VERSUM MATERIALS

Installation / Operation / Maintenance Manual

CHEMGUARD GenIII BCD

Chemical Equipment

Manual Part Number: 477442

Edition: Rev-3

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Revision Control Summary

Chapter	Revision	File Name
Chapter 1 – Delivery and Inspection	Rev-0	MNL000504.doc
• Initial Release		
Chapter 2 – Site Preparation	Rev-0	MNL000505.doc
• Initial Release		
Chapter 3 – Installation	Rev-2	MNL000506.doc
• Deleted Trickle Purge Pigtail section		
Chapter 4 – Changing Reservoir Container	Rev-0	MNL000507.doc
• Initial Release		
Chapter 5 – Features and Components	Rev-2	MNL000508.doc
• Updated ROR sensor trip point		
Chapter 6 – System Operation	Rev-0	MNL000509.doc
• Initial Release		
Chapter 7 – Maintenance and Calibration	Rev-1	MNL000510.doc
• Added note in section 7.2.5 & 7.2.6		
Appendix G – Models SS2 & SS4 Fire Detector	Rev-3	MNL000115.doc
• Initial Release		
Addendum Y – UVIR Detector	Rev-6	MNL000114.doc
• Initial Release		

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Chapter 1

Delivery and Inspection

Section 1 **Delivery**

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1.1 Delivery

The ChemGuard® Gen III Bulk Chemical Delivery (BCD) may be shipped in multiple packing boxes. The packing slip on the outside of one of the cartons indicates the number of items in the order. A separate Shipping Identification Sheet (SIS), or packing checklist, included with the manuals, identifies all components in the shipment. Before unpacking, make sure your order includes the correct number of packages.

This shipment does not include an empty reservoir container. You will need to order a container or containers containing chemical. The contents of the packing boxes are:

- The ChemGuard® Gen III BCD Cabinet
- Start-up kit (See Packing Checklist included with shipment)
- Shipping Identification Sheet (packing checklist)
- ChemGuard® Gen III BCD Quality Inspection Records

NOTE: Save all cartons (along with foam supports and padding) for re-use in case unit must be returned to Versum Materials, Inc.

1.2 Inspection

Be sure each item on the packing checklist is included in the shipment. Notify Versum Materials, Inc. within 30 days if anything is missing. After 30 days, it is the customer's responsibility to purchase missing or damaged parts.

1. Verify that the part numbers on the items are the same as specified on the Shipping Identification Sheet (SIS).
2. Keep the packing checklist for use in any future communication with Versum Materials, Inc. Customer Service.

Chapter 2

Site Preparation

This chapter describes the space and clearances required to install ChemGuard® BCD systems along with specifications for power, gas, vacuum, cabinet exhaust, reservoir vent and chemical delivery line.

Before the ChemGuard® BCD unit can be installed, the customer must prepare the location site as detailed in the following section to provide sufficient space and clearance around the unit. Ensure the AC power, vacuum and gas sources are available in close proximity to the unit. Please read the information in this chapter carefully to avoid problems later.

The user of this product is responsible for compliance with all applicable environmental laws and regulations including local governing agencies and state/local laws (i.e., Clean Water Act, Clean Air Act, and Hazardous Waste Laws).

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ChemGuard® hazard location groups include Class I, Division II Groups B, C, D (United States) and Group 2, Category 3 ATEX (Europe).

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

2.1 Facility Preparation

Determine a suitable location for ChemGuard® BCD cabinet. Versum Materials, Inc. recommends installing the cabinet in close proximity to:

- Your AC power source
- Your vacuum supply
- Your helium push gas and nitrogen purge gas supplies

Ensure that there is ample space to allow the cabinet doors to open completely and that there is proper clearance around the unit. (See Table 2-1 for required cabinet clearances.) If an optional fire extinguisher is installed, additional clearance may be required.

Table 2-1: Cabinet Clearances

PLACEMENT	DIMENSIONS	CLEARANCES
Height	185.87 cm (73.18 in.) to top of cabinet 205.76 cm (81.01 In.) to top of exhaust duct	35.5 cm (14 In.) above top of cabinet to remove top panel
Width	91.5 cm (36 in.) **NOTE**: If ordered, an additional 53.34 cm (21 in.) on left side is required for an optional fire suppression system	91.5 cm (36 in.) clearance required on left side of (and back) cabinet for electrical code **NOTE**: Provide sufficient clearance around cabinet to gain access to back
Depth	Front to back with doors closed: 108.2 cm (42.6 in.) With doors open: 153.7 cm (60.5 in.)	182.88 (72.0 in.) in front of cabinet required to install container using a hand pallet jack

2.1.1 Bolt-Down and Ground Cabinet Requirements

The ChemGuard® BCD provides four mounting points for seismic/earthquake protection. The mounting points (bolt downs) are located within the area for spill containment to minimize footprint.

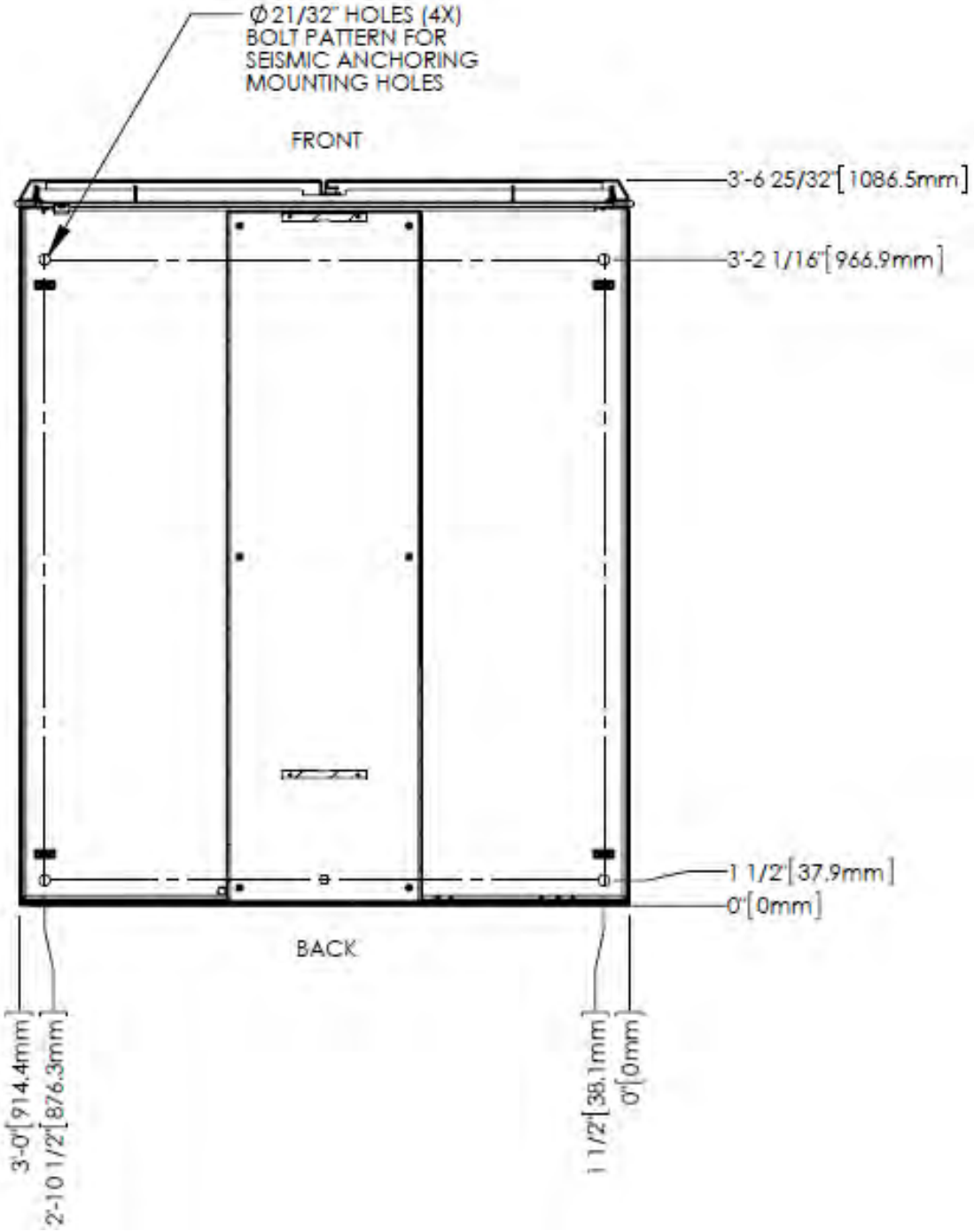
A 12.7 mm (½ in.) bolt with a self-sealing washer should be used for securing and to maintain the containment area.

Set the ChemGuard® BCD cabinet over the bolt-down points and attach securely. Verify ChemGuard® is in a level location where it can be serviced easily, and is out of the main thoroughfare.

Per current United States UBC and SEMI S2-STANDARD requirements, floor bolts must be at least Grade 5 (metric Grade 8.8), at a recommended minimum length of 2.5 in. (6.35 cm).

1. Place the cabinet at the designated location.
2. Verify that there is enough room around the cabinet to fully open the door, or perform maintenance tasks.
3. The ChemGuard® must be grounded in accordance with Article 250 - Grounding, The National Electrical Code 2003. Refer to Figure 2-1 for the location of the grounding lug. Versum Materials, Inc. recommends a ground resistance of <1.0 Ohms.

Figure 2-1: Earthquake Bolt-Down Pattern



2.2 Facility Requirements

When selecting a location for the unit, ensure that the following facilities are available to make connections on top of the cabinet.

- Environmental
- Electrical
- Supply gases
- Vacuum
- Exhaust and Vent
- Chemical Delivery Line
- Outlet Manifold
- Auto Switching BCD Pairs

Figure 2-2: CHEMGUARD® GEN III BCD Cabinet Connections, Top View

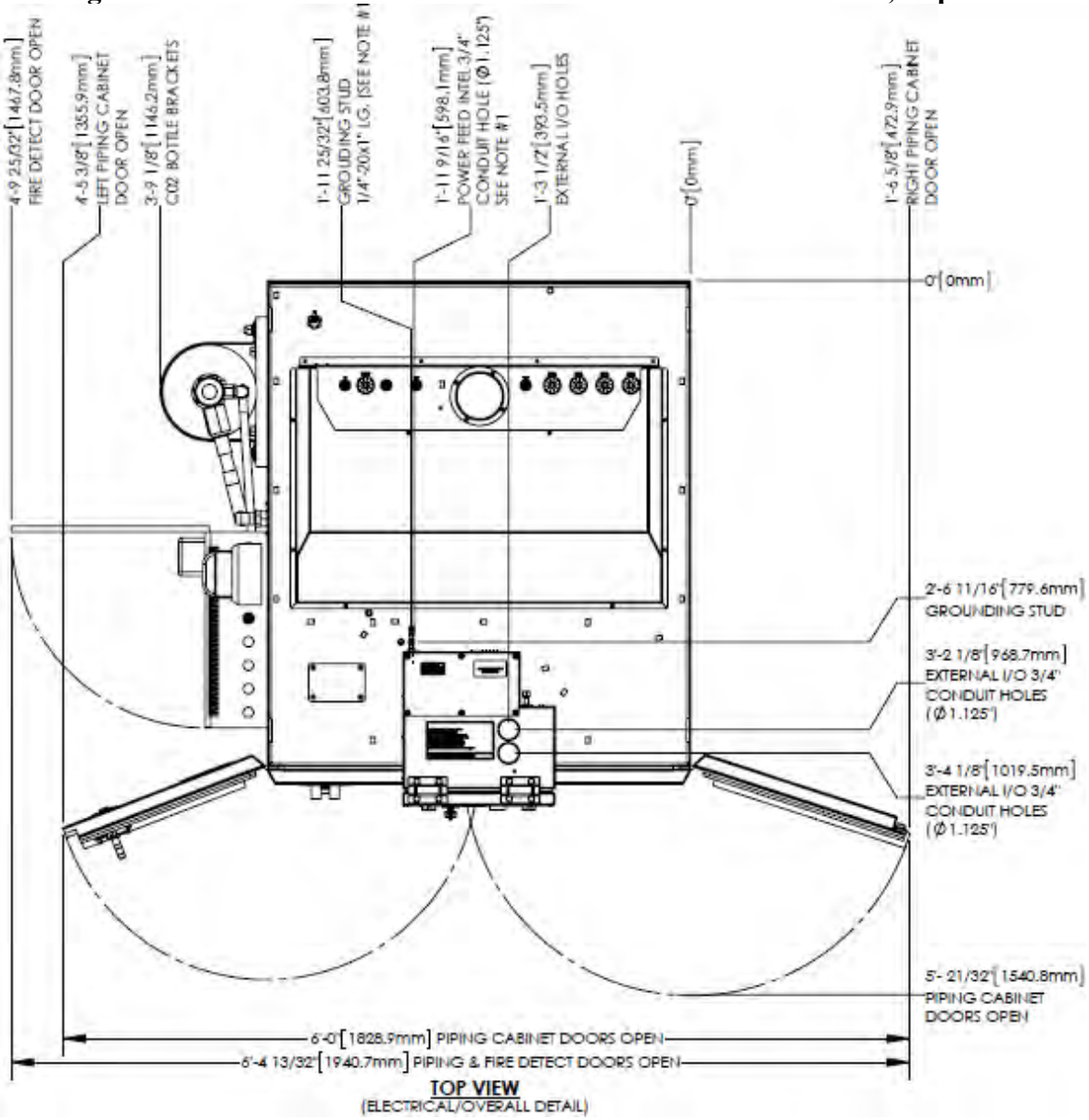


Figure 2-3: CHEMGUARD® GENIII BCD Piping Detail, Top View

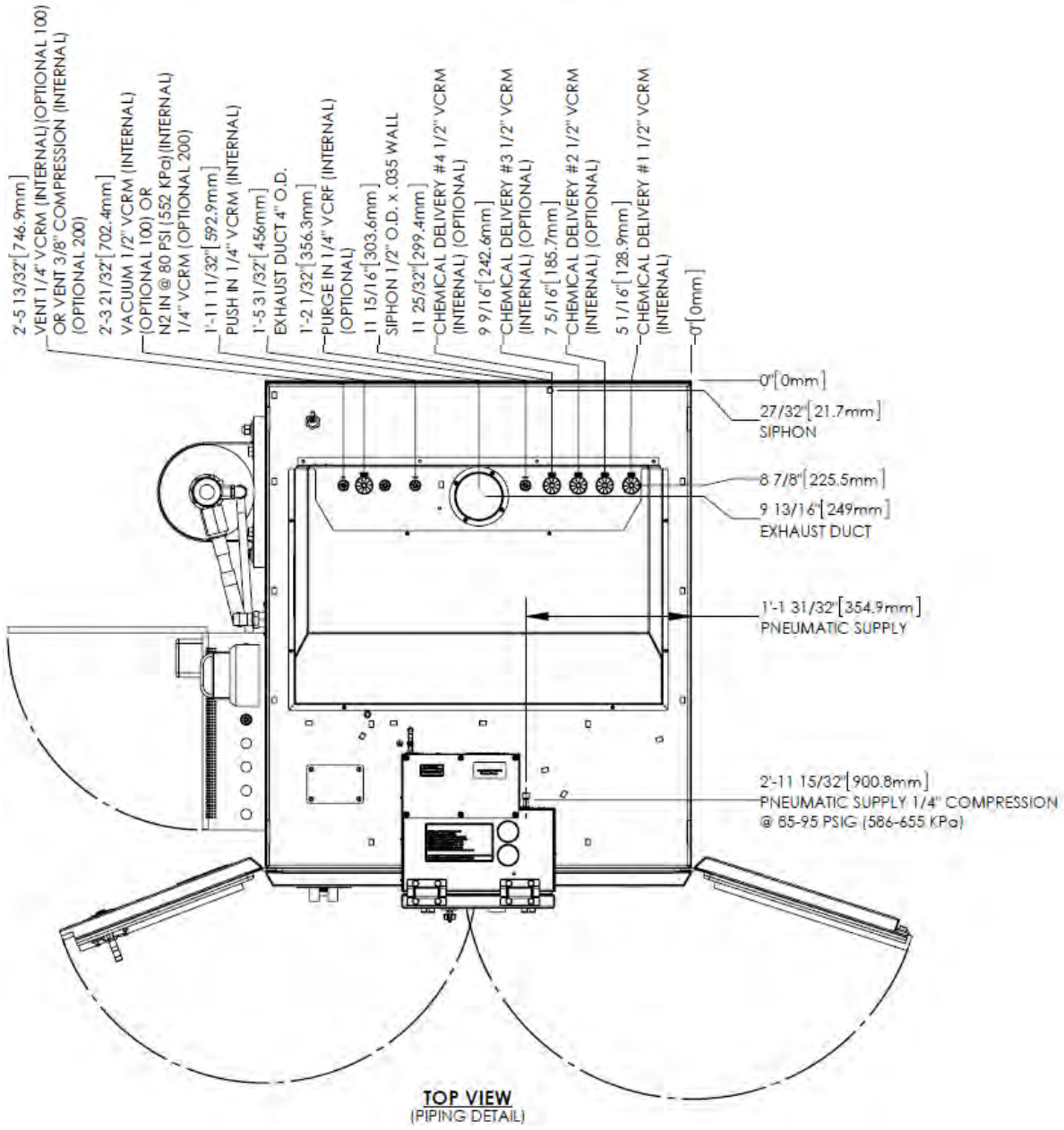


Figure 2-4: CHEMGUARD® GEN III BCD Cabinet Connections, Front View

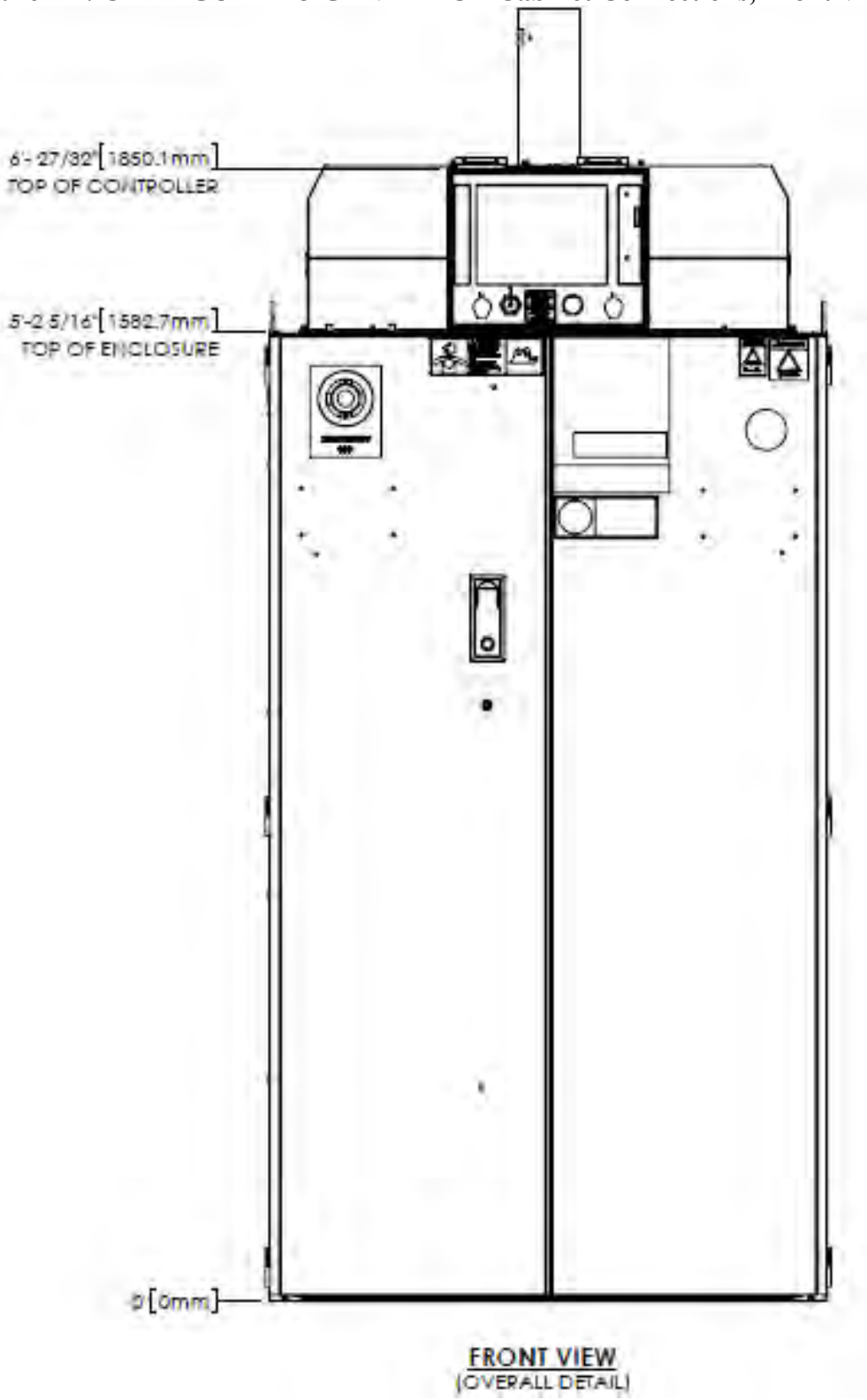


Figure 2-5: CHEMGUARD® GEN III BCD Cabinet Connections, Rear View

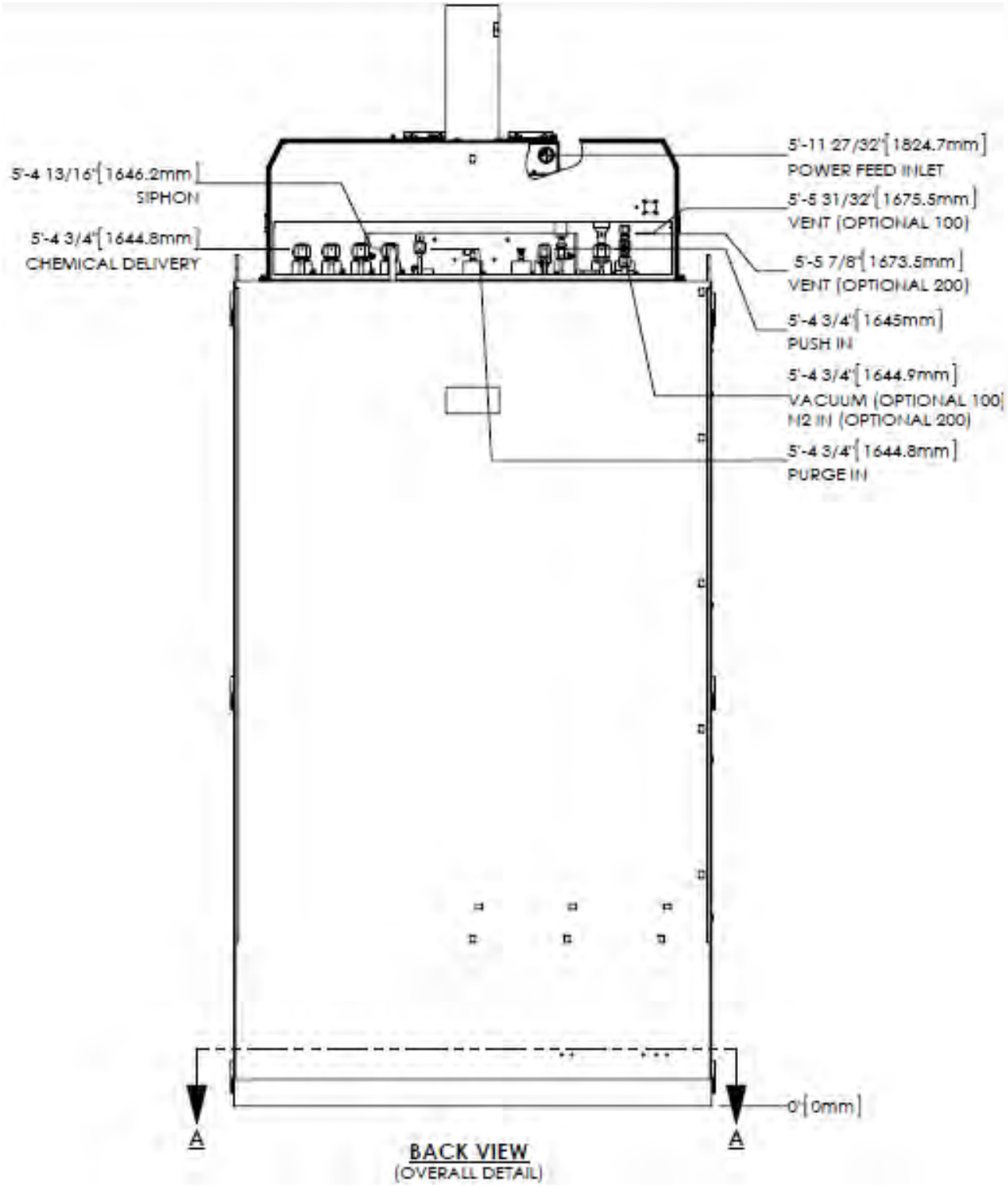
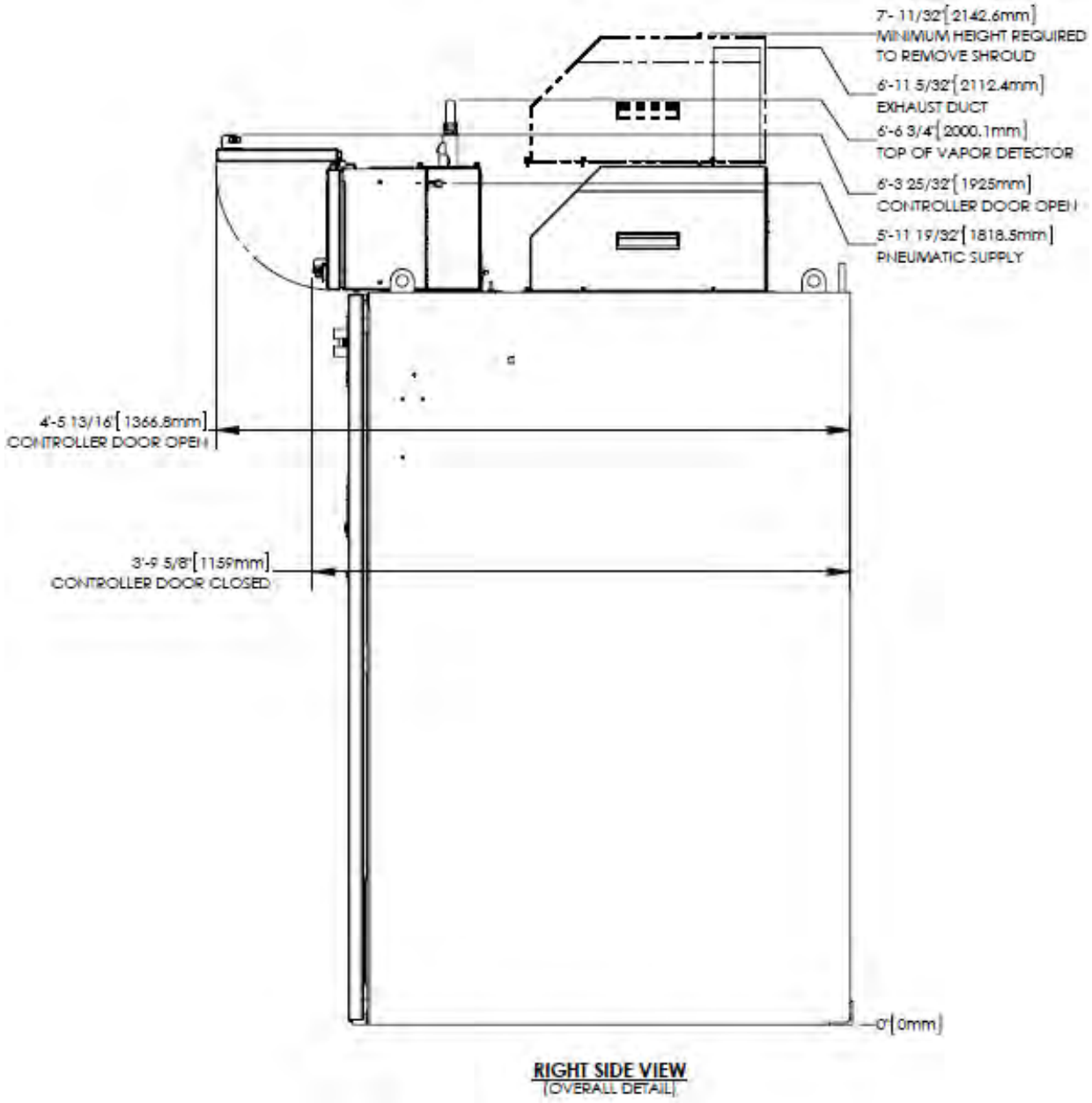


Figure 2-6: CHEMGUARD® GEN III BCD Cabinet Connections, Right View



2.2.1 Environmental Requirements

The customer is responsible for compliance with applicable environmental laws and regulations, including local governing agencies and state/local laws (i.e. Clean Water Act, Clean Air Act, Hazardous Waste Laws).

Table 2-2: Environmental Requirements

CONDITION	RANGE
Environmental	Operating Temperature: 0ºC to 40ºC Humidity: 5% to 95% RH, non-condensing Temperature must be compatible with chemical used.
Lighting	Minimum of 300 lux of illumination

2.2.2 Electrical Requirements

Versum Materials, Inc. recommends connection to an Uninterrupted Power Supply (UPS) and a Ground-Fault Circuit Interrupter (GFCI). Versum Materials, Inc. recommends that customer electrically ground the CHEMGUARD® cabinet and plumbing.

SEMI S2 requires a lockout type circuit breaker setup for the AC power. OSHA standards require customer to install lockout-type, 10K interrupt current (AIC) circuit breaker for AC power. Recommend placement of breaker 1 – 10 meters (3 – 32 ft.) from BCD.

Per SEMI S2 requirements, all electrical work for CHEMGUARD® GEN III is Type 1 and Type 2.

Type 1 = Equipment fully de-energized
Type 2 = Equipment is energized

S2 requires a lockout type circuit breaker setup for the AC power.

WARNING

Live circuits are covered and/or insulated, Lockout / Tagout is required while work is performed at a remote location to preclude accidental shock.

Table 2-3: Electrical Requirements

CONDITION	RANGE
AC Power	100 - 240 VAC, 100 W @ 50 - 60 Hz; Single-Phase, 3 wires; Neutral solidly grounded.

2.2.3 Process Tool Interface and Life Safety Interconnect

The external interface cable hookup between ChemGuard® product line and OEM Tool or Site Area Monitor System is customer responsibility. It is recommended to use multi-conductors shield cable with twisted pairs, 22-20 AWG, 7x30 stranded, rated 300-600V RMS, minimum 7-10 pairs (14-20 conductors) per interface.

Table 2-4: Digital I/O

DIGITAL INPUTS		DIGITAL OUTPUTS	
Input current, On	4.07 mA min.5.3 mA max.	**Resistive Load**	1.0 A @ 30 VDC, 0.5 A @ 120 VDC
Input voltage, On	24.0 VDC ±20%	**Switching Power**	30 W max.
Input current, Off	100 µA max.	**Contact material**	Silver alloy, gold-etched clad
Input voltage, Off	1.0 VDC max.		
Protection	36V Zener		

2.2.4 Supply Gases

The customer is required to supply all gases, filters, check-valves, and regulators. Ensure that the required gases are available in close proximity to the ChemGuard® installation site. (see Chapter 3 for further details). Ensure there are shutoff valves and filters for gas lines feeding the ChemGuard®. Ensure the correct gases are used for the process chemical and the properties of the gas are correct for the process chemical (i.e. dry N2). (See Table 2-5).

To reduce the potential of flow fluctuations, the end-user must properly design the facilities for the ChemGuard®, i.e. incoming gas supplies and chemical delivery line layouts with adequate line size, vertical rise, horizontal length between the ChemGuard® and the refill ChemGuard®s, process tool(s).

To avoid potential process failures here are some guidelines the end users should consider when facilitate ChemGuard® cabinets at central location.

- ChemGuard® cabinets centrally located and within close proximity to the process tool(s) to minimize the vertical and horizontal length of the chemical delivery lines.
- The incoming main gas supply to multiple ChemGuard® cabinets should be properly sized to provide adequate pressure and flow before branching out to multiple ChemGuard® cabinet connection points.
- After the main gas supply has been branched off to the individual ChemGuard® cabinets, Individual gas supply lines are equipped with individual regulators, check valves and isolation valves which have been properly sized to meet the pressure and flow requirements of the process tool(s).

A gas filter is required on the houseline supplying the ChemGuard® push gas. Failure to install a filter will void regulator and valve warranty if failed component found to have particles embedded on the seat.

Minimum filter specifications:

- Filter = 0.003 micron.
- Flow = 50 slpm.
- Material = Electropolished 316L Stainless Steel.
- Membrane = 316L Stainless Steel or PTFE.
- Leak Tested = 100% Helium leak tested to $5x10^{-9}$ atm cc/sec ($3.8x10^{-9}$ Torr L/sec).

WARNING

DO NOT deliver process/purge gases from a high pressure gas cylinder source. The supply gases must be delivered from the house line gas source regulated to no more than 120 psig with flow not greater than 250 slpm.

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

Table 2-5: Supply Gases

PROCESS GAS	**NOTE**: Pressure Transducer used reads in absolute pressure (psia) and not standard gauge pressure (psig). Absolute pressure is the difference between gauge pressure and the atmospheric pressure where the CG BCD is located, as referenced from the elevation at sea level (i.e. absolute pressure minus 14.7 psi equals gauge pressure). Helium gas is Ultra High Pure semiconductor-grade recommended. Water content < 10 ppb and O2 content < 2ppm. Recommended to use Inert Gas Purifier model # SS2500KFI4RR or equivalent. Inert gas such as Nitrogen or Argon or other qualifies gas (Hydrogen for the BCD200) may be used as the process requires. The gas source must be Ultra High Purity and meet the Water and Oxygen content above. Required to install a 0.003 micron gas filter. Regulated to 620 ± 70 kPa (90 ± 10 psig) Cabinet 6.35 mm (¼ in.) male VCR connection Connects to CABINET He IN port with .003 micron filter (See Figure 2-3) **For moisture sensitive chemicals, gas requirements are as follows:** Recommended the Water content < 10 ppb and O2 content < 2ppm. The customer is required to supply all gases with shut-off valves, regulators, check-valves, filters and/or gas purifier in-line feeding the ChemGuard®. Ensure the required gases are available in close proximity to the ChemGuard® installation site. **WARNING:** DO NOT connect high pressure gas cylinder directly to the cabinet process/purge gas ports.
TRICKLE PURGE / VENTURI SOURCE (IF BCD200)	VENTURI SOURCE / PURGE GAS (BCD200) This venturi vacuum source is installed in BCD200 for specific high volatility chemicals with vapor pressures are greater than 100 torr at 20°C. Contact Versum Materials Inc. DS Technical support for additional information.

	Nitrogen gas is pure semiconductor-grade or better is recommended. Water content <10 ppb and O2 content <2 ppm. Recommended to use Inert Gas Purifier model # SS2500KFI4RR or equivalent. Required to install a 0.003 micron gas filter Inlet Pressure: 620 ± 70 kPa (90 ± 10 psig; MAWP 150 psig) at 50 liters per minute Cabinet 6.35 mm (¼ in.) male VCR connection Connect to VENTURI VACUUM IN port **NOTE**: N2 @ 551 kPA results in 100 Torr vacuum with a, minimum 9.4 mm (3/8 in.) vent line The customer is required to supply all gases with shut-off valves, regulators, check-valves, filters and/or gas purifier in-line and overpressure protection feeding the ChemGuard®. Ensure the required gases are available in close proximity to the ChemGuard® installation site.
PURGE GAS (IF OPTIONAL PURGE OUTLET MANIFOLD IS INSTALLED)	Nitrogen gas is Ultra Pure semiconductor-grade or better is recommended. Water content <10 ppb and O2 content <2 ppm. **NOTE**: For Helium reduction option use Nitrogen gas only, do not use Helium gas. Recommended to use Inert Gas Purifier model # SS2500KFI4RR or equivalent. Required to install a 0.003 micron gas filter. Regulated to 140-275 kPa (20-40 psig) with check-valve and 70 psig PRV Cabinet 6.35 mm (¼ in.) female VCR connection Connects to CABINET N2 IN port with .003 micron filter (See Figure 2-3) **For moisture sensitive chemicals, gas requirements are as follows:** Recommended the Water content < 10 ppb and O2 content < 2ppm. The customer is required to supply all gases with shut-off valves, regulators, check-valves, filters and/or gas purifier in-line feeding the ChemGuard®. Ensure the required gases are available in close proximity to the ChemGuard® installation site. **WARNING:** DO NOT connect high pressure gas cylinder directly to the cabinet process/purge gas ports.
PNEUMATIC	Nitrogen gas is semiconductor-grade or better is recommended. Regulated to 620 ± 70 kPa (90 ± 10 psig) Cabinet 6.35 mm (¼ in.) Swagelok connection Connects to PNEUMATIC port, coarse filter recommended (See Figure 2-3) A pneumatic supply of inert gas without oxygen is recommended for our controllers. **It is strongly advised to not use clean dry air for pneumatic supply.** The pneumatic supply may be shared in the controller between the pneumatic solenoids and the enclosure inerting/pressurizing service (Z-purge). Based on results from DC power harness testing, clean dry air may promote the corrosion of electrical connectors for interconnecting power cables. The presence of oxygen enhances the corrosion effect and may result in deterioration of controller performance. The customer is required to supply all gases with shut-off valves, regulators, check-valves, filters and/or gas purifier in-line feeding the ChemGuard®. Ensure the required gases are available in close proximity to the ChemGuard® installation site.

2.2.5 Vacuum Requirements – BCD100 Only

The customer is required to provide a vacuum source to ensure complete removal of vapors and atmospheric gases that invariably enter the ChemGuard® lines during reservoir change operation.

The pump should provide a vacuum pressure of less than 15 mTorr if chemical vapor pressure is < 500 mTorr at 20°C or < 50 mTorr if chemical vapor pressure is > 500 mTorr at 20°C, either by way of the Process Tool vacuum pump or through the use of a stand-alone vacuum pump.

If a stand-alone vacuum is used, Versum Materials, Inc. recommends a dry-vacuum pump. Connect it to the Vacuum IN port on the top of the cabinet. See Figure 2-3.

If Cabinet is sharing vacuum pump with Process Tool, then provide an isolation valve in-line between Cabinet and Tool and/or interlock to allow for maintenance and prevent cross contamination.

Multiple ChemGuard® BCD100 units can be connected to a shared single vacuum pump only when using compatible chemicals. Include isolation valves in-line between ChemGuard® cabinets to allow for maintenance and prevent cross contamination.

When multiple cabinets share a common pump, use the vacuum status outputs and bulk/process vacuum interlock inputs on the AP1614 Tool I/O PCB to prevent multiple ChemGuard® units from using the vacuum pump at same time preventing cross contamination during container change out.

NOTE: BCD200 uses N2 purge venturi as vacuum source for Change Bulk so vacuum pump is not required.

Table 2-6: Vacuum Requirements

VACUUM (BCD100 only)	Recommended customer to evaluate a dry vacuum pump requirement with the pump manufacturer in selection a compatible, adequate and suitable of handling the process chemical and/or solvent liquid as well as vapor. < 15 mTorr pressure for chemicals with a vapor pressure < 500 mTorr at 20°C < 50 mTorr pressure for chemicals with a vapor pressure > 500 mTorr at 20°C Minimum 19.05 mm (3/4 in.) Vacuum line or larger recommended. Connection is 12.70 mm (1/2 in.) male VCR, connects to cabinet VACUUM connection (See Figure 2-2) Isolation valve is recommended. Recommended vacuum line tube size versus distance: • 19.05mm (3/4 in) for distance < 5 meters (15 feet). • 25.40 mm (1.0 in.) for distance < 10 meters (32 feet). • 50.80 mm (2.0 in) for distance < 20 meters (65 feet). • 102.00 mm (4.0 in) for distance < 50 meters (164 feet). **NOTE:** Venturi vacuum sources are not recommended for chemicals with a vapor pressure less than 100 Torr at 20°C

WARNING

WARNING: Pump exhaust contains chemical vapor. Pump exhaust must be connected to the appropriate abatement system for chemical used.

WARNUNG: Die Abgase der Pumpe enthalten chemische Dämpfe. Pumpenabgase müssen über ein für das jeweilig Chemikal geeignetes Abgassystem abgeführt werden.

AVERTISSEMENT: Le tuyau d'échappement de la pompe contient des vapeurs chimiques. Le tuyau d'échappement doit être connecté à un système de réduction adéquat au produit chimique utilize.

WARNING

WARNING: Excess push gas from the Reservoir Container will be saturated with chemical vapor. Secure the vent line to the exhaust, and test to prevent vapors from escaping to the environment.

WARNUNG: Überschüssiges Treibgas vom Vorratsbehälter ist mit chemischen Dämpfen gesättigt. Um ein Austreten dieser Dämpfe in die Umgebung zu vermeiden, muß daher die Entlüftungsleitung an einen Abscheider angeschlossen und getestet werden.

AVERTISSEMENT: L'excès des gaz de poussée venant de la caisse du réservoir se trouve saturé de vapeurs chimiques. La conduite d'évent des gaz doit être installée solidement au scrubber afin d'empêcher ces gaz de s'échapper dans l'environnement.

2.2.6 Vacuum Pump IS Off and Interlock Signals

The vacuum pump is off signal allows ChemGuard® to monitor a health status signal from the vacuum pump. A closed relay contact, or a 24 VDC signal connected to AP1614 indicates the proper operation of the vacuum pump connected to ChemGuard®, Refer to Chapter 3 for signal location.

If the contact is opened or the voltage input is below 0 VDC when beginning a vacuum operation, the cabinet detects a vacuum alarm condition and prevents the vacuum operation to start and A VACUUM PUMP NOT AVAILBLE Alarm text message is displayed on the screen.

The vacuum interlock signal indicates the system is in an operation by another cabinet. An open relay contact, or the voltage input is below 0 VDC to the AP1614 prevents starting a vacuum operation. A Vacuum Pump In-Use Alarm text message is displayed on the screen, Refer to Chapter 3 for signal location.

2.2.7 Exhaust and Vent Requirements

NOTE: Vent line can be installed to the facility exhaust if exhaust is connected to the appropriate abatement system for the chemical used. Versum Materials, Inc. recommends facility exhaust controls/abatement in lieu of on-board (localized) controls/abatement system.

The reservoir vent function allows removal of pressure from the Reservoir Container. The vent should be connected to the appropriate abatement system for chemical used. Ventilation measurements should be made at a distance of four (4) duct diameters from the cabinet.

Versum Materials, Inc. recommends that ducting be made from zinc-plated steel, with operation at static pressure of 0.7 in. of water.

For chemicals authorized for use in ChemGuard® Refer to document V-TSA060, ChemGuard® Chemical Fill Matrix or contact Versum Materials for detail.

NOTE: If your installation has the combustible, lower explosion limit (LEL) vapor-detector option, see facilities requirements.

Table 2-7: Exhaust and Vent Requirements

EXHAUST	101.6 mm (4 in.) diameter circular duct Cabinet Exhaust Flow/Pressure Set Point: 850 Liter/minute (30 CFM) minimum recommended Connect to the appropriate abatement system for chemical used. **It is recommended to install the Exhaust line perpendicular and/or above the main abatement duct. DO NOT ENTER BELOW THE MAIN ABATEMENT DUCT TO AVOID LIQUID TRAP (See Below).**
VENT	Connect to the appropriate abatement system for chemical used. Cabinet 6.35 mm (¼ in.) Swagelok connection. Connects to VENT port (See Figure 2-2) **Vent line is to be connected directly to the main abatement duct and not the ChemGuard® exhaust duct.** **It is recommended to install the Vent line perpendicular and/or above the main abatement duct. DO NOT ENTER BELOW THE MAIN ABATEMENT DUCT TO AVOID LIQUID TRAP (See Below).** **NOTE**: Certain chemicals, having high vapor pressures and low ignition energies could potentially ignite in the vent header downstream from the ChemGuard® cabinet when exposed to atmospheric Oxygen. For such chemicals either the exhaust must be routed to a burn box or the deluge trickle flow option must be specified. Contact Versum Materials, Inc. for detail.

2.2.8 Chemicals Authorized for Use in CG GenIII BCD

For physical hazards and hazard thresholds associated with these chemicals, contact Versum Materials, Inc. for SDS information for each chemical type. It is the customer's responsibility to comply with OSHA Hazard Communication Standards regarding chemical container labeling and cabinet labeling. Versum Materials, Inc. advises customer to affix a label outside the ChemGuard® BCD cabinet identifying the chemical being used.

Use of chemicals in ChemGuard® BCD may fall under the guidelines of specific government agencies. It is the user's responsibility to determine and comply with appropriate guidelines for specific chemicals used.

Versum Materials, Inc. recommends that the exhaust connection to the ChemGuard® BCD be a facility-based control.

Table 2-8: Chemical Exhaust, Vent and Container Requirements

ABBREVIATION	CHEMICAL NAME	VAPOR PRES; Torr	REQUIRED EXHAUST	CONTAINER REQUIRED
TEOS	Tetraethyl-orthosilicate	1.2	1	BK200000SGS
Z4MS	TetramethylSilane	602	1	BK190000SJA
ZTOMCATS™	Tetramethyl-cyclotetraSiloxane	7	1	BK200000SGA
BTBAS	Bis(tert-butylamino)silane	1.1	1	N/A
TCS	Trichlorosilane	400	1	N/A
GECL	Germanium tetrachloride	76	2	N/A
SICL	Silicon tetrachloride	195	2	N/A

NOTE: Connect exhaust vent to the appropriate abatement system for chemical used. There are no significant expected exposure levels from residue in the exhaust system.

1. Organic scrubbed exhaust @ 30 cfm, using activated carbon scrubbers.
2. Inorganic scrubbed exhaust @ 30 cfm.

2.2.9 Chemical Delivery Line Requirements

The end user must have knowledge of process flow requirements, prepare flow calculations for sufficient flow and have a carefully designed layout plan for the installation of the ChemGuard® cabinet – preferably at a central location where the facilities will meet the process tool requirements. Proper facilitation and installation will reduce and avoid potential failures, tool downtime and rework costs.

Chemical delivery line to each fill point, i.e. Liquid VMB, ChemGuard®, process tool(s) should be designed and install with minimum distance in vertical rise (height) and horizontal length between ChemGuard® cabinet and the process tool(s) to meet process operating pressure and flow rate required of the process tool(s). Refer to Chemical Delivery Line Requirements Position Paper DOC000140.

NOTE: All chemical delivery line requirements are the customer's responsibility. Versum Materials, Inc. recommends installing coaxial Chemical Delivery Lines. Versum Materials, Inc. recommends customer install a lockable shutoff valve on the chemical delivery line, to comply with OSHA lockout/tagout requirements.

The customer provides the chemical delivery line. All bends should meet SEMATECH standards for bend radius.

The chemical line should be helium leak-checked, purged, cleaned and certified prior to installing and chemical introduction.

The chemical delivery line is connected to the chemical output manifold and is then directed to the Process Tool's chemical input manifold.

Table 2-9: Chemical Delivery Line Requirements

CHEMICAL DELIVERY LINE	12.70 mm (1/2 in.) male VCR connection 316L stainless steel, electro-polished line. Connects to Chem Delivery 1-4 (See Figure 2-3) Bends should meet SEMATECH standards for bend radius. Versum Materials, Inc. recommends inside electro-polish rating 10RA maximum. Chemical Line should be Helium leak-checked, purged, and cleaned before installing ChemGuard.
Optional Outer Coaxial Line	Optional Outer Coaxial Line (if required by customer or local regulations): 19.5 mm (3/4 in.) stainless steel. Bends should meet SEMATECH standards for bend radius.

2.2.10 Installing the Optional Coaxial Chemical Delivery Lines

The Optional Coaxial Chemical Delivery Lines comprised of:

- Outer line, 19.50 mm (3/4 in.) stainless steel line.
- Inner line, 12.70 mm (1/2 in.) stainless steel line.

Specification for outer lines

- Stainless steel line
- The line should be welded
- Sharp edges should be removed and de-burred at breaks in the line to prevent stainless steel inner line from being scratched or torn when routing through the outer line.
- Type of fittings, connection tie offs, and line purge requirement is end-user responsibility.

2.2.11 Chemical Bulk Refill Line (Optional)

The chemical refill line is an additional line, routed on top of the ChemGuard®. It allows the BULK reservoir container to be filled from an external source (i.e., ChemGuard® BCD100 cabinet).

Table 2-10: Chemical Bulk Refill Line Requirements

CHEMICAL Bulk Refill LINE	6.35 mm (¼ in.) male VCR connection 316L stainless steel, electro-polished line. Connects to External Refill Line (See Figure 2-3) Bends should meet SEMATECH standards for bend radius. Versum Materials, Inc. recommends inside electro-polish rating 10RA maximum. Chemical Refill Line should be Helium leak-checked, purged, and cleaned before installing ChemGuard®. Optional Outer Coaxial Line (if required by customer or local regulations): 12.7 mm (½ in.) stainless steel.

2.2.12 Output Manifold

The Output Manifold option allows the ChemGuard® to feed chemical up to four (4) tools simultaneously. Manual purge of the house lines is also available. A variety of manifolds are available, connected by 12.70 mm (1/2 in.) VCR fittings. Consult your Versum Materials, Inc. sales representative for further details.

2.2.13 Auto Switching BCD Pairs

The ChemGuard® BCD can be configured for auto switching when facilities are consuming high volumes of chemical. Two ChemGuard® BCD cabinets can be configured together to provide continuous supply of chemical with zero percent (0%) down time.

Thru software management two ChemGuard® BCDs are configured together with one designated as the primary cabinet and the other as the secondary cabinet. The primary cabinet will be placed in fill operation while the secondary cabinet will be on standby. Once the Bulk Container of the primary cabinet goes empty, thru digital IO signals connecting the two cabinets together, the primary cabinet will be removed from the fill operation and will switch to the secondary cabinet. The secondary cabinet will now be placed in fill and continue to deliver chemical without interruption.

A Change Bulk operation can now be performed on the primary cabinet. Once Change Bulk is completed the primary cabinet is placed back on line and will go to the standby mode. When the Bulk Container of the secondary cabinet goes empty the secondary cabinet will be removed from the fill operation and will switch to the primary cabinet.

When configuring the chemical delivery lines, connecting the chemical line between ChemGuard® BCDs will provide line containment within the cabinets and avoid having to install a separate Liquid VMB cabinet. Figure 2-7 and Figure 2-8 shows one example which allows for 6 external fill points from the auto switching pairs. Figure 2-9 and Figure 2-10 shows the auto switching pair filling to an external 8X Liquid VMB.

There are many combinations that can be used. Contact Versum Materials if additional information or guidance is required.

Figure 2-7: Auto-Switching Pair with Primary Cabinet in Fill

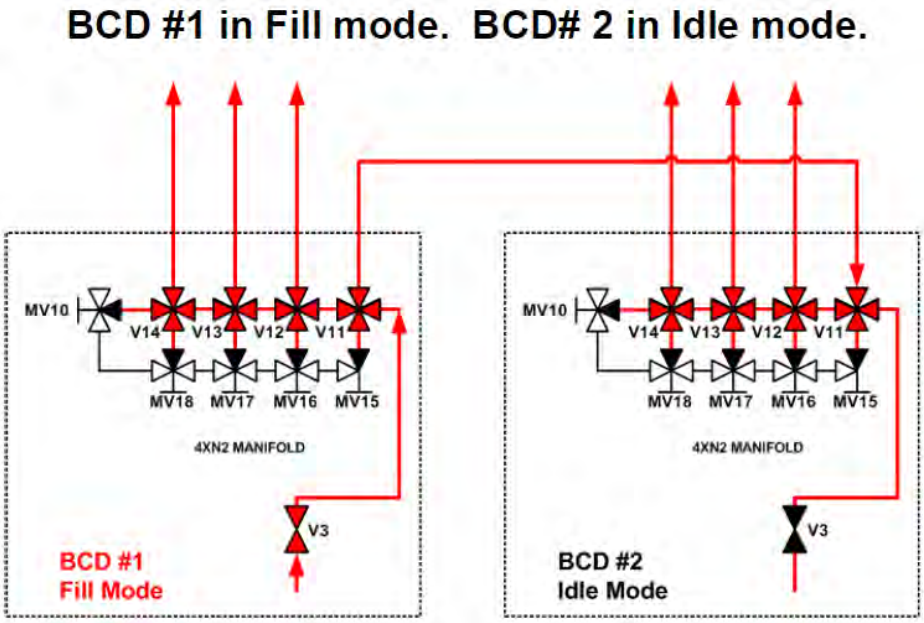


Figure 2-8: Auto-Switching Pair with Secondary Cabinet in Fill

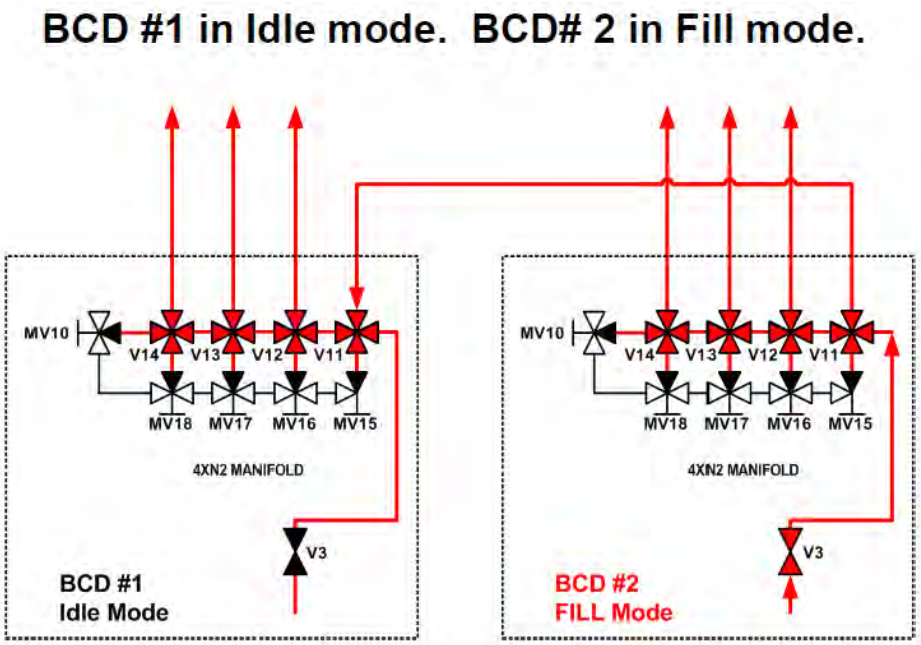


Figure 2-9: Auto-Switching Pair with Primary Cabinet Filling to LVMB

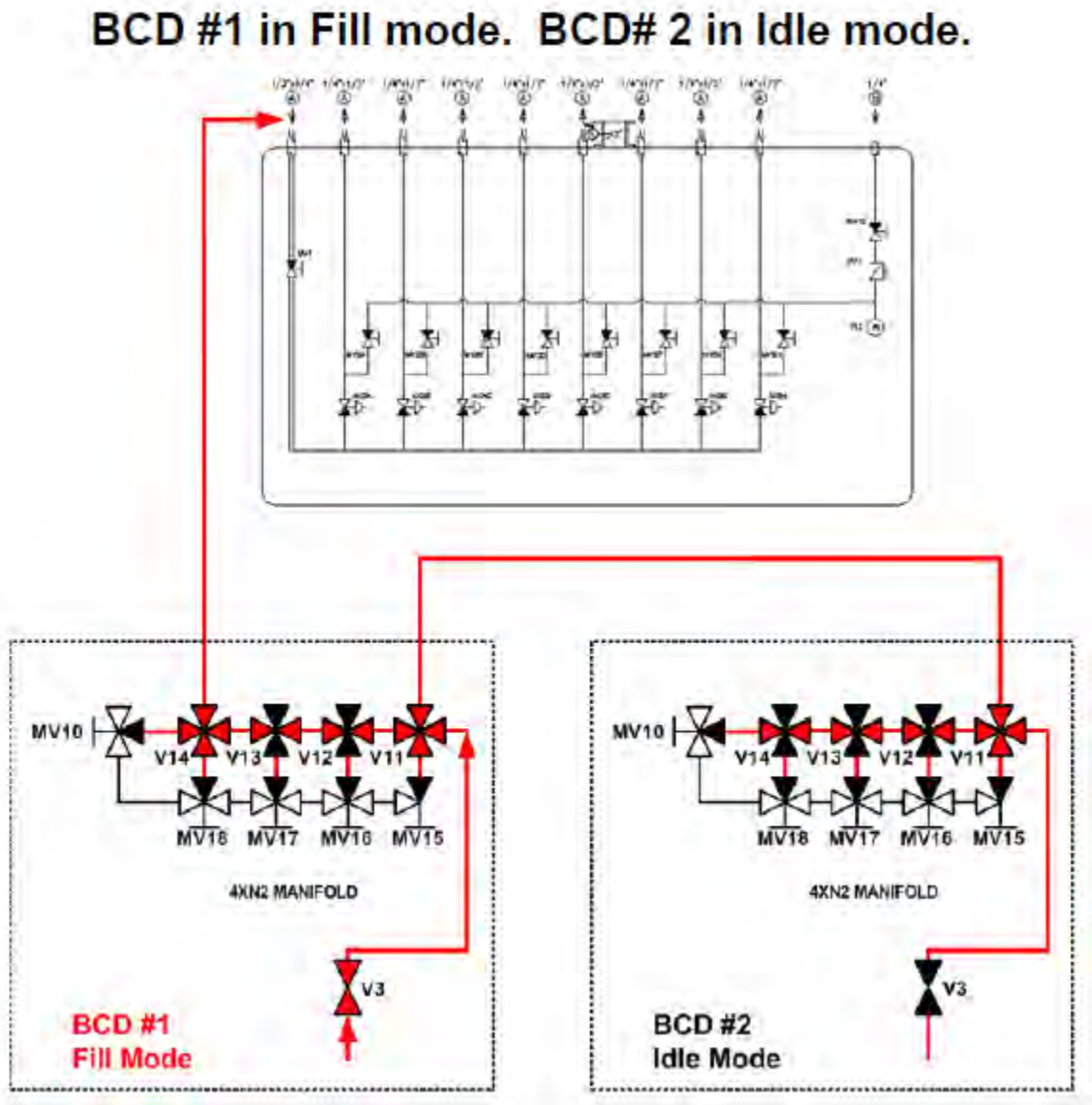
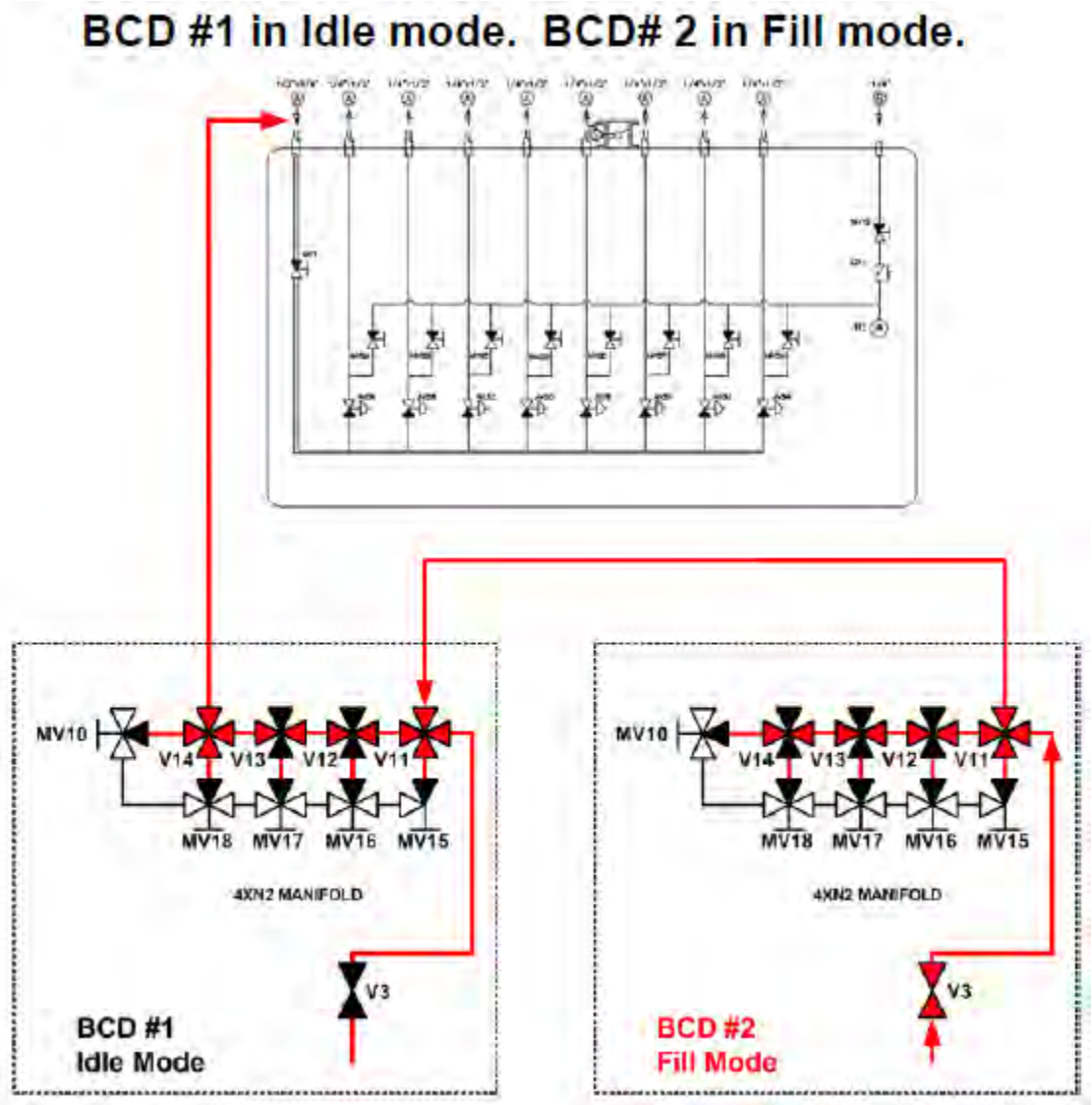


Figure 2-10: Auto-Switching Pair with Secondary Cabinet Filling to LVMB



2.3 Tag and Lockout Routine

When performing certain maintenance procedures described in this manual, electrical power to the ChemGuard® must be de-energized, using site lockout/tag out procedures.

Consult your company's safety procedures for tagging and lockout instructions to be followed when performing such maintenance.

It is the customer's responsibility to ensure compliance with local electrical regulations external to the equipment.

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.

2.4 Spill Cleanup Routine

In dealing with chemical spills/mitigating releases, always use proper personal protective equipment, including gloves, face and eye protection, respirators, and protective clothing. Due to various factors in each spill incident, it has been determined unsafe to provide generic spill instructions for each type of chemical delivered by ChemGuard® cabinets. For example, two spills of the same type of chemical could have two different spill procedures. Therefore, in the event of a spill, we recommend immediately contacting Versum Materials, Inc. EH&S department at **1-866-624-7677** (Chemical Emergency Option) or **1-760-931-9555** for specific chemical spill recommendations and environmental regulatory information. It is the responsibility of the customer to follow their EH&S procedures for hazardous material cleanup.

SDS (MSDS) for all Versum Materials, Inc. chemicals are available from Versum Materials, Inc. EH&S department.

In addition, consult your company's environmental hazard/safety procedures for specific instructions to be followed in the event of a chemical spill from ChemGuard® GEN III.

Chapter 3

Installation

Section 13 System Leak Check – BCD200

Section 14 Finishing the ChemGuard® Installation

3.1. Introduction

This chapter describes the installation of ChemGuard® GEN III BCD cabinet.

Because each customer application may vary, these instructions are provided as a guideline and should not be considered as comprehensive. Please do not begin installing the ChemGuard® BCD unless trained individuals are present.

The ChemGuard® BCD comes pre-calibrated and cabinet-tested. The ChemGuard® BCD Bulk Scale, dual float spill detector, combustible vapor detector (option), and UVIR (option) are setup prior to leaving the factory. These items should not require calibration during installation. Please contact Versum Materials, Inc. if any of these components do not function properly.

NOTE: When highly flammable chemicals are used and present within the equipment you must:

- Ensure the all connections made to the cabinet are leak tight.
- Use an inert gas purge to dilute the concentration of highly flammable vapors in the exhaust header to which the vent piping is connected.
- Use an inert gas purge to the vacuum pump gas ballast connection, BCD100 only.

3.2. Reference Documents

For facilities inspection, pre-startup and commissioning procedure and check-off/sign-off lists refer to:

- **SW017057**_BCD100 and BCD200 Installation Drawing
- **DOC000191**_for the ChemGuard® GEN III P&ID Drawing
- **V-TSA054**_BCD100 GEN III Installation, Startup, Commissioning Procedure and Check List
- **V-TSA055**_BCD100 GEN III Commissioning Check List
- **V-TSA056**_BCD200 GEN III Installation, Startup, Commissioning Procedure and Check List
- **V-TSA057**_BCD200 GEN III Commissioning Check List
- **V-TSA060**_Chemical Maximum Fill Value Table

3.3. Installation

3.3.1. Pre-installation

This chapter describes items that should be identified and resolved prior to installing ChemGuard® BCD.

The end user must have knowledge of process flow requirements, prepare flow calculations for sufficient flow and have a carefully designed layout plan for the installation of the ChemGuard® cabinet – preferably at a central location where the facilities will meet the process tool requirements. Proper facilitation and installation will reduce and avoid potential failures, tool downtime and rework costs.

Chemical delivery line to each fill point, i.e. Liquid VMB, ChemGuard®, process tool(s) should be designed and install with minimum distance in vertical rise (height) and horizontal length between ChemGuard® BCD cabinet and each fill point to meet process operating pressure and flow rate required of the process tool(s).

- The maximum range that a standard ChemGuard® BCD can deliver chemical is dependent on the chemical and the pressure of the push gas. Contact Versum Materials, Inc. for any specific delivery requirements beyond 250 meters of horizontal run and 10 meters of vertical run. These distances could be increased contingent on bends and valve count in the system.
- Install ChemGuard® BCD using the earthquake bolt down points. Verify that the location has the stability and strength to permit the installation of support bolts.
- Verify AC power is available for ChemGuard® BCD. (Power requirements are described in Chapter 2)
- Verify all required gases are delivered to an area near the final position of ChemGuard® BCD. (Refer to Chapter 2)

NOTE: All chemical delivery line requirements are the customer's responsibility.

- Gases required for ChemGuard® BCD cabinet operation are described in Chapter 2.
- The ChemGuard® BCD100 requires vacuum in order to ensure complete removal of chemical vapors or atmospheric gases from the lines during a reservoir change operation.

NOTE: The customer must provide the vacuum source which is a requirement to operate the cabinet.

- The ChemGuard® BCD200 uses N2 venturi vacuum in order to ensure complete removal of chemical vapors or atmospheric gases from the lines during a reservoir change operation. Venturi vacuum sources are not recommended for chemicals with a vapor pressure less than 100 Torr at 20°C.
- The ChemGuard® requires an exhaust flow of 30 CFM. In addition to cabinet exhaust, ChemGuard® contains a reservoir vent function that permits the removal of pressure from the reservoir container. This vent should be connected to the appropriate abatement system for the chemical used.

- Coaxial chemical delivery lines are recommended for all process chemicals. In the event that a leak or rupture occurs in the main delivery lines, the liquid will be contained and be prevented from entering the environment.
- The liquid from any leak will be contained in the ChemGuard® cabinet and be detected by the spill detector, and container then relieved to prevent any further spillage.

3.3.2. Available Configurations

The number and type of refill equipment installed may limit the setup configuration of ChemGuard® BCD. Also to consider is the volume of chemical to be consumed. This may warrant setting up the ChemGuard® BCD in an auto switching configuration, refer to Chapter 2. Before configuring to the refill equipment, i.e., Liquid VMB, ChemGuard®, process tool(s) contact Versum Materials if additional information or guidance is required.

3.4. Installing the ChemGuard® BCD Cabinet

Verify that the cabinet is in a level location with enough clearance around it so that its doors can be fully opened and so that it can be serviced easily.

Set the ChemGuard® cabinet over the bolt-down points and attach securely.

Per current United States UBC and SEMI requirements, floor bolts must be at least Grade 5 (metric Grade 8.8), at a recommended minimum length of 2.5 in. (6.35 cm).

The ChemGuard® must be grounded in accordance with Article 250 - Grounding, The National Electrical Code 1993. See Chapter 2 for the location of the grounding lug. Versum Materials, Inc. recommends a ground resistance of <1 Ohms.

3.4.1. Electrical Connections

Versum Materials, Inc. recommends that the customer electrically ground ChemGuard® cabinet and plumbing. OSHA standards require customer to install lockout-type circuit breaker for AC power. Per SEMI S2-93A requirements, all electrical work for ChemGuard® GEN III is Type 1 and Type 2.

Type 1 = Equipment fully de-energized.
Type 2 = Equipment is energized.

Live circuits are covered or insulated. Work is performed at a remote location to preclude accidental shock.

3.4.2. Electrical Requirements

AC POWER:
100 - 240 VAC, 100 W @ 50 - 60 Hz; Single-Phase, 3 wires; Neutral solidly grounded.

OSHA standards require customer to install lockout-type circuit breaker for AC power. Versum Materials, Inc. recommends an over current protection of 10,000 Ampere Interrupt Capacity (AIC) be provided in close proximity to the unit.

WARNING

WARNING: Electrical connections should be made by a qualified electrician. AC power junction box requires Lock-out Tag-out ON/OFF capability. ½’ AC power conduit hole exits top of cabinet.

WARNUNG: Elektrische Anschlüsse sollten nur durch qualifizierte Elektriker hergestellt werden. Wechselstrom-Verteilerkästen müssen einen EIN/AUS-Schalter zur Verriegelung bzw. Isolierung besitzen. Oben am Schrank wird ein ca. 15 cm (0,5 Fuß) langes flexibles Schutzrohr für Wechselstromleitungen herausgeführt.

AVERTISSEMENT: Les connexions électriques doivent être réalisées par un électricien qualifié. La boîte de dérivation de courant alternatif requiert une capacité de connexion et déconnection "ON/OFF". 15 cm (0,5 pieds) du tube souple de courant alternatif ressort du haut de la boîte.

WARNING

WARNING: Failure to follow the procedure for connecting the AC line voltage could result in injury to operator and damage to the ChemGuard unit.

WARNUNG: Nichteinhalten des Verfahrens zum Anschluß der Wechselstromspannung kann zu Verletzungen des Bedienpersonals und Beschädigung der ChemGuard -Einheit führen.

AVERTISSEMENT: Ne pas se conformer aux procédés pour le raccord de la conduite de voltage CA peut causer un danger pour l'opérateur et des dégâts à l'appareil ChemGuard.

WARNING

WARNING: To prevent electrical shock, the ChemGuard cabinet must be earth-grounded. Electrical connections should be made only by a qualified electrician.

WARNUNG: Um elektrische Schläge zu vermeiden, muß der Schrank des ChemGuard geerdet werden. Elektrische Anschlüsse sollten nur durch qualifizierte Elektriker hergestellt werden.

AVERTISSEMENT: Pour éviter tout choque électrique, la boîte ChemGuard doit être reliée à la masse. Les raccords électriques doivent être seulement exécutés par.

3.4.3. Connecting Line AC Power

WARNING

WARNING: Do not connect AC power to live line voltage until all electrical connections have been made and protective covers installed.

WARNUNG: Die Wechselstromleitung erst nach Erstellung aller elektrischen Anschlüsse und Einbau der Schutzabdeckungen an das Netz anschließen.

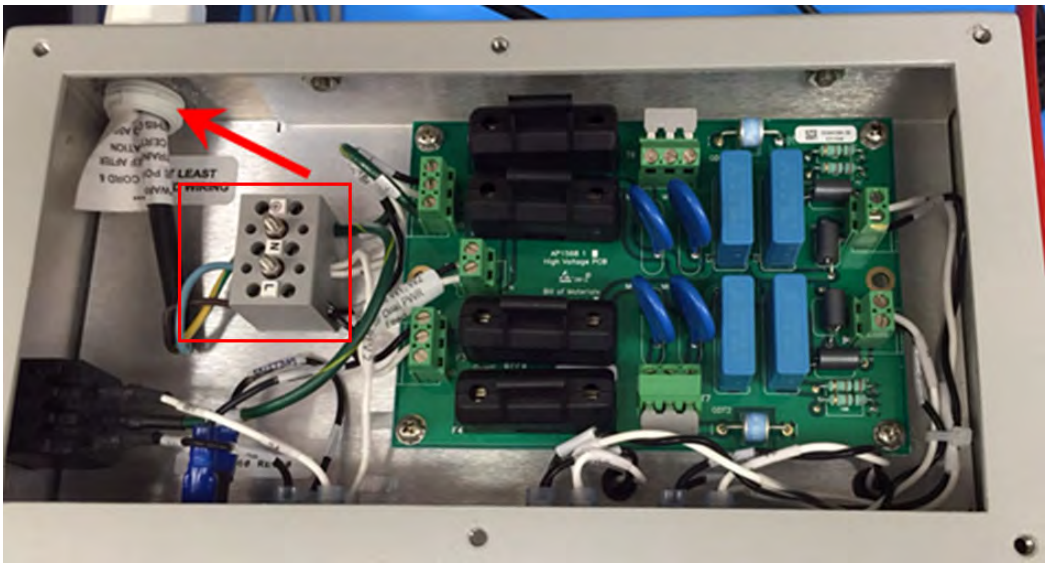
AVERTISSEMENT: Ne pas raccorder le cordon secteur à une tension d'une ligne active jusqu'à ce que tous les raccordements électriques aient été accomplis et tous les couvercles protecteurs installés.

Figure 3-1: Rear view of Conduit Power Entrance

WARNING
ELECTRICAL HAZARD

A ¾" conduit hole is supplied for connecting the 100-240 VAC AC line to the cabinet. The conduit hole is located on the upper back wall of the controller enclosure, red arrow. The power input must be wired to the terminals shown below, in red box.

Figure 3-2: Single Power Feed / Dual Supply Terminal Connection



NOTE: For dual incoming AC power feed systems, two (2) din rail terminal blocks will be installed. Two separate power inputs will route thru the conduit hole and connect to the individual terminal blocks.

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

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 ChemGuard® 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.

NOTE: For Systems approved for installation and use in Explosive Atmospheres (Europe), refer to Chapter 4 for additional instructions.

WARNING

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

External cabling that runs between the ChemGuard® and other pieces of customer equipment must be shielded. The shield must be single point grounded at the customer end of the cable. If the cable is over 10m in length, it must be routed in grounded metallic conduit.

Replaceable fuses - F1, F2, F3, and F4 located on the power board are 4A super quick acting fuses. Also, when a degasser pump is present, a Schurter, PN 7022.0700 10A/ 500VAC Super Quick Action fuse is located on the inside of the controller.

3.4.4. USP Port Blocker

ChemGuard® controller software files may need to be modified to customize the system or add optional features.

When loading new software files onto the ChemGuard® a USB thumb drive is required to do so. A 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 3-3 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 controller door.

Safety standards require that the front-panel USB port be tool accessible. To meet the standard, a Lindy USB Port Blocker, Figure 3-4 will be factory installed on all controllers. In order to use the USB port, the USB Port Blocker plug must be removed using a Lindy key. Remember, electrical devices should never be operated, connected to, or disconnected from the USB port unless the area surrounding the equipment is known to be free of flammable material. When finished using the USB port, the USB Port Blocker plug must be reinstalled along with the USB cover.

Figure 3-3: Electrical Warning Label

Figure 3-4: Lindy USB Port Blocker and Key

3.5. Connecting ChemGuard® BCD Gas Lines

The customer is required to supply all gases with shut-off valves, regulators, check-valves, filters and/or gas purifier. (See Chapter 2 for further details.)

Ensure there are shutoff valves and filters for gas lines feeding the ChemGuard® cabinet.

WARNING

WARNING: System pressures above 120 psig exceed the rating of Versum Materials, Inc. chemical containers.

WARNUNG: Bei Systemdrücken über 120 psig werden die Nennwerte für die Chemikalienbehälter der Fa. Versum Materials, Inc. überschritten.

AVERTISSEMENT: Les pressions du système dépassent l'échelle des récipients Versum Materials, Inc. au delà de 120 psig (827,76 kg/cm2).

CAUTION

CAUTION: Use of a dry vacuum pump is strongly recommended. If an oil pump is used, provide trapping mechanism to minimize chemical vapor mixing with pump oil and molecular flow of oil back into mechanism.

VORSICHT: Der Einsatz einer Trockenvakuumpumpe wird unbedingt empfohlen. Wird jedoch eine Ölpumpe eingesetzt, so muß eine Scheidevorrichtung angebracht werden, um das Vermischen der chemischen Dämpfe mit dem Pumpenöl und eine Molekularströmung des Öls zurück zum Abscheider so gering wie möglich zu halten.

ATTENTION: Il est fortement recommandé d'utiliser une pompe à vide à air sec. Si une pompe à huile est utilisée, prévoir un mécanisme de rétention pour réduire au minimum tout mélange de vapeurs chimiques avec l'huile de la pompe et tout reflux moléculaire de l'huile au mécanisme de rétention.

CAUTION

CAUTION: Only one (1) ChemGuard should be open to the vacuum source at a time. Do not operate in any mode that requires using the vacuum concurrently in multiple ChemGuards. Possible cross-contamination could result.

VORSICHT: Es sollte nur jeweils eine (1) ChemGuard -Einheit zu einer Unterdruckquelle offen sein. Der Betrieb darf nicht in einem Modus stattfinden, der Saugdruck in mehreren ChemGuard -Einheiten gleichzeitig erfordert, da dies zu gegenseitiger Kontamination führen kann.

ATTENTION: Seulement un (1) ChemGuard doit s'ouvrir à la source d'aspiration à un moment donné. Ne pas l'opérer sous aucun mode qui exige l'utilisation simultanée d'aspiration dans des ChemGuard multiples. Une contamination croisée peut en résulter.

3.5.1. Chemical Delivery Line Requirements

NOTE: All chemical delivery line requirements are the customer's responsibility.

Table 3-1: Chemical Delivery Line Connections

CHEMICAL DELIVERY LINE	CONNECTS TO VALVE	VALVE CONTROL
Chemical Delivery Line #1	Valve V11	Electrically controlled by Process Tool. Table 3-4 & Table 3-5
Chemical Delivery Line #2	Valve V12	Electrically controlled by Process Tool. Table 3-4 & Table 3-5
Chemical Delivery Line #3	Valve V13	Electrically controlled by Process Tool. Table 3-4 & Table 3-5
Chemical Delivery Line #4	Valve V14	Electrically controlled by Process Tool. Table 3-4 & Table 3-5

Table 3-2: Purge Valve on Chemical Delivery Lines

INDIVIDUAL PURGE CHEMICAL DELIVERY LINE	CONNECTS TO VALVE	VALVE CONTROL
Chemical Delivery Line #1	MV15	Manually operate.
Chemical Delivery Line #2	MV16	Manually operate.
Chemical Delivery Line #3	MV17	Manually operate.
Chemical Delivery Line #4	MV18	Manually operate.
COMMON PURGE CHEMICAL DELIVERY LINE	**CONNECTS TO VALVE**	**VALVE CONTROL**
Common Purge Line 1-4	MV10	Manually operate.

NOTE: These valves are normally closed during normal flow of chemical to the Tools.

3.5.2. Change Bulk Helium Reduction (Option) – ChemGuard® BCD100

The Change Bulk Helium Reduction option provides N2 purge gas to the Bulk Inlet/Outlet pigtails when conducting a Change Bulk operation. N2 purge spool connects into the Helium line with an isolation valve, V18 which opens during several Change Bulk purge steps reducing Helium supply gas.

The Change Bulk Helium Reduction spool connects to the N2 inlet port of the 4XN2 manifold. Purge gas to the manifold must be N2. This feature is only available on ChemGuard® BCD100.

NOTE: The primary valve to operate Change Bulk Helium Reduction mode is V18.

3.5.3. Vacuum Requirements – ChemGuard® BCD100

The customer must provide a vacuum source to ensure complete removal of chemical vapors and atmospheric gases that invariably enter the ChemGuard® lines during the Change operation.

Connect a vacuum line from the vacuum pump to the Vacuum connection port on top of the ChemGuard® cabinet.

WARNING

Warning: Pump exhaust contains chemical vapor. Pump exhaust must be connected to the appropriate abatement system for chemical used.

WARNUNG: Die Abgase der Pumpe enthalten chemische Dämpfe. Pumpenabgase müssen über ein für das jeweilig Chemikal geeignetes Abgassystem abgeführt warden.

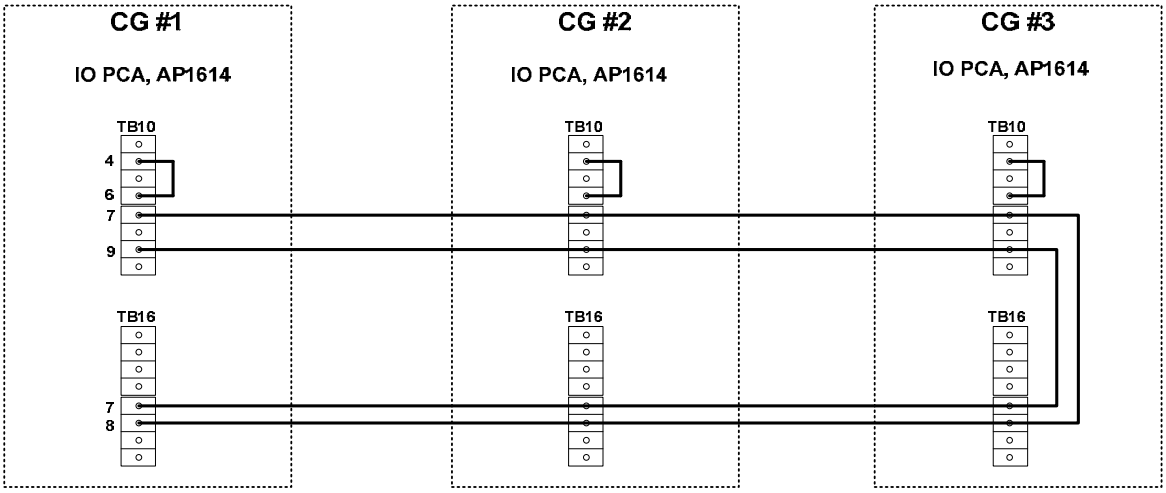
AVERTISSEMENT: Le tuyau d'échappement de la pompe contient des vapeurs chimiques. Le tuyau d'échappement doit être connecté à un système de réduction adéquat au produit chimique utilisé.

3.5.4. Multiple ChemGuard® BCD100s Connected To A Single Vacuum Pump

Multiple ChemGuard® BCD100s can be connected to a shared single vacuum pump only when using compatible chemicals.

To use this feature, the "VACUUM INTERLOCK" output of each ChemGuard® must be connected to the "VACUUM INTERLOCK" input on all the other ChemGuard® BCD100 units.

Figure 3-5: Vacuum Pump Interface



3.5.5. Exhaust and Vent Requirements

For Exhaust and Vent installation requirements refer to Chapter 2.

3.5.6. Connecting ChemGuard® Exhaust

1. Connect Exhaust line to the 101.6 mm (4 in.) Exhaust port on ChemGuard® cabinet (see Chapter 2).
2. The ChemGuard® cabinet also requires exhaust for venting of the reservoir container. During system operation the reservoir container will relieve excess push-gas to the vent connection on ChemGuard®.

3.5.7. Hazardous Gas/Vapor Leak Detection System

A gas/vapor leak detection system must be installed by the customer for all toxic gases used in the ChemGuard® Gen III cabinet. The detection points must include the interior of the chemical cabinet. If a leak is detected, the system must provide signals that will shut down the chemical cabinet.

3.5.8. ChemGuard® Z-Purge

According to NFPA 497 and SEMI S6, if adequate reduction of flammable gas cannot be achieved, special electrical designs or purging may be used to address potential ignition sources.

The ChemGuard® GEN III cabinet was evaluated and the 1) Controller; 2) VGA LED display panel; 3) CG IO Interface Module was identified as the only components with a potential spark source. Provided that these components are purged and pressurized at a flow of 25 scfh, the risk of spark is eliminated.

Every ChemGuard® shipped has Z-purge enabled and can be installed in hazardous areas.

3.5.9. Z-Purge Setup

A Z-Purge flow valve is located on the right rear of the controller and can be adjusted via the penetration into the ChemGuard® cabinet between the pneumatic control bulkheads.

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

There are three pressure switches located within the cabinet. There is one switch in the controller housing, one in the upper cabinet door and one in the interface box to ensure adequate pressure (0.1" H_2O) during the Z-purging. Low Z-purge alarms will be triggered if pressure falls below the pressure adjustment in the pressure switches. The nitrogen flow must be increased until the alarms can be reset.

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

1. Close the controller front and tighten both latches completely.
2. Open the needle valve 4 to 5 turns (counter-clockwise). Allow the controller to purge for 30 minutes.
3. Adjust needle valve to satisfy all three of 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 minimum flow rate of 5.5 SLPM will be needed, depending on the tightness of the individual controller and the installation.

Figure 3-6: Controller Z-Purge Pressure Switch

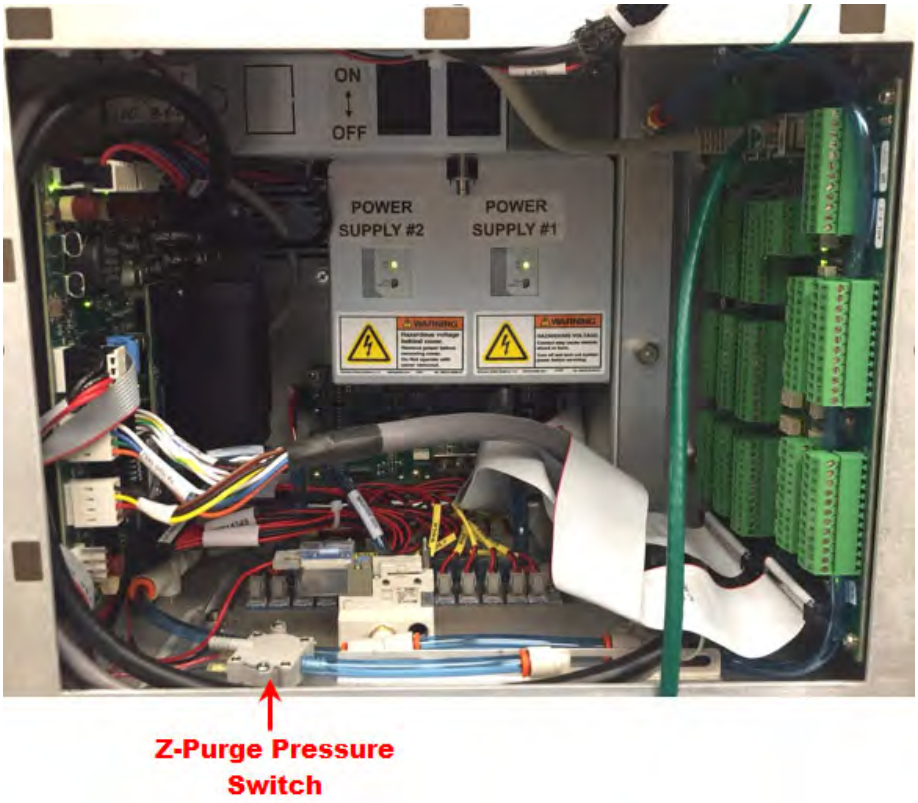


Figure 3-7: Display Panel Z-Purge Pressure Switch

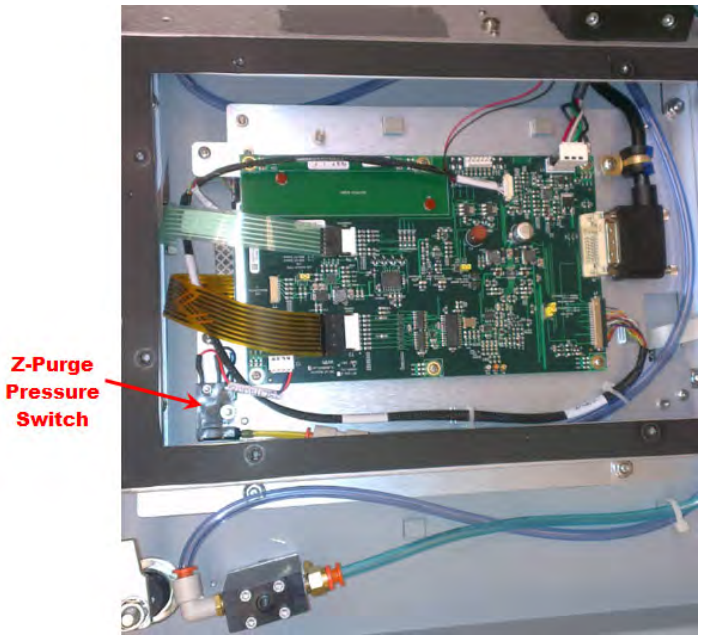
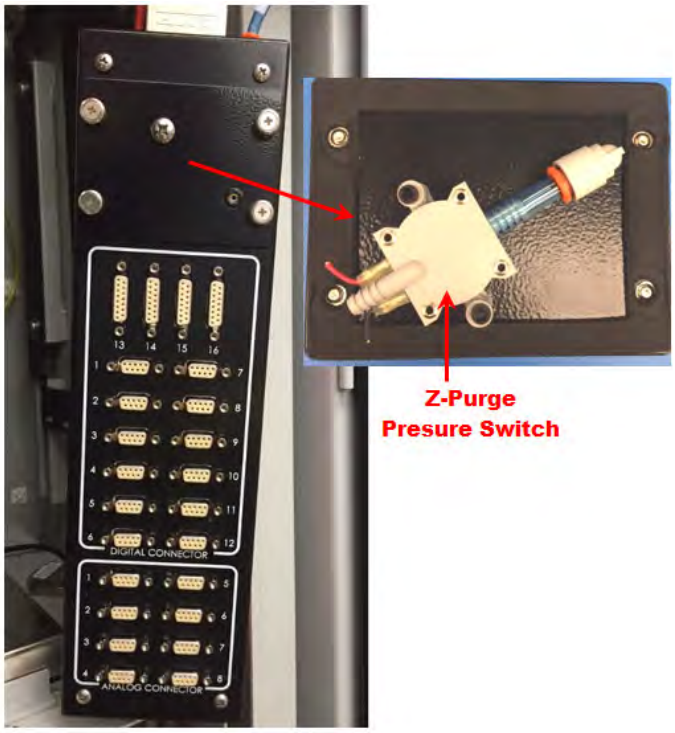


Figure 3-8: Interface Module Z-Purge Pressure Switch



3.6. Installing ChemGuard® BCD Bulk Scale

One reservoir scale is shipped with the ChemGuard® BCD cabinet and installed inside the cabinet for the Bulk container.

NOTE: For the Bulk scale and Process scale calibration procedures, refer to Chapter 7.

3.6.1. Bulk Scale Installation

Carefully remove the optional ChemGuard® Bulk reservoir scale assembly from its shipping carton. This step requires a minimum of two people, as the scale weighs approximately 22.6 kg (50 lb). This is a precision instrument that can be damaged if mishandled.

CAUTION

CAUTION: Do not drop ChemGuard Reservoir Scale while installing. This may cause damage.

VORSICHT: Die Waage beim Einsetzen nicht aufschlagen lassen da sie dadurch baschadigt warden kann.

ATTENTION: Ne pas faire tomber la balance lors de son installation. Cela pourrat causer des dommages.

CAUTION

CAUTION: Do not connect or disconnect scale with power ON.

VORSICHT: Die Waage nicht bei eingeschaltetem Strom anschließen.

ATTENTION: Ne pas raccorder la balance lorsque qu'elle est sous tension.

1. Turn the reservoir scale so that the scale connector is facing toward the back of the cabinet.
2. Ensure the scale assembly is centered on the shelf, and not touching the side walls of the cabinet.
3. Press and turn to attach the scale connector to the socket inside the cabinet under the shelf. The scale connector has been designed so that it can only be installed one way.
4. Perform scale calibration per Chapter 7.

3.7. ChemGuard® Communications

3.7.1. Connecting Inputs/Outputs

The Process Tool Interface Connection enables the Liquid VMB, ChemGuard®, process tool(s) to automatically control refill from the ChemGuard® BCD. It also provides spill detect interlocks between the ChemGuard® BCD and refill equipment and ChemGuard® BCD auto switching cabinets.

For all field terminations on the DB25 or DB9 customer connections, connectors that require a tool for connection and disconnection are required. Also, the customer must ensure that the outputs are energy limited to meet US and CE requirements.

Use the following tables to connect customer Inputs and Outputs.

3.7.2. Connecting Digital Inputs

Table 3-3: Life Safety Shutdown Input

Digital Input #	Input Label	AP1614	
		TB11	CONFIGURATION
36	* Life Safety Shutdown * Jumper must be installed or Customer Supplied Input required to satisfy Life Safety Shutdown condition	10	Dry Contact
		12	
		11 - GNDD	Sourcing max. 1A @ 24vdc ±2.4
		12 - +24vdc	

Table 3-4: Tool Input - Valve Control, Dry Contact

Digital Input #	Input Label	AP1614		DB25 Bulkhead Connector
		TB5-TB7	CONFIGURATION	
22	V11 Control	TB5; 11&12	Dry Contact J1 to A position J1 pin 1&2	J1; 12&13
23	V12 Control	TB6; 11&12	Dry Contact J2 to A position J2 pin 1&2	J2; 12&13
24	V13 Control	TB7; 11&12	Dry Contact J3 to A position J3 pin 1&2	J3; 12&13
25	V14 Control	TB8; 11&12	Dry Contact J4 to A position J4 pin 1&2	J4; 12&13

Table 3-5: Tool Input - Valve Control, Sinking Inputs

Digital Input #	Input Label	AP1614		DB25 Bulkhead Connector
		TB1-TB4	CONFIGURATION	
22	V11 Control	TB1; 11&12	Sinking	J1; 12&13

23	V12 Control	TB2; 11&12	Sinking	J2; 12&13
24	V13 Control	TB3; 11&12	Sinking	J3; 12&13
25	V14 Control	TB4; 11&12	Sinking	J4; 12&13

Table 3-6: Tool Input – Chem On

Digital Input #	Input Label	AP1614		DB25 Bulkhead Connector
		TB1-TB4	CONFIGURATION	
37	Fill Op – Output 1 (V11)	TB1; 1&2	Dry Contact	J1; 20&22
39	Fill Op – Output 2 (V12)	TB2; 1&2	Dry Contact	J2; 20&22
41	Fill Op – Output 3 (V13)	TB3; 1&2	Dry Contact	J3; 20&22
43	Fill Op – Output 4 (V14)	TB4; 1&2	Dry Contact	J4; 20&22

NOTE: 1 of the 4 inputs must be closed in order to enable Chem On operation. If not "No Tools Active" alarm will be generated and prevent Chem On.

Table 3-7: Vacuum Interlock

Digital Input #	Input Label	AP1614	
		TB10	CONFIGURATION
30	* BCD Vac Interlock * Jumper must be installed or Customer Supplied Input required or BCD Vac Interlock Shutdown alarm will be activated	4 6	Dry Contact
31	* Vacuum Interlock * Input must be open to start Change Bulk Operation	7 9	Dry Contact

Table 3-8: BCD Auto Switching Input

Digital Input #	Input Label	AP1614	
		TB10	CONFIGURATION
32	* AUTO SWITCH INPUT – from Auto Switching BCD Pair * Input must be open to enable/start Chem On (BCD Fill) operation	10 12	Dry Contact

3.7.3. Connecting Digital Outputs (Outputs: max. 1A @ 24vdc)

Table 3-9: Life Safety Outputs

Digital Output #	Output Label	AP1614	
		TB15	CONFIGURATION
9	Exhaust	1	N/O
		2	Common
		3	N/C
10	Cabinet Spill – Dual Floats	4	N/O
		5	Common
		6	N/C
11	FIRE (Option) • Heat ROR • UVIR	7	N/O
		8	Common
		9	N/C
12	Door Open	10	N/O
		11	Common
		12	N/C

Table 3-10: Life Safety Outputs (Cont.)

Digital Output #	Output Label	AP1614	
		TB13	CONFIGURATION
13	Remote Spill *Interfaces to 2nd BCD when setup for Auto Switching pair	1	N/O
		2	Common
		3	N/C
14	Z-Purge	4	N/O
		5	Common
		6	N/C
16	Vapor Detect	10	N/O
		11	Common
		12	N/C

Table 3-11: BCD Auto Switching Output

Digital Output #	Output Label	AP1614	
		TB14	CONFIGURATION
24	AUTOSWITCH OUT *Output closes when in Chem On (BCD Fill). Used when 2 BCDs setup for Auto Switching mode. 2nd BCD will be held in standby until output opens, when 1st BCD no longer in Fill mode.	10	N/O
		11	Common
		12	N/C

Table 3-12: Alarm Outputs - Tool 1

Digital Output #	Output Label	AP1614		DB25 Bulkhead Connector
		TB5	CONFIGURATION	

25	Shutdown Alarm	1&2	Dry Contact	J1; 8&15
26	Fault Alarm	3&4	Dry Contact	J1; 10&16
27	Chem On (Bulk in Fill)	5&6	Dry Contact	J1; 9&17
28	Bulk Empty	7&8	Dry Contact	J1; 6&8

Table 3-13: Alarm Outputs - Tool 2

Digital Output #	Output Label	AP1614		DB25 Bulkhead Connector
		TB6	CONFIGURATION	
25	Shutdown Alarm	1&2	Dry Contact	J2; 8&15
26	Fault Alarm	3&4	Dry Contact	J2; 10&16
27	Chem On (Bulk in Fill)	5&6	Dry Contact	J2; 9&17
28	Bulk Empty	7&8	Dry Contact	J2; 6&8

Table 3-14: Alarm Outputs - Tool 3

Digital Output #	Output Label	AP1614		DB25 Bulkhead Connector
		TB7	CONFIGURATION	
25	Shutdown Alarm	1&2	Dry Contact	J3; 8&15
26	Fault Alarm	3&4	Dry Contact	J3; 10&16
27	Chem On (Bulk in Fill)	5&6	Dry Contact	J3; 9&17
28	Bulk Empty	7&8	Dry Contact	J3; 6&8

Table 3-15: Alarm Outputs - Tool 4

Digital Output #	Output Label	AP1614		DB25 Bulkhead Connector
		TB8	CONFIGURATION	
25	Shutdown Alarm	1&2	Dry Contact	J4; 8&15
26	Fault Alarm	3&4	Dry Contact	J4; 10&16
27	Chem On (Bulk in Fill)	5&6	Dry Contact	J4; 9&17
28	Bulk Empty	7&8	Dry Contact	J4; 6&8

3.7.4. Connecting ChemGuard® to Monitoring System

ChemGuard® can be connected to a Global Communication System (GCS) that provides continuous, 24-hour, on-line monitoring of the status of the cabinet. The connection should be made with a 10BaseT Ethernet cable.

Figure 3-9: Tool I/O Board (AP1614)

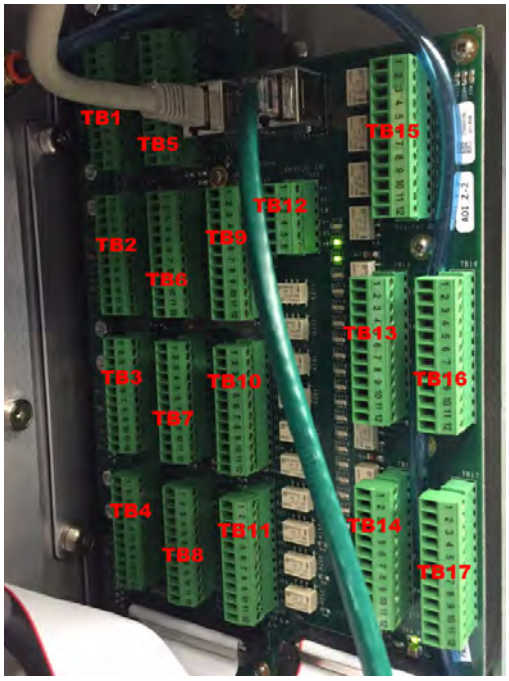


Figure 3-10: Tool 1-4 DB25 Connectors

3.8. ChemGuard® Start-up and Initialization

3.8.1. Turing On System Power

1. Apply AC power to the Controller.
2. Place power switch, (1) for single power supply or (2) for dual power supply located above power supplies inside controller to the ON position. Verify power LED lit, refer to Figure 3-2.
3. Verify power is on to the CG. The CG Display will light and go to boot-up display.
4. Acknowledge any alarms and log into the main menu to verify the display is working properly.

3.8.2. ChemGuard® BCD Display

The ChemGuard® GENIII has a color VGA LED screen on the front face of the cabinet that shows a graphical display of the Bulk and Process reservoir, shutdown and fault alarm boxes. The system screen allows the operator to easily understand the operation and to quickly identify operating status. The chemical flow path is indicated by an animated dashed line and controller status is displayed in the middle of the top of the screen. Conforming to ISA standards, open valves are shown in red and closed valves are shown in green, refer to Figure 3-11.

NOTE: A legend for the color code is on the side of the LCD for reference.

Figure 3-11: ChemGuard® BCD100 Controller VGA Display Screen

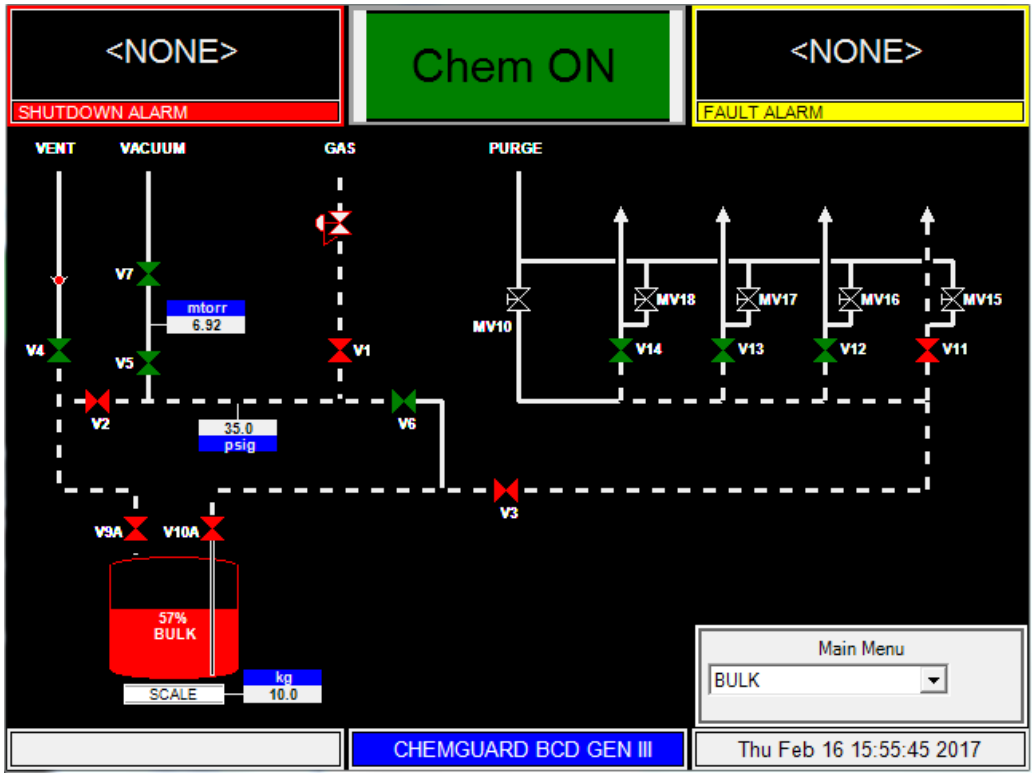
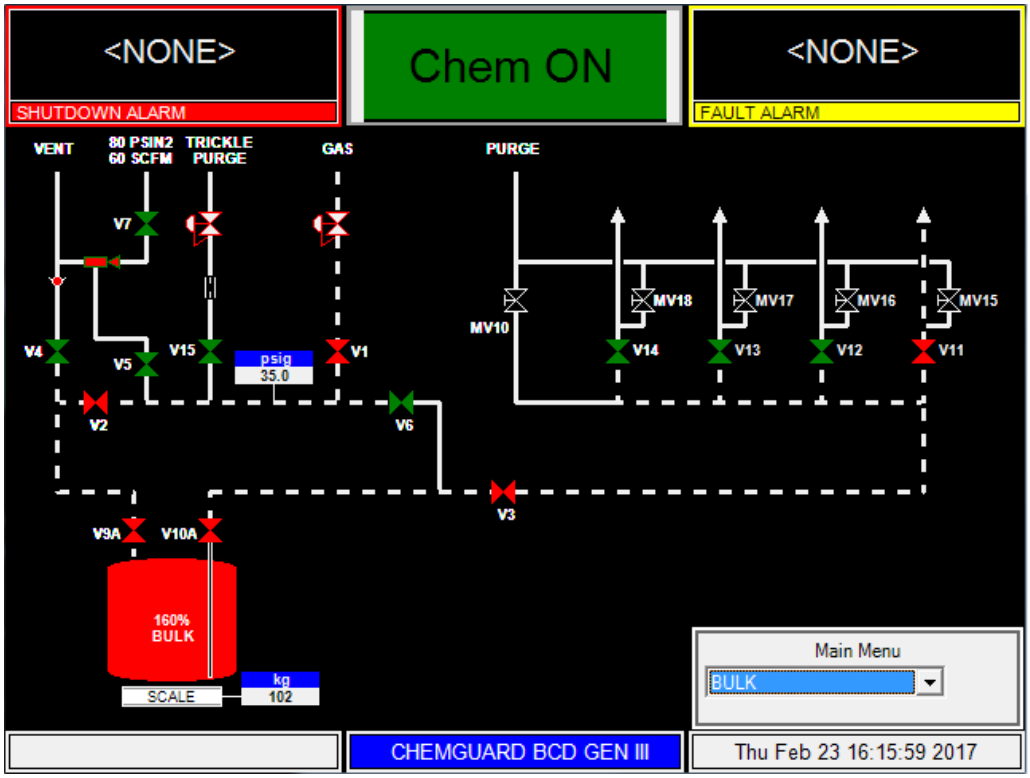


Figure 3-12: ChemGuard® BCD200 Controller VGA Display Screen



3.8.3. System Status LEDs

System Status LEDs displaying ChemGuard® alarm conditions, Process Fill enable and ARS ready signal are located to the right of the VGA display. The table below describes these LEDs and their functions.

Figure 3-13: Controller LEDs

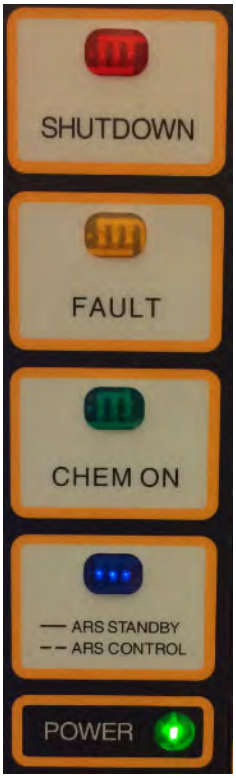


Table 3-16: Controller LEDs

LED	FUNCTION
SHUTDOWN ALARM	This LED flashes red on Shutdown alarm. Once acknowledged, the LED stops flashing but remains red until it is reset.
FAULT ALARM	This LED flashes yellow on Fault alarm. Once acknowledged, the LED stops flashing but remains yellow until it is reset.
CHEMICAL FLOWING	This LED lights green when Process Fill is enabled and tool inputs are satisfied.
ARS – Auto-Restart	This blue LED lit and in steady state indicates Auto-Restart option enabled and monitoring system status. LED flashing blue indicates Auto-Restart was activated.
POWER	This LED indicates that there is +5 VDC power to the unit.

3.8.4. Password Log-in

A password is required to access the main menu display. There are 4 levels of password protection in the ChemGuard® GEN III Controller.

Each password level allows a user more access to the features and operation of the controller.

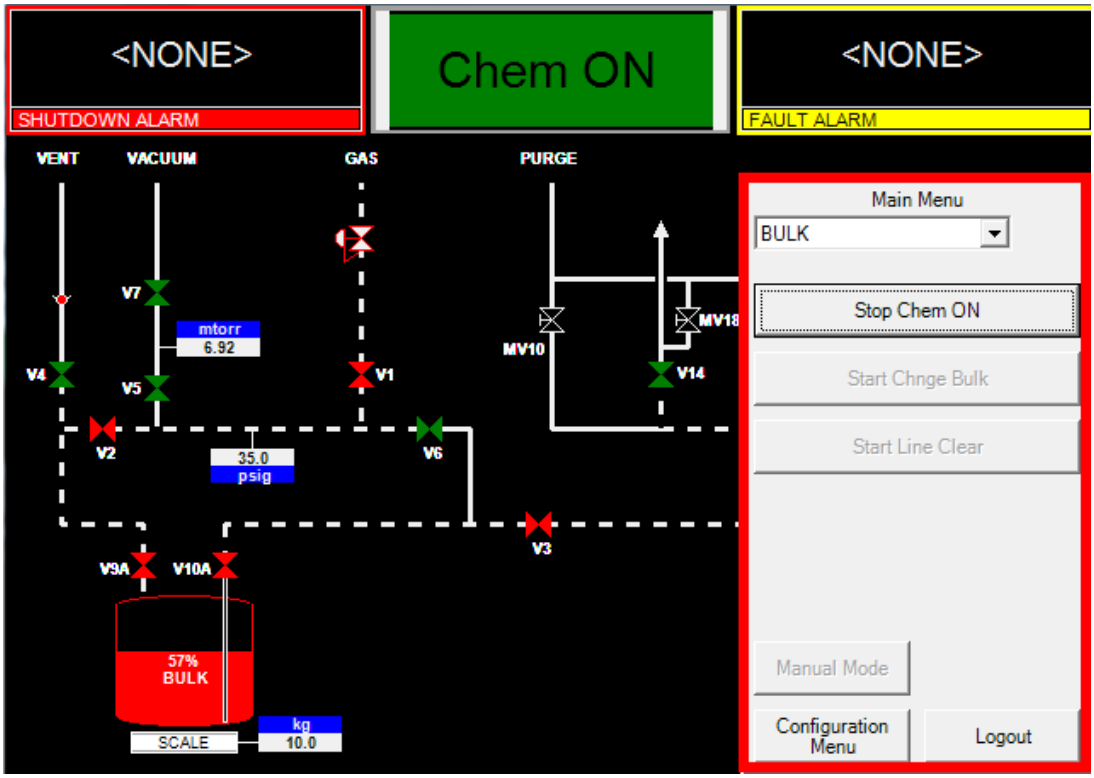
From the Main Menu, enter Config Menu ->

- 1st Security List > default **11234**
- 2nd Security List > default **25678**
- 3rd Security List > default **39999**

3.8.5. Main Menu and Configuration Selection Window

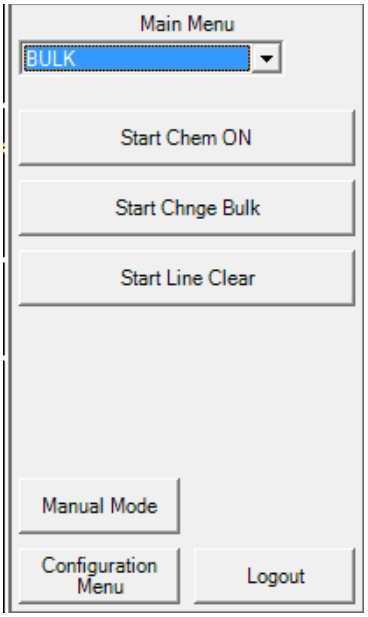
Once a password is successfully entered, the selection window will display on the right side of the screen to show prompts and menu selections. It will remain displayed for a configurable amount of time or until the “LOGOUT” key is pressed.

Figure 3-14: ChemGuard® Main Menu Display Screen

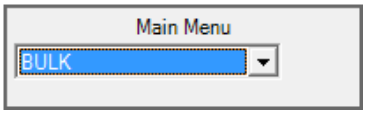


3.8.6. ChemGuard® Controller Main Menu

To view the Main Menu in full screen mode, touch the words "Main Menu at the top of the window.



To return the Main Menu to its normal size, simply touch the words, "Main Menu," again.



3.8.7. 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. A time stamp of when the alarm occurred will be displayed with each alarm.

NOTE: If <NONE> is displayed, no alarm conditions are present.

Controller Status Box, in upper middle field displays green when Chem On or Ext-Fill is enabled.

Figure 3-15: Alarm and Controller Status Box

3.8.8. Screen Saver

When the programmed amount of time has elapsed since the operator's last keypad action, the screen saver blanks the display screen and a randomly-moving mode indicator box appears. This occurs during the following states: idle, Chem On.

The screen saver will de-activate if a new alarm appears.

To manually de-activate the screen saver, touch anywhere on the display screen.

The screen saver function will not be active while a fault or shutdown alarm is present, an active prompt is displayed, or during any mode/sequence other than idle and Chem On.

3.9. ChemGuard® System Configuration

3.9.1. User Setpoints – Bulk Scale (Analog)

Configuring Bulk analog scale "Fill" & alarm setpoints.

From the Main Menu, enter Config Menu -> User Setpoints -> Bulk Scale. Note, values shown are recommended.

Table 3-17: User Setpoints > Bulk Scale

Num	Alarm Label	Percent
1	BULK RES Overfull	105%
2	BULK RES Low	5%
3	BULK RES Empty	0%

3.9.2. User Setpoints – Bulk Push (Analog)

Configuring Bulk Push PT1 "Pressure Alarm" setpoints.

From the Main Menu, enter Config Menu -> User Setpoints -> Bulk Push. Note, values shown are recommended.

Table 3-18: User Setpoints > Bulk Push

Num	Alarm Label	Setpoint
1	LOW PUSH PRES BK	5 psig below R1 setting
2	HI PUSH PRES BK	59 psig
3	LOW PUSH PRES BK	5 psig below R1 setting
5	N2 VENT FAIL	5 psig
7	PGTL PRES PT1 FAIL	10 psig
8 (BCD Only)	BASE VAC TIMEOUT	5 psig

3.9.3. User Setpoints – Vacuum (Analog)

Configuring Vacuum PTV Change Bulk and Change Process base vacuum setpoints.

From the Main Menu, enter Config Menu -> User Setpoints -> Vacuum. Note, values shown are recommended.

Table 3-19: User Setpoints > Vacuum (BCD100 only)

Num	Alarm Label	Setpoint
1	VACUUM GUAGE FAIL	300 mtorr
2	BASE VAC TIMEOUT	+10 mtorr above vacuum base reading
3	PMPDWN TIMEOUT	300 mtorr

3.10. Manual Mode

CAUTION

Only experienced operators should operate the ChemGuard® in manual mode. Operating valves out of their proper sequence could potentially cause damage to the product by interrupting or providing insufficient gas flow. Manual operation should not be used for normal, daily operation.

Manual mode provides a means of flowing purge gas through the purge and process gas panels during cabinet installation and pre-start-up procedures. It also provides a means of flowing purge gas while maintenance or repairs are being performed or when performing leak checks, Vacuum "Rate of Rise" or Pressure Decay tests.

3.10.1. How to Operate Manual Mode

WARNING

Operating in Manual Mode could cause the following hazards which can result in Personal Injury or damage to the Equipment.

- **Opening valves when liquid chemical is present at the valve.**
- **Liquid chemical could be vented or released.**
- **Opening valves when container pigtails are not connected and sealed.**

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

3.10.2. Selecting Manual Mode

1. Select anywhere on the Color Touch;
2. Display to bring up Main Menu screen and enter the password;
3. Press “OK”;
4. From the Main Menu screen, select "MANUAL MODE";
5. The MANUAL MODE window will display, refer to Figure 3-16.

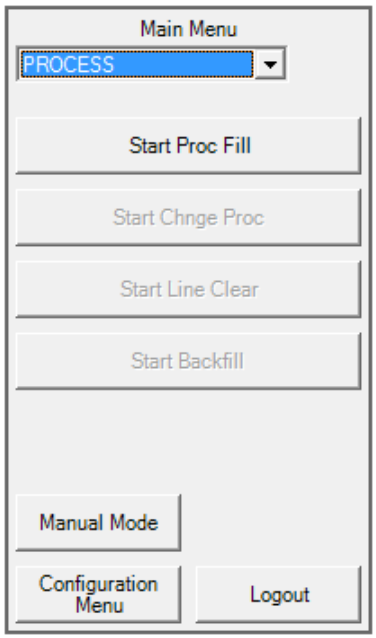
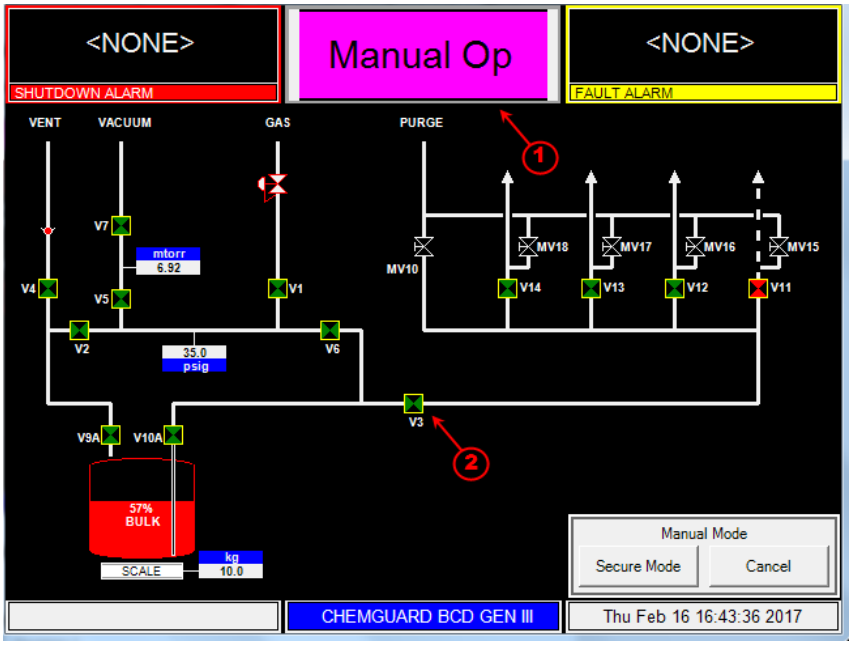
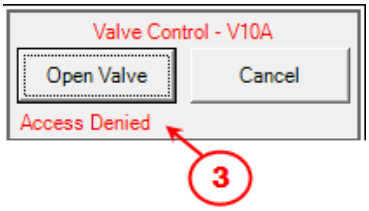


Figure 3-16: ChemGuard® Manual Mode Display



1. Controller Status box changes to Violet for operation selected, Bulk or Ext Fill
2. Yellow box around valves that can be controlled via Manual Mode
3. Valve lock for a valve that cannot be open in Manual Mode



3.10.3. How to Open Valve in Manual Mode

To open a valve:

1. Select by touching the valve. The valves that can be manually operated from the display will be highlighted with a yellow box.
2. The valve confirmation window will appear, asking you to

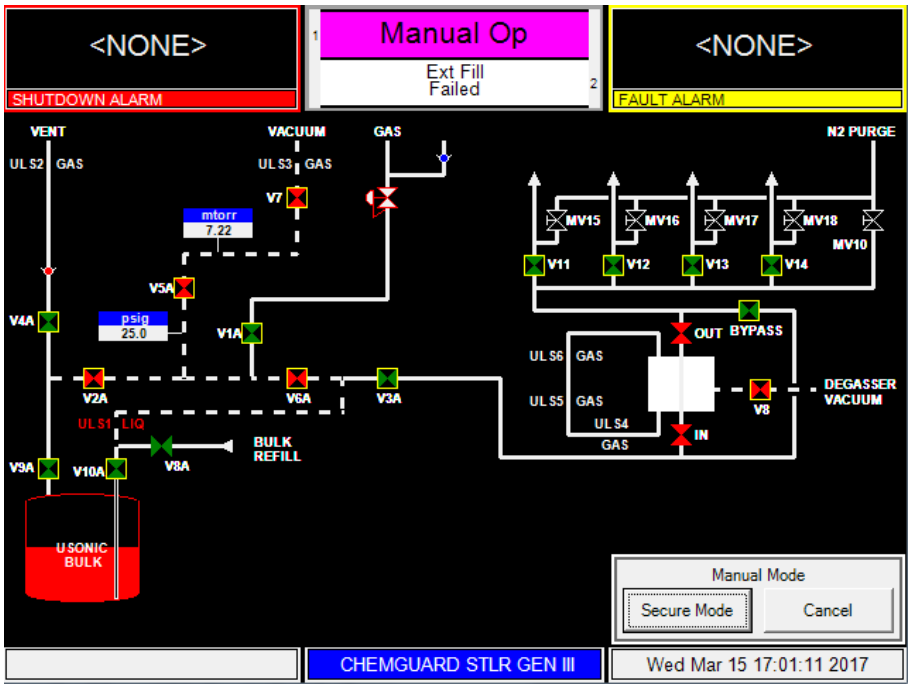
confirm that you want to open the valve by pressing “OPEN VALVE”. Pressing “CANCEL” will close the window, leaving valve closed, refer to Figure 3-16.

3.10.4. How to Close Valve in Manual Mode

To close a valve:

1. Touch the valve you want to close by selecting the valve on the display.

Figure 3-17: ChemGuard® in Manual Mode



3.10.5. To SECURE Manual Mode

The Secure option allows the operator to exit the Manual Mode menu while remaining in manual mode with valves open. (The Secure option will not be selectable if no valves are open) When the operator chooses Secure Mode from the Manual Mode window it allows the operator to go to other menu screens. Any open valve will remain open, and the Mode Status Box will continue to indicate manual mode. Manual mode will remain active or ‘secured’ until an operator re-enters the Manual Mode window. While manual mode is ‘secured’, Manual Mode will be the only selectable option on the Main Menu.

⚠CAUTION

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

NOTE: Pressing “CANCEL” will automatically close any valves which were left open unless the secure mode feature is used as seen below.

3.11. Pressure Regulator Adjustment

3.11.1. BCD100 Bulk PT1 and R1 Test and Adjustment

NOTE: Test Bulk PT and Regulator R1 together at same time.

1. Slowly open regulator R1 by turning R1 fully clockwise
2. Step to Bulk Menu
3. Step to Manual Mode and open V1. Verify valve indicator switches from green to red
4. Turn main supply gas off to the BCD, 0 psig
5. Vent off pressure to PT1 by opening V5 and V7. Note, verify vacuum pump is running and any manual isolation valve on vacuum line to BCD is open
6. Confirm PT1 pressure drops to 0 psig. Close V5 and V7
7. Set main supply gas pressure to10 psig. Verify PT1 reads 10.0 ± 0.5 psig
8. Set main supply gas pressure to 25, 35 & 55 psig. At each setting verify PT1 reads setting ± 0.5 psig
9. Return main gas supply pressure to original setting, 60-90 psig
10. Slowly close regulator R1 by turning R1 fully counterclockwise
11. Close V1 and open V5 and V7. Confirm PT1 pressure drops to 0 psig. Close V5 and V7
12. Open V1
13. Slowly open regulator R1 by turning R1 clockwise to user selected pressure setting, typically 25 psig
14. Close V1

NOTE: Regulators are not self venting. If the desired push pressure is exceeded the flow path must be vented in manual mode, then the pressure regulator adjustment repeated.

3.11.2. Bulk Regulator Creep Test

1. After PT1 tested and R1 set to user selected pressure setting, wait 5mins for pressure to stabilize
2. Document PT1 pressure reading = _____ psig
3. Let BCD sit for 4 hours = _____Start_____ Stop
4. The pressure reading should not drift by more than +/-2 psig
5. Record final reading = _____ psig

3.11.3. BCD200 Bulk PT1 and R2 Test and Adjustment

NOTE: Test Bulk PT and Regulator R2 together at same time.

1. Slowly open regulator R2 by turning R2 fully clockwise
2. Step to Bulk Menu
3. Step to Manual Mode and open V15. Verify valve indicator switches from green to red
4. Turn main supply gas off to the BCD, 0 psig
5. Vent off pressure to PT1 by opening V2 and V4.
6. Confirm PT1 pressure drops to 0 psig. Close V2 and V4
7. Set main supply gas pressure to10 psig. Verify PT1 reads 10.0 ± 0.5 psig

8. Set main supply gas pressure to 25, 35 & 55 psig. At each setting verify PT1 reads setting ± 0.5 psig
9. Return main gas supply pressure to original setting, 60-90 psig
10. Slowly close regulator R1 by turning R1 fully counterclockwise
11. Close V15 and open V2 and V4. Confirm PT1 pressure drops to 0 psig. Close V2 and V4
12. Open V15
13. Slowly open regulator R2 by turning R2 clockwise to user selected pressure setting, typically 35 psig
14. Close V15

NOTE: Regulators are not self venting. If the desired push pressure is exceeded the flow path must be vented in manual mode, then the pressure regulator adjustment repeated.

3.11.4. Bulk Regulator Creep Test

1. After PT1 tested and R2 set to user selected pressure setting, wait 5mins for pressure to stabilize
2. Document PT1 pressure reading = _____ psig
3. Let BCD200 sit for 4 hours = _____Start_____ Stop
4. The pressure reading should not drift by more than +/-2 psig
5. Record final reading = _____ psig

3.12. System Leak Check – BCD100

3.12.1. Leak Check – Main Manifold (Pressure Decay)

Confirm Bulk Inlet and Outlet pigtails are securely capped.

1. At Main Display, step to Bulk Menu and enter Manual Mode. Select and open valve V1.
2. Wait for 1 minute. Place Manual Mode in Secure Mode.
3. From the Main Menu, enter Config Menu -> System Test -> Test Analog In. Record values of Bulk Push pressures, Gross and Raw.
   _____PSIG _____VDC
4. Enter Manual mode, close V1.
5. Return to System Test -> Test Analog In. Verify Bulk Push values. Confirm change in pressure (Pressure decay) is less than 1psig, 0.08vdc.
6. Close/confirm manual shutoff valve on vacuum line from vacuum pump to CG, V7 is closed.
7. Enter Manual mode, open V1, V2, V3, V6, V5 and V7 (if manual shutoff valve installed).
8. Wait 5 minutes and then close V1.
9. Wait for 5 minutes. Place Manual Mode in Secure Mode.
10. Return to System Test -> Test Analog In. Compare Bulk Push pressure from values recorded in step 3. Confirm change in pressure (Pressure decay) is less than 1psig, 0.08vdc.
    _____PSIG _____VDC
    Note: if pressure drop is greater than specified, troubleshoot until pressure decay meets this specification.
11. Cancel out of Manual mode.

3.12.2. Leak Check – Main Manifold (Vacuum Rate of Rise)

Confirm Bulk Inlet and Outlet pigtails are securely capped.

1. Open/confirm manual shutoff valve on vacuum line from vacuum pump to CG, V7 is open.
2. At Main Display, step to Bulk Menu and enter Manual Mode. Select and open valve V7.
3. Wait for 5 minute. Place Manual Mode in Secure Mode.
4. From the Main Menu, enter Config Menu -> System Test -> Test Analog In. Record values of Vacuum, Gross and Raw.
   _____mTOR _____VDC
5. Enter Manual mode, close V7.
6. Return to System Test -> Test Analog In. Verify Vacuum values. Confirm change in vacuum (Rate of Rise) is less than 10mtorr, 0.25vdc.
7. Enter Manual mode, open V2, V6, V5 and V7.
8. Wait 5 minutes and then close V7.
9. Wait for 5 minutes. Place Manual Mode in Secure Mode.
10. Return to System Test -> Test Analog In. Compare Vacuum reading from values recorded in step 4. Confirm change in vacuum is less than 10mtorr, 0.25vdc.
    _____mTOR _____VDC
    Note: if vacuum ROR is greater than specified, troubleshoot until vacuum ROR meets this specification.
11. Cancel out of Manual mode.

3.12.3. Leak Check – Vent Line

Confirm Bulk Inlet and Outlet pigtails are securely capped.

1. At Main Display, step to Bulk Menu and enter Manual Mode. Select and open valve V1, V2 and V4.
   Note: If Helium gas is used Helium gas will flow to vent. If Helium gas is in short supply to prevent high consumption only keep V1 open for short duration or skip step one and perform visual check, step 2 only.
2. Visually check ¼" VCR connection at outlet of V4 and ¼" Swagelok connection at inlet and outlet of Check Valve, CV1. Confirm connections are secure and no presence of gas can be detected.
3. Optional, if push gas being supplied to the CG is Helium; obtain a suitable Helium Leak Detector. Using outboard leak detection method, sniff connections of V4 and CV1. Confirm no Helium gas is detected at connections.
   Note: If Helium gas is detected, remake connections at V4 and CV1
4. Cancel out of Manual mode.

3.12.4. Leak Check – Chemical Output Line (Pressure Decay)

Confirm Bulk Inlet and Outlet pigtails are securely capped.

1. At Main Display, step to Bulk Menu and enter Manual Mode. Select and open valve V1.
2. Wait for 1 minute. Place Manual Mode in Secure Mode.
3. From the Main Menu, enter Config Menu -> System Test -> Test Analog In. Record values of Bulk Push pressures, Gross and Raw.
   _____PSIG _____VDC
4. Enter Manual mode, close V1.
5. Return to System Test -> Test Analog In. Verify Bulk Push values. Confirm change in pressure (Pressure decay) is less than 1psig, 0.08vdc.
6. Enter Manual mode, open V1, V6, V3, V11 (V12, V13, V14). Confirm output valves, V11 thru V14 chemical delivery lines connected and have valve closed at next fill point, LVMB, CG, tool.
7. Wait 15 minutes and then close V1.
8. Wait for 15 minutes. Place Manual Mode in Secure Mode.
9. Return to System Test -> Test Analog In. Compare Bulk pressure from values recorded in step 3. Confirm change in pressure (Pressure decay) is less than 1psig, 0.08vdc.
   _____PSIG _____VDC
   Note, if pressure drop is greater than specified, troubleshoot until pressure decay meets this specification.
10. Cancel out of Manual mode.

3.12.5. System Vacuum Purge

Confirm Bulk Inlet and Outlet pigtails are securely capped
<u>(Do not perform when Bulk Container Installed)</u>

1. Due to software interlock V3 cannot be manual opened at same time V7 is open. Remove pneumatic air line from V1 and V3. Install V1 pneumatic air line to V3 during this test.
2. Open/confirm manual shutoff valve on vacuum line from vacuum pump to CG, V7 is open.
3. At Main Display, step to Process Menu and enter Manual Mode. Select and open V7, V2, V5, V6, V1 (which now opens V3) and Output Valves V11 thru V14 where a Chemical Delivery lines is connected to next fill point, LVMB, CG, tool.
4. Place Manual Mode in Secure Mode.
5. Place in System Vacuum Purge overnight, or for 4-12hrs.
   _____Start Time _____End Time
6. Cancel out of Bulk Manual mode.
7. Remove V1 pneumatic air line from V3 and re-install to V1. Re-install V3 pneumatic air line to V3.

3.13. System Leak Check – BCD200

3.13.1. Leak Check – Main Manifold (Pressure Decay)

Confirm Bulk Inlet and Outlet pigtails are securely capped.

1. At Main Display, step to Bulk Menu and enter Manual Mode. Select and open valve V1.
2. Wait for 1 minute. Place Manual Mode in Secure Mode.
3. From the Main Menu, enter Config Menu -> System Test -> Test Analog In. Record values of Bulk Push pressures, Gross and Raw.
   _____PSIG _____VDC
4. Enter Manual mode, close V1.
5. Return to System Test -> Test Analog In. Verify Bulk Push values. Confirm change in pressure (Pressure decay) is less than 1psig, 0.08vdc.
6. Enter Manual mode, open V1, V2, V6, and V3.
7. Wait 5 minutes and then close V1.
8. Wait for 5 minutes. Place Manual Mode in Secure Mode.
9. Return to System Test -> Test Analog In. Compare Bulk Push pressure from values recorded in step 3. Confirm change in pressure (Pressure decay) is less than 1psig, 0.08vdc.
   _____PSIG _____VDC
   Note: if pressure drop is greater than specified, troubleshoot until pressure decay meets this specification.
10. Cancel out of Manual mode.

3.13.2. Leak Check – Main Manifold (Vacuum Rate of Rise)

Confirm Bulk Inlet and Outlet pigtails are securely capped.

1. At Main Display, step to Bulk Menu and enter Manual Mode. Select and open valve V7 and V5.
2. Wait for 5 minute. Place Manual Mode in Secure Mode.
3. From the Main Menu, enter Config Menu -> System Test -> Test Analog In. Record values of Vacuum, Gross and Raw.
   _____PSIG _____VDC
4. Enter Manual mode, close V5 and V7 in that order.
5. Return to System Test -> Test Analog In. Verify Vacuum values. Confirm change in vacuum (Rate of Rise) is less than 1psig, 0.08vdc.
6. Enter Manual mode, open V2, V6, V5 and V7.
7. Wait 5 minutes and then close V7.
8. Wait for 5 minutes. Place Manual Mode in Secure Mode.
9. Return to System Test -> Test Analog In. Compare Vacuum reading from values recorded in step 3. Confirm change in vacuum is less than 1psig, 0.08vdc.
   _____PSIG _____VDC
   Note: if vacuum ROR is greater than specified, troubleshoot until vacuum ROR meets this specification.
10. Cancel out of Manual mode.

3.13.3. Leak Check – Vent Line

Confirm Bulk Inlet and Outlet pigtails are securely capped.

1. At Main Display, step to Bulk Menu and enter Manual Mode. Select and open valve V1, V2 and V4.
2. Visually check ¼" VCR connection at outlet of V4 and ¼" Swagelok connection at inlet and outlet of Check Valve, CV1. Confirm connections are secure and no presence of gas can be detected.
3. Optional, if push gas being supplied to the CG is Helium; obtain a suitable Helium Leak Detector. Using outboard leak detection method, sniff connections of V4 and CV1. Confirm no Helium gas is detected at connections.
   Note: If Helium gas is detected, remake connections at V4 and CV1
4. Cancel out of Manual mode.

3.13.4. Leak Check – Chemical Output Line (Pressure Decay)

Confirm Bulk Inlet and Outlet pigtails are securely capped.

1. At Main Display, step to Bulk Menu and enter Manual Mode. Select and open valve V1.
2. Wait for 1 minute. Place Manual Mode in Secure Mode.
3. From the Main Menu, enter Config Menu -> System Test -> Test Analog In. Record values of Bulk Push pressures, Gross and Raw.
   _____PSIG _____VDC
4. Enter Manual mode, close V1.
5. Return to System Test -> Test Analog In. Verify Bulk Push values. Confirm change in pressure (Pressure decay) is less than 1psig, 0.08vdc.
6. Enter Manual mode, open V1, V6, V3, V11 (V12, V13, V14). Confirm output valves, V11 thru V14 chemical delivery lines connected and have valve closed at next fill point, LVMB, CG, tool.
7. Wait 15 minutes and then close V1.
8. Wait for 15 minutes. Place Manual Mode in Secure Mode.
9. Return to System Test -> Test Analog In. Compare Bulk pressure from values recorded in step 3. Confirm change in pressure (Pressure decay) is less than 1psig, 0.08vdc.
   _____PSIG _____VDC
   Note, if pressure drop is greater than specified, troubleshoot until pressure decay meets this specification.
10. Cancel out of Manual mode.

3.13.5. System Vacuum Purge

Confirm Bulk Inlet and Outlet pigtails are securely capped
<u>(Do not perform when Bulk Container Installed)</u>

1. Due to software interlock V3 cannot be manual opened at same time V7 is open. Remove pneumatic air line from V1 and V3. Install V1 pneumatic air line to V3 during this test.

2. At Main Display, step to Process Menu and enter Manual Mode. Select and open V7, V2, V5, V6, V1 (which now opens V3) and Output Valves V11 thru V14 where a Chemical Delivery lines is connected to next fill point, LVMB, CG, tool.
3. Place Manual Mode in Secure Mode.
4. Place in System Vacuum Purge overnight, or for 4-12hrs.
   _____Start Time _____End Time
5. Cancel out of Bulk Manual mode.
6. Remove V1 pneumatic air line from V3 and re-install to V1. Re-install V3 pneumatic air line to V3.

3.14. Finishing the ChemGuard® Installation

3.14.1. Installation of the standard Bulk Container

Refer to Chapter 4 for the installation of the standard Bulk Container.

3.14.2. Chemical Delivery Line Certification

Verify and confirm the Chemical Delivery Lines have been completed and certified, i.e. leak check and vacuum purged for a minimum of eight (8) hours to remove any atmospheric moisture before starting the chemical fill.

To perform system vacuum purge, refer to 3.12.5 and 3.13.5.

NOTE: It is the end user's responsibility to evacuate the delivery line from the ChemGuard® cabinet's output manifold to the Process Tool.

3.14.3. Chem On (Bulk Fill) Operation

Confirm with the end user that the ChemGuard® is ready to be placed system in Chem On and refill equipment, LVMB, CG, process tool(s) are ready to receive chemical.

1. To place the Bulk container into fill operation, from the main menu, select BULK.
2. Select "Start Chem On". The Controller status box for Bulk will change from white to green indicating Bulk is enabled and is a Bulk fill, Bulk valves are on, in red and dash line activated showing chemical flow.
3. Chem On terminates either by operator selecting "Stop Chem On" or a life safety shutdown alarm terminates Bulk Fill.

3.14.4. Chemical Fill Out to Tool

NOTE: Verify the end user has completed the evacuate of the chemical delivery line from the ChemGuard® cabinet's output manifold to the refill equipment, LVMB, CG, and Process Tool(s).

Recommend the Process Tool(s) controls the Chemical Output Valves V11, V12, V13 and V14 enabling the input signals on the AP1614 Tool Interface PCB, refer to Table 3-4 and Table 3-5.

Chapter 4

Changing Reservoir Container

The Change Bulk operation is an automated procedure that guides the operator through the steps required to change out the Bulk containers.

NOTE: This warranty is expressly conditioned on compliance with Versum Materials, Inc. operating instructions and the use of the equipment only for authorized chemicals. Operation of the equipment other than as set forth in Versum Materials, Inc. operating instructions or the use of the equipment for unauthorized chemicals shall void all of Versum Materials, Inc. warranties hereunder.

NOTE: The remove-and-replace procedure described in Section 4.2 and 4.3 applies to the Bulk container except as noted. The appearance of your Bulk container may vary slightly from those shown in the illustrations in this chapter.

NOTE: Ensure the product in the Bulk container is at room temperature prior to installation and startup of the ChemGuard®. Some chemicals have relatively high freezing points.

WARNING

WARNING: Review corporate safety policy and in-house safety procedures before handling any chemical. The chemical handler should follow procedures in the Safety Data Sheet (MSDS) on chemical being used. Secondary containment and cleanup material should be available in the event of chemical spill. Proper personal protective equipment must be used.

WARNUNG: Vor dem Umgang mit Chemikalien die in Ihrem Unternehmen geltenden Sicherheitsbestimmungen und betriebsinternen Sicherheitsverfahren revidieren. Alle mit Chemikalien umgehenden Personen sollten mit den in den Sicherheitsdatenblättern (MSDS) aufgeführten Verfahren über die jeweils verwendete Chemikalie vertraut sein. Ein Zweitbehälter und Reinigungsmittel sollten bereitstehen, falls Chemikalien verschüttet werden.

AVERTISSEMENT:Réexaminer les règles de sécurité instituées à votre entreprise et les procédés de sécurité en force avant la manipulation de tous produits chimiques. Tout utilisateur d'un produit chimique doit suivre les procédés prescrits dans les feuilles de normes pour matières (MSDS) concernant les produits chimiques en usage.Un récipient secondaire et du matériel de nettoyage doivent être disponibles au cas où le produit chimique se renverse.

4.1. Safety Notes

Review corporate safety policy and in-house safety procedures before handling any chemical. The chemical handler should be familiar with the SDS (MSDS) and chemical being used.

For caution, all appropriate personal safety protection equipment should be used. Secondary containment and clean-up material should be available in the event of chemical spill or breakage of the container.

When lifting fully filled chemical containers, Versum Materials, Inc. recommends using a pallet jack. The Versum Materials Inc. Bulk containers use 20 cm (8 in) forks on 54.94 cm (21.63 in) centerline spacing. Note that the pallet jack must be balanced to carry a minimum 333 kg (735 pound) load (assuming TEOS as the process chemical; other chemical densities will vary).

4.2. Removing and Replacing the Reservoir Containers

WARNING

WARNING: Be sure the manual valves on the container are closed before disconnecting the lines.

If pneumatic valves are used on the container, disconnect the pneumatic tubes prior to disconnecting the container connections.

WARNUNG: Vor dem Trennen der Leitungen sicherstellen, daß die handbetätigten Ventile am Vorratsbehälter geschlossen sind.

Werden am Vorratsbehälter Druckluftventile verwendet, müssen zuerst die Druckluftleitungen getrennt werden, bevor die Anschlüsse am Behälter entfernt werden.

AVERTISSEMENT: Avant de débrancher la ligne, s'assurer que les soupapes de manoeuvre se trouvant sur le réservoir soient fermées.

Si les valves pneumatiques sont utilisées sur le réservoir, alors déconnecter les tubes pneumatiques avant de débrancher les connexions du récipient.

CAUTION

CAUTION: Do not allow valves on container to rotate.

Damage to VCR faces may result in leaks, preventing proper system operation.

VORSICHT: Die Ventile am Behälter dürfen sich nicht drehen.

Eine Beschädigung der VCR-Berührungsflächen kann zu Leckage führen, die den ordnungsgemäßen Betrieb des Systems beeinträchtigen.

ATTENTION: Ne pas laisser tourner les soupapes sur la boîte métallique.

Tout dégât aux surfaces des pièces en VCR peut causer des fuites et, donc, empêcher le fonctionnement propre du système.

WARNING

TO PREVENT BACK INJURY, USE PROPER LIFTING TECHNIQUE WHEN HANDLING CONTAINERS.

1. Have the following equipment ready:
   a) New container containing desire (correct) chemical
   b) Wrenches (15/16 in. and 1-1/16 in. open end)
   c) 12.70mm (1/2 in.) stainless steel, VCR gaskets
   d) Proper personal protective equipment (PPE)
2. Put on personal protective equipment.

4.3. Change BULK Container Operation

WARNING

WARNING: Review corporate safety policy and in-house safety procedures before handling any chemical. The chemical handler should follow procedures in the Safety Data Sheet (MSDS) on chemical being used.

Secondary containment and cleanup material should be available in the event of chemical spill. Proper personal protective equipment must be used.

WARNUNG: Vor dem Umgang mit Chemikalien die in Ihrem Unternehmen geltenden Sicherheitsbestimmungen und betriebsinternen Sicherheitsverfahren revidieren. Alle mit Chemikalien umgehenden Personen sollten mit den in den Material-Sicherheitsdatenblättern (MSDS) aufgeführten Verfahren über die jeweils verwendete Chemikalie vertraut sein.

Ein Zweitbehälter und Reinigungsmittel sollten bereitstehen, falls Chemikalien verschüttet werden.

AVERTISSEMENT:Réexaminer les règles de sécurité instituées à votre entreprise et les procédés de sécurité en force avant la manipulation de tous produits chimiques. Tout utilisateur d'un produit chimique doit suivre les procédés prescrits dans les feuilles de normes pour matières (MSDS) concernant les produits chimiques en usage.

Un récipient secondaire et du matériel de nettoyage doivent être disponibles au cas où le produit chimique se renverse.

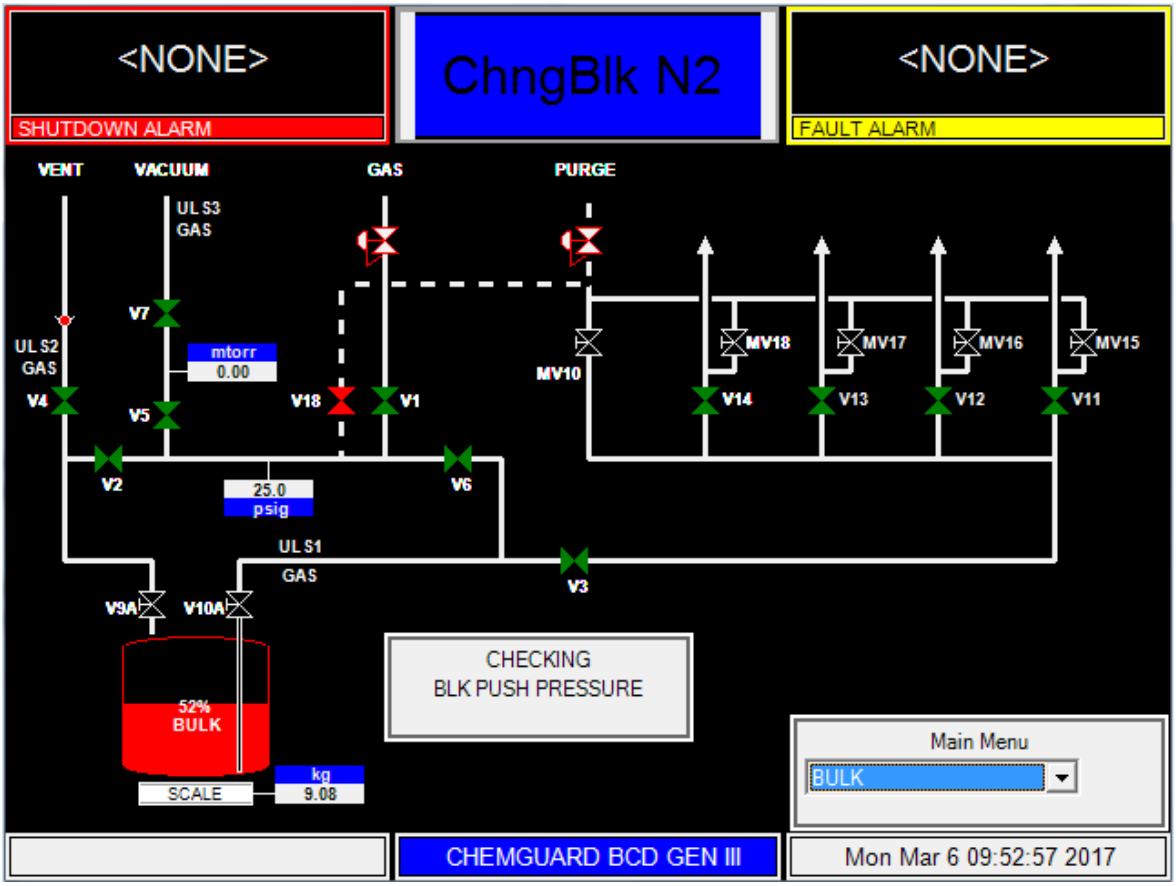
4.3.1. Changing the BULK Container

This option guides the operator through steps to remove and replace Bulk container. Change Bulk operation must be performed any time to remove or install Bulk container.

NOTE: There will be two (2) “Start Change Bulk” selections on the main menu display if ChemGuard® BCD100 ordered with the Helium Reduction option, addition of the V18 N2 spool.

- **Start ChngBlk** is the standard selection which uses Helium gas and is available for both non-Helium Reduction and Helium Reduction ChemGuard® BCD100.
- **Start Start ChngBlkN2** is only available when the Helium Reduction option is ordered and uses N2 gas when performing Change Bulk operation.

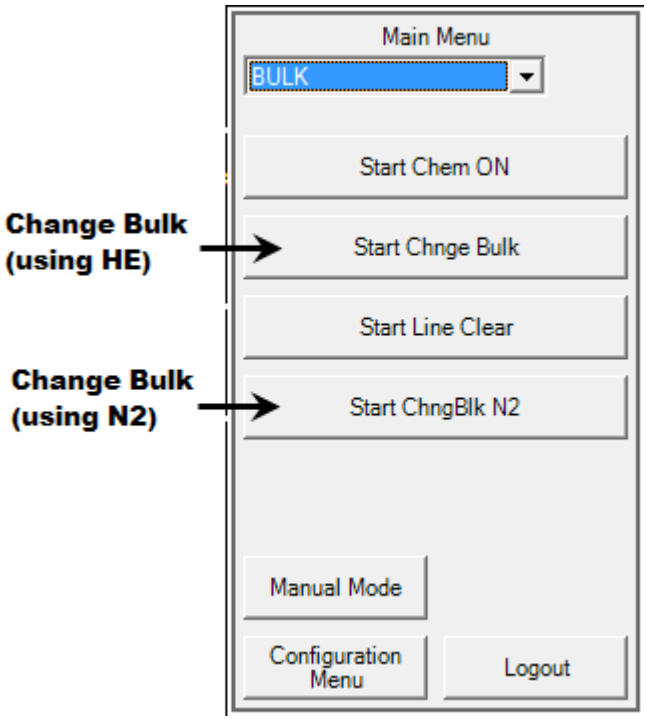
Figure 4-1: ChemGuard® with Helium Reduction option, V18



To start Change Bulk operation:

- Select Main Menu – Bulk
- Select Start Chnge Bulk – (Select when configured with the Helium Reduction option and when Helium required for Change Bulk operation)
- Controller status box for Bulk will change from white to blue and display Chnge Bulk
- Click on Stop Chnge Bulk button to stop change bulk operation
- Select Start Chnge Bulk N2 – (Select when configured with the Helium Reduction option and when N2 required for Change Bulk operation)

NOTE: Bulk>Process Fill and External Fill must first be disabled before Change Bulk can start.



Change Bulk operation will not proceed if any of the following conditions exists:

- A Life Safety or Change Bulk Shutdown alarm is activated.
- Operator terminates operation by selecting Stop Chnge Bulk from Bulk menu.
- The Vacuum pump is not turned on.

NOTE: For any reason if Change Bulk operation is terminated before its completion Chem On cannot be enabled. Successful completion of the Change Bulk operation is required to place ChemGuard® into the Chem On mode.

4.3.2. Detail Description of the Change Bulk Operation

1. When selecting the main screen, "Password" window displays. Enter a valid password and select "OK".
2. Select "Bulk" from the pull-down menu. If Chem On operation is enabled, select STOP CHEM ON to disable Bulk fill operation.
3. Select Bulk from the pull-down menu and select either START Chnge Bulk or START ChngBlk N2 (if Helium Reduction option available) to start the Change Bulk operation.
4. The controller status box will change from white to blue and indicate, Chnge Bulk.
5. At any time, the operator can terminate the Change Bulk operation by selecting STOP Chnge Bulk or STOP ChngBlk N2 from the Bulk Menu.

   NOTE: If Bulk change operation is stopped before its completion Chem On cannot be enabled. Successful completion of the Change Bulk operation is required to place ChemGuard® into a Chem On Mode.

6. The Bulk change operation continues to run until either one of the following occurs

a) A Life Safety or Change Bulk Shutdown alarm is activated
b) Technician/Operator terminates the operation by selecting **Stop Chnge Bulk**

7. During the Change Bulk operation, the system first performs a LINE CLEAR function, pushing liquid chemical from the Bulk outlet pigtail back into the Bulk container.
8. The operator/technician is then prompted to close the Bulk container manual valves, if configured for a manual valve container.
9. The Change Bulk operation then performs a series of Vacuum Cycle steps to ensure chemical/residue has been completely removed and dried from the Bulk inlet and outlet pigtails.
10. A leak test, vacuum rate of rise test will be performed before the Bulk container is removed. This ensures all chemical/residue has been completely removed and dried from the Bulk inlet and outlet pigtails and to ensure there is no across the valve seat leak of either the valves on the Bulk container or ChemGuard® valves.
11. The system will prompt the operator to remove the spent Bulk container.
12. Disconnect the pneumatic quick-disconnect fittings, if the container has pneumatic valves.
13. Disconnect the two (2) VCR connections connecting the Bulk pigtails to Bulk container valves. Take special care to account for the 2 used VCR gaskets ensuring they are not left attached to the Bulk pigtail connections.

CAUTION

<u>DO NOT</u> loosen the VCR connection of the inlet and outlet valves where they connect to the body of the Bulk Container

14. Open the spill doors and lower the roll-in access ramps, refer to Figure 4-2.
15. Using a pallet jack, carefully remove the expended bulk container.
16. Obtain a new bulk container. Carefully remove the shipping lid of the Versum Materials Inc. Bulk container.

CAUTION

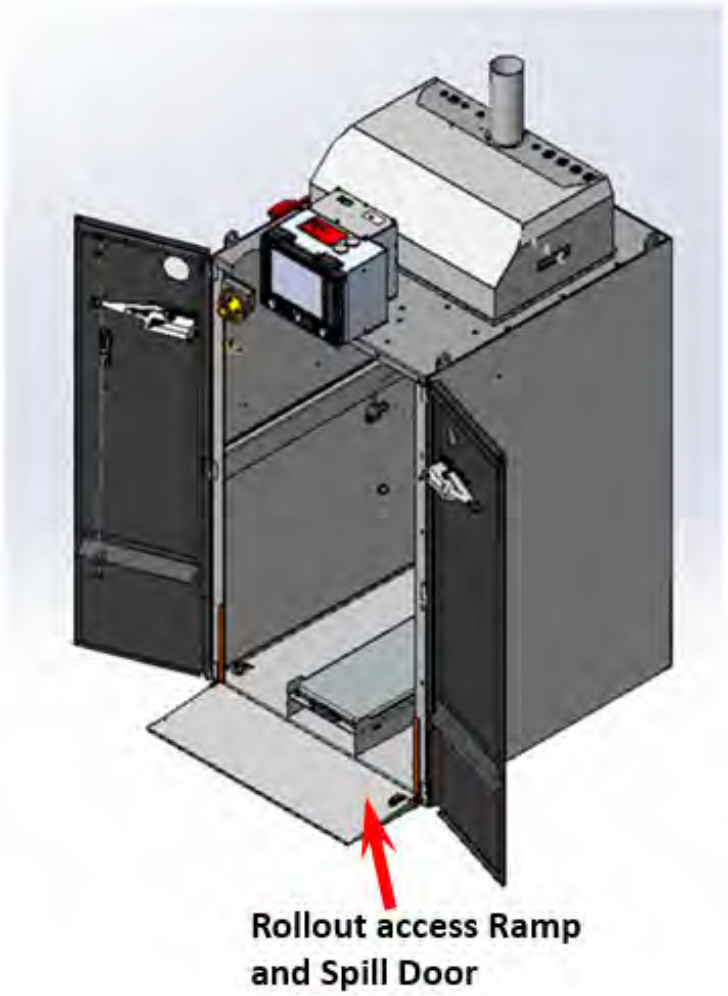
Shipping lid weighs in excess of 16 kg (35 lb). Use 2 man lift rule when removing and replacing lid to avoid personnel injury's

17. Remove the spent container and install the shipping caps to the VCR connections on the valves.
18. Remove the pallet jack, replace the roll-in access ramps, and close spill doors.
19. The operator will now be prompted to install the new Bulk container. **DO NOT** press OK until Bulk container has been installed and connected to the Bulk pigtails.
20. Replace with two (2) new VCR gaskets and connect the Bulk pigtails to the Bulk container valves.

NOTE: Ensure the pigtails closely aligned with the VCR fittings on the Bulk container valves ensuring there is no strain or stress applied to the Bulk container when the pigtails are connected. This can cause an incorrect reading of the Bulk Scale.

21. If there is a barcode option, the software will prompt to ENTER OR SCAN THE BARCODE ON THE NEW BULK CAN. Following this there will be a prompt which says INSTALL NEW CAN (this prompt will appear regardless of whether the system has a barcode option or not). At this point install the new Bulk can and press the OKAY button on the screen.
22. Reconnect the pneumatic quick-disconnect fittings, if the container has pneumatic valves.
23. The operator will now be prompted to enter a numeric entry for the valve type of the Bulk container, 2 for manual bulk valves or 3 for pneumatic bulk valves.
24. The Change Bulk operation will now continue with the post container change and perform a "Gross" leak test pressure decay test followed by several vacuum cycle purge steps and finally a leak test, vacuum rate of rise test. This ensures all moisture/air has been completely removed and dried from the Bulk inlet and outlet pigtails before Chem On commences.
25. The operation will now be prompted to enter the chemical liquid weight, which is printed on the label on front of the Bulk container.
26. If Bulk container configured with manual valves the operator will be prompted to open the manual valves.
27. Change Bulk operation is now completed and the controller status box will change from blue to white and indicate, ChngBlk Completed.

Figure 4-2: ChemGuard® BCD Access Ramp and Spill Doors



4.3.3. Change Bulk Diagnostics

WARNING

WARNING: Do NOT disconnect any fittings until all chemical has been removed.	WARNUNG: KEINE Verschraubungen lösen, bis nicht alle Chemikalien entfernt worden sind.	AVERTISSEMENT: NE PAS détacher les raccords de tuyauterie avant que tout produit chimique no soit extrait.

The following are alarm errors that could occur during the Change Bulk operation and possible causes and corrective actions to take:

Table 4-1: Change Bulk Alarm Errors

ALARM ERROR	POSSIBLE CAUSES	CORRECTIVE ACTION
PMPDWN TIMEOUT alarm BASE VAC TIMEOUT alarm LOW VACUUM TIMEOUT alarm	- Vacuum Pump failure - PPMPDWN / BASE VAC setpoint set too low - Change Bulk cycles incorrectly set	- Check vacuum pump for correct operation, check for leaks - Check base pressure reading of pump - Check vacuum setpoints - Check Change Bulk sub-cycle setting
LOW PUSH PRES BLK alarm HIGH PUSH PRES BLK alarm	- PT1 Pressure Transducer fail - Supply gas problem, incoming gas supply - R1 regulator fail – reg creep - R1 reg adjustment issue	- Check function of PT1 - Check incoming gas supply, main regulator setting - Check R1 regulator, test for reg creep - Re-adjust R1 to setpoint
Bulk Vent Failed alarm	- PT1 Pressure Transducer fail - Vent valve fail - Bulk check valve, CV1 fail	- Check function of PT1 - Check V2 and V4 valves - Check CV1 check valve for blockage, check valve plugged - Check vent line to exhaust for blockage
PIGTAIL NOT EMPTY alarm	- V6A valve fail - UltraSonic Sensor ULS1 on Bulk Pigtail fail	- Check V6 valve - Check pneumatic air pressure to V6 - Check function and placement of ULS1 Bulk Pigtail sensor
VAC GAUGE FAIL alarm	- PTV Vacuum Gauge fail	- Check function of PTV Vacuum Gauge
LEAK TEST FAILURE alarm GROSS LEAK PT1	- Valve leak, leak across valve seat - Loose VCR connection - Change Bulk cycles incorrectly set	- Perform valve seat leak check, leak test across valve seat - Check VCR connections - Check Change Bulk sub-cycle setting

Chapter 5

Features and Components

Section 1 **Overview**

Section 2 **Component Description**

Section 3 **Available Options**

5.1. Overview

NOTE: Only spare parts that meet the manufacturer's specifications should be used in the ChemGuard® GenIII BCD product line.

5.1.1. Operational Features

The ChemGuard® GenIII BCD is an automated fab-wide chemical delivery system which will control and monitoring all major system operations, including;

- Continuously delivers uninterrupted supply of chemical from the Bulk container to the point of use refill equipment, i.e. Liquid VMB, ChemGuard®, and process tool(s).
- To provide continuous un-interrupted supply of chemical two (2) ChemGuard® BCD can be configured together in an auto-switching pair for sites using large quantity of chemical. When bulk container of one BCD goes empty the BCD sends signal to a 2nd BCD waiting in idle and that one comes on line. The bulk container of the 1st BCD can be changed while the 2nd provides un-interrupted supply of chemical.
- Automated Bulk Change Operation.
- Display shows all operating parameters, current status of Bulk container, chemical levels of each container, and system setup information.
- All purge, process gas lines, exhaust line and pneumatic lines can be monitored continuously for pressure.
- Programmable container change operation, Leak Rate & Cycle Purge parameters.
- Purge procedures that monitors the removal of all chemical from container s.
- Automatic leak check detects leaks which safeguards against chemical exposure.
- Patented UltraSonic Empty Sensor allows 100% Utilization of Chemical from Bulk Container.
- All alarms are displayed on the LED HMI color touch display.
- System alarm displayed for ease of troubleshooting and include Life Safety, system pressure, system level, system status, vacuum status and degasser alarms, if degasser option is ordered.

5.1.2. Purity Control Features

- Process gas lines welded, electro-polished 316L stainless steel.
- All wetted surfaces constructed of 316L stainless steel, the valve seats made of KEL-F on certain model, other valve seat materials are available on certain models as well.
- All orbital TIG welded plumbing using VCR fittings to maximize leak integrity.
- Reservoir container constructed of 316L stainless steel.
- Cycle Purge and Leak Checks automated to prevent atmospheric contamination of the chemical during reservoir change out.

5.1.3. Safety and Security Features

- No spark sources in chemical storage area of cabinet for inherently safe design.
- Built-in seismic safety bolts down points per S2 Standard. Refer to Chapter 3 for bolt down dimensions.
- Specially designed scale for accurate weight detection of the Bulk containers, 1000lb and 1500lb size, ± 0.1% of full scale.
- Spill doors with lower roll-in access ramps to simplify bulk container replacement.
- 110% primary spill containment is standard on ChemGuard® Cabinets.

- Redundant overfill protection of the Bulk containers, including ultrasonic liquid sensors mounted on the vent and vacuum lines.
- Latching cabinet front door with key lock.
- Redundant dual liquid spill detection standard in all cabinets.
- Bulk container ASME-certified for pressure, rated to 120 PSIG.
- Pressure-relief is built in to prevent over-pressure of the Bulk containers. Pressure-relief valve set for 110 PSIG.
- Designed using SEMI S2, CE Heavy Industry and U.L. safety specifications as guidelines.
- Optional lower explosion limit (LEL) combustible vapor detection sensor is available. Consult your Versum Materials, Inc. Sales Representative.
- Optional fire (temperature rate of rise) detection sensor is available. Consult your Versum Materials, Inc. Sales Representative.
- Optional Fire Suppression System is available. Consult your Versum Materials, Inc. Sales Representative.

5.1.4. Installation in Classified Locations

The ChemGuard® is approved for use in NEC (National Electric Code) Class I, Division 2 (U.S.A) and ATEX Zone (Group) 2, Category 3 (Europe) classified locations provided that the controller Type Z purge in enabled.

The Type Z purge is required to maintain a positive pressure of Nitrogen at or above 0.10 in. W.C. as dictated by the National Fire Protection Agency (NFPA) and European directives (ATEX). In applications where Type Z purge is required, the controller will be equipped with a pressure switch to monitor the presence of purge gas. The Type Z purge will require a flow rate of approximately 5.5 LPM.

5.1.5. Z-Purge Setup and 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 door and secure latch completely.
2. Open the needle valve 4 to 5 turns (counter-clockwise). Allow the controller to purge for 30 minutes at 5.5 SLPM flowrate.
3. 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 5.5 LPM will be needed, depending on the tightness of the individual controller and the installation.

5.2. Component Description

The ChemGuard® GenIII consists of these major subassemblies:

- Chemical Cabinet
- Controller Electronics Enclosure
- Emergency Manual Stop (E-Stop)
- LED VGA Color Touch Display Screen

NOTE: The Bulk container not included with the ChemGuard® cabinet unless the External Bulk Refill option is ordered which includes the refillable Bulk container. Consult your Versum Materials, Inc. representative for more details.

Figure 5-1: ChemGuard® GenIII BCD

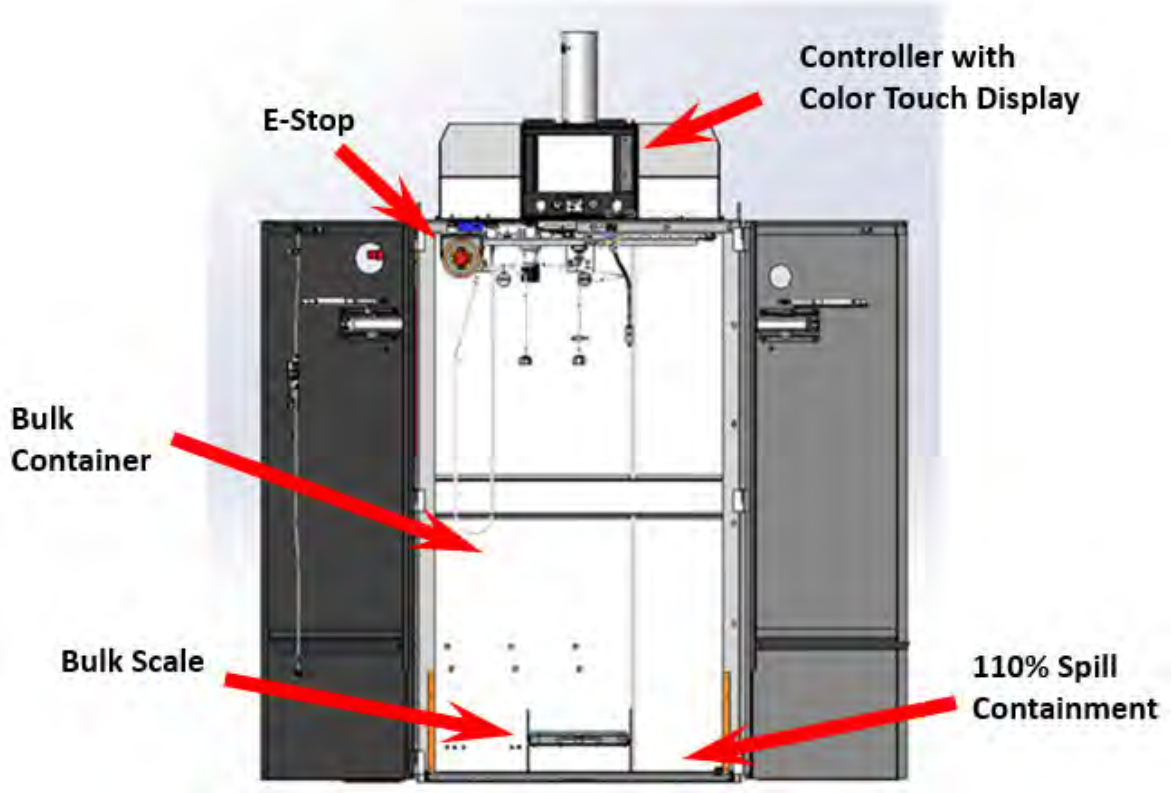
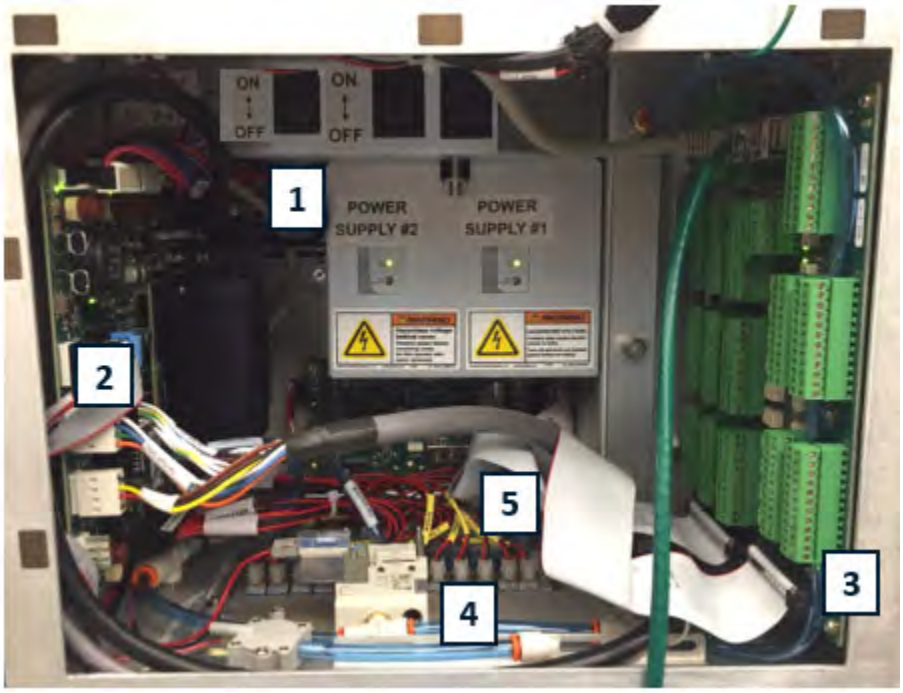


Figure 5-2: ChemGuard® Electronic Enclosure



ITEM#	ITEM	FUNCTION
1	Power Supply	Single or dual, redundant power supply with On-Off switch and power indicator
2	Carrier board, AP1565	Main controller board with on-board microprocessor and redundant ARS (automated restart) microprocessor
3	Tool IO board, AP1614	Cabinet IO Interface with Life Safety and Process Tools
4	Master Solenoid	Controls main pneumatic air supply to ChemGuard® cabinet. Closes to isolate pneumatic supply (hardware interlock) in a life safety alarm condition
5	Solenoid Manifold	Main manifold for all pneumatic control valves in the ChemGuard® cabinet

5.2.1. Emergency Manual Off (E-Stop)

The Emergency Manual Off (E-Stop) circuit provides for emergency shutdown of ChemGuard® cabinet. The E-Stop switch is located on the upper door, immediately on the lower right of the upper door. When pressed, it will cutoff the pneumatic air pressure to the master solenoid and all valves will return to their normally de-activated condition.

NOTE: System power will remain on to the ChemGuard® allowing continual monitoring of system conditions.

Figure 5-3: Color Touch Display Screen – BCD100

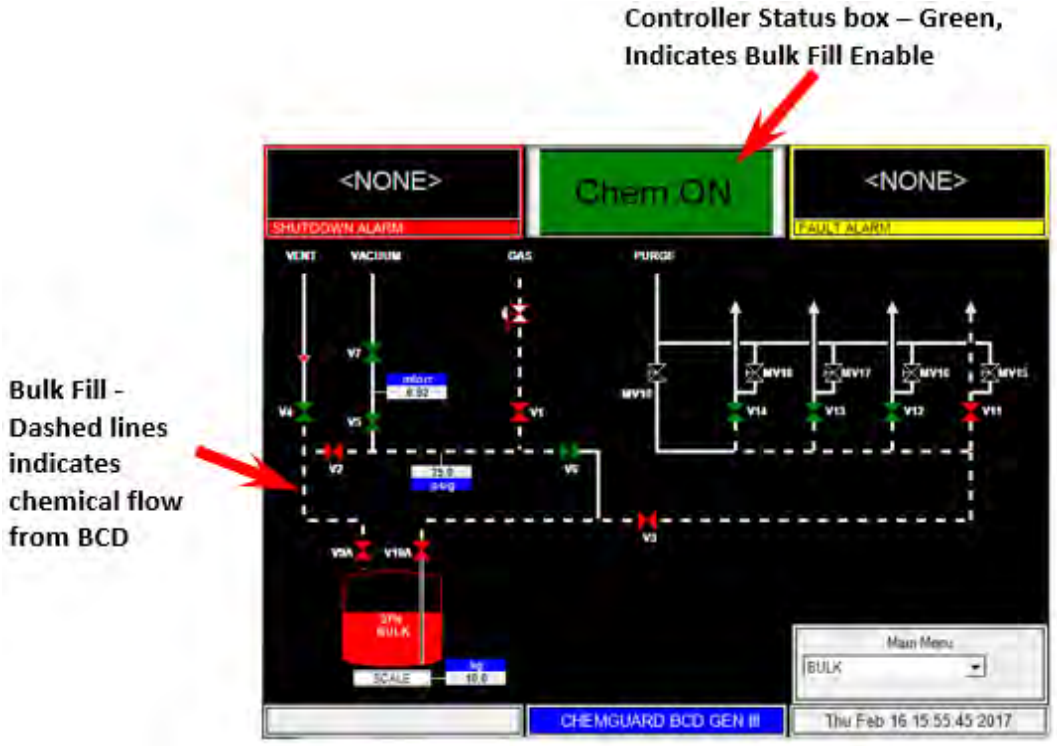
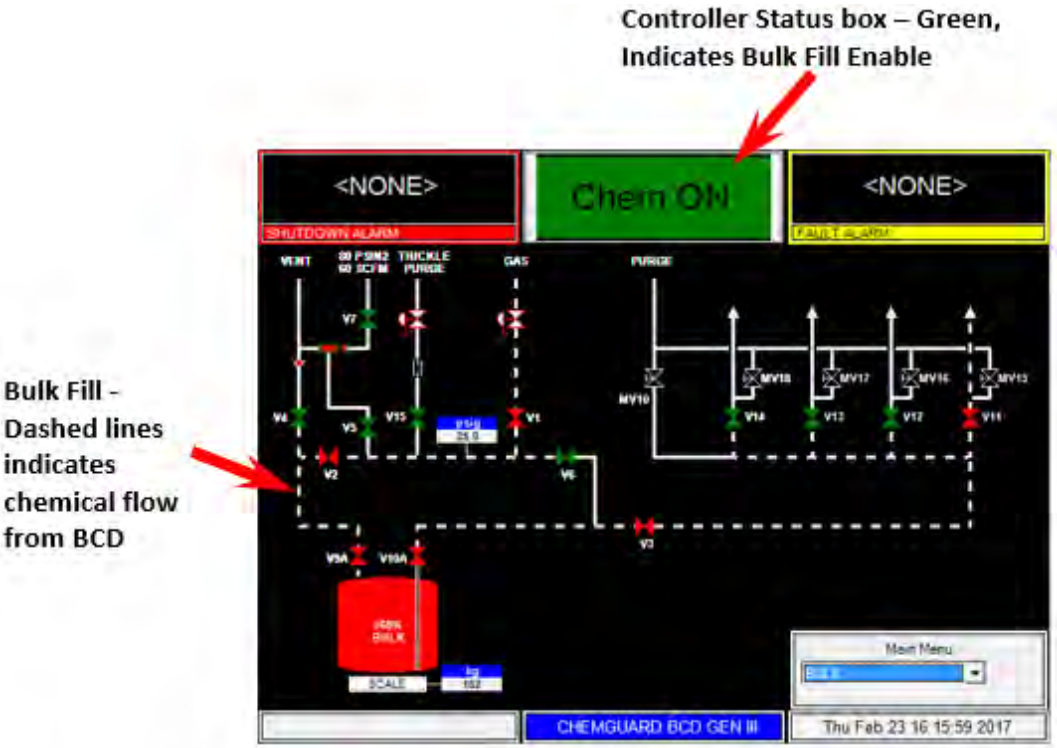


Figure 4: Color Touch Display Screen – BCD200



NOTE: The above figures are typical display screens of the ChemGuard® Gen III BCD100 and BCD200, respectively, depending on system configuration and options ordered.

5.2.2. Bulk Container

The bulk container stores and supply the process chemical used in customer applications.

Many bulk container-types are available for use with ChemGuard®. Depending on customer requirements, containers of different capacities may be used in one ChemGuard® installation.

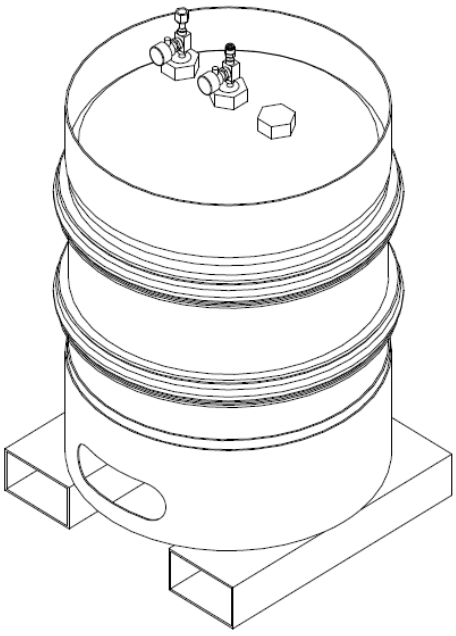
Standard Bulk Pigtail Connections:

- Inlet Pigtail has 1/2 inch male VCR (1/2" MVCR) connection to container valve on headspace (gas) side.
- Outlet Pigtail has 1/2 inch male VCR (1/2" MVCR) connection to container valve on diptube (liquid) side.

NOTE: The Bulk container is not included with the ChemGuard® BCD cabinet. Contact your Versum Materials, Inc. representative for more details. It is the customer's responsibility to determine container requirements based on their processes and chemical usage needs.

Bulk Container installation is described in Chapter 4.

Figure 5-5: 200 Liter Bulk Container



5.2.3. Chemicals Authorized for Use in ChemGuard®

Please contact an Versum Materials, Inc. service representative for complete list of authorized chemistries to be used in the ChemGuard® and the model ChemGuard® required.

For chemicals authorized for use in ChemGuard® Refer to document V-TSA060, ChemGuard® Chemical Fill Matrix or contact Versum Materials for detail.

Some of these chemicals require specially-configured ChemGuard® cabinets. For physical hazards and hazard thresholds associated with these chemicals, contact Versum Materials, Inc. for SDS information for each chemical-type.

It is the customer's responsibility to comply with OSHA Hazard-Communication Standards regarding chemical container-labeling and cabinet-labeling. Versum Materials, Inc. advises the customer to affix a label outside the ChemGuard® cabinet, identifying the chemical therein.

Use of chemicals in ChemGuard® may fall under the guidelines of specific government agencies. It is the customer's responsibility to determine and comply with appropriate guidelines for specific chemicals used. For further information, contact Versum Materials, Inc.

Versum Materials, Inc. recommends that exhaust connection to the ChemGuard® be a facility-based control.

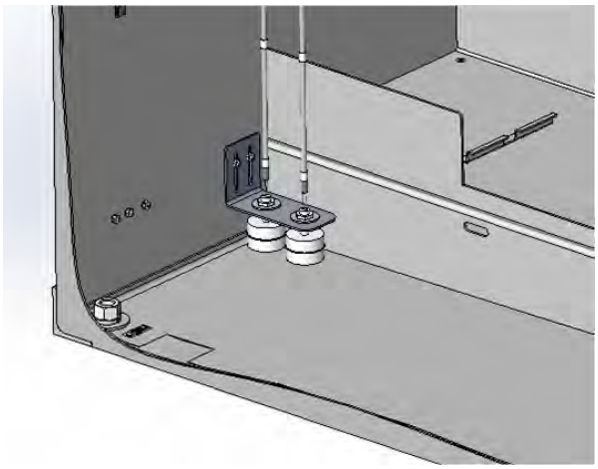
5.3. Available Options

5.3.1. Cabinet Spill Detection

Sump Spill (Dual Float Sensors)
The ChemGuard® BCD is equipped with dual float switches as standard offering for spill detection. When a single float detects a spill, a fault alarm is displayed. If both float switches detect a spill, a shutdown alarm will be generated and will terminate all operations and return the cabinet to IDLE state.

NOTE: The Dual Float Sensors (SUMP SPILL) does not require any calibration, it is recommended to verify the floats move freely by lifting each one up and it should free fall down. Verify no build-up on the Float and Stem which can cause hang-up. Please refer to Chapter 7 for more detail test on the Sump Spill (Dual Float Sensors).

Figure 5-6: Sump Spill (Dual Float Sensors)



Secondary Sump Spill (Single Float Sensor)
The ChemGuard® BCD is equipped with a secondary single float switch that is used when two (2) ChemGuard® BCD cabinets are configured for Auto Switching.

When the single float detects a spill, a shutdown alarm will terminate any operation in progress, and will return all valves to their safe (deactivated) condition to prevent further chemical flow.

A signal is also sent to the secondary ChemGuard® BCD which takes the cabinet off line and places in an offline condition

5.3.2. Ultraviolet Infrared (UVIR) Detector (Option)
An optional Ultraviolet Infrared (UVIR) Detector can be ordered for the ChemGuard® BCD. The UVIR combines a UV and an IR flame detector in one device to respond to a flame condition. This will provide an early indication of a fire inside the ChemGuard® cabinet.

When a fire is detected by the UVIR a “UVIR DETECT” alarm will be generated and returning the cabinet to IDLE state.

Refer to Addendum Y for calibration and maintenance of the UV/IR.

5.3.3. High Temperature Detection Switch (optional)

A temperature switch mounted on the exhaust sensor assembly will alarm if temperature inside the ChemGuard® cabinet rises above 45-52°C. A High Temp alarm will be generated and will terminate all operations and return the cabinet to IDLE state. Refer to Chapter 7 for testing of the sensor.

5.3.4. System Combustible Vapor Detection (optional)

An optional combustible vapor detector is located near the exhaust flow stream of the ChemGuard®. When combustible chemical vapors come from the inner ChemGuard® cabinet, a VAPOR Alarm is activated.

This alarm will terminate any operation in progress, and will return all valves to their safe (deactivated) condition to prevent further chemical flow.

The vapor pressures of many process chemicals used in the ChemGuard® are too low to be detected by the vapor detector, and also are too low to be in their flammable/combustible ranges. However, most are air-sensitive chemicals that will develop byproducts detectable by the combustible vapor detection system.

NOTE: The combustible vapor detection system is not designed for use in detecting Threshold Limit Value (TLV) concentrations of process chemical. The customer is responsible for determining whether such protection is required and for providing this equipment. Refer to Chapter 7 for vapor detector calibration and maintenance.

5.3.5. Hazardous Vapor Sniffer Port

There is a sniffer port located on the display door of the cabinet enclosure as shown in the below figure. In an event where the chemical containment is in question or the internal cabinet atmosphere needs to be verified, removal of the sniffer port screw can allow access for a customer approved gas detector to be inserted.

WARNING

Always wear proper PPE for hazardous atmosphere when the cabinet internal atmosphere is in question or unknown. THIS PORT IS NOT TO BE USED WHEN FLAMMABLE OR TOXIC ATMOSPHERE IS KNOWN TO EXIST INSIDE CABINET.

Figure 5-7: Sniffer Port Location

5.3.6. Fire Suppression System (optional)

The Fire Suppression System is an independent system, equipped with a rate of rise detection sensor. The sensor will trigger an alarm if a rise of temperature in the cabinet exceeds 40°F in a period of less than one (1) minute. The Fire Suppression System will then be activated and CO_2 released into the ChemGuard® cabinet extinguishing a fire within the cabinet. It will also send a signal to the ChemGuard® generating a shutdown alarm and returning the cabinet to IDLE state.

As the fire suppression option is an independent system, authorized personnel should always review the manufacturers operation manual prior to install or service.

WARNING

The system must be independently powered down and locked out at the circuit breaker prior to any work.

WARNING

Hazardous energy present includes stored pressurized CO_2. Always wear proper PPE and follow manufacturer's instruction manual.

NOTE: The CG Fire option is an external and independent Fire Detection and Suppression System. The CG Fire option installs directly onto ChemGuard® cabinet to minimize space requirements and piping connections. While the CG Fire option is not certified to meet CE Standard, it does meet the minimum safety requirements outlined in the manufacturer's operating manual.

Refer to Appendix G for calibration and maintenance of the Fire Detection and Suppression System.

Chapter 6

System Operation

NOTE: The ChemGuard® GEN III cabinet must remain locked during normal operation. The operating personnel shall only unlock and open the lower cabinet door while performing canister changes or prescribed preventative maintenance procedures and the area is known to be free of flammables.

6.1. Theory of Operation

6.1.1. Overview

The ChemGuard® BCD is designed to deliver liquid chemical (from 1, 2, or 4 chemical output lines) directly to eternal refill equipment, i.e. Liquid VMB, ChemGuard® and process tool(s).

All Versum Materials Inc. chemical is supplied in bulk stainless steel reservoir containers (refer to Chapter 5).

Using pressurized inert gas, Nitrogen, Helium or Argon, the ChemGuard® pushes chemical from the bulk container to the external refill equipment upon a fill request or when the refill equipment opens its controlling refill valve. Fill continues until the refill equipment reaches the refill level and either terminates the request or closes its controlling refill valve.

The ChemGuard® is a Windows CE operation system which monitors all key parameters that control the operations. The controller automatically performs most maintenance functions. For example, the Cycle Purge and Leak Check operations are automated functions designed into the Change Bulk operation. This automation reduces the time and effort involved in performing common maintenance tasks.

An automated Change Bulk operation ensures the ability to change the chemical container without contaminating the chemical or causing exposure to the user or the environment. The plumbing lines to the bulk container are designed with flexibility to help while installing the container. Pressure relief is provided to prevent over-pressurization of the bulk container.

The Emergency Manual Off (EMO) circuit provides an emergency stop to shutdown the Pneumatic supply source to the cabinet.

A remote life safety input can be hooked up directly to the ChemGuard® controller to place system in a safe, idle condition. Contact Versum Materials Inc. for details.

Password protection prevents unauthorized personnel from attempting key tasks. Operating modes are displayed to simplify operation.

The ChemGuard® has been designed to meet or exceed industry environmental / safety regulations and specifications. The cabinet is steel, and contains 110% spill containment. All power sources capable of providing shocks or sparks have been isolated and contained completely outside of the chemical cabinet.

Communication to the Process Tool is provided via the input/outputs from the Tool IO board, AP1614, refer to Chapter 3.

NOTE: The exact configuration required depends on the Process Tools in use. Please contact Versum Materials, Inc. service or marketing to determine the best setup for your application.

6.2. Description of Menus and Operations

2 Primary Operations performed by the ChemGuard® BCD:

- Chem On (Bulk Fill)
- Bulk Change

6.2.1. Chem On (Bulk Fill)

External refill equipment sends request to have their onboard supply ampoules replenished without affecting chemical delivery or chemical pressure to the process tool.

Chemical will be pressurized from the Bulk container through valve V3 to the output manifold valves V11-V14. To fill chemical from the ChemGuard® BCD to the refill equipment, valves V11-V14 must be activated by applying input signal to the CHEM ON VALVE input.

6.2.2. Change BULK Operation

- Automated Bulk Change operation.
- Does not affect chemical delivery to the process tool
- Ultrasonic empty sensor generates bulk empty alarm once 100% of chemical has been utilized
- Optional bulk scale will monitor chemical level of Bulk container
- Operator prompts to perform user tasks- i.e. “Change Bulk”
- Purge and leak test operations automatically performed
- Bulk container weight updated when optional bulk scale installed
- Chem On “locked out” until successful completion of Change Bulk operation

Table 1: ChemGuard® BCD Vacuum verse Venturi

VACUUM – BCD100	VENTURI – BCD200
Vacuum pressure can reach 2-3mtorr dependent on pump	Venturi pressure can only reach 25-30 torr dependent on construction, N2 flow/pressure
Vacuum can outgas chemical residue from CG plumbing for chemicals with vapor pressures as low as 50 mtorr	Venturi can only outgas liquid chemical residue for chemicals with vapor pressures as low as 80 torr
Vacuum cycle purging and leak check rate of rise test can be performed to ensure all chemical residue removed before breaking of VCR fittings	Venturi purging can be performed but leak check cannot be performed to ensure all chemical residue has been removed before breaking of VCR fittings
Container change can be completed in 2-3 hours – TEOS at 1.2 torr	Container change takes approximately 6-8 hours to complete – TCS at 400 torr
Dry vacuum pump required and typically expensive	Venturi inexpensive and only requires N2 to perform
Typical chemicals that can be purged using vacuum – TEOS, ZTOMCATS™, BTBAS	Typical chemicals that can be purged using venturi – TCS, SiLC4, GECL, 4MS

6.3. Operating Menu

6.3.1. Display Screen

Located on the front face of the controller, the display screen is an LED color touch display that contains a graphical display of the Bulk and Process container, shutdown and fault alarm boxes, a controller status box and selection window. The LED display provides a lighted display, and visual indication of pneumatic valve positions. Open valves are shown in red and closed valves are shown in green. The valve condition colors conform to ISA standards.

Figure 6-1: ChemGuard GENIII BCD100 CHEM ON Display Screen

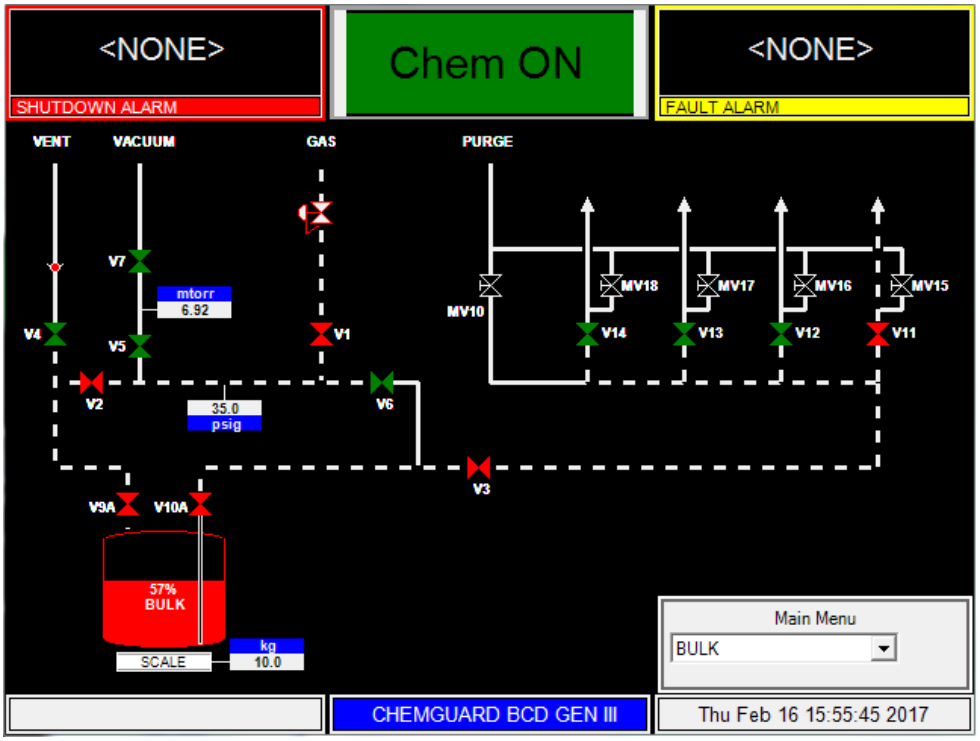


Figure 6-2: ChemGuard GENIII BCD100 CHEM ON Display Screen with V18 Helium Reduction Option

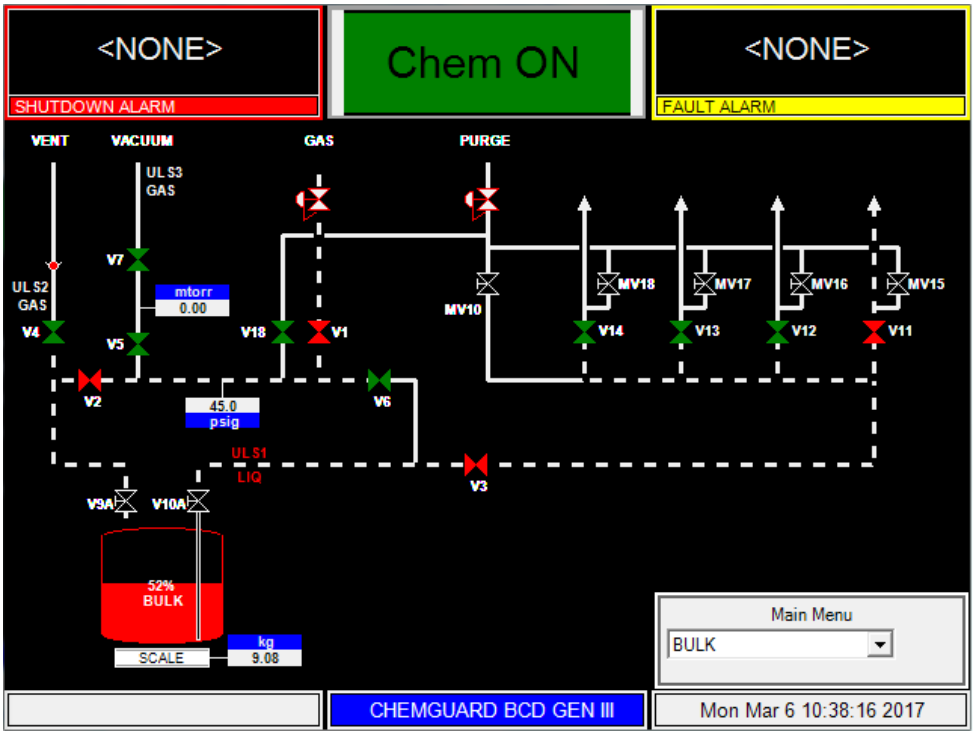
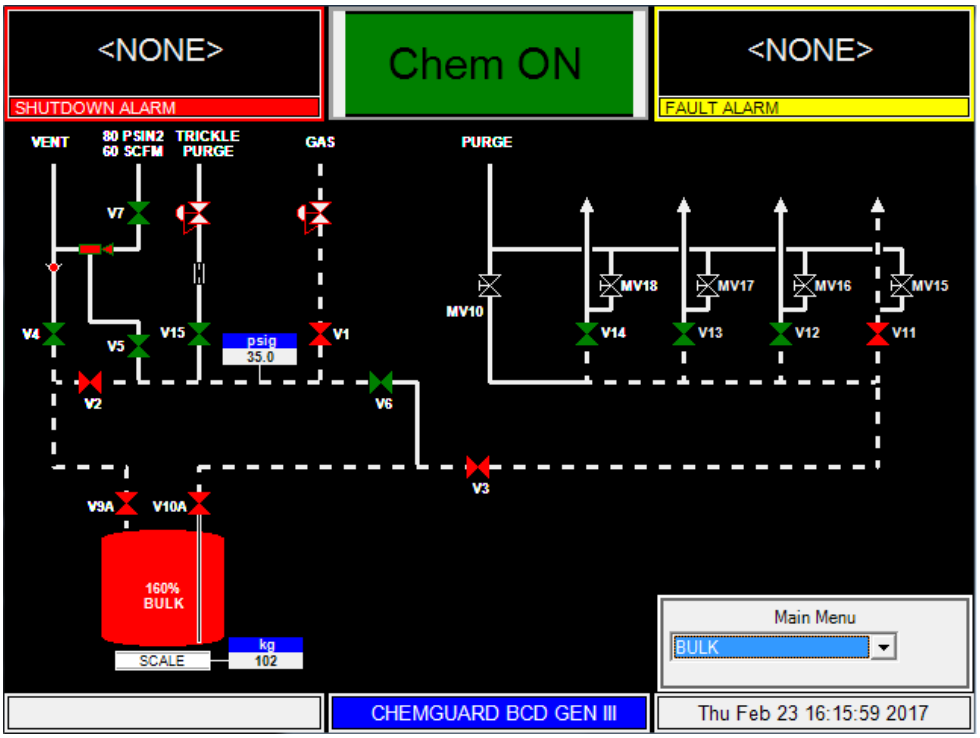


Figure 6-3: ChemGuard GENIII BCD200 CHEM ON Display Screen



6.3.2. Alarm and Controller Status Boxes

Shutdown alarms in the cabinet appear on the SHUTDOWN ALARM box, located in the top left hand corner of the screen. Fault alarms 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 in the cabinet. A time stamp of when the alarm occurred will be displayed with each alarm. Alarms can be acknowledged and the alarm buzzer can be muted by clicking once anywhere on the alarm box. Double clicking on the alarm text box will clear the alarm.

Figure 6-4: Alarm and Controller Status Box

6.3.3. System Status LEDs

Additionally, LEDs that display ChemGuard® functions are located to the right of the LCD display. The table below describes these LEDs and their functions. The fault alarms are indicated by a yellow color and the shutdown alarm is identified by red.

Figure 6-5: System Status LEDs

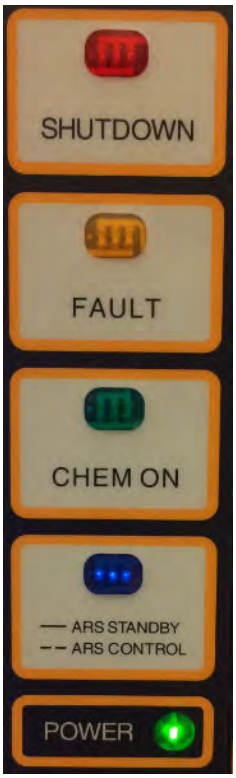


Table 6-2: System Status LEDs Description

LED	FUNCTION
SHUTDOWN ALARM	This LED flashes red on Shutdown alarm. Once acknowledged, the LED stops flashing but remains red until it is reset.
FAULT ALARM	This LED flashes yellow on Fault alarm. Once acknowledged, the LED stops flashing but remains yellow until it is reset.
CHEMICAL FLOWING	This LED lights green when Process Fill is enabled and tool inputs are satisfied.
ARS – Auto-Restart	This blue LED lit and in steady state indicates Auto-Restart option enabled and monitoring system status. LED flashing blue indicates Auto-Restart was activated.
POWER	This LED indicates that there is +5 VDC power to the unit.

6.3.4. Main Menu

The selection window, which is shown as a Main Menu, is located on the right side of the screen after a password has been successfully entered. This menu will remain displayed for a configurable amount of time or until the "LOGOUT" key is pressed.

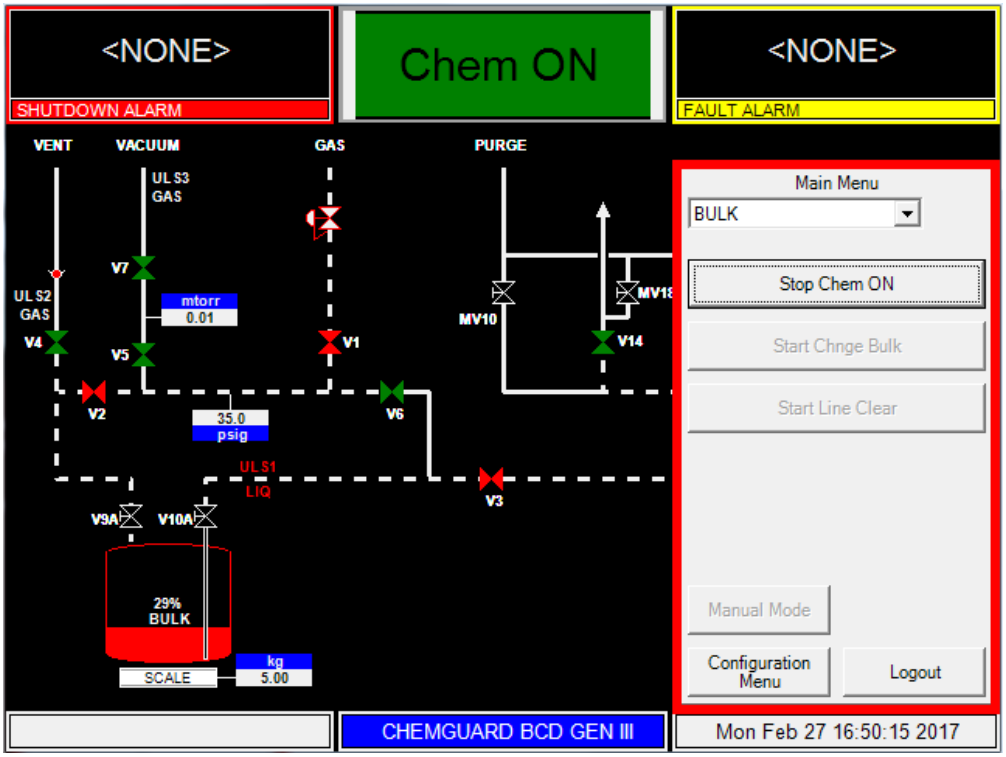
The Main Menu has a pull-down window with two options: BULK, and EXT FILL. Any operation associated with the Bulk container should be selected by choosing Bulk from the pull-down menu, also referred to as the Bulk Main Menu.

It is possible to resize the Main Menu to get a full view of screen. To resize the Main Menu, touch the label, "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.

Figure 6-6: ChemGuard® BCD100 Main Menu Display Screen



6.3.5. Screen Saver

The screen saver function becomes active during idle or process on states, after the programmed amount of time has elapsed since the last operator keypad action. The screen saver blanks the screen and displays a randomly-moving mode indicator box.

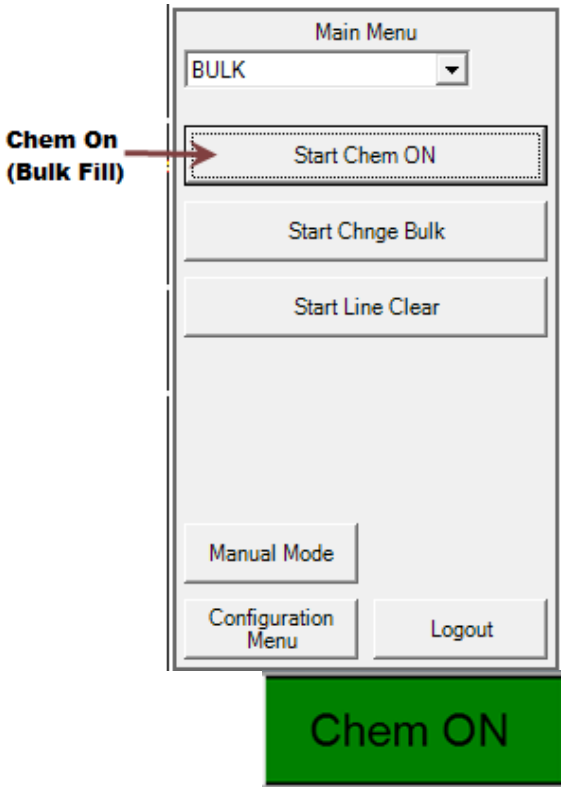
If the operator presses any key or a new alarm appears while the screen saver is active, the screen saver function will become inactive and the key pressed will be ignored. The screen saver function will not be active while a fault or shutdown alarm is present, an active prompt is displayed, or during any mode/sequence other than idle and Chem On.

6.3.6. Bulk Main Menu Options

Chem On (Start Bulk Fill)

This operation allows chemical to fill from the Bulk container to the External Refill equipment via the outputs valves V11 thru V14. From the pull-down menu of the Main Menu, select Bulk (if not selected) to gain access to the Bulk Main Menu. Click **START Chem ON**.

- In this option: Select **Start Chem ON** to enable Bulk fill
- Bulk fill enable requires either Memory Management > Variables, 77-80 to be set for 0.00 (factory default) or a Bulk fill signal input at TB1-4 on the Tool IO board, refer to Chapter 3
- Controller status box changes from Chem ON Stopped, white to Chem ON, green
- Menu option **Stop Chem ON** will be enabled once **Start Chem ON** is selected. Clicking on **Stop Chem ON** option stops, disables Bulk fill



The cabinet remains in Chem ON status until one of the following conditions occurs:

- Chemical level in the Bulk container reaches empty
- Operator terminates the operation by selecting Stop Chem ON
- A shutdown alarm occurs

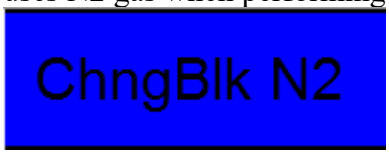
Change Bulk operation (START CHNGE BULK)

This option guides the operator through steps to remove and replace Bulk container. Change Bulk operation must be performed any time to remove or install Bulk container.

NOTE: There will be two (2) "Start Change Bulk" selections on the main menu display if ChemGuard® BCD ordered with the Helium Reduction option, addition of the V18 N2 spool.

- **Start ChngBlk** is the standard selection which uses Helium gas and is available for both non-Helium Reduction and Helium Reduction ChemGuard® BCD.

- **Start Start ChngBlkN2** is only available when the Helium Reduction option is ordered and uses N2 gas when performing Change Bulk operation.



Refer to Chapter 4 for detail information.

WARNING

WARNING: Review corporate safety policy and in-house safety procedures before handling any chemical. The chemical handler should follow procedures in the Material Safety Data Sheet (MSDS) on chemical being used. Secondary containment and cleanup material should be available in the event of chemical spill. Proper personal protective equipment must be used.

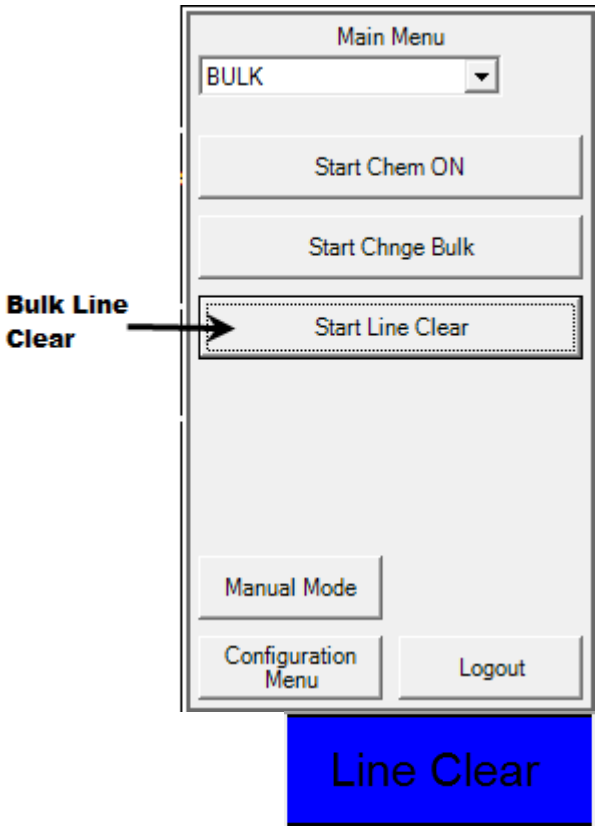
WARNUNG: Vor dem Umgang mit Chemikalien die in Ihrem Unternehmen geltenden Sicherheitsbestimmungen und betriebsinternen Sicherheitsverfahren revidieren. Alle mit Chemikalien umgehenden Personen sollten mit den in den Material-Sicherheitsdatenblättern (MSDS) aufgeführten Verfahren über die jeweils verwendete Chemikalie vertraut sein.
Ein Zweitbehälter und Reinigungsmittel sollten bereitstehen, falls Chemikalien verschüttet werden.

AVERTISSEMENT:Réexaminer les règles de sécurité instituées à votre entreprise et les procédés de sécurité en force avant la manipulation de tous produits chimiques. Tout utilisateur d'un produit chimique doit suivre les procédés prescrits dans les feuilles de normes pour matières (MSDS) concernant les produits chimiques en usage.Un récipient secondaire et du matériel de nettoyage doivent être disponibles au cas où le produit chimique se renverse.

Bulk Line Clear Operation (START LINE CLEAR)

Bulk line clear operation pushed chemical from the Bulk outlet pigtail back into the Bulk container. It will continue until Bulk Empty sensor, ULS1 no longer detects liquid but detects gas.

- To start the Bulk line clear operation, click on **START LINE CLEAR** from the Bulk Main Menu
- The Controller status box for Bulk will display "Line Clear" and the STOP LINE CLEAR option will be enabled on the Main Menu
- Select **STOP LINE CLEAR** to stop line clear operation at any time
- Bulk Line Clear operation will continue until Bulk Empty sensor, ULS1 no longer detects liquid
- Bulk line clear operation can be started if there are no shutdown alarms in the cabinet



Bulk Manual Mode Operation (START Manual Mode)

The Bulk Manual Mode operation is a function to operate individual valve during startup or maintenance mode as well as for troubleshooting, refer to Figure 6-7.

- To start Bulk Manual Mode operation, select **MANUAL MODE** from the Bulk Main Menu.
- Select desired valve on touch screen to be actuated and confirm by pressing "OK".
- For desired valves to remain actuated, then select the "SECURE" box before changing to different screen.
- At anytime all valves can return to normal state by pressing the "CANCEL" box.

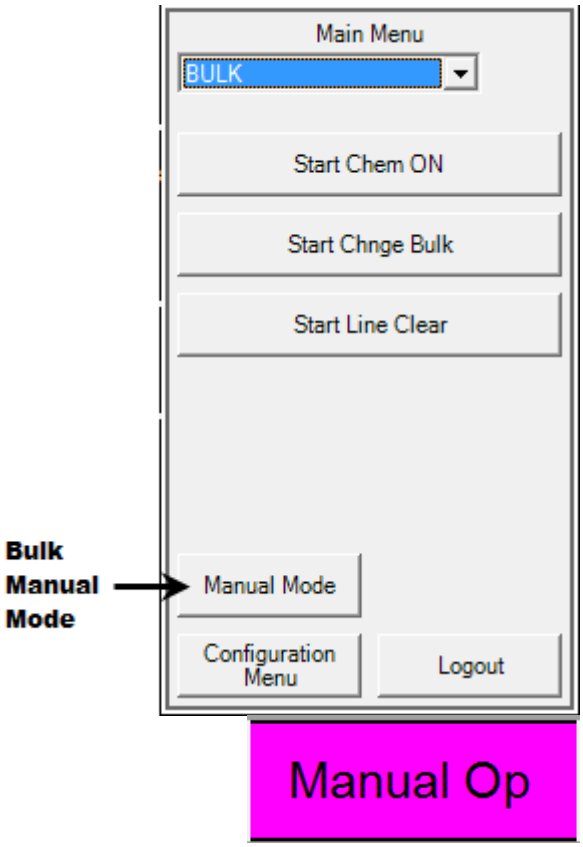
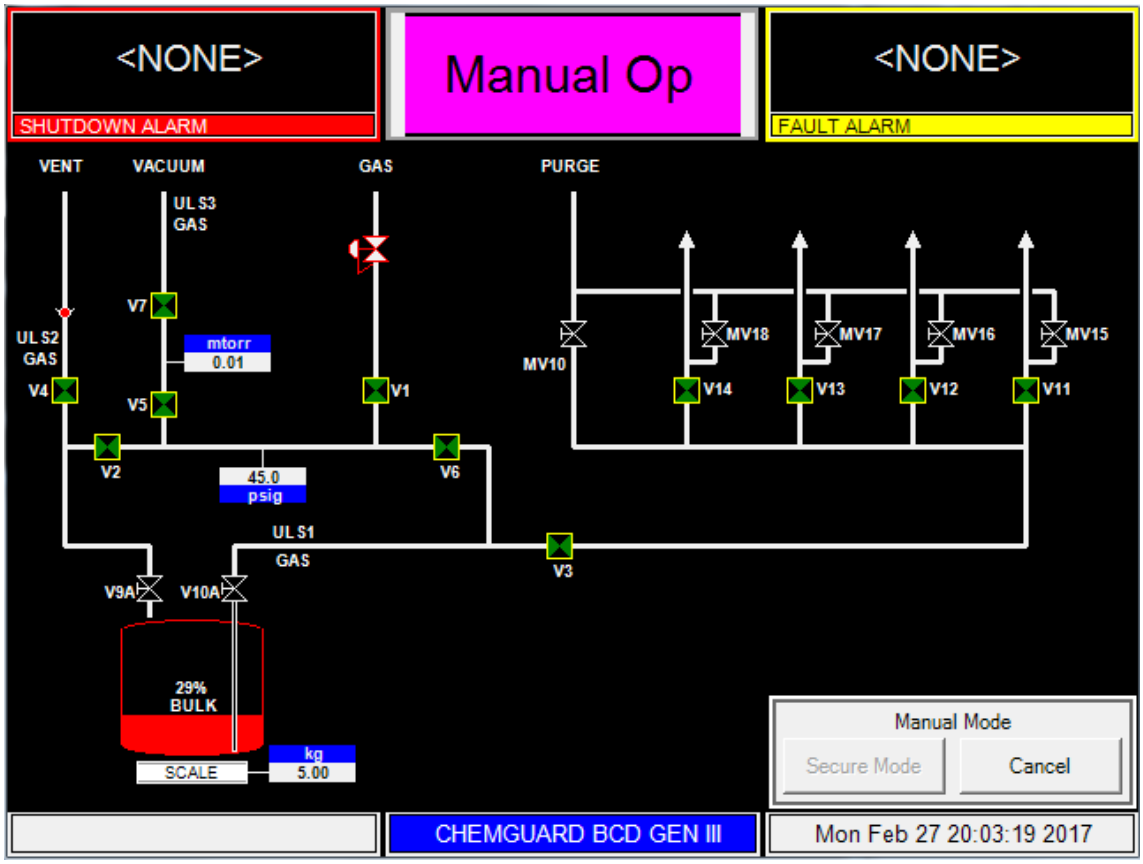


Figure 6-7: CHEMGUARD® Main Menu Display Screen



NOTE: Yellow box symbol around all valves allowed to be controller in manual mode.

6.4. Alarm Types

The alarms in the ChemGuard® cabinet can be classified either as SHUTDOWN alarms or FAULT alarms. Shutdown alarms appear on the SHUTDOWN ALARM box, in RED, located in the top left hand corner of the screen. Fault alarms appear on the FAULT ALARM box, in YELLOW, 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.

Any alarm that occurs in ChemGuard® is displayed along with date and time stamp indicating date and time of alarm occurrence. In addition, independent output signals for shutdown and fault alarm are sent to all the available IO connections in ChemGuard®.

A SHUTDOWN alarms sets off a buzzer, which continues to sound until the alarm has been cleared. A shutdown alarm LED flashes red when an un-acknowledged shutdown alarm is present. The Alarm can be acknowledged by clicking anywhere on the alarm text box. Double-clicking anywhere on the alarm text box will clear the alarm. Once acknowledged, the LED stops flashing, but remains red until it is reset.

A FAULT alarm LED flashes yellow when a fault alarm is present. Once acknowledged, the LED stops flashing, but remains yellow until it is reset. If a light bar tower is available in the system, a red section of light bar flashes when an un-acknowledged shutdown alarm is present. Once acknowledged, the LED stops flashing, but remains red until it is reset. A yellow section of light bar flashes yellow when a fault alarm is present. Once acknowledged, the LED stops flashing, but remains yellow until it is reset.

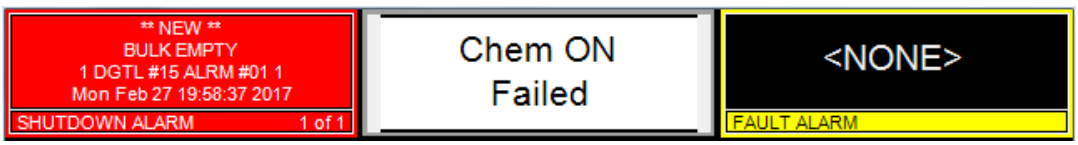
If multiple alarms are present, alarms will scroll in the alarm box with an index and number of alarms present in the cabinet at that time. The ChemGuard® can be configured so that, when the power at the ChemGuard® is turned off, all alarms are activated at the I/O, which in turn, alerts the process tool of a loss of power on the ChemGuard®.

Unacknowledged alarms are marked with keyword “**NEW**”. Even after an alarm is cleared (by double clicking anywhere on alarm text box), if alarm condition exists in the cabinet, the alarm will come back.

6.4.1. SHUTDOWN Alarms

When a shutdown alarm occurs, all operations are stopped and all valves return to normal stage. In addition, alarm text message will be displayed, shutdown alarm LED will flash and relay output is sent to all active IO connections so that signal can be sent to the process tool. If there is a light bar in the cabinet, a red section of the light bar will flash if shutdown alarm is un-acknowledged and will remain solid red after the alarm is acknowledged.

Figure 6-8: Shutdown Alarm Displayed



6.4.2. FAULT Alarms

When a fault alarm occurs, alarm text message will be displayed, fault alarm LED will flash and relay output is sent to all active IO connections so that signal can be sent to the process tool. If there is a light bar in the system, a yellow section of the light bar will flash if the fault alarm is un-acknowledged and will remain solid yellow after the alarm is acknowledged.

Figure 6-9: Fault Alarm Displayed

6.4.3. Alarm History Menu

A time stamp of when the alarm occurred will be displayed with each alarm. Hundreds of alarms and user log in/out times can be reviewed in System Information > Alarm History Menu, refer to Figure 6-10.

1. Tab anywhere on the lower task bar. System Information menu will be displayed
2. Select Alarm History tab
3. Alarm History (Read Only) menu will be displayed
4. Using scroll bar on right, Alarm History alarm list can be reviewed, refer to Figure 6-11

Figure 6-10: Accessing Alarm History Menu

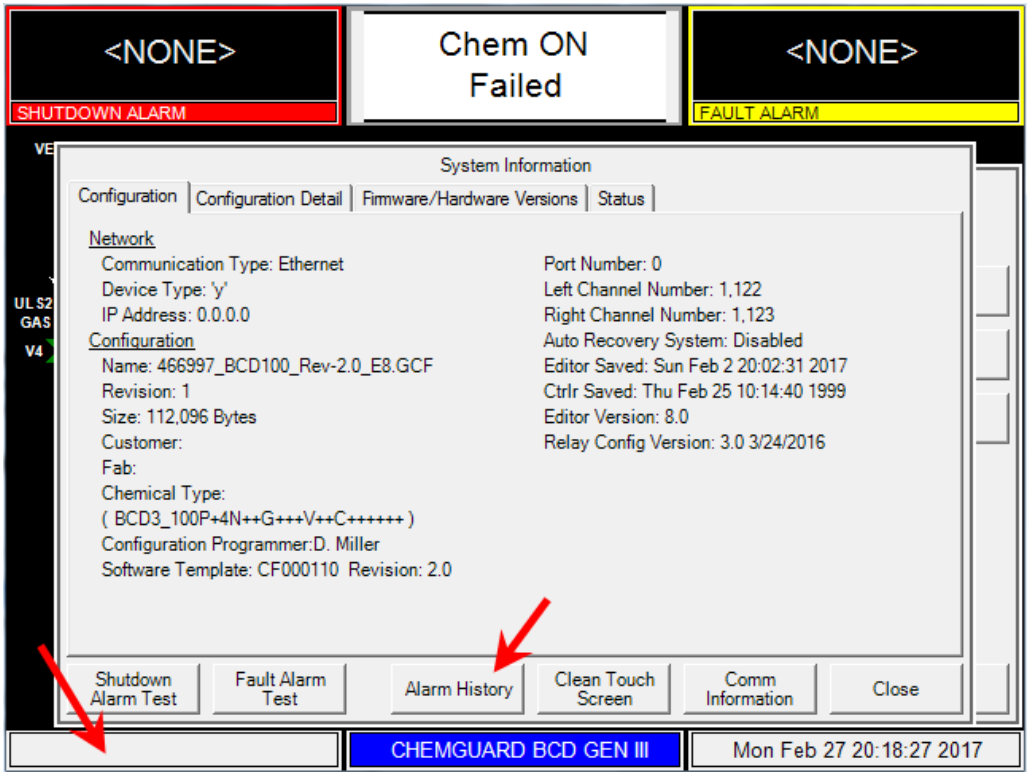
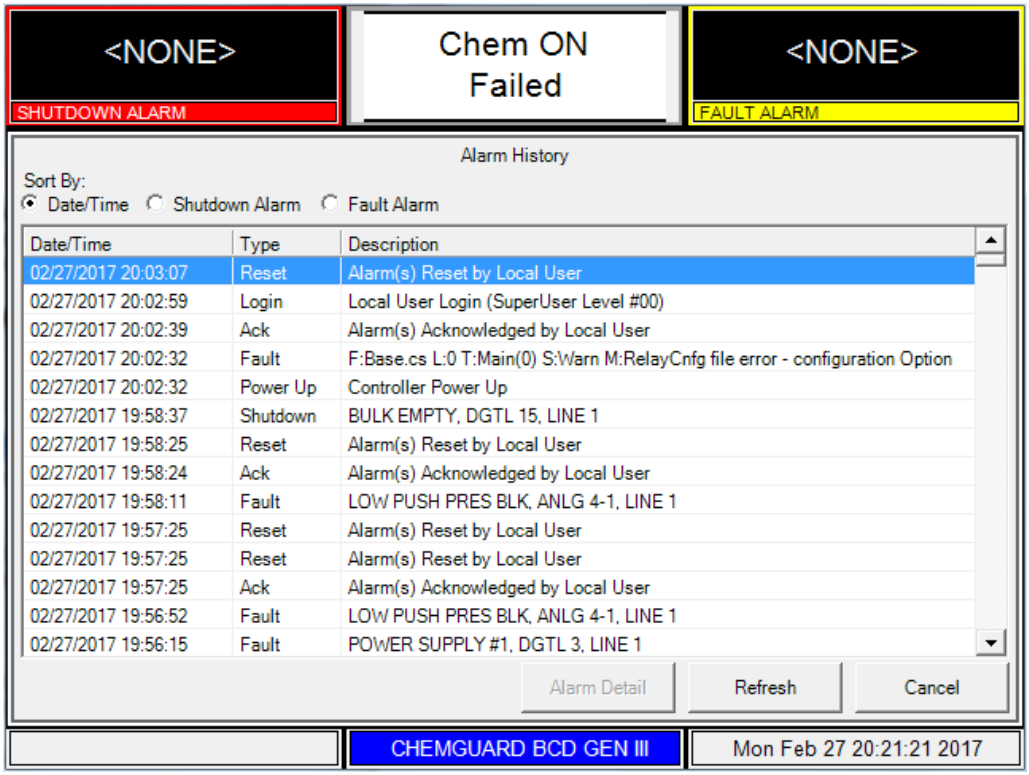


Figure 6-11: Alarm History Menu



Chapter 7

Maintenance and Calibration

7.1. Introduction

The ChemGuard® is designed to have minimal maintenance activity associated with its electronics. Proper Lockout-Tagout procedures should be followed to ensure that power is disconnected from the electronic enclosure before any work is performed on this equipment.

7.2. Calibration and Testing

Calibration and testing, and any resulting maintenance, should be performed at regular intervals. Refer to Table 7-1.

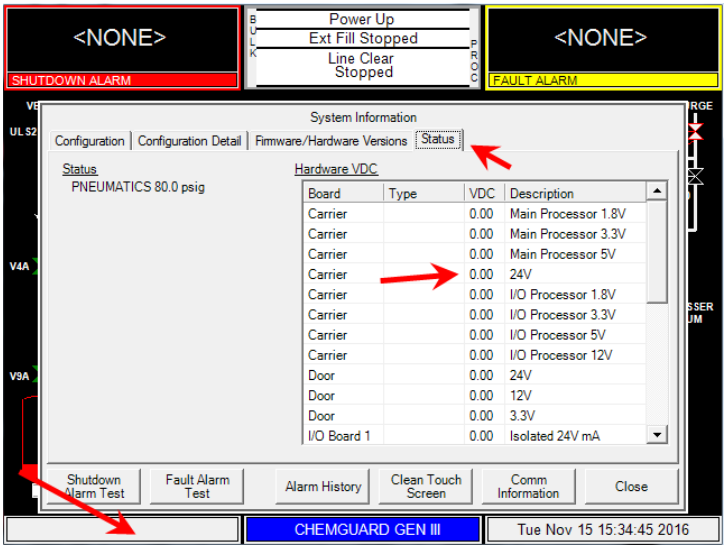
Only qualified personnel trained on the Operation and Maintenance of the ChemGuard® GEN III should attempt to perform maintenance and calibration of the System.

Table 7-1: Inspection Schedule

Periodic Inspection	Frequency
Power Supply Verification	12 Months
Scales Verify/Calibration	24 Months or When replaced
Sump Spill Sensor Verification	24 Months
R1 Regulator Verification – refer to Chapter 3	12 Months
R2 Regulator Verification – refer to Chapter 3 (BCD200 only)	12 Months
PT1 Verification – refer to Chapter 3	12 Months
Vacuum Thermal Couple (BCD100 only)	12 Months or When replaced
Ultrasonic Sensor Verification	12 Months
Ultrasonic Sensors Maintenance	24 Months
Vapor Detector Verify/Calibration	12 Months
High Temp Sensor Verification	12 Months

7.2.1. Power Supply Verification

1. Select the lower task bar at bottom of the display screen
2. System information screen will be displayed. Select the top tab on the far right labeled “Status”
3. While monitoring Carrier > 24V, adjust Power Supply 1 or 2 for 24V ± .2 vdc



4. When Dual Power Supply option used turn power off at Power Supply 2 to adjust Power Supply 1
5. Turn power off at Power Supply 1 to adjust Power Supply 2
6. Turn both Power Supply’s on

7.2.2. Scale Calibration

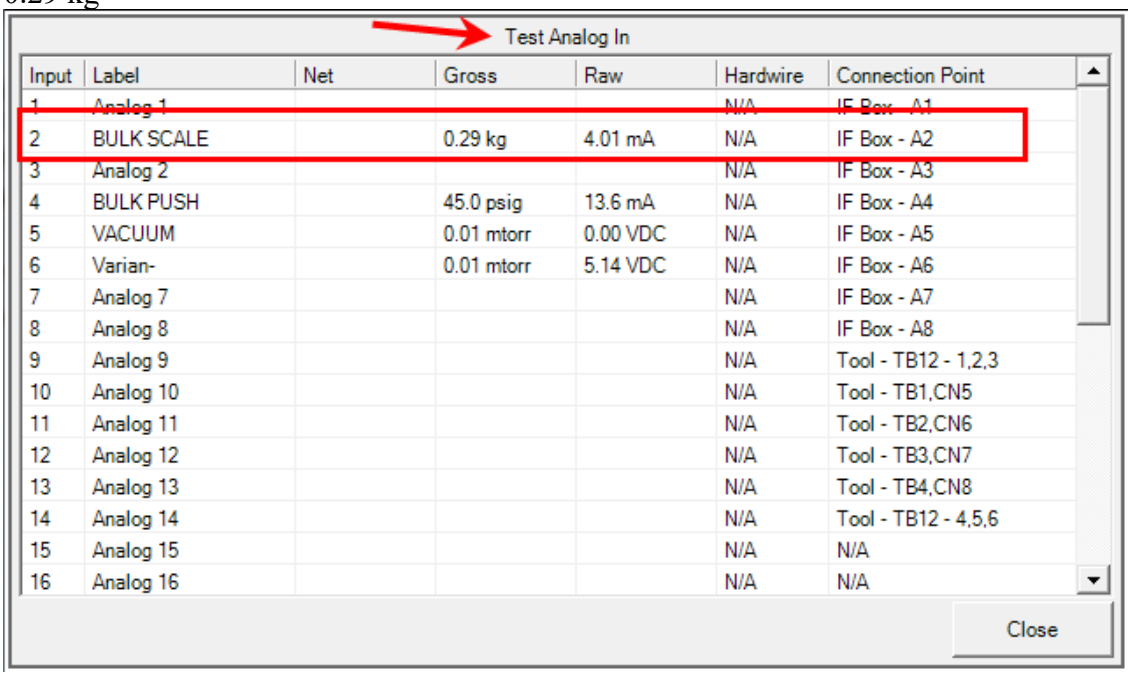
This procedure is used to set the accuracy of the Bulk scale. Calibrated weights are typically used to calibrate the scale but if calibrated weights are not available the weight of the Bulk container can be used.

The container weight will be referenced on the label, both tare weight of the empty container and the total weight of the empty container and chemical fill weight.

When calibrating the scale use the total weight referenced on the label of a full container and then calibrate before completing the Change Bulk operation and before any chemical is removed from the Bulk container.

Perform Bulk Scale calibration during Change Bulk when user interface prompts operator to Calibrate Scale.

1. Perform Change Bulk operation. After starting Change Bulk, when prompted to replace the container, terminate the Change Bulk operation
2. Once Change Bulk operation has been terminated and the spent bulk container has been removed, calibrate the scale
3. Step to Configuration Menu and then select System Test and then TEST ANALOG IN
4. Adjust the zero pot (left side) on front edge of scale as required so the current reads 4.0 mA ±0.01mA on the TEST ANALOG IN display, Label – Bulk Scale. The reading should be at 0.29 kg



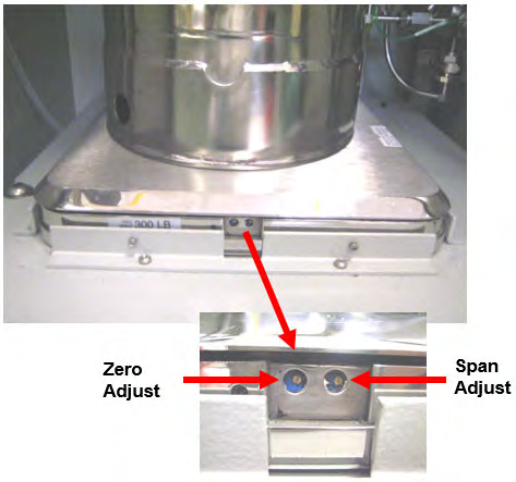
Input	Label	Net	Gross	Raw	Hardwire	Connection Point
1	Analog 1				N/A	IF Box - A1
2	BULK SCALE		0.29 kg	4.01 mA	N/A	IF Box - A2
3	Analog 2				N/A	IF Box - A3
4	BULK PUSH		45.0 psig	13.6 mA	N/A	IF Box - A4
5	VACUUM		0.01 mtorr	0.00 VDC	N/A	IF Box - A5
6	Varian-		0.01 mtorr	5.14 VDC	N/A	IF Box - A6
7	Analog 7				N/A	IF Box - A7
8	Analog 8				N/A	IF Box - A8
9	Analog 9				N/A	Tool - TB12 - 1,2,3
10	Analog 10				N/A	Tool - TB1,CN5
11	Analog 11				N/A	Tool - TB2,CN6
12	Analog 12				N/A	Tool - TB3,CN7
13	Analog 13				N/A	Tool - TB4,CN8
14	Analog 14				N/A	Tool - TB12 - 4,5,6
15	Analog 15				N/A	N/A
16	Analog 16				N/A	N/A

5. Install full Bulk container and place on scale. Verify the weight reading against the actual gram value of the calibrated weight
6. Adjust the span (right side) pot on front edge of scale as required so the weight is within ±10 kg of the actual calibrated weight

7. Remove weight(s) and verify zero grams ±1 kg. Adjust the zero pot (left side) on front edge of scale as required so NET weight is within ±1 kg
8. Repeat until no adjustment is required and measurements are within specifications

NOTE: When calibrating during Change Bulk operation, must re-start Change Bulk operation and re-run from beginning. Keep valves on container closed during pre-purge routine.

Figure 1: Bulk Scale Zero and Span Adjust



7.2.3. Sump Dual Spill Sensors Verification

The Dual Spill Sensor(s) consist of hermetically sealed reed switches actuated by magnetic floats. As the floats rise and fall with the liquid level, the magnetic field passing the switch causes the switch to either open or close.

The ChemGuard® uses Dual Float Sensors which are closed in the normally dry condition and open when wet to generate Fault and/or Shutdown alarms depending on the operation mode.

This procedure should be performed during a CHANGE BULK Operation, as the Bulk Reservoir must be removed to perform sensor verification.

During the Dual Float Sensors verification, the ChemGuard® should be in an idle condition, it will not deliver chemical to the OEM tools.

NOTE: The Dual Float Sensors do not require calibration. It is recommended to verify the floats move freely by lifting each one up and it should freely fall down. Verify there is no build-up of debris on the float and stem which could cause hang-up. The assembly can be cleaned using isopropyl alcohol.

1. The Dual Float Sensors are mounted in the lower portion of the cabinet, mounted to front right side below the bulk container shelf. Reach in and gently lift up one float at a time. The test result should be a SPILL DETECTED or SPILL DETECTED 2 fault alarm.
2. Clear alarm and test other float.
3. Verify each float sensor movement several times to ensure the floats are free falling.
4. Gently lift up both floats at once. The test result should be a DUAL SPILL DETECT shutdown alarm.
5. Verify that the DUAL SPILL DETECT alarm can be cleared

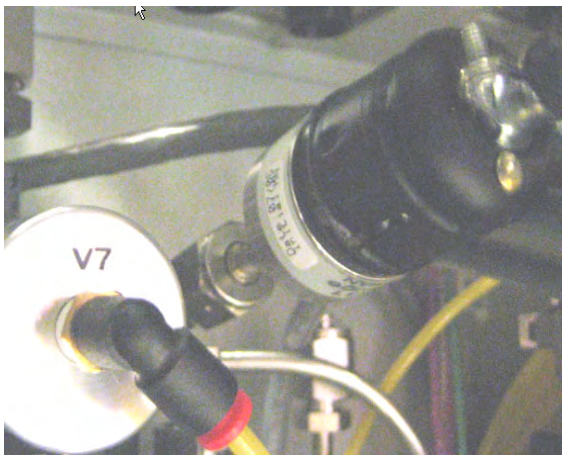
7.2.4. Thermocouple Gauge Verification (BCD100)

Calibration is not required.

1. Connect a calibrated vacuum reference to the vacuum pump.
2. Apply vacuum to the vacuum port on the ChemGuard®.
3. Enter Manual Mode and open V7. Wait for the vacuum reading on the "Analog Test-In" display of the ChemGuard® to stabilize, 5-10 minutes.
4. The cabinet vacuum base pressure should read approximately 10-50 mTorr. This may be higher than the calibrated vacuum reference.
5. Switch V7 off and remove the vacuum reference.

NOTE: Document base pressure reading for this cabinet. This reading will be used for Change Bulk operation and when conducting leak checks of the system.

Figure 7-2: BCD100 Thermocouple Gauge



7.2.5. Ultrasonic Clamp-On Sensor Verification

This procedure is used to verify that the Ultrasonic clamp-on sensors operate at the appropriate alarm conditions. The clamps are removed one at a time and then monitored at the System Test menu under Digital Input.

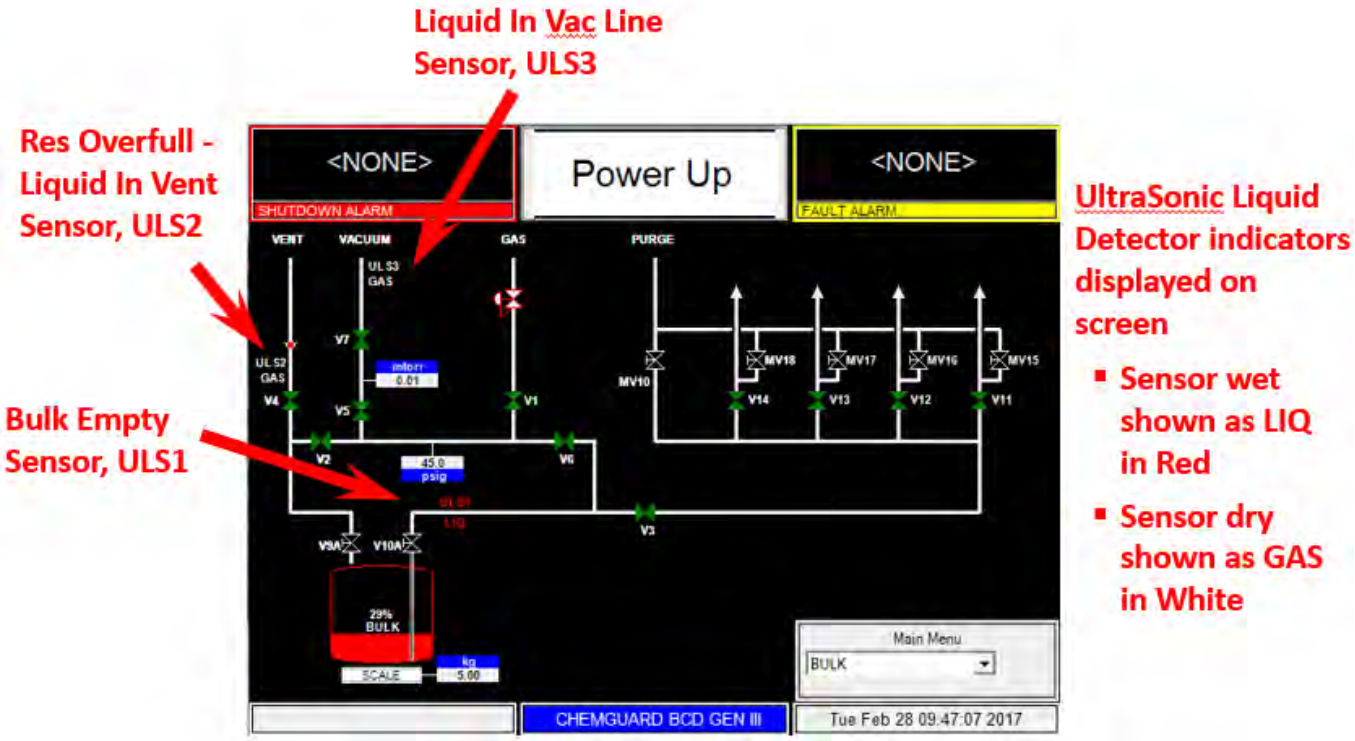
1. Locate the 3 Ultrasonic sensors mounted at their respective locations and note the mounting location for each
   - Bulk Empty Sensor – Blue – Bulk Liquid Pigtail – ULS1
   - Res Overfull – Yellow – Vent Line, Above V4 – ULS2
   - Liquid in Vac Line – Black – Vacuum Source, Above V7 on BCD100, above V5 on BCD200 – ULS3
2. To verify the alarm activates for each, remove each sensor one at a time to verify the alarms appear on Main Display and changes states;
   - Sensor wet shown as LIQ in red
   - Sensor dry shown as GAS in white
3. Carefully replaced sensor and press the alarm field on the Main Display to verify the alarm clears from the Main Display to reset alarm. Do not over tighten knurled thumbscrew as this can crack and damage sensor

   NOTE: All three sensors will cause an additional Ultrasonic Failure alarm

   NOTE: Please ensure all sensors are replaced in the correct locations. Refer to Figure 7-4 .

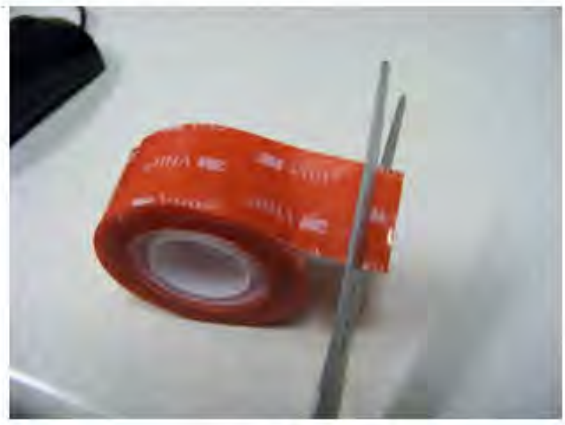
4. Verify the Bulk Empty sensor by entering Configuration Menu and then selecting SYSTEM TEST and then TEST DIGITAL IN
5. Find Input labeled BULK EMPTY. The Input displayed will show the corresponding state of the input (closed or open). When the empty sensor is removed from the tubing, the status will change from closed to open
6. Reinstall the Bulk Empty sensor and verify the status returns to the closed
7. Repeat for other 2 sensors, Inputs labeled RES OVERFULL and LIQ IN VAC LINE

Figure 7-3: Ultrasonic Sensor Test

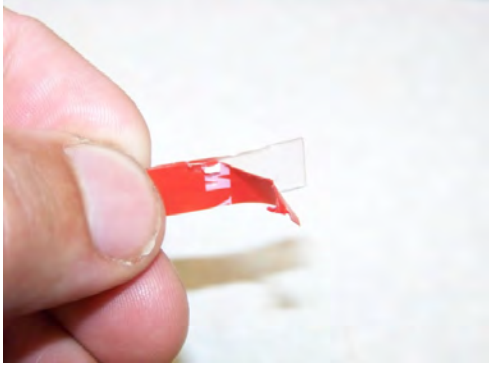


7.2.6. Ultrasonic Clamp-On Sensor Maintenance

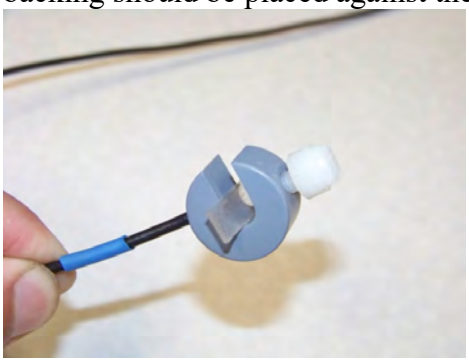
1. Turn off all fill operations (bulk to process, process fill, and external refill)
2. Open the cabinet door
3. Remove the ultrasonic sensors one at a time to avoid mounting them in the wrong location
4. Use a clean wipe to remove the vacuum grease from the stainless tubing. Make sure all sides of the tubing are clean
5. Clean the grease from the ultrasonic sensor
6. Cut a ¼" by 1" strip of gel tape – PN 164016



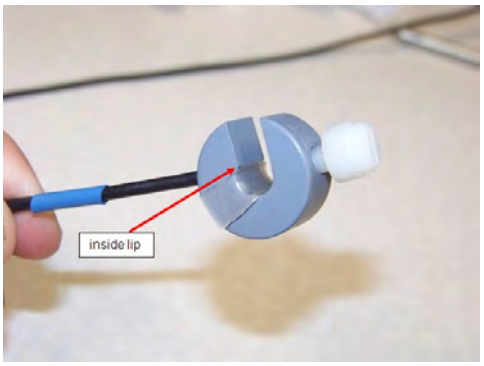
7. Remove the red backing from the tape



8. Lay the tape inside the sensor, over top of the sensor wire (the side of tape which had the red backing should be placed against the sensor)



9. Bend the overlap of the tape, down onto the sensor and grasp either side of overlap with the thumb and forefinger to hold the tape in place (be careful not to stretch the gel tape)



10. Attach the sensor to the piping (be sure that the front edge of the gel tape is behind the "inside lip" of the sensor to avoid doubling-over of the gel tape as the sensor is pushed onto the piping)

11. Tighten the set screw by hand. The sensor should be snuggly mounted on the piping
12. Make sure the tape is sitting in place correctly and did not shift
13. Repeat steps 2-12 for each sensor
14. Check for any ultrasonic alarms. If any alarms are present, replace the gel tape on the applicable sensor
15. Log into the controller. Check the status of all of the ultrasonic sensors on the Main Display, refer to UltraSonic Liquid Detector test in this section.

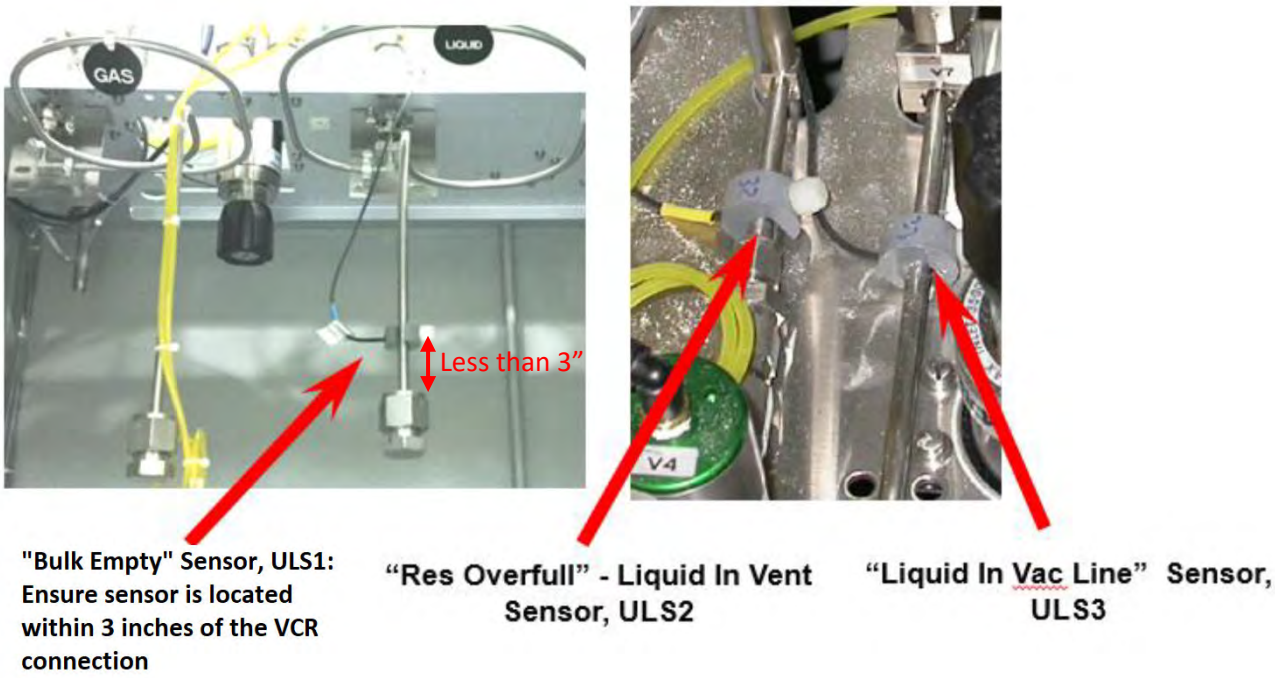
    NOTE: If the signal toggles from OPEN to CLOSED, even briefly, the gel tape should be replaced on the applicable sensor. The digital inputs must be watched for 10 minutes or longer (if the gel tape is not mounted correctly, the sensor may not fail immediately)

16. Reset alarms

    NOTE: If applicable, can use Dow Corning High Vacuum Grease, Dow Corning PN 976HVG and apply to the inner wall of the clamp on sensor in lieu of the Gel Tape.

    NOTE: Once maintenance is complete, please ensure all sensors are replaced in the correct locations. Refer to Figure 7-4.

Figure 7-4: UltraSonic Detector Sensor Locations



Sierra Vapor Detector Verification / Calibration (System Option)

This procedure is used to verify/calibrate the detection limit of the optional Sierra Vapor Detector. Failure to perform this calibration may fail to detect sensor drift over time, resulting in inaccurate response of the Vapor Detector. This inaccuracy can manifest itself as over-sensitivity (causing the alarm to be triggered when no vapors are present), or as insensitivity (causing no alarm when vapors are present). Drift is not predictable and may vary in direction and magnitude from system to system and may change as the Vapor Detectors age.

The optional Vapor Detector should be verified / calibrated every twelve (12) months, or when exhaust flow over an interval changes. The user should be familiar with the operation and calibration of the Vapor Detector prior to servicing the detector.

For calibration of the Dräger gas detector refer to chapter 5 of the Dräger Polytron 8700/8720 instruction manual.

NOTE: Before conducting this procedure, any Remote Alarm interfaced to Life Safety control or monitoring station should be tagged out a avoid a false alarm to the site.

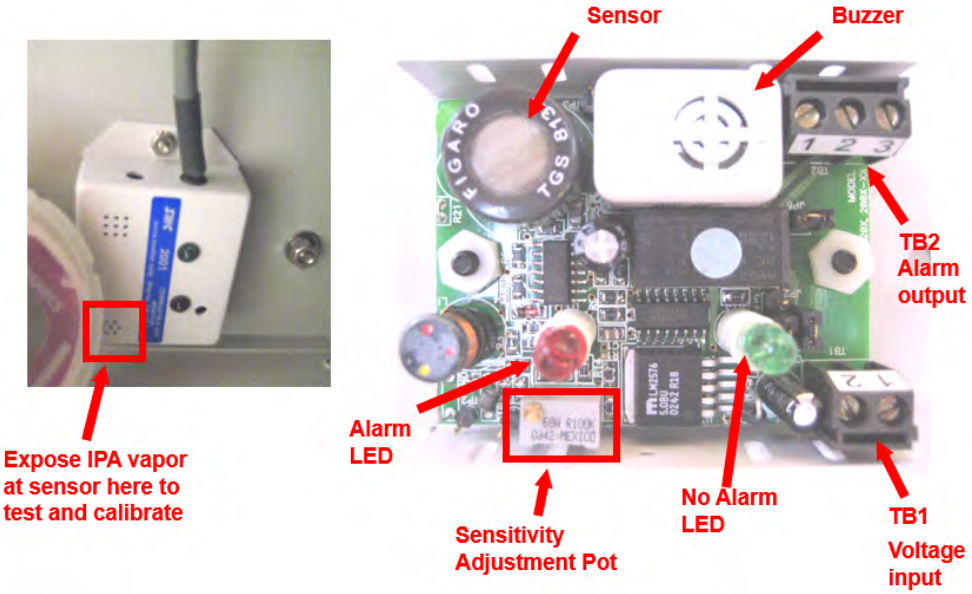
This optional vapor detector is a Sierra Monitor Corporation Gas Sensor Module, Model 2001-00.

1. Test Vapor Detector by using Isopropyl Alcohol, IPA with air mixture, by placing small amount of IPA onto a clean room wipe
2. Hold clean room wipe directly to the sensor area for a maximum of 60 seconds allowing for IPA vapor to be detected by sensor, refer to following slide for sensor location. DO NOT USE LIQUID
3. The detector should trip and the red LED will be on
4. A Combust Vapor Detect alarm will be displayed on the Shutdown (RED) Alarm Field on the Main Display
5. Verify the Bulk and Process Container valves are open to vent. Vents head pressure of containers
6. If the detector does not trip after 60 seconds place additional IPA on the clean room wipe and test for another 60 seconds
7. If detector still fails to trip, adjust the potentiometer counter-clockwise until the alarm turns on
8. Remove clean room wipe from detector
9. Verify that the alarm turns off after the gas is removed from the sensor. Usually takes 2 to 3 minutes

   NOTE: The cabinet may have to be ventilated for a few minutes, by holding door open if the alarm does not deactivate

10. If the alarm fails to turn off after ventilating the cabinet, adjust the potentiometer clockwise until the alarm turns off
11. Repeat the test again to verify sensor is operating without further adjustment

Figure 7-5: Sierra Vapor Detector (optional)



7.2.7. High Temperature Sensor Verification

This test can be used on the exhaust high temp sensor assembly.

NOTE: Do not point the heat gun at anything other than the high temp sensor.

1. Using Heat Gun apply heat directly to the sensor, but not more than 1 minute.
2. An alarm message “Fire Detected” will display within 10-20 seconds.
3. Remove the heat gun and wait until the temp sensor cools down.
4. Verify that the alarm message self-clears from display.

7.2.8. Other Tests

Other tests that should be performed on a periodic basis include:

- Triggering the E-Stop switch on front door of cabinet to verify system shutdown
- Verification of cabinet exhaust
- Verification of all system parameters
- Test of the UVIR sensor if option is installed refer to Addendum Y
- Test of the Auto-Pulse 542R Fire Control panel refer to Appendix G

Appendix G

Multi-Spectrum Digital, Electro-Optical Radiant Energy Models SS2 & SS4 Fire Detectors

NOTE: Versum Materials, Inc. recommends customer always review and reference to the device manual shipped along with the ChemGuard equipment package, it is an indication a device in-use has accurate information such as operation, specification, calibration and maintenance schedule.

Fire Sentry Corporation

Multi-Spectrum
Digital, Electro-Optical
Radiant Energy

Models SS2 & SS4 Fire Detectors

Frequently asked Questions

Model SS2 and SS4 Electro-Optical Fire Detectors - Frequently Asked Questions

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Model SS2 and SS4 Electro-Optical Fire Detectors - Frequently Asked Questions

Question	Answer
What is an Electro-Optical Radiant Energy Fire Detector?	An Electro-Optical Radiant Energy Fire Detector senses the electro-optical radiant energy emitted by a fire. The radiant energy comprises Ultraviolet (UV), Infrared (IR) and Visible (VIS) light spectra. (Fire Sentry uses visible light to provide additional rejection of false alarm sources). Nothing known travels faster than electromagnetic radiant energy (about 300,000,000 meters per second or about 186,000 miles per second), therefore, an Electro-Optical Radiant Energy Fire Detector is truly an early warning device for the rapid detection of a flaming fire.
What is meant by the Detector's Field of View?	The Field-of-View describes the actual area the Fire Detector is capable of seeing with its sensor "eyes". For example, if the Detector has a 120-degree Field of View, the coverage is 60 degrees to either side of the axis of the Fire Detector like a conical funnel. The SS2 and SS4 cover a volumetric area approximately four (4) times that of conventional flame detectors with 90 degrees field-of-view.
What is an Ultraviolet (UV) only Flame Detector?	A UV Flame Detector, which uses a Geiger-Mueller gas filled tube, detects radiant energy in the 185-250 nanometer (0.185 to .25 micron) UV region of the electro-optical spectrum. Solar radiation in this ultraviolet band is absorbed by the atmospheric ozone layer before reaching the earth's surface. Although "solar blind" UV Fire Detectors are sensitive to fires, they also have a propensity to false alarm to many non-fire sources of UV radiation, such as arc welding, quartz halogen lamps, lightning, sparks, X-rays, etc.
What is an Infrared (IR) Only Narrow Band Flame Detector?	An IR only Narrow Band Flame Detector is a device that senses "flickering" radiant energy in the 4.3-micron narrow band IR (CO_2 emission band) region of the electro-optical spectrum. Conventional Fire Detectors utilize *pyroelectric* or *thermopile* thermal IR sensors. These IR sensors function by detecting the absorption of IR energy (heat) on their substrate, but many non-fire IR sources (sunlight, hot manifolds, etc.) can fool these devices. To reduce false alarms, with *pyroelectric* or *thermopile* IR sensors manufacturers use narrow band optical filters in order to selectively focus on the unreliable and unpredictable carbon dioxide (CO_2) emission band. This region of the IR spectrum, known as the "CO_2 spike", is located at approximately 4.3 microns and is characteristic of well oxygenated, hydrocarbon fires.

Model SS2 and SS4 Electro-Optical Fire Detectors - Frequently Asked Questions

What are some of the numerous Inadequacies and Shortcomings of Narrow Band Single, Dual and Triple-IR Band 4.3 micron IR Flame Detectors?

The inadequacies and shortcomings of using IR only Narrow Band (or "spike band") for flame detection are numerous. These shortcomings are the same whether or not one or two (**Dual IR** and "**Triple IR**") guard bands are used for false alarm rejection purposes:

1. Only fires that have carbon are detectable, and therefore they can only detect hydrocarbon fires. While it is true that most fires are hydrocarbon, many are not and are classified as non-hydrocarbon fires.

2. The narrow CO_2 band IR flame detectors are susceptible to blindness due to water absorption in any form (ice, snow, rain, dew, fog, condensation, water mist suppression, etc.) whether on its window lens or in the path between itself and the fire.

3. They can be blinded by CO_2 gas (which is used as a suppression agent) itself since Kirchoff's Law states a good emitter is also a good absorber."

4. If the fire is not well oxygenated, the output tends to shift out of the 4.3-micron band because more carbon monoxide (CO) is produced instead of carbon dioxide (CO_2).

5. There are also limitations associated with the use of narrow band optical filters. The physical characteristics of these interference type filters means that the maximum sensitivity to radiant energy is on axis. As the off axis angle increases, sensitivity diminishes considerably. The optical filter selected is the narrow band CO_2 emission spike that means that there is very little signal to detect in real world "dirty fires". The result is a flame detector with low sensitivity and narrow field of view.

What is a UV/IR Fire Detector?

Conventional UV/IR Flame Detectors use narrow band IR sensor in conjunction with Geiger-Mueller type UV tube for detection of fires in an attempt to reduce the numerous false alarms. While this was an improvement, these devices still had a low sensitivity, narrow Fields of View and false alarm to non-fire sources. They are limited to detecting only well oxygenated, hydrocarbon based fires and could not detect non-hydrocarbon fires such as Hydrogen and Silane.

What is a Multi-Spectrum Radiant Energy Fire Detector?

A Multi-Spectrum Radiant Energy Fire Detector senses radiant energy over a large region of the electro-optical spectrum. The Fire Sentry Models SS2 and SS4 Fire Detectors detect Ultraviolet, Wide Band Infrared and Visible light spectrums. Coupled with microcomputer intelligence and advanced digital signal processing software algorithms, this makes Fire Sentry Fire Detectors superior to conventional Electro-Optical Fire Detector currently available.

Model SS2 and SS4 Electro-Optical Fire Detectors - Frequently Asked Questions

What is the Difference between a Flame Detector and a Radiant Energy Fire Detector?	The difference between a "flame" and "fire" detector is a flame detector senses primarily the molecular spike emission of flames. The cleaner and purer the flame, the better these type of detectors perform. The most common molecular flame emitter is the 4.3 micron narrow band generated by combustible carbon dioxide (CO2) molecules. A true radiant energy fire detector, on the other hand, senses all the radiant energy a fire produces, not just the flames itself, but also the hot Planckian blackbody particulate radiators that real-world "dirty fires" generate. To accomplish this, Quantum type WideBand IR sensors are used. The primary reason most manufacturers use the 4.3 micron band for sensing the flame component of fires, is the fact that detector requires no actual signal processing. Without sophisticated signal process algorithms to process the WideBand IR™ signals, the detector would generate an unacceptable level of false alarms. The Models SS2 and SS4 series Fire Detectors utilize sophisticated signal processing algorithms as well as the UV and visible spectral bands to provide the highest level of false alarm immunity in the industry and this has been proven in thousands of successful installations worldwide since 1990.
Why are the Models SS2 and SS4 Multi-Spectrum Fire Detectors superior to the conventional Narrow Band UV/IR Fire Detectors?	The conventional combination of UV and IR sensors slightly improved the performance of older Fire Detectors, but the use of *pyroelectric* or *thermopile* thermal type IR sensors greatly limits their response to real world fires. The type of IR sensor used by Fire Sentry Corporation in its SS2 and SS4 Detectors is a lead sulfide (PbS) *quantum* type that detects WideBand IR™ radiant energy in the 0.7 to 3.5 micron range. The Wide Band *quantum* IR sensor directly captures incident IR photons, giving it a much faster response. This type of sensor is *many* times more sensitive and responsive than *pyroelectric or thermopile* IR sensors used by other manufacturers. This Wide Band IR™ technology enables Fire Sentry's Electro-Optical Radiant Energy Detectors to detect in excess of 88% of a fire's total radiated energy, compared to less than 1% seen by older type *pyroelectric or thermopile* IR sensors with narrow band optical filters. PbS IR sensors are used by NASA, the Department of Defense and all branches of the military for many different sensing applications.
Why do the SS2 and SS4 detect all fires?	Since the Fire Sentry Models SS2 and 4 Fire Detectors do not rely on the unpredictable and unreliable narrow 4.3 micron band CO_2 emission spike, the SS2 and SS4 are able to detect all types of hydrocarbon and non-hydrocarbon fires, whether or not water in any form (such as ice on the lens) is present or carbon dioxide gas is present as a suppression release.
Why do the SS2 and SS4 use a Visible sensor?	The use of the Visible light spectrum enhances fire detection capability while increasing non-fire source rejection. The information from the multi-spectrum sensor array (UV, Visible, Wide Band IR™) is processed by solid-state, digital microprocessor technology, which utilize sophisticated digital signal processing software algorithms. (fires emit very little or no significant Visible band radiant light)

Model SS2 and SS4 Electro-Optical Fire Detectors - Frequently Asked Questions

Do the SS2 and SS4 have Built-In Self-Test?	The SS4 Detector has automatic built-in "through the lens" self-test which checks the window cleanliness, checks the sensor response and carries out an electronics diagnostic test. The SS2 Detector does not have built-in "through the lens" self-test, although it does have internal self-checking tests.
How are SS2 & SS4 Detectors UV sensor tubes different from other manufacturers?	One of the largest costs of ownership for UV/IR Detectors is the short life expectancy of UV tubes. Older type UV tubes are prone to early failure and are expensive to replace. Fire Sentry's UV tubes are manufactured to the highest quality standards. Anodes and cathodes are fabricated from steel and the large area of glass sealing the anode and cathode wires ensures no leakage or cracking during vibration and stress. This makes Fire Sentry SS2 & SS4 Fire Detectors extremely rugged and suitable for use in high vibration areas. Other manufacturers have to replace their UV tubes periodically, but Fire Sentry UV tubes have been rated for a service life in excess of ten years.
Do the SS2 and SS4 require a dedicated Controller?	The Model SS2 & SS4 Fire Detectors can be used as stand alone, unitized devices that do not require a Controller. Integral Fire and Fault dry contact relays can be connected to a conventional fire alarm panel or a PLC. Each Fire Detector requires regulated 24 VDC power. An optional 4-20mA output is available if required with the Model SS4 series.
What is the SS2 and SS4 power consumption?	For the SS2 Detector, the power consumption is a low 56mA in quiescent state and 75mA in alarm. For the SS4 the power consumption is a low 68mA in quiescent state and 75mA in alarm. Fewer backup batteries are required for 24-hour backup, which means smaller, lower cost fire control panels are required.
When would it be useful to use a Controller?	When the end-user requires a fully intelligent, addressable system, the Model CM1-A™ Controller is the best choice. The proven Model CM1-A wall-mount Controller monitors up to 30 Model SS4 or SS2 Fire Detectors and is a fully addressable and intelligent system using Fire Sentry FireBusI™ RS-485 (4) wire loop communication. The CM series Controller has many advanced features. It functions as the system manager, provides power to the Fire Detectors and continuously monitors all devices on a 4-wire RS-485 loop. Fire and Fault history files, Tri-Mode Plot™ and FirePic™ are stored in non-volatile, solid-state memory, and can be accessed via the RS-232 port, using a PC computer and Fire Sentry's UC2000™ software. System status is shown on a backlit LCD display and there is a built-in audible alarm and battery back-up system.

Model SS2 and SS4 Electro-Optical Fire Detectors - Frequently Asked Questions

What are the outputs from the CM1-A™ Controller?	The Fire Sentry CM1-A™ Controller has six (6) each 10 amp SPDT relays for Fire Alarm outputs. One relay is the Common (Master) Fire Alarm relay and the remaining four Fire Alarm relays can be configured by zone or voting preference. One 10-amp SPDT relay is available for Fault annunciation. An RS-232 port is also available for interfacing with a PC or Laptop computer operating Fire Sentry's UC2000™ software.
What are the wiring requirements between the SS2 and SS4 and the CM1-A™ Controller?	Four conductor shielded cable is required. Fire Sentry recommends a minimum of 18 AWG solid wire. Two conductors are for 24 VDC power and two conductors are for RS-485 communications, using FireBusI™ protocol. Using the RS-485 loop requires far less wiring than traditional "home run" installations and therefore saves on wiring and installation costs.
What is the power consumption of the CM1-A™ Controller?	Low power consumption: 115mA in quiescent state; 312mA in alarm. Battery backup is provided. Less battery backup is required for 24-hour backup that means less costly fire control panels.
What is FirePic™?	Fire Sentry's FirePic™ is the capability of the SS2 and SS4 Fire Detectors to record the electro-optical data immediately prior to the fire alarm being declared. This data is stored in non-volatile solid-state memory and can be downloaded using Fire Sentry PC software and Interface Box, or via a CM1-A Controller and PC software. This is essential information to have when postulating the cause of a fire, especially if a fire event was not immediately apparent.
What is SnapShot™?	With SnapShot™, both the SS2 and SS4 Detectors have the ability to record the real-time spectral energy response of the UV, visible and IR sensor array against test fires and false alarm sources. To do this, use the Fire Sentry Interface Box, the Fire Sentry PC Software, and a laptop or desktop PC computer. The resultant data can be plotted and analyzed using a graphing program such Microsoft Excel®. The ability to record real-time data is invaluable when optimizing the SS2 and SS4 Detectors against new, untested combustible materials and unusual false alarm stimuli.
What is Tri-Mode Plot™?	Fire Sentry's Tri-Mode Plot™ is the capability of the Fire Detectors to see real-time the UV, IR and Visible electro-optical data in the Field of View. Tri-Mode Plot can be used as a diagnostic tool to "view" the local environment and to ensure that the Fire Detector is not detecting a potential source of "friendly fire", such as a flare stack. It can also be used as a preventive maintenance tool for regular checking of the normal operation of the Fire Detector.

Model SS2 and SS4 Electro-Optical Fire Detectors - Frequently Asked Questions	
Can the SS2 and SS4 Interface with PLC and DCS systems?	The SS2 and SS4 Detector can interface with a variety of third party systems, such as rack-mounted controllers, PLC and DCS systems via dry relay contacts. The SS4 Detector can be supplied with an optional 4-20mA output module for interfacing with PLC or DCS systems.
Is there a swivel mount for the SS2 and SS4?	A swivel mount, Model SM4, is available for aiming the Detector. This is a fully adjustable, calibrated 316 Stainless Steel mounting bracket.

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Addendum Y

UVIR Detector

VERSUM MATERIALS, INC.' RECOMMENDATIONS FOR FLAME DETECTION

NOTE: Versum Materials, Inc. recommends that the customer review and refer to the UVIR device manual shipped along with the system. The manual provides accurate information regarding operation, specification, calibration and maintenance of the UVIR.

1.1 For flame detection, Versum Materials, Inc. uses a Fire Sentry/Honeywell SS4-A or SS4-A2 UV/IR in GG500, APx, TEx, and ChemGuard cabinets, racks, wall-mounts, VMBs, VMPs, HFS, VHFS, and BSGS. Versum Materials, Inc. strongly recommends the use of a UV/IR detector over any other type of flame detection device.

1.1.1 The Model No. SS4-A/-A2 Detector is a microprocessor based Electro-Optical Fire/Flame Detector that "sees" the ultraviolet (UV), visible and wide band infrared (IR) spectral bands of optical spectra. This fast-acting, digital, configurable Fire Detector will alarm to Type A, B, and C fires (Table 1).

Table 1: Fire Types

Class of Fire	Fuel Source
A	Ordinary combustibles (i.e., trash, wood, paper, cloth)
B	Flammable Liquids (i.e., oils, grease, tar, gasoline, paint, thinners)
C	Electricity (i.e., live electrical equipment)

1.1.2 "The Fire Sentry UV/IR model SS4-A features algorithms that process multiple spectrums to determine if a fire exists while also rejecting false alarm signals. UV/IR monitors are tuned to respond to both UV and IR emissions (as well as other variables such as visible light, flicker frequency, etc) that algorithms use to declare a flame or reject as a false alarm. The SS4-A detector analyzes ultraviolet (UV), visible (VIS), and wideband infrared (IR) energy before declaring a fire. Generally, flames have little VIS but significant UV and IR allowing the VIS signal to assist in false alarm rejection logic. In the case of non-hydrocarbon fires, and Silane fires in particular, the spectrum that is emitted results from the interaction of oxygen and hydrogen that forms water vapor (H_20) as well as oxygen-hydrogen (OH) radicals. OH emits strongly in the 306 nanometer UV spectral band and additional emission peaks within the UV spectral band between 180 – 240 nanometers. It also emits IR radiant energy in the Near IR band with several peaks within the 1 – 3 micron spectral IR band. Water (H_20) emits mainly in the near IR band with a strong peak at 2.7 microns. Detecting the emitted radiation from a Silane flame simultaneously at both these spectral bands (UV and IR) enables fast and reliable Electro-Optical fire detection with high immunity to false alarms. Note that this Silane flame detection does not rely on IR absorbance associated with CO_2 (4.3 microns) evolution from hydrocarbon fires." (Excerpt from Matthew H. MacConnell's "UVIR Flame Detection", Rev 1, 30 May 03)

1.2 Field of View: The UVIR can detect a fire within a 120 degree cone. The detector is pointed at the largest fire threat area for the fastest response times to the smallest size fire. In Versum Materials, Inc.' equipment the UVIR will be positioned to see all VCR connections.

1.3 Certifications:

Class I, Div. 1 & 2, Groups B, C, & D

Class II, Div. 1 & 2, Groups E, F, G

Class III

1.4 Versum Materials, Inc. Configuration Settings

The configuration of the SS4-A/-A2 UV/IR Detector is set using DIP switches located on the middle circuit board of the detector. Configuration options and Versum Materials, Inc. settings are discussed below.

1.4.1 Verification Time: The verification time is the amount of time the detector will wait until it declares a fire. If a fire is detected, the detector will use the specified amount of time to confirm the existence of a fire. If at the end of the time period the detector no longer detects a flame, the detector will not alarm. If at the end of the time period the detector still detects a flame, the detector will alarm. Verification time helps in reducing the number of false detections. Versum Materials, Inc. sets the verification time to 5 seconds and the verification time is always enabled. Therefore, if the detector detects a flame for 5 continuous seconds, the detector will declare a Fire Verify. Verification time is controlled by the settings of dip switches 1, 2, and 3.

1.4.2 Latching: In the SS4-A/-A2 Latching mode, the Fire or Verify Relay will energize and Red LEDs will remain illuminated until the detector power is cycled (power is turned off and on). If Verify is enabled when the Verify Relay energizes it will remain energized until the detector is reset. Latching is determined through the setting of dip switch 4.

1.4.3 IR-Only Enable: The IR-only setting allows the detector to declare a fire in situations where UV is not present or is obscured. For Silane systems, the detector must detect both UV and IR to declare a fire. This is done to reduce false detections, since silane systems are sometimes sited outdoors. These detectors are labeled with “Configured for Silane”. For all other gas systems, the detector will declare a fire if UV and IR are present, but can declare a fire with only the presence of IR. False detections have not occurred on systems using the IR only mode. When the detector detects only IR in this IR only mode, it begins a UV self test. During this test, the internal UV source is turned on, UV reflects off the metal lens guard, and should be sensed by the UV sensor. If the detector does not sense the internally generated UV, it assumes that the lens is blocked, and will declare a fire based only on IR. If the internally generated UV is sensed, the detector assumes that it is working properly, and that IR is present without UV (and therefore, no fire exists). The detector will not declare a fire in this condition. IR-Only Enable is controlled by the dip switch 5 setting.

1.4.4 Test Cycle: Testing of the UV sensor occurs every 30 minutes. The detector has an internal UV source and performs a self-test every 30 minutes. During the self-test, the UV source is turned on, and UV is reflected off of the metal lens guard. The UV should

be sensed by the UV sensor. If the detector does not sense the UV, a fault alarm will be set off. The test cycle frequency is controlled by the dip switch 6 setting.

1.4.5 Fire Range/Sensitivity: The fire range/sensitivity setting is measured by the distance between the sensor and the fire (15, 30, 45, or 60 ft). The sensitivity setting refers to the distance that the detector is guaranteed to detect a burning 1 square foot puddle of gasoline. Versum Materials, Inc. sets the UV/IR so it will detect a 1 square foot gasoline fire at a distance of 60 feet. Since a leaking low pressure VCR connection would produce a significantly smaller flame than a puddle of gasoline, the sensitivity is set to a much higher distance than the actual distance of the potential leak. The fire range/sensitivity is controlled by the dip switches 7 and 8 settings.

1.4.6 Dip Switch Settings (GG500, APx, TEx, ChemGuard)

The SS4-A/-A2 is configured at the Versum Materials, Inc. Factory as listed in Table 2.

Table 2: Versum Materials, Inc.' SS4-A/-A2 Dip Switch Setting

Switch	State	Description
1	Closed	Verify is enabled and the verify time is 5 seconds
2	Open	
3	Open	
4	Closed	Latching mode (LEDs stay on until reset)
5	Open	Used for silane only. UVIR must detect both UV and IR to declare a fire. This is done to reduce false detections, since Silane systems are sited outdoors. These detectors are labeled with "Configured for Silane".
5	Closed	Used for all other gases. The detector will declare a fire if UV and IR are present, but can declare a fire with only the presence of IR.
6	Open	Testing of the UV sensor occurs every 30 minutes.
7	Closed	The UVIR is set to detect a 1 square foot gasoline fire at a distance of 60 feet.
8	Closed	

1.5 SS4-A/-A2 Detector System Relays

1.5.1 Fault Relay: The fault relay checks for normal operation of the UV/IR Detector. The detector issues a fault condition by de-energizing its Fault Relay and the controller will show a UV/IR Fault alarm on its screen. If there is a fault, the detector will illuminate one LED to visually indicate the fault. The list of Detector Faults include temperature fault, excessive input voltage fault, no power fault, detector fault, relay fault, self-checking fault, and analog '0' current. The LED will not light if the fault is "no power". If the fault condition is eliminated, the detector will return to normal operation and the LEDs will return to blinking every 10 seconds. Faults requiring factory recertification will be indicated with the LEDs rapidly blinking.

Temperature Fault: The detector will fault due to temperature if during operation the internal temperature rises about 85°C or falls below -40°C. This will cause both LEDs to blink rapidly. The corrective action for this type of fault is to return the UV/IR for factory re-certification.

Excessive Input Voltage Fault: The detector will fault due to excessive input voltage if the input voltage becomes greater than 45 Volts. This will also cause both LEDs to blink rapidly, and the corrective action requires returning the detector for factory re-certification.

Low Input Voltage Fault: The detector will fault due to low input voltage if the input voltage becomes too low. In this cause, one LED is illuminated until the fault is corrected.

No Power Fault: The detector will fault if there is no power and/or the input voltage is interrupted or turned off. The LEDs will not be lit in this case.

Detector Fault: The detector will fault if the Optical Sensors fail the automatic built-in lens test. In this case one LED is on until the fault is corrected. The user should clean the inside and outside of the lens, then the exposed surface of the UV sensors, and the protective grill mounted on the outside of the housing cover. Testing of the UV sensor (automatic built-in lens test) occurs every 30 minutes (Versum Materials, Inc. setting) and the testing frequency is controlled by dip switch 6.

Relay Fault: The detector will fault if one of its relay circuits fails. This fault will be indicated by one LED being lit continuously.

Self-Checking Fault: The detector will fault if its internal microprocessor finds a failure during its self-check of the hardware and software. One LED will be lit until the fault is corrected.

Analog "0" Current: All of the faults described will produce an output current loss with the 4- 20 mA module option.

1.5.2 Fire Relay: If the detector senses a fire, the fire relay will energize and the detector will fault. The detector fault will cause the controller to issue a shutdown alarm. The detector will monitor the same x/y coordinates for a specified duration of time to verify the existence of a fire. Versum Materials, Inc. specifies the verification time to be 5 seconds. The fire relay and verification time is enabled by dip switches 1, 2, and 3.

1.5.3 Verify Relay: The verify relay signals the existence of a fire. For Versum Materials, Inc. applications, the Fire Verify Relay is always enabled. In the case of a fire, the Verify Relay will energize and the Fire Relay will de-energize if the fire conditions are still present at the end of the Verify Time period of five seconds. Therefore, if the sensor detects a fire (through the use of the fire relay), the Fire Verify Relay will energize and if it continues to detect a fire in the exact x/y coordinates for five seconds, the detector will declare a fire in the cabinet. The verify relay is controlled by dip switches 1, 2, and 3.

1.6 Controller Alarms Associated with the SS4-A/-A2 UV/IR Detector

1.6.1 UV/IR Fault – If the detector's fault relay deenergizes, the controller's UV/IR fault alarm will be initialized. The UV/IR Fault alarm is a fault alarm and indicates that the UV/IR detector is not functioning properly (possible detector faults are described in section 1.5.1).

1.6.2 Flame Detect – If the detector's fire relay energizes, the controller's flame detect alarm will be initialized. The flame detect alarm is a shutdown alarm and will close all the valves on the side of the system that detected a fire. On VMBs, this alarm is a hardwire alarm

1.6.3 Flame Verify – If the detector's verify relay energizes, the controller's flame verify alarm will be initialized. The flames verify alarm is a shutdown alarm, and the alarm will close all valves throughout the system and stop the flow of gas. Power will also be turned off to the UV/IR detector. This alarm is initiated when the detector senses a steady flame or fire for five seconds. Flame verify is a hardwire alarm. The alarm is not used on VMBs since only two inputs are used, UV/IR Fault and Flame Detect (which is hardwired).

1.7 Operation of the Fire Sentry SS4-A UV/IR (excerpt taken from PTB071, Jan 22, 2004)

There are two LEDs on the SS4-A UV/IR that indicate the state of the detector. During normal operation without an alarm condition, the LED's on the face of the UV/IR will blink every 10 seconds. Every 30 minutes, as defined by switch 6, the detector performs a self-test. The detector tests itself by turning on a UV source inside the housing. This UV is transmitted through the lens, reflects off the metal lens guard, and is detected by the UV sensor. If the detector fails to sense the self generated UV, it will go into fault, and the controller will declare a UV/IR fault.

If the UV/IR detects a fire during testing or operation, both LED's will remain on continuously. The controller will alarm with UV/IR Flame Detect (a shutdown alarm), closing all valves on the side that detected the fire if two UV/IRs are used, or all valves if only one detector is used. If the detector continues to detect a flame for 5 continuous seconds, as defined by switches 1 through 3, the detector will declare a Fire Verify. The controller will alarm with the hardwired shutdown UV/IR Flame Verify, closing all system valves. If the system is an Automatic Backup System (ABS) Primary, it will also signal the ABS Backup to Shutdown. The fire alarm LEDs will remain on until power is cycled to the unit (power turned on and off).

The controller turns off UV/IR power when the UV/IR Flame Verify occurs. Power is restored to the UV/IR when the operator presses the controller's reset button. This causes the UV/IR to reset and un-latch. Since this Flame Verify would interrupt process gas, alternate methods can be used to manually reset the detector without interrupting process gas.

1.8 Version SS4-A2: "The operation of this unit is identical to the SS4-A, except the fire alarm LEDs turn off once the fire threat is eliminated, without power cycling of the device." Excerpt from Installation and Operating Manual, Model SS4-A/-A2, Rev A, July 2014.

Since Versum Materials, Inc. controllers use the relay outputs not the LEDs for detection, the SS4-A and SS4-A2 are considered identical and interchangeable in Versum Materials, Inc. equipment.

1.9 Testing/Maintenance of the SS4-A/-A2 Flame Detector

1.9.1 The SS4-A/-A2 can be manually tested to verify proper operation and should be done at least yearly. Testing the SS4-A/-A2 will require a shutdown of the equipment. A UV/IR Fault can be simulated by placing a non-reflective surface (i.e. black paper) in front of

the UV/IR metal lens protector for at least 30 minutes. This causes the UV/IR to fail its self-test, and generate a fault.

A UV/IR Flame Detect can be simulated by generating UV and IR in front of the lens. This can be done with an actual flame (NOTE: This method is dependent upon the hazard location of the UV/IR and should not be done in an area considered to be hazardous), or with a UVIR test source. It must be done continuously for at least 5 seconds. Any interruption in the UV/IR source during the 5 seconds will cause the UV/IR to restart the 5 second period.

1.9.2 Automatic testing of the detector is performed during detector operation. Versum Materials, Inc. specifies that the detector will self test every 30 minutes. A red LED on the detector will remain illuminated to indicate contamination of the window lens, missing the protective self-test grill, or when removing the enclosure.

1.8.3 The housing glass or lens should be cleaned at least every 6 months if the device is located indoors. If located outdoors, the lens should be cleaned at least monthly. To clean the housing glass, a blast of an air hose or an oil-free cloth (oil degrades the performance of UV detectors) can be used. The use of a solvent, such as alcohol, is acceptable in some cases.

2.0 RELATED DOCUMENTS

2.1 Visit honeywellanalytics.com for Product Description, Specifications, Data Sheets, and FAQs.

2.2 See attached Fire Sentry SS4-A/-A2 Operating Manual.

END