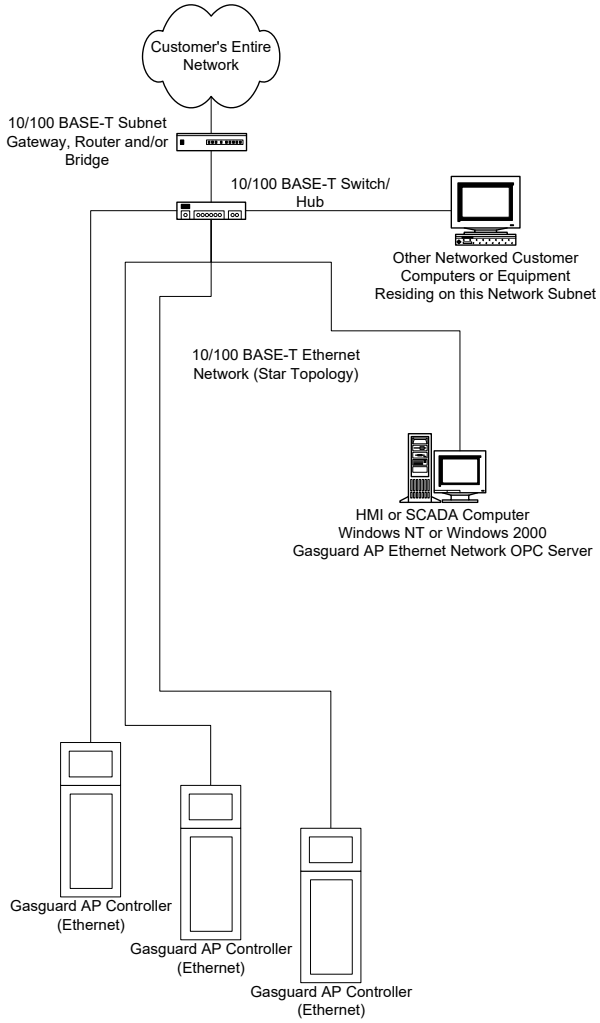


Figure 2-15 Typical GCS Network Architecture

Startup and Commissioning Checklist

A BSH eV Startup and Commissioning Checklist is provided in Chapter 9 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.

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.

5.0 Explosive Atmosphere (ATEX) Installations

BSH eV modules that have the label shown in Figure 2-16 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.

BSH 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.

Figure 2-16: BSH eV ATEX Label

5.1 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 “nA” for non-arcing.
- 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.

5.2 Special Conditions for Safe Use

- **Environmental Limits**
  - BSH eV controllers are intended for outdoor installation out of direct sunlight and precipitation. 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 Chapter 4 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 AP11 controller enclosure ensure that there is no danger of explosion in the atmosphere and wait at least 20 minutes after the power has been removed.
  - Before turning the power supply ON, be sure to close the ECC 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

System Description

⚠ WARNING

This equipment is not intended for use by the general public. Only personnel trained in GASGUARD® BSH eV operation and the hazards associated with this equipment should operate and maintain this equipment.

1.0 System Specifications and Components

The overall system consists of the BSH eV module and up to Y-cylinder/drum heater blankets. Other equipment may be present in a complete bulk installation. These could be a bulk delivery system, purge module, purifier, 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.

System Specifications

Physical Characteristics

Module Weight (estimated):	400 lbs. (180 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: 18 in (457 mm) Sides: 24 in (610 mm)
Anchoring:	(Qty 4) 9/16” (14.3 mm) mounting holes

Range of Environmental Conditions

- -20 to 60ºC operating temperature range
- 95% maximum relative humidity
- 2000 meters above sea level, maximum

Paint Specification

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.

BSH eV Module

Module Configurations

The GASGUARD® BSH eV is configurable by two option sets:

- Number/type of sources (single or dual)
- Source container type (Y-cylinder or drum) – determines the type of insulation blanket provided

The following provides more details about each option set:

Sources:

Single Source (SS) – One process gas container, either a Y cylinder or a drum

Dual Source (DS) - Two process gas containers, either 2 Y cylinders or 2 drums

Source Container Types:

Y-cylinder – A container with an internal volume of ~448L, more common than drum

Drum – A container with a volume of up to 1100L, normally has a lower pressure rating than a Y-cylinder so typically found only with gases having vapor pressures of less than 300 psig.

Electrical Devices, Customer Digital Inputs, and Digital Outputs

The following is a list of electrical devices that may be present in the BSH 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. Digital output relays provide the customer with a remote indication of system alarm status if the customer chooses to wire to these outputs.

Please see the installation drawings located in Chapter 7 for additional information.

TE-101-1, standard for single source, included with dual source as TE-101-2. This is a thermocouple located within the heater blanket that monitors the temperature of the source container. TE-101 performs multiple functions. They are:

TE-101-1/2 – TALL very low source temperature fault alarm. This fault alarm notifies the operator that container temperature is very low. This may indicate the liquid has been sub-cooled by an unusually high withdrawal rate or low ambient temperature, a tripped GFCB, failed SSR, or incorrect temperature controller setpoint. This alarm is user-configurable.

TE-101-1/2 – TAL low source temperature fault alarm. This fault alarm notifies the operator that container temperature is low. This may indicate the liquid is being sub-cooled by an unusually high withdrawal rate or low ambient temperature, a tripped GFCB, failed SSR, or incorrect temperature controller setpoint. This alarm is user-configurable.

TE-101-1/2 – TAH high source temperature fault alarm. This fault alarm notifies the operator that container temperature is high. This may indicate the ambient temperature is above the setpoint of the cylinder heater, failed SSR, or incorrect temperature controller setpoint. This alarm is user-configurable.

TE-101-1/2 – TAHH very high source temperature fault alarm. This fault alarm notifies the operator that container temperature is very high. This may indicate the cylinder heater has overshot the cylinder heater setpoint, potentially due a recovery from a high flow condition, failed SSR, or incorrect temperature controller setpoint. This alarm is user-configurable.

TE-101-1/2 – TAUT under-temperature fault alarm. This fault alarm notifies the operator that the container temperature is severely low. This may indicate that the TE-101 thermocouple has been wired backwards. This alarm is not user-configurable.

TE-101-1/2 – TAOT over-temperature fault alarm. This fault alarm notifies the operator that the container temperature is severely high. This may indicate that the TE-101 thermocouple has been damaged or the presence of a short. If the alarm is due to an actual, long-duration overtemperature condition, the dedicated high temperature shutdown will automatically shut off power to the heater blanket. This alarm is not user-configurable.

TE-101-1/2 – TATC open thermocouple alarm fault alarm. This fault alarm notifies the operator that the TE-101 thermocouple is not connected to the BSH eV module. This alarm is not user-configurable.

TE-102-1/2 is **Standard** – This is one of two thermocouples located within the electrical heater blanket that is used to monitor the internal temperature of the blanket. The output is monitored on analog input AI51 (blanket #1) or AI52 (blanket #2). The internal blanket temperature inhibit functionality is activated when the TE-102 reading exceeds 48.9C/120F. Limiting the internal blanket temperature below the NFPA 55 51.7C/125F high temperature limit for compressed gas cylinders helps to ensure that no violations of NFPA 55 occur.

TE-102-1/2 – TAUT under-temperature fault alarm. This fault alarm notifies the operator that the container temperature is severely low. This may indicate that the TE-102 thermocouple has been wired backwards. This alarm is not user-configurable.

TE-102-1/2 – TATC open thermocouple alarm fault alarm. This fault alarm notifies the operator that the TE-102 thermocouple is not connected to the BSH eV module. This alarm is not user-configurable.

TE-103-1/2 is **Standard** – This is the second of two thermocouples located within the electrical heater blanket that is used to monitor the internal temperature of the blanket. The output is monitored on analog input AI53 (blanket #1) or AI54 (blanket #2). The internal blanket temperature inhibit functionality is activated when the TE-103 reading exceeds 48.9C/120F. Limiting the internal blanket temperature below the NFPA 55 51.7C/125F high temperature limit for compressed gas cylinders helps to ensure that no violations of NFPA 55 occur.

TE-103-1/2 – TAUT under-temperature fault alarm. This fault alarm notifies the operator that the container temperature is severely low. This may indicate that the TE-103 thermocouple has been wired backwards. This alarm is not user-configurable.

TE-103-1/2 – TATC open thermocouple alarm fault alarm. This fault alarm notifies the operator that the TE-103 thermocouple is not connected to the BSH eV module. This alarm is not user-configurable.

TE-104-1/2 is **Standard** – This is a thermocouple located within the electrical heater blanket that is used as a dedicated overtemperature monitor and shutdown circuit. The thermocouples are monitored by Limit Controller 1 and Limit Controller 2 which are in turn connected to digital inputs DI49 (blanket #1) or DI50 (blanket #2). The overtemperature shutdown is preset by the factory to 51.7C/125F in accordance with NFPA 55 high temperature limit for compressed gas cylinders.

BCM-1 is Standard – This is a current monitoring device that checks the draw from source blanket 1 via CT-100 in ECC-1. If electrical elements within the blanket fail, the blanket will draw less current when all of the electrical elements are in proper working order. A fault alarm will be registered through analog input 17 if the device senses that the normal current draw for the blanket has been impacted.

BCM-2 is Optional – This is a current monitoring device that checks the draw from source blanket 2 via CT-100 in ECC-2. If electrical elements within the blanket fail, the blanket will draw less current when all of the electrical elements are in proper working order. A fault alarm will be registered through analog input 17 if the device senses that the normal current draw for the blanket has been impacted.

AI-56 is **Standard** – This is the analog input assigned to the cylinder 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 "Y-CYL HEATER SET". If the dual heater blanket option is installed, this setpoint will be used for both blankets. This setpoint is user configurable.

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 heater blanket and ECC. This contact is powered to 24 VDC, 3 mA.

UA-2 is **Standard -** It is the customer 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 heater blanket and ECC. 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 power will be turn off to the heater blanket and ECC. This contact is powered to 24 VDC, 3 mA.

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 inch water column. 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 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.

DI-53 is Standard – This is a magnetic switch that detects the position of the J-Box-1 lower door. When the door opens it generates a shutdown alarm for Heater-1. This shutdown is necessary to prevent disconnection of heater power under load.

DI-54 is Optional is a magnetic switch that detects the position of the J-Box-2 lower door. When the door opens it generates a shutdown alarm for Heater-2. This shutdown is necessary to prevent disconnection of heater power under load.

Relay 1; DO9 is **Standard -** It is the Source 1 Heater Fault digital output. This relay changes state when a fault alarm is present associated with source heater 1. This is a dry contact rated for 24 VDC, 1 Amp, and can be wired normally closed or normally open.

Relay 2; DO10 is **Optional -** It is the Source 2 Heater Fault digital output. This relay changes state when a fault alarm is present associated with source heater 2. 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 Source Heater 1 shutdown alarm digital output. This relay changes state when any shutdown alarm is present, in any mode on source heater 1. 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 Source Heater 2 shutdown alarm digital output. This relay changes state when any shutdown alarm is present, in any mode on source heater 2. This is a dry contact rated for 24 VDC, 1 Amp, and can be wired normally closed or normally open.

Relay 13; DO21 is **Standard -** It is the Source Heater 1 inhibit digital output. This relay changes state when TE-102 or TE-103 on source heater blanket 1 are above 48.9C/120F. This is reserved for use by the system.

Relay 14; DO22 is **Optional -** It is the Source Heater 2 inhibit digital output. This relay changes state when TE-102 or TE-103 on source heater blanket 2 are above 48.9C/120F. This is reserved for use by the system.

Relay 16; DO24 is **Standard -** It is the Source Heater 1 limit reset. This relay changes state when the current limiter associated with TE-104 on source heater blanket 1 is being reset after the overtemperature protection has been activated. This is reserved for use by the system.

Relay 17; DO25 is **Optional -** It is the Source Heater 2 limit reset. This relay changes state when the current limiter associated with TE-104 on source heater blanket 2 is being reset after the overtemperature protection has been activated. This is reserved for use by the system.

Mechanical Components

The BSH eV system does not any contain mechanical components that are in contact with process gases.

The system is designed to support the use of Versum Materials Gen II heater blankets. The basic layout of these blankets is shown below in Figure 3-1.

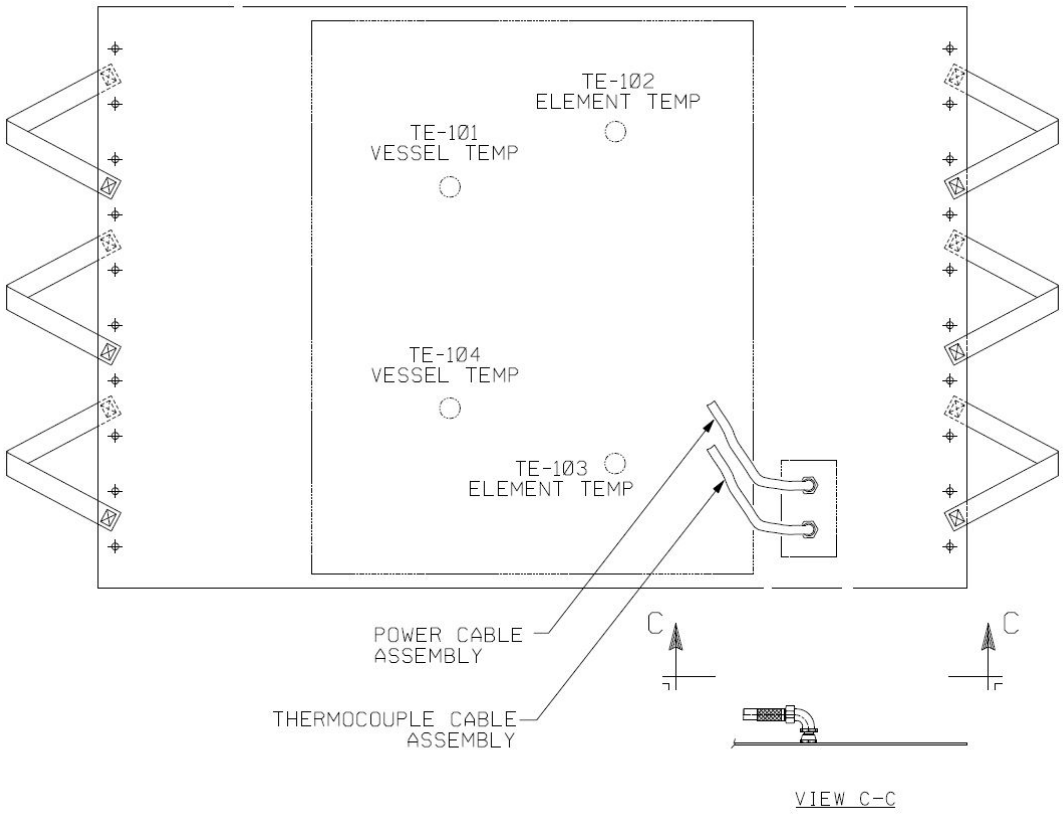


Figure 3-1: Basic layout of Versum Materials Gen II heater blanket

2.0 AP11 Controller

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

The controller screen allows the operator to easily understand the operation and to quickly identify operating problems. The path of gas flow is indicated by an animated dashed line and controller status is displayed in the middle of the top of the screen. Any shutdown alarms are displayed in the SHUTDOWN ALARM box in the top left-hand corner of the screen. Fault alarms are displayed in the FAULT ALARM box in the top right-hand corner of the screen

Figure 3-2. GASGUARD® AP11 Controller

Controller Components

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.

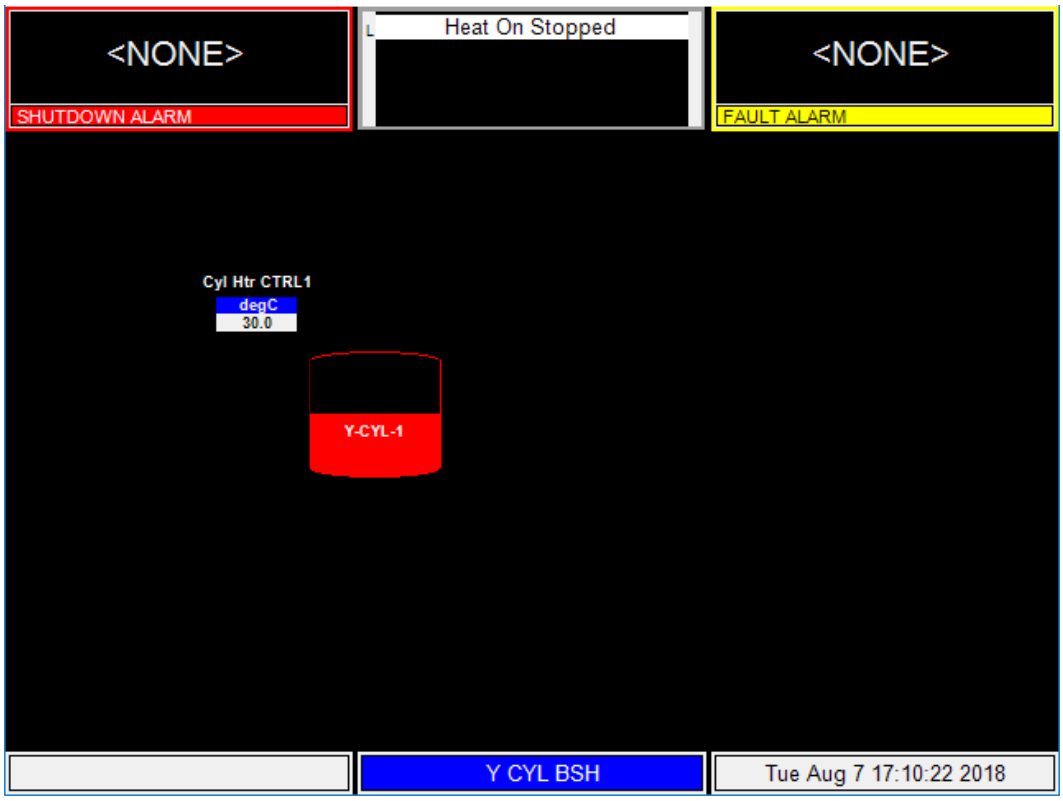


Figure 3-3: BSH eV AP11 Power Up Screen

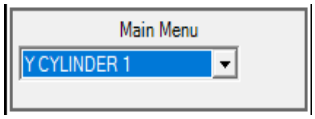
The Main Menu and Cabinet Configuration Selection Window

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 3-4. The Main Menu will remain displayed for a configurable amount of time or until the Logout key is pressed.

Figure 3-4: BSH eV Controller Main Menu

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

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



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

Alarm and Controller Status Boxes

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

The CONTROLLER STATUS box is located in the top center of the screen and displays the current status of the process panel. Refer to Figure 3-5.

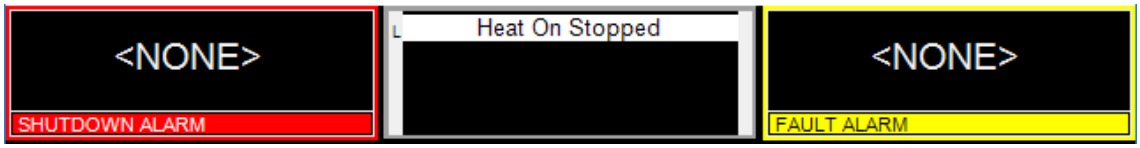


Figure 3-5: Alarm and Controller Status Boxes

System Information

The system information window can be reached by touching the blue title button at the bottom of the screen. This window displays the firmware, network, and configuration information. The user also has the option of testing the shutdown and/or fault alarms as well as cleaning the screen. Refer to Figure 3-6.

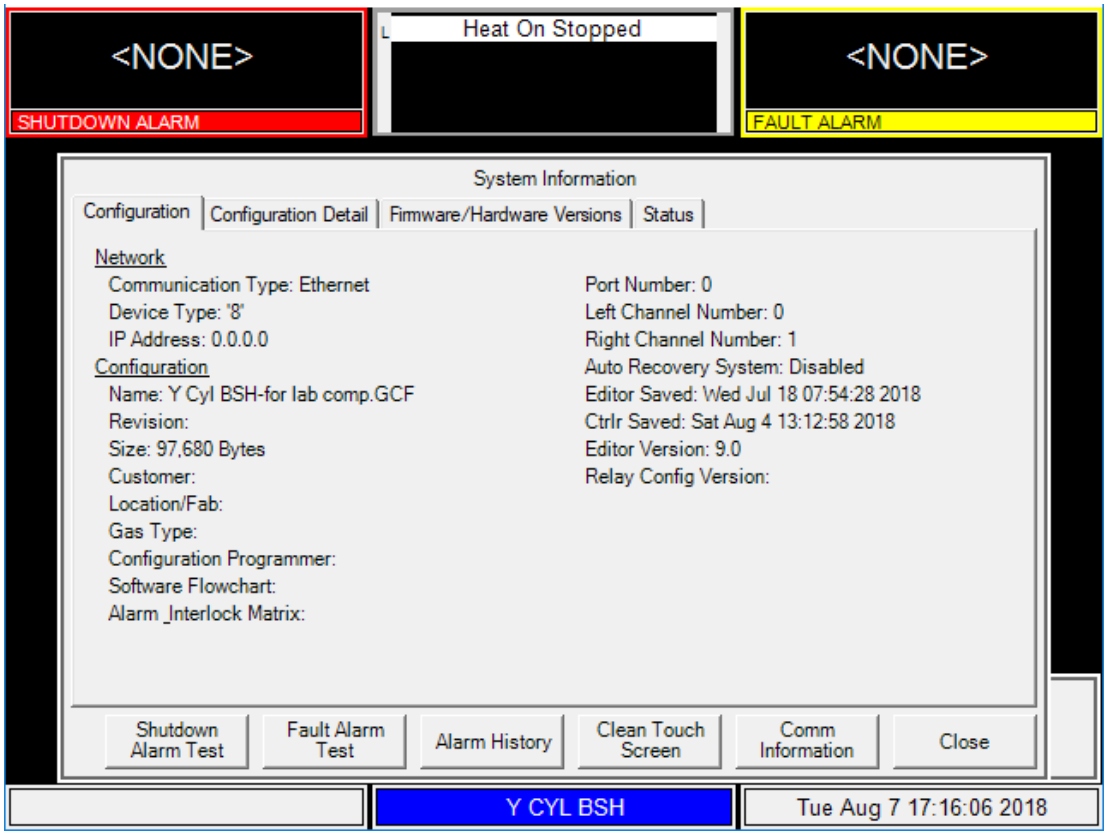


Figure 3-6. System Information Window

LCD Display

The 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 3-2), 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 3-7 for their location.

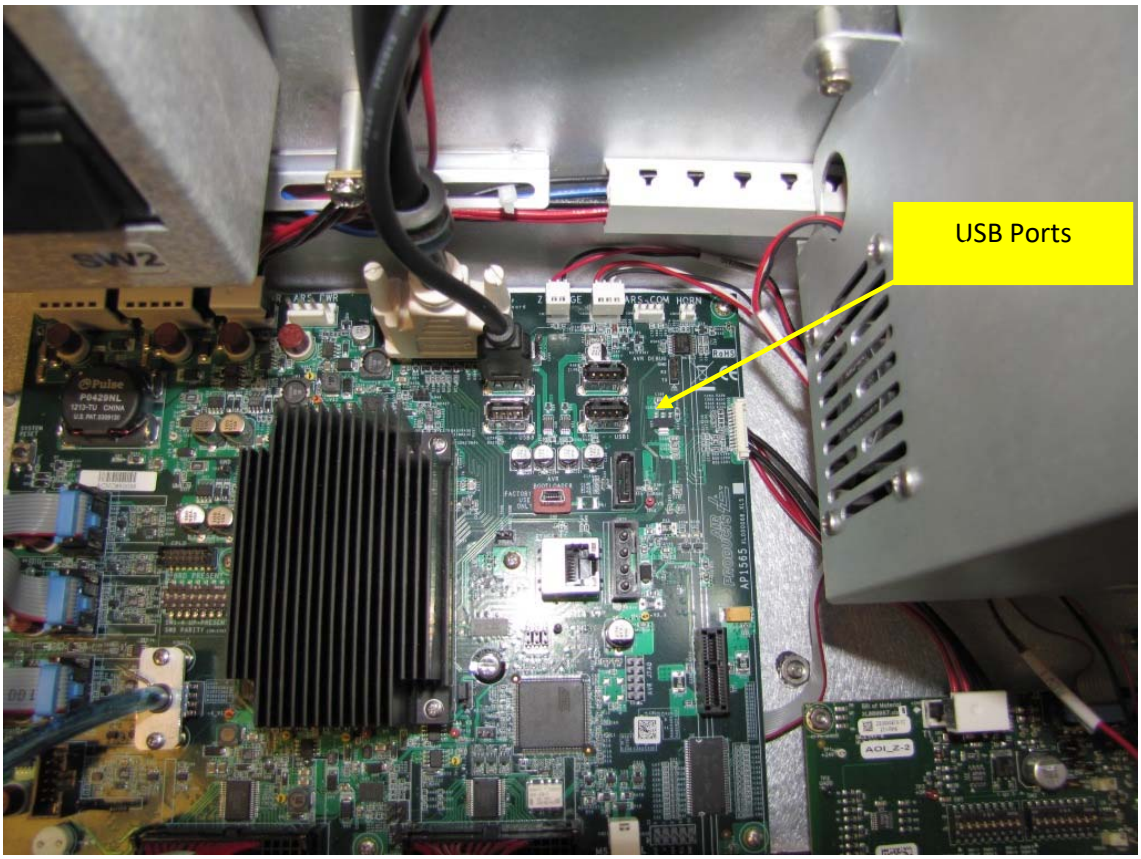


Figure 3-7: USB Ports

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 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 4, 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:

Start Heat On / Stop Heat On

This menu option starts and stops the Y-cylinder heater.

Manual Mode

This menu option does not provide any functionality at this time.

Field I/O Connections

All field digital and analog I/O signals are terminated in the AP11 controller enclosure. Details of I/O terminations are shown in the electrical installation drawing located in Chapter 7.

Figure 3-8 shows where field terminations are made on the AP1580 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.

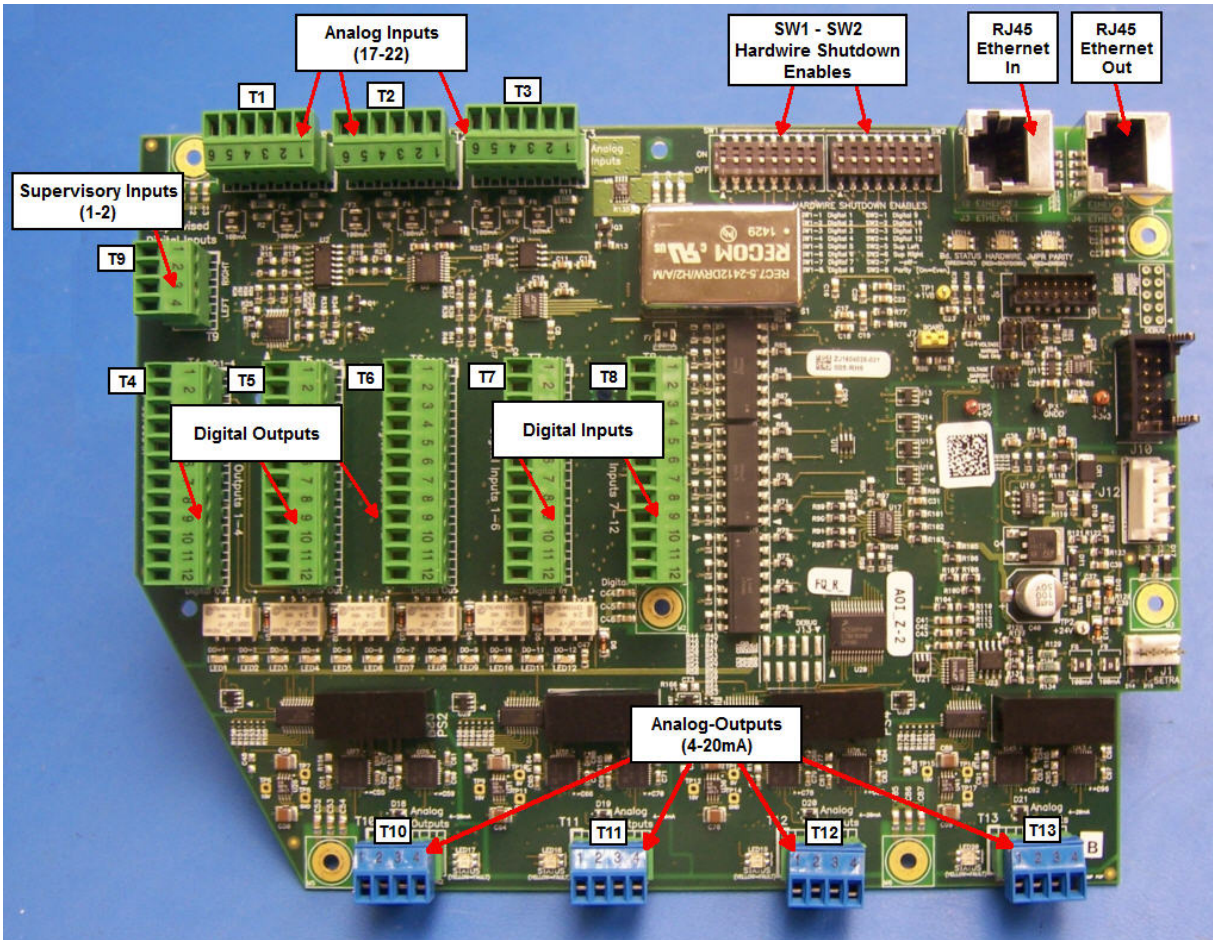


Figure 3-8: AP1580 Expansion Customer I/O Terminal Blocks (AP1563 board shown)

The heater blanket(s) 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 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 dedicated hardwire shutdown circuit is provided for the heater blanket(s) that works off a dedicated thermocouple imbedded the heater blanket and a current limiter. When the current limiter trips, it opens the contactor and interrupts power from SSR to the heater blanket. Similarly, any hardwired shutdown signal that occurs in the AP11 controller will also interrupt power from SSR to heater blanket(s).

3.0 Power and I/O Enclosures

An Electrical Control Cabinet (ECC) is installed on all BSH eV modules with single source modules having one and dual source modules having two. All incoming power terminations for the heater blanket are made in the ECC. Power for the AP11 controller is terminated within the AP11 controller itself. Power distribution for the heater blanket(s) is done from an electrical junction box located on the side(s) of the piping enclosure. See Chapters 2 and 7 for more details and electrical drawings.

Chapter 4

Operation

Section 1	**Install and Remove Cylinder Blanket**
Section 2	**Emergency Stop**
Section 3	**AP11 Controller Operation**
Section 4	**Startup and Operation**
Section 5	**System Shutdown and Startup - Planned / Unplanned**

1.0 Install and Remove Heater Blanket

⚠ DANGER

Do not operate equipment without covers in place.

Cylinder Skid Arrangement

A Y-Cylinder will arrive with a skid equipped with special riser brackets to give approximately 1” of clearance between the Y-Cylinder and skid frame for heater blanket installation. See Figure 4-1.

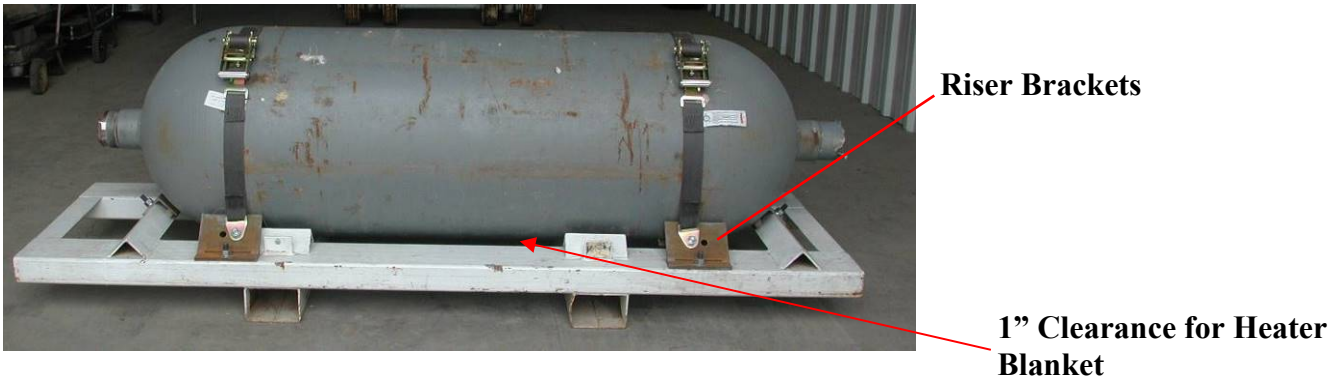


Figure 4-1: Heating Blanket Configuration.

Figure 4-2 shows a diagram of the electric heater blanket and its various components. The brass grommets will be used as an attachment point for the lifting tool. The grommets will also be used to install the stainless steel bars in order secure the blanket tightly to itself once it is installed around the Y-cylinder vessel. In addition, rubber bungee cords will also be supplied to hold the heater blanket in place before installing the stainless steel bars.

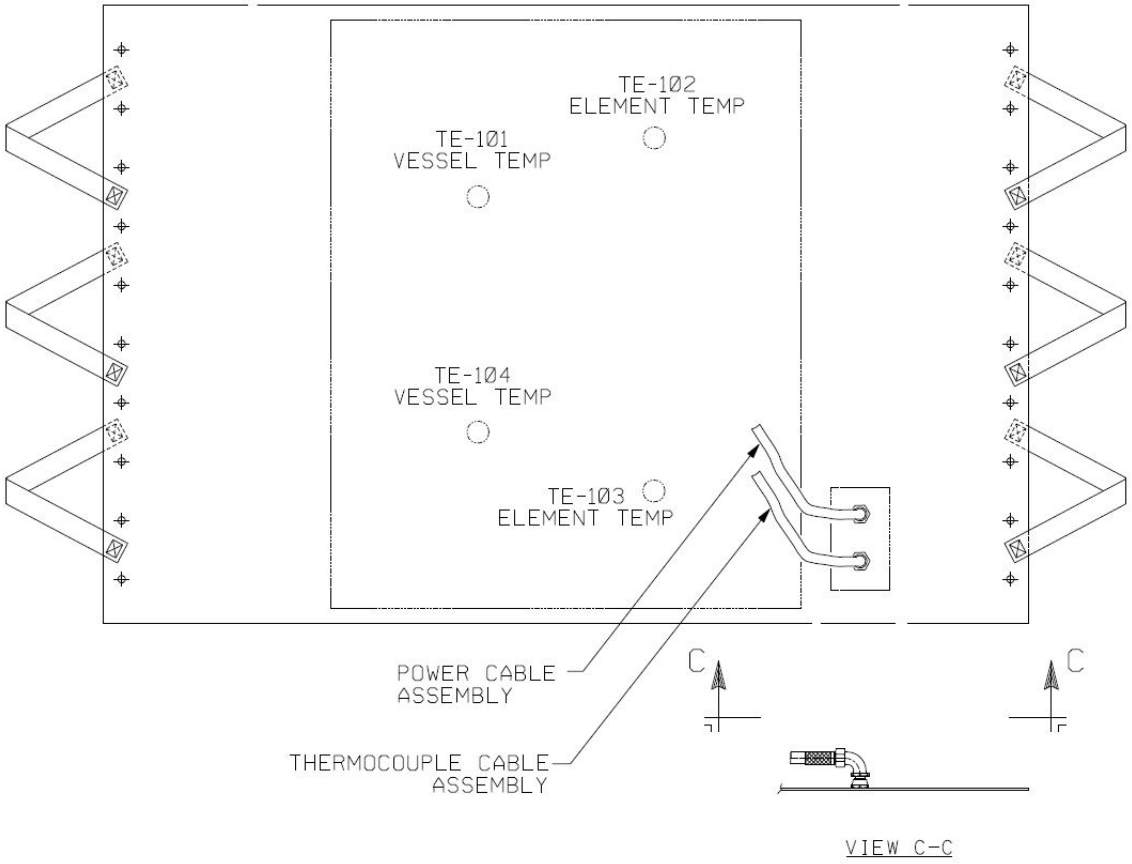


Figure 4-2: Electric Heater Blanket and Components.

Tools for Installing and Securing the Heater Blanket to the Y-Cylinder

Figure 4-3 shows the Lifting Tool designed to pull the heater blanket under the Y-cylinder.

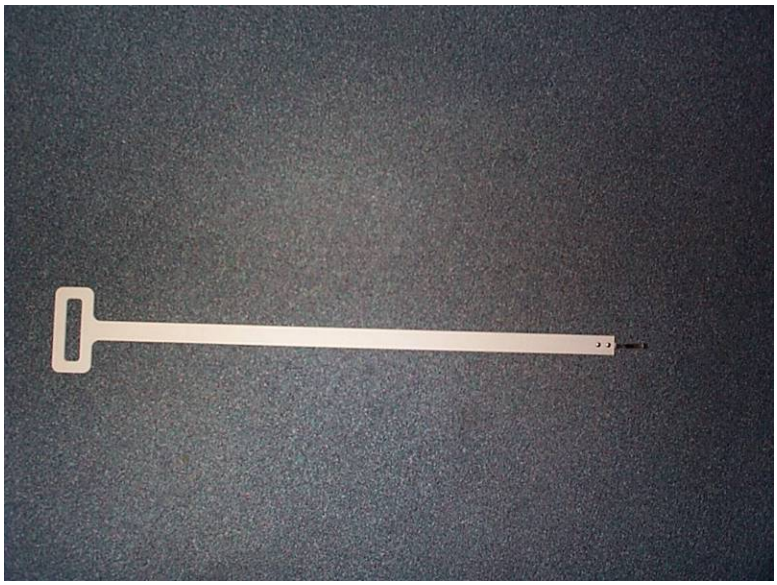


Figure 4-3: Lifting Tool for Heater Blanket.

Figure 4-4 shows the stainless steel bar designed to tension the heater blanket with ratcheting straps.

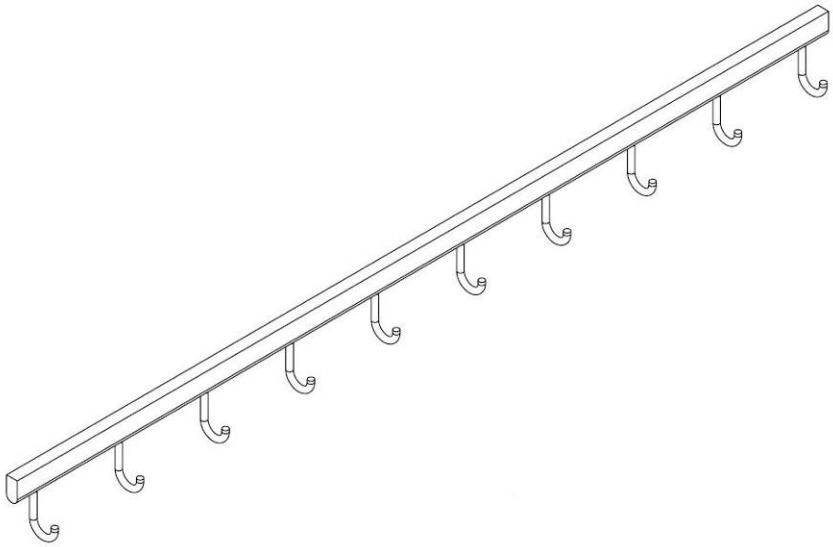


Figure 4-4: Stainless Steel Bar.

Figure 4-5 shows a diagram of a 10-inch rubber strap, also known as rubber bungee cords.

Figure 4-5: Heater Blanket Bungee Cord or Strap.

Heating Blanket Installation

Figure 4-6 illustrates the preferred position for the heater blanket installation. The heater blanket is draped over the Y-Cylinder in preparation for install/sliding under the cylinder. The leading edge of the heater blanket shown below will be pulled into the 1-inch gap between the bottom of the Y-cylinder and the top of the skid/pallet.

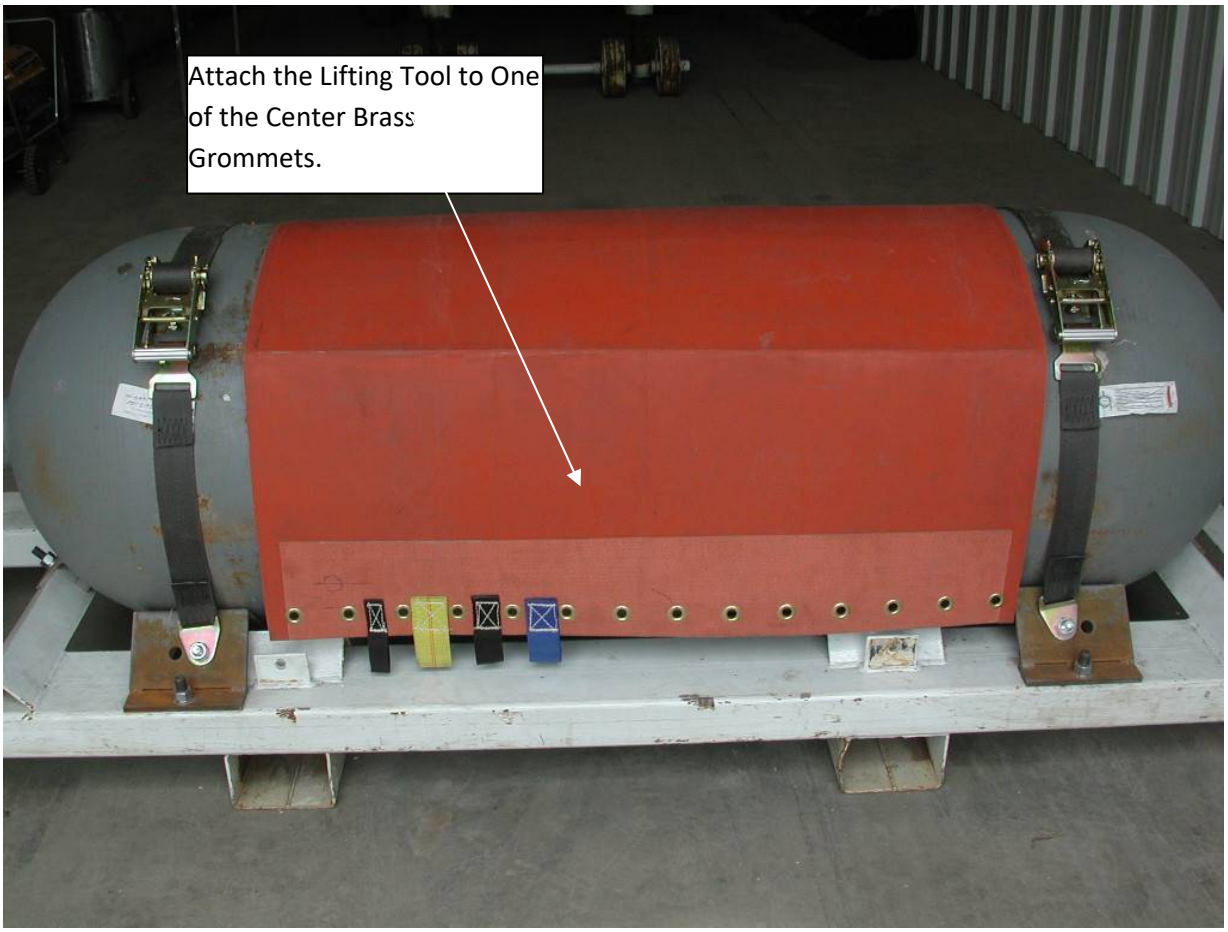


Figure 4-6: Preferred Position of Heater Blanket.

Position the Heater Blanket and Hook the Lifting Tool to the Heater Blanket's brass grommet.

After tucking the leading edge of the heater blanket behind the two existing pieces of angle iron welded to the skid frame, hook the end of the lifting tool to the heater blanket's center brass grommet and pull the heater blanket. The lifting tool is pliable and can be bent to match the curve of the Y-cylinder. Then, hook the stainless steel bars on every brass grommets of both edges.

One Operator should stand on the opposite side and extend the lifting tool through the gap under the cylinder to the other side. Hook and secure the end of the lifting tool to a brass grommet/eyelet at the center of the blanket length.

Figures 4-7 and 4-8 illustrate the use of the lifting tool. Note the Operator on the right side guiding and unweighting the heater blanket as the Operator on the left side is pulling the heater blanket under the Y-cylinder.

Figure 4-7

Figure 4-8

Figure 4-9 illustrates the installation of the stainless steel, rubber straps, and ratcheting straps to secure the blanket tightly to the Y-cylinder. The heater elements are imbedded in the center of the heater blanket, in order to heat the liquefied gas in the bottom half of the Y-cylinder. It is very important to have close contact between the heater blanket and the bottom of the Y-cylinder. Two ratcheting straps are used to tighten the stainless steel bars on top of the Y-cylinder which aid in pulling the heater blanket tight around the cylinder. The rubber bungee cords can be used to hold the heater blanket in place before applying ratcheting straps. The operator can check for gaps by reaching under the skid and pushing up against blanket and observing any movement or gap between it and the vessel wall.

Figure 4-9: Installation of stainless steel bars, rubber straps, and ratcheting straps.

Figure 4-10 shows the completed installation of an electric heater blanket onto a Y-cylinder.

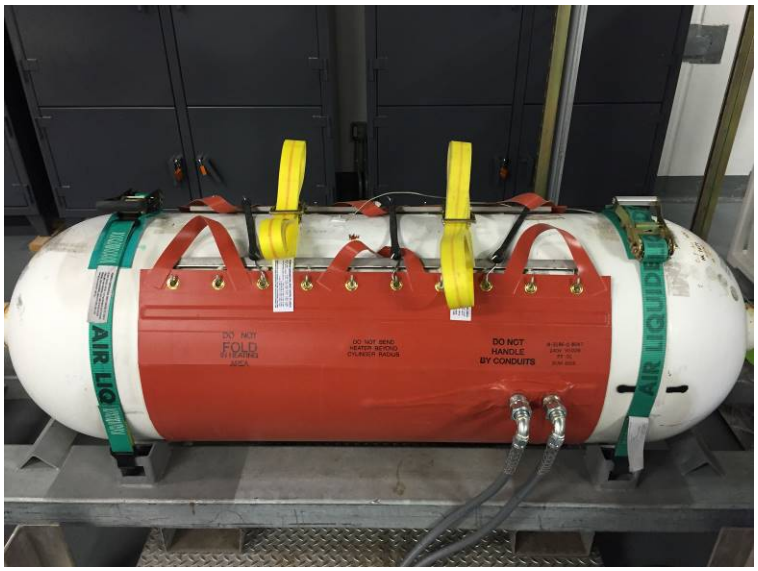


Figure 4-10: Completed Heater Blanket Installation.

WARNING: ***Do not overtighten the tension bars as it will rip off the grommets.***

Figure 4-11: Hooks attachment on the Grommet.

Installing the Insulation Cover Blanket

Figure 4-12 illustrates the installation of the insulating cover blanket. This insulating blanket conserves the heat generated by the electric heater blanket. The operator uses the handhold straps on the insulating cover blanket to lift it above the Y-cylinder and into place.

Figure 4-12: Installation of Insulating Cover Blanket.

Figure 4-13 shows the insulation cover blanket in place over the heater blanket and Y-cylinder assembly. Note the ends of the insulating blanket use Velcro tabs to wrap and secure under the ends of the Y-cylinder. Please note the slits in the side of the cover that provide clearance for the electrical power conduits.

Figure 4-13: Cover Blanket in Place.

Heater Blanket Power and Thermocouple Connections

1) Connect magnetic grounds to skid, cylinder, and heater conduit as shown in Figure 4-13a.

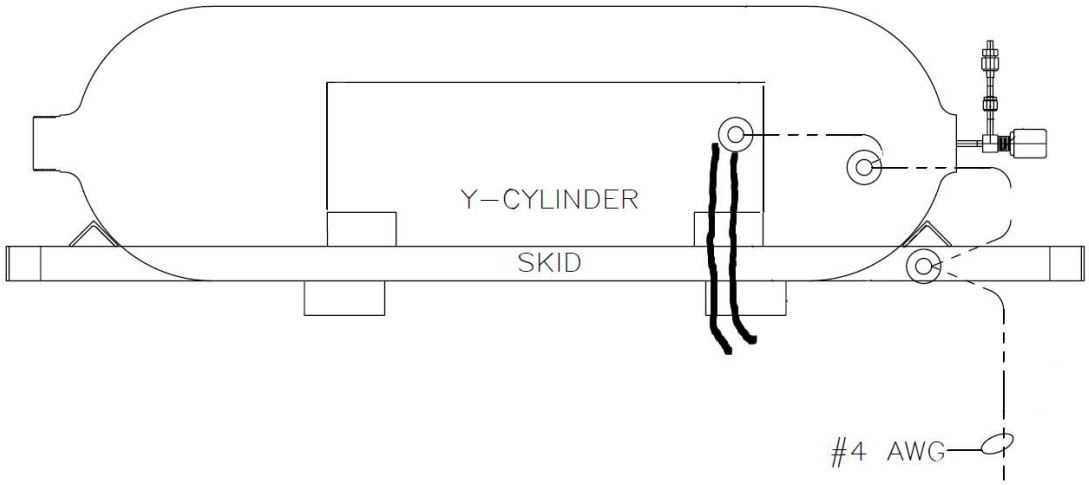


Figure 4-13a: Cylinder/Heater Grounding

Figure 4-13b: J-Box Connections.

2) Open J Box lower door using a screwdriver. Acknowledge the shutdown alarm on the AP11.

 Only open the lower door. The upper left door contains potentially live terminal blocks.

3) Pass the connectors through the holes in the bottom of the J-Box and connect as shown. Lock the connectors in place.

   The Power connector has a ring that twists to lock in place.

   The Thermocouple connector has a latching lever on the right side. Push down to lock.

 Make sure that both cables from the blanket connect to the correct J-Box if this is a dual heater system.

4) Close the door and secure latches.

Heating Blanket Removal

Heating Blanket removal is simply the reverse order of the proceeding section Heater Blanket Installation instructions.

5) Remove insulating cover from the top of the Y-cylinder using hand holds to lift, as shown in Figure 3-13. Place in clean area where the blanket cannot be damaged. Ideally, hang the cover from the handhold loops against a wall or other flat structure.
6) Disconnect electrical cables as described in pervious section, make sure the grounding clamp is the last cable disconnected. Place electrical cabling on the opposite side of the Y-cylinder from the heater blanket connection points by draping both cables over the top of the cylinder. This will facilitate blanket removal.
7) Remove the ratcheting straps, rubber bungee cords, and stainless steel bars from the blanket edge grommets.
8) Stand on the electrical cable connection side of the cylinder and grasp the handholds on the electric heater blanket and pull the blanket away and upward, revolve it around the cylinder toward the opposite side.
9) From the other side of the cylinder, complete the revolving step until the bottom (heating element) side of the blanket is on top of the vessel.
10) The electrical cabling can be coiled up and brought to the blanket. Each operator can hold a coiled cable in one hand while grasping the heater blanket hand holds and lift it vertically and off the Y-cylinder.

WARNING: Do not fold or bend the heating blanket in the heating element area.

11) Using the handhold straps, carefully lay the blanket on a clean, flat surface or hang it on a wall or other flat structure, with the electrical cable end up (90 degree conduit fittings point downward). Be careful not to kink the electrical cables nor bend, fold or otherwise kink the heating element portion of the blanket. Repeatedly bending or kinking the heating and conduit connection of the heating blanket may break the electrical heating elements and conductors.

2.0 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 BSH 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 cylinder heater.

Note: The AP11 "Emergency Stop" (E-Stop) circuit 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 AP11 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.

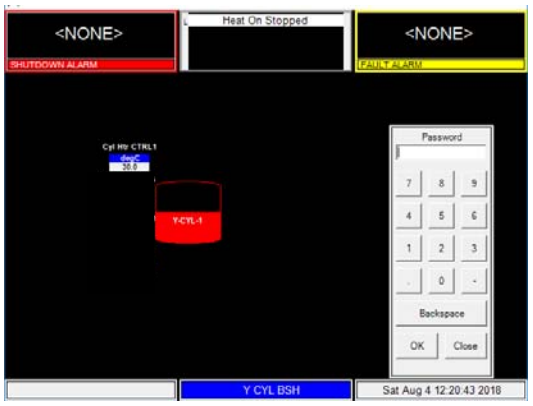
Note: The Emergency Stop (E-Stop) button is located on the AP11 controller which sits above the piping. The height of this button exceeds the SEMI standard maximum height of 64.5" (1638mm). To change the height of this button would require a redesign of the system. The button is reachable by 90% of the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

3.0 AP11 Controller Operation

Entering a Password and Selecting Menu Options

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

1. Touch anywhere on the graphics portion of the screen. The screen will appear as shown.



2. Enter the password using the numeric keypad.

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

3. Press “OK”.

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

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

Note: Unavailable menu options are grayed out.

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

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

4.0 Startup and Operation

1. Validate that the Module is ready for startup by verifying that all the following have been completed:
   - Completion of the Facilitation and Startup Checklist – See Chapter 9 of this manual for this checklist.
   - Leak checks of field installed piping.
   - Functional testing of control systems.
   - Facility nitrogen is connected to the controller for pneumatics and Z-purge, and available at 85-95 psig (5.9-6.5 barg).
   - Verify that 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.
   - Cylinder blanket is installed as per the instructions in the previous section of this manual chapter.
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 AP11 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:

AP11 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:

a. Close the controller front and tighten both latches completely.
b. Open the needle valve 4 to 5 turns (counter-clockwise). Allow the controller or ECC to purge for 20 minutes.
c. 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. BSH eV will require 7 LPM (15CFH). Flowrates should be monitored during Type Z purge. Do not exceed 7 LPM (15 CFH) during purge of BSH eV.

Figure 4-14: Rear View of GASGUARD® AP11 Controller

ECC Z-Purge Procedure

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

a) Close the controller front and tighten both latches completely.

b) Open the needle valve fully (counter-clockwise). Allow the controller to purge for 30 minutes.

c) Adjust needle valve to satisfy the "Z-Purge" alarm (approximately 1/4 total turn open).

Flow during purge will reach 2.4 LPM (5 CFH). Flow requirements to satisfy Z-Purge are typically very low and is dependent on the tightness of the individual controller and the installation.

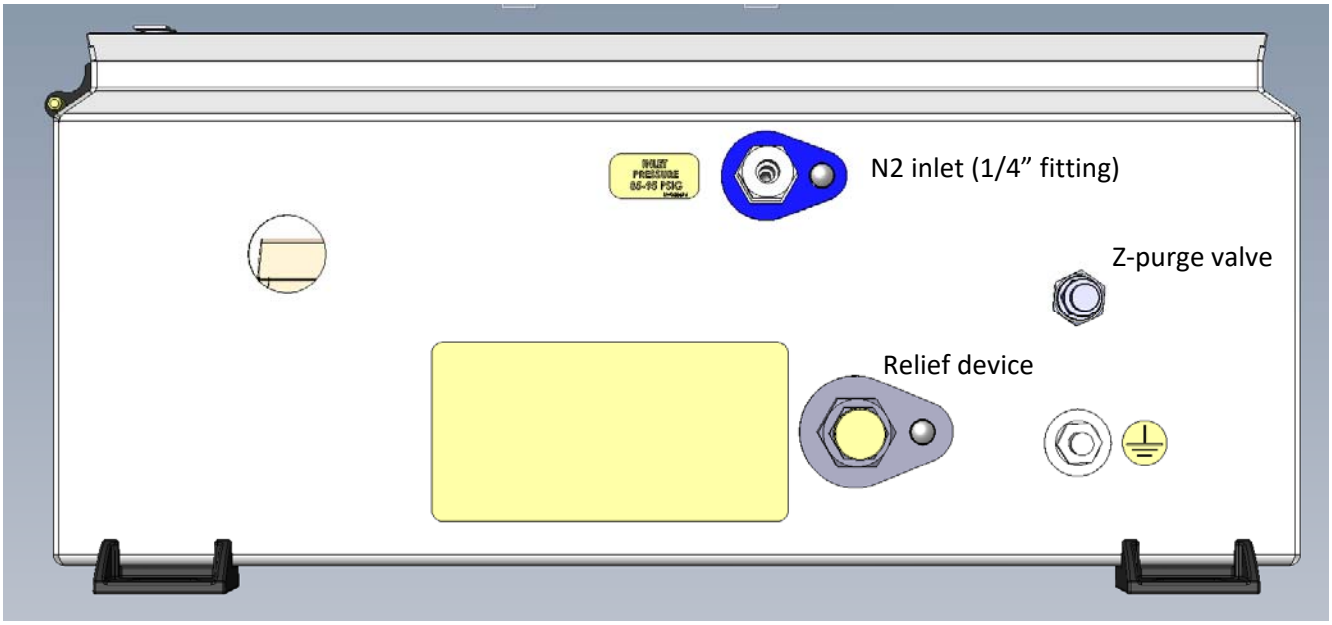
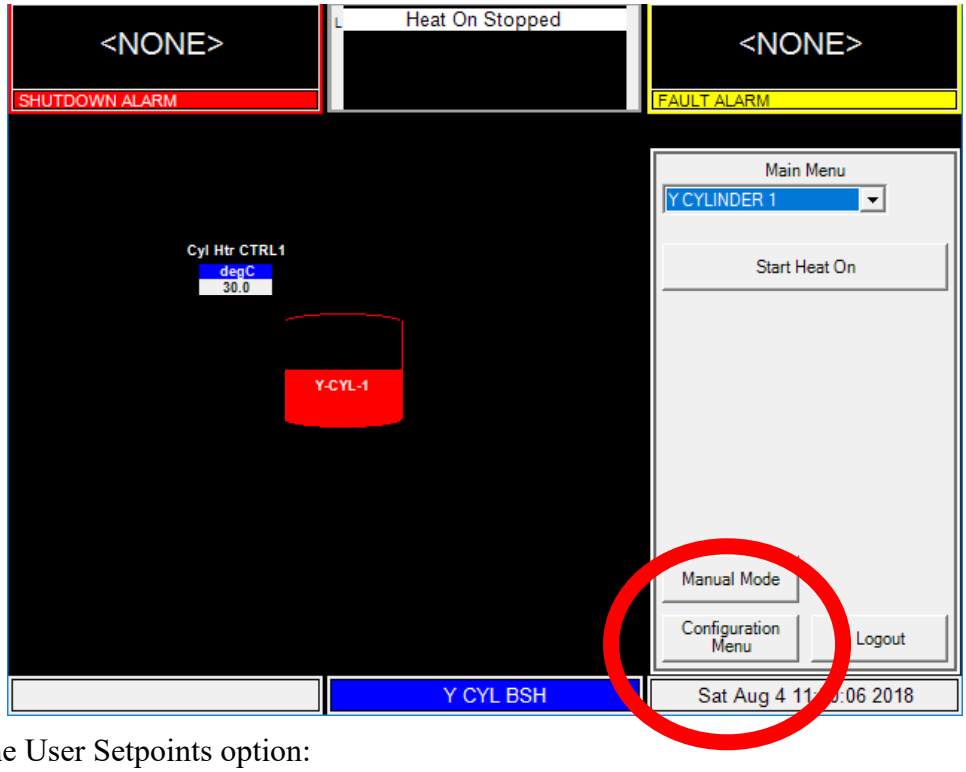


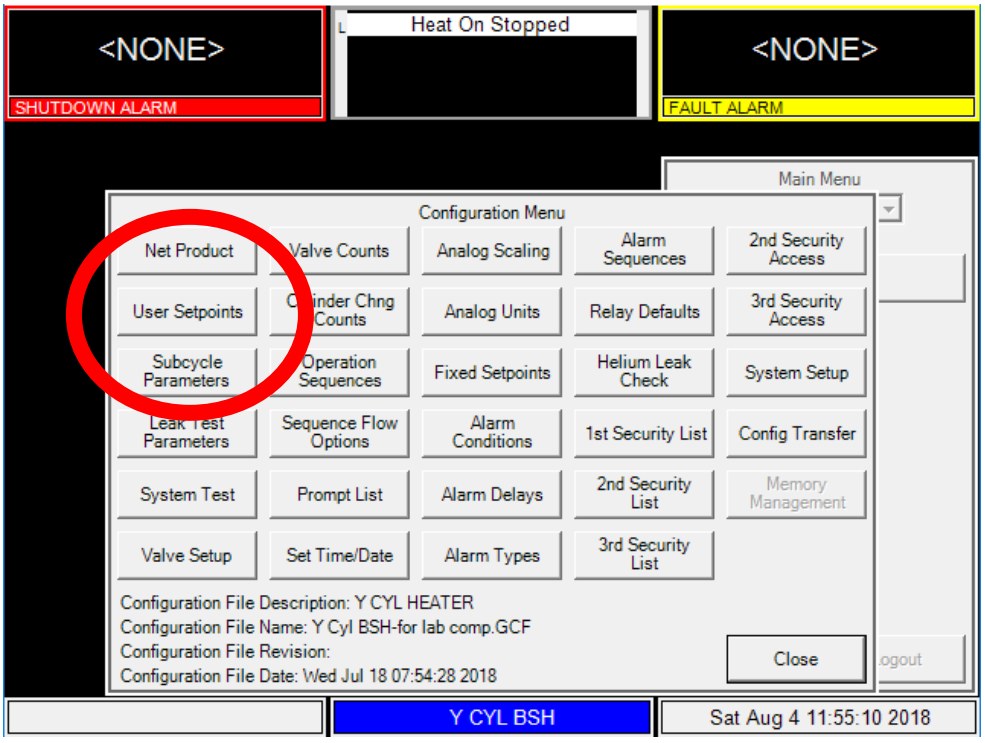
Figure 4-15: Underside View of BSH eV ECC

3. Turn on Power to AP11 controller and ECC(s).
4. 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.
5. On the GASGUARD® AP11 controller, at the module, verify that the system is in the "Stop Heat On" mode.

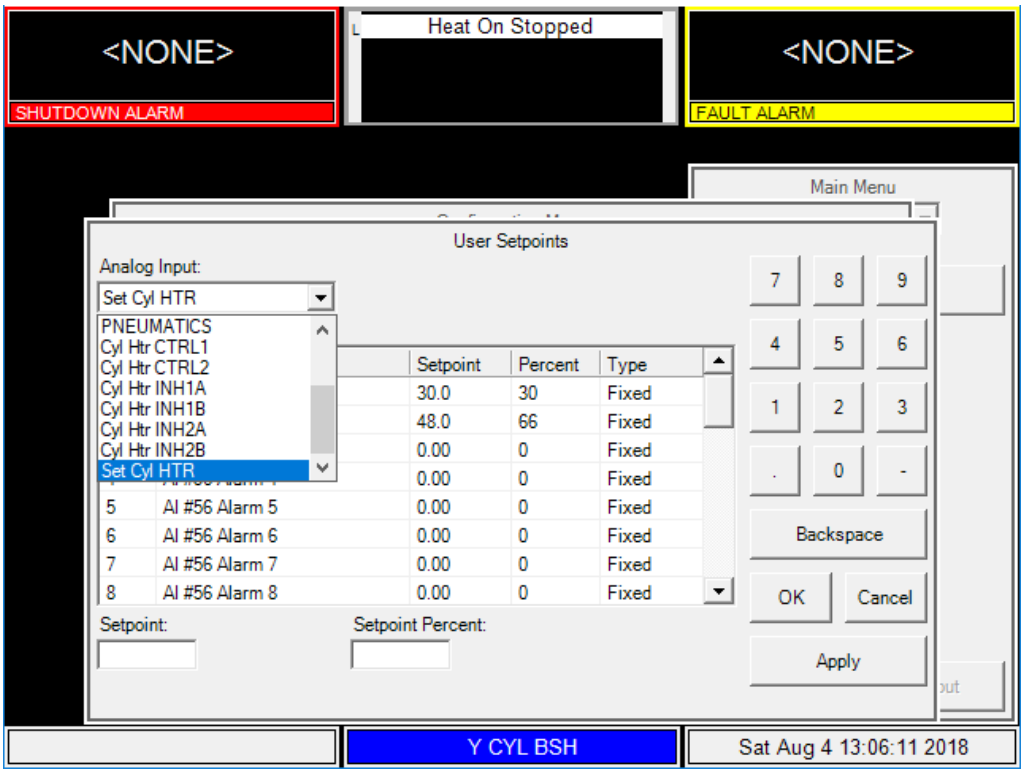
6. If the cylinder heater blanket setpoint(s) need to be adjusted (factory setting is 30ºC), use a 3rd level password to enter into the Configuration Menu:



Enter into the User Setpoints option:

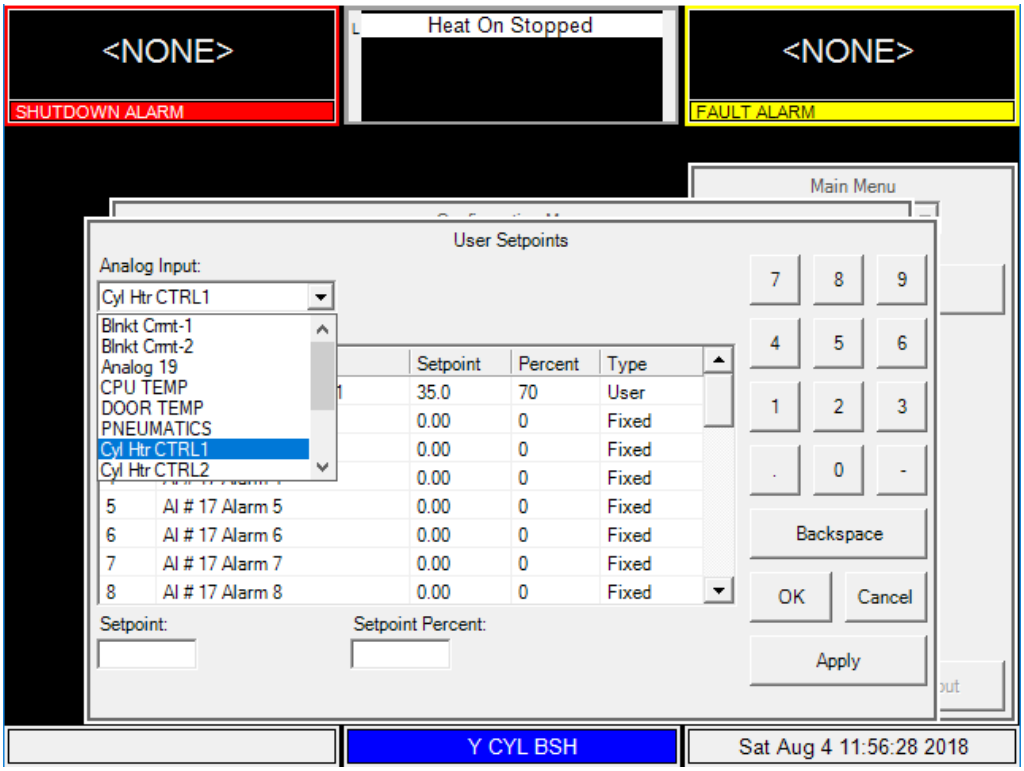


Scroll down to the "Set Cyl HTR" option on the drop-down menu:



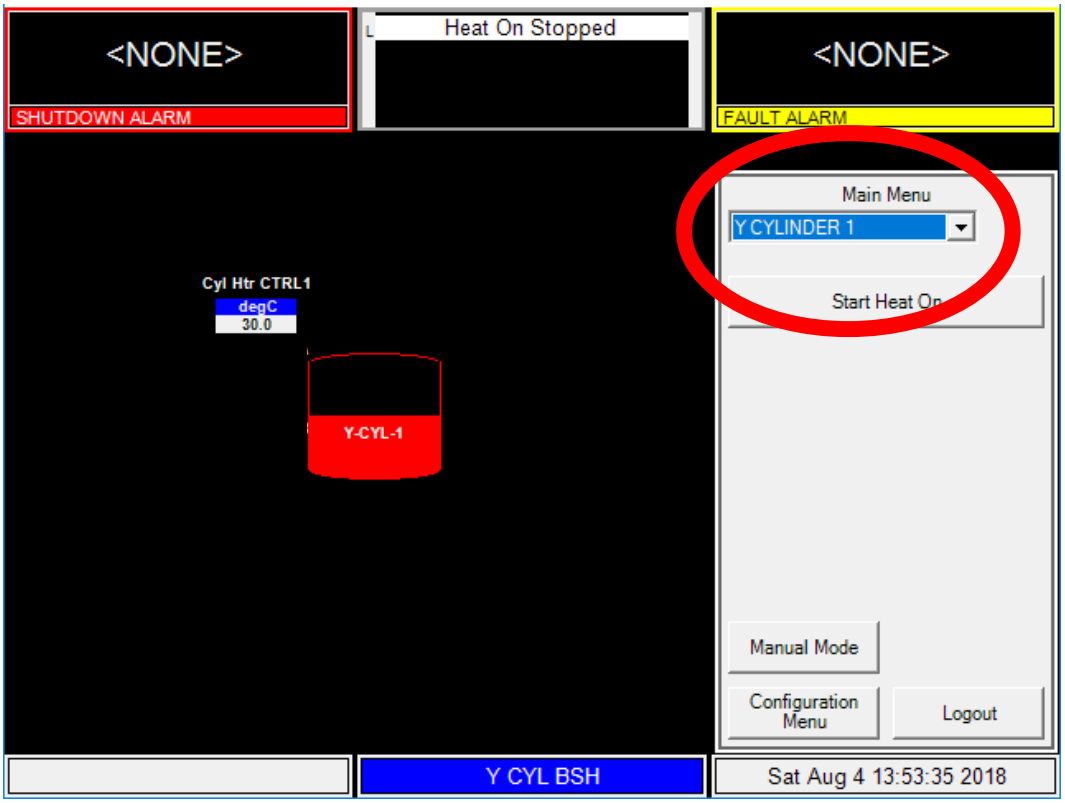
Enter in the desired heater setpoint value.and click on the “Apply” button after entry. When finished, click on “OK” to exit this menu.

NOTE: If you are changing the cylinder heater setpoint from the factory setting, then you must also adjust the Cyl Htr CTRL setpoints as well in order to avoid nuisance fault alarms. These setpoints are used to notify operators of the performance of the blanket. In order to adjust these setpoints, enter into the User Setpoint menu and scroll down to the “Cyl Htr CTRL1” (or CTRL2 for 2nd blanket) on the drop-down menu:



Adjust the setpoints for Very Low, Low, High, and Very High temperature fault alarms to the desired values and click on the "Apply" button after entry. The low alarms must be below the cylinder setpoint and the high alarms must be above it in order to avoid nuisance alarms. The interval between setpoints is set a 2C from the factory, but that value can be whatever the operator requires in order to provide the desired level of process monitoring. When finished, click on "OK" to exit this menu.

7. To apply heat to the cylinder, initiate the Start Heat On program sequence by logging into the AP11 controller screen. Select the source container that is to be heater using the drop-down menu:



Click on the "Start Heat On" button to initiate cylinder heating. Note that there will be low temperature process alarms until the cylinder comes up to temperature.

8. To turn off the cylinder heater blanket, choose the correct source cylinder from the Main Menu drop-down menu and then click on the "Stop Heat On" button.

NOTE – The BSH eV should be put into the Stop Heat On mode when a source change is taking place or if the cylinder heater blanket is being handled.

5.0 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. After power has been restored, the gas delivery system being supplied by the BSH eV should remain in idle mode until all heated components are up to operating temperature, by comparison to the data taken prior to the shutdown. 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.

After power has been restored, the gas delivery system being supplied by the BSH eV should remain in idle mode until all heated components are up to operating temperature, by comparison to the data taken prior to the shutdown. 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 heater blanket 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.

Chapter 5

Troubleshooting

Section 1 **System Errors/Alarm**

Section 2 **Cylinder Heater Overtemperature Reset Procedure**

1.0 System Errors / Alarms

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

- System Down, No Lights on Controller
- Low Cylinder Temperature/Delivery Pressure
- High Cylinder Temperature
- Purge Supply

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.

Low Cylinder Temperature/Delivery Pressure

Possible Source of Problem	Test	Solution
Module has not been placed into online mode.	Check mode on AP11 display.	Start online mode as per Chapter 4 of this manual.
Alarm setpoints are wrong/overlapping or too close to cylinder control setpoint	Check controller face for analog input 49 or 50 setpoints	Update setpoints so that alarms do not occur. AI56 should be set above all AI49/50 low temperature alarm setpoints.
Flow demand from cylinder exceeds heater capacity.	Low cylinder temperature alarms resolve when flow demand decreases.	Increase heater setpoint at AI56. Contact Versum Materials representative if problem persists.
Cylinder blanket not installed properly.	Inspect blanket to make sure it is in contact with the cylinder surface.	Verify blanket has been installed as per the recommendation in Chapter 4.
Partial loss of electrical heating elements within blanket	Check for BCM-1/2 alarms on controller. Verify phase-to-phase resistance within blanket is less than 8 ohms. Inspect the blanket surface for any signs of localized hot spots/discoloration.	Replace blanket. Handle blanket as recommended in Chapter 4.

High Cylinder Temperature (AI49/AI50)

Possible Source of Problem	Test	Solution
Alarm setpoints are wrong/overlapping or too close to cylinder control setpoint	Check controller face for analog input 49 or 50 setpoints	Update setpoints so that alarms do not occur. AI56 should be set below all AI49/50 high temperature alarm setpoints.

UT Low Cylinder Temperature

Possible Source of Problem	Test	Solution
Cylinder very cold <-20degC	Check Cylinder	
Thermocouple Wires Reversed	On the AP11 analog input test screen, check all of the thermocouples associated with that cylinder. If indicated temperature falls when cylinder is heated, then wires are reversed.	Correct Wiring

Cylinder Overtemperature Alarm (DI49/DI50)

Possible Source of Problem	Test	Solution
Cylinder blanket not installed properly.	Inspect blanket to make sure it is in contact with the cylinder surface.	Verify blanket has been installed as per the recommendation in Chapter 4.
Blanket Thermocouple connector not plugged in.	Open Lower door on junction box and check that blanket thermocouple connector in plugged in.	Plug in blanket
Loss of ECC 24VDC supply caused by: • Loss of AC supply to ECC • Blown fuses (FS-100, FS-104, FS-1041)	Open AP11 controller. If limit controller is not lit, then it has either failed or lost 24VDC power.	Use appropriate LOTO/PPE and determine cause of loss of power.
Open thermocouple	Open AP11 controller. If limit controller is indicating open TC use multimeter to find where thermocouple is broken.	Find where TC wiring is broken. Once fixed, reset alarm from AP11 screen. This will reset limit controller.
Failed power switching component or miswiring of control thermocouples resulting in an actual overtemperature state.	Open AP11 controller. If limit controller is indicating a temperature >51.6C, then limit controller is indicating overtemp. If limit controller is indicating ovetemp, log into AP11 controller, go to the Analog Input Test Screen and confirm that thermocouples associated with that blanket are all reading values consistent with the limit controller	Resolve underlying issue and reset.

Low Blanket Current

Note: Blanket current is only checked immediately after heating starts. To troubleshoot this issue requires stopping and restarting of the heater in question.

Possible Source of Problem	Test	Solution
Blanket Power connector not plugged in.	Open Lower door on junction box and check that blanket power connector in plugged in.	Plug in blanket
GFCI tripped	While in Heat On mode, go into the analog input test screen check analog inputs 17 or 18. If the current associated with blanket is 0 and remains 0, then this could be the issue.	Using appropriate LOTO and PPE, check the GFCI in the ECC. If tripped, determine cause of trip before resetting.
Damaged Blanket	While in Heat On mode, go into the analog input test screen check analog inputs 17 or 18. If the current associated with blanket is non-zero, then this could be the issue.	Visually inspect blanket. If there are burnt spots, this may be caused by broken heating wires within the blanket.
Low Input Voltage	While in Heat On mode, go into the analog input test screen check analog inputs 17 or 18. If the current associated with blanket is non-zero, then this could be the issue.	The BSH eV is designed to work with 208-240V. If the input voltage is below 208V it may cause this alarm.

Z-Purge Supply Alarms

Low Z-Purge

Probable Cause	Corrective Action
Pressure inside the controller or ECC 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.

2.0 Cylinder Heater Overtemperature Reset Procedure

Each cylinder heater blanket has a dedicated shutdown circuit using TSH-104 within the blanket and a dedicated current limiter within the AP11 controller. This system's purpose is to turn off power to the heater in the unlikely event the cylinder temperature reaches 125ºF (51.7ºC) in order to prevent a violation of NFPA 55 and US DOT codes.

Following a trip, the shutdown alarm must be manually reset through the AP11 controller face. The operator then must manually restart the source heater program.

Chapter 6

Maintenance

1.0 Warranty

Seller warrants the Equipment manufactured by it to be free from defects in material and workmanship at the time of shipment from Seller's factory for a period of twelve (12) months from the date of shipment, (herein referred to as the "warranty period"). If, during the warranty period, any part of such Equipment is found to have been defective or damaged at the time it was shipped, at Seller's option it will either be repaired at Seller's factory, or it will be replaced by a similar part provided that Buyer gives Seller immediate written notice upon the discovery of any defective or damaged items, whereupon Seller shall have the option of requiring the return of the defective material to establish the claim. This warranty is expressly conditioned upon installation of the Equipment in accordance with the Equipment drawings and instructions of the Seller, and upon Buyer availing itself of the services of Seller's installation and startup advisors, to ensure the correct installation and successful operation of the equipment.

As to all apparatus and products not manufactured by Seller which are component parts of the Equipment, furnished by Seller, Seller's only obligation shall be to obtain for Buyer such warranties or guarantees are obtainable from the manufacturers. Such warranties or guarantees shall extend over the longest period of time obtainable in this instance without payment by Seller of additional consideration therefore, and Seller shall use reasonable efforts to require its vendors to fulfill obligations of their warranties of guarantees on such apparatus or products furnished in connection with this quotation or any contract resulting therefore.

The replacement or repair of defective parts, as aforesaid, shall be Buyer's only remedy for breach of the material and workmanship warranties of Seller. As to the Equipment of other manufacturers, resort shall be had against such manufacturers only. No allowance will be made for repairs or alterations made without the written consent of Seller, in which event all Sellers' warranties hereunder shall be void and of no effect. Buyer agrees to assume responsibility and pay for such defects which are attributable to it and for damages which may occur to the Equipment after delivery to it. Seller shall not be responsible for any defects due to or caused by normal wear and tear, corrosion, erosion or disregard of Seller's operating and maintenance instructions, or improper use of equipment.

2.0 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 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.
Electrical Heater Blanket	Inspect blanket for damage to the surface. Replace if signs of damage are present. Verify that heater blanket is stored in a flat position when not in use. Reinstall and secure to the source container as per Chapter 4.

Daily

Component	Task
BSH eV Module	Visually inspect the cabinet for damage 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. Replace components as required.

Every 3 Months

Component	Task
BSH 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 / Z-Purge	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
E-Stop Interlock	Verify that when the emergency stop button is depressed, the system shuts down.
Remote Shutdown Signal	Verify that if the customer's remote shutdown signal is activated, the system shuts down.
Overtemperature Shutdown	Verify that disconnecting the thermocouple connector inside the lower door of J-Box-1 and J-Box-2 results in overtemperature digital alarms on DI-49 and DI-50 respectively.
Current Limit Monitor	Verify that if blanket power connector is not attached, that current monitor alarms.

Every 12 Months

Component	Task
Electrical Control System	 **Shock Hazard** 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.
	 **Shock Hazard** Verify operation of the E-Stop circuit by initiating a shutdown using the E-Stop push button on the system. Visually confirm that CON-100 in each ECC actuates based on the E-Stop signal.
	 **Shock Hazard** Verify operation of the J-Box-1 door switch circuit by opening the lower door on J-Box-1. Visually confirm that CON-100 in ECC-1 actuates based on opening the door. Repeat for J-Box-2/ECC-2.
	Verify operation of Audible alarm horn.
	Complete Z-Purge check in Section 4 of this Chapter.
	Complete ground fault interrupter test in Section 4 of this Chapter.
	Complete ground continuity test in Section 4 of this Chapter.

3.0 Mechanical Integrity Program

The electrical grounding associated with the BSH eV module should be inspected and verified on an annual basis.

The E-stop and remote E-stop buttons should be inspected every 3 years.

4.0 Electrical Maintenance and Test Procedures

When performing maintenance on BSH 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.

Heater Ground Fault Interrupter Test

Shock Hazard

Required Tools:

Digital Volt Meter
Screwdriver

With the control system energized open the ECC enclosure door. With ground fault circuit breaker **GFP-100** energized heater line voltage should be present on the output terminals (Wires 1002 & 1012). Use a DVM to verify.

Press the **TEST** button on **GFP-100** and verify that the breaker trips. Use a DVM to verify. **Reset GFP-100**.

Ground Continuity Test

Required Tools:

Digital Ohm Meter

Set the volt ohmmeter switch to measure resistance. Touch the voltmeter leads together to determine a baseline resistance reading. This reading will need to be subtracted from the readings taken at the test points.

Continuity meter readings must be less than 1.0 ohms to be acceptable.

Measure resistance between the system grounding split bolt electrode located on the cabinet behind the AP11 controller to each of the following points.

- With AP11 door open measure to the exposed metal around the door opening.
- Metal surface on inside of AP11 door.
- Ground stud on bottom of ECC(s)
- Ground stud on side of J-Box(es)
- Ground stud on inside of J-Box Lower Doors
- All conduit poured seals
- Remove magnetic ground clamp and measure to the conduit elbow on the heater blanket.

Z-Purge Check

Required Tools:

Screwdriver (if necessary)
Electrical PPE (if necessary)

Check AP11 controller for Z-Purge faults. If none are present, no further work is required.

If Z-purge faults are present, go to the digital input test screen on the AP11 controller. Find the digital input associated with the alarm. Slowly open the Z-Purge flow valve for the associated enclosure:

- For AP11, it is located on the rear of the controller between the conduit penetrations.
- For the ECCs it is located on the bottom.

Turn the valve about ¼ turn past the point where the pressure switch closes.

If you are unable to satisfy the alarm by opening the valve, the leakage rate is excessive. Find the source of the leak and repair it.

Shock Hazard

If this requires entry into the ECC, appropriate electrical PPE will be required.
Lockout the source of heater power before working in the ECC.

Note: This alarm may also be caused by failure of the Z-Purge pressure switch.

5.0 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, PS-104**	10 yrs
Temperature Limit Controllers **Limit Controller-1, Limit Controller-2**	10 yrs (typical) Life expectancy varies depending on the ambient temperature.
Power Solid-State Relays **SSR-100**	5 yrs (typical) Life expectancy varies depending on the duty cycle of the heater and the ambient temperature.
Power Contactor **CON-100**	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 **PPS-113**	10 yrs

6.0 Decommissioning

Decommissioning is the process by which the equipment is taken out of service. The safe isolation and securing of the power and gas lines to and from the equipment is the sole responsibility of the System Owner requiring adequate coordination between gas technicians and the Fab Owner. This section is to provide general guideless for decommissioning BSH eV. All heaters must be removed from containers prior to using this procedure. Before decommissioning the system, ensure the all pressure in the system has been relieved.

Procedures are only to be performed by trained personnel who understand the hazards of the system.

Personal injury or death may result if proper personal protective equipment (PPE) is not worn when performing work on this system.

Before attempting to decommission the service the system components, all pressure in the system should be relieved and electrical power to the system turned off.

Lockout and all sources of power and gas feeding this system.

Decommissioning Checklist

1. Verify all site paperwork has been completed for Heating Equipment Shut Off request. _____
2. Ensure that proper PPE has been obtained and donned. Refer to site documentation. _____
3. Gather all required tools. Refer to site documentation. _____
4. Ensure all electrical power to the system has been turned off and locked out. _____
5. Ensure that all heaters have been removed from the cylinders per Section 4.1. _____
6. Ensure all pressure in the system has been relieved. _____
7. Remove any Fab Tool ID and Status Tags (such as On-line) from the Cabinet and hang a “Prior Use” Tag on the Cabinet with the Date and Fab Tool Name. _____
8. All equipment associated utilities should be isolated and disconnected from the equipment and OK to DEMO Tag attached _____

Chapter 7

Drawings

This section will contain field installation drawings for the BSH eV module

Chapter 8

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	Door Board	1	0	VERSUM MATERIALS	**407726**	Door Board, part # AP1562
5	Display	1	0	NEC	**409057**	Display (CCFL BACKLIGHT TYPE)
6	Display	1	0	NEC	**436466**	Display (LED BACKLIGHT TYPE)
7	Display	1	0	NEC	**409058**	Inverter Board
8	Display	1	0	NEC	**436908**	CCFL Replacement Backlight for GASGUARD® Part #409057
9	Display	1	0	Quadrangle	**439367**	Display Cable
10	Fuse	5	0	Littlefuse	**409610**	Fuse 250MA radial, (37002500410)
11	Fuse	5	0	Littlefuse	**409611**	Fuse 500MA radial, (37005000410)
12	Fuse	5	0	Littlefuse	**409608**	Fuse 1A radial, (37011000410)
13	Fuse	5	0	Littlefuse	**418758**	Fuse 4A radial, (37014000410)
14	Graphics	1	0	VERSUM MATERIALS	**415647**	Graphic Overlay/Touch Screen Assembly
15	Pressure Switch	1	0	Micro Pneumatic Logic	**809-418802**	Differential Pressure Switch, For Z-Purge, 0.1" H2O, N.O., 1/16" Barbed Special.
16	Solenoid	1	0	SMC	**420179**	Master Solenoid Valve (L Style, 24V, w/base)
17	Power Supply	1	0	Phoenix Contact	**409506**	Power Supply, 24 VDC, 4A
18	Power Supply	1	0	VERSUM MATERIALS	**414764**	AP11 Power Cooling Fan (SW008286.SLDDRW)
19	Power Supply	1	0	VERSUM MATERIALS	**414762**	PCB High Voltage AP11, AP1568

Item	Category	Critical Spare Part (Qty)	Recommended Spare Part (Qty)	Manufacturer	GASGUARD® Part #	Description
20	Power Supply	1	0	VERSUM MATERIALS	**436467**	10Awg Power Wire Modification Kit
21	Misc.	0	1	VERSUM MATERIALS	**400509**	SETRA Exhaust sensor cable (SW008106.SLDDRW)
22	Misc.	0	1	Allen Bradley	**409501**	Push Button - Mushroom Head - Red - Maintained Push/Pull Twist to Release.
23	Misc.	0	1	Mallory / Sonalert	**171538**	Mallory Sonalert Horn
24	Graphics	0	1	VERSUM MATERIALS	**199117**	AP11 Logo w/ Z Purge Warning
25	Graphics	0	1	VERSUM MATERIALS	**199116**	AP11 Graphic Overlay Optional Valve Legend
26	Fuse	4	0	Schurter or SIBA	**416974**	Fuse 4A, super quick acting (Schurter 7022.0660 or SIBA 189020.4)
27	Misc.	0	1	Honeywell	**418571**	Pressure-sensor, 150psi, 2%
28	Misc.	0	1	Lindy	**435058**	USB Type-A Port Blocker
29	Customer Board	1	0	VERSUM MATERIALS	**469624**	Customer Board with **Analog-Out**, part # AP1580 (replacement board only, see item 30 for complete kit)
30	Customer Board	0	1	VERSUM MATERIALS	**2300948**	Customer Board with **Analog-Out** Kit (includes AP1580 board & cables to add customer input/output alarm function)
31	Heater Board	1	0	VERSUM MATERIALS	**467662**	Heater Control Board, part # AP1602 (replacement board only, see item 32 for complete kit)
32	Heater Board	0	1	VERSUM MATERIALS	**459769**	Heater Control Board Kit (includes AP1602 board & cables to add customer input/output alarm function)
33	Display	0	1	VERSUM MATERIALS	**457266**	Epoxy Coated LED Light Bar

BSH 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	SSR	1	0	Crydom	**2301592**	Solid State Relay, 90A, 3-32VDC input.
102	Relay	1	0	ABB	**483910**	Relay, 50A, 24VDC coil
103	Fuse	2	0	Bussman	**180021**	Fuse, 2A (GMC-2-R)
104	Fuse	2	0	Bussman	**2301554**	Fuse, Class J, Time Delay, 50A (LPJ-50SP)
105	Fuse	2	0	Bussman	**EL-01-FUSE05600**	Fuse, Class CC, Fast Acting, 5A (KTK-R-5)
106	Control	1	0	Watlow	**TBD**	Temperature Limit Controller
107	Monitor	0	1	Dwyer	**2301553**	Current Transformer 0-50A in, 4-20mA out
108	Switch	1	0	Pilz	**2301591**	Magnetic Safety Switch
109	Heater Accessories	0	0	Versum Materials	**889-607587**	Insulation Blanket for Y-Cylinder
110	Heater Accessories	0	0	Versum Materials	**889-609981**	Insulation Blanket for Tonner
111	Heater Accessories	0	0	Versum Materials	**889-607590**	Lifting Tool
112	Heater Accessories	0	0	Versum Materials	**471973**	Ratchet Strap
113	Heater Accessories	0	0	Versum Materials	**519-805640**	Magnetic Ground Clamp
114	Heater Accessories	0	0	Versum Materials	**482479**	Tension Bar
115	Heater	1	0	Versum Materials	**466128**	9kW Flexible Heater

Chapter 9

Facilitation and Startup 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

BSGS - Bulk Specialty Gas System.

BSH – Bulk Source Heater

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 Commissioning and Startup Team personnel. Completing this checklist and following this procedure will help ensure the BSH eV Heater Controller is properly installed, commissioned, and functionally tested. All tasks identified in this document must be completed prior to the BSH eV Heater Controller equipment being placed into full operational service to the Customer.

Instructions Complete the checklist as follows:

1. Make sure all required tasks 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/e-mail the completed checklist to the attention of the Versum Materials Project Engineer of record.

Customer Name:		**Dates:**	
Customer Location:		**BSGS Gas Type:**	
Controller Model Number:		**Controller Serial Number:**	
Commodity Description:			

1. Pre-Facilitation Checklist Review and Visual Inspection

		Initials or N/A	Date
A.	Review equipment Source Inspection (QAF) / Factory Acceptance Testing (FAT) documents and address any open items.		
B.	An individual Versum Materials Facilitation and Commissioning Checklist must be completed for each individual equipment module that makes up this complete BSGS installation.		
C.	General appearance of all equipment is satisfactory.		

2. Mechanical Checklist

		Initials or N/A	Date
A.	Verify all equipment is properly mounted and secure to concrete pad (anchor bolts), supports, or walls. Verify seismic bracing installed, if required.		
B.	Verify all Unistrut and supports have no sharp edges or are capped to prevent injury.		
C.	Verify all doors close and latch properly, check alignment, verify seals/gaskets OK.		
D.	Verify all door locks function and gather all keys-will turn over all to Customer/Megasys.		
E.	Verify canopy / roof (for weather protection) is complete, if required.		
F.	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.		
G.	Verify equipment/enclosure labeling – equipment nameplates, equipment model/serial numbers, D.O.T. labels, safety warnings, electrical information, safety inspection tags, tool identification label, etc.		

3. Safety Protocols / Equipment Checks

		Initials or N/A	Date
A.	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.		
B.	Conduit seals installed, packed, and poured once electrical checkout complete and all wiring verified. Paint conduit seal red once poured.		
C.	Danger / warning stickers and Arc Flash sticker installed on each piece of equipment as required by Customer and Versum Materials safety protocols.		
D.	Voltage level warning stickers installed on each piece of equipment as required by Customer and Versum Materials safety protocols.		
E.	Verify a grounding conductor / pigtail is terminated to the magnetic grounding clamps. Verify a magnetic grounding clamp is attached to the metal shell of the Y-Cylinder and to the blanket condiut prior to energizing the Y-Cylinder Heater.		
F.	Assist with the completion of the Versum Materials Operational Readiness Inspection (ORI) and verify the ORI is signed off by Versum Materials and Customer representatives.		
G.	Verify Customer Safety Level 2 (SL2) approval for Hazardous Gas is complete.		

4. Electrical Commissioning and Checkout

		Initials or N/A	Date
A.	Obtain copy of BSH eV Elementary Wiring Diagram used to manufacture this controller. Record drawing number and revision. ECC(s): Dwg # _____, Rev. ___. System: Dwg # _____, Rev. ___.		
B.	If any equipment is installed within an electrically rated Hazardous / Classified area, list the Hazardous Classification of the area: Class:___, Division:___, Group:___. List each piece of 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.		
C.	Verify all field conduit and wiring installed per design package. Record drawing number and revision of electrical installation drawing. Dwg # _____, Rev.___.		
D.	Verify conduit installed properly-all outdoor conduit is RGS, 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 tie wraps, etc.		
E.	Verify Versum Materials-supplied conduit hubs and auto-drains were not removed during conduit installation. All outdoor conduits must be weather-tight and o-ring gasketed and provide low-point water drainage.		
F.	Verify all unused openings in all equipment are sealed with o-ring gasketed plugs and are weather / rain tight.		

G.	Verify all internal wiring is tight and properly connected / terminated. Ensure GFP-100 is in the ON position and all fuses are installed.		
H.	Ensure all terminal boxes and enclosures are vacuumed out and cleaned before energizing.		
I.	Verify the Heater Blanket(s) shows no sign of damage to the insulation jacket or the silicone blanket and that it is ready to be installed on the bulk container.		
J.	Inspect both the thermocouple and power cable assemblies and connectors for signs of physical damage to the insulation jacket and for mechanical integrity at the Heater Blanket(s).		
K.	Install the Heater Blanket(s) on the bulk container(s).		
L.	Install the thermocouple plug and power plug from the first blanket into the mating receptacles in J-BOX-1. Verify that both connectors are locked into place. The power plug has a locking ring.		
M.	Install the thermocouple plug and power plug from the second blanket (if installed) into the mating receptacles in J-BOX-2. Verify that both connectors are locked into place. The power plug has a locking ring.		
N.	Verify incoming power feed with installation electricians. Control Power: 100-240VAC, 2 Wire plus ground, 50/60Hz, 125W. Terminate to T1 on the high voltage board in the top of the AP11. Heater Power (each ECC): 208-240VAC, 2 Wire plus ground, 50/60Hz, 38A Full Load. Terminate the power conductors to the top side of FS-100. Terminate the ground conductor to the terminal block to the left of FS-100. Verify incoming power wiring is the proper size and rating and it is labeled and terminated correctly. Verify power Locked and Tagged Open / Off.		
O.	If incoming power feeds are long in length from the source power panel to the BSH eV, verify that the electrical contractor has increased the feeder conductor size to ensure less than 3% voltage drop at the equipment. Reference current edition of NFPA 70 – National Electrical Code, Sections 215.2(A)(4) and 210.19(A)(1).		
P.	Customer / electricians must provide Megger Test Results of all power circuits to Versum Materials. 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.		
Q.	Verify that equipment is labeled with nameplate that indicates Source of incoming power, voltage level, current, and frequency.		
R.	Test and record the power feed at the Customer power panel with electricians / Customer. **Incoming Power** (fed from: _____) L1 – L2:_____VAC, L1 – Gnd:_____VAC, L2 – Gnd:_____VAC, Freq:_____Hz		
S.	Verify that equipment and canopy structure have lightning protection, if located outdoors.		
T.	Verify the properly-sized equipment grounding conductor / pigtail is connected to the split-bolt grounding lug on the controller. 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. ___. Y-Cylinder Heater Controller: _____ Ohms		

U.	Verify the properly-sized equipment grounding conductor / pigtail is connected to the weight scale split bolt grounding lug and the magnetic ground connectors for the actual Y-Cylinder metal container ground and heater ground. Perform Ground Resistance Test (3-Point Fall-of-Potential test or equivalent) for this grounding conductor and record test results of ground resistance with reference to ground grid. Record Grounding drawing number and revision. Dwg # _____, Rev. ___. Y-Cylinder-1 Ground: _____ Ohms Y-Cylinder-1 Conduit Ground _____ Ohms Y-Cylinder-2 Ground: _____ Ohms Y-Cylinder-2 Conduit Ground _____ Ohms		
V.	Verify ground continuity between ECC input ground, ECC output ground, Junction box ground terminal blocks, cabinet chassis, and AP11 chassis.		
W.	Verify that there are hipot labels on the AP11 and ECC(s).		
X.	Perform and record the **500 VDC Megger Tests** of the Y-Cylinder Heater Blanket. Measure at the blanket plug. L1 – Gnd:_____ Ohms, L2 - Gnd:_____ Ohms		
Y.	Using a multimeter, measure resistance to ground from the from the following terminal blocks: ECC1-1001:_____ ECC2-1001:_____ ECC1-1011:_____ ECC2-1011:_____ ECC1-1003:_____ ECC2-1003:_____ ECC1-1004:_____ ECC2-1004:_____ ECC1-1013:_____ ECC2-1013:_____		
Z.	Using a multimeter, measure resistance phase to phase from the from the following terminal blocks (without blanket plugged in): ECC1-1001 to 1011:_____ ECC2-1001 to 1011:_____ ECC1-1004 to 1013:_____ ECC2-1004 to 1013:_____		
AA.	Plug in heater blanket(s). Measure resistance of the heater blanket(s) as seen at the ECC. It should be <8.5 ohms. ECC1-1004 to 1013:_____ ECC2-1004 to 1013:_____		
BB.	Verify that all high voltage guards are in place. These include AP11 internal guards, ECC door(s), J-Box door(s)		
CC.	Obtain a copy of the City Inspection (or applicable Authority Having Jurisdiction – AHJ) from the Customer/Electrical Contractor.		
DD.	Verify all required safety approvals /checks (SL1) are complete and signed off, energize incoming power to Y-Cylinder Heater Controller. Verify proper voltage / frequency at DISC-100. **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.**		
EE.	Test and record the incoming power at the ECC(s). Measure at the line side of FS-100. **Incoming Power** (fed from: _____) ECC1: L1 – L2:_____VAC, L1 – Gnd:_____VAC, L2 – Gnd:_____VAC ECC1: L1 – L2:_____VAC, L1 – Gnd:_____VAC, L2 – Gnd:_____VAC		

FF.	Press the Test button on GFP-100 in ECC-1. Using a multimeter check the output of GFP-100 to confirm that it opened. Reset GFP-100.		
GG.	(DUAL ONLY) Press the Test button on GFP-100 in ECC-2. Using a multimeter check the output of GFP-100 to confirm that it opened. Reset GFP-100.		
HH.	Measure 24VDC power supply voltage at the terminal blocks in each ECC: ECC1-1042 to 1051:_____ ECC2-1042 to 1051:_____		
II.	Close ECC door(s)		
JJ.	Open AP11. Turn on power switches. Click on the blue system information button on the bottom of the screen. Record system information: Firmware revision:_____. Config File:_____.		
KK.	In the top of the AP11, turn off Power Supply 2. Acknowledge PS2 fault. Go to the status tab of the system information screen. Record the carrier board 24VDC supply voltage. 24VDC supply voltage (AP11-PS1):_____ Turn on Power Supply 2, and turn off Power Supply 1. Acknowledge PS1 Fault. Record the carrier board 24VDC supply voltage. 24VDC supply voltage (AP11-PS2):_____ Turn on Power Supply 1. Clear PS1 fault.		
LL.	Turn on pneumatic supply to AP11 controller and to ECCs (if purge to be used). Log into AP11 controller, go to Analog Input Test Screen. Record Analog Input 19 (Pneumatic Pressure): _____ PSIG. (Pressure will read 0 until hardwire alarms cleared)		

5. 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.	As each Fault Alarm or Shutdown Alarm is activated, verify the Relay Outputs are properly causing the appropriate response. Each response must be tested. Also, verify the Outputs to the Customer.		
C.	Verify the AP11 controller Hardwire Shutdowns are set as follows. 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 #6: SW2-5 must be set to ON, only if this input has been enabled in the software. Digital Input #35: SW1-3 must be set to ON, only if this input has been enabled in the software. Parity: at the end of the switch bank is SW2-8, the Parity switch. If one or three of the digital inputs have been set to on, the Parity switch must be set to OFF. If two of the digital inputs have been set to on, the Parity switch must be set to ON. Verify the Jumper Parity LED on the upper right of the circuit board is green. If not, the parity switch must be switched to the opposite position. Note that when the hardwired switches are set, the hardwire jumper LED will turn red unless the circuit is satisfied (wired and continuity exists). The LED will remain red until all of the hardwired circuits are satisfied.		
D.	Verify Supervisory Input (if installed) is landed to Customer Board T9, Pins 3,4 Verify functionality (DI5/6)		
E.	Verify Life Safety Input (if installed) is landed to Customer Board T7, Pins 5,6 Verify functionality (DI35)		
F.	Verify that Source 1 Heater Inhibit is landed to Customer Board T7, Pins 1,2 Verify functionality (DI33) If it is not installed, install a jumper.		
G.	Verify that Source 2 Heater Inhibit is landed to Customer Board T7, Pins 3,4 Verify functionality (DI34) If it is not installed, install a jumper.		
H.	Verify that Source 1 Heater Fault is landed to Customer Board T4, Pins 1 (NO), 2 (C), 3 (NC) Verify Functionality (DO9)		
I.	Verify that Source 2 Heater Fault is landed to Customer Board T4, Pins 4 (NO), 5 (C), 6 (NC) Verify Functionality (DO10)		
J.	Verify that Source 1 Remote Shutdown is landed to Customer Board T4, Pins 7 (NO), 8 (C), 9 (NC). Verify Functionality (DO11)		

K.	Verify that Source 2 Remote Shutdown is landed to Customer Board T4, Pins 10 (NO), 11 (C), 12 (NC). Verify Functionality (DO12)		
L.	Verify that Source 1 Blanket Temperature (if installed) is landed to AP1580 T10 Pins 1(+)/2(-). Confirm temperature displayed on the delivery system is within 2degC of that displayed on BSH eV display.		
M.	Verify that Source 2 Blanket Temperature (if installed) is landed to AP1580 T11 Pins 1(+)/2(-). Confirm temperature displayed on the delivery system is within 2degC of that displayed on BSH eV display.		
N.	Inside AP11, confirm that Limit controller 1 displays ambient temperature.		
O.	(DUAL ONLY) Inside AP11, confirm that Limit controller 2 displays ambient temperature.		
P.	Log into AP11, go to the Analog input test screen. Check that Analog inputs 49, 51, and 52 are reading ambient.		
Q.	If this is a dual heater system, Check that Analog Inputs 50, 53, and 54 are reading ambient.		
R.	Open the lower door for J-Box 1. Confirm J-Box Interlock-1 Alarm.		
S.	Disconnect Thermocouple connector. Confirm Cyl Overtemp-1 Alarm (DGTL-49) On the Analog input test screen, confirm Analog Inputs 49, 51, and 52 are reading 1200degC. Reconnect thermocouple connector and close J-Box 1 door. Clear all alarms.		
T.	(DUAL ONLY) Open the lower door for J-Box 2. Confirm J-Box Interlock-2 Alarm.		
U.	(DUAL ONLY) Disconnect Thermocouple connector. Confirm Cyl Overtemp-2 Alarm (DGTL-50) On the Analog input test screen, confirm Analog Inputs 50, 53, and 54 are reading 1200degC. Reconnect thermocouple connector and close J-Box 1 door. Clear all alarms.		
V.	From AP11 screen, Start Heat on for Y-Cylinder 1. Acknowledge low temperature alarms. Confirm no low blanket current alarms.		
W.	Use a clamp on current meter to measure blanket current in ECC-1. The best time to measure current is immediately after confirming heater start as the software turns the heater on at 100% duty cycle for several seconds to check blanket current. Blanket 1 current:_____ Amps		

X.	With heater 1 turned on, go into the analog input test screen on the AP11. During warmup, inhibit thermocouples AI51 and AI52 will quickly rise to between 45 and 55 degC. Likewise, control TC AI49 and overtemperature TC (LC-1 inside AP11) will rise more slowly indicating container temperature. Any temperatures that fall when heating is an indication that thermocouple wires may be reversed. Record temperatures below. Inhibit TCs: AI51:_____degC, AI52:_____degC Control TC: AI49:_____degC, LC1(inside AP11): _____degC		
Y.	From AP11 screen, Stop Heat on for Y-Cylinder 1.		
Z.	(DUAL ONLY) From AP11 screen, Start Heat on for Y-Cylinder 2. Acknowledge low temperature alarms. Confirm no low blanket current alarms.		
AA.	(DUAL ONLY) Use a clamp on current meter to measure blanket current in ECC-2. The best time to measure current is immediately after confirming heater start as the software turns the heater on at 100% duty cycle for several seconds to check blanket current. Blanket 2 current:_____ Amps		
BB.	(DUAL ONLY) With heater 2 turned on, go into the analog input test screen on the AP11. During warmup, inhibit thermocouples AI53 and AI54 will quickly rise to between 45 and 55 degC. Likewise, control TC AI50 and overtemperature TC (LC-2 inside AP11) will rise more slowly indicating container temperature. Any temperatures that fall when heating is an indication that thermocouple wires may be reversed. Record temperatures below. Inhibit TCs: AI51:_____degC, AI52:_____degC Control TC: AI49:_____degC, LC2(inside AP11): _____degC		
CC.	(DUAL ONLY) From AP11 screen, Stop Heat on for Y-Cylinder 2.		
DD.	**AP11 Z-Purge Pressure Switch (PAL-206/DI2)**: Verify conduit seals are poured. Verify AP11 door is closed and latched. Adjust Z-purge control valve on back of AP11 for the minimum flow required to satisfy DI2 and open ¼ turn further to prevent nuisance alarms. If Z-purge is not going to be used, disable DI2 alarm on AP11.		
EE.	**ECC-1 Z-Purge Pressure Switch (DI45)**: Verify conduit seals are poured. Verify ECC-1 door is closed and latched. Verify supply pressure to ECC-1 is between 85-95 psig. Adjust Z-purge control valve on bottom of ECC-1 for the minimum flow required to satisfy DI45 and open ¼ turn further to prevent nuisance alarms. If Z-purge is not going to be used, disable DI45 alarm on AP11.		
FF.	**ECC-2 Z-Purge Pressure Switch (DI46)**: Verify conduit seals are poured. Verify ECC-2 door is closed and latched. Verify supply pressure to ECC-2 is between 85-95 psig. Adjust Z-purge control valve on bottom of ECC-2 for the minimum flow required to satisfy DI46 and open ¼ turn further to prevent nuisance alarms. If Z-purge is not going to be used, disable DI46 alarm on AP11.		

6. Closeout Section

		Initials or N/A	Date
A.	Copies (hard or soft) of all documents shall be given to Customer / local Versum Materials personnel.		
B.	Copy (hard or soft) of this document shall be given to Customer / local Versum Materials personnel.		
C.	Verify that all Operating Manuals, keys, safety documentation, and extra commissioning spare parts are handed over to Customer or Versum Materials Megasys Operations.		
D.	After completing all information in this document and transcribing it into the electronic format, forward original hand-written document to the Project Engineer of record.		
E.	Document all changes or discrepancies from this procedure/checklist in the Notes Section on the last page. Include as much detail as possible.		
F.	Record all **Calibration Information** for all test equipment used. Record Make, Model Number, Calibration Date, and Calibration Company for all equipment. Insulation Resistance Tester (Megger): Digital Volt Meter: Clamp-On Ammeter: Ground Resistance Tester: Thermocouple Calibrator: 4-20mA Calibrator:		

This BSH eV module was installed in accordance with applicable Versum Materials Engineering Standards and Practices. By signature, this site is ready for final commissioning and startup by the Versum Materials Operations / Customer Operations Startup Team.

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
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