

Model H1301 Recovery and Recycling System Installation, Operation and Maintenance Manual



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I. Unpacking and Inspection

- A. Upon receipt of the system, visually inspect the shipping carton for signs of damage or mishandling. Immediately contact the carrier for an inspection if the shipping carton is damaged or evidence of mishandling exists.
- B. Carefully remove the outer crating materials. Care must be taken during unpacking to avoid enclosure damage or scratching.
- C. Inspect the system for dents, scratches, or other evidence of mishandling during shipment. Request an immediate inspection from the carrier if damage is evident.
- D. Inventory the contents of the shipping carton against the packing list provided with the shipping documents.
- E. Observe the pressure indications of the Refrigeration Section: System #1 - High and Low side and System #2 – High and Low side pressure gauges located at the lower-rear panel of the machine: refer to figure #1 below. Pressure indications below 130 psi for system #1 and below 65 psi for system #2 may indicate a break in the plumbing: Contact the factory for further assistance.



- F. Open the Filter Access Door located at the top-right corner of the Control Panel Black Hood. Using an inspection light source visually verify the integrity of the internal tubing contained under the Hood. Close the Filter Access Door.

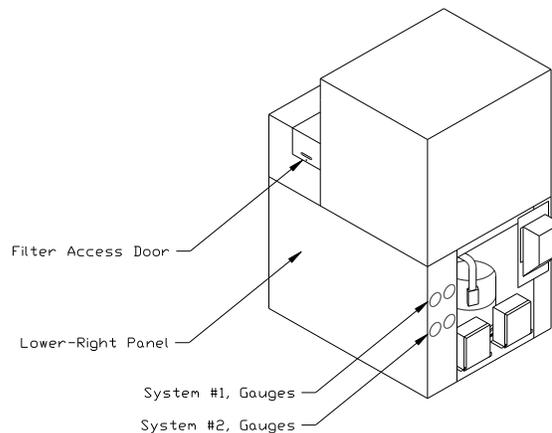


Figure #1:
High and Low Side Gauges

II. System Warnings

The following lists warnings concerning the installation, operation, and maintenance of the system as well as general safety issues. The warnings listed here are both specific and generalized and may or may not be repeated throughout the manual

A. General Safety Issues

- ◆ **KEEP AWAY FROM LIVE ELECTRICAL CIRCUITS.** Operating personnel should observe all safety precautions at all times. Do not replace components or make adjustments inside the equipment with the high voltage energized to the system unless directed to do so in the maintenance sections of this manual. Dangerous potentials exist internal to the system and under certain conditions may exist even with the system power switch in the off position.
- ◆ **DO NOT SERVICE OR ADJUST THE SYSTEM ALONE.** All maintenance or system adjustments should be accomplished in the presence of someone capable of rendering aid in the unlikely event of injury.
- ◆ **ONLY PERMIT FULLY TRAINED PERSONEL TO OPERATE THE SYSTEM.**
- ◆ **COMPLETELY READ AND UNDERSTAND THIS MANUAL BEFORE ATTEMPTING INSTALLATION, OPERATION, OR MAINTENANCE TO THE EQUIPMENT.**
- ◆ **ALWAYS WEAR SAFETY GLASSES** when operating the equipment or working with the Agent containers.

B. Installation Warnings

- ◆ **DO NOT INSTALL THE SYSTEM IN AN OUTDOOR ENVIRONMENT.** The system is designed for indoor locations with ambient temperature from 70 to 80 degrees F (21.1° to 26.7°C).
- ◆ **DO NOT LOCATE THE SYSTEM NEAR DRIPPING, SPRAYING, OR STANDING MOISTURE OR WATER.** The system enclosure **IS NOT NEMA** rated. Contact with moisture and water may result in electrical short circuits which may cause health and system hazards.
- ◆ **ALWAYS LOCATE THE SYSTEM ON AN EVEN AND LEVEL SURFACE,** use wheel chocks to insure the machine will not roll if accidentally pushed, or roll from operational vibration.
- ◆ **ALWAYS MAINTAIN A SERVICE AREA OF 3-FEET AROUND ALL SIDES OF THE MACHINE** to provide adequate ventilation of the refrigeration section.
- ◆ **ALWAYS ATTEMPT TO LOCATE THE SYSTEM IN AN AREA THAT IS COOL, DRY, AND AWAY FROM DIRECT SUNLIGHT.**
- ◆ **DO NOT LOCATE THE EQUIPMENT IN OR NEAR THE VICINITY OF FLAMMABLE MATERIALS OR VAPORS.**
- ◆ **DO NOT CONNECT THE EQUIPMENT TO ANY POWER SOURCE OTHER THAN SPECIFIED BY THE INSTALLATION PROCEDURES OF THIS MANUAL. FOLLOW LOCAL AND NATIONAL SAFETY CODES WHEN INSTALLING THE EQUIPMENT.**
- ◆ **ALWAYS ATTEMPT TO MAINTAIN A MINIMUM 3/16" INSIDE DIAMETER PLUMBING CONNECTIONS TO THE PORTS OF THE MACHINE WITH A MINIMUM OF BENDS, LOOPS, LOW SPOTS, OR SAGS.**

II. System Warnings (continued)

C. Operation Warnings

- ◆ **DO NOT OPERATE THE EQUIPMENT WITH THE EXTERNAL PANELS REMOVED.**
- ◆ **DO NOT RESTRICT THE FLOW OF AIR THROUGH THE ENCLOSURE GRATES.**
- ◆ **DO NOT INTRODUCE ANY SUBSTANCE OTHER THAN AGENTS HALON 1301, HALON 1211, FM200, FE25 OR CLEAN DRY NITROGEN GAS INTO THE EQUIPMENT.**
- ◆ **DO NOT INTRODUCE AGENT INTO THE EQUIPMENT THAT IS KNOWN TO EXCEED THE FOLLOWING CONTAMINATION LEVELS:**
 - ❖ **Moisture in excess of 100 PPM**
 - ❖ **Oil in excess of 500 PPM**
 - ❖ **Acid in excess of 80 PPM**
 - ❖ **Particulates in excess of 80 PPM**
- ◆ **DO NOT INTRODUCE AGENT INTO THE EQUIPMENT THAT IS CONTAMINATED WITH SUBSTANCES OTHER THAN MOISTURE, OIL, ACID, PARTICULATES NITROGEN OR AIR.** The equipment is only capable of removing the aforementioned contaminants and WILL NOT purify Agent contaminated with other substances.
- ◆ **DO NOT EXCEED INPUT PRESSURES GREATER THAN 600 PSIG PROPERTY DAMAGE AND INJURY MAY RESULT.**
- ◆ **NEVER OPERATE THE SYSTEM WITHOUT AN EXTERNAL STORAGE VESSEL CONNECTED TO THE OUTPUT PORT OF THE SYSTEM.** Failure to connect a storage container to the outlet port of the machine could result in total loss of recovered Agent.
- ◆ **NEVER OPERATE THE SYSTEM WITHOUT A SOURCE OF AGENT OR CLEAN DRY NITROGEN CONNECTED TO THE INLET PORT OF THE SYSTEM.** Failure to connect a source container to the inlet port of the machine may result in the introduction of ambient air into the system that will saturate the moisture filters and cause ice formation and internal blockage to the machine.
- ◆ **DO NOT RESTRICT THE NITROGEN VENT PORT OF THE MACHINE.** Restricting the vent port may result in poor recycling quality.
- ◆ **ALWAYS SECURE THE SOURCE CONTAINER BEFORE DISCHARGE OF THE CONTAINER.** Source containers such as system tanks may be under extreme pressures and will present a hazardous condition if not properly handled by trained personnel.
- ◆ **ALWAYS EVACUATE EMPTY EXTERNAL STORAGE VESSELS AND ASSOCIATED PLUMBING TO A 2500-MICRON MINIMUM VACUUM LEVEL BEFORE PROCESSING AGENT THROUGH THE MACHINE.**

II. System Warnings (continued)

D. Maintenance Warnings

- ◆ **ALWAYS EVACUATE THE EQUIPMENT TO A MINIMUM VACUUM LEVEL OF 1000 MICRONS WHENEVER THE SYSTEM PLUMBING HAS BEEN INVADED AND EXPOSED TO AMBIENT AIR.** Failure to properly evacuate the system will result in moisture freezing internal to the system causing ice blockage, liquid level switch and or outlet pump failure.
- ◆ **NEVER OPEN THE ENCLOSURE OF THE EQUIPMENT WITH THE EQUIPMENT CONNECTED TO THE MAIN POWER SOURCE.**
- ◆ **DO NOT REPLACE COMPONENTS OR MAKE ADJUSTMENTS INSIDE THE EQUIPMENT WITH THE EQUIPMENT OPERATIONAL** unless directed to do so by the maintenance sections of this manual.
- ◆ **NEVER INVADE THE INTERNAL PLUMBING OF THE EQUIPMENT BEFORE VERIFICATION OF LOW PLUMBING PRESSURE.**
- ◆ **ALWAYS PERFORM A COMPLETE SYSTEM EVACUATION SECTION-VII. K of this document BEFORE CHANGING PROCESSING FROM ONE TYPE OF AGENT TO ANOTHER TYPE OF AGENT.**

III. General System Description

The Recovery/Recycling machine will recover and clean fire extinguishing Agents of moisture, acid, oil, particulate, and non-condensable gases, and pump the cleaned Agent into user storage containers.

Agent refers any of the types of fire extinguishing media that may be recovered using the recycling system: **Halon 1301, Halon 1211, FM200 or FE25.**

The recovery machine is comprised of five major component groups, contained in the one enclosure, as depicted by figure-2. Each component group will provide the functions necessary to recover, recycle and pump out Agent with a minimum of operator involvement.

A temperature controller regulates the temperature of the internal processing tank by operating the cascade refrigeration section.

During automatic processing, a programmable controller (PLC) receives input information regarding the status of the source container and the internal processing tank. Based on this information the PLC operates the components required for the appropriate actions of recovery and recycling. The PLC also monitors the process and will indicate error conditions by suspending operation and flashing the processing lamp with one, or a combination of the liquid level lamps, located on the front panel, indicating the error condition detected. See section-VIII.A for a description of the error codes.

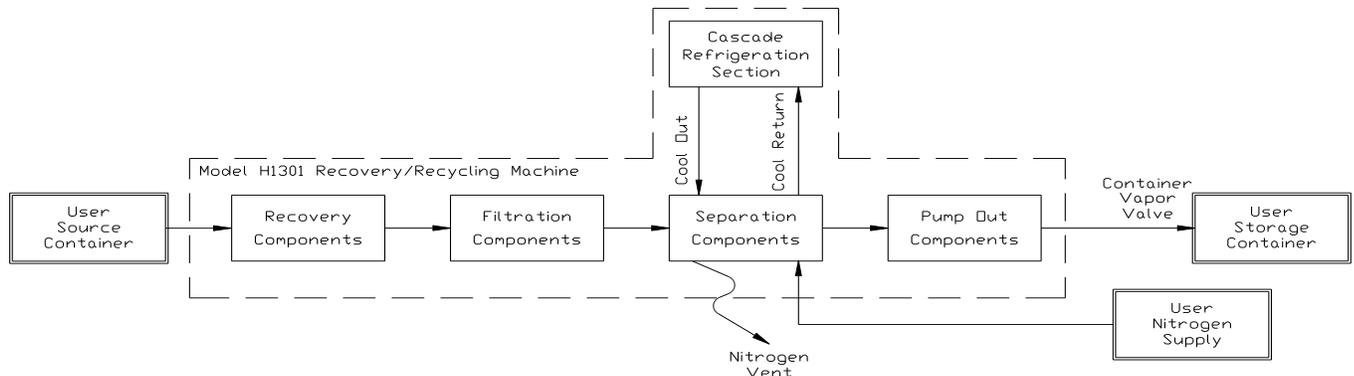
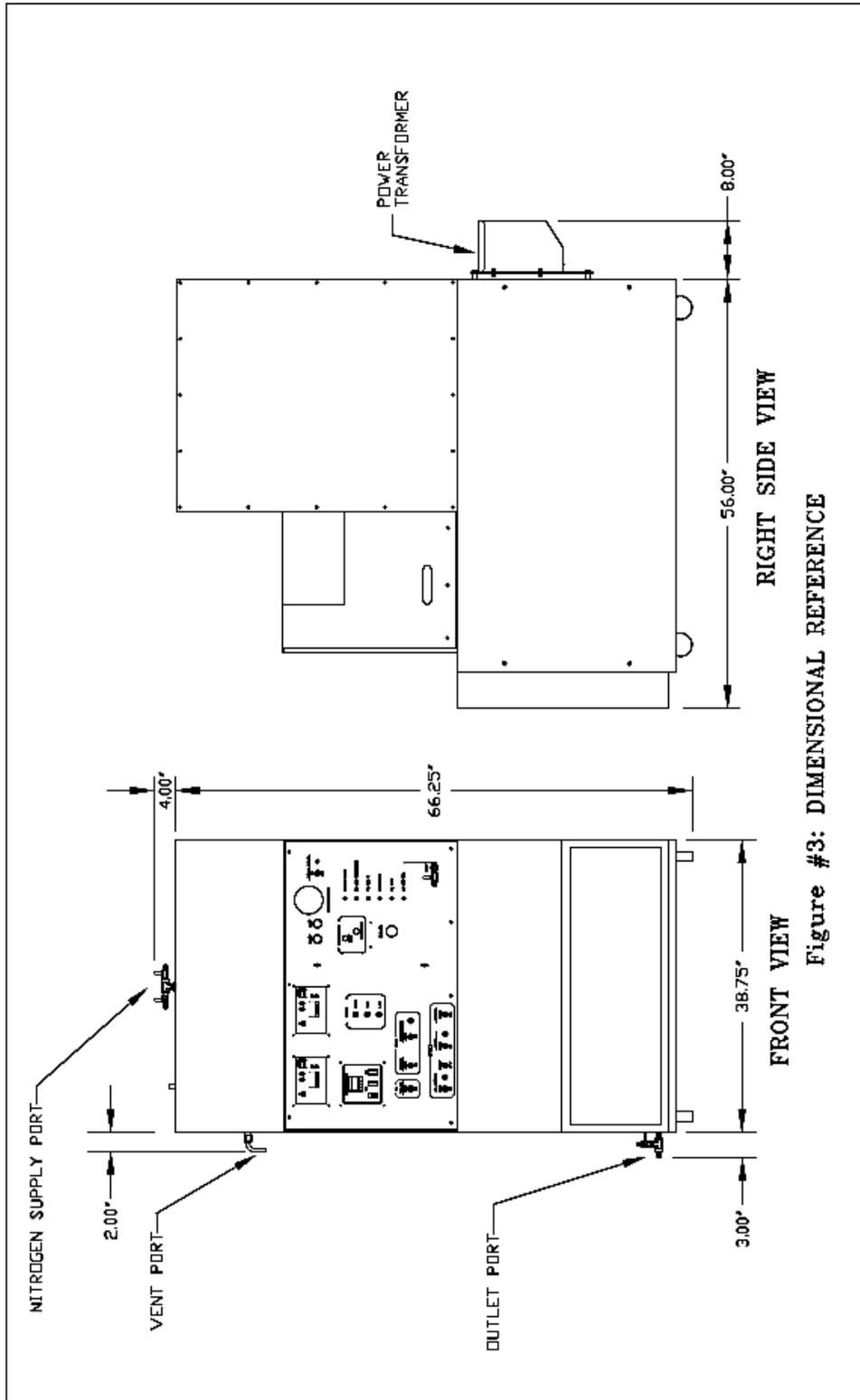


Figure 2
System Component Overview

IV. System Installation

The user is urged to carefully study the following installation procedures and fully understand them BEFORE attempting installation of the recovery/recycling system. Refer to figure-3 below for the physical dimensions of the machine. Clearance of 3-feet is recommended on all sides of the machine.

Weight: 1000 US pounds (453.6 Kg)



IV. System Installation (continued)

A. Machine Location

Position the machine on a clean, level surface and use wheel chocks to insure that the machine will not roll if accidentally pushed, or roll from operational vibration.

Maintain a service area of at least 3-feet around all sides of the machine to allow for proper air circulation.

The ports of the machine are ¼" x 45° SAE Male Flare fittings. Refrigeration service hoses of the appropriate length may be used to connect to the ports of the machine.

- ◆ **ALWAYS LOCATE THE SYSTEM ON AN EVEN AND LEVEL SURFACE.**
- ◆ **DO NOT INSTALL THE SYSTEM IN AN OUTDOOR ENVIRONMENT.** The system is designed for indoor locations with ambient temperature from 70 to 80 degrees F (21.1° to 26.7°C).
- ◆ **DO NOT LOCATE THE EQUIPMENT IN OR NEAR THE VICINITY OF FLAMMABLE MATERIALS OR VAPORS.**
- ◆ **DO NOT LOCATE THE SYSTEM NEAR DRIPPING, SPRAYING, OR STANDING MOISTURE OR WATER.** The system enclosure **IS NOT NEMA** rated. Contact with moisture and water may result in electrical short circuits which may cause health and system hazards.
- ◆ **ALWAYS LOCATE THE SYSTEM IN AN AREA THAT IS COOL, DRY, AND AWAY FROM DIRECT SUNLIGHT.**
- ◆ **ALWAYS ATTEMPT TO MAINTAIN A MINIMUM 3/16" INSIDE DIAMETER PLUMBING CONNECTIONS TO THE PORTS OF THE MACHINE WITH A MINIMUM OF BENDS, LOOPS, LOW SPOTS, OR SAGS.**

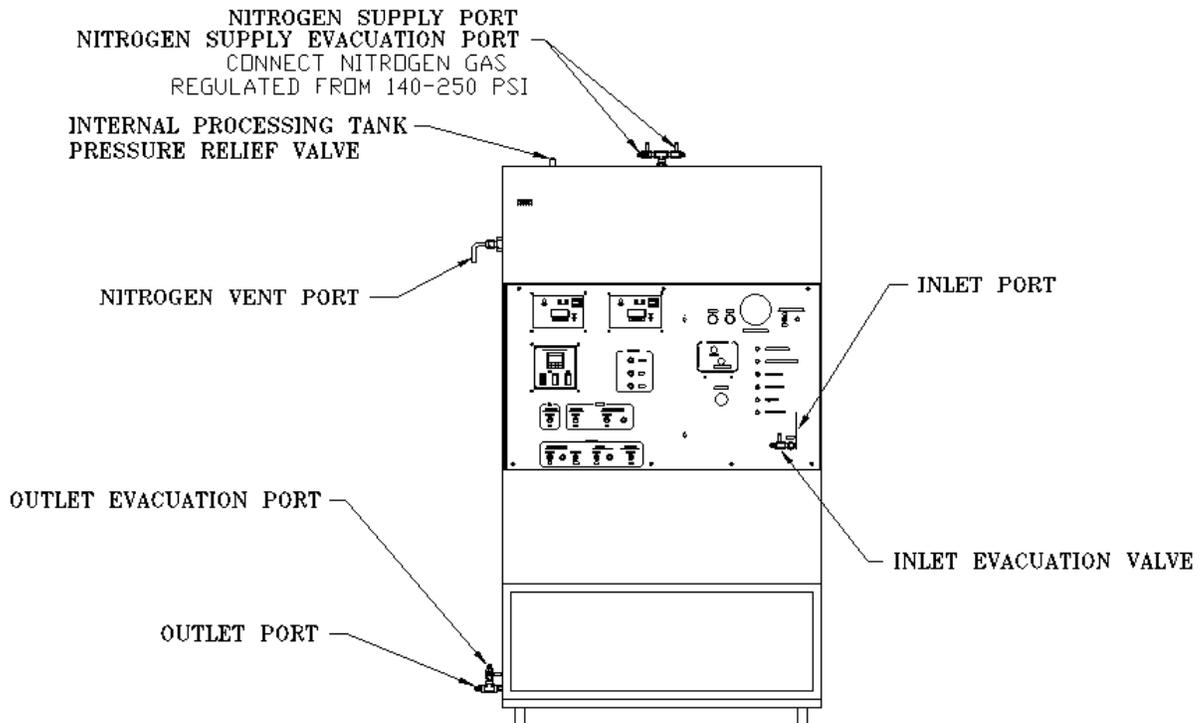


Figure #4: PORT LOCATIONS
Valves shown in the closed positions

IV. System Installation (continued)

B. Pressure Relief Valve Port

The Pressure Relief Valve port of the machine is a 5/8" x 45° SAE Male Flare fitting located on the top of the machine see figure-4. The port is fitted with a plastic plug to keep dirt and debris out of the valve. This plastic plug will be ejected if the valve operates. **DO NOT CONNECT ANY PLUMBING OR CAP TO THE PRESSURE RELIEF VALVE PORT.** This is a safety device that will prevent rupturing of the internal processing tank due to an over pressure condition. If the internal pressure exceeds 300 psi, the valve will open releasing the vapor side of the tank to maintain the internal pressure to below 300 psi.



WARNING! Do Not Plug or Restrict the Pressure Relief Valve at the top of the machine. Damage to the Machine, Property Damage and Injury May Result.

IV. System Installation (continued)

C. Electrical Supply

NOTE: It is the customer's responsibility to comply with all local and national electric codes and safety requirements when installing the electrical service for the machine. The following requirements are intended only to address the issues of the machine operation.

WARNING: DO NOT CONNECT THE EQUIPMENT TO ANY POWER SOURCE OTHER THAN THAT SPECIFIED BY THIS MANUAL.

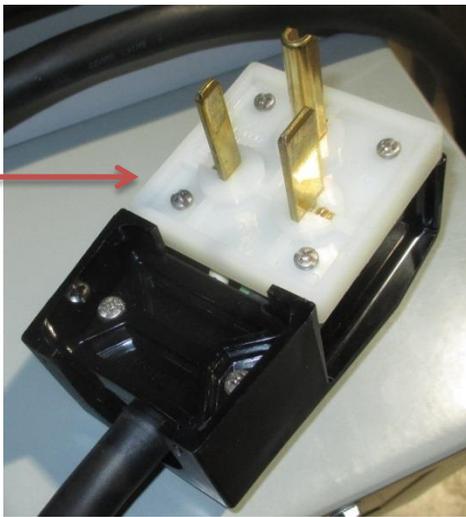
The main power cable must reach the electrical service location without undue stress or tension on the cord and the cord must be routed away from possible contact with walkways and peripheral moving equipment.

A check mark will appear below in the box next to the required electrical service for the machine. The specific schematic drawings have been inserted into a pocket at the end of this section of the manual. The electrical requirement is also listed on the serial number label located in the upper-left corner on the rear panel of the machine.

- 208-230 VAC/60Hz, single phase, 9.0 KVA service
Electrical Schematic SC-E-0316
- 230 VAC/50hZ, single phase, 9.0 KVA service
Electrical Schematics SC-E-0425 and SC-E-0382
- 240 VAC/50hZ, single phase, 9.0 KVA service
Electrical Schematics 020043 and SC-E-0779

The power circuit for the machine should be protected with dual circuit breakers or fuses that will limit the maximum current to the machine to 50 amps.

The machine is supplied with a ten foot #8 AWG 3-wire power cable terminated with a USA NEMA 2-pole 3-wire ground plug.



The mating receptacle for the plug is a USA NEMA type 6-50R 2-pole 3-wire ground receptacle, Hubble part number 9367 or equivalent.

IV. System Installation (continued)

D. Nitrogen Vent Port

The Nitrogen Vent port of the machine is a 1/4" x 45° SAE Male Flare fitting at the end of a deflector tube located on the left side of the machine see figure-4. The tube is curved downward to direct the stream of venting nitrogen away from personnel and to channel condensation down and away from contact with the automatic valve of the machine.

Remove the cap and the bagged Deflector Tube from the Vent port.



Connect the Deflector Tube to the Vent Port finger tight. Then just lightly tighten snug with a 5/8" open end wrench. Do not over tighten: this may twist the internal plumbing of the machine.

The vent port must be plumbed to an outside area when processing FE25. Use minimum 3/16" inside diameter plumbing. Be sure to route the plumbing so that moisture condensing inside the plumbing will drain out and not back to the machine otherwise the nitrogen vent valve may freeze in the open position resulting in total loss of the processing Agent. Install screening at the end of the plumbing to guard against entry and clogging by debris and insects.

CAUTION: DO NOT RESTRICT THE NITROGEN VENT PORT OF THE MACHINE. Restricting the vent port may result in poor recycling quality.

IV. System Installation (continued)

E. Nitrogen Supply

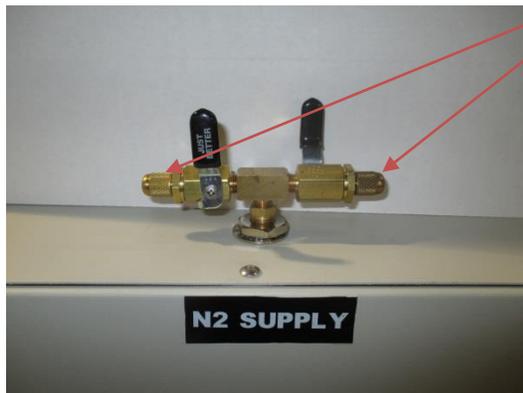
Clean and dry commercial grade nitrogen gas will be required for system operation.

Evacuate the plumbing to a 2500 micron minimum vacuum level before opening the nitrogen supply to the machine.

The nitrogen supply must be regulated to no greater than 250 PSIG. Connecting a supply greater than 250 PSIG to the Nitrogen Supply Port may cause the pressure relief valve inside the machine to activate.

The Nitrogen Supply port and Evacuation Port are located at the top of the machine. The connections are interchangeable use either valve for nitrogen or evacuation.

Two shut off valves are provided with ¼" x 45° SAE male flare connectors.



Evacuation and Leak Testing Method:

1. Remove the valve caps and set aside.
2. Connect the nitrogen gas source to one of the valves. Do not open the nitrogen cylinder.
3. Connect a vacuum pump and vacuum gauge to the remaining valve.
4. Open both valves, with the nitrogen source closed, and operate the vacuum pump to achieve a 2500 micron vacuum level: this will remove air from the interconnecting plumbing.
5. Close the valve connected to the vacuum pump. Discontinue vacuum pump operation and disconnect the vacuum pump from the valve. Reconnect the valve cap back to the valve.
6. Open the nitrogen gas source regulated from 140 to 250 PSI with the valve of the machine remaining opened.
7. Leak test the plumbing connections using leak detect fluid. If no leakage is detected the nitrogen installation is complete, or repair any leaks if required, then repeat the evacuation procedure.

WARNING: DO NOT CONNECT GAS IN EXCESS OF 250 PSIG TO THE NITROGEN SUPPLY PORT OF THE MACHINE. DAMAGE TO THE EQUIPMENT MAY RESULT.

IV. System Installation (continued)

F. Receiver Storage Container Connections

NOTE: It is the customer's responsibility to comply with all local and national safety requirements and codes for the selection of storage and shipping containers used to capture the recovered Agent. The following requirements are intended only to address the issues of the machine operation.

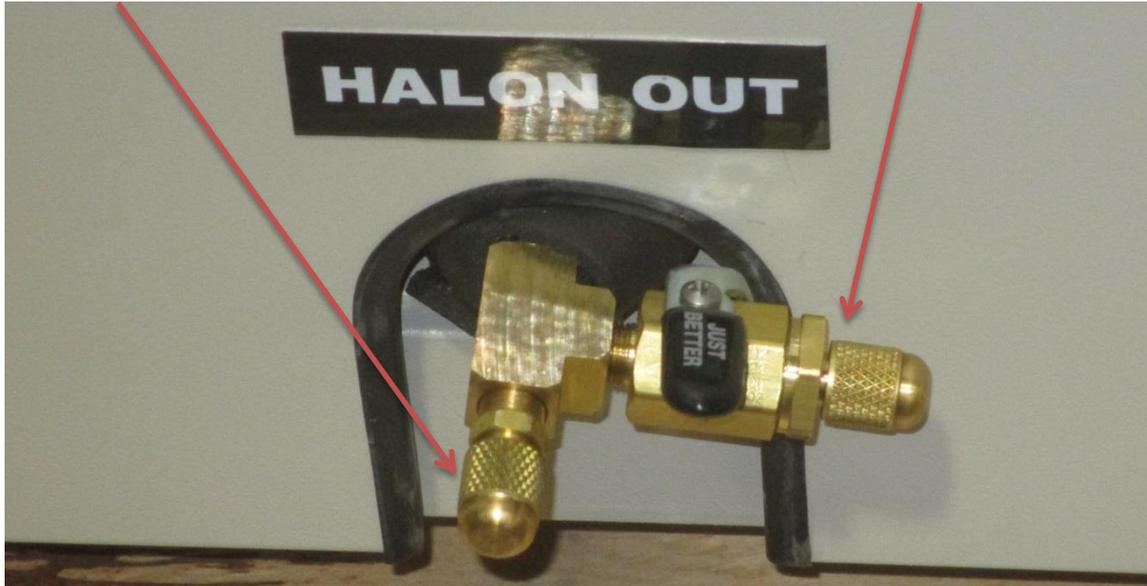
The Receiver Storage Container must be installed onto a weigh scale or be able to be weighed to avoid an overfill condition of the container.

Process Connections: Connect the Vapor Port of the storage container to the OUTLET Port of the machine. The storage container must be either evacuated to a 2500 micron minimum vacuum level or contain clean Agent prior to processing.

Evacuation and Leak Testing The plumbing connections should first be tested for leakage using clean dry nitrogen from 200 to 250 psi then evacuated to a 2500-micron vacuum level using a vacuum pump through the evacuation valve fitted to the outlet port of the machine.

OUTLET PORT

EVACUATION VALVE



CAUTION: Failure to leak test the plumbing connections could result in total loss of recovered Agent.

CAUTION: Failure to evacuate the storage container and plumbing connections will result in contamination of the recovered Agent and unexpected high pressure in the storage container.

CAUTION: Operation of the machine without a storage container connected to the Outlet Port of the machine will result in total loss of recovered Agent.

During the pump-out cycle, the machine will pump recycled liquid Agent from the Outlet Port of the Machine into the storage container. Nitrogen gas will also pressurize the internal processing tank of the machine through the Nitrogen Supply Port. This is required to prime the liquid pumps of the machine.

IV. System Installation (continued)

F. Receiver Storage Container Connections (continued) Outlet Leak Testing and Evacuation Method:

1. Connect the Vapor Port of the storage container to the Outlet Port of the machine.



The storage container is placed on a weigh scale.

2. DO NOT OPEN the storage container valve.

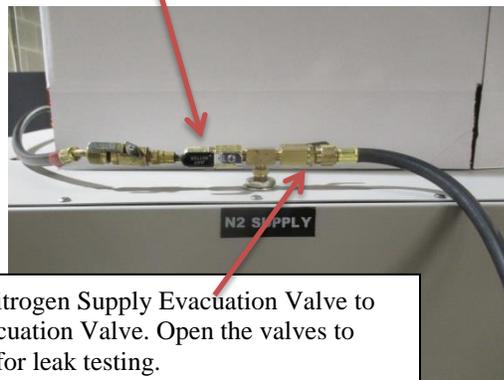
3. Pressurize the plumbing through the Outlet Evacuation Valve with 200 to 250 psi nitrogen gas and leak test the plumbing connections with leak detect fluid.



A hose connection from the Nitrogen Supply Evacuation Valve may be used to pressurize the plumbing in place of using a second source of nitrogen gas.



Nitrogen Supply Connected

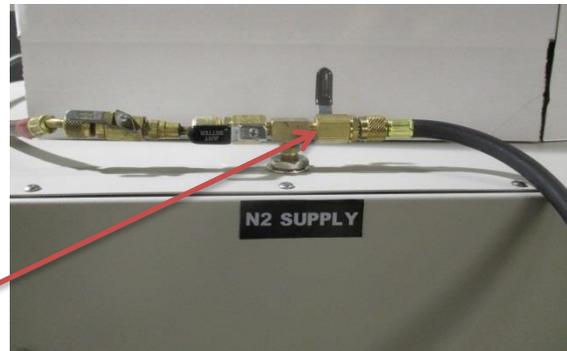


Connect Nitrogen Supply Evacuation Valve to Outlet Evacuation Valve. Open the valves to pressurize for leak testing.

IV. System Installation (continued)

F. Receiver Storage Container Connections (continued) Outlet Leak Testing and Evacuation Method (continued)

4. Close the Outlet Evacuation Valve.



5. Shut off the nitrogen gas.

6. Slowly bleed the pressure by loosening then disconnect the nitrogen gas from the valve.



7. Open the Outlet Evacuation Valve to release the nitrogen pressure.

8. Connect a vacuum gauge and vacuum pump to the open Outlet Evacuation Valve.



If the storage container DOES NOT CONTAIN AGENT: Open the vapor valve of the storage container: this will evacuate the container along with the plumbing connections at the same time.

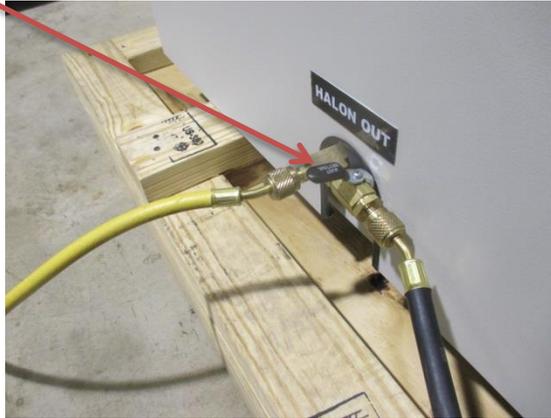
If the storage container HAS SOME AMOUNT OF AGENT IN IT: Leave the storage container vapor valve closed: otherwise all the agent in the container will be lost.

IV. System Installation (continued)

F. Receiver Storage Container Connections (continued)

Outlet Leak Testing and Evacuation Method (continued)

9. Operate the vacuum pump to achieve a minimum 2500 micron vacuum level indication on the vacuum gauge.
10. Close the Outlet Evacuation Valve.



11. Discontinue vacuum pump operation.
12. Disconnect the vacuum pump and vacuum gauge from the Outlet Evacuation Valve.
13. Cap the Outlet Evacuation Valve.



14. Open the vapor valve of the storage container if it is closed.



The Receiving Storage Container is now ready for use.

IV. System Installation (continued)

G. Source Container Connections

Source Containers will be installed to the machine to recover and recycle the agent from the containers. **The instructions presented in this section should be accomplished only when ready to perform the Initial Start-Up procedure section-V.B. of this document or when ready to begin System Operation as described in section-V.D. of this document.**

The Manual Inlet Valve port and Inlet Evacuation Valve port of the machine are 1/4" x 45° SAE Male Flare fittings. High pressure rated refrigeration service hoses of the appropriate length may be used to connect the AGENT source container to the machine.

Inlet Evacuation Valve and Port

Manual Inlet Valve and Port



The inlet valve plumbing to the source container must be leak tested before operating the machine to guard against Agent loss. Leaks in the inlet connections will also allow ambient air to enter the machine during the vapor recovery cycle.

The source container shall be fitted with a shut-off valve in the event that the source container must be disconnected from the Inlet Valve of the machine before processing has been completed.

WARNING! A method must be employed to restrain Agent source containers against recoil when safety anti-recoil fittings are removed from the containers. Uncontrolled discharge of pressurized containers will provide high velocity container recoil resulting in Property Damage, Personal Injury or Death.

WARNING! Do Not Connect Agent or Nitrogen in excess of 600 psig to the Inlet Port of the machine. Damage to the Machine May Result.

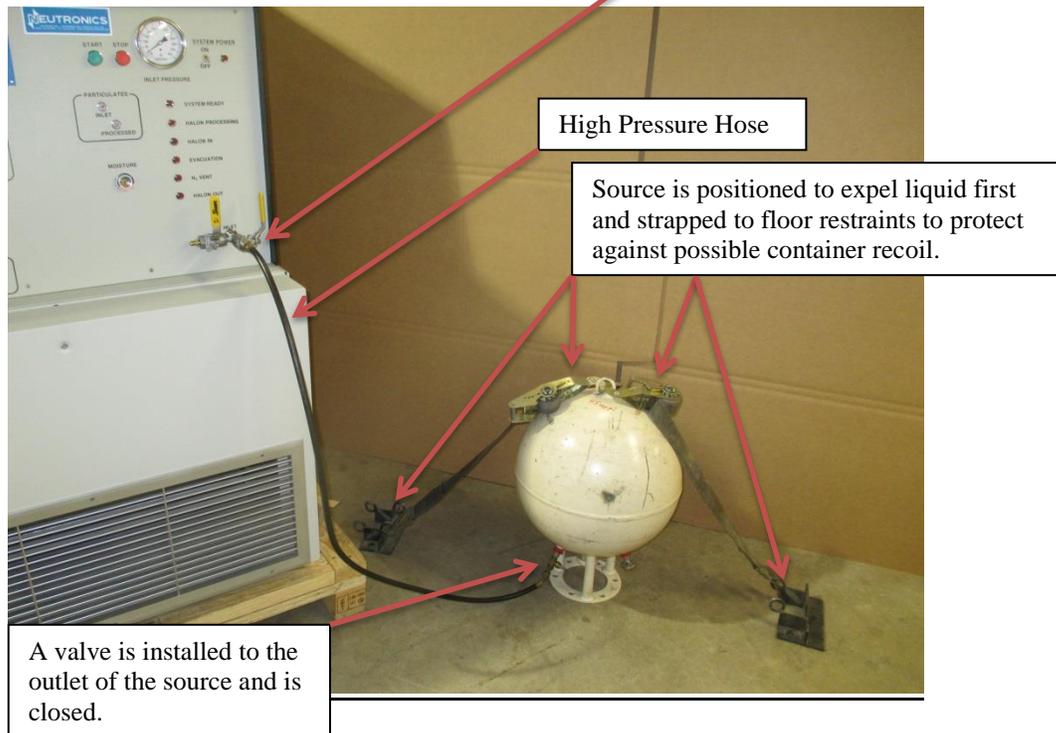
CAUTION: Failure to leak test the plumbing connections could result in total loss of Agent.

IV. System Installation (continued)

G. Source Container Connections (Continued)

Inlet Leak Testing and Evacuation Method:

1. Connect the Agent source container to the Manual Inlet Valve Port. **Do not open the source container.**



2. Connect nitrogen gas regulated to the pressure of the Agent source container to the Inlet Evacuation Valve Port.



3. Open the Evacuation Valve and the Manual Inlet Valve to pressurize the plumbing with the nitrogen and leak test the plumbing connections using leak detect fluid.
4. Shut off the nitrogen, Close the Evacuation Valve and disconnect the nitrogen.

IV. System Installation

G. Source Container Connections

Inlet Leak Testing and Evacuation Method (Continued)

5. Open the Evacuation Valve to depressurize the plumbing.
6. Connect a vacuum pump to the open Evacuation Valve Port.



7. With the Evacuation Valve and Manual Inlet Valve still open; operate the vacuum pump to gain a vacuum indication on the Front Panel Inlet Pressure Gauge.
 8. Close the Evacuation Valve.
 9. Discontinue vacuum pump operation.
 10. Disconnect the vacuum pump from the Evacuation Port.
 11. Close the Manual Inlet Valve.
 12. Cap the Evacuation Port.
- The source plumbing is now prepared for use.

CAUTION: NEVER INITIATE RECOVERY WITHOUT A SOURCE OF AGENT OR CLEAN DRY NITROGEN CONNECTED TO THE INLET PORT OF THE SYSTEM. Failure to connect a source container to the inlet port of the machine may result in the introduction of ambient air into the system that will saturate the moisture filters and cause ice formation and internal blockage to the machine.

V. System Operation and Controls

This section of the manual will detail system start up, automatic operation, and manual overrides of the machine. The user is urged to study this section of the manual completely and fully understand all phases of machine operation **BEFORE** operating the machine.

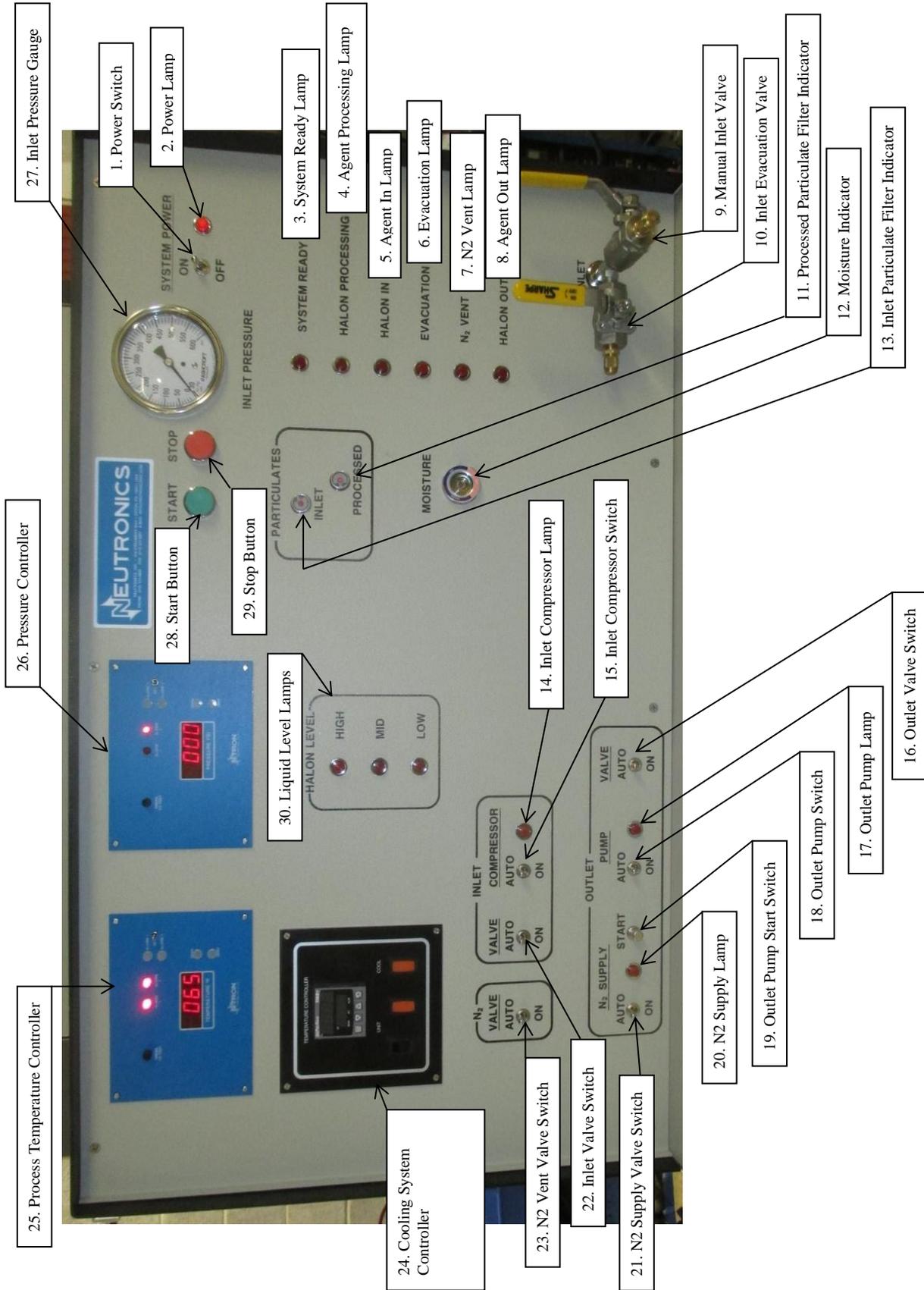
A. Manual Overrides and System Control Description

Normal system operation will be accomplished in the automatic mode as described in the following sections of the manual. Occasionally the user may desire to manually override the function of system components. Manual operation of the machine is required during maintenance operations. This section of the manual will describe the purpose and function of all front control panel components. Refer to figure-5: Front Control Panel Detail.

- 1. System Power Toggle Switch:** Controls the supply of user connected main power to the machine.
- 2. System Power Lamp:** Indicates the condition of user connected main power to the machine. The lamp is illuminated when the system power switch is in the on position.
- 3. System Ready Lamp:** Indicates when the machine internal processing tank has been cooled to the value of the temperature controller alarm #1 setting.
- 4. Processing Lamp:** Continuously illuminated when the machine is processing in the automatic mode. The source container is not empty and ready for removal until this lamp has extinguished. This lamp will also flash along with a combination of level lamps to indicate an error condition.
- 5. Halon In Lamp:** Indicates that the inlet solenoid valve of the machine is open allowing Agent to flow into the machine.
- 6. Evacuation Lamp:** Indicates when the machine is evacuating vapor from the source container using the evacuation compressor and the compressor inlet solenoid valve.
- 7. N2 Vent Lamp:** Indicates when the machine is separating nitrogen from the Agent. During separation the nitrogen vent solenoid valve will be open and nitrogen will be purging out of the machine.
- 8. Halon Out Lamp:** Indicates when recycled AGENT is being pumped out of the machine through the outlet pump and solenoid valve into the user's receiving container.
- 9. Manual Inlet Valve:** Opening this valve will allow Agent connected to the inlet port of the machine to flow into the machine through the inlet particulate filter and inlet pressure regulator up to the inlet solenoid valve.
- 10. Inlet Evacuation Valve: Use this valve and port for connection to a vacuum pump to evacuate any plumbing connected to the Manual Inlet Valve.** This valve may also be used as a secondary Manual Inlet Valve.
- 11. Processed Particulate Indicator:** Indicates requirement of the processed particulate filter element maintenance. When the red indicator of the filter pops out, the filter element will require replacement.
- 12. Moisture Indicator:** The indicator serves as a sight glass for inspection of the incoming Agent flow. It will indicate the moisture content of the agent via a color change: When the color indicator of the sight glass is violet the agent is dry. When the color of the indicator is orange the agent has moisture contamination, the filter elements may need to be replaced.

V. System Operations and Controls
A. Manual Overrides and System Controls (continued)

Figure #5: Front Control Panel Detail



- 1. Power Switch
- 2. Power Lamp
- 3. System Ready Lamp
- 4. Agent Processing Lamp
- 5. Agent In Lamp
- 6. Evacuation Lamp
- 7. N2 Vent Lamp
- 8. Agent Out Lamp
- 9. Manual Inlet Valve
- 10. Inlet Evacuation Valve
- 11. Processed Particulate Filter Indicator
- 12. Moisture Indicator
- 13. Inlet Particulate Filter Indicator
- 14. Inlet Compressor Lamp
- 15. Inlet Compressor Switch
- 16. Outlet Valve Switch
- 17. Outlet Pump Lamp
- 18. Outlet Pump Switch
- 19. Outlet Pump Start Switch
- 20. N2 Supply Lamp
- 21. N2 Supply Valve Switch
- 22. Inlet Valve Switch
- 23. N2 Vent Valve Switch
- 24. Cooling System Controller
- 25. Process Temperature Controller
- 26. Pressure Controller
- 27. Inlet Pressure Gauge
- 28. Start Button
- 29. Stop Button
- 30. Liquid Level Lamps

V. System Operations and Controls

A. Manual Overrides and System Controls (continued)

- 13. Inlet Particulate Filter Indicator:** Indicates requirement of the Inlet particulate filter element maintenance. When the red indicator of the filter pops out; the filter element will require replacement.
- 14. Inlet Compressor Lamp:** illuminates to provide a visual indication that the inlet vapor compressor is operating.
- 15. Inlet Compressor Toggle Switch:** Provides a manual override for operating the vapor compressor and opening the compressor inlet solenoid valve. Placement of the switch to the ON position will start the compressor and open the compressor inlet solenoid valve. Placement of the switch to the Auto position will allow the machine programmable controller to operate the compressor and solenoid valve.
- 16. Outlet Valve Toggle Switch:** Provides a manual override for opening the Outlet solenoid valve. Placement of the switch to the ON position will open the Outlet solenoid valve and allow flow of AGENT from the processing tank. Placement of the switch to the Auto position will allow the machine programmable controller to operate the solenoid valve.
- 17. Outlet Pump Lamp:** Illuminates when the Outlet Pump is operating.
- 18. Outlet Pump Toggle Switch:** Provides a manual override for operating the Outlet Liquid pumps. Placement of the switch to the ON position will start the outlet pumps. The Outlet Valve switch must also be placed to the ON position to allow flow of liquid from the machine Outlet Port. Placement of the switch to the Auto position will allow the machine programmable controller to operate the pump.
- 19. Outlet Start Push Button:** Provides a manual override in the *AUTOMATIC CONTROL OPERATION MODE* to initiate the machine programmable controller to begin the liquid pump out cycle.
- 20. N2 Supply Lamp:** illuminates when the N2 Supply Solenoid Valve is open and admitting gas into the processing tank.
- 21. N2 Supply Toggle Switch:** Provides a manual override for opening the Nitrogen Supply solenoid valve. Placement of the switch to the ON position will open the Nitrogen Supply solenoid valve and allow flow of nitrogen into the head space of the processing tank. Placement of the switch to the Auto position will allow the machine programmable controller to operate the solenoid valve.
- 22. Inlet Valve Toggle Switch:** Provides a manual override for opening the Inlet solenoid valves. Placement of the switch to the ON position will open the inlet solenoid valves and allow flow of AGENT into the machine through the filters and into the processing tank. Placement of the switch to the Auto position will allow the machine programmable controller to operate the solenoid valve.
- 23. N2 Vent Valve Toggle Switch:** Provides a manual override for opening the nitrogen vent solenoid valve. Placement of the switch to the ON position will open the solenoid valve and vent the processing tank to the atmosphere. Placement of the switch to the Auto position will allow the machine programmable controller to operate the solenoid valve.
- 24. Cooling System Controller:** Provides cooling control of the cascade refrigeration system through an adjustable setting, displays the process temperature, and the control temperature setting.

V. System Operations and Controls

A. Manual Overrides and System Controls (continued)

- 25. Process Temperature Controller:** Provides a digital display of the machine processing tank temperature. The controller also is the interface for temperature information to the system programmable controller and microprocessor unit controller. The adjustable alarm #1 setting of the controller will control the System Ready Lamp.
- 26. Pressure Controller:** Provides a digital display of the pressure in the processing tank in absolute pressure per square inch units. The controller also is the interface for pressure information to the system programmable controller. The adjustable alarm settings of the controller will control nitrogen venting parameters.
- 27. Inlet Pressure Gauge:** Provides pressure indications of the source container when the manual inlet valve and the source container outlet valves are both open.
- 28. Start Push Button:** Provides initialization of the automatic operation sequence when pushed and released.
- 29. Stop Push Button:** Depression of this switch will cease the automatic operation sequence.
- 30. Liquid Level Lamps:** Provides a visual indication of AGENT levels inside the processing tank. Lamps of Low, Mid and High will continuously illuminate whenever the AGENT level in the processing tank is at or above the specific lamp height. Low-Level is approximately 30 pounds fill, Mid-Level approximately 80 pounds and High-Level is approximately 105 pounds. The machine automatically processes from Low to Mid liquid levels. One or more of the liquid level lamps will flash along with the processing lamp to indicate error conditions.

V. System Operations and Controls (continued)

B. Initial System Start-Up Procedure

Before processing AGENT, the machine must be loaded with a “priming charge” of AGENT. This initial charge will provide thermal contact in the processing tank for the temperature sensors. Without the initial charge of AGENT, the cooling system controller will not regulate or display the correct temperature of the processing tank. Twenty to thirty five pounds of the initial charge of the Agent will always remain in the machine until manually removed during maintenance operations.

Required Materials:

- ◆ Minimum 40 pound supply of AGENT liquid this will be the Agent Source
- ◆ Connection plumbing from the AGENT Source to the Inlet Port of the machine

1. Install the machine as per System Installation: section-IV of this manual. Do not install the AGENT source container to the Inlet Port of the machine as per section-IV.G, of this manual, until directed to do so by this procedure.

NOTE: The source container must be configured to present a liquid discharge into the machine. Trying to initially charge the machine with AGENT vapor will result in a lengthy process and may be unsuccessful in the presence of nitrogen.

2. View the front panel manual controls and verify:
 - ◆ All override switches are in the AUTO position
 - ◆ The Cooling System Controller Power Switch is in the On position
3. Verify the valve cap has been removed from the nitrogen vent port. Retain this cap for periods of disuse and maintenance requirements. The curved vent deflector tube should be installed to the nitrogen vent port or the vent port is plumbed to the outside for FE25.
4. Place the Front Panel System Power Switch to the On position and verify the following.
 - ◆ System Power Lamp illuminates
 - ◆ Cooling System Controller Power Lamp illuminates
 - ◆ Cooling System Controller Cool Lamp illuminates
 - ◆ Refrigeration System #1 Activates followed by System #2 (after an approximate 30-second delay)

Note: Operation of the refrigeration section may be verified by observing the system-1 and system-2 high and low side pressure gauges on the back of the machine.

- ◆ Process Temperature Controller displays a temperature within 15 degrees of ambient
- ◆ Cooling System Controller upper display indicates a temperature within 15 degrees of ambient

Note: The factory setting of the Cooling System Controller is for 1301 or FE25 setting -63°F step #5 below may not need to be performed if 1301 or FE25 is used for start-up.

5. Press the Function-Key of the Cooling System Controller. Use the up and down arrow keys of the controller to adjust the temperature setting for the type of Agent as listed below. Press the Function-key of the controller to return the controller to the operating display (reference section-VII.P for detailed adjustment instructions.)

- ◆ Halon 1301 and FE25 setting -63°F
- ◆ Halon 1211 setting -23°F
- ◆ FM200 setting -15

V. System Operations and Controls

B. Initial System Start-Up Procedure (continued)

6. Nitrogen Gas Purge.

NOTE: The machine is shipped with a small amount of nitrogen gas pressurizing the system. Clear the nitrogen from the system by performing the following steps (a) through (e). When charging the machine after system maintenance evacuation procedures these steps are NOT TO BE PERFORMED unless nitrogen gas has been added to the system.

- a. Place the Inlet Valve switch to the ON position.
 - b. Place the N2 Valve switch to the ON position.
 - c. Observe the pressure controller display. Wait for the pressure to drop to a 15 to 16 PSI display.
 - d. Place the Inlet Valve switch to the AUTO position.
 - e. Place the N2 Valve switch to the AUTO position.
7. Install the agent source container to the machine as per section-IV.G. of this manual.
 8. Open the valve of the source container to allow agent to flow to the Manual Inlet Valve of the machine.

NOTE: If the inlet plumbing requires repairs the trapped Agent in the plumbing may be drawn into the machine by first closing the outlet valve of the source container. Then open the Manual Inlet Valve of the machine followed by placing the Inlet Valve Switch to the ON position. The Inlet Pressure Gauge of the machine should drop to zero pressure. Close the Manual Inlet Valve and place the Inlet Valve Switch to the AUTO position. Repair the leak points and begin again with step-7.

9. Open the Manual Inlet Valve of the Machine.
 10. Place the Inlet Valve Switch to the ON position. AGENT will now flow into the machine.
 11. Observe the Moisture Indicator Sight Glass on the front panel. The sight glass should initially appear empty then fill with the incoming AGENT liquid.
 12. Observe the Agent Liquid Level Lamps on the front panel. **When the Low Level Lamp illuminates: Close the valve of the source container to stop the flow of agent to the machine.**
 13. Observe the Moisture Indicator Sight Glass and the Inlet Pressure Gauge on the front panel. When the sight glass once again appears empty and the pressure is below 100 psi for 1301 and FE25 or below 30 psi for FM200 or below 15 psi for 1211: perform step-14.
 14. Place the Inlet Compressor Switch to the ON position. The vapor compressor will begin to evacuate the remaining vapor from the inlet plumbing connected to the source container.
 15. Observe the Inlet Pressure Gauge of the front panel. When the pressure gauge indicates a vacuum level, continue with step-16.
 16. Place the Inlet Compressor Switch to the AUTO position.
 17. Place the Inlet Valve Switch to the AUTO position.
 18. Close the Manual Inlet Valve of the machine.
- The machine is now primed. The source container may be disconnected from the machine, or after reviewing sections-V.C: Inlet Pressure Switch Function and Adjustment and sections-V.D: Automatic System Operation of this manual. The source container can be completely emptied and evacuated into the machine in either the automatic mode or manually.

V. System Operations and Controls (continued)

C. Inlet Pressure Switch Function and Adjustment

There are two automatic modes of recovery: liquid recovery and vapor recovery.

During the liquid recovery mode the AGENT liquid containing dissolved nitrogen is forced into the machine from the pressure of the nitrogen charge in the source container.

During the vapor recovery mode the AGENT vapor and free nitrogen gas is drawn into the system using the vapor compressor of the machine. This evacuation process will continue until the source container is emptied to (-10") Hg vacuum level.

The inlet pressure switch is the sensor that determines whether the machine will operate in the liquid recovery mode or the vapor recovery mode. When the pressure of the source container is **above the set point** of the inlet pressure switch; the machine will operate in the **liquid recovery mode**. When the pressure of the source container drops **below the set point** of the switch; the machine will operate in the **vapor recovery mode**. **The factory setting of the inlet pressure switch is for Halon 1301 or FE25 set at 90 to 100 psi.**

AGENT source containers pressurized to 360 psi with nitrogen, when properly positioned to discharge liquid first, will usually discharge all of the liquid AGENT with 90 psig of AGENT vapor and nitrogen remaining in the container.

The machine will recover in the liquid mode until the pressure in the source container drops below 90 psig then the machine will operate in the vapor recovery mode. **Recovery from source containers super pressurized with nitrogen will usually require no adjustment of the inlet pressure switch from the factory set point.**

The factory setting of 90 psig should always be used when processing Halon 1301 or FE25.

The inlet pressure switch will need adjustment when recovering Halon 1211 or FM200 from source containers with a low nitrogen charge, (less than 200 psig), or no charge at all. These container pressure conditions will present liquid AGENT to the inlet of the machine below 90 psig at ambient temperatures. **Unless the pressure switch is adjusted to below the vapor pressure** liquid AGENT will be drawn into the machine during the vapor recovery mode. **The machine will begin a self-evacuation process** to clear the liquid from the inlet plumbing preventing the vapor compressor from becoming damaged. **During the self-evacuation process the machine will not recover Agent from the source container** until the inlet plumbing of the machine is cleared of liquid. **This will greatly slow down the recovery process.** The self-evacuation mode can be identified when the control panel Compressor Lamp is illuminated while the Evacuation Lamp is not illuminated. Normally both lamps will be illuminated simultaneously.

The condition of the source containers of agent must be evaluated and the inlet pressure switch may be adjusted using the adjustment procedure beginning on the following page. The source container may also be charged with nitrogen within the limits of the working pressure of the container to avoid pressure switch adjustment.

V. System Operations and Controls

C. Inlet Pressure Switch Function and Adjustment (continued)

Inlet Pressure Switch Adjustment Procedure

Required Materials:

- ◆ Clean Dry Commercial Grade Nitrogen Gas Regulated from 25 to 250 psi Max.
- ◆ Connection plumbing from the Nitrogen Source to the Inlet Port of the machine
- ◆ Screwdriver
- ◆ 3/8" Open End Wrench

NOTE: The set point of the pressure switch is adjustable from 10 to 100 psig. The set point is decreased by rotating the switch adjustment screw counterclockwise and increased with a clockwise rotation of the adjustment screw.

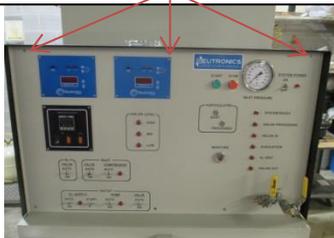
NOTE: The control panel hood may be removed to gain easy access to the switch and to observe the PLC status indicators. Otherwise, the switch is accessible through the filter access door and the PLC status indicators may be viewed using an inspection mirror.

1. Place the power switch of the machine to the off position. Disconnect the main electrical power from the machine.
2. Open the filter access door of the hood and **separate the two halves of the hood fan electrical connector J5.**



3. Remove the three screws along the top of the control panel and the three screws on both sides of the control panel hood. With a helper, lift the hood up and over the control panel.

Three screws top of Control Panel

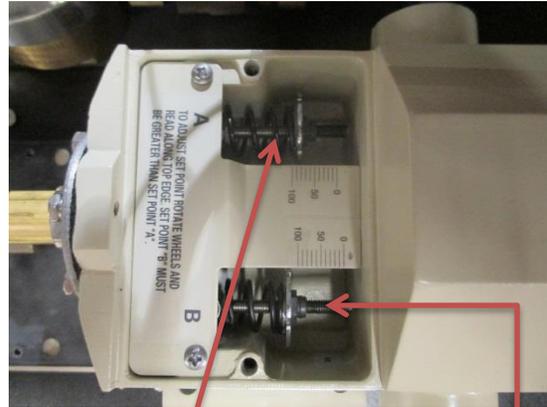
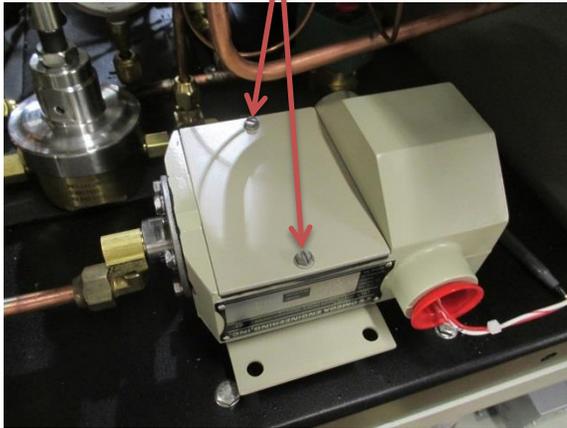


Three screws both bottom sides

V. System Operations and Controls

C. Inlet Pressure Switch Function and Adjustment (continued)

4. Remove the two screws that retain the cover of the pressure switch.



5. Remove the cover and gasket to gain access to the adjustments.

NOTE: B adjustment screw is not used and must be set to over 100 psi to allow adjustment A to travel the full range.

6. Connect the main electrical power back to the machine.
7. Place the machine power switch to the ON position.

WARNING! Do not touch or place any body part onto any of the electrical connections or wiring with power applied to the machine.

8. A source of dry nitrogen can be used to pressurize the inlet port of the machine, with the manual inlet valve open, until the desired actuation pressure is achieved as indicated by the inlet pressure gauge.



An external gauge may be connected to the opposite valve for finer adjustment. Close the manual inlet valve to maintain the desired pressure.

V. System Operations and Controls

C. Inlet Pressure Switch Function and Adjustment (continued)



9. If the #A7 status indicator of the PLC input display is illuminated: rotate the pressure switch A adjustment screw to decrease the pressure using a 3/8" end wrench until the #A7 status lamp of the PLC goes out.



10. If the #A7 indicator is not illuminated: slowly rotate the adjustment screw to increase the pressure and stop when the #A7 indicator illuminates.

NOTE: The pressure set point of the switch should then be checked and readjusted as required by pressurizing the inlet plumbing of the machine until the #A7 indicator goes out and then slowly releasing pressure from the manual inlet valve while observing the #A7 indicator and the inlet pressure gauge. The #A7 indicator should not be illuminated at pressures higher than the desired set point and should illuminate at the desired pressure as the pressure is decreased.

11. Disconnect power from the machine reinstall the pressure switch cover, the hood and reconnect the fan electrical connector.

CAUTION: The inlet pressure switch must always be adjusted to no lower than 10 psi below the Alarm #1 pressure setting of the control panel Pressure Controller. For example: if the pressure controller alarm #1 set point is set to 50 then the lowest setting for the inlet pressure switch would be 40psig.

Recommended Pressure Settings

Halon 1301 and FE25	100 psi
Halon 1211	15 psi
FM200	20 psi

V. System Operations and Controls (continued)

D. Automatic System Operation

NOTE: Normal system operation will always be performed in the automatic mode. When using for the first time after machine installation or, after system evacuation maintenance operations: complete the Initial System Start-Up procedure section-V.B. of this manual before operation in the automatic mode. **A Complete System Evacuation section-VII. K, and System Start-Up section-V. B, must be performed before processing a different type of agent otherwise the agent will be cross contaminated**

1. Connect clean dry nitrogen gas to the Nitrogen Supply Port of the machine as per section-IV.E: Nitrogen Supply. Install a receiving container to the Outlet of the machine as per section-IV.F: Receiver Storage Container Connections.

WARNING! The receiving container must be capable of containing the quantity of AGENT to be automatically processed to a fill level no greater than 80% of container volume: otherwise a dangerous overflow condition of the receiving container will occur.

CAUTION: Never operate the machine in the Automatic Mode without a receiving container connected to the Outlet Port of the machine. Total loss of recycled AGENT will result. Leak test and evacuate the receiving container and all interconnecting plumbing to the receiving container to a minimum 2500-micron vacuum level. Failure to evacuate will result in air and moisture contamination of the receiving container. If the receiving container already contains clean AGENT: only the interconnecting plumbing will require evacuation.

CAUTION: Failure to leak test the plumbing connections could result in total loss of recovered Agent.

2. Remove the valve cap from the nitrogen vent port. Retain this cap for periods of disuse and maintenance requirements.
3. View the manual controls and verify:
 - ◆ All override switches are in the Auto position
 - ◆ The Cooling System Controller power switch is in the On position
4. Place the front panel power switch to the On position.
5. Adjust the Cooling System Controller set point if necessary to **-63°F for 1301** operation, **-23°F for 1211** or **-15°F for FM200** operation (reference section-VII.P for detailed adjustment instructions.)
6. Adjust the Process Temperature Controller alarm set points, (reference section-VII.N) to the values listed below for the appropriate type of agent.

	Alarm #1	Alarm #2
Halon 1301 and FE25	-55	-60
Halon 1211	-15	-20
FM200	-5	-10

7. Adjust the Process Pressure Controller alarm set points, (reference section-VII.M) to the values listed below for the appropriate type of agent.

	Alarm #1	Alarm #2
Halon 1301 and FE25	50	20 to 25
Halon 1211	25	20 to 25
FM200	30	20 to 25

V. System Operations and Controls

D. Automatic System Operation (continued)

8. If required adjust the Inlet Pressure Switch per source container application refer to section-V.C: Inlet Pressure Switch Function and Adjustment.
9. Install the AGENT source container containing the Agent to be processed to the Inlet port of the machine per section-IV. G: Source Container Installation.

WARNING! A method must be employed to restrain Agent source containers. Uncontrolled discharge of pressurized containers will provide high velocity container recoil resulting in Property Damage, Personal Injury or Death.

WARNING! Do Not Connect AGENT or Nitrogen in excess of 600 psig to the Inlet Port of the machine. Damage to the Machine, May Result.

NOTE: The source container must be configured to present a liquid discharge into the machine. Discharge from the vapor side of a container containing liquid will result in processing times 3 to 10 times longer than liquid discharge processing times.

10. Allow the machine to cool until the System Ready Lamp of the front panel illuminates.
11. Open the outlet valve of the source container.
12. Open the Manual Inlet Valve of the Machine.
13. Depress and release the Start Button of the front panel. The machine will immediately begin to process the source Agent. The processing and inlet lamps of the front panel will illuminate and after a short delay liquid should be visible in the moisture indicator sight glass.

CAUTION: To avoid increased processing time and possible damage to the vapor compressor of the machine: 1. DO NOT process source containers that are below room temperature. 2. Maintain position of source containers to provide complete liquid transfer before loss of nitrogen propellant into the machine. 3. NEVER introduce liquid AGENT into the machine whenever the front panel Evacuation lamp is illuminated. 4. NEVER place the inlet compressor switch of the machine front panel into the on position during automatic processing or whenever liquid is being introduced into the machine unless directed to do so by this manual.

V. System Operations and Controls

D. Automatic System Operation (continued)

14. Allow the machine to operate. During operation, various indicator lamps will illuminate and turn off. Input, nitrogen venting, and pump out of AGENT will cycle until all of the Agent has been extracted from the source container. **PROCESSING OF AGENT FROM THE SOURCE CONTAINER IS NOT COMPLETE UNTIL THE AGENT PROCESSING LAMP OF THE MACHINE IS NO LONGER CONTINUOUSLY ILLUMINATED.** The processing lamp may flash on and off to indicate an error condition. When the processing lamp flashes: the source container may not be empty. Refer to section-VIII.A. of this manual for a description of the error codes.

15. When the processing lamp of the front panel goes out and the pressure gauge of the front panel indicates a vacuum condition:

Close the Manual Inlet Valve of the machine.

Close the Valve on the Source Container.

Disconnect the source container from the machine.

WARNING: Always verify that the source container is in a vacuum using the inlet pressure gauge located on the front panel of the machine before disconnecting the source container from the machine. Some system fire extinguisher tanks with automatic discharge heads may automatically close again during processing before the tank is empty. Attempt to again activate the discharge mechanism of the tank or use any other appropriate method to verify that the tank really is empty before disconnecting the tank from the machine.

The machine is immediately ready to process another source container. Install the next AGENT source, containing the Agent to be processed, to the Inlet port of the machine per section-IV.G: Source Container Installation.

Refer to section-V.E: Disconnecting the Source Container When it is not Empty if it becomes necessary to disconnect the agent source container from the inlet of the machine before the machine finishes processing in the automatic mode.

Refer to section-V.F: Receiving Container Replacement to replace a full receiving container with a new empty container when continuing processing.

Refer to section-V.G: System Shutdown when discontinuing processing.

V. System Operations and Controls (continued)

E. Disconnecting the Source Container When it is not Empty

NOTE: Use the following procedure if it becomes necessary to disconnect the agent source container from the inlet of the machine before the machine finishes processing in the automatic mode.

1. Depress and release the Stop Button on the front panel.
2. Close the valve of the source container to stop the flow of agent to the machine.

CAUTION: Failure to close the source container valve will result in agent loss and may cause damage to the evacuation compressor of the machine.

3. Close the Manual Inlet Valve of the machine.
4. Observe the temperature display of the Process Temperature Controller and the pressure display of the Pressure Controller.
5. If the temperature is below the alarm #2 set point of the Process Temperature Controller (-60°F for Halon 1301 and FE25, -20°F for Halon 1211 or -10°F for FM200) then complete the following purge procedure otherwise wait for the refrigeration section to cool to the set point before continuing.
6. Place the N2 Valve Switch to the ON position venting from the process tank until the pressure display is at least below 50 PSI. When the pressure is below 50 psi: place the N2 Valve Switch to the AUTO position discontinuing venting.
7. Open the Manual Inlet Valve of the Machine.
8. Place the Inlet Valve Switch to the ON position.
9. Observe the Inlet Pressure Gauge on the front panel. When the pressure is below 100 psi: continue with step-10.
10. Place the Inlet Compressor Switch to the ON position. The vapor compressor will begin to evacuate the remaining vapor from the inlet plumbing connected to the source container.
11. Observe the Inlet Pressure Gauge of the front panel. When the pressure gauge indicates a vacuum level, continue with step-12.
12. Place the Inlet Compressor Switch to the AUTO position.
13. Place the Inlet Valve Switch to the AUTO position.
14. Close the Manual Inlet Valve of the machine.
15. Disconnect the source container from the machine.

A method of capping the source container outlet should be used to guard against loss in the event of shut off valve leakage or failure.

V. System Operations and Controls (continued)

F. Receiving Container Replacement

NOTE: Receiving Container replacement is most easily accomplished just after the machine stops processing automatically and the empty source container is disconnected. If the source container is not empty perform section-V.E: Disconnecting the Source Container When it is not Empty; Before starting this procedure. **Observe the Inlet Pressure Gauge: the gauge must indicate zero pressure or a vacuum condition.**

1. Depress and release the Stop Button on the front panel.
2. Connect the Outlet Evacuation Valve to the Inlet Evacuation Valve using a refrigeration service hose. Both valves remain closed.
3. Connect a vacuum pump to the Manual Inlet Valve of the front panel.
4. Open the Inlet Evacuation Valve.
5. Open the Manual Inlet Valve.
6. Operate the vacuum pump to achieve a vacuum indication on the Inlet Pressure Gauge of the front panel.
7. Close the Manual Inlet Valve.
8. Discontinue vacuum pump operation and disconnect the vacuum pump from the Manual Inlet Valve.
9. Close the receiving container valve.
10. Open the Outlet Evacuation Valve.
11. Place the Inlet Valve Switch to the ON position.
12. Observe the Inlet Pressure Gauge on the front panel. When the pressure is below 100 psi for Halon 1301 and FE25, below 15 psi for Halon 1211 and below 20 psi for FM200: continue with step-13.
13. Place the Inlet Compressor Switch to the ON position. The vapor compressor will begin to evacuate the remaining vapor from the outlet plumbing connected to the receiving container.
14. Observe the Inlet Pressure Gauge of the front panel. When the pressure gauge indicates a vacuum level, continue with step-15.
15. Place the Inlet Compressor Switch to the AUTO position.
16. Place the Inlet Valve Switch to the AUTO position.
17. Close the Inlet Evacuation Valve.
18. Close the Outlet Evacuation Valve.
19. Disconnect the hose installation from the Outlet Evacuation Valve to the Inlet Evacuation Valve.
20. Disconnect the receiving container from the machine.

A method of capping the receiving container ports should be used to guard against loss in the event of shut off valve leakage or failure.

Refer to the installation section-IV.F: Receiver Storage Container to connect a new empty container to the machine.

V. System Operations and Controls (continued)

G. System Shutdown

NOTE: System Shutdown is most easily accomplished just after the machine stops processing automatically and the empty source container is disconnected. If the source container is not empty perform section-V.E: Disconnecting the Source Container When it is not Empty; Before starting this procedure. **Observe the Inlet Pressure Gauge: the gauge must indicate zero pressure or a vacuum condition.**

1. Depress and release the Stop Button on the front panel.
2. Do not close the valve on the receiving container until all the frost is melted from the interconnecting plumbing or wait ½ hour before closing the receiving container valve. This will allow the liquid trapped in the plumbing to vaporize into the head space of the container. Then Close the receiving container valve.

WARNING: DO NOT close the receiving container valve until the plumbing warms. Otherwise cold liquid trapped in the plumbing will quickly expand as it warms and may rupture the outlet plumbing.

WARNING: The following depressurization procedure must be performed whenever the machine is to be powered down to avoid cold liquid from being trapped in a section of the machine plumbing or high pressure in the process tank. The liquid will expand and the pressure will rise as the machine warms and may result in damage to the machine or activation of the process pressure relief valve which will cause loss of AGENT from the process tank.

3. Observe the temperature display of the Process Temperature Controller and the pressure display of the Pressure Controller.
4. If the temperature is below the alarm #2 set point of the Process Temperature Controller(-60°F for Halon 1301 and FE25, -20°F for Halon 1211 or -10°F for FM200) then complete the following purge procedure otherwise wait for the refrigeration section to cool to the set point.

CAUTION: The Manual Inlet Valve of the machine must be in the closed position to prevent air from entering the machine before completing the next step.

5. Place both the N2 Valve Switch and the Inlet Valve Switch to the ON position and vent from the process tank until the pressure display is at least below 50 PSI. When the pressure is below 50 psi place both the N2 Valve Switch and the Inlet Valve Switch to the AUTO position.

CAUTION: Do not manually vent the process tank with the temperature warmer than the alarm #2 setting this will result in excessive AGENT vapor loss.

6. Place the System Power Switch to the OFF position.
7. Install the valve caps back to any open ports of the machine.

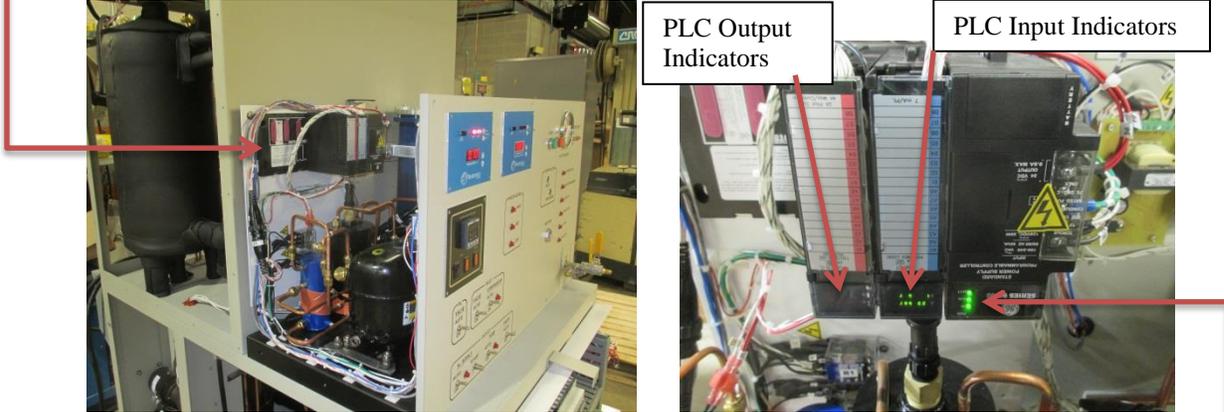
NOTE: To conserve power disconnect main electrical power from the machine.

VI. System Operational Description and Component Review

This section of the manual will detail automatic system operations through each of the internal components of the machine. Refer to the enclosed pneumatic diagram, for component identification and AGENT flow through the machine.

A. PLC unit Status Indicators

The PLC unit coordinates and controls all of the functions of the machine.



The PLC unit has sixteen inputs numbered A1 through A8 and B1 through B8 that are connected to the various sensors of the machine. The inputs correspond to the numbers on the of the PLC status display on the Input Module. The number is illuminated when the corresponding input is activated and off when the input is deactivated.

The PLC unit has sixteen 110 VAC outputs that drive the solenoid valves, control panel lamps, and pumps of the machine. The outputs are numbered A1 through A8 and B1 through B8 and correspond to the status indicator numbers on the Output Module. The number is illuminated when the corresponding output is active and off when the output is deactivated.

The PLC status indicators of the Power Supply Module contains internal PLC information. The PLC will be operating correctly when the “OK” and “RN” indicators are illuminated.

The PLC unit requires no user adjustments. Below is a listing of the input and output connections so that a better understanding of the component level operation of the machine may be gained. The below listing will also aid with trouble shooting in the event of component failure.

INPUT	SOURCE	FUNCTION
A1	TEMPERATURE CONTROLLER ALARM #2 Closes	OK TO VENT
A2	PRESSURE CONTROLLER ALARM #2 Opens	END FINAL VENT
A3	PRESSURE CONTROLLER ALARM #1 Closes	END INTERMEDIATE VENT
A4	START SWITCH Closes	START AUTO MODE
A5	STOP SWITCH Opens	STOP AUTO MODE
A6	VACUUM SWITCH (P2) Opens	SOURCE TANK EMPTY
A7	INLET PRESSURE SWITCH (P1) Closes	INLET VAPOR RECOVERY
A8	PROCESS LIQUID LEVEL SWITCH (L2) Closes	HIGH LIQUID LEVEL
B1	ACCUMULATOR LEVEL SWITCH (L1) Opens	SELF EVACUATION MODE
B2	PROCESS LIQUID LEVEL SWITCH (L2) Closes	LOW LIQUID LEVEL
B3	PUMP START SWITCH Closes	BEGIN PUMP OUT CYCLE
B4	PROCESS LIQUID LEVEL SWITCH (L2) Closes	MID LIQUID LEVEL
B5	PROCESS TANK PRESSURE SWITCH (P3) Opens	STOP INLET / WAIT TO VENT
B6	NOT USED	
B7	COMPRESSOR PRESSURE SWITCH (P5) Opens	STOP & INDICATE ERROR
B8	NOT USED	

VI. System Operational Description and Component Review (continued)

A. PLC unit Status Indicators (continued)

OUTPUT #	COMPONENT
A1	NOT USED
A2	INLET SOLENOID VALVES (SV1, SV1A) & INLET LAMP
A3	PROCESSING LAMP
A4	VENT SOLENOID VALVE (SV3) & N2 VENT LAMP
A5	HIGH LEVEL LAMP
A6	COMPRESSOR INLET SOLENOID VALVE (SV2) & EVACUATION LAMP
A7	LOW LEVEL LAMP
A8	NITROGEN SUPPLY SOLENOID VALVE (SV3) & N2 SUPPLY LAMP
B1	OUTLET PUMPS (LP1)
B2	OUTLET SOLENOID VALVE (SV4) & OUT LAMP
B3	EVACUATION COMPRESSOR (C1) & COMPRESSOR LAMP
B4	MID LEVEL LAMP
B5	NOT USED
B6	NOT USED
B7	NOT USED
B8	NOT USED

B. The Nitrogen Vent Cycle

There are **two nitrogen vent modes**: the **intermediate vent** and the **final vent**.

The Intermediate vent mode is activated when the pressure in the processing tank has been above the pressure controller alarm #1 set point (PLC input #A3 Deactivates) for over five minutes, or if the processing tank pressure reaches 200 psi (PLC input #B5 Deactivates). The PLC discontinues inlet recovery and begins the nitrogen vent process.

When the temperature in the process tank drops below the Temperature Controller #2 alarm setting (PLC input #A1 Activates) the PLC will open the N2 Vent Solenoid Valve venting nitrogen.

The intermediate vent cycle will end when the pressure in the process tank falls below the pressure controller alarm #1 set point (PLC input #A3 Activates). The PLC will close the vent solenoid valve.

The final vent mode is activated when the liquid level in the process tank reaches mid-level (PLC input #B4 Activates), or the inlet vacuum switch indicates that the source container is at (-10") Hg vacuum (PLC input #A6 Deactivates). The PLC discontinues inlet recovery and begins the nitrogen vent process. The final vent will complete the nitrogen separation process for the quantity of AGENT contained in the process tank.

When the temperature in the process tank drops below the Temperature Controller #2 alarm setting (PLC input #A1 Activates) the PLC will open the N2 Vent Solenoid Valve venting nitrogen to the ambient air.

The final vent cycle will end when the pressure in the process tank drops below the pressure controller alarm #2 set point (PLC input #A2 Deactivates). A pump out to the receiving container will follow a final vent if the liquid in the process tank is above low-level (PLC input #B2 activates).

VI. System Operational Description and Component Review (continued)

C. Inlet Recovery Component Review

The user will connect an AGENT storage receiving container to the outlet valve and nitrogen to the Nitrogen Supply port of the machine as instructed by the installation section of this manual.

During recovery, the user will connect a source container of AGENT and open the manual ball valve MV-1. AGENT will enter the machine past the inlet pressure gauge G1 and the inlet pressure switch P1 through the inlet particulate filter F1 to reach the inlet pressure regulator R1. The pressure regulator will reduce the AGENT pressure to permit passage of flow past the inlet vacuum switch P2 and up to the inlet solenoid valve SV-1. The user will then press the start push button on the front panel (PLC input #A4 Activates). The inlet solenoid valves SV-1 and SV-1A will open (PLC output #A2 Activates). The passage of AGENT through the remainder of the recovery component group will depend upon the inlet pressure switch P1. Refer to section-V.C: Inlet Pressure Switch Description and Adjustment. At inlet pressures above the set point of the switch (PLC input A7 Deactivates) the AGENT flow will continue through check valve CV-1 and into the filtration components. When the inlet pressure decays to below the set point of the inlet pressure switch (PLC input #A7 Activates) the compressor inlet solenoid valve SV-2 will open and the evacuation compressor C1 will operate (PLC outputs #A6 and #B3 Activate).

AGENT vapor will pass through solenoid valve SV-2, through the compressor inlet vapor check valve CV-2 and into the accumulator tank. The accumulator tank will protect the vapor compressor from liquid slugging via the liquid level switch L1. The hermetically sealed vapor compressor will provide the vacuum and motive force for the AGENT vapor recovery and transfer. From the vapor compressor the flow continues through an oil return separator F2 that removes entrained oil from the AGENT returning it back to the compressor. After oil separation the vapor will pass through the vapor compressor discharge check valve CV-3 and onto the filtration components.

If L1 senses that the accumulator tank is receiving liquid flow, PLC input #B1 is deactivated, and the compressor inlet solenoid valve SV-2 will close. The compressor will continue to operate, without receiving flow from the AGENT source, until the liquid present in the accumulator tank has been vaporized and passed through to the filtration component section. During this self-evacuation flow of AGENT, from the source container, may continue to the filtration section through SV-1 and CV-1.

D. Filtration Component Review

The AGENT liquid or vapor from the recovery section will pass an emergency relief valve PV-3 (provides recovery and filtration section over pressure protection at 450 psi) through a maintenance manual ball valve MV-2 and into the acid filter F3 where acid contaminants will be neutralized out of the AGENT flow. Flow will continue out of the acid filter, past a maintenance access valve AV-4 and into the moisture filter F4, where moisture contamination will be removed. Flow will then continue into the processed particulate filter F5 for final particulate removal and through a sight glass moisture indicator S1. The AGENT will then flow through a second maintenance manual ball valve MV-3 and into the separation components for nitrogen and non-condensable gas separation.

VI. System Operational Description and Component Review (continued)

E. Nitrogen Separation Component Review

The separation components will remove nitrogen in solution from the recovered AGENT as well as control the overall operation of the equipment in terms of recovery and pump out modes. AGENT from the filtration components will flow past a maintenance access valve AV-1 and into a plate heat exchanger for pre-cooling. The pre-cooled AGENT will pass through the process tank inlet solenoid valve SV-1A through the process tank manual maintenance ball valve MV-5 through the process tank inlet check valve CV-4 and then enter the process tank. The AGENT will now be held in the process tank for final cooling and nitrogen separation. The nitrogen will come out of solution as the liquid in the process tank cools to lower temperature ranges. Cooling in the process tank is accomplished by an internal coil connected to the cascading refrigeration system.

NOTE: The coolant for the plate heat exchanger and the process tank coil is provided by the cascading refrigeration section. Details of the cascading system are provided by the PP Series Temperature Chamber Operation, and Maintenance Manual attached following this document.

The conditions in the process tank are monitored by the three position liquid level switch L2, the temperature probe T1 that is connected to the front panel process temperature controller, pressure switch P3 and pressure transducer P4 that is connected to the front panel pressure controller. All of these sensors will communicate with the system PLC to accomplish final nitrogen separation refer to section VI.B: The Nitrogen Vent Cycle, for a complete description of the separation process.

When conditions are correct the machine will begin a nitrogen venting process. This will allow nitrogen gas to be released from the process tank reducing the pressure and solubility of the nitrogen in the AGENT.

The sequence will begin with the opening of the nitrogen vent solenoid valve SV-3 (PLC output #A4 Activates). The nitrogen will travel past the emergency pressure relief valve PV-1 (provides process tank over pressure protection at 300 psi) the pressure switch P3, the pressure transducer P4, through the solenoid valve SV-3, through the nitrogen vent check valve CV-5, and out of the nitrogen vent port. The nitrogen will continue to flow until the venting sequence is complete or changes in conditions occur to those not suitable for venting.

The AGENT remaining in the process tank has now been cleansed of moisture, acids, particulates, oils and nitrogen and is ready for pump out.

VI. System Operational Description and Component Review (continued)

F. Pump Out Component Review

After completion of the nitrogen vent cycle, the PLC will verify that conditions in the process tank are ideal for a pump out sequence. Should conditions not be ideal the machine may initiate additional cooling and vent cycles or additional inlet recovery operations. The pump out sequence will not commence until the liquid level in the process tank has risen to the mid-level of the liquid level switch (PLC input #B4 Activates). Or the source container has been evacuated to a (-10") Hg vacuum level (PLC input #A6 Deactivates) with at least a low liquid level indication in the process tank (PLC input #B2 Activates), and in either case, a successful final nitrogen venting sequence has been accomplished.

Once the pump out sequence has been initiated the Nitrogen Supply solenoid valve SV-5 will open (PLC output #A8 Activates). Nitrogen will travel through the manual ball valve MV-7 and past the emergency pressure relief valve PV-2 (provides overpressure protection of the Nitrogen Supply components to 300 psi). The flow will continue through the nitrogen pressure regulator R2 past the regulator pressure gauge G2, through the SV-5 solenoid valve and CV-7 check valve, and into the vapor space of the processing tank.

After the pressure in the process tank increases to above the Pressure Controller alarm #1 set point (PLC input #A3 Deactivates) the outlet solenoid valve SV-4 (PLC output #B2 Activates) will open and the outlet liquid pumps LP1 and LP2 will operate (PLC output #B1 Activates). Liquid AGENT will flow from the process tank through the manual maintenance ball valve MV-4, through the liquid pump particulate filter F6, and into the inlet port of the LP1 liquid pump. The pump will boost the liquid from the pump outlet into LP2 liquid pump. The AGENT will travel past maintenance access valve AV-5, through the outlet solenoid valve SV-4 and outlet check valve CV-6, and out the outlet port. The flow will continue through the user connection plumbing and into the valve of the receiving container.

The pump out sequence will end when the liquid level in the process tank drops below and stays below the low liquid level sensor in the process tank for eight seconds (PLC input #A7 Deactivates). If the process tank is below low liquid level, and the source container is at a (-10") vacuum level, the machine will stop processing and deactivate the front panel processing lamp. If the source container is not evacuated, the machine will automatically begin inlet recovery operations again with the processing lamp illuminated.

In the event that the user is manually pumping AGENT out of the machine using the front panel toggle switches: never pump out for more than 10 seconds after the low level indicator of the process tank goes out. Enough AGENT must always remain in the process tank to provide thermal contact for the temperature sensors and internal cooling coils of the tank.

VII. System Maintenance Procedures

This section of the manual will detail routine maintenance and calibrations to keep the machine working at peak efficiency levels.

A. Recommended On-Hand Spare Parts Listing

Qty.	Description	Neutronics Part Number
10	Moisture Filter Core	A4-05-2100-00-0
5	Acid Filter Core	A4-05-2100-01-0
10	Filter Shell Gasket	4-04-7000-12-0
2	Particulate Filter Element	A4-05-2500-00-1
2	Particulate Filter O-Ring	A4-04-7060-00-0
2	Particulate Filter Backup Ring	A4-04-7060-00-1
2	Solenoid Valve Rebuild Kit	A4-04-0530-00-0
3	Access Valve Cap	4-04-5000-01-0
2	Access Valve Core	4-04-0000-01-0
1	¼" Check Valve	A4-04-5530-01-0
1	3/8" Check Valve	A4-04-5540-02-0

B. Recommended Maintenance Schedule

Figure-7 depicts a recommended maintenance schedule for the user to perform to provide trouble free operation. The user shall tailor the schedule to best meet the specific application.

MAINTENANCE TASK	EACH USE	AFTER 2000 lb Processed	AFTER 10000 lb Processed	AFTER 20000 lb Processed	EACH MONTH	EACH YEAR	Manual Section
Inspect Moisture Indicator	*						C
Inspect Particulate Indicators	*						D
Inspect Cooling System Pressures	*						E
Inspect Vapor Compressor Oil	*						F
Clean Condenser Coil	*						G
Replace Moisture Filter/Drier Core		*					H
Replace Acid Filter/Drier Core		*					H
Replace Inlet Particulate Filter Element			*				I
Perform Heat Exchanger Evacuation			*				J
Perform Complete System Evacuation				*			K
Leak Check System Plumbing					*		L
Calibrate Pressure Controller						*	M
Calibrate Inlet Vacuum Switch					*		Q
Change Vapor Compressor Oil						*	Q
Replace Processed Particulate Filter Element						*	H
Calibrate Process Temperature Controller						*	N

Figure 7
Recommended Maintenance Schedule

NOTE: Details of the cascading system recommended maintenance are provided by the PP Series Temperature Chamber Operation, and Maintenance Manual attached following this document.

VII. System Maintenance Procedures (continued)

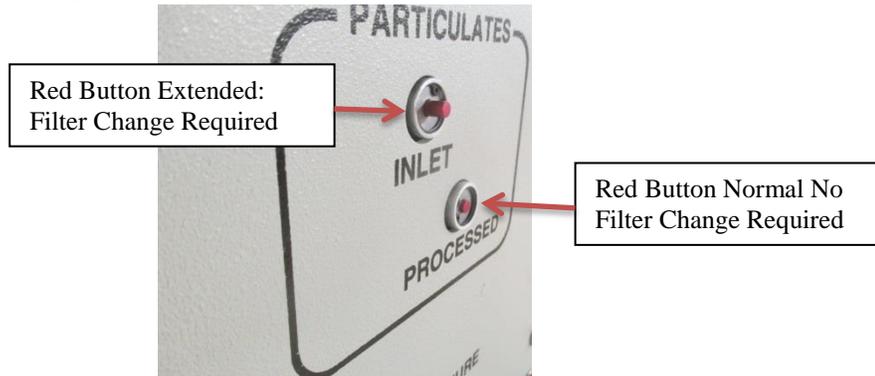
C. Moisture Filter Inspection

View the moisture indicator sight glass located on the front panel of the machine when liquid AGENT is passing through the sight glass and the color-indicating dot is immersed in the liquid. If the color indication of the dot ranges between the “wet” and “caution” colors printed on the sight glass: replace the acid and moisture filter cores per section-H. This may also indicate that the AGENT currently being processed is heavily contaminated with water and that a complete system evacuation needs to be performed per section-K. If the AGENT contains over 100 PPM of water contaminate: the Agent should be dried using external banks of filter drier cores before continuing processing.



D. Particulate Filter Indicator Inspection

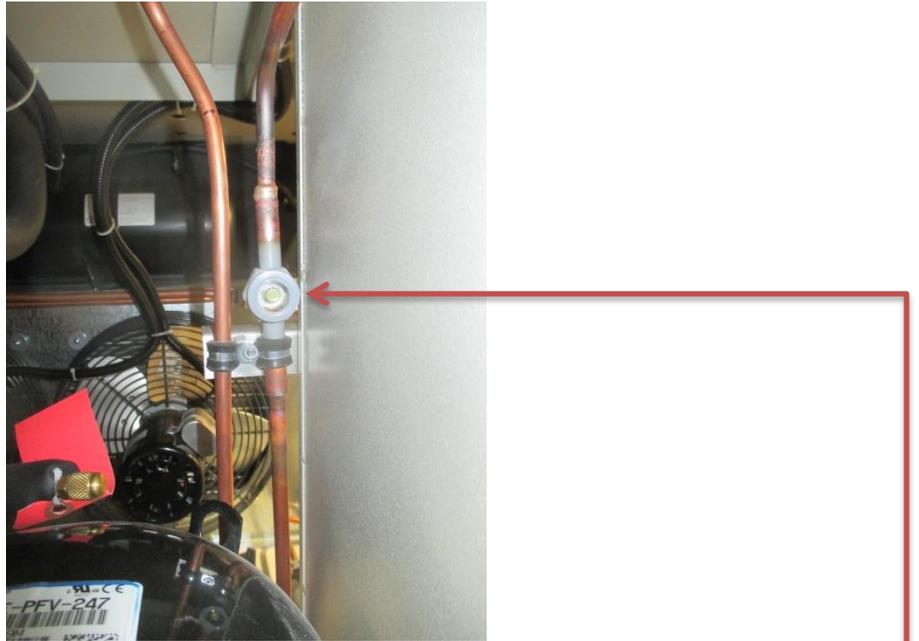
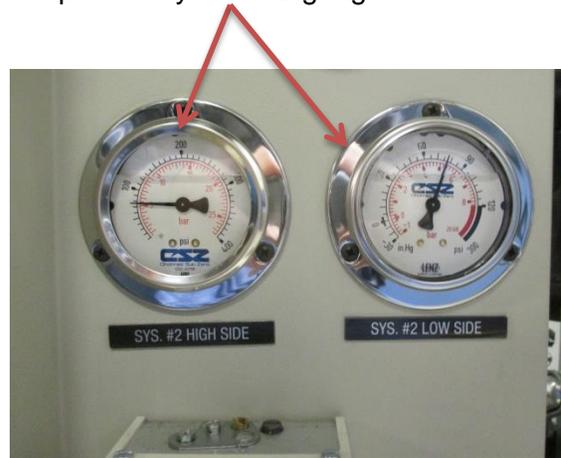
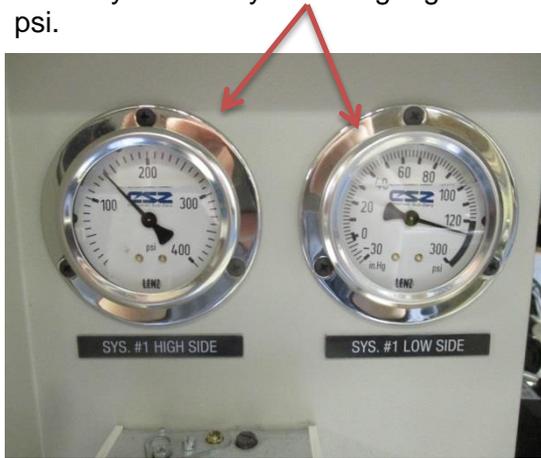
View the red button on the inlet and processed particulate filters visible on the front panel of the machine while the machine is processing AGENT. If the red button projects out of the filter: push the button back in using your finger. If the button pops back out again the filter element for that filter may need to be replaced per section-I for the inlet filter and section-H for the processed filter. The inlet particulate filter will capture almost all of the incoming particulates and will need replacement much more often than the processed particulate filter element.



VII. System Maintenance Procedures (continued)

E. Cooling System Pressures Inspection

A loss in cooling system refrigerant charge will increase the amount of time it takes for the machine to cool the AGENT to processing temperatures and may damage the compressors of the refrigeration system. View the system #1 and system #2 high and low side pressure gauges on the rear of the machine after the machine has remained idle for 12 hours and the high and low side readings have equalized. A cascade refrigeration specialist should be called in to inspect the system for leaks and add charge as required to the systems if system #1 gauges fall below 130 psi and system #2 gauges fall below 65 psi.

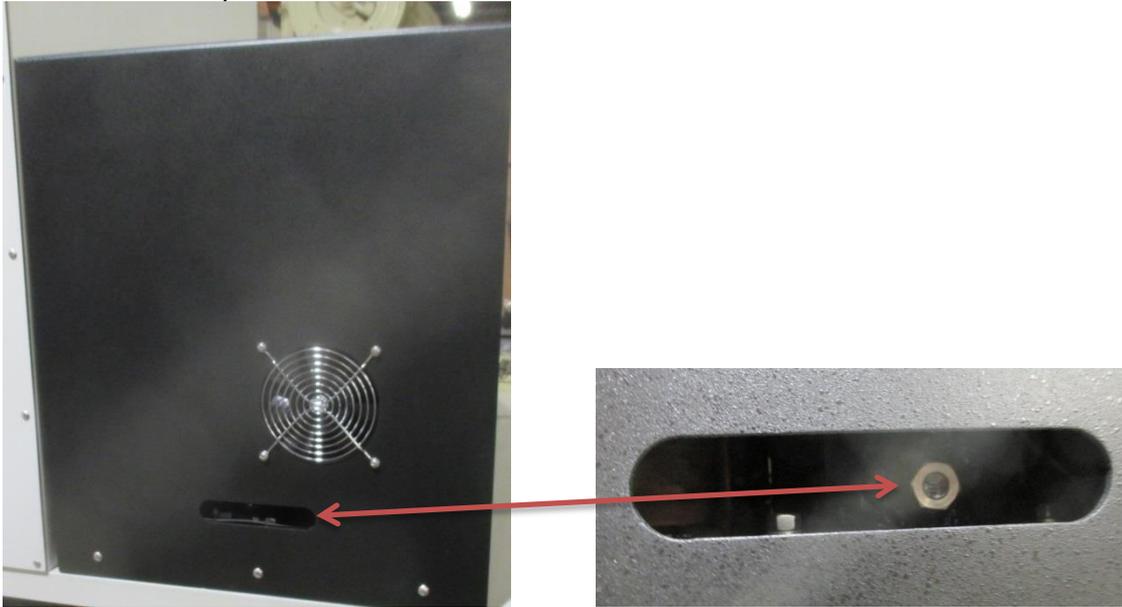


Additionally system #1 will be fully charged when system #1 sight glass is completely liquid full when system #1 compressor is operating. View the sight glass as the compressor starts: a few bubbles should be visible at first and then dissipate into solid liquid as the compressor runs. The sight glass is visible through the rear of the machine.

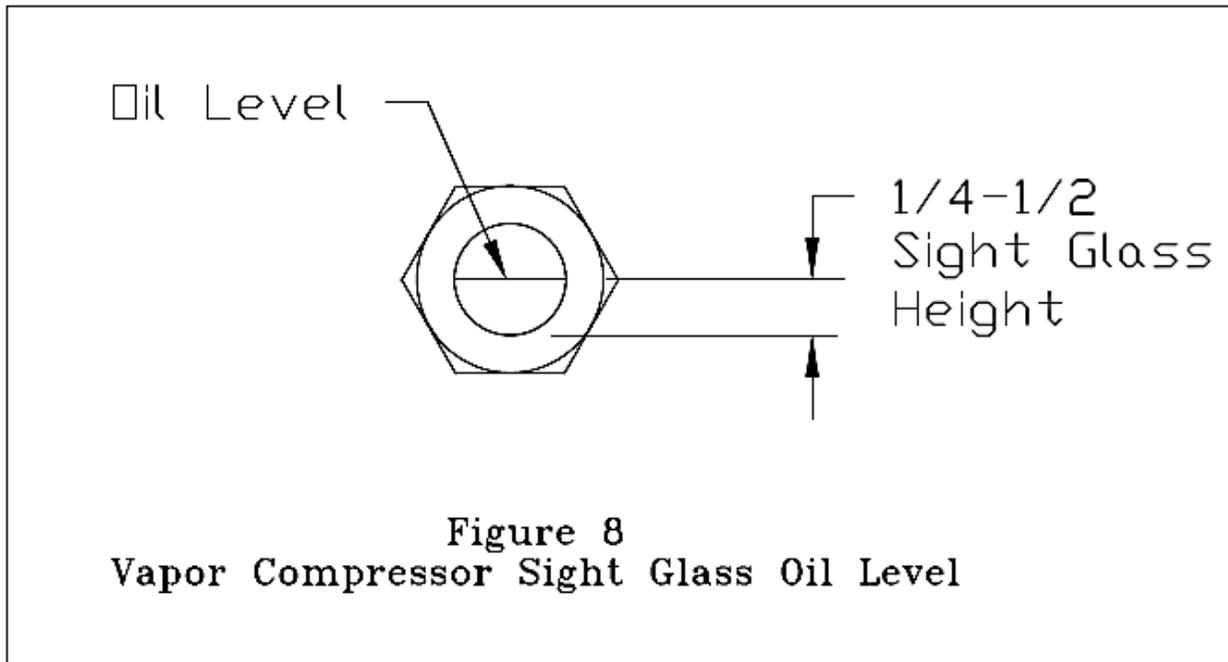
VII. System Maintenance Procedures (continued)

F. Compressor Oil Maintenance

The vapor compressor is a hermetically sealed reciprocating compressor that must contain the proper oil charge for operation. The machine is equipped with a filter that will capture entrained oil and return the oil back to the compressor housing so that the compressor will not lose excessive amounts of oil during operation. Figure-8 will depict the correct oil fill level as viewed through the oil level sight glass on the compressor. The sight glass may be viewed using an inspection light through the large slot on the bottom-left side of the control panel black hood.



The oil level is correct when the sight glass is from 1/4 to 1/2 full.



**Figure 8
Vapor Compressor Sight Glass Oil Level**

VII. System Maintenance Procedures (continued)

F. Compressor Oil Maintenance (continued)

To Add Oil to the Compressor

Required Materials:

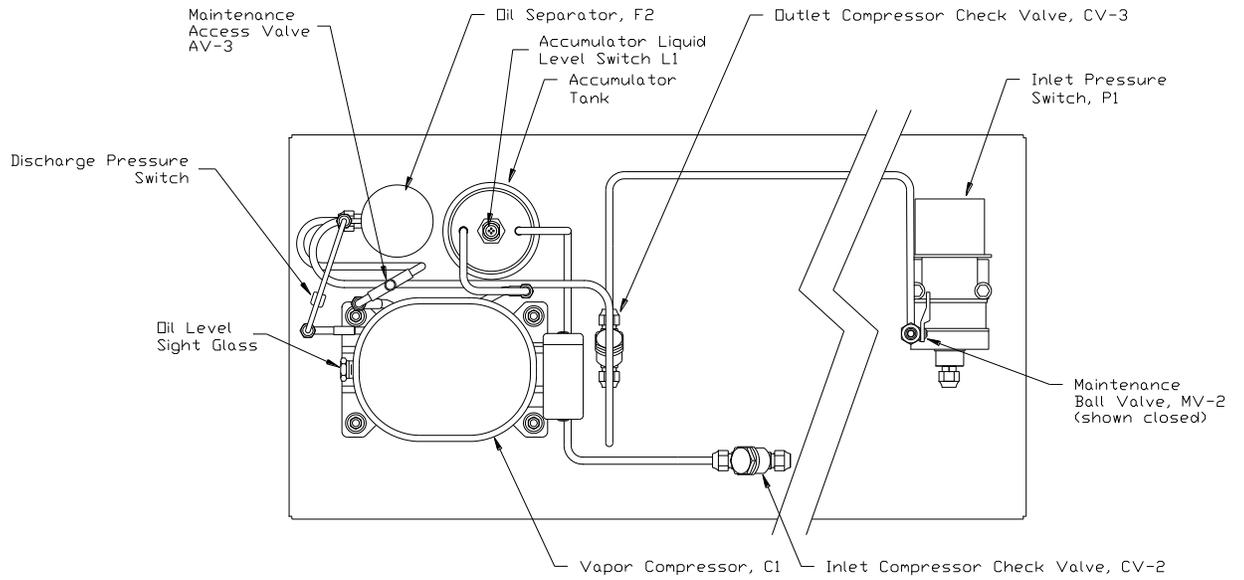
- ◆ Compressor Refrigeration Mineral Oil 3GS Grade-150 (Do not use synthetic oils use mineral oil only)
 - ◆ Cut a ¼” refrigeration service hose to form a hose with one fitting end containing a Schrader valve core depressor and the opposite end of the hose is the open cut end
 - ◆ Straight Blade Screwdriver
 - ◆ Clean 8 ounce container
1. Place approximately 8 ounces of compressor refrigeration mineral oil 3GS, Grade-150 into a container.
 2. Place the front panel power switch to the on position.
 3. Verify that the manual inlet ball valve on the front panel of the machine is in the closed position and is capped with an access valve cap.
 4. Place the inlet compressor and inlet valve switch to the on positions. Allow the compressor to operate until a vacuum condition is indicated by the inlet pressure gauge on the front panel.
 5. Place the inlet compressor and inlet valve switch to the AUTO positions. Place the front panel power switch to the off position.
 6. Disconnect the main electrical power from the machine.
 7. Open the filter access door of the hood and separate the two halves of the hood fan J5 electrical connector.
 8. Remove the three screws along the top of the control panel and the three screws on both sides of the control panel hood. With a helper, lift the hood up and over the control panel.
 9. Place the open cut end of the modified hose so that it is under the surface of the oil.
 10. Remove the valve cap from the compressor oil maintenance access valve AV-3 refer to figure-9 (next page) for the location of the valve.
 11. Connect the fitting service end of the modified hose containing the core depressor onto the AV-3 access valve. The vacuum in the compressor housing will immediately begin to draw oil from the container through the hose.
 12. View the compressor oil sight glass and disconnect the hose from the AV-3 access valve when the oil level is from 1/4 to 1/2 full on the sight glass.

CAUTION: Do Not Overfill the compressor with oil.

13. Reinstall the valve cap back to the AV-3 access valve.
14. Reinstall the hood and connect the hood fan electrical connector. Reconnect the main electrical power back to the machine.

VII. System Maintenance Procedures

F. Compressor Oil Maintenance (continued)



Note:

1. Components removed for clarity.
2. View is looking down on machine with black hood located behind front panel removed.

Figure 9
Vapor Compressor Component Identification



Alternately:

An Oil Fill Syringe is available from Neutronics: part number 6-02-6001-51-0. The Syringe connects directly to the AV-3 access valve. The Syringe holds the oil and fills through a manual on/off valve: eliminating the need for filling through a refrigeration service hose.

VII. System Maintenance Procedures (continued)

G. Condenser Coil Cleaning

To insure optimum cooling efficiency the condenser coil of the refrigeration system should be kept clean. Initial cleaning should be performed before each use to gain perspective on the cleaning period required for the ambient conditions of the machine location. A cleaner environment will require less frequent cleaning of the condenser coil. When the condenser coil becomes restricted with dust, the machine will take longer to reach the cooling set point, and the cascade system #1 will operate at increased high side pressures. A badly soiled condenser will cause system #1 to shut down from over pressure conditions. During operation the high side pressure gauge should never increase to above 300 psi as indicated by the high side pressure gauge located on the rear of the machine.

Cleaning Procedure

Required Materials:

- ◆ Source of Compressed air With nozzle
- ◆ Soft Brush
- ◆ Vacuum Cleaner
- ◆ Straight Blade Screwdriver

1. Disconnect the main electrical power from the machine.
2. Remove the lower-front panel located directly below the front control panel by loosening the one captive screw at the top-center of the panel.



The condenser coil is directly below the main wire box of the machine.

3. Remove either one of the lower side panels of the machine by loosening the four captive screws on each corner of the panel.
4. Use compressed air to blow through the condenser coil from the interior of the machine out the front of the machine.
5. Use a soft brush and a vacuum cleaner to remove dust from the front of the condenser under the main wire box of the machine.
6. Install the side panel and front panel back into position.
7. Reconnect main electrical power back to the machine.

VII. System Maintenance Procedures (continued)

H. Moisture, Acid, and Processed Particulate Filter Element Replacement

Figures 10 and 11 will detail the location and replacement of the moisture, acid, and processed particulate filter elements. The moisture and acid filter/drier cores should be replaced after every 2000 pounds of AGENT processed or whenever the moisture indicator of the front panel does not indicate a violet color. The processed particulate filter element should be replaced at yearly intervals due to the low influx of particulate contamination at this point in the machine. The processed particulate filter element will require early replacement if the red indicating button of the filter is extended out past the indicator ring. The moisture and acid filters cores must be replaced if the processed particulate filter element is serviced.

CAUTION: ALWAYS replace both the moisture and acid filter/drier cores together. The indication of required maintenance applies to both the moisture and acid filters.

Replacement Procedure

Required Materials:

- ◆ Vacuum Pump
- ◆ Clean Dry Nitrogen Gas
- ◆ Cloth Rags
- ◆ Vacuum Gauge
- ◆ Pressure Gauge
- ◆ ¼" Refrigeration Service Hoses
- ◆ Straight Blade Screwdriver
- ◆ ½" Socket Torque Wrench 20 to 100 inch pound indicator
- ◆ Leak Detector Fluid

NOTE: Filter replacement is most easily accomplished just after the machine stops processing automatically and the empty source container is disconnected. If the source container is not empty perform section-V.E: Disconnecting the Source Container When it is not empty; before starting this procedure.

1. Depress and release the Stop Button on the front panel.
2. Verify that the Manual Inlet Valve (MV-1), and the Inlet Evacuation Valve (MV-8) are closed.
3. Connect nitrogen gas regulated from 140 to 250 psi to the Manual Inlet Valve (MV-1). The nitrogen supply to the machine can be used in place of a second source of nitrogen gas. This can be accomplished by connecting the Nitrogen Supply Evacuation Valve (MV-6) to the Manual Inlet Valve (MV-1) with a refrigeration service hose.



VII. System Maintenance Procedures

H. Moisture, Acid, and Processed Particulate Filter Element Replacement (continued)

4. Open the nitrogen source (MV-6) to the machine.
5. Loosen the hose connection at the Manual Inlet Valve to purge air from the hose connection then retighten the hose to seal.
6. Open the Manual Inlet Valve MV-1.
7. Place the Inlet Valve Switch to the On position allowing nitrogen to flow into the machine. This will purge any remaining agent trapped in the inlet and filter sections of the machine into the process tank.
8. Observe the Pressure Controller. Allow the pressure to increase from the incoming nitrogen from 50 to 100 psi display. Then continue with step-9.
9. Close the nitrogen source valve (MV-6).
10. Crack open the Inlet Evacuation Valve (MV-8) to depressurize the hose connections.
11. When the front panel Pressure Gauge indicates zero pressure: Close the Inlet Evacuation Valve MV-8.
12. Close the Manual Inlet Valve MV-1.
13. Remove the hose connection from the Nitrogen Supply Evacuation Valve MV-6 to the Manual Inlet Valve MV-1.
14. Observe the temperature display of the Process Temperature Controller and the pressure display of the Pressure Controller.
15. If the temperature is below the alarm #2 set point of the Process Temperature Controller (-60°F for Halon 1301 and FE25, -20°F for Halon 1211 and -10°F for FM200): continue with step-16 otherwise, wait for the refrigeration section to cool to the set point, before continuing.
16. Place the N2 Valve Switch to the ON position venting from the process tank until the pressure display is at least below 25 PSI.
17. When the pressure is below 25 psi: place the N2 Valve Switch to the AUTO position discontinuing venting.
18. Place the Inlet Valve Switch to the AUTO position.
19. Place the machine System Power Switch to the Off position.
20. Disconnect main electrical power from the machine.
21. Open the filter maintenance access door on the top-right corner of the control panel black hood.
22. Locate the two filter maintenance manual ball valves MV-2 and MV-3 and close both valves. The valves will be closed when the handle of the valve is at a 90° angle with the body of the valve. Refer to figure-11 for component locations.
23. Remove the cap from the filter maintenance access valve AV-4. Set the cap aside for reinstallation.
24. Depress the valve core of the AV-4 access valve to release the residual nitrogen pressure from the filter shells this will ease the removal of the filter caps.
25. Remove the aluminum housing of the processed particulate filter by rotating it counterclockwise and pulling it straight away from the filter head.
26. Clean the interior of the filter housing and head using a soft brush or cloth.
27. Remove the filter element by pulling it straight away from the filter head.
28. Install a new filter element; part number A4-05-2500-00-1, as depicted by figure-10.
29. Verify the integrity of the filter head O-ring and backup ring seals. Replace the seals as required using O-ring, A4-04-7060-00-0, and backup ring, A4-04-7060-00-1.

VII. System Maintenance Procedures

H. Moisture, Acid, and Processed Particulate Filter Element Replacement (continued)

30. Install the aluminum housing onto the filter head and over the filter element by threading in a clockwise rotation.
31. Remove the bolts from the top cover of the moisture filter and acid filter using the ½” socket wrench. Remove the top covers from the filter housings.
32. Remove the sealing gasket from each top cover. Do not scratch or mar the seal glands of the top covers.
33. Lift the spent filter/drier cores from the housing of each filter.
34. Install two new moisture filter cores part number, A4-04-2100-00-0, into the moisture filter housing as depicted by figure-10.
35. Install a new acid filter core part number, A4-04-2100-01-0, into the acid filter housing as depicted by figure-10.
36. Install new sealing gaskets part number, 4-04-7000-12-0, or use the gaskets supplied with the filter cores, to the glands of both top covers.
37. Position the top covers onto the filter housings and secure into position using the bolts previously removed. Initially tighten the bolts to 40-inch pounds. Retighten all bolts to verify an even torque on each bolt. Retighten all the bolts in 20-inch pounds increments to achieve an evenly distributed 100-inch pounds of torque on each bolt.

CAUTION: Do not allow the filter/drier cores to remain exposed to the ambient air. Install the cores immediately after opening the sealed containers. The cores will absorb moisture from the air reducing the water removal capacity of the filters.

38. Connect a source of clean dry nitrogen, regulated from 200 to 250 psi, to the filter maintenance access valve AV-4 pressurizing the filter section.
39. Leak test the processed particulate filter housing to filter head seal using leak detector fluid.
40. Leak test the moisture filter and acid filter top covers using the leak detector fluid.

NOTE: Leaks in the moisture and acid filter top cover seals usually can be stopped by tightening the retaining bolts. Leaks in the processed particulate filter may require new O-ring or backup ring installation.

41. Close and disconnect the nitrogen source from the AV-4 access valve.
42. Depress the core of the AV-4 access valve to release the nitrogen pressure from the filter housings.
43. Connect a vacuum pump and vacuum gauge to the AV-4 access valve. Operate the pump to evacuate the filter housings to a 1000-micron minimum vacuum level.
44. Remove the vacuum pump and vacuum gauge from the AV-4 access valve.
45. Adjust the pressure of the nitrogen source to provide low pressures between 5 and 10 psi.
46. Connect the low-pressure nitrogen source to the AV-4 access valve and pressurize the filter section from 5 to 10 psi.
47. Close and remove the nitrogen source from the AV-4 access valve and install the cap back to the access valve.
48. Open the two maintenance ball valves MV-2 and MV-3 previously closed.
49. Close and secure the filter maintenance access door of the control panel black hood.
50. Reconnect the main electrical power back to the machine.

VII. System Maintenance Procedures

H. Moisture, Acid, and Processed Particulate Filter Element Replacement (continued)

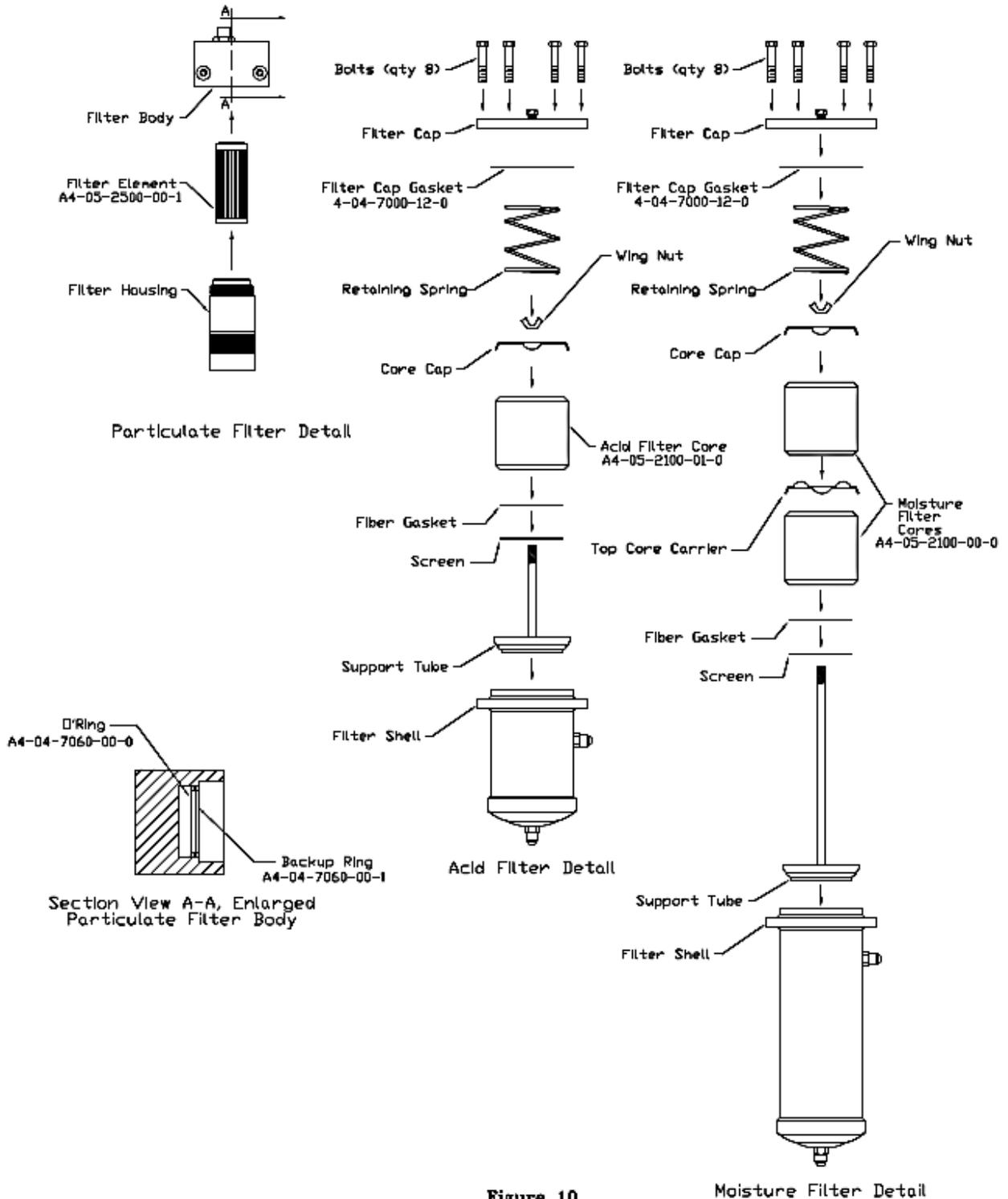
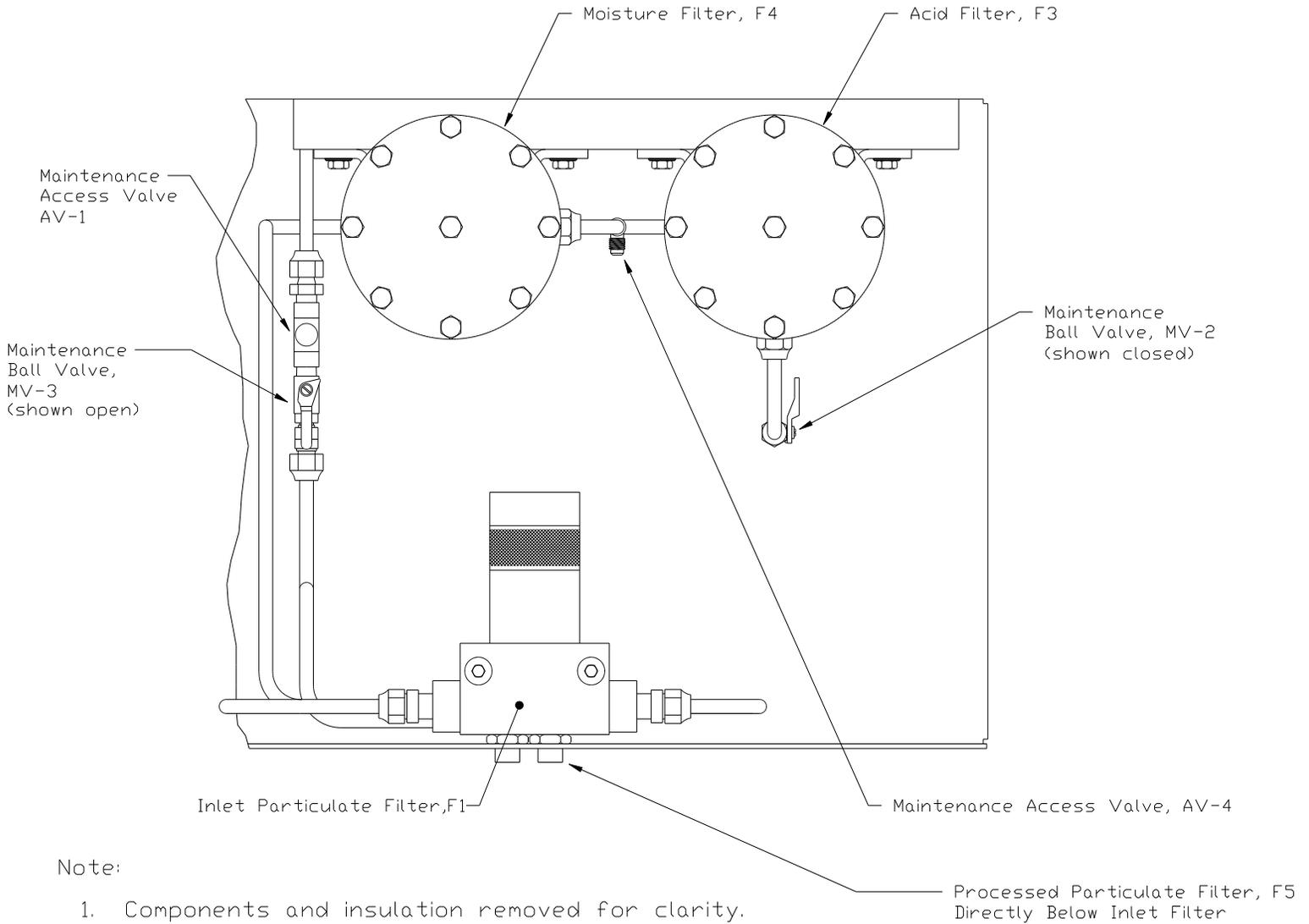


Figure 10
Exploded Filter Details



Note:

1. Components and insulation removed for clarity.
2. View is down through top of machine with black hood located behind front control panel removed.

Figure 11
Filtration Components Identification

VII. System Maintenance Procedures (continued)

I. Inlet Particulate Filter Element Replacement

NOTE: Filter replacement is most easily accomplished just after the machine stops processing automatically and the empty source container is disconnected. If the source container is not empty perform section-V.E: Disconnecting the Source Container When it is not empty; before starting this procedure.

Figures 10 and 11 will detail the location and replacement of the inlet particulate filter element. The inlet particulate filter element should be replaced after every 10000 pounds of AGENT processed. The inlet particulate filter element will require early replacement if the red indicating button of the filter is extended out past the indicator ring.

Replacement Procedure

Required Materials:

- ◆ Vacuum Pump
- ◆ Clean Dry Nitrogen Gas
- ◆ Cloth Rags
- ◆ Vacuum Gauge
- ◆ Pressure Gauge
- ◆ ¼" Refrigeration Service Hoses
- ◆ Leak Detector Fluid

1. Verify the Manual Inlet and Inlet Evacuation Valves are Closed.
2. Place the front panel System Power Switch to the On position.
3. Place the front panel Inlet Valve Switch to the On position.
4. Place the front panel Inlet Compressor Switch to the On position.
5. Wait for the front panel Pressure Gauge to indicate a vacuum condition.
6. Place the front panel Inlet Compressor Switch to the AUTO position.
7. Place the front panel Inlet Valve Switch to the AUTO position.
8. Place the machine System Power Switch to the Off position.
9. Disconnect main electrical power from the machine.
10. Open the filter maintenance access door on the top-right corner of the front control panel black hood.
11. Locate the filter maintenance manual ball valve MV-2 and close the valve. The valve will be closed when the handle of the valve is at a 90° angle with the body of the valve. Refer to figure-11 for component locations.
12. Open and then Close the Manual Inlet Valve to release the vacuum.
13. Remove the aluminum housing of the inlet particulate filter by rotating it counterclockwise and pulling it straight away from the filter head.
14. Clean the interior of the filter housing and head using a soft brush or cloth.
15. Remove the filter element by pulling it straight away from the filter head.
16. Install a new filter element; part number A4-05-2500-00-1, as depicted by figure-10.
17. Verify the integrity of the filter head O-ring and backup ring seals. Replace the seals as required using O-ring, A4-04-7060-00-0, and backup ring, A4-04-7060-00-1.
18. Install the aluminum housing onto the filter head and over the filter element by threading in a clockwise rotation.
19. Remove the cap from the inlet valve of the machine and connect a source of clean dry nitrogen, regulated from 200 to 250 psi, to the Manual Inlet Valve. The nitrogen supply to the machine may be used see section-VII.H.
20. Open the Manual Inlet Valve to pressurize the inlet components with the nitrogen.

VII. System Maintenance Procedures

I. Inlet Particulate Filter Element Replacement (continued)

21. Leak test the inlet particulate filter housing to filter head seal using leak detector fluid.

NOTE: Leaks in the inlet particulate filter may require new O-ring or backup ring installation.

22. Close the nitrogen source.

23. Open then Close the Inlet Evacuation Valve MV-8 to release the nitrogen pressure from the hose connection and the inlet section of the machine. Remove the nitrogen connections from the machine.

24. Verify 0-psi indication on the front panel Inlet Pressure Gauge.

25. Close the Manual Inlet Valve MV-1.

26. Connect a vacuum pump and vacuum gauge to the Manual Inlet valve MV-1 or the Inlet Evacuation Valve MV-8 of the machine. With the valve in the open position, operate the pump to evacuate the inlet section of the machine to a 2500-micron minimum vacuum level.

27. Close the Inlet valve of the machine. Discontinue evacuation and remove the vacuum pump and vacuum gauge from the machine.

28. Open the Filter Maintenance Valve MV-2 previously closed.

29. Close and secure the filter maintenance access door of the control panel black hood.

30. Reconnect the main electrical power back to the machine.

VII. System Maintenance Procedures (continued)

J. Heat Exchanger Evacuation

The heat exchanger evacuation should be performed after every 10000 pounds of processed AGENT to reduce moisture and ice formation internal to the machine. The evacuation procedure will also need to be performed if the front panel displays the vapor compressor discharge high-pressure error. The error is indicated when the machine stops processing with the front panel processing lamp the mid-level and the high level lamps all flashing off and on.

NOTE: Evacuation is most easily accomplished just after the machine stops processing automatically and the empty source container is disconnected. If the source container is not empty perform section-V.E: Disconnecting the Source Container When it is not empty; before starting this procedure.

Evacuation Procedure

Required Materials:

- ◆ Vacuum Pump
- ◆ Vacuum Gauge
- ◆ ¼" Refrigeration Service Hoses
- ◆ #2 Phillips Drive Screwdriver

1. Complete steps #1 through #20 of section-H: Moisture Acid and Processed Particulate Filter Element Replacement of this manual. This will purge any agent vapor in the inlet and filter sections of the machine into the process tank.
2. Disconnect main electrical power from the machine. Allow the machine to warm to room temperature.
3. Remove the upper rear panel from the machine.
4. Reference figure-12 to locate the process tank manual inlet valve MV-5. Close manual valve MV-5. The valve will be closed when the valve handle is at a 90° angle to the valve body.
5. Open the filter maintenance access door on the top-right corner of the control panel black hood.
6. Locate the filter maintenance manual ball valve MV-3 and close the valve. The valve will be closed when the handle of the valve is at a 90° angle with the body of the valve. Refer to figure-11 for component locations.
7. Locate and remove the valve cap from access valve AV-1 located next to manual valve MV-3. Set the cap aside for reinstallation.
8. Depress the valve core of the AV-1 access valve to release any residual nitrogen pressure.
9. Connect a vacuum pump and vacuum gauge to the AV-1 access valve. Operate the pump to evacuate the heat exchanger to a 1000-micron minimum vacuum level.
10. Remove the vacuum pump and vacuum gauge from the AV-1 access valve.

VII. System Maintenance Procedures

J. Heat Exchanger Evacuation (continued)

11. Install the cap back to the AV-1 access valve.
12. Open the two maintenance ball valves MV-3 and MV-5 previously closed.
13. Close and secure the filter maintenance access door of the control panel black hood.
14. Install the rear panel back into position.
15. Reconnect the main electrical power back to the machine.

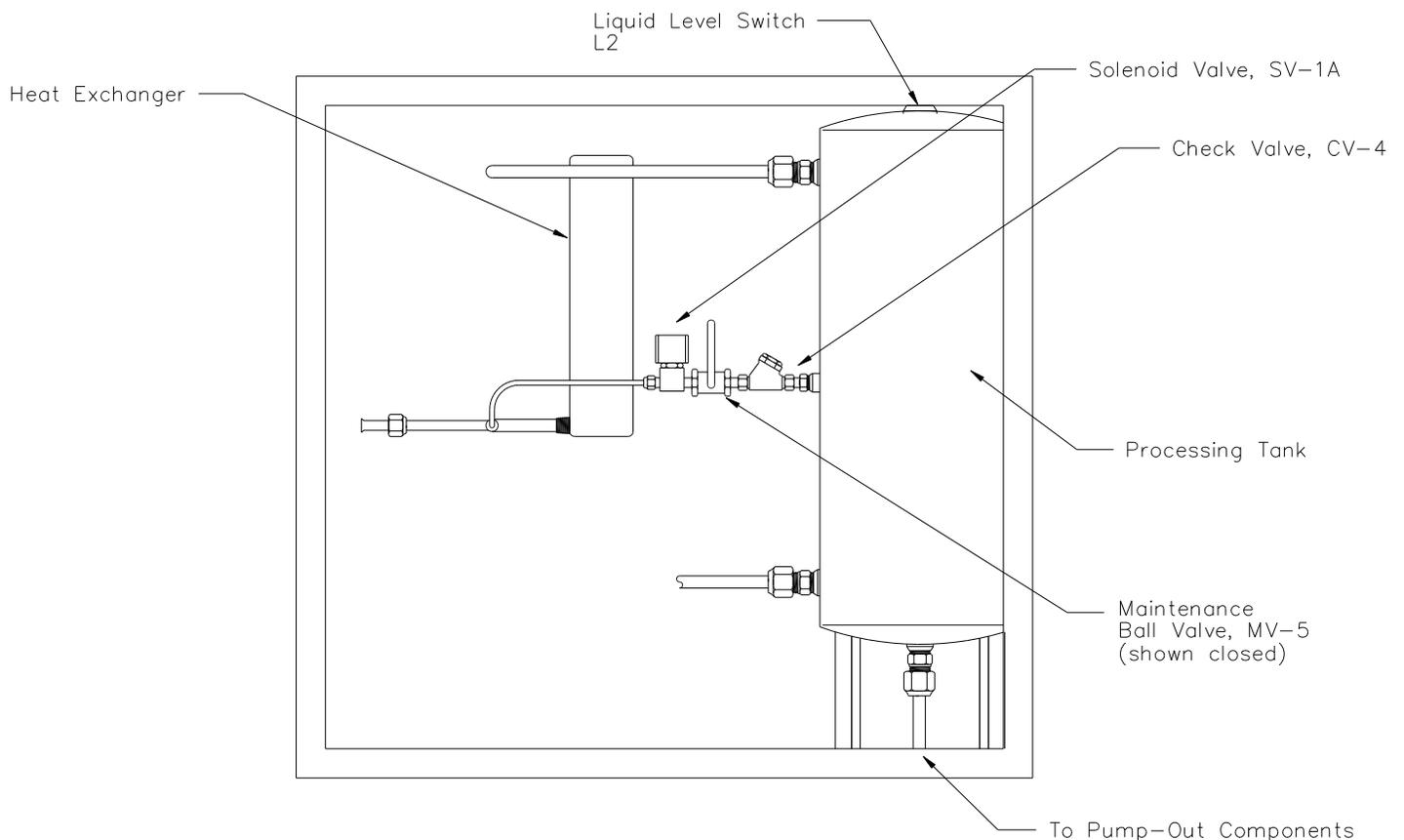


Figure 12
Processing Tank: Inlet Components
Rear View / Upper Section / Back Panel Removed

VII. System Maintenance Procedures (continued)

K. Complete Machine Evacuation

A complete machine evacuation should be performed after every 20000 pounds of processed AGENT to reduce moisture and ice formation internal to the machine. The evacuation procedure will also need to be performed if water contamination of processed AGENT becomes apparent or if component failures occur due to ice formation internal to the machine.

A complete machine evacuation must be performed before processing a different type of agent.

Figures 10, 11, 12 and 13 will detail the valve locations required to perform this procedure.

DO NOT EMPTY THE MACHINE INTO GOOD PROCESSED AGENT STORAGE TANKS. A SEPARATE EMPTY STORAGE TANK MUST BE USED. THE CAPTURED AGENT THEN MAY BE USED TO PROVIDE THE INITIAL CHARGE PER SECTION-V.B AFTER THIS EVACUATION PROCEDURE HAS BEEN COMPLETED FOR THE SAME TYPE OF AGENT.

Machine Evacuation Procedure

Required Materials:

- ◆ Vacuum Pump
- ◆ Leak Detector Fluid
- ◆ Evacuated AGENT Storage Cylinder as Specified in procedure
- ◆ Clean Dry Nitrogen Source regulated to 200 psi
- ◆ Vacuum Gauge
- ◆ ¼" Refrigeration Service Hoses
- ◆ Straight Blade Screwdriver
- ◆ #2 Phillips Drive Screwdriver
- ◆ ½" Socket Torque Wrench 20 to 100 inch pound indicator

NOTE: All plumbing connections to the various access valves of the machine require SAE ¼" x 45° Female Flare connectors. Access valve locations designated by "AV" will require valve core depressors. Standard ¼" refrigeration service hoses will mate to all of the access valves and may be used to simplify all plumbing connections.

1. Receiving Storage Container Selection:

The container must be pressure rated to contain the type of agent in the machine.

The inlet port must enter on the vapor side of the container.

The container must have a shut off valve installed to the inlet port of the container.

The container must have a safety pressure relief valve installed to the vapor side of container. The working pressure of the container should be no less than 80% of the rated opening pressure of the relief valve.

The receiving containers must be sized according to the amount of AGENT contained in the process tank of the machine as listed below:

- **Below low liquid level indication: Minimum 50 pound capacity tank.**
- **Above low liquid level and below mid liquid level indication: Minimum 100 pound capacity tank.**
- **Above mid liquid level up to high liquid level indication: Minimum 200 pound capacity tank.**

VII. System Maintenance Procedures

K. Complete Machine Evacuation (continued)

2. Nitrogen Supply Installation

- a. Install the nitrogen supply as per section-IV.E of this manual.

3. Receiving Container Installation

- a. Install the receiving container as per section-IV.F of this manual.

4. Inlet Section Evacuation

- a. Verify that all the control panel override toggle switches are in the AUTO position.
- b. Place the front panel Power Switch to the ON position. Allow the machine to cool to the setting of -63° F for 1301 and FE25, -23° F for 1211, or -10° F for FM200

CAUTION: The Manual Inlet Valve MV-1 and the Inlet Evacuation Valve MV-8 must be closed to prevent air from entering the machine.

- c. Place the control panel Inlet Valve Switch to the ON position.
- d. Place the control panel Compressor Switch to the ON position. Allow the compressor to operate for 10-minutes.

WARNING! Do not manually operate the compressor with the inlet valve switch in the auto position. The compressor will be pumping into dead ended plumbing. The inlet valve switch must be positioned to the ON position allowing flow from the compressor discharge to enter the process tank.

- e. Place the Compressor Switch to the AUTO position.
- f. Place the Inlet Valve Switch to the AUTO position.

5. Complete steps #2 through #18 of section-VII.H: Moisture Acid and Processed Particulate Filter Element Replacement. This will purge any agent vapor in the inlet and filter sections of the machine into the process tank.

VII. System Maintenance Procedures

K. Complete Machine Evacuation (continued)

6. Process Tank Liquid Purge.

- a. Place the N2 Supply Switch to the ON position to pressurize the process tank with nitrogen. Wait for the pressure display of the Pressure Controller to stabilize to a pressure above 50 psi.
- b. Place the Outlet Valve Switch to the ON position.
- c. Place the Pump Switch to the ON position: AGENT should now be entering the receiving container.

After the Low Level indicator goes out there is 25 to 30 pounds of AGENT remaining in the machine. Listen to the sound of the pump and observe the weigh scale: when the weight of the receiving container stops increasing and the sound of the pump changes abruptly: the liquid AGENT has all been expelled from the machine. **IMMEDIATELY PERFORM STEP-d. DO NOT ALLOW THE PUMPS TO OPERATE WITHOUT LIQUID IN THE MACHINE. DAMAGE TO THE LIQUID PUMPS WILL RESULT.**

- d. Place the following Control Panel Switches to the AUTO positions **IN THE SEQUENCE AS LISTED.**
 - **Pump Switch**
 - **Outlet Valve Switch**
 - **N2 Supply Switch**
- e. Place the N2 Valve Switch to the ON position. Vent the process tank until the pressure stops decreasing as indicated on the Front Panel Pressure Controller. Then place the N2 Valve Switch to the AUTO position.
- f. Place the Cooling System Temperature Controller Power Switch to the OFF position.
- g. Observe the condition of the plumbing connecting the receiving container to the Outlet Port of the machine. Wait for any frost that may have formed on the plumbing to dissipate. If no frost is observed: wait for at least 15-minutes before continuing.
- h. Close the shut off valve of the receiving container and disconnect the receiving container from the Outlet Port of the machine.
- i. Install the valve cap to the Nitrogen Vent Port.

VII. System Maintenance Procedures

K. Complete Machine Evacuation (continued)

7. Filter Replacement

- a. Place the System Power Switch to the Off position.
- b. Disconnect main electrical power from the machine.
- c. Open the filter maintenance access door on the top-right corner of the control panel black hood.
- d. Remove the cap from the filter maintenance access valve AV-4. Set the cap aside for reinstallation.
- e. Depress the valve core of the AV-4 access valve to release the pressure from the filter shells this will ease the removal of the filter caps.
- f. Remove the bolts from the top cover of the moisture filter and acid filter using the ½" socket wrench. Remove the top covers from the filter housings.
- g. Remove the sealing gasket from each top cover. Do not scratch or mar the seal glands of the top covers.
- h. Lift the spent filter/drier cores from the housing of each filter.
- i. Install two new moisture filter cores part number, A4-04-2100-00-0, into the moisture filter housing as depicted by figure-10.
- j. Install a new acid filter core part number, A4-04-2100-01-0, into the acid filter housing as depicted by figure-10.
- k. Install new sealing gaskets, supplied with the filter cores, to the glands of both top covers.
- l. Position the top covers onto the filter housings and secure into position using the bolts previously removed. Initially tighten the bolts to 40-inch pounds. Retighten all bolts to verify an even torque on each bolt. Retighten all the bolts in 20-inch pounds increments to achieve an evenly distributed 100-inch pounds of torque on each bolt.

CAUTION: Do not allow the filter/drier cores to remain exposed to the ambient air. Install the cores immediately after opening the sealed containers. The cores will absorb moisture from the air reducing the water removal capacity of the filters.

- m. Connect a source of clean dry nitrogen, regulated to 200 psi, to the filter maintenance access valve AV-4 pressurizing the filter section.
- n. Leak test the moisture filter and acid filter top covers using the leak detector fluid.

NOTE: Leaks in the moisture and acid filter top cover seals usually can be stopped by tightening the retaining bolts.

- o. Close and disconnect the nitrogen source from the AV-4 access valve.
- p. Depress the core of the AV-4 access valve to release the nitrogen pressure from the filter housings.
- q. Connect a vacuum pump and vacuum gauge to the AV-4 access valve. Operate the pump to evacuate the filter housings to a 1000-micron minimum vacuum level.

NOTE: The access valve end of the interconnection plumbing must contain a valve core depressor.

VII. System Maintenance Procedures

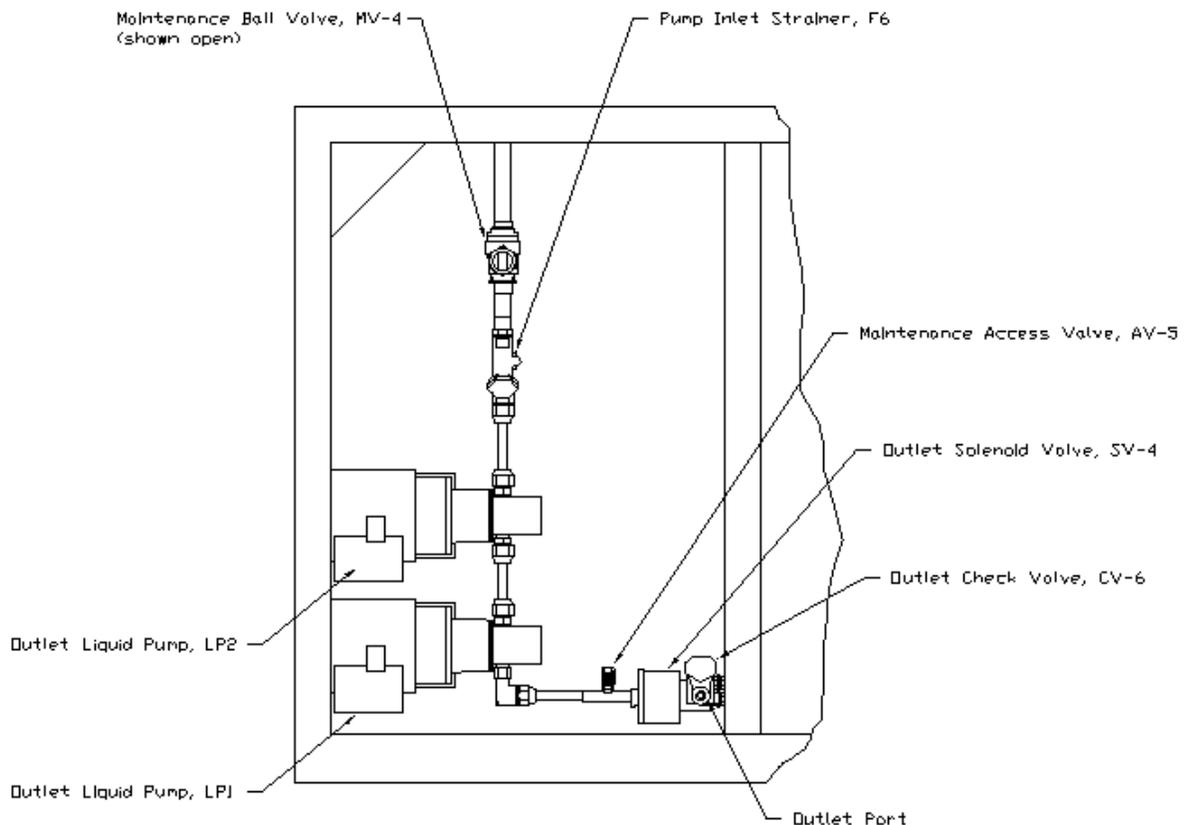
K. Complete Machine Evacuation (continued)

7. Filter Replacement (continued)

- r. Remove the vacuum pump and vacuum gauge from the AV-4 access valve.
- s. Adjust the pressure of the nitrogen source to provide low pressures between 5 and 10 psi.
- t. Connect the low-pressure nitrogen source to the AV-4 access valve and pressurize the filter section from 5 to 10 psi.
- u. Close and remove the nitrogen source from the AV-4 access valve and install the cap back to the access valve.

8. Process Tank Evacuation

- a. Remove the lower-left panel of the machine by loosening the four captive screws at each corner of the panel. This is the panel on the outlet valve side of the machine.
- b. Remove the valve cap from the AV-5 Access Valve. Refer to figure-13.



Note:

- 1. Insulation removed from components for clarity.
- 2. View is looking into pump cavity with left side panel removed.

Figure 13
Outlet Component Identification

Figure-13

VII. System Maintenance Procedures

K. Complete Machine Evacuation

8. Process Tank Evacuation (continued)

- c. Connect a vacuum pump and vacuum gauge to the AV-5 access valve. Operate the pump to evacuate the process tank to a 1000-micron minimum vacuum level. This may require several hours of run time depending on the moisture levels inside the process tank.

NOTE: The access valve end of the interconnection plumbing must contain a valve core depressor.

- d. Remove the vacuum pump and vacuum gauge from the AV-5 access valve.
- e. Adjust the pressure of the nitrogen source to provide low pressures between 5 and 10 psi.
- f. Connect the low-pressure nitrogen source to the AV-5 access valve and pressurize the process tank from 5 to 10 psi.
- g. Close and remove the nitrogen source from the AV-5 access valve and install the cap back to the access valve.
- h. Install the lower-left side panel back to the machine.
- i. Connect main electrical power to the machine.
- j. Perform Section-V.B: Initial System Start-Up Procedure.

VII. System Maintenance Procedures (continued)

L. Agent System Leak Test

Leak testing of the machine should be performed using an electronic leak detector to identify a leakage area and then leak detector fluid to pinpoint the exact location of the leak.

Leak testing is best performed when the machine is dry of condensation at ambient temperatures.

Manual ball valves and access valves are installed in several locations of the machine to allow for isolating sections of the plumbing. The solenoid valves of the machine may also be used to isolate sections of the plumbing since all of the valves will be closed when not powered. Use pneumatic diagram, enclosed to best determine the valve closures and access valve points to use to isolate and depressurize the section of the machine that contains the leak. AGENT is to be recovered from the appropriate access valve. After the leakage is repaired, the section of the plumbing exposed to ambient air must be evacuated to a 1000-micron minimum vacuum level before opening the isolating valves.

VII. System Maintenance Procedures (continued)

M. Pressure Controller Adjustment and Calibration

The pressure in the Process Tank is monitored by a 4-20mA-loop system consisting of three main components. Refer to figure #14 for the mounting locations of these components. **The power supply** provides the low voltage DC power to drive the loop system. **The pressure transmitter** is the pressure-sensing device for the process tank. **The front panel pressure controller** receives the transmitter signal, displays the processing tank pressure, and communicates the tank pressure to the system PLC via two alarm outputs. The calibration of the system is critical for the correct operation of the machine.

Power Supply part number 6-01-1000-10-0

Specifications:

- ◆ Input Power 100-130 VAC 50/60 Hz
- ◆ Output 12 VDC 6-WATTS

Pressure Transmitter part number 1-16-3026-00-0

Specifications:

- ◆ 0 to 250 PSIA operating range, 500 PSIA over-pressure
- ◆ Input Power 12 Volts DC @20mA
- ◆ Output Signal 4-20mA corresponding to 0-250 PSIA

Pressure Controller part number 7-06-1300-00-0

Specifications:

- ◆ Input Power 104-130 VAC 50/60 Hz
- ◆ Signal Input 4-20mA
- ◆ Two Adjustable Relay Contact Alarm Outputs
- ◆ 0 to 2.5 VDC Signal Output Corresponding to 0 to 250 psia
- ◆ 3 1/2 Digit LED Display

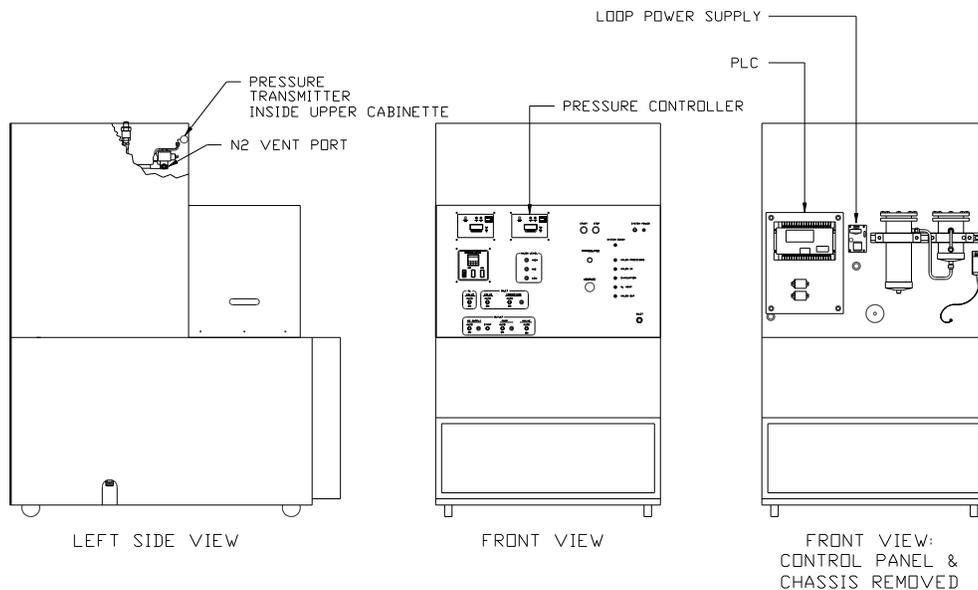


FIGURE #14:
4-20mA LOOP COMPONENT LOCATIONS

VII. System Maintenance Procedures

M. Pressure Controller Adjustment and Calibration (continued)

1. Alarm Set Point Adjustment: Reference figure-15

To Adjust Alarm #1:

- Place the front panel Power Switch to the ON Position.
- Position and hold the Alarm Set Switch to the Alarm 1 position. The alarm 1 set point will be displayed on the pressure controller display.
- Use a calibration screwdriver to adjust the alarm 1 potentiometer to the desired set point.

The factory set point for alarm #1 is 50 psia. The Alarm #1 LED will be illuminated above the set point.

- Release the Alarm Set Switch and the display will return to the pressure reading of the process tank.

To Adjust Alarm #2:

- Place the front panel Power Switch to the ON Position.
- Position and hold the Alarm Set Switch to the Alarm 2 position. The alarm 2 set point will be displayed on the pressure controller display.
- Use a calibration screwdriver to adjust the alarm 2 potentiometer to the desired set point.

The factory set point for alarm #2 is 25 psia. The Alarm #2 LED will be illuminated below the set point.

- Release the Alarm Set Switch and the display will return to the pressure reading of the process tank.

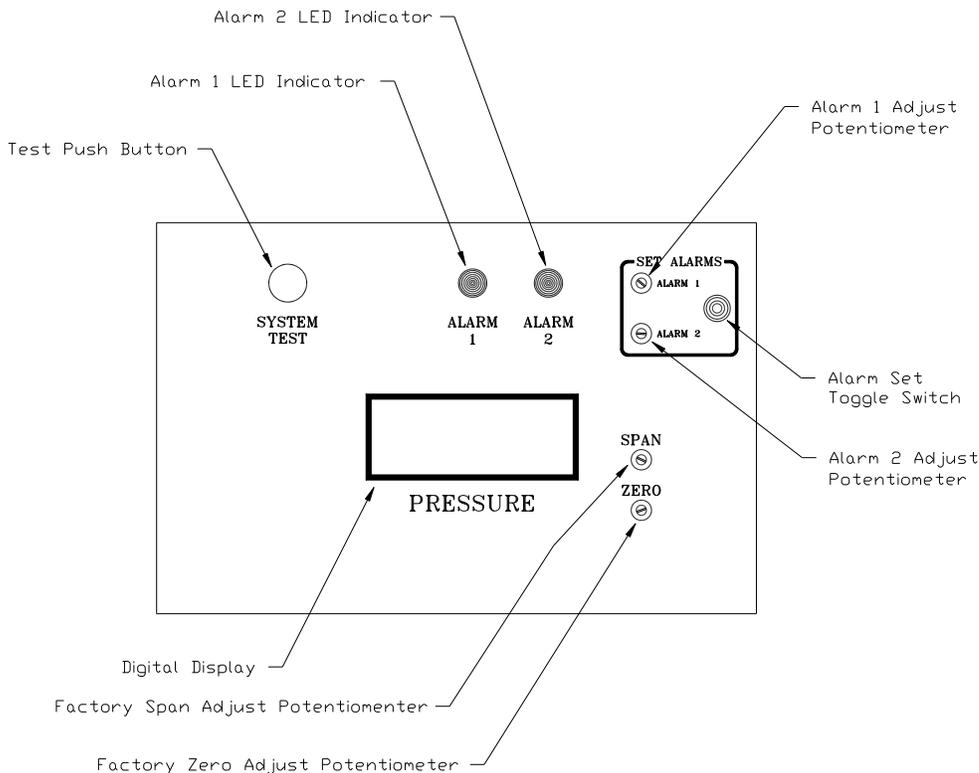


Figure 15
Pressure Controller Detail

VII. System Maintenance Procedures

M. Pressure Controller Adjustment and Calibration (continued)

2. Pressure Loop System Calibration

The following procedure will detail the routine maintenance calibration procedure that is possible without accomplishing component level maintenance. If satisfactory operation is not obtained using this procedure then verify component operation set forth in the following sections for troubleshooting and pressure controller calibration.

Required Materials:

- ◆ Calibrated Pressure Gauge 0-300 psi in 1-psi increments ¼% accuracy
 - ◆ ¼" Refrigeration Service Hose
 - ◆ Commercial Grade Nitrogen Gas Source Regulated to 250 psi
- a. Connect a source of clean dry nitrogen gas regulated to 250 psi to the front panel Inlet Port of the machine.
 - b. Open the nitrogen source to the machine.
 - c. Briefly loosen the nitrogen connection at the Inlet Port to purge air out of the connecting plumbing. Then retighten the connection.
 - d. Open the manual Inlet Valve MV-1 of the machine.
 - e. Place the front panel Power Switch to the ON Position and allow the machine to cool to the appropriate setting for the type of agent in the machine.
 - f. Connect the pressure gauge to the nitrogen vent port of the machine.
 - g. Place the front panel N2 Switch to the ON position. The pressure in the process tank will now be indicated by the pressure gauge connected to the nitrogen vent port.
 - h. The pressure in the process tank may now be controlled. Reduce the pressure in the tank by loosening the connection at the pressure gauge to vent the tank. Increase the pressure in the tank by operating the Inlet Valve Switch on the front panel. Use this method to **gain a 5 psi indication on the pressure gauge connected to the nitrogen vent port. DO NOT RELEASE THE PROCESS TANK PRESSURE ABOVE THE TEMPERATURE CONTROLLER ALARM #2 SETTING FOR THE SPECIFIC TYPE OF THE AGENT IN THE MACHINE THIS WILL RESULT IN EXCESSIVE AGENT LOSS.**
 - i. Observe the display of the front panel pressure controller. **Adjust the zero potentiometer of the controller to obtain a pressure controller display of 20.**

NOTE: Add 15 psi to the reading on the external pressure gauge to determine what the pressure controller display should indicate. For example: ideally, the pressure controller should display 50 when the external gauge indicates 35 psi.

NOTE: The accuracy of the pressure controller may now be verified by increasing the pressure in the process tank in steps and comparing the external pressure gauge with the display of the pressure controller. The pressure controller should be +/- 1 psi from 20 to 25 psi display indication and +/- 5 psi across the 200 psi range of the system. It is most important to have the best accuracy from the 20 to 50 psi range so that the pressure controller alarm outputs will operate at the proper pressures for vent operations.

- j. Place both the N2 Valve and Inlet Valve switches to the AUTO positions.

VII. System Maintenance Procedures

M. Pressure Controller Adjustment and Calibration (continued)

2. Pressure Loop System Calibration (continued)

- k. Disconnect the pressure gauge from the nitrogen vent port.
- l. Shut off the nitrogen supply. Close the Manual Inlet Valve MV-1 of the machine and disconnect the nitrogen supply from the Inlet Port.
- m. Operate the N2 Valve Switch to vent the process tank to below 50 psi before turning the machine off. **DO NOT TURN THE MACHINE OFF WITH PRESSURE HIGHER THAN 50 PSI IN THE PROCESS TANK.**

VII. System Maintenance Procedures

M. Pressure Controller Adjustment and Calibration (continued)

3. Pressure Loop Power Supply Troubleshooting

The following procedure will detail how to verify correct operation of the pressure loop system power supply. If the criteria listed below are not obtainable then the power supply must be replaced. Consult the factory for replacement.

Required Materials:

- ◆ Straight Blade Screwdriver
- ◆ 499 ohm ½ watt resistor
- ◆ Voltmeter: 20 VDC and 200 VAC Ranges

- a. Place the System Power Switch to the OFF Position.
- b. Disconnect the main electrical power from the machine.
- c. Open the filter access door of the hood and separate the two halves of the hood fan electrical connector.
- d. Remove the three screws along the top of the control panel and the three screws on both sides of the control panel hood. With a helper, lift the hood up and over the control panel.
- e. Place all of the Front Panel Control Switches to the AUTO position.
- f. Place the Cooling System Controller Power Switch to the OFF position.
- g. Connect Main Power to the machine.
- h. Place the System Power Switch to the ON position.

WARNING! THE AREA INSIDE THE CONTROL PANEL HOOD CONTAINS 120VAC POWER CONNECTIONS; DO NOT REST ANY PART OF YOUR BODY ON ANY OF THE INTERNAL COMPONENTS.

- i. Using the Voltmeter, configured for AC voltage measurement, verify 100 to 130 VAC between J1-1 and J1-2 at the Loop Power Supply J1 connector refer to figure 16.
- j. Using the Voltmeter, configured for DC voltage measurement, verify 12 \pm 0.6 VDC at the Loop Power Supply J1 connector. Refer to figure 16 and connect the Voltmeter as follows:
 - ◆ Voltmeter Positive Probe to J1-6
 - ◆ Voltmeter Negative Probe to J1-5

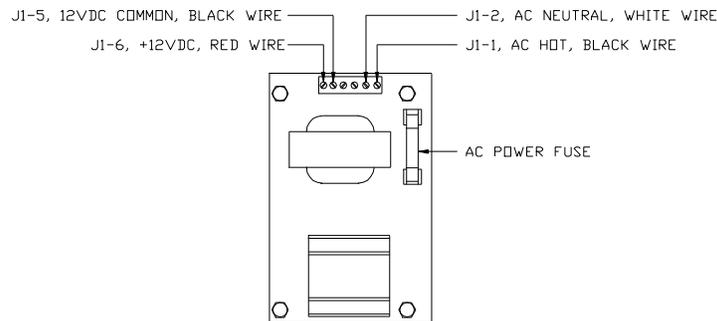


FIGURE #16: PRESSURE LOOP POWER SUPPLY DETAIL

NOTE: If the voltage is within the specified range continue with the Section-3: Pressure Transmitter Trouble Shooting Guide. If the voltage is greater than 12.6VDC or less than 11.4VDC: continue with this procedure.

VII. System Maintenance Procedures

M. Pressure Controller Adjustment and Calibration

3. Pressure Loop Power Supply Troubleshooting (continued)

- k. Place the System Power Switch to the OFF position.
- l. Disconnect the Main Power from the machine.
- m. Disconnect the Loop Red wire from J1-6 and the Loop Black wire from J1-5.
- n. Verify the integrity of the AC Power Fuse of the power supply. Replace the fuse if required with a 1 AMP 250 volt fuse.
- o. Connect the 499 ohm resistor between the J1-5 and J1-6 terminals.
- p. Connect Main Electrical Power to the machine.
- q. Place the System Power Switch to the ON position.
- r. Again measure the voltage from J1-5 to J1-6.

If the voltage remains less than 11.4VDC or greater than 12.6VDC: the Power Supply should be replaced.

If the voltage falls within the specified range: Place the System Power Switch to the OFF Position. Disconnect Main Power to the machine. Remove the resistor and install the Red Loop wire to J1-6 and the Black Loop wire to J1-5. Continue with the following Pressure Transmitter Trouble Shooting Guide.

VII. System Maintenance Procedures

M. Pressure Controller Adjustment and Calibration (continued)

4. Pressure Transmitter Troubleshooting

The following procedure will detail how to verify correct operation of the pressure transmitter. If the criteria listed below are not obtainable then the transmitter must be replaced. Consult the factory for replacement.

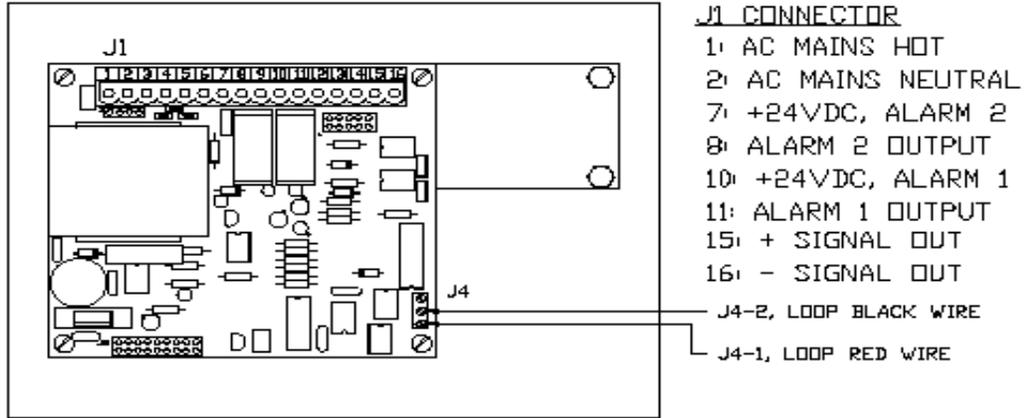
Required Materials:

- ◆ **Calibrated Pressure Gauge 0-300 psi in 1-psi increments ¼% accuracy**
 - ◆ **¼" Refrigeration Service Hose**
 - ◆ **Commercial Grade Nitrogen Gas Source Regulated to 250si**
 - ◆ **Voltmeter: 20 VDC and 200 VAC Ranges**
 - ◆ **Ammeter: 0-20mA Input Range with .1mA resolution and less than 100 ohms input impedance.**
- a. Place the System Power Switch to the OFF Position.
 - b. Disconnect the main electrical power from the machine.
 - c. Remove the Loop Signal Wires; a red and a black wire encased within a gray jacket, from the J4 terminal block located on the Pressure Controller Circuit refer to figure 17.
 - d. Connect the Loop Signal Wires to the Ammeter as follows: (Refer to Block Diagram #1)
 - ◆ **Loop Red Wire to Ammeter Positive Probe**
 - ◆ **Loop Black Wire to Ammeter Negative Probe**
 - e. Connect a source of clean dry nitrogen gas regulated to 250 psi to the front panel Inlet Valve of the machine.
 - f. Open the nitrogen source to the machine.
 - g. Briefly loosen the nitrogen connection at the Inlet Valve to purge air out of the connecting plumbing. Then retighten the connection.
 - h. Open the manual Inlet Valve of the machine.
 - i. Place the front panel Power Switch to the ON Position and allow the machine to cool to the setting for the appropriate type of agent.

NOTE: The Pressure Controller is now disconnected from the 4-20mA Loop. The display of the Pressure Controller will typically read -50PSIA.

- j. Connect the pressure gauge to the nitrogen vent port of the machine.
- k. Place the front panel N2 Switch to the ON position. The pressure in the process tank will now be indicated by the pressure gauge connected to the nitrogen vent port.

The pressure in the process tank may now be controlled. Reduce the pressure in the tank by loosening the connection at the pressure gauge to vent the tank. Increase the pressure in the tank by operating the Inlet Valve Switch on the front panel. DO NOT RELEASE THE PROCESS TANK PRESSURE ABOVE MINUS 60 DEGREES FOR 1301 AND FE25 MINUS 20 DEGREES FOR 1211 MINUS 10 DEGREES FOR FM200 THIS WILL RESULT IN EXCESSIVE AGENT LOSS.



PRESSURE CONTROLLER REAR VIEW

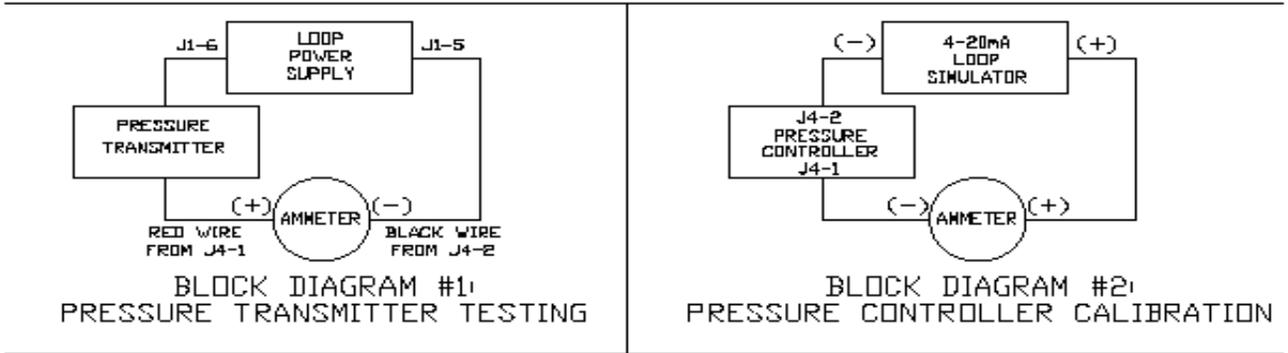


FIGURE #17: PRESSURE TRANSMITTER TESTING



Pressure Controller Micro Switch Settings

VII. System Maintenance Procedures

M. Pressure Controller Adjustment and Calibration

4. Pressure Transmitter Troubleshooting (continued)

- i. Observe the display of the ammeter installed to the 4-20mA Loop wire connections: the ammeter now displays the Output Signal of the Loop Pressure Transmitter. The calibration of the Loop Pressure Transmitter may be verified by comparison of the pressure gauge reading to the ammeter at several process tank pressure levels.

Note: the ammeter will indicate a pressure value approximately 15PSI greater than that indicated by the pressure gauge.

The output signal of the Pressure Transmitter shall be: 64uA per 1PSIA of pressure plus the 4mA zero offset +/-0.25% of reading. For example:

$$5 \text{ PSIG} = 20\text{PSIA} = 4\text{mA} + (.064\text{mA} \times 20) = 5.3 \text{ +/-}0.013\text{mA}$$

$$25 \text{ PSIG} = 40\text{PSIA} = 4\text{mA} + (.064\text{mA} \times 40) = 6.56 \text{ +/-}0.016\text{mA}$$

$$85 \text{ PSIG} = 100\text{PSIA} = 4\text{mA} + (.064\text{mA} \times 100) = 10.4 \text{ +/-}0.026\text{mA}$$

NOTE: If the signal output of the Pressure Transmitter is found to be out of the specified range: the Pressure Transmitter should be replaced. Contact the factory for replacement information. If the signal output of the Pressure Transmitter is found to be within the specified range: continue with the Pressure Controller Calibration/Trouble Shooting Procedure.

Complete the following when the testing is complete

- m. Place both the N2 Valve and Inlet Valve switches to the AUTO positions.
- n. Disconnect the pressure gauge from the nitrogen vent port.
- o. Shut off the nitrogen supply. Close the Manual Inlet Valve of the machine and disconnect the nitrogen supply from the Inlet Valve.
- p. Place the System Power Switch to the OFF Position.
- q. Disconnect the main electrical power from the machine.
- r. Install the Loop Signal Wires, back to the J4 terminal block located on the Pressure Controller Circuit refer to figure 17.
- s. Connect the main electrical power to the machine.
- t. Place the System Power Switch to the ON Position.
- u. Operate the N2 Valve Switch to vent the process tank to below 50 psi before turning the machine off. **DO NOT TURN THE MACHINE OFF WITH PRESSURE HIGHER THAN 50 PSI IN THE PROCESS TANK. DO NOT RELEASE THE PROCESS TANK PRESSURE ABOVE THE TEMPERATURE CONTROLLER ALARM #2 SETTING THIS WILL RESULT IN EXCESSIVE AGENT LOSS.**
- v. Place the System Power Switch to the OFF position.

VII. System Maintenance Procedures

M. Pressure Controller Adjustment and Calibration (continued)

5. Pressure Controller Troubleshooting and Calibration

Required Materials:

- ◆ Calibration Screwdriver
- ◆ Voltmeter: 20 VDC and 200 VAC Ranges
- ◆ Ammeter: 0-20mA Input Range with .1mA resolution and less than 100 ohms input impedance.
- ◆ 4-20mA Loop Simulator: 4-20 Loop Simulators may be purchased from instrumentation supply companies such as Omega Engineering. Alternatively any stable DC current source, with 4mA and 20mA outputs capable of driving a 10 ohm load, may be used

NOTE: Reference figure-17 for depictions of the wiring locations and connections.

- a. Place all Control Panel switches to the AUTO position and the Cooling System Controller Power Switch to the OFF position.
- b. Place the System Power Switch to the ON position.

WARNING! THE AREA INSIDE THE CONTROL PANEL HOOD CONTAINS 120VAC POWER CONNECTIONS; DO NOT REST ANY PART OF YOUR BODY ON ANY OF THE INTERNAL COMPONENTS.

- c. Using the Voltmeter, configured for AC voltage measurement, to verify 104 to 130VAC from the Pressure Controller J1-1 terminal to the J1-2 terminal.
- d. Place the System Power Switch to the OFF position.
- e. Disconnect Main Power from the machine.
- f. Remove the Loop Signal Wires, a red and a black wire encased within a gray jacket, from the J4 terminal block located on the Pressure Controller Circuit.
- g. Refer to figure-17 Block Diagram #2. Connect the Ammeter and 4-20mA Loop Simulator to the J4 connector of the Pressure Controller Circuit as follows:
 - ◆ Loop Simulator Positive Output to Ammeter Positive Probe
 - ◆ Loop Simulator Negative Output to Controller J4-2
 - ◆ Ammeter Negative Probe to Controller J4-1
- h. Connect Main Power to the machine.
- i. Place the System Power Switch to the ON position.
- j. Use the 4-20mA Simulator to input 4.0mA as displayed by the ammeter. Observe the Pressure Controller Display and adjust the Pressure Controller Zero Potentiometer to obtain a zero pressure display.
- k. Use the 4-20mA Simulator to input 20.0mA as displayed by the ammeter. Observe the Pressure Controller Display and adjust the Pressure Controller Span Potentiometer to obtain a 250 PSIA pressure display.
- l. Repeat steps j & k until the zero and span potentiometers of the Pressure Controller do not require adjustments.
- m. Use the 4-20mA Simulator to input 12.0mA as displayed by the ammeter. Observe the Pressure Controller Display shall be 125 PSIA.

NOTE: If the Pressure Controller cannot be calibrated it should be replaced. Contact the factory for replacement information.

VII. System Maintenance Procedures

M. Pressure Controller Adjustment and Calibration

5. Pressure Controller Troubleshooting and Calibration (continued)

- o. Depress and hold the Test Button, located on the upper-left corner of the Pressure Controller Front Panel, and observe the LED display of the Machine Computer. The #A2 and #A3 input LEDs should alternately flash on and off. If the specified LEDs do not toggle on and off: complete the tests described in section-6: Pressure Controller Alarm Output Trouble Shooting; otherwise continue with step-p.
- p. Place the System Power Switch to the OFF Position.
- q. Disconnect the main electrical power from the machine.
- r. Install the Loop Signal Wires, back to the J4 terminal block located on the Pressure Controller Circuit refer to figure 17.
- s. Reinstall the hood and fan electrical connector.
- t. Recalibrate the pressure system as per section-2: Pressure Loop System Calibration**

VII. System Maintenance Procedures

M. Pressure Controller Adjustment and Calibration (continued)

6. Pressure Controller Alarm Output Troubleshooting

Required Materials:

- ◆ Voltmeter: 20 VDC and 200 VAC Ranges

a. Place the System Power Switch to the ON position.

WARNING! THE AREA INSIDE THE CONTROL PANEL HOOD CONTAINS 120VAC POWER CONNECTIONS; DO NOT REST ANY PART OF YOUR BODY ON ANY OF THE INTERNAL COMPONENTS.

b. Configure the voltmeter for DC voltage measurement.

c. Connect the negative voltmeter probe to the PLC -24VDC. Connect the voltmeter positive probe to the PLC +24VDC Terminal and verify a 24 +/-3VDC voltmeter measurement.

NOTE: If a 24 +/-3VDC measurement is not obtained: the PLC should be replaced.

d. With the negative voltmeter probe connected to the Machine Computer -24VDC Terminal; Verify +24VDC at the Pressure Controller J1-7 and J1-10 terminals using the voltmeter positive probe.

NOTE: If 24VDC is not present: the wire run from the Machine Computer terminal #2 (red wire) to the Pressure Controller is not intact

e. With the negative voltmeter probe connected to the Machine Computer -24VDC Terminal; depress and hold the controller test switch. Connect the voltmeter positive probe to the Pressure Controller J1-8 terminal and verify a voltage measurement that toggles from 0 to 24 VDC +/- 3 VDC. Repeat this procedure for the Pressure controller J1-11 terminal.

NOTE: If the voltage does not toggle on and off the pressure controller must be replaced.

f. With the negative voltmeter probe connected to the Machine Computer -24VDC Terminal; depress and hold the controller test switch. Connect the voltmeter positive probe to the PLC #A2 input terminal and verify a voltage measurement that toggles from 0 to 24 VDC +/- 3 VDC. Repeat this procedure for the PLC #A3 input terminal.

NOTE: If the voltage does not toggle on and off the wire runs from the pressure controller to the PLC are not intact. If the voltage does toggle on and off but the PLC #A2 and #A3 input LEDs do not toggle on and off the PLC must be replaced.

VII. System Maintenance Procedures (continued)

N. Process Temperature Controller Adjustment and Calibration

The temperature in the process tank is monitored by a system consisting of two main components. **The RTD Probe** is the temperature-sensing device for the process tank. The **Process Temperature Controller** displays the tank temperature, directly controls the front panel System Ready Lamp via alarm #1 output, and communicates to the PLC via alarm #2 output. The calibration of the system is critical for the correct operation of the machine. Refer to figure-18 for the location of these components.

Resistance Temperature Detector (RTD) part number A1-16-4000-03-0

Specifications:

- ◆ Range: -200°C to 500°C
- ◆ Output: 100 +/- 0.1 ohms @32°F, 0.217 ohms per °F positive temperature coefficient
- ◆ Accuracy: +/-0.3 ohms (+/-1.4°F)

Process Temperature Controller part number 7-06-1400-00-0

Specifications:

- ◆ Input Power: 104-130 VAC 50/60 Hz
- ◆ Two Adjustable Relay Contact Alarm Outputs
- ◆ -2.0 to 2.0 VDC Signal Output corresponding to -200°F to 200°F
- ◆ 3-1/2 Digit LED Display

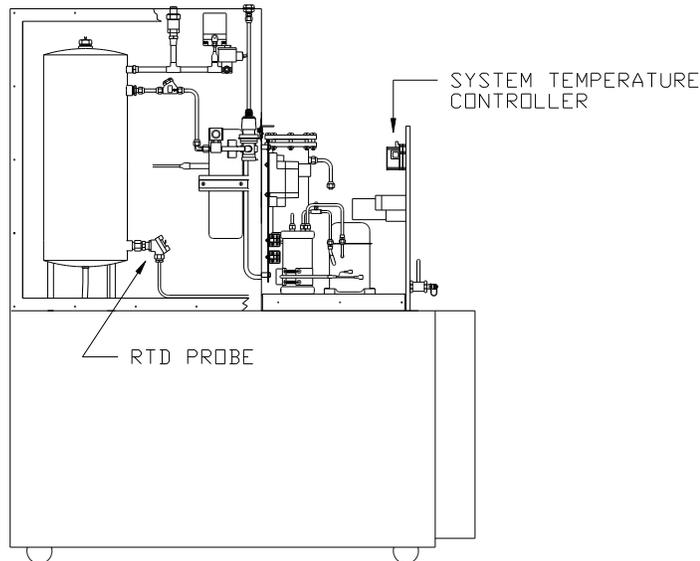


Figure #18:
Process Temperature Components

VII. System Maintenance Procedures (continued)

N. Process Temperature Controller Adjustment and Calibration (continued)

1. Alarm Set Point Adjustment: Reference figure-19

To Adjust Alarm #1:

- Place the front panel Power Switch to the ON Position.
- Position and hold the Alarm Set Switch to the Alarm 1 position. The alarm 1 set point will be displayed on the temperature controller display.

The factory set point for alarm #1 is -55. The Alarm #1 LED will be illuminated above the set point.

- Use a calibration screwdriver to adjust the alarm 1 potentiometer to the desired set point.
- Release the Alarm Set Switch and the display will return to the temperature reading of the process tank.

To Adjust Alarm #2:

- Place the front panel Power Switch to the ON Position.
- Position and hold the Alarm Set Switch to the Alarm 2 position. The alarm 2 set point will be displayed on the temperature controller display.

The factory set point for alarm #2 is -60. The Alarm #2 LED will be illuminated above the set point.

- Use a calibration screwdriver to adjust the alarm 2 potentiometer to the desired set point.
- Release the Alarm Set Switch and the display will return to the temperature reading of the process tank.

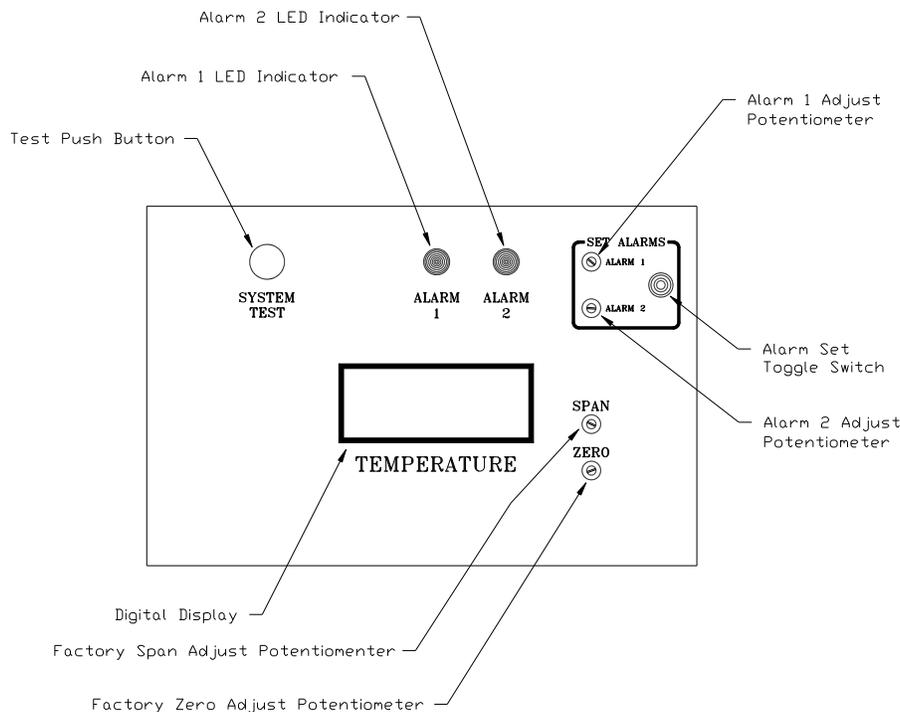


Figure #19
Temperature Controller Detail

VII. System Maintenance Procedures (continued)

N. Process Temperature Controller Adjustment and Calibration (continued)

The following procedure will detail the routine maintenance calibration procedure that is possible without accomplishing component level maintenance. If satisfactory operation is not obtained using this procedure then verify component operation set forth in the following sections for troubleshooting.

2. Calibration Procedure

Required Materials:

- ◆ Calibration Screwdriver
- ◆ Voltmeter: 20 VDC and 200 VAC Ranges
- ◆ Straight Blade Screwdriver
- ◆ 92.8 ohm Resistor (may be constructed from a resistor network)
- ◆ 77.6 ohm Resistor (may be constructed from a resistor network)

- a. Place the System Power Switch to the OFF Position.
- b. Disconnect the main electrical power from the machine.
- c. Open the filter access door of the hood and separate the two halves of the hood fan electrical connector.
- d. Remove the three screws along the top of the control panel and the three screws on both sides of the control panel hood. With a helper, lift the hood up and over the control panel.
- e. Place all of the Front Panel Control Switches to the AUTO position.
- f. Place the Cooling System Controller Power Switch to the OFF position.
- g. Disconnect the Red and Black RTD signal wires from the Controller J2 terminal block. Reference figure-20.
- h. Connect the 92.8 ohm resistor from the J2-1 to the J2-2 terminals where the RDT signal wires were connected.
- i. Connect Main Power to the machine.
- j. Place the System Power Switch to the ON position.

WARNING! THE AREA INSIDE THE CONTROL PANEL HOOD CONTAINS 120VAC POWER CONNECTIONS; DO NOT REST ANY PART OF YOUR BODY ON ANY OF THE INTERNAL COMPONENTS.

- k. Adjust the temperature controller zero potentiometer to obtain a 0 controller display.
- l. Place the System Power Switch to the OFF Position.
- m. Disconnect the main electrical power from the machine.
- n. Replace the 92.8 ohm resistor with the 77.6 ohm resistor.
- o. Connect Main Power to the machine.
- p. Place the System Power Switch to the ON position.
- q. Adjust the temperature controller span potentiometer to obtain a -70 degree controller display.
- r. Repeat the adjustments using the two resistors until the potentiometers no longer require adjustment.
- s. Connect the RTD signal wires back to the Controller J2-1 and J2-2 terminals. The connection is not polarized the black and red wire positions may be interchanged.
- t. Reinstall the Control Panel Hood and connect the hood fan connectors.

VII. System Maintenance Procedures (continued)

N. Process Temperature Controller Adjustment and Calibration (continued)

3. Signal Wire Inspection

Required Materials:

- ◆ Straight Blade Screwdriver
 - ◆ Philips Drive Screwdriver
- a. Place the System Power Switch to the OFF Position.
 - b. Disconnect the main electrical power from the machine.
 - c. Open the filter access door of the hood and separate the two halves of the hood fan electrical connector.
 - d. Remove the three screws along the top of the control panel and the three screws on both sides of the control panel hood. With a helper, lift the hood up and over the control panel.
 - e. Remove the upper-left side panel of the machine. Remove enough of the insulation to gain access to the temperature probe located at the bottom of the process tank.
 - f. Remove the cap from the RDT probe to gain access to the signal wires.
 - g. The signal wires from the probe to the controller are a red and black wire enclosed in a gray jacket. Examine the condition of the wires and connection. The connection must be clean and tight. Poorly connected wires will result in unstable temperature indications from the temperature controller. Repair the wires as required.

NOTE: With the Temperature Controller operation and the signal wire integrity verified: malfunctions of the system will require replacement of the RTD temperature probe. Complete section-3: RDT Probe Replacement.

4. RDT Probe Replacement

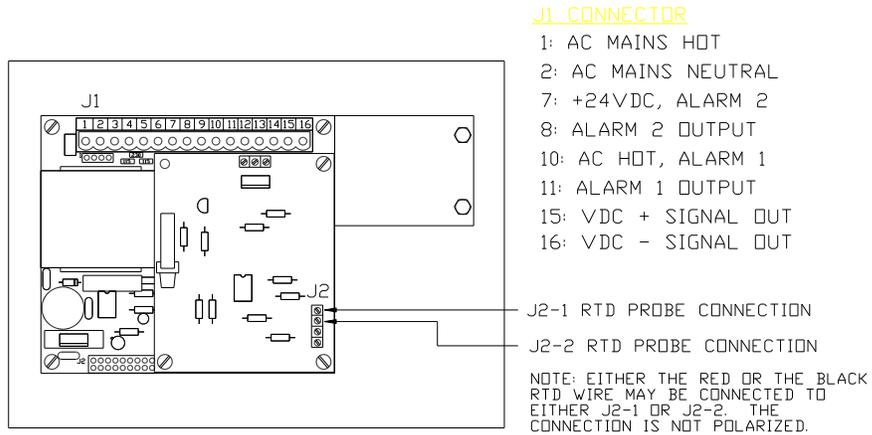
Required Materials:

- ◆ Straight Blade Screwdriver
 - ◆ Philips Drive Screwdriver
 - ◆ 1-1/8" Open End Wrench
 - ◆ 7/8" Open End Wrench
- a. Place the System Power Switch to the OFF Position.
 - b. Disconnect the main electrical power from the machine.
 - c. Remove the upper-left side panel of the machine. Remove enough of the insulation to gain access to the temperature probe located at the bottom of the process tank.
 - d. Remove the cap from the RDT probe to gain access to the signal wires. Remove the signal wires from the probe.
 - e. Engage the hex of the RDT Probe Sheath with the 1-1/8" wrench.
 - f. Engage the hex of the RDT Probe with the 7/8" wrench. Hold the sheath from moving and remove the RDT Probe with a counterclockwise rotation of the 7/8" wrench.

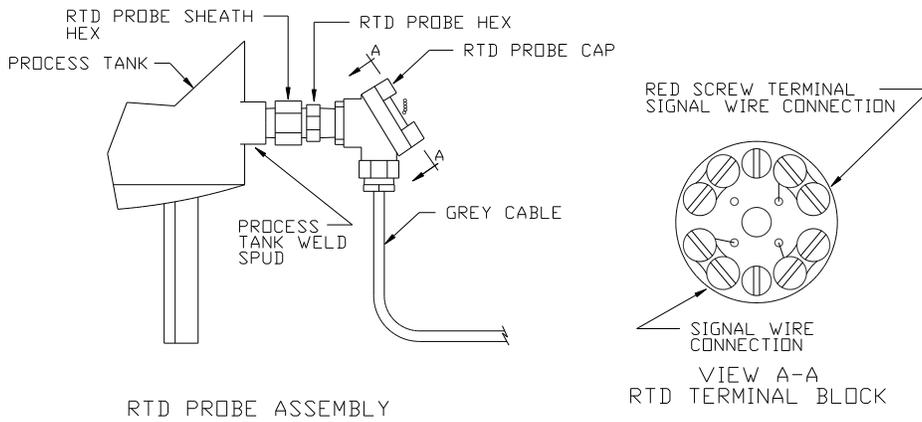
CAUTION: Do Not allow the RDT Probe Sheath to turn or the seal to the process tank may begin to leak AGENT from the tank.

WARNING! Wear safety glasses when removing or installing the probe.

- g. Installation of the new probe is the opposite of removal.



TEMPERATURE CONTROLLER
 REAR VIEW



RTD PROBE ASSEMBLY

FIGURE #20: Temperature Controller & Probe



Temperature Controller Micro Switch Settings

VII. System Maintenance Procedures (continued)

N. Process Temperature Controller Adjustment and Calibration (continued)

5. Alarm Contact Testing

- a. Press and hold the Temperature Controller Test Button and verify that the System Ready Lamp of the control panel flashes on and off and Input #A1 lamp on the PLC flashes on and off. If either one or both the lamps do not toggle on and off complete the remaining portion of this procedure.
- b. Place the System Power Switch to the OFF Position.
- c. Disconnect the main electrical power from the machine.
- d. Open the filter access door of the hood and separate the two halves of the hood fan electrical connector.
- e. Remove the three screws along the top of the control panel and the three screws on both sides of the control panel hood. With a helper, lift the hood up and over the control panel.

NOTE: Step #6 will detail Alarm #1 Troubleshooting and Step #7 will detail Alarm #2 Troubleshooting.

6. Alarm #1 Contact Troubleshooting

Required Materials:

- ◆ VAC Voltmeter
 - ◆ Straight Blade Screwdriver
- a. Connect Main Power to the machine.
 - b. Place the System Power Switch to the ON position.

WARNING! THE AREA INSIDE THE CONTROL PANEL HOOD CONTAINS 120VAC POWER CONNECTIONS; DO NOT REST ANY PART OF YOUR BODY ON ANY OF THE INTERNAL COMPONENTS.

- c. Verify 104 to 130 VAC from the Temperature Controller J1-2 to J1-10 terminals.

If the voltage is not obtained the jumper wire from J1-1 to J1-10 is not intact. Disconnect power from the machine repair the jumper and retest.

- d. Connect the voltmeter from J1-2 to J1-11. Press and hold the test button of the Temperature Controller the voltmeter should toggle from a low AC to High AC voltage reading.

If the voltage does not toggle, the Temperature Controller should be replaced.

If the voltage does toggle but the System Ready Lamp does not flash on and off: The System Ready Lamp is defective or the wire runs to the lamp are not intact.

VII. System Maintenance Procedures (continued)

N. Process Temperature Controller Adjustment and Calibration (continued)

7. Alarm #2 Contact Testing

Required Materials:

- ◆ VDC Voltmeter
- ◆ Straight Blade Screwdriver

- a. Connect Main Power to the machine.
- b. Place the System Power Switch to the ON position.

**WARNING! THE AREA INSIDE THE CONTROL PANEL HOOD CONTAINS
120VAC POWER CONNECTIONS; DO NOT REST ANY PART OF
YOUR BODY ON ANY OF THE INTERNAL COMPONENTS.**

- c. Connect the negative voltmeter probe to the PLC (-24VDC) terminal Connect the positive voltmeter probe to the PLC (+24 VDC) terminal: Verify +24 +/-3 VDC.

If the specified voltage cannot be obtained the PLC is defective.

- d. With the negative voltmeter probe connected to the PLC (-24 VDC) terminal connect the positive voltmeter probe to the Temperature Controller J1-7 terminal and verify +24 +/-3 VDC.

If the specified voltage cannot be obtained the wire run from the PLC to J1-7 is not intact.

- e. With the negative voltmeter probe connected to the PLC (-24 VDC) terminal connect the positive voltmeter probe to the Temperature Controller J1-8 terminal. Press and hold the test switch of the Temperature Controller. Verify a voltage that toggles from 0 to +24 VDC.

If the voltage does not toggle the Temperature Controller must be replaced.

- f. With the negative voltmeter probe connected to the PLC (-) terminal connect the positive voltmeter probe to the PLC Input #A1 press and hold the test switch of the Temperature Controller. Verify a voltage that toggles from 0 to +24 VDC.

If the voltage does not toggle the wire run from the Temperature Controller J1-8 to the PLC input #A1 is not intact.

If the voltage does toggle but the #A1 lamp on the PLC status indicator does not toggle on and off the PLC is defective and must be replaced.

VII. System Maintenance Procedures (continued)

O. Vapor Compressor Oil Renewal

The vapor compressor oil should be changed at least once a year or more often with heavy usage of the machine. When an oil change is anticipated the machine should be allowed to operate through normal recovery until the oil level in the compressor just falls to the bottom of the compressor sight glass. This will result in minimum oil spillage during the renewal procedure. Refer to section-F figures 8 and 9 for component location.

Required Materials:

- ◆ Straight Blade Screwdriver
- ◆ Philips Drive Screwdriver
- ◆ 1" Socket Torque Wrench
- ◆ Oil Sump Pump
- ◆ Funnel with Flexible Fill Tube
- ◆ Cloth Rags
- ◆ Vacuum Pump
- ◆ Vacuum Gauge
- ◆ Nitrogen Gas Source
- ◆ Leak Detector Fluid
- ◆ Teflon Pipe Thread Tape
- ◆ Compressor Oil 3GS 150 Grade
- ◆ Cut a ¼" refrigeration service hose to form a hose with one fitting end containing a Schrader valve core depressor and the opposite end of the hose is the open cut end
- ◆ Clean 18 ounce container

1. Place the System Power Switch to the OFF Position.
2. Disconnect the main electrical power from the machine.
3. Open the filter access door of the hood and separate the two halves of the hood fan electrical connector.
4. Remove the three screws along the top of the control panel and the three screws on both sides of the control panel hood. With a helper, lift the hood up and over the control panel.
5. Close filter maintenance ball valve MV-2
6. Place a small container under the oil sight glass of the compressor.
7. Remove the sight glass using the 1" wrench.
8. Clean any thread tape residue from the threads of the sight glass and the threads of the compressor spud.
9. Complete removal of the compressor oil by feeding a tube down into the compressor housing through the empty sight glass spud and sucking the oil out with the oil sump pump.
10. Use the funnel with the flexible fill tube to fill the compressor housing with the 3GS compressor oil until the oil level is just at the bottom of the sight glass spud.
11. Apply Teflon thread tape to the threads of the sight glass and install the sight glass back into the compressor-housing spud using the torque wrench with the 1" socket.

WARNING! DO NOT OVER TIGHTEN THE SIGHT GLASS above 20 foot-pounds of torque. DO NOT reuse the sight glass if the viewing window is cracked, scratched, or marred in any way.

12. Remove the cap from the AV-3 oil fill maintenance valve.
13. Adjust the pressure of the nitrogen source to 200 psi.

VII. System Maintenance Procedures

O. Vapor Compressor Oil Renewal (continued)

14. Connect the nitrogen source to the AV-3 access valve and pressurize the compressor housing to 200 psi. The access valve end of the connecting plumbing must contain a valve core depressor.
15. Leak test the threads of the sight glass using leak detector fluid.
16. Remove the nitrogen source and depressurize the compressor housing by depressing the valve core of the AV-3 access valve.
17. Connect the vacuum pump and vacuum gauge to the AV-3 access valve. Operate the pump to gain a minimum vacuum indication of -28 " Hg then remove the vacuum pump from the access valve and immediately complete the following final oil fill.
18. Place approximately 18 ounces of compressor refrigeration oil 3GS, Grade-150 into a container.
19. Place the open cut end of the modified hose so that it is under the surface of the oil.
20. Connect the fitting service end of the modified hose containing the core depressor onto the AV-3 access valve. The vacuum in the compressor housing will immediately begin to draw oil from the container through the hose.
21. View the compressor oil sight glass and disconnect the hose from the AV-3 access valve when the oil level is from 1/4 to 1/2 full on the sight glass.

CAUTION: Do Not Overfill the compressor with oil.

22. Reinstall the valve cap back to the AV-3 access valve.
23. Reinstall the hood and connect the hood fan electrical connector. Reconnect the main electrical power back to the machine.



Alternately:

An Oil Fill Syringe is available from Neutronics; part number 6-02-6001-51-0. The Syringe connects directly to the AV-3 access valve. The Syringe holds the oil and fills through a manual on/off valve: eliminating the need for filling through a refrigeration service hose.

VII. System Maintenance Procedures (continued)

P. Cooling System Controller Setting

The cooling controller will regulate cooling provided by the cascading refrigeration system to the plate heat exchanger and the process tank. This procedure and figure-21 will detail set point adjustments.

The upper display line of the Controller shows the measured process variable. This is the actual temperature as measured by a thermocouple probe soldered onto the bottom of the process tank. The lower display line of the Controller shows the programmed set point. The upper display line will display "OPEN" if a fault with the thermocouple probe is detected. The factory set point is -63°F.

Section-2 of this procedure will detail the calibration of the cooling system controller and section-3 lists the factory settings of the controller setup.

1. To Adjust the Cooling System Temperature Set Point:

- a. Place the machine main power switch to the ON position.
- b. Verify that the cooling system controller power switch is in the ON position.

CAUTION: The cooling system temperature controller power switch shall always be in the on position unless otherwise directed by this manual.

- c. Press the Function-key of the controller to change the upper display line to the value of the set point.
- d. Use the UP and DOWN arrow keys to change the set point value.
- e. Again Press the Function-key of the controller to change the display to normal mode.

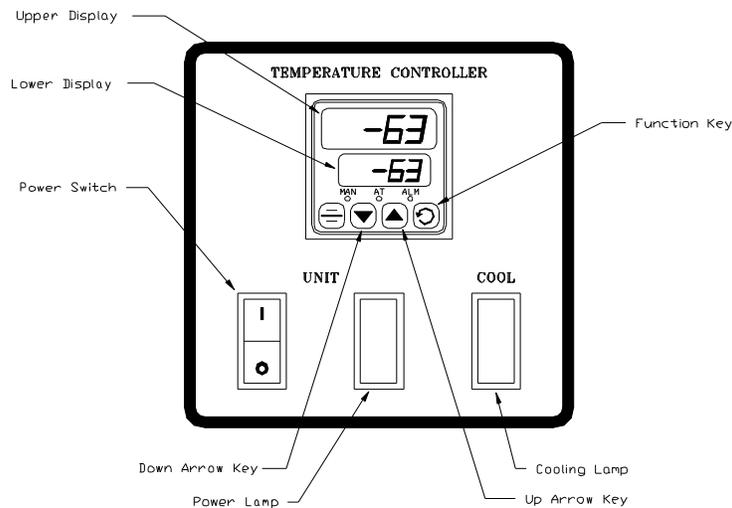


Figure 21
Cooling System Controller Detail

VII. System Maintenance Procedures

P. Cooling System Controller Setting (continued)

2. Cooling System Temperature Controller Calibration:

During AGENT processing it is normal for the Process Temperature Controller and the Cooling System Temperature Controller displays to differ by as much as 15 degrees. This is caused by the flow of AGENT into the machine and the variations of liquid and vapor levels in the process tank. When inlet recovery stops, the machine will cool the process tank and condense any vapor phase AGENT into a liquid. When the vapor is condensed, and the machine has cooled to the set point of the controller, the temperature display of the process temperature controller and the cooling system temperature controller should match within $\pm 3^{\circ}$.

If the two controller temperature displays differ by more than 5° after a cooling cycle, just after the system compressors shut down, then maintenance should be performed. First, perform the Process Temperature Controller Calibration Section-VII.N.1. of this document. The cooling system controller may then be calibrated using the process temperature controller as the reference temperature.

Allow the machine to cool to the set point of the controller and the compressors of the machine to shut down. The calibration shall be accomplished by adjusting the cooling system process display to match the Process Temperature Controller Display. When calibrating the machine must not be processing AGENT and the cooling system compressors must be off.

- a. Calibrate the Process Temperature Controller as detailed by section-VII.N.2.
- b. Place the machine main power switch to the ON position.
- c. Allow the machine to cool to the set point of the controller and the cooling system compressors to shut down. Place the Cooling System Controller Power Switch to the Off position. Then place the Cooling System Controller Power Switch back to the On position.
- d. Press and hold the Function-key then press and hold with the UP arrow key within 30 seconds after power on: the controller will enter the Select Mode. Press the Down Arrow-key so that the upper display indicates SETP. Press the Function-key: the lower line should display ULOC.
- e. Use the UP arrow key to enter the number 20 into the upper display line then press the Function-key. The controller should now enter the setup programming mode.
- f. The controller lower line should display FiLE while the upper line should display 2.0.
- g. Press the Function-key the upper display line will now indicate the process variable offset value. The bottom display will indicate OFFS.
- h. Use the UP and DOWN arrow keys to enter the difference between the Process Temperature Controller Display and what the Cooling System Temperature Controller had displayed. Negative numbers will be entered by pressing the down arrow key past the 0 display. For example: if the Process Temperature controller indicated a -70 reading while the Cooling System Controller indicated -65 then -5 should be entered as the offset value.

CAUTION: If offsets greater than ± 8 need to be entered then the thermocouple connection at the bottom of the process tank and the foam insulation should be inspected for integrity and adhesion to the bottom of the tank.

- i. Place the Cooling System Power Switch to the OFF position. Wait 1-minute then place the Cooling System Power Switch to the ON position.

VII. System Maintenance Procedures

P. Cooling System Controller Setting (continued)

3. Cooling System Temperature Controller Setup Parameters:

The cooling system temperature controller setup parameters have been factory programmed and do not need to be adjusted with the exception of the offset calibration OFFS. The below listing is for reference only or may need to be completed if installing a new controller. Set up parameters not listed below are not applicable for the machine operation and may be set to any available selection. Changing any of the Configuration Menu parameters will automatically set all of the Set Up parameters to the default settings. A detailed description of the controller setup parameter function may be found in the enclosed temperature chamber manual.

To access the Configuration Mode:

- a. Press and hold the Function-key then press and hold with the UP arrow key within 30 seconds after power on: the controller will enter the Select Mode. Press the Down Arrow-key until the upper display indicates ConF. Press the Function-key: the lower line should display ULOC.
- b. Use the UP arrow key to enter the number 20 into the upper display line then press the Function-key. The controller should now enter the configuration programming mode.
- c. Use the Function-key to step through the menu items.

Configuration Mode Factory Settings:

<u>Prompt</u>	<u>Setting</u>
inPE	tF
rul	80
rLL	-80
CtYP	SnGL
Ctrl	dir
ALA1	nonE
ALA2	nonE
LAEn	diSA
Inhi	none
USE 1	Pri
diSP	1
CLoc	20

VII. System Maintenance Procedures

P. Cooling System Controller Setting (continued)

3. Cooling System Temperature Controller Setup Parameters (continued)

To access the Setup Mode:

- a. Press and hold the Function-key then press and hold with the UP arrow key within 30 seconds after power on: the controller will enter the Select Mode. Press the Down Arrow-key so that the upper display indicates SEtP. Press the Function-key: the lower line should display ULOC.
- b. Use the UP arrow key to enter the number 20 into the upper display line then press the Function-key. The controller should now enter the setup programming mode.
- c. Use the Function-key to step through the menu items.

Setup Mode Factory Settings:

<u>Prompt</u>	<u>Setting</u>
FILE	2.0
OFFS	Adjust per the Calibration Procedure section-2
PPLJ	Power Output Read Only
Pb_P	0
diFP	.5
SPuL	80
SPLL	-80
Ctl	8
APE	diSA
PoEn	diSA
_SPr	diSA
rP	OFF (upper display is blank)
SP	-63
SLoc	20

VII. System Maintenance Procedures (continued)

Q. Inlet Vacuum Switch Calibration

The inlet vacuum switch P2 sets the pressure or vacuum level for the final evacuation of the source container.

The Factory Setting of the Inlet Vacuum Switch is $-10''$ Hg vacuum.

The vapor compressor will evacuate the source container until the set point of the Inlet Vacuum Switch is attained. When the set point is attained, the Inlet Vacuum Switch deactivates input #A6 on the PLC. This signals the PLC that the source container is empty and all inlet recovery operations will end. The following will detail the Inlet Vacuum Switch calibration. Refer to figure-23 for the location and depiction of the switch.

Calibration Procedure

Required Materials:

- ◆ Clean Dry Nitrogen Source regulated to 200 psi
- ◆ Vacuum Gauge
- ◆ $\frac{1}{4}$ " Refrigeration Service Hoses
- ◆ Straight Blade Screwdriver

1. Open the filter maintenance door of the control panel hood to gain access to the Inlet Pressure Switch adjustment screws.

WARNING! THE AREA INSIDE THE CONTROL PANEL HOOD CONTAINS 120VAC POWER CONNECTIONS; DO NOT REST ANY PART OF YOUR BODY ON ANY OF THE INTERNAL COMPONENTS.

2. Connect a source of clean dry nitrogen gas regulated to 10 psi, and the vacuum gauge to the front panel Inlet Valve of the machine as depicted by figure-22 below.

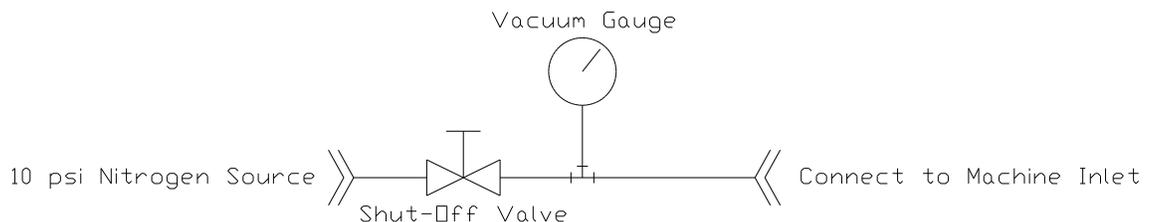


FIGURE #22: VACUUM SWITCH TEST PLUMBING

3. Open the nitrogen source to the machine.
4. Loosen the nitrogen connection at the Inlet Valve to purge air out of the connecting plumbing. Then retighten the connection.
5. Open the manual Inlet Valve of the machine.
6. Place the System Power Switch to the ON position.
7. Shut off the nitrogen supply using the installed shut-off valve so that the vacuum gauge is still open to the inlet of the machine.

VII. System Maintenance Procedures

Q. Inlet Vacuum Switch Calibration (continued)

8. Press the Start Button. The machine will immediately enter the evacuation mode. The evacuation mode will then end as the inlet section of the machine is evacuated.
IMMEDIATELY PRESS THE STOP BUTTON or the machine will attempt to vent and pump out. Observe the indication of the vacuum gauge connected to the inlet port of the machine. The reading on the gauge is the current switch set point.
9. The vacuum level set point of the switch may be increased for a higher vacuum level by turning the round adjustment screw in a clockwise direction. Turning the round adjustment screw counterclockwise will provide reduced vacuum levels up to positive pressure settings of 50 psi.

CAUTION: DO NOT adjust the square adjustment screw of the vacuum switch. The square adjustment screw sets the pressure difference between the activation pressure and the deactivation pressure. This adjustment will always be maintained at the factory setting of 5-psi.

WARNING! The machine will automatically stop processing from the source container when the pressure in source container reaches the set point of Switch. It is possible to adjust the switch to a setting resulting in Agent remaining in the source container after the machine front panel Processing Lamp goes out and automatic processing stops.

10. After adjusting the switch, repeat the inlet nitrogen pressurization and automatic evacuation until the Inlet Pressure Switch is adjusted to the desired set point.

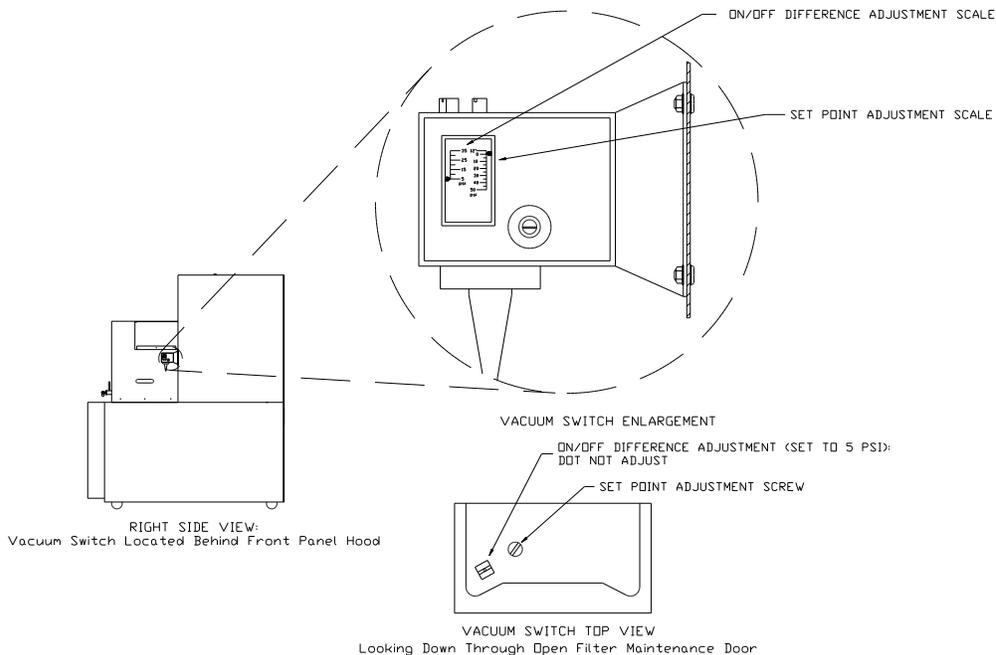


FIGURE #23: Inlet Vacuum Switch Detail

VII. System Maintenance Procedures (continued)

R. Outlet Section Maintenance

This procedure will detail the isolation and evacuation procedures required for the maintenance or replacement of any of the outlet components: Liquid Pump Particulate Filter F6, Liquid Pump LP1, Liquid Pump LP2 and Outlet Solenoid Valve SV-4. Refer to figure-13 in section-VII.K.

Machine Evacuation Procedure

Required Materials:

- ◆ AGENT Vapor Recovery Pump
- ◆ Vacuum Pump
- ◆ Leak Detector Fluid
- ◆ Evacuated AGENT Storage Cylinder
- ◆ Clean Dry Nitrogen Source regulated to 200 psi
- ◆ Vacuum Gauge
- ◆ ¼" Refrigeration Service Hoses
- ◆ Straight Blade Screwdriver
- ◆ Wrench Set

NOTE: All plumbing connections to the various access valves of the machine require SAE ¼" x 45° Female Flare connectors. Access valve locations designated by "AV" will require valve core depressors. Standard ¼" refrigeration service hoses will mate to all of the access valves and may be used to simplify all plumbing connections.

1. Place the front panel Power Switch to the OFF position and disconnect Main Electrical Power from the Machine.
2. Remove the lower left side panel of the machine
3. Remove the valve cover from the Process Outlet Manual Valve MV-4. Support the Large Hex of the valve with a wrench and rotate the center bar of the valve clockwise to close the valve.
4. Close the receiving container valves.
5. Disconnect the receiving container from the machine and cap the Outlet Port of the machine.
6. Recover the trapped AGENT from the machine pump plumbing through the AV-5 access valve.
7. Maintenance or replacement of the Liquid Pump Particulate Filter F6, Liquid Pump LP1, Liquid Pump LP2 and Outlet Solenoid Valve SV-4 may now be performed. Leak test any plumbing connections using 200 psi of nitrogen gas through the AV-5 access valve and the leak detector fluid. Depressurize the plumbing after leak testing through the AV-5 access valve.
- 8 To Clean the Liquid Pump Particulate Filter: hold the body of the filter with an adjustable wrench and rotate the large hex of the filter counterclockwise. Unscrew the hex and remove the filter screen. Empty the filter screen. Replace the filter screen and large hex back to the filter body and tighten securely.
9. Evacuate the pump plumbing to a minimum 1000-micron vacuum level using a vacuum pump through the AV-5 access valve then disconnect the vacuum pump and cap the AV-5 access valve.
10. Open the Process Outlet Manual Valve MV-4.
11. Replace the lower left side panel of the machine

VIII. Trouble Shooting Guide

A. Error Codes

The machine will discontinue automatic operation and flash the front panel Processing Lamp along with one or a combination of the front panel Liquid Level Lamps when faults are detected by the PLC.

The combination of lamps will identify the fault as listed below. Pressing the control panel Stop button will clear the fault and return the front panel lamps to their normal indicating conditions. Possible corrective actions are also listed below.

NOTE: The control panel Processing Lamp is continuously illuminated when the machine is processing in the automatic mode.

WARNING! DO NOT disconnect the AGENT source container from the inlet port of the machine when the Processing Lamp is continuously illuminated or flashing. The source container may not be fully discharged.

LOW LIQUID LEVEL LAMP and the PROCESSING LAMP FLASHING indicates a Nitrogen Vent fault.

1. Nitrogen Vent Solenoid Valve SV-3 is not opening refer to section-VIII.J.
2. The valve cap is still installed to the nitrogen vent port. Remove the cap.
3. System Temperature Controller requires maintenance. See section-VII.N.
4. System Pressure Controller requires maintenance. See section-VII.M.
5. Cooling System is not cooling. See section-VII.E. and VII.P.

MID LIQUID LEVEL LAMP and the PROCESSING LAMP FLASHING indicates a Pump Out fault.

1. Receiving container valves are not open. Open the valves.
2. Receiving container is not properly installed refer to section-IV.
3. Plumbing between the machine and the receiving container is restricted or blocked.
4. Liquid Pump is not operating refer to section-VIII.K.
5. Outlet Solenoid Valve SV-4 is not opening refer to section-VIII.J.
6. Nitrogen Supply Solenoid Valve SV-5 is not opening refer to section-VIII.J.
7. Process Tank Low Liquid Level position is bad or switch is frozen refer to section-VIII.L.
8. Outlet Check Valve CV-6 is stuck closed. Strike the body of the valve sharply with the handle of a screwdriver. If the valve does not open or continues to malfunction, replace the valve with part number A4-04-5530-01-0.
9. Liquid Pump Particulate Filter is clogged. Clean filter per section-VII.R.

VIII. Trouble Shooting Guide

A. Error Codes (continued)

HIGH LIQUID LEVEL LAMP and the PROCESSING LAMP FLASHING the liquid AGENT in the processing tank has risen to the high level.

1. Inlet Solenoid Valves SV-1 and SV-1A are not closing refer to section-VIII.J.
2. Process Tank Mid Liquid Level position is bad or switch is frozen refer to section-VIII.L.
3. Process Tank High Liquid Level position is bad or switch is frozen refer to section-VIII.L.
4. Machine has been manually filled to the high level. Manually pump out machine to Low level.
5. Receiving container valves were not closed after machine shutdown. Manually pump out machine to Low level inspect Outlet Check Valve CV-6 for operation.

MID LIQUID LEVEL LAMP, HIGH LIQUID LEVEL LAMP and the PROCESSING LAMP FLASHING indicates a Vapor Compressor High Pressure fault.

1. Any of the following manual valves may be closed Filter Maintenance Valves MV-2 and MV-3, Process Tank Inlet Valve MV-5. Locate and open the valve.
2. Compressor Discharge Pressure Switch P5 wiring to PLC input #B7 is disconnected. Ohm-out and correct wiring.
3. Plate Heat Exchanger is blocked with ice. Perform section- VII.J. Examine source AGENT for high water contamination. Perform section-VII.H.
4. Compressor Discharge Check Valve CV-3 is stuck closed. Strike the body of the valve sharply with the handle of a screwdriver. If the valve does not open or continues to malfunction, replace the valve with part number A4-04-5540-02-0.
5. Inlet Solenoid Valve SV-1A is not opening refer to section-VIII.J.
6. Process Tank Inlet Check Valve CV-4 is stuck closed. Strike the body of the valve sharply with the handle of a screwdriver. If the valve does not open or continues to malfunction, replace the valve with part number A4-04-5530-01-0.
7. Compressor Oil Separator filter F2 is clogged replace filter.

LOW LIQUID LEVEL LAMP, HIGH LIQUID LEVEL LAMP and the PROCESSING LAMP FLASHING indicates a Mid Liquid Level Indication without a Low Liquid Level Indication fault.

1. Process Tank Low Liquid Level position is bad or switch is frozen refer to section-VIII.L.

VIII. Trouble Shooting Guide (continued)

B. Machine Will Not Operate

1. Machine is not connected to the main electrical power. Connect to main power per section-IV.C.
2. Power Switch is in the off position. Place the power switch into the on position so that the power lamp is illuminated.
3. Supply circuit breakers of the machine have been tripped. Open the lower door of the machine and reset the tripped breakers. Consult the factory if the breakers continue to trip.
4. User power supply is not the one as directed by this manual. Consult the factory.

C. Cooling System will Not Operate

1. Cooling System Temperature Controller Power Switch is in the OFF position. Place the power switch to the ON position.
2. Cooling Controller requires maintenance Refer to section- VII.P: Cooling Controller Setting.
3. Refer to the enclosed PP Series Temperature Chamber Manual for further troubleshooting.

D. Cooling System is not Cooling Properly

1. Cooling Controller requires maintenance Refer to section- VII.P: Cooling Controller Setting.
2. Condenser coil is dirty. Refer to section-VII.G: Condenser Coil Cleaning.
3. Refrigerant charges are low. Refer to section-VII.E: Cooling System Pressures.
4. Refer to the enclosed PP Series Temperature Chamber Manual for further troubleshooting.

E. System Ready Lamp will not illuminate

1. Process Temperature Controller or System Ready Lamp requires maintenance refer to section-VII.N.
2. Cooling system is not operating correctly see step-C and D above.

VIII. Trouble Shooting Guide (continued)

F. Machine will not perform Inlet Processing

1. Manual inlet Valve MV-1 is not open: open the valve.
2. Start button has not been depressed: press the Start Button.
3. Front panel toggle switches are not all in the AUTO position: Place all front panel toggle switches to the AUTO position.
4. Source AGENT container outlet valve is closed: Open the valve and press Start.
5. Source AGENT container is empty: Replace the container.
6. Plumbing from the AGENT source is blocked or restricted: Repair the plumbing.
7. Inlet Vacuum Switch is not reset and requires maintenance refer to section-VII.Q.
8. Any of the following manual valves may be closed Filter Maintenance Valves MV-2 and MV-3, Process Tank Inlet Valve MV-5: Locate and open the closed valve.
9. Inlet Solenoid Valves SV-1 and SV-1A are not opening: refer to section-VIII.J.
10. Inlet Liquid Check Valve CV-1 is stuck closed. Strike the body of the valve sharply with the handle of a screwdriver. If the valve does not open or continues to malfunction, replace the valve with part number A4-04-5540-02-0.
11. Process Tank Inlet Check Valve CV-4 is stuck closed. Strike the body of the valve sharply with the handle of a screwdriver. If the valve does not open or continues to malfunction, replace the valve with part number A4-04-5530-01-0.
12. Plate Heat Exchanger is blocked with ice. Perform section- VII.J: Heat Exchanger Evacuation. Examine source AGENT for high water contamination.
13. Inlet Particulate Filter F1 is clogged. Perform section-VII.I: Inlet Particulate Filter Element Replacement.

VIII. Trouble Shooting Guide (continued)

G. Machine will not evacuate the AGENT source container.

1. Manual inlet Valve MV-1 is not open: open the valve.
2. Start button has not been depressed: press the Start Button.
3. Front panel toggle switches are not all in the AUTO position: Place all front panel toggle switches to the AUTO position.
4. Source AGENT container outlet valve is closed: Open the valve and press Start.
5. Plumbing from the AGENT source is blocked, restricted or leaking: Repair the plumbing.
6. Liquid AGENT is trapped below the outlet port of the source container. The liquid will cool as the vapor expands producing frost on the outside of the container. Heat the source container to boil off the liquid as the evacuation cycle proceeds.
7. Inlet Pressure Switch P1 set point requires maintenance refer to section-V.C.
8. Inlet Vacuum Switch P2 vacuum adjustment requires maintenance refer to section-VII.Q.
9. Vapor Compressor is burnt out or has blown seals refer to section-VIII.M: Vapor Compressor Trouble Shooting.
10. Machine is in a self-evacuation mode due to liquid AGENT present during an evacuation cycle. Refer to section-V.C: Inlet Pressure Switch Description and Adjustment.
11. Inlet Solenoid Valve SV-1, or Compressor Inlet Solenoid Valve SV-2 are not opening: refer to section-VIII.J.
12. Inlet Vapor Check Valve CV-2 is stuck closed. Strike the body of the valve sharply with the handle of a screwdriver. If the valve does not open or continues to malfunction, replace the valve with part number A4-04-5540-02-0.
13. Compressor Discharge Check Valve CV-3 is stuck open. Strike the body of the valve sharply with the handle of a screwdriver. If the valve does not close or continues to malfunction, replace the valve with part number A4-04-5540-02-0.

H. Machine Will Not Vent.

1. Nitrogen Vent Solenoid Valve SV-3 is not opening refer to section-VIII.J.
2. The valve cap is still installed to the nitrogen vent port. Remove the cap.
3. System Temperature Controller requires maintenance. See section-VII.N.
4. System Pressure Controller requires maintenance. See section-VII.M.
5. Cooling System is not cooling. See section-VII.E. and VII.P.

I. Machine Will Not Pump Out.

1. See Section-VIII.A. Error Code: MID LIQUID LEVEL LAMP and the PROCESSING LAMP FLASHING indicates a Pump Out fault.
2. Final Nitrogen Vent has not been successful see step-H above.

VIII. Trouble Shooting Guide (continued)

J. Solenoid Valve Trouble Shooting

NOTE: If valve replacement or rebuilding is required: the applicable sections of the machine must be isolated using the manual shut off valves. AGENT must be removed from the isolated section using access or solenoid valves. When repairs are completed, and leak tested, the isolated section must be evacuated to a 1000-micron minimum vacuum level before reopening the isolation valves.

1. Solenoid valve will not shut off:

- a. Solenoid valve seals are worn out. Replace solenoid valve seals and spring using rebuild kit part number A4-04-0530-00-0.
- b. Solenoid valve seals are fouled with particulates. Replace solenoid valve seals and spring using rebuild kit part number A4-04-0530-00-0. Examine particulate content to determine the source and correct as requires.
- c. Solenoid valve seals are swollen due to the introduction of refrigerants other than Agent into the machine. Evacuate the machine and rebuild valves using kit part number A4-04-0530-00-0.

2. Solenoid valve will not open during automatic processing or when the front panel switch is in the ON position:

- a. Solenoid wiring is disconnected. Ohm-out wiring and repair connection.
- b. Solenoid valve coil is open. Replace entire solenoid valve with part number A1-15-1010-00-0.
- c. Solenoid valve seals are swollen due to the introduction of refrigerants other than Agent into the machine. Evacuate the machine and rebuild valves using kit part number A4-04-0530-00-0.

3. Solenoid valve will not open during automatic processing but does open when the front panel toggle switch is placed to the ON position.

- a. PLC output fuse is blown. The fuse is located just below the PLC. Examine the fuse and replace as required with same rated fuse.
- b. Solenoid PLC wiring is disconnected. Ohm-out wiring and repair connection.
- c. PLC output section is damaged. Consult factory.

4. Solenoid valve will open during automatic processing but does not open when the front panel toggle switch is placed to the ON position.

- a. Solenoid switch wiring is disconnected. Ohm-out wiring and repair connection.

5. Solenoid valve makes a buzzing noise when energized.

- a. Solenoid wiring is defective. Ohm-out wiring and repair connection.
- b. Solenoid valve coil is burnt out. Replace entire solenoid valve with part number A1-15-1010-00-0.

VIII. Trouble Shooting Guide (continued)

K. Liquid Pump Trouble Shooting

1. Pump begins to Operate but then stops.

NOTE: If power remains applied to the pump with the pump head stopped: the thermal overload switch, located internal to the pump, will open disconnecting the pump motor from the input power. The pump will need to cool down for approximately 15-minutes before the pump will operate again.

- a. Receiving container valves are not open. Open the valves.
- b. Plumbing between the machine and the receiving container is restricted or blocked.
- c. Outlet Solenoid Valve SV-4 is not opening, refer to section-VIII.J.
- d. Outlet Check Valve CV-6 is stuck closed. Strike the body of the valve sharply with the handle of a screwdriver. If the valve does not open or continues to malfunction, replace the valve with part number A4-04-5530-01-0.
- e. **The receiving container is in a high pressure or dangerous overflow condition. Inspect the pressure and fill level of the receiving container.**

2. Pump will not operate during automatic processing or when the front panel switch is placed to the ON position:

- a. Pump is frozen with water contamination or fouled with particulates. Complete the following
 - a.1. Place the front panel Power Switch to the OFF position and disconnect Main Electrical Power from the Machine.
 - a.2. Remove the lower left side panel of the machine
 - a.3. Using a small allen-key wrench; attempt to rotate the fan blades accessible through the concentric slots in the rear of the pump motor.
 - ❖ **If the fan can be easily rotated: continue the remaining troubleshooting procedure with step-b: in the order as presented.**
 - ❖ **If the fan cannot be rotated easily, or does not rotate at all, complete step-a4.**
 - a.4. Remove the foam insulation from the pump head. Heat the pump head using a heat gun until the pump head remains warm to the touch after the heat gun is removed; again try to manually rotate the fan of the pump.
 - ❖ **If the fan does not rotate the pump head is fouled with particulates: Contact the factory or replace the pump using part number A1-15-2000-03-0.**
 - ❖ **If the fan can be easily rotated the pump is contaminated with water: complete section-VII.R: Outlet Section Maintenance.**
- b. Pump relay is not operating. Inspect the second relay mounted under the PLC unit for operation using the front panel Outlet Pump override switch to energize the relay.
- c. Pump wiring is disconnected. Ohm-out wiring and repair connection.
- d. Pump is worn out. Replace with part number A1-15-2000-03-0 per section-VII.R.

VIII. Trouble Shooting Guide

K. Liquid Pump Trouble Shooting (continued)

3. Pump will not operate during automatic processing but will operate when the front panel switch is in the ON position:

- a. PLC output fuse is blown. The fuse is located just below the PLC. Examine the fuse and replace as required with same rated fuse.
- b. Pump PLC wiring is disconnected. Ohm-out wiring and repair connection.
- c. PLC output section is damaged. Consult factory.

4. Pump will operate during automatic processing but will not operate when the front panel switch is in the ON position:

- a. Pump switch wiring is disconnected. Ohm-out wiring and repair connection.

VIII. Trouble Shooting Guide (continued)

L. Process Tank Liquid Level Switch Trouble Shooting

The AGENT liquid level inside the process tank is monitored by a three-station magnetic float switch. A 24VDC signal is sent by the system PLC to the Common Lead (black wire) of the switch. As the liquid raises the floats of the switch, a magnetic sensor connects the 24VDC to the appropriate switch output lead wire: Low Level (Red Wire), Mid-Level (Yellow Wire), and High Level (Blue Wire). The switch may be tested by first disconnecting the lead wires from the PLC inputs. Continuity from the Black wire to the various position lead wires will indicate a liquid level indication and no continuity will indicate no liquid present at that level. A dielectric breakdown tester may be used to verify switch integrity by connecting all four of the switch leads to one of the tester probes and the other test probe to the metal hex fitting of the switch.

NOTE: The liquid level switch connection wiring can be identified using the enclosed machine wiring diagram and section-VI.A: PLC Status Indicators.

NOTE: The process tank will require complete removal of AGENT before a liquid level switch is replaced and final evacuation after switch replacement. Use section-VII.K: Complete System Evacuation as a guide.

1.Liquid Level Indicators stick to the ON or OFF positions when the machine is cold but not when the machine is at room temperature.

- a. The level switch is contaminated with water. Perform section-VII.K: Complete System Evacuation.

2.Liquid Level Indicators remain OFF regardless of the machine temperature.

- a. Liquid Level Switch L2 is defective. Test and if required replace with part number A6-06-0000-00-2.
- b. Level switch wiring to the PLC Inputs is not intact. Ohm-out and correct wiring.
- c. PLC level switch input indicator number illuminates but the PLC output number does not illuminate within 1-minute. The PLC is malfunctioning consult the factory.
- d. PLC output fuse is blown. The fuse is located just below the PLC. Examine the fuse and replace as required with same rated fuse.
- e. Wiring from the PLC outputs to the Front panel level indicator lamps is not intact: verify wiring integrity, and repair as required.
- f. Front panel level indicator lamps are burnt out. Test lamps with 90 to 130 VAC and replace as required.

3.Liquid Level Indicators remain ON regardless of the machine temperature.

- a. Liquid Level Switch L2 is defective. Test and if required replace with part number A6-06-0000-00-2.
- b. The PLC is malfunctioning consult the factory.

VIII. Trouble Shooting Guide (continued)

M. Vapor Compressor Trouble Shooting

WARNING: Always place the front panel Inlet Valve Switch to the ON position whenever the Compressor Switch is placed to the ON position.

- 1. Vapor Compressor will not operate during automatic processing or when the front panel switch is placed to the ON position:**
 - a. Compressor is over heated. Allow the compressor to cool.
 - b. Compressor relay is not operating. Inspect the first relay mounted under the PLC unit for operation using the Compressor front panel override switch to energize the relay.
 - c. Compressor wiring is disconnected. Ohm-out wiring and repair connection.
 - d. Compressor start components are defective. Consult the factory.
 - e. Compressor is burnt out. Replace with compressor part number A6-06-2000-06-2.

- 2. Vapor Compressor will not operate during automatic processing but will operate when the front panel switch is placed to the ON position:**
 - a. PLC output fuse is blown. The fuse is located just below the PLC. Examine the fuse and replace as required with same rated fuse.
 - b. Compressor PLC wiring is disconnected. Ohm-out wiring and repair connection.
 - c. PLC output section is damaged. Consult factory.

- 3. Vapor Compressor will operate during automatic processing but will not operate when the front panel switch is placed to the ON position:**
 - a. Compressor switch wiring is disconnected. Ohm-out wiring and repair connection.

- 4. Vapor Compressor operates but does not produce a vacuum at the AV-3 access valve:**
 - a. Verify that check valves CV-1, CV-2 and CV-3 are not stuck in the open or closed positions. If any valves are found to be defective: replace with check valve part number A4-04-5540-02-0. Retest the vapor compressor.
 - b. If all check valves are operating correctly and the compressor still does not produce a vacuum at the AV-3 access valve then the compressor is defective: replace with compressor replacement assembly part number A6-06-2000-06-2.

IX. System Specifications

1. Recovery Performance Agent 1301 only

Recovery Efficiency: +98%
Nitrogen Removal Efficiency: 99.6% Min.
Internal Capacity: 80 lbs.
Maximum Input Pressure: 600 psig Standard (Input pressures up to 900 psi are available)
Process Rate: 1-2 lbs. / minute

2. Recycled Purity Agent 1301 only

Non-Volatile Residue: Max 0.01% by Volume
Acid Content: Max. 3.0 PPM by weight
Water Content: Max 20 PPM by Mass
Particulate Content: None Visible
Liquid Phase Purity: 99.6 mole %
Vapor Phase Purity: Less Than 1.5% by Volume

3. Filtration System

Acid Filter: 42 cubic inch
Moisture Filter: 84 cubic inch
Particulate Filter: 98% retention 1-micron liquid phase, 0.4-micron vapor phase

4. Nitrogen Separation System

Cold Venting

5. Factory Set Points: For 1301 Recovery (refer to the proper sections of the manual for 1211 settings and adjustments)

Temperature Controller Alarm #1: -55° F
Temperature Controller Alarm #2: -60° F
Pressure Controller Alarm #1: 50 psia
Pressure Controller Alarm #2: 20-25 psia
Cooling System Control Set Point: -63° F
Inlet Pressure Regulator: 250 psig
Nitrogen Supply Pressure Regulator: 80 to 140 psig
Inlet Pressure Switch: 90-100 psig
Inlet Vacuum Switch: -10 Hg
Process Tank Pressure Switch: Open 200 psig
Process Tank Pressure Switch: Close 150 psig

6. Standard Power Requirements (other single phase voltages at 50hZ are available)

Electrical: 208-230 VAC, single phase, 60 Hz, 9 kW Load

7. Miscellaneous

Warm Up Period: 20 minutes from power-up
Dimensions 38.75" Wide x 64" Deep x 70.25" Height
Weight: 1000 lbs.

8. Maximum AGENT Contamination Levels

Do Not Introduce AGENT into the equipment that is known to exceed the following levels:
Moisture in excess of 100 PPM
Oil in excess of 500 PPM
Acid in excess of 80 PPM
Particulates in excess of 80 PPM
Other Contaminates in excess of 0.5%
Nitrogen – No Limit

X. System Warranty

NEUTRONICS warrants, subject to the terms listed below, that the goods will be free from defects in design, materials, and workmanship for a period of (1) one year from the date that the goods are shipped to the buyer or commissioned in service by Neutronics personnel.

The sole liability of Neutronics for all purposes shall be to repair or replace, at the sole option of Neutronics, defects appearing within the (1) one year period. Neutronics shall have no obligation for repair or replacement unless Neutronics has received written notice of the alleged defect within the (1) one year period and the defective goods are promptly returned by the buyer to Neutronics at: 456 Creamery Way Exton, PA 19341 USA, and the defect occurs under the circumstances of proper use in accordance with all instructions and manuals provided to the buyer. Neutronics will deliver the repaired or new goods to the buyer at Neutronics expense. In no event will Neutronics be liable for any loss or damage directly or indirectly arising from the defects or from the use of the goods or from consequential or incidental damages, whether in contract, tort, or otherwise, for personal injury or property damage or any financial loss.

Buyer shall be responsible for insuring that the goods are functioning properly at all times and shall not use any goods which are not functioning properly. Buyer, therefore, agrees to indemnify NEUTRONICS from and against all losses and claims to or by any person or property caused in any manner by the goods or the use of the goods, including any expenses and attorney's fees in connection with all claims, demands, proceedings, or other expenses. Any description of the goods contained in any documents to which these warranty provisions relate, including any quotations or purchase orders relating to the goods being delivered to the buyer, are for the sole purpose of identifying the goods, and any such description, as well as any sample or model which may have been displayed to or seen by the buyer at any time, have not been made part of the basis of the bargain and have not created or amounted to any express warranty that the goods would conform to any such description or any such sample or model.

NEUTRONICS DOES NOT WARRANT THAT THE GOODS ARE FREE OF THE RIGHTFUL CLAIM OF ANY THIRD PERSON BY THE WAY OF INFRINGEMENT OF PATENT OR OTHER PROPRIETARY INFORMATION AND DISCLAIMS ANY WARRANTY AGAINST SUCH INFRINGEMENT.

It shall be the responsibility of the buyer to read carefully and abide by all instructions provided to the buyer in the instruction manual or elsewhere. If the buyer, or the employees of the buyer, did not abide by such instructions, then the alleged defect shall not be deemed to have arisen under circumstances of proper use.

The terms of these warranty provisions shall apply to all products sold by Neutronics, except filters which are considered "consumable items," and as such are not covered by the terms of these warranties. No waiver, alteration or modification of the terms of these provisions shall be valid unless in writing and signed by an executive officer of NEUTRONICS.

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