



Product Manual

Trifecta® Pro 30K Gas Supply System



Designed and Built by:

Chart Inc.

407 7th Street NW

New Prague, MN 56071 USA

(800) 400-4683



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Revision Log

Revision Level	Date	Description
A	01/01/2022	Manual Creation
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Preface

General

The Trifecta Pro 30K is the preferred solution for reliable and continuous laser assist gases for delivery pressures up to 550 psig and flow rates up to 30,000 scfh. Drawing liquid from a standard bulk tank, the Trifecta system boosts the liquid pressure by alternately feeding two liquid cylinders equipped with innovative multi-function pressure building vaporizers. The Trifecta solution utilizes a standard bulk tank, which requires no manufacturing downtime when the tank is refilled. This convenient solution eliminates high-pressure pumps, compressors, cylinder cradles and surge tanks.

Product Highlights

- System utilizes standard medium-pressure bulk tank to lower investment and use existing assets
- No downtime - system maintains pressure and flow when bulk tank is filled and eliminates product losses associated with filling high-pressure bulk tanks
- Cylinders switch by pressure instead of level to further reduce product loss and protect against pressure decay
- Robust design features streamlined all stainless-steel piping with only five control valves and one integrated electronic control system (PLC) for increased durability and reliability
- Computer-controlled design simplifies installation, start-up and continuous operation
- Frame assembly features a protective top cover in a compact footprint (72" x 84") with an elevated base for improved ventilation
- Available for nitrogen or argon (600 MAWP) service

Product Manual

The Trifecta Pro Series 30K Product Manual is designed to be used in conjunction with all Trifecta models provided by Chart. If there are any questions regarding the operation of this system, contact Chart's Technical Service division at 1-800-400-4683.

This manual contains information regarding the safe operation and handling of liquid nitrogen, argon and oxygen with this system. It should be thoroughly read and understood by anyone that operates the equipment.

The safety requirements for operating the system and handling or transporting extremely cold liquid products are shown in the Safety section. Use this safety section as a "Safety Checklist" each time the equipment is being used.

The Introduction section discusses the general features of the system and describes typical layout and flow capacity.

In the Installation section information is available on the best location of the skid, connecting piping, power supply and commissioning of the system.

For information on settings and operation of the system refer to the Operations section.

The Service, Preventive Maintenance, and Troubleshooting sections of this manual should aid in answering common questions about the system. Part numbers are also available for ease of ordering through www.chartparts.com.

Terms

Throughout this manual safety precautions will be designated as follows:



Warning! *Description of a condition that can result in personal injury or death.*



Caution! *Description of a condition that can result in equipment or component damage.*



Note: *A statement that contains information that is important enough to emphasize or repeat.*

Acronyms / Abbreviations

The following acronyms / abbreviations are used throughout this manual:

BAR	Pressure (Metric)
CGA	Compressed Gas Association
MAOP	Maximum Allowable Operating Pressure
MAWP	Maximum Allowable Working Pressure
MPT	Male Pipe Thread
NFPA	National Fire Protection Association
PB	Pressure Builder
PLC	Programmable Logic Controller
PN	Part Number
PSI	Pounds per Square Inch
PSIG	Pounds per Square Inch (Gauge)
SCFH	Standard Cubic Feet Hour

Introduction

General

Congratulations, you are now the owner of a Chart Trifecta Pro Series 30K high-pressure gas supply system.

Chart works closely with our customers to ensure the total system is designed properly, making the Trifecta system as effective as possible. Built for long-term durability and industry leading design, these systems give customers the highest performance at the lowest operating cost - all while providing a single point of contact for efficient project management.

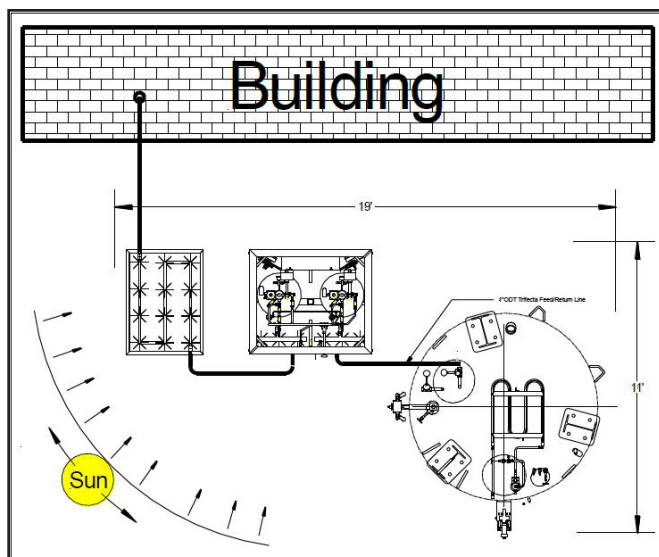
Typical Layout

There are three main components to the "Trifecta" system:

- Medium Pressure Bulk Tank (Minimum 175 psig)
- Vaporizer(s)
- Trifecta Pro 30K Skid

The Trifecta Pro 30K has been designed for ease of installation and operation. An ideal install has the Trifecta Pro Series skid close to the liquid use valve on the bulk tank, the pressure building side (back) of the skid and the vaporizer facing the sun ("heat of the day").

A typical layout is shown here:



Flow Capacity

The Trifecta Pro 30K system is designed to supply high pressure cryogenic liquid to a vaporizer, while the reserve tank is being filled with lower pressure liquid. Its priority is to maintain supply pressure at or above the required pressure setting. The unique design has self-contained diagnostics that alert the operator when the process exceeds the flow rating of the Trifecta.

The Pro Series can supply liquid nitrogen and liquid argon in a maximum allowable working pressure of 600 psi.

Service	MAWP* (psig)	MAOP* (psig)
LIN	600	550
LAR	600	550

*MAWP = Maximum Allowable Working Pressure

MAOP = Maximum Allowable Operating Pressure

The system uses ambient vaporizers to maintain pressure and convert the cryogen into gas; therefore, the performance is dependent on the weather conditions. The best ambient conditions are warm, dry air. The worst is damp air just above the freezing point.

The Pro Series was developed and tested by Chart's New Product Development group Ball Ground, GA.

For example: the Trifecta 30K is rated to deliver liquid nitrogen at 550 psi @ 30,000 SCFH in ambient conditions similar to Ball Ground. If the end user can tolerate lower delivery pressures, the Pro 30K can deliver even greater flow rates.



Note: Rated flows on standard Trifectas are not for continuous duties in excess of 8-10 hours per day. Higher duty cycles require auxiliary pressure build capacity and properly sized process vaporizers.

The flow performance depends on the ability of the total system to:

- Build pressure in the transfer tanks using gravity and ambient coils.
 - Proper air flow and sunlight reaching the pressure building coils.
 - Extreme weather conditions, and/or duty cycles, may require de-icing of the pressure building system or the addition of higher capacity vaporizers.
 - Vaporize liquid into gas to maintain pressure and flow at the use point.
 - The vaporizer must be sized for the geographical location, flow/pressure requirements and duty cycle.
 - Less than optimum sun light and air flows across the coils will reduce the performance.
 - Fill times - refilling the reserve tank from the bulk tank prior to the primary tank emptying.
 - The overall flow rate of the system can be limited by the systems ability to refill. Flow out cannot exceed flow in!
- Special care must be given in selection of the bulk tank that supplies the Trifecta.
 - The tanks heat leak performance is critical in transferring cryogen in the liquid state to the Trifecta.
 - Liquid use lines and valves out of the bulk tank must be sized properly. Small restrictive liquid lines and valves will increase fill times and increase losses.
 - The pressure building system of the bulk tank needs to be sized to build tank sub-cool. The sub-cool condition (pressure above the liquid saturation pressure) helps keep flow rates up and the cryogen in the liquid state as it travels to the Trifecta.
 - Liquid feed lines from the bulk tank to the Trifecta must be kept as short as possible. Longer liquid fill lines will lead to longer fill times and additional losses. Take great care in laying out your Trifecta system. Insulating the liquid feed line will reduce its effective length resulting in decreased fill times and reduced losses.



Safety

General

All operators should have a full and complete understanding of the content of this manual before operating the equipment described. This manual is intended to describe the operation of the equipment and not intended to supersede any site-specific standards.

As with any cryogenic system, it should be observed that any non-insulated piping can get extremely cold and should not be touched by exposed skin. If the system requires maintenance, it should be shut down and allowed to warm-up.

If maintenance is to be done on the system, such as changing valve seats, it is extremely important that the pressure be relieved from the system through the vent valves. The five transmitters can monitor the system pressure and liquid levels.

When doing maintenance on the system, it is recommended that the manual isolation valve to the bulk tank be closed.

Safety Summary

Strict compliance with proper safety and handling practices is necessary when using a cryogenic system. We recommend that all our customers re-emphasize safety and safe handling practices to all their employees and customers.

While every possible safety feature has been designed into the unit and safe operations are anticipated, it is essential that the user of the cryogenic system carefully read to fully understand all WARNINGS and CAUTION notes listed in this safety summary and enumerated below.

Also read the information provided in the Safety Bulletin for Oxygen and Inert Gases following this Safety Summary. Periodic review of the Safety Summary is recommended.



Warning! *In oxygen enriched atmospheres flammable items burn vigorously and could explode.*



Warning! *Do not permit smoking or open flame in any area where oxygen is stored, handled, or used. Failure to comply with this warning may result in serious personal injury.*

Excess accumulation of oxygen creates an oxygen-enriched atmosphere (defined by the Compressed Gas Association as an oxygen concentration above 23%). Certain items considered non-combustible in air may burn rapidly in such an environment. Keep all organic materials and other flammable substances away from possible contact with oxygen; particularly oil, grease, kerosene, cloth, wood, paint, tar, coal, dust, and dirt which may contain oil or grease.

Exposure to such an oxygen deficient atmosphere can lead to unconsciousness and serious injury, including death.



Caution! *Before removing any parts or loosening fittings, empty the cryogenic container of liquid contents and release any vapor pressure in a safe manner.*

External valves and fittings can become extremely cold and may cause painful burns to personnel unless properly protected. Personnel must wear protective gloves and eye protection whenever removing parts or loosening fittings. Failure to do so may result in personal injury due to the extreme cold and pressure in the tank.



Warning! *Accidental contact of liquid gases with skin or eyes may cause a freezing injury similar to a burn.*

Handle liquid so that it will not splash or spill. Protect your eyes and cover skin where the possibility of contact with liquid, cold pipes and equipment, or cold gas exists. Safety goggles or a face shield should be worn if liquid ejection or splashing may occur or cold gas may issue forcefully from equipment. Clean, insulated gloves that can be easily removed and long sleeves are recommended for arm protection. Cuffless trousers should be worn over the shoes to shed spilled liquid.

Do not use regulators, fittings, hoses, etc., which have been previously used in a compressed air environment. And do not use oxygen equipment for compressed air. Failure to comply with these instructions may result in serious damage to the container.



Caution! *Before locating oxygen equipment, become familiar with the relevant National Fire Protection Association (NFPA) standards for “Bulk Oxygen Systems at Customer Sites,” and with all local safety codes.*

The NFPA standard (www.nfpa.org) covers general principles recommended for installing bulk oxygen systems on industrial and institutional consumer premises.



Caution! *To prevent possible tip over, do not leave tank standing upright unless it is secured to its foundation (bolted down).*

Transporting and erection of the tank should be performed in accordance with rigging instructions available from Chart. Failure to comply with these instructions may result in serious damage to the container.

Safety Bulletin

Portions of the following information is extracted from Safety Bulletin SB-2 from the Compressed Gas Association, Inc. Additional information on oxygen, nitrogen, argon, and cryogenics is available from the CGA at www.cganet.com.

Cryogenic containers, stationary or portable, are from time to time subjected to assorted environmental conditions of an unforeseen nature. This safety bulletin is intended to call attention to the fact that whenever a cryogenic container is involved in any incident whereby the container or its safety devices are damaged, good safety practices must be followed. The same holds true whenever the integrity or function of a container is suspected of abnormal operation.

Good safety practices dictate the contents of a damaged or suspect container be carefully emptied as soon as possible. Under no circumstances should a damaged container be left with product in it for an extended period of time. Further, a damaged or suspect container should not be refilled unless the unit has been repaired and re-certified.

Incidents which require that such practices be followed include: highway accidents, immersion of a container in water, exposure to extreme heat or fire, and exposure to most adverse weather conditions (earthquake, tornadoes, etc.) As a rule of thumb, whenever a container is suspected of abnormal operation, or has sustained actual damage, good safety practices must be followed.

In the event of known or suspected container vacuum problems (even if an extraordinary circumstance such as those noted has not occurred), do not continue to use the unit. Continued use of a cryogenic container that has a vacuum problem can lead to embrittlement and cracking. Further, the carbon steel jacket could possibly rupture if the unit is exposed to inordinate stress conditions caused by an internal liquid leak.

Prior to reusing a damaged container, the unit must be tested, evaluated, and repaired as necessary. It is highly recommended that any damaged container be returned to Chart for repair and re-certification.

The remainder of this safety bulletin addresses those adverse environments that may be encountered when a cryogenic container has been severely damaged. These are oxygen deficient atmospheres, oxygen enriched atmospheres, and exposure to inert gases.

Oxygen Deficient Atmospheres



Warning! *Nitrogen and argon vapors in air may dilute the concentration of oxygen necessary to support or sustain life. Exposure to such an oxygen deficient atmosphere can lead to unconsciousness and serious injury, including death.*

The normal oxygen content of air is approximately 21%. Depletion of oxygen content in air, either by combustion or by displacement with inert gas, is a potential hazard and users should exercise suitable precautions.

One aspect of this possible hazard is the response of humans when exposed to an atmosphere containing only 8 to 12% oxygen. In this environment, unconsciousness can be immediate with virtually no warning.

When the oxygen content of air is reduced to about 15 to 16%, the flame of ordinary combustible materials, including those commonly used as fuel for heat or light, may be extinguished. Somewhat below this concentration, an individual breathing the air is mentally incapable of diagnosing the situation because the onset of symptoms such as sleepiness, fatigue, lassitude, loss of coordination, errors in judgment and confusion can be masked by a state of “euphoria,” leaving the victim with a false sense of security and well being.

Human exposure to an atmosphere containing 12% or less oxygen leads to rapid unconsciousness. Unconsciousness can occur so rapidly that the user is rendered essentially helpless. This can occur if the condition is reached by an immediate change of environment, or through the gradual depletion of oxygen.

Most individuals working in or around oxygen deficient atmospheres rely on the “buddy system” for protection - obviously the “buddy” is equally susceptible to asphyxiation if he or she enters the area to assist the unconscious partner unless equipped with a portable air supply. Best protection is obtainable by equipping all individuals with a portable supply of respirable air. Life lines are acceptable only if the area is essentially free of obstructions and individuals can assist one another without constraint.

If an oxygen deficient atmosphere is suspected or known to exist:

1. Use the “buddy system.” Use more than one “buddy” if necessary to move a fellow worker in an emergency.
2. Both the worker and “buddy” should be equipped with self-contained or airline breathing equipment.

Oxygen Enriched Atmospheres

An oxygen-enriched atmosphere occurs whenever the normal oxygen content of air is allowed to rise above 23%. While oxygen is nonflammable, ignition of combustible materials can occur more readily in an oxygen-rich atmosphere than in air; and combustion proceeds at a faster rate although no more heat is released.

It is important to locate an oxygen system in a well ventilated location since oxygen-rich atmospheres may collect temporarily in confined areas during the functioning of a safety relief device or leakage from the system.

Oxygen system components, including but not limited to, containers, valves, valve seats, lubricants, fittings, gaskets and interconnecting equipment including hoses, shall have adequate compatibility with oxygen under the conditions of temperature and pressure to which the components may be exposed in the containment and use of oxygen. Easily ignitable materials shall be avoided unless they are parts of equipment or systems that are approved, listed, or proven suitable by tests or by past experience.

Compatibility involves both combustibility and ease of ignition. Materials that burn in air may burn violently in pure oxygen at normal pressure, and explosively in pressurized oxygen. In addition, many materials that do not burn in air may do so in pure oxygen, particularly when under pressure. Metals for containers and piping must be carefully selected, depending on service conditions. The various steels are acceptable for many applications, but some service conditions may call for other materials (usually copper or its alloy) because of their greater resistance to ignition and lower rate of combustion.

Similarly, materials that can be ignited in air have lower ignition energies in oxygen. Many such materials may be ignited by friction at a valve seat or stem packing, or by adiabatic compression produced when oxygen at high pressure is rapidly introduced into a system initially at low pressure.



Warning! *If clothing should be splashed with liquid oxygen it will become highly flammable and easily ignited while concentrated oxygen remains. Such clothing must be aired out immediately, removing the clothing if possible, and should not be considered safe for at least 30 minutes.*

Nitrogen and Argon

Nitrogen and argon (inert gases) are simple asphyxiates. Neither gas will support or sustain life and can produce immediate hazardous conditions through the displacement of oxygen. Under high pressure these gases may produce narcosis even though an adequate oxygen supply sufficient for life is present.

Nitrogen and argon vapors in air dilute the concentration of oxygen necessary to support or sustain life. Inhalation of high concentrations of these gases can cause anoxia, resulting in dizziness, nausea, vomiting, or unconsciousness and possibly death. Individuals should be prohibited from entering areas where the oxygen content is below 19% unless equipped with a self-contained breathing apparatus. Unconsciousness and death may occur with virtually no warning if the oxygen concentration is below approximately 8%. Contact with cold nitrogen or argon gas or liquid can cause cryogenic (extreme low temperature) burns and freeze body tissue.

Persons suffering from lack of oxygen should be immediately moved to areas with normal atmospheres. SELF-CONTAINED BREATHING APPARATUS MAY BE REQUIRED TO PREVENT ASPHYXIATION OF RESCUE WORKERS. Assisted respiration and supplemental oxygen should be given if the victim is not breathing. If cryogenic liquid or cold boil-off gas contacts worker's skin or eyes, the affected tissue should be flooded or soaked with tepid water (105-115°F or 41-46°C). DO NOT USE HOT WATER. Cryogenic burns that result in blistering or deeper tissue freezing should be examined promptly by a physician.

Chart customer stations are designed with the following safety features:

- A vacuum maintenance system specifically designed to provide long life and all possible safety provisions.
- Safety relief devices to protect the pressure vessel and vacuum casing sized and selected in accordance with ASME standards to include a dual relief valve. While Chart equipment is designed and built to the most rigid standards, no piece of mechanical equipment can ever be 100% foolproof.



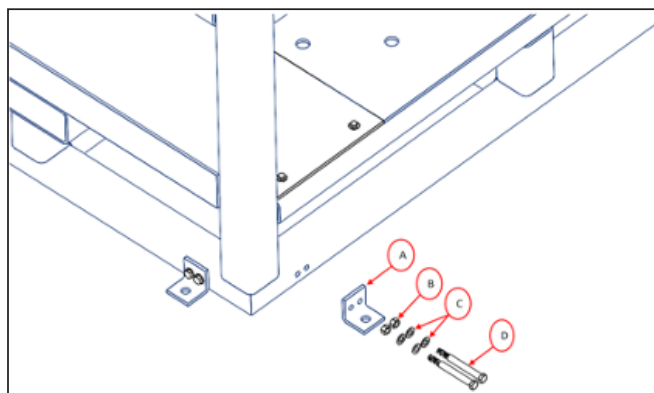
Installation

Installation Procedure

The installation of the Trifecta Pro 30K should be done in the following order:

1. Place Trifecta Pro 30K Skid on concrete pad next to bulk tank — concrete pad specifications should be in conformance with local building codes and reviewed by a licensed engineer.
2. Attach feet (A) to Trifecta 30K stand in (8) places on base of frame using hardware supplied, parts B, C, and D in pre-drilled holes:

	Description	Qty
A	FOOT	8
B	3/8-16 SS HEX NUT	16
C	3/8 SS FLAT WASHER	32
D	3/8-16 SS HEX BOLT	16



3. Pipe Trifecta 30K liquid fill line to bulk tank labeled "From Bulk Tank." For maximum efficiency, this line should be insulated and no smaller than 1. Part A is pre-drilled for anchor bolts as showing the second image below (See Fig. 1)

a. Use liquid withdrawal line on bulk tank



Note: Do not use the dip tube line.

4. Pipe Trifecta 30K gas use line to external vaporizer labeled "To Vaporizer." To minimize ice build-up on pipe, this line should be insulated (See Fig. 1).
5. Connect power supply to dedicated 120V AC, 15 amp circuit. Connect ethernet cable.
6. Commission Trifecta Pro 30K System.

Placement of Trifecta 30K Skid

The Trifecta Pro 30K skid has four lifting lugs on the top of the skid. These lifting lugs allow for placement of the skid by overhead crane. If an overhead crane is not available, the skid has fork truck access as well.



Note: The Trifecta Pro Series assembly weighs almost 4500 lbs. empty (2041 kg).

The Trifecta Pro 30K skid should be placed on the concrete pad near the bulk storage tank as seen in the Introduction portion of this manual. The skid should be placed as close to the bulk tank as possible without interfering with any other equipment or service requirements of the tank. The system requires a transfer of liquid and gas between the bulk storage tank and the Trifecta Pro 30K skid. This process becomes less efficient with increasing transfer line length.



Note: Each site may have unique requirements; however, it is recommended to follow the basic layout located in the Introduction section of this manual.

The skid should also be placed such that there is easy access to all sides of the unit. The skid should be placed where it may receive a maximum amount of sunlight and airflow. One must be able to check the individual cylinder gauges, the control box, and any of the solenoid valves or transmitters at any time. Consideration should also be given to the external vaporizer placement on the concrete pad.



Note: It is important that the sun and wind contact both the external vaporizer and pressure build coils inside the skid to insure optimal operation of the unit and prevent unusual buildup of ice.



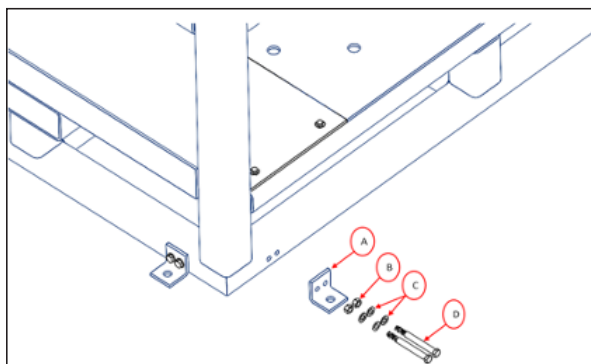
Note: Do not locate the Trifecta or Vaporizer near equipment that produces excessive moisture (i.e. cooling towers, drains, etc.)

Trifecta Pro 30K Skid - Optional Stand

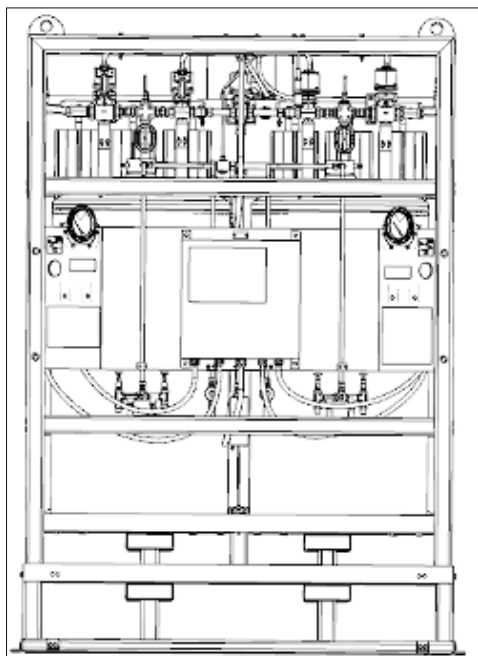
To install the optional 12" stand with the Trifecta 30K skid, follow steps on the next page.

1. Install Optional Stand on concrete pad next to bulk tank — concrete pad specifications should be in conformance with local building codes and reviewed by a licensed engineer.
2. Prior to installing Trifecta 30K skid on Optional Stand, remove feet from Trifecta 30K skid in (8) places.
3. Retain parts B, C and D supplied with frame to attach feet (See page 9, No. 3) for securing skid to stand.

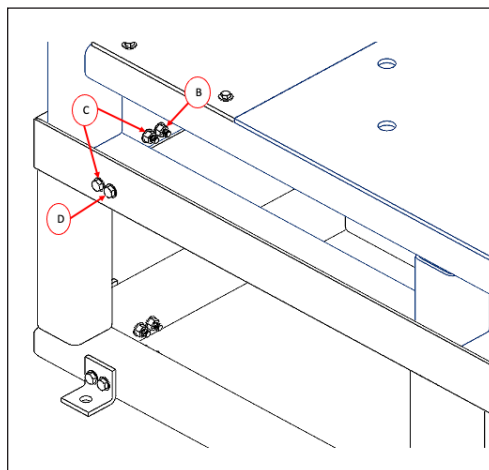
	Description	Qty
A	FOOT	8
B	3/8-16 SS HEX NUT	16
C	3/8 SS FLAT WASHER	32
D	3/8-16 SS HEX BOLT	16



4. Install skid on stand



5. Replace parts B, C, and D to secure skid to stand.



Liquid Line Piping to Bulk Tank

The Trifecta Pro 30K skid requires a liquid line piped from the bulk storage tank. This line will serve two functions. First, to allow the high pressure gas to return to the liquid side of the bulk tank (reduce losses), second, to allow the transfer of liquid from the bulk tank to the Trifecta. By removing the tube connection between A and B — shown in Fig. 1 on next page — the high-pressure vent gas can be separately piped to the gas phase of the bulk tank, or totally vented to atmosphere. Venting the Trifecta to the gas phase is often useful when the customer has a gas requirement out of the same tank.

The backside (PB Side) of the Pro Series skid has two/three connection points (See Fig. 1).

- Connection (A) serves as both the high pressure gas outlet and the liquid inlet when the tubing connection between A and B is in place
- Connection (B) is the high pressure gas outlet when the tubing connector between A and B has been removed.
- Connection (C) is the high pressure liquid outlet to the process vaporizers .

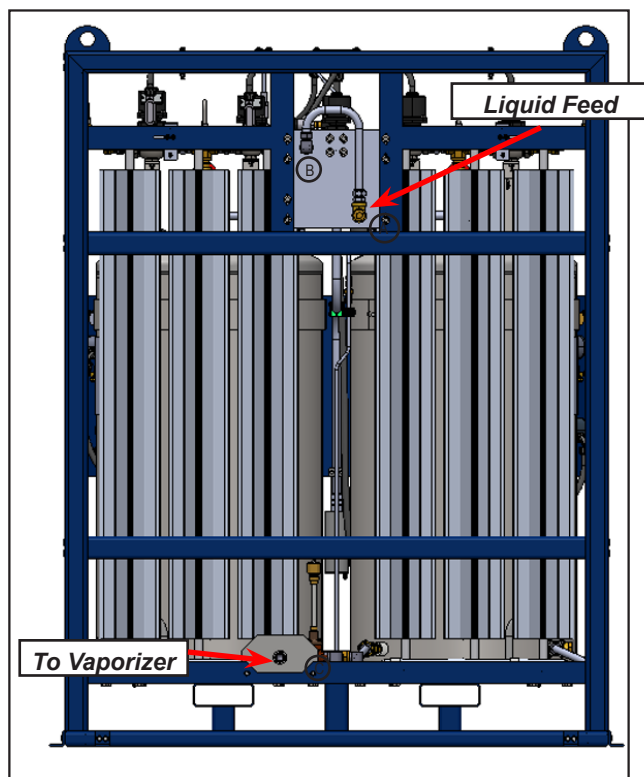


Figure 1



Note: It is recommended to insulate the liquid feed line to minimize fill times and reduce losses. The fill line (from bulk tank to Trifecta) length should be limited to 15 total feet (5 meters).



Note: The isolation valve on the bulk tank liquid line should not be opened until all plumbing connections are complete.



Note: It is important to make sure the vaporizer assembly is protected against over pressurization from trapped liquid. The vaporizer installation must include a thermal relief valve just downstream of the vaporizer, set at 720 psig for the 600 psi high-pressure Trifecta Gas Supply System



Note: The relief device (SRV-3) on the Trifecta Pro 30K is a fail-safe device and should not be relied upon as the only thermal relief. Operation of the Trifecta Pro 30K “Gas Use” relief device may vent liquid, creating a noticeable vapor cloud.

The piping and components from the Trifecta Pro 30K to the vaporizer must be at least 1” (25.4 mm) copper or its equivalent and of adequate pressure rating. Small diameter lines will introduce undesirable pressure drops and impact overall system performance. The outlet of the vaporizer should be piped to the customer house line with final line regulation as required.



Note: Installation of an additional purge valve downstream of the vaporizer is highly recommended. This valve aids in the purging of the Trifecta Pro 30K and external vaporizer. This valve will also serve as an emergency gas feed port.



Note: Ensure that the house line is rated for the maximum pressure that can be produced by the Trifecta. Include additional relief valves and line regulation as required.

Piping to Vaporizer

The Trifecta Pro 30K system does not contain final vaporization. Consequently, one or more freestanding, external vaporizer(s) must be connected to the “To Vaporizer” line of the Trifecta Pro 30K. The vaporizer(s) should have a pressure rating of at least 700 psig.



Warning! Do not set operating pressure higher than the lowest relief device!

Bulk Tank Pressure Transmitter

The system controller requires the pressure input of the bulk tank to perform the filling procedure as efficiently as possible. This is done through a pressure transmitter. The pressure transmitter measures the pressure of the bulk tank and sends an electrical signal back to the controller. The transmitter for the bulk tank is located in the upper piping of the Trifecta Pro 30K and pre-wired into the control box. No additional piping is required by the customer to receive the bulk tank pressure; this will automatically read the current bulk tank pressure, unlike previous models.

Electrical Power Supply

A dedicated 120-volt AC, 60 Hz, 15 amp circuit must be provided to power the Trifecta Pro 30K control system. If 120 VAC is not available, an appropriately sized transformer may be necessary.

The Allen Bradley PLC is mounted within a NEMA 4 control box as shown in the following photograph (Fig 2)

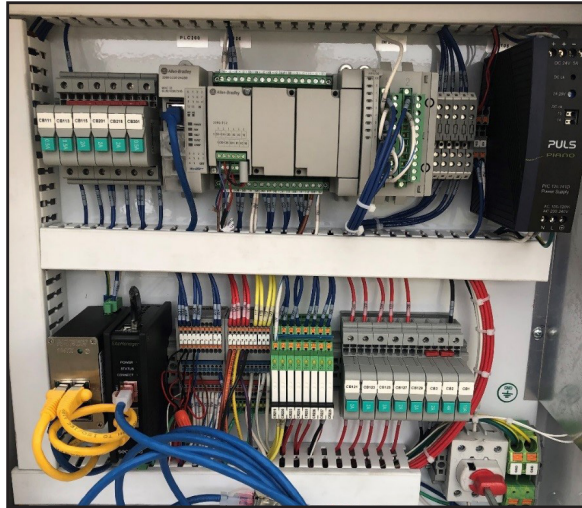


Figure 2 - Allen Bradley Control Panel

It is important that care is taken to install the Trifecta Pro 30K system on a dedicated electrical power circuit that is clean and protected. Circuits that are susceptible to noise and brownouts may cause erratic system behavior. Care should also be taken to avoid installation on a circuit that regularly gets turned on and off to provide power to another piece of equipment (lights, heaters, cooling systems etc.). It should be recognized that a PLC (computer) controls the Trifecta Pro 30K system and a clean, steady circuit must be used to power the Trifecta Pro 30K system. Connecting the Trifecta to a circuit that is backed up by a generator might also be advantageous.

Commissioning

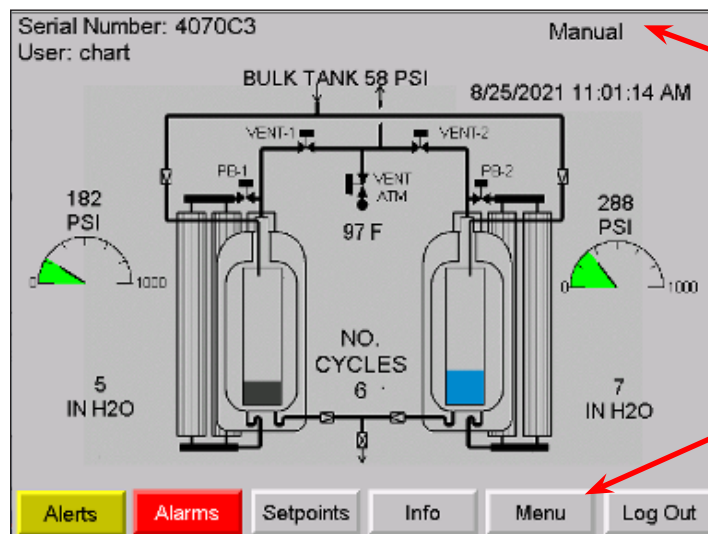
The following procedures should be followed when first commissioning the Trifecta.



Warning! *It is important to purge the entire Trifecta Pro 30K and piping with warm, dry nitrogen before running the system with liquid. Water vapor can cause ice crystals to form that may cause the solenoid valves and other critical components to operate improperly.*

Purge and Pre-Charge of the Trifecta Pro 30K (Ref. to Fig. 4, Pg. 23 for valve tags)

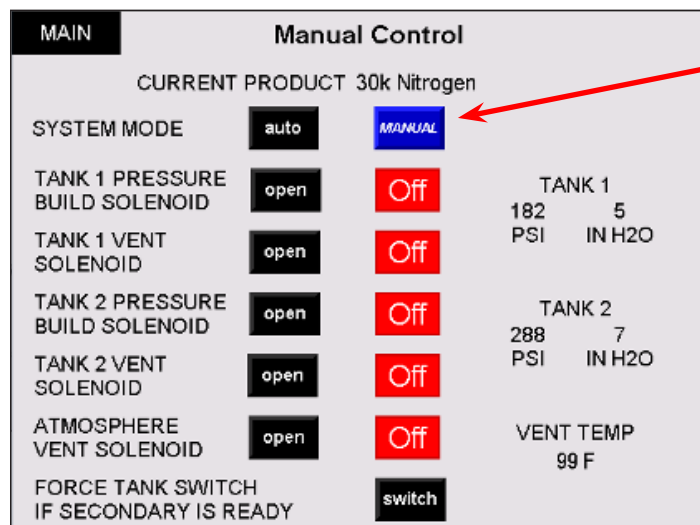
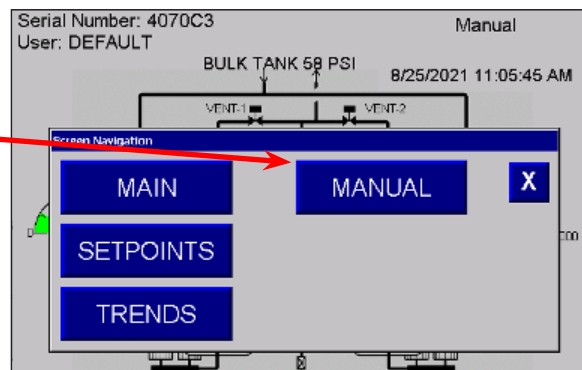
Verify that the controller is in the manual mode (see details below) and all valves are closed.



Before beginning purging, in the top right hand of the screen should say "Manual." If it says "Automatic," you will need to change it to manual

First, you will touch the Menu button on the screen. This will bring up a pop up box.

Then touch the "Manual" button on the screen.



Then press the "Manual" button, which should be blue when it is in manual mode.



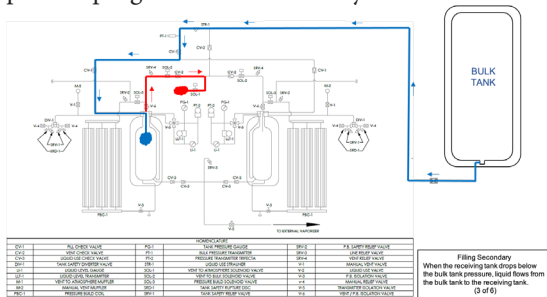
Note: The manual control screen can be used to manually open/close all the solenoid valves. This will be required for initially purging the Trifecta and for troubleshooting.

Purge and Pre-Charge of the Trifecta 30K Cont.

- Crack both of the 1/4" Swagelok® nuts on the bottom of the two Wika liquid level gauges (LL-1) until you can hear nitrogen gas flowing. Purge through both the high and low phase connections on both LL gauges for 10 to 15 seconds.

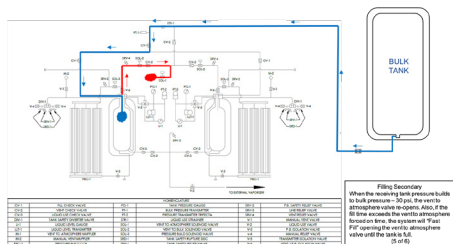


- Ensure that each 1/4" nut is tightened back up after purging.
- Open the purge valves on the safety circuit.

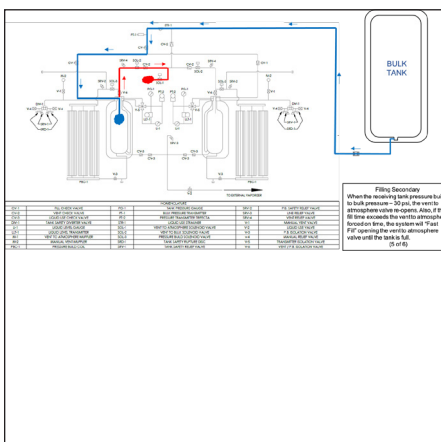


Purge and Pre-Charge of the Trifecta 30K Cont.

- Open the P.B. Isolation valve on the bottom of tank 1 and tank 2 (V-3)

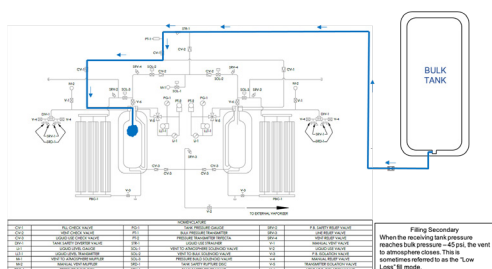


- Allow purge gas to flow out of each port where the ½" plug was removed for 10 to 15 seconds.
- Close the P.B. Isolation valves on the bottom of tank 1 and tank 2 (V-3).

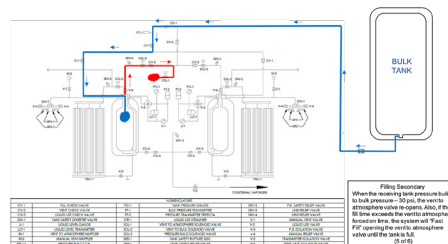


Note If isolation valves are present in place of the 1" plugs and auxiliary pressure build vaporizers are installed, ensure that you purge through the auxiliary PB vaporizers before filling the trifecta tanks with liquid.

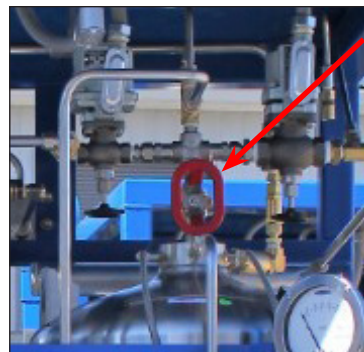
- Retape the 1" plugs and install them back into each cross from which they were removed.



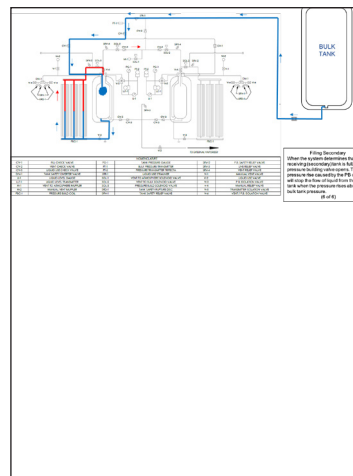
- Open the P.B. Isolation valve on the bottom of tank 1 and tank 2 (V-3).



- Open VENT/PB Isolation valve on the top of tank 1 and tank 2 (V-6). Leak check the 1" plugs that were removed for purging.

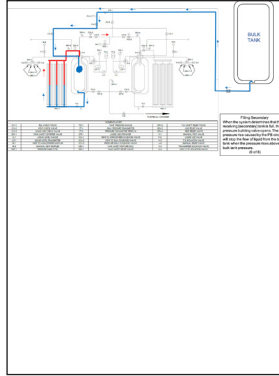


- Check recipe and settings in control panel for correctness (see Operation).
- Slowly open the use valve (V-2).



Purge and Pre-Charge of the Trifecta 30K Cont.

- Leak check all pressurized lines.
- If you have a courtesy valve downstream of the process vaporizer, open it in order to purge the vaporizer(s).
- If you do not have a courtesy valve, you can close the use valve and remove a safety downstream of the process vaporizer. Then slowly open the use valve (V-2) and purge through the vaporizer(s).

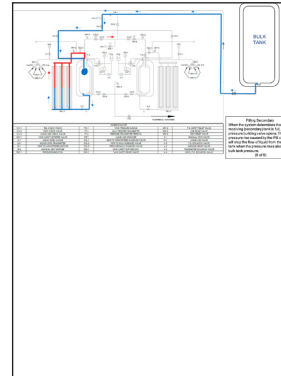


- While you're purging out the use valve(V-2) open the vent to bulk solenoid valves and the vent to atmosphere solenoid valve on the Manual Control Screen (Fig. 3), in order to purge through the auto vent plumbing circuits.
- Close the use valve (V-2).
- Open the liquid line on the bulk tank and let it equalize with the Trifecta Pro 30K.
- Press the AUTO button on the manual control screen. This will start the fill process.

MAIN		Manual Control	
CURRENT PRODUCT 30k Nitrogen			
SYSTEM MODE	auto	MANUAL	
TANK 1 PRESSURE BUILD SOLENOID	open	Off	TANK 1 182 5 PSI IN H2O
TANK 1 VENT SOLENOID	open	Off	
TANK 2 PRESSURE BUILD SOLENOID	open	Off	TANK 2 288 7 PSI IN H2O
TANK 2 VENT SOLENOID	open	Off	
ATMOSPHERE VENT SOLENOID	open	Off	VENT TEMP 99 F
FORCE TANK SWITCH IF SECONDARY IS READY	switch		

Figure 3 - Manual Control Screen

- From the Manual Control Screen, put the unit into Auto by pressing the Auto Button (See Fig. 3). Both tanks should now begin to fill and pressurize.
- Once both tanks are filled and pressured up, allow all lines to thaw.
- Leak check entire system at operating pressure.
- Slowly open the use valve (V-2) to pressure up the process vaporizer and house lines.



- Leak check the house lines at operating pressure.

Check Trifecta Pro 30K Cylinder Relief Valves

Check each cylinder's main relief valves. During operation, the pressure in tank one and/or two will rise to approximately 550 psig. The relief valve must not open. If it does, the valve should be replaced as it is opening at a pressure that is too low. Repeat same procedure on tank two. Open diverter valve for each cylinder to verify secondary set of safety devices.

Operation

The Trifecta Pro 30K operation is based on pressure first and liquid level second. This logic assures that the system pressure is maintained. Pressure is the primary concern.

Hard Sets (Complete Parameter List)

The following tables are intended to give detailed information on the internal parameters. Most of these settings are hard-coded into the program and password protected. They cannot be changed by the operator.

Description	600 psi Ar.	600 psi N2
ID	11	12
MAWP (psi)	600	600
Tank ID (in)	28	28
Tank Over Pressure Bulk (psi)	590	590
Tank Over Pressure ATM (psi)	590	590
ATM Temp LOLO Alarm (degF)	-260	-280
ATM Temp LOLO Timer (sec)	3	3
ATM Temp LOLO Disarm (sec)	120	120
Primary Too Low to Assist SP (in)	25	25
Secondary Too Low to Assist SP (in)	85	85
Default Bulk Critical SP (psi)	150	150
Fill Level SP (in)	46	29
Bulk Vent to ATM SP (psi)	40	40
Low Loss SP (psi)	45	45
Vent Loss SP (psi)	30	30
Fill Time Resulting in Vent Opening (sec)	300	300
Fill Time Resulting in Alarm/Alert (sec)	360	360
Start Flow Timer (in)	25	25
Stop Flow Timer (in)	18	18
Flow Timer Exceeds 4in (sec)	113	113
Vent ATM Freeze Alarm (degF)	-260	-280
PB ON Default SP (psi)	525	525
PB OFF Adder SP (psi)	25	25
PB ON Upper Limit SP (psi)	550	550
Fast Drop On PB SP (psi)	10	10
Pressure Drop Fast (sec)	10	10
Secondary PB On (psi)	50	50
Secondary PB OFF SP (psi)	25	25
Secondary Pressure Assisting to Primary When Below PB ON SP (sec)	10	10
Freeze Error Code (sec)	120	120
Customer Low Pressure SP	50	50

Description	600 psi Ar.	600 psi N2
Safety Valve Enable (0=Disabled, 1=Enabled)	0	0
Bulk Tank Pressure Transmitter Scale Min Value (mA)	4	4
Bulk Tank Pressure Transmitter Scale Max Value (mA)	20	20
Bulk Tank Pressure Transmitter Span Min Value (psi)	0	0
Bulk Tank Pressure Transmitter Span Max Value (psi)	500	500
Bulk Tank Pressure Transmitter Too Low Error SP (psi)	-5	-5
Bulk Tank Pressure Transmitter Too High Error SP (psi)	600	600
Tank Pressure Transmitter Scale Min Value (mA)	4	4
Tank Pressure Transmitter Scale Max Value (mA)	20	20
Tank Pressure Transmitter Span Min Value (psi)	0	0
Tank Pressure Transmitter Span Max Value (psi)	600	600
Tank Pressure Transmitter Too Low Error SP (psi)	-5	-5
Tank Pressure Transmitter Too High Error SP (psi)	630	630
Tank Level Transmitter Scale Min Value (mA)	4	4
Tank Level Transmitter Scale Max Value (mA)	20	20
Tank Level Transmitter Span Min Value (in)	0	0
Tank Level Transmitter Span Max Value (in)	100	100
Tank Level Transmitter Too Low Error SP (in)	-0.5	-0.5
Tank Level Transmitter Too High Error SP (in)	100	60

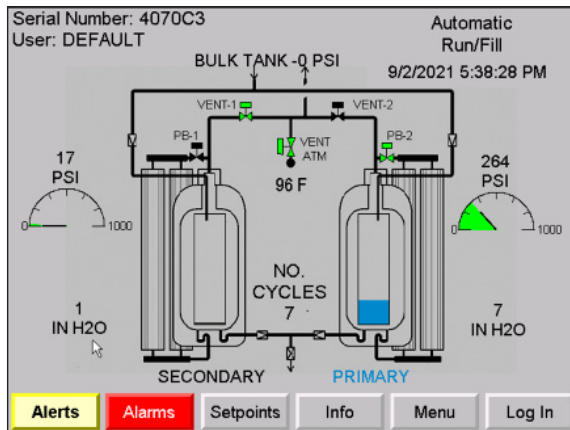
600 PSI MAWP N2

Below are the different set points for different services. These settings will be the default settings.

Fill Level	Nitrogen	Argon
Adjustable	29"	46"
Temperature	Nitrogen	Argon
Hard Set	-280	-260

HMI Screens

MAIN Screen



Serial Number field — Displays Serial Number of Unit when logged in as user other than default

User field — Shows current logged in user

Auto/Manual field — Displays if the Trifecta is in Auto or Manual mode

Status field — Displays the status of the Trifecta when in **Auto**

- **Run/Fill** — Secondary tank is filling
- **Run/PB Hold** — Secondary tank is building pressure
- **Run/Ready** — Secondary tank is ready to be used
- **Run/Assist** — Secondary tank is being called for assist

Date & Time field — Displays current date and time

Bulk Tank field — Displays the pressure of the liquid coming from the bulk tank

Pressure gauges — Shows pressure of tanks 1 and 2

Level gauges — Displays the level of tanks 1 and 2. Primary tank's level is shown in blue

Vent Temperature field — Displays the temperature at Trifecta's vent to atmosphere

Valve indicators — Displays the status of Trifecta's five valves. Green indicates the valve is open

Cycle Count field — Displays the number of cycles the Trifecta has had. Users may tap on the Cycle Count to open RESET COUNTS popup

Primary/Secondary fields — Displays which tank is presently the Primary tank and which is the Secondary.

Alerts/Alarms button — Displays ALERTS and ALARMS screens, respectively

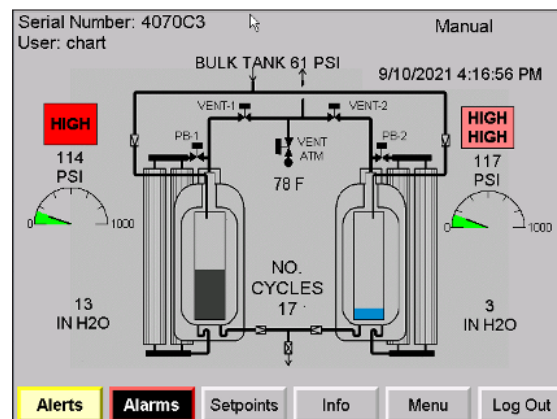
Setpoints — Brings user to Setpoints popup

Info button — Displays the INFO popup

Menu — Displays the SCREEN NAVIGATION popup

Login/Logout — Displays the Login popup is logged in as default. Logs out the current user if logged in as user other than default.

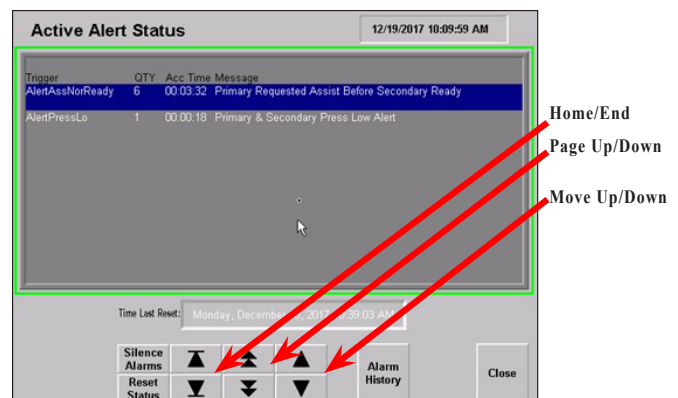
HIGH/HIGH HIGH ALARM Screen



High/High High Pressure popups — Display that a High (tank overpressure) or High High (Pressure transmitter fault) has occurred

High High Level popups — displays that a High High Level (Level transmitter fault) has occurred

Alert Screen



Alert Screen Cont.

Date & Time field — Displays current date and time

Alert Table

- **Trigger Column** – Displays label of Alert
- **Qty** – Displays number of times Alert has been triggered since Time Last Reset
- **Acc Time** – Displays Accumulated time of Alert since Time Last Reset
- **Message** – Description of Alert



Note: Selected Alert is shown with a blue background and white text

Time Last Reset — Date and Time of last Reset Status

Silence Alarms button — Stops strobe light on control panel from flashing if currently flashing. Will also silence any alarms running to the customer facility from customer alarm relay

Reset Status — Resets Quantity count and Accumulation Time of each Alert and Alarm trigger

Home — Jumps to first Active Alert

End — Jumps to last Active Alert

Page Up — Moves up 1 page of Active Alerts

Page Down — Moves down 1 page of Active Alerts

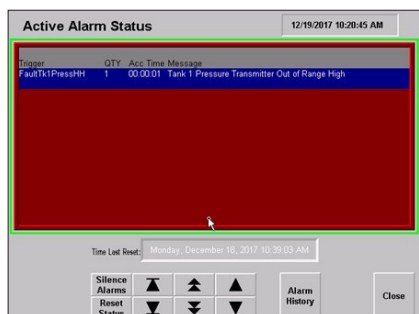
Move Up — Scrolls up Active Alerts

Move Down — Scrolls down Active Alerts

Alarm History — Opens the ALARM & ALERT HISTORY Screen

Close — Returns to MAIN Screen

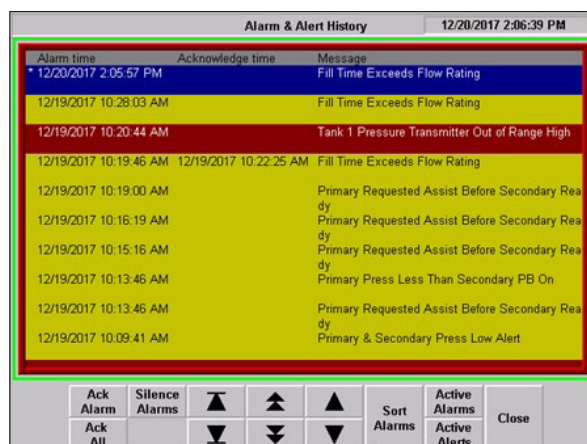
ALARM Screen



Displays the Active Alarms (Shutdown Alarms)

ALARM & ALERT HISTORY Screen

Displays the history of Alarms and Alerts



Note: Alerts are shown with a yellow background and black text. Alarms are shown with a red background and white text. Selected Alarm/Alert is shown with a blue background and white text.

Ack Alarm button — Acknowledges selected Alarm/Alert

Ack All — Acknowledges all Alarms and Alerts

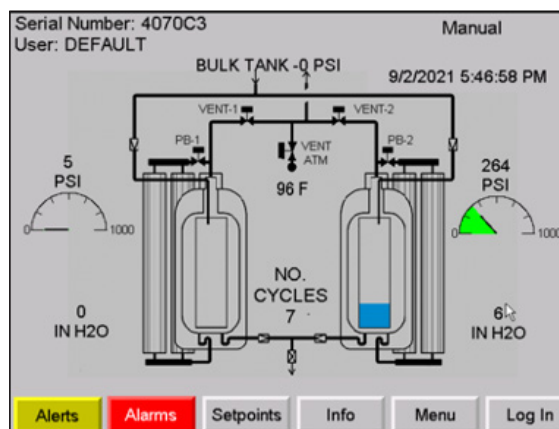
Clear All — Clears all Alarms and Alerts from History

Sort Alarms — Sorts the history by time or by trigger

Active Alerts — Displays the ACTIVE ALERTS screen

Active Alarms — Displays the ACTIVE ALARMS screen

RESET COUNTS Popup



Current Cycle Time field — Amount of time for the current cycle

Prev. Cycle Time — Amount of time for previous cycle

Cycle Count — Number of cycles Trifecta has had since last reset

Reset — Resets cycle count to 0. A non-resettable counter can be found on a password protected screen.

INFO Popup

PLC Rev field — Revision of PLC Program running on unit

HMI Rev — Revision of HMI Program running on Trifecta

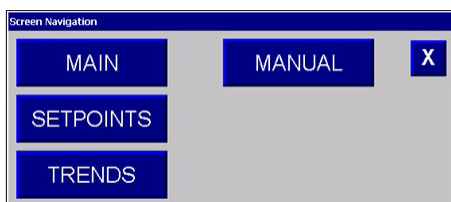
Trifecta Service # — Chart Customer Service phone number

Serial Number — Serial number of the Trifecta

Current PLC Program — Current recipe running on the Trifecta PLC

User — User currently logged into unit

Enclosure Temp — Temperature inside of the Control Panel

SCREEN MENU NAVIGATION Popup**ACTIVE SETPOINT Screen**

ACTIVE SETPOINTS - 30k Nitrogen			MAIN
29.0	Fill inches	reset	Reset to Default Setpoints
525.0	Pressure Build (PB) On		
150.0	Default Bulk Critical		
550.0	Pressure Build (PB) Off	-0.3	Bulk Tank Level Snapshot
475.0	Reserve PB On	39.6	Vent to Atm On SP
500.0	Reserve PBOff	-45.4	Vent to Atm Off SP
535.0	Fast Drop PB Setpoint	-30.4	Vent Low Loss SP
4.4	Primary Too Low to Assist	300	Slow Fill Time Resulting in Vent Open (sec)
24.7	Secondary Too Low to Assist		
590.0	Tank 1 Pressure relief setpoint		
590.0	Tank 2 Pressure relief setpoint		MS Settings

Fill Inches field — The level to fill tanks to

Pressure Build (PB) On — The pressure at which to begin Pressure Build on Primary Tank

Default Bulk Critical — Displays Bulk Tank Pressure at which Trifecta will only vent to atmosphere

Reset — Resets setpoints to default settings

Pressure Build (PB) Off field — The pressure at which Pressure Build will stop

Reserve PB On — The pressure at which to begin PB on Secondary Tank if not assisting

Reserve PB Off — The pressure at which PB of Secondary Tank will stop

Fast Drop PB Setpoint — The pressure at which to begin Pressure Build if Pressure is dropping fast

Primary Too Low to get an assist — The level at which the primary tank will automatically switch to the secondary tank (low level value is programmed into the hard sets of the PLC)

Secondary Too Low to Assist — The level at which the Secondary Tank is too low to assist the primary tank (75% of the current liquid level setpoint) and a primary tank switch will occur.

Level SP -1.5 — The adjusted fill level if pressure in Secondary Tank is greater than 130 psi at the end of the fill cycle

Level SP +1.5 — The adjusted fill level in pressure in Secondary Tank is less than 80 psi at the end of the fill cycle

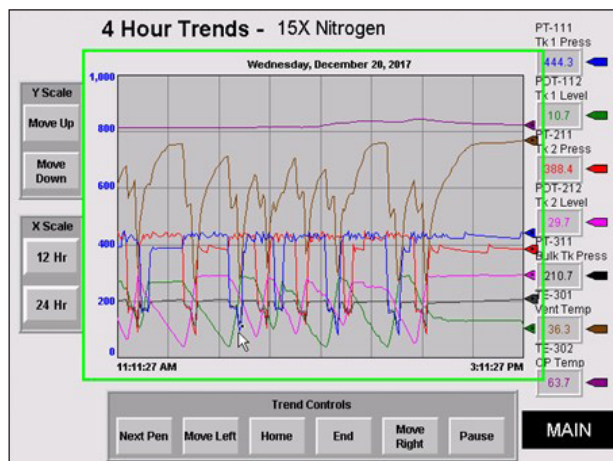
Bulk Tank Level Snapshot — The point at which the PLC takes a snapshot of the bulk tank pressure to determine when to turn on and off the vent to atmosphere during the filling process.

Vent to ATM on SP (initial depressurization) — The pressure at which a Secondary Tank will begin Vent to Atmosphere if it drops below

Vent to ATM Off SP (while filling) — The pressure at which a Secondary Tank will stop Venting to Atmosphere if it drops below

Vent Low Loss SP (while filling) — The pressure at which a Secondary Tank will resume Venting to Atmosphere if it rises above

TREND Screen



Tk1 Press field — Pressure of Tank 1 in psig

Tk1 Level — Level of Tank 1 in H₂O

Tk2 Press — Pressure of Tank 2 in psig

Tk2 Level — Level of Tank 2 in H₂O

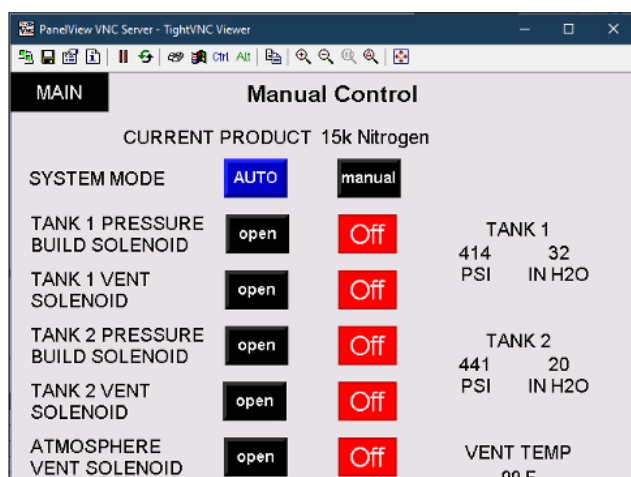
Bulk Tk Press — Pressure of the Bulk Tank in psig

Vent Temp — Temperature at the vent in °F

CP Temp — Temperature in the Control Panel in °F

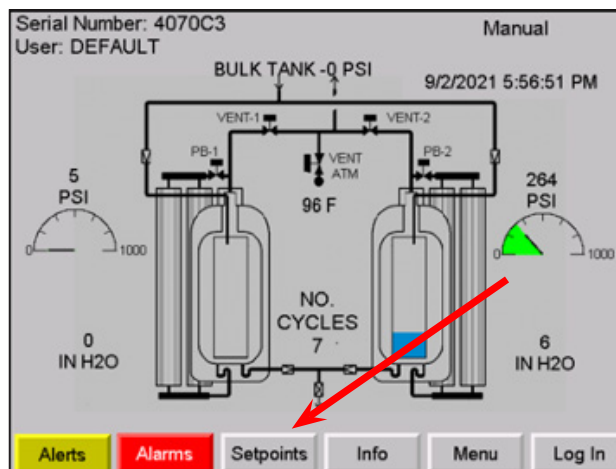
Next Pen — Toggles Active Pen

MANUAL CONTROL Screen



When system is in “manual,” the operator can manually open each solenoid valve by touching the “open” buttons. This screen can also be used to force a tank switch. See Service Section for details.

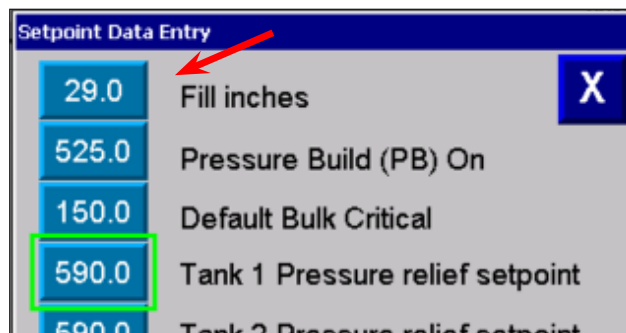
Parameter Settings



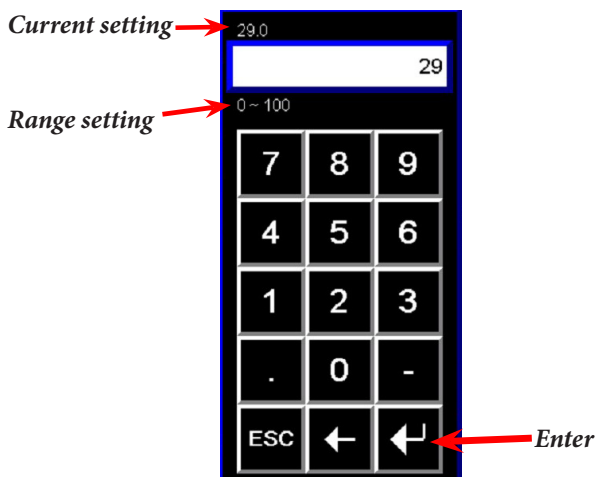
These settable parameters are accessible from the HMI “Setpoints” button. These parameters are key to setting all parameters. To get the adjustable setpoints, the “Setpoints” button will bring up the “Setpoint Data Entry” popup menu. Here you can adjust the fill inches. Pressure Build On and the Bulk Critical.

FILL SETPOINT

Pressing of “Fill inches” button will bring up another popup window.



Here you can enter a new value and press enter to save it.



Pressure Build Setpoint

Pressing of the “Pressure Build” button will bring up another popup window.

Setpoint Data Entry		X
29.0	Fill inches	
525.0	Pressure Build (PB) On	
150.0	Default Bulk Critical	
590.0	Tank 1 Pressure relief setpoint	
590.0	Tank 2 Pressure relief setpoint	

Here you can enter a new value and press enter to save it.

Current setting → 425.0

Range setting → 200 ~ 450

7	8	9
4	5	6
1	2	3
.	0	-
ESC	←	↵



Note: “PB OFF” setpoint will be automatically set to 25 psig above the “PB ON” setpoint.

Bulk Critical Setpoint

Pressing of the “Bulk Critical” button will bring up another popup window.

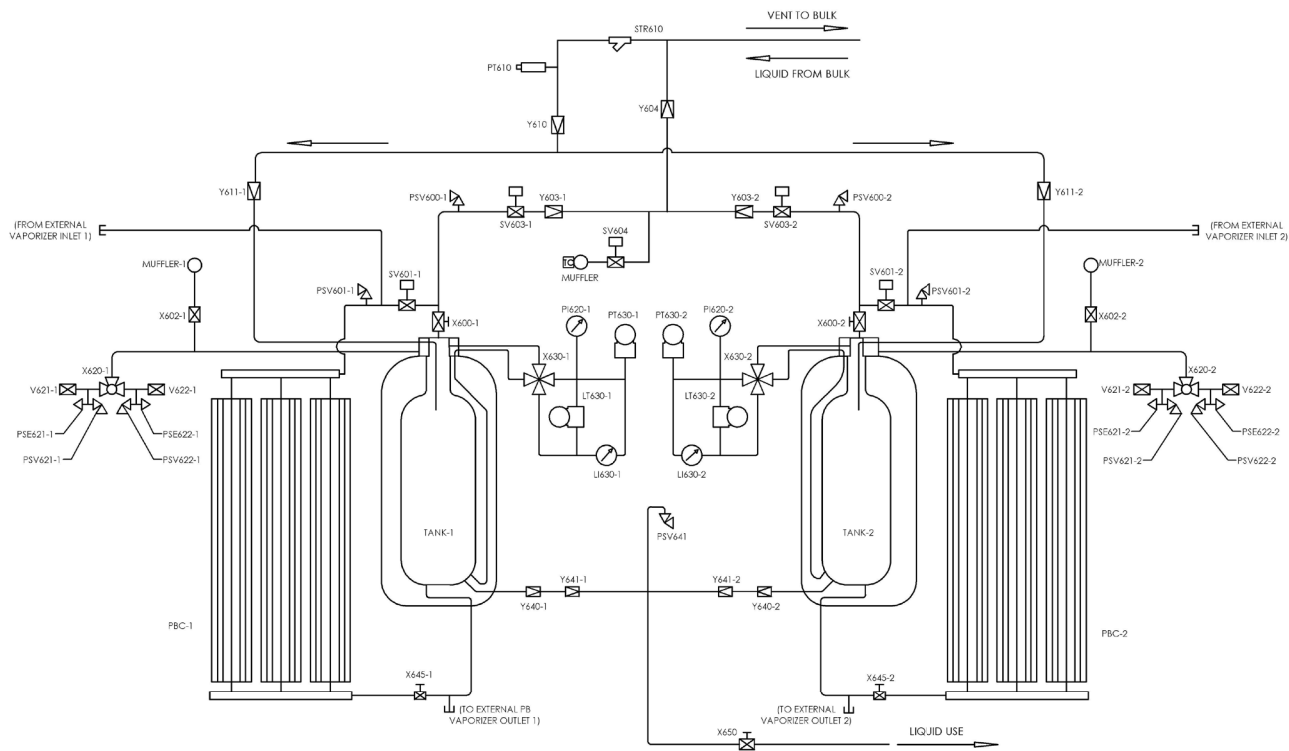
Setpoint Data Entry		X
29.0	Fill inches	
525.0	Pressure Build (PB) On	
150.0	Default Bulk Critical	
590.0	Tank 1 Pressure relief setpoint	



Note: Since the tanks are warm upon initial installation, they may vent for several minutes before they are cold enough to accumulate liquid.

Operation Details

The Trifecta Pro Series 30K logic keys on pressure instead of liquid level. The components have been minimized (reduced) yet the design has duplication of key components.



NOMENCLATURE					
CV-1	FILL CHECK VALVE	PG-1	TANK PRESSURE GAUGE	SRV-2	P.B. SAFETY RELIEF VALVE
CV-2	VENT CHECK VALVE	PT-1	BULK PRESSURE TRANSMITTER	SRV-3	LINE RELIEF VALVE
CV-3	LIQUID USE CHECK VALVE	PT-2	PRESSURE TRANSMITTER TRIFECTA	SRV-4	VENT RELIEF VALVE
DIV-1	TANK SAFETY DIVERTER VALVE	STR-1	LIQUID USE STRAUNER	V-1	MANUAL VENT VALVE
LI-1	LIQUID LEVEL GAUGE	SOL-1	VENT TO ATMOSPHERE SOLENOID VALVE	V-2	LIQUID USE VALVE
LLT-1	LIQUID LEVEL TRANSMITTER	SOL-2	VENT TO BULK SOLENOID VALVE	V-3	P.B. ISOLATION VALVE
M-1	VENT TO ATMOSPHERE MUFFLER	SOL-3	PRESSURE BUILD SOLENOID VALVE	V-4	MANUAL RELIEF VALVE
M-2	MANUAL VENT MUFFLER	SRD-1	TANK SAFETY RUPTURE DISC	V-5	TRANSMITTER ISOLATION VALVE
PBC-1	PRESSURE BUILD COIL	SRV-1	TANK SAFETY RELIEF VALVE	V-6	VENT / P.B. ISOLATION VALVE

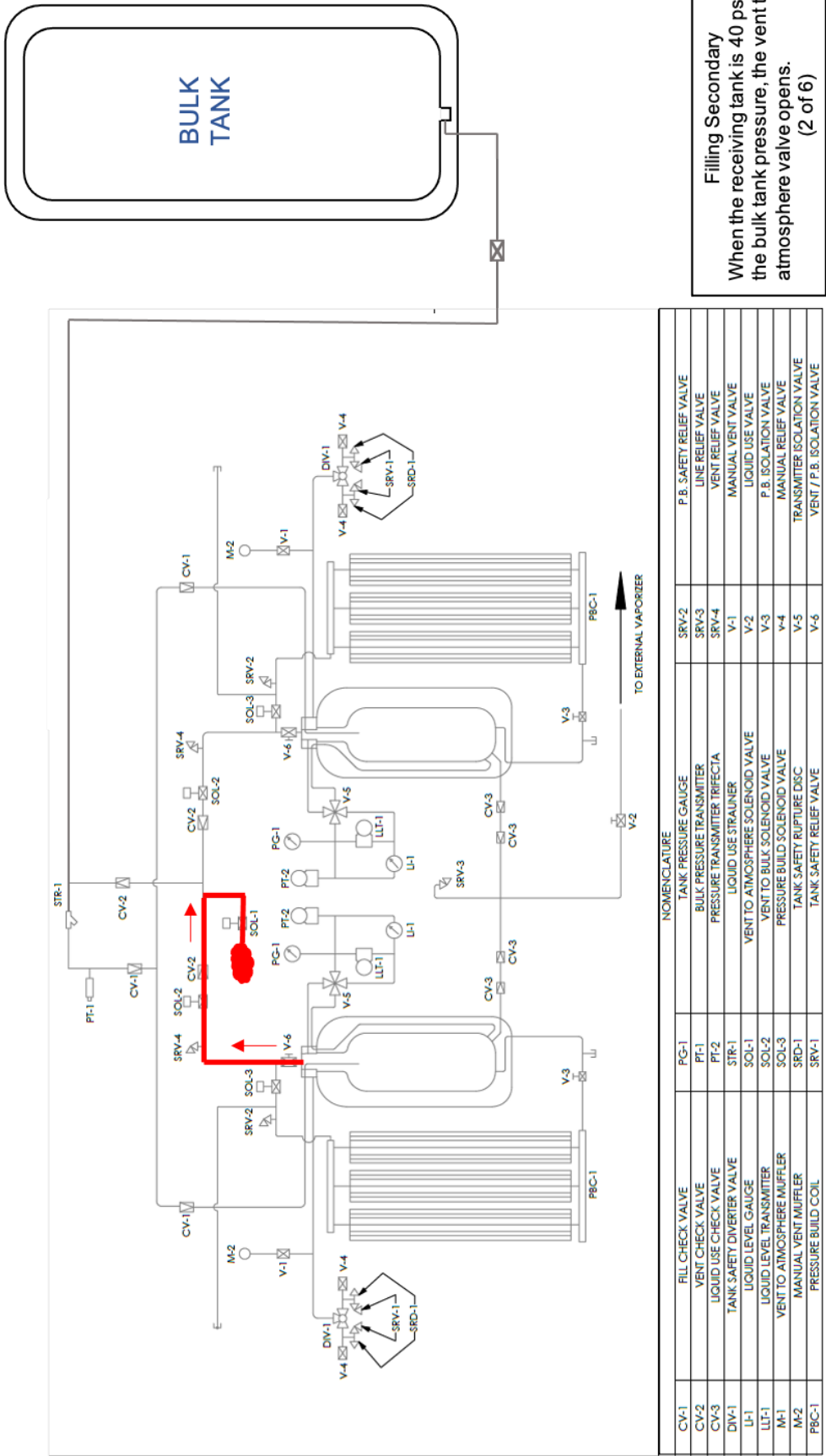
Figure 4 - Schematic

There are four key modes:

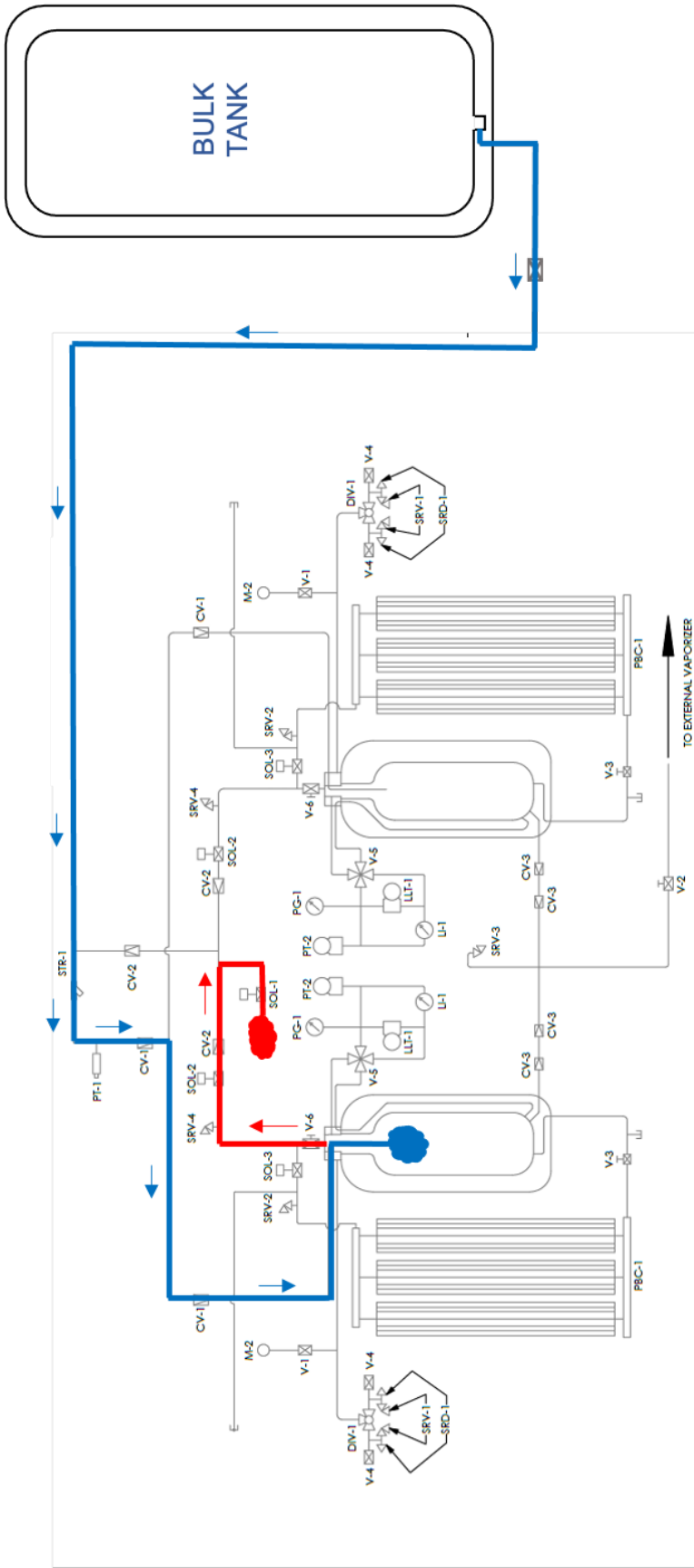
- Run/fill
- Initial pressure build
- Run/Ready
- Assist

These modes along with the parameter settings determine the operation of the system.

Run/Fill

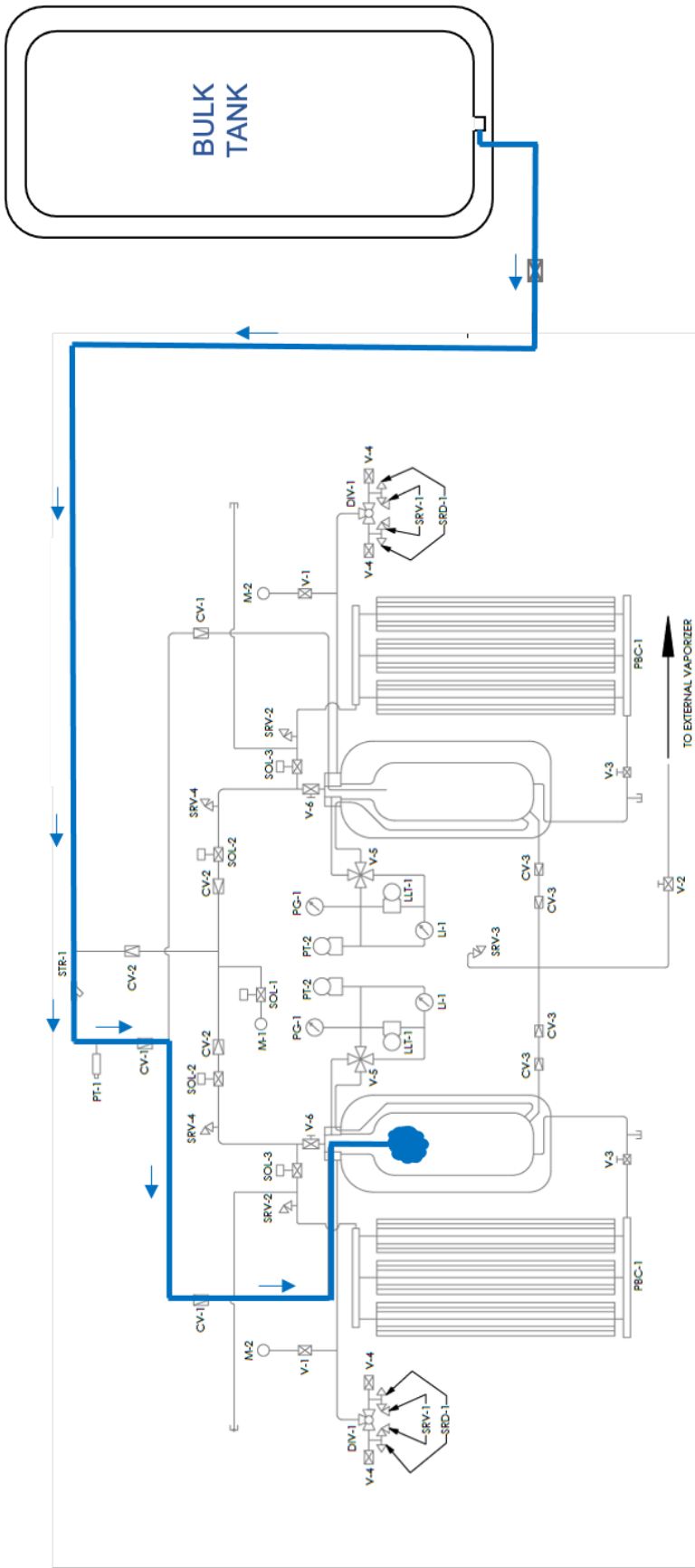


Filling Secondary



NOMENCLATURE					
CV-1	FILL CHECK VALVE	PG-1	TANK PRESSURE GAUGE	SRV-2	P.B. SAFETY RELIEF VALVE
CV-2	VENT CHECK VALVE	PT-1	BULK PRESSURE TRANSMITTER	SRV-3	LINE RELIEF VALVE
CV-3	LIQUID USE CHECK VALVE	PT-2	PRESSURE TRANSMITTER TRIFECTA	SRV-4	VENT RELIEF VALVE
DIV-1	TANK SAFETY DIVERter VALVE	STR-1	LIQUID USE STRAINER	V-1	MANUAL VENT VALVE
LIT-1	LIQUID LEVEL TRANSMITTER	SOL-1	VENT TO ATMOSPHERE SOLENOID VALVE	V-2	LIQUID USE VALVE
M-1	VENT TO ATMOSPHERE MUFFLER	SOL-2	VENT TO BULK SOLENOID VALVE	V-3	P.B. ISOLATION VALVE
M-2	MANUAL VENT MUFFLER	SOL-3	PRESSURE BUILD SOLENOID VALVE	V-4	MANUAL RELIEF VALVE
PBC-1	PRESSURE BUILD COIL	SRD-1	TANK SAFETY RUPTURE DISC	V-5	TRANSMITTER ISOLATION VALVE
				V-6	VENT / P.B. ISOLATION VALVE

Filling Secondary

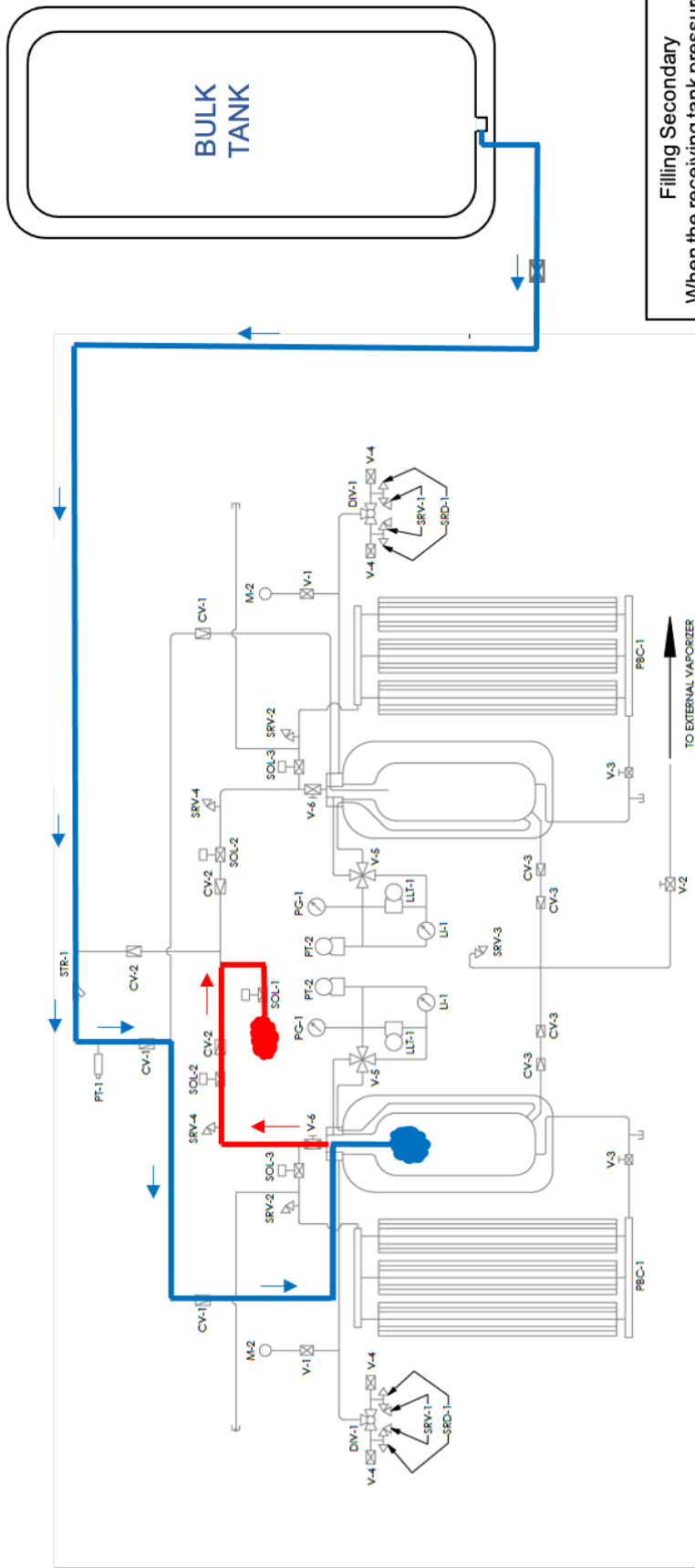


Filling Secondary
When the receiving tank pressure reaches bulk pressure – 45 psi, the vent to atmosphere closes. This is sometimes referred to as the "Low Loss" fill mode.

(4 of 6)

NOMENCLATURE					
CV-1	FILL CHECK VALVE	PG-1	TANK PRESSURE GAUGE	SRV-2	P.B. SAFETY RELIEF VALVE
CV-2	VENT CHECK VALVE	PT-1	BULK PRESSURE TRANSMITTER	SRV-3	LINE RELIEF VALVE
CV-3	LIQUID USE CHECK VALVE	PT-2	PRESSURE TRANSMITTER TRIFECTA	SRV-4	VENT RELIEF VALVE
DIV-1	LIQUID SAFETY DIVERter VALVE	STR-1	LIQUID USE STRAINER	V-1	MANUAL VENT VALVE
LI-1	LIQUID LEVEL GAUGE	SOL-1	VENT TO ATMOSPHERE SOLENOID VALVE	V-2	LIQUID USE VALVE
LI-2	LIQUID LEVEL TRANSMITTER	SOL-2	VENT TO BULK SOLENOID VALVE	V-3	P.B. ISOLATION VALVE
M-1	VENT TO ATMOSPHERE MUFFLER	SOL-3	PRESSURE BUILD SOLENOID VALVE	V-4	MANUAL RELIEF VALVE
M-2	MANUAL VENT MUFFLER	SRD-1	TANK SAFETY RUPTURE DISC	V-5	TRANSMITTER ISOLATION VALVE
PBC-1	PRESSURE BUILD COIL	SRV-1	TANK SAFETY RELIEF VALVE	V-6	VENT / P.B. ISOLATION VALVE

Filling Secondary



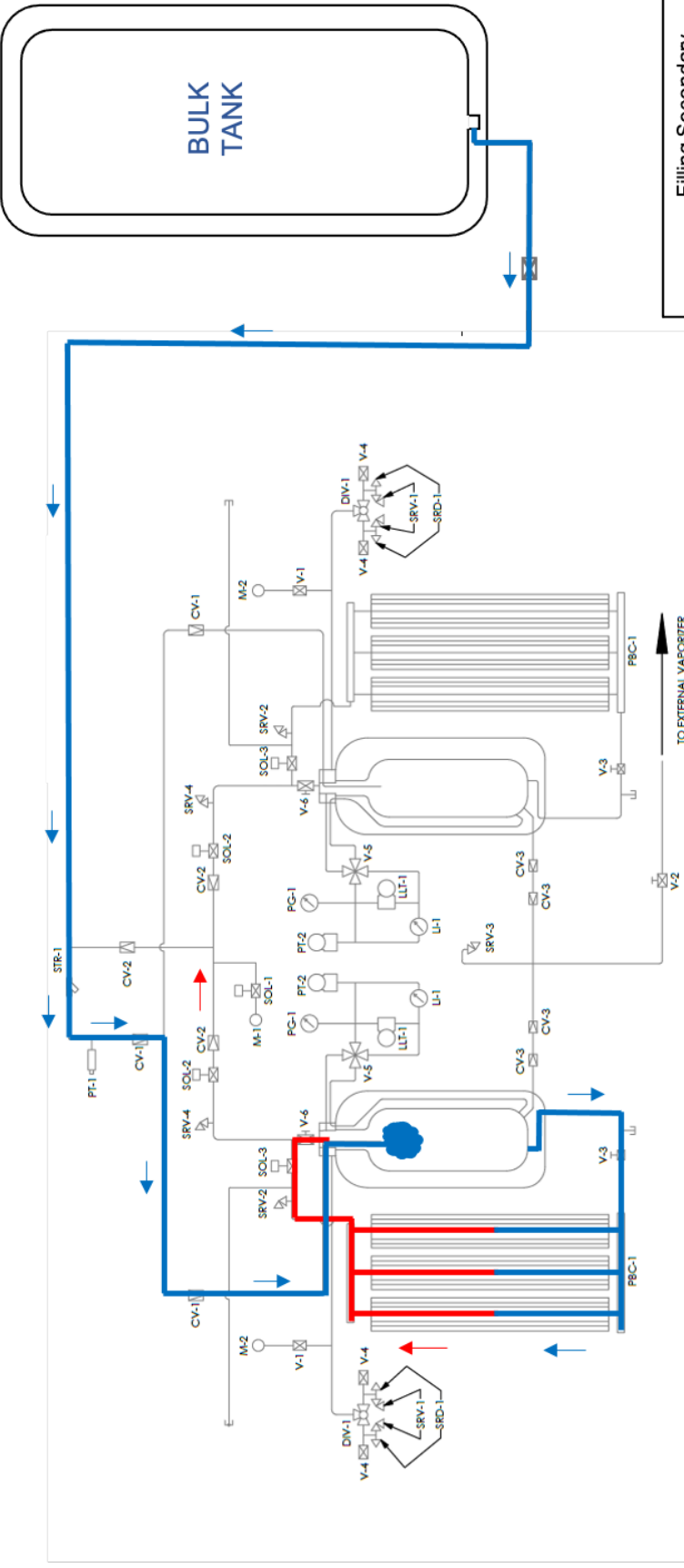
Filling Secondary

When the receiving tank pressure builds to bulk pressure – 30 psi, the vent to atmosphere valve re-opens. Also, if the fill time exceeds the vent to atmosphere forced on time, the system will “Fast Fill” opening the vent to atmosphere valve until the tank is full.

(5 of 6)

NOMENCLATURE					
CV-1	FILL CHECK VALVE	PG-1	TANK PRESSURE GAUGE	SRV-2	P.B. SAFETY RELIEF VALVE
CV-2	VENT CHECK VALVE	PT-1	BULK PRESSURE TRANSMITTER	SRV-3	LINE RELIEF VALVE
CV-3	LIQUID USE CHECK VALVE	PT-2	PRESSURE TRANSMITTER TRIFECTA	SRV-4	VENT RELIEF VALVE
DW-1	TANK SAFETY DIVERter VALVE	STR-1	LIQUID USE STRAINER	V-1	MANUAL VENT VALVE
LH-1	LIQUID LEVEL GAUGE	SOL-1	VENT TO ATMOSPHERE SOLENOID VALVE	V-2	LIQUID USE VALVE
LTL-1	LIQUID LEVEL TRANSMITTER	SOL-2	VENT TO BULK SOLENOID VALVE	V-3	P.B. ISOLATION VALVE
M-1	VENT TO ATMOSPHERE MUFFLER	SOL-3	PRESSURE BUILD SOLENOID VALVE	V-4	MANUAL RELIEF VALVE
M-2	MANUAL VENT MUFFLER	SRD-1	TANK SAFETY RUPTURE DISC	V-5	TRANSMITTER ISOLATION VALVE
PBC-1	PRESSURE BUILD COIL	SRV-1	TANK SAFETY RELIEF VALVE	V-6	VENT / P.B. ISOLATION VALVE

Filling Secondary



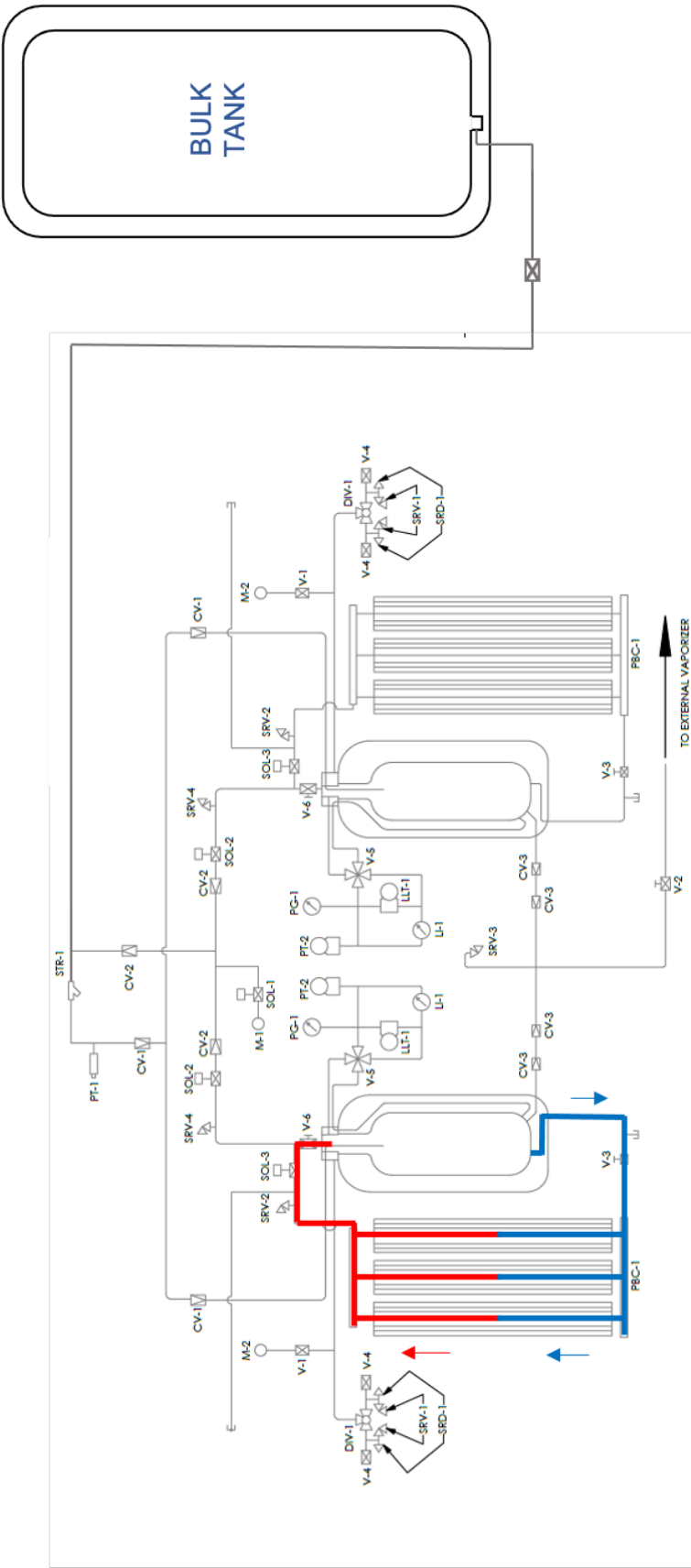
Filling Secondary

When the system determines that the receiving (secondary) tank is full, the pressure building valve opens. The pressure rise caused by the PB circuit will stop the flow of liquid from the bulk tank when the pressure rises above the bulk tank pressure.

(6 of 6)

NOMENCLATURE					
CV-1	FILL CHECK VALVE	PG-1	TANK PRESSURE GAUGE	SRV-2	P.B. SAFETY RELIEF VALVE
CV-2	VENT CHECK VALVE	PT-1	BULK PRESSURE TRANSMITTER	SRV-3	LINE RELIEF VALVE
CV-3	LIQUID USE CHECK VALVE	PT-2	PRESSURE TRANSMITTER TRIFECTA	SRV-4	VENT RELIEF VALVE
DW-1	LIQUID USE DIVERter VALVE	STR-1	LIQUID USE STRAINER	V-1	MANUAL VENT VALVE
LT-1	LIQUID LEVEL TRANSMITTER	SOL-1	VENT TO ATMOSPHERE SOLENOID VALVE	V-2	LIQUID USE VALVE
LT-2	LIQUID LEVEL TRANSMITTER	SOL-2	VENT TO BULK SOLENOID VALVE	V-3	P.B. ISOLATION VALVE
M-1	VENT TO ATMOSPHERE MUFFLER	SOL-3	PRESSURE BUILD SOLENOID VALVE	V-4	MANUAL RELIEF VALVE
M-2	MANUAL VENT MUFFLER	SRV-1	TANK SAFETY RUPTURE DISC	V-5	TRANSMITTER ISOLATION VALVE
PBC-1	PRESSURE BUILD COIL		TANK SAFETY RELIEF VALVE	V-6	VENT / P.B. ISOLATION VALVE

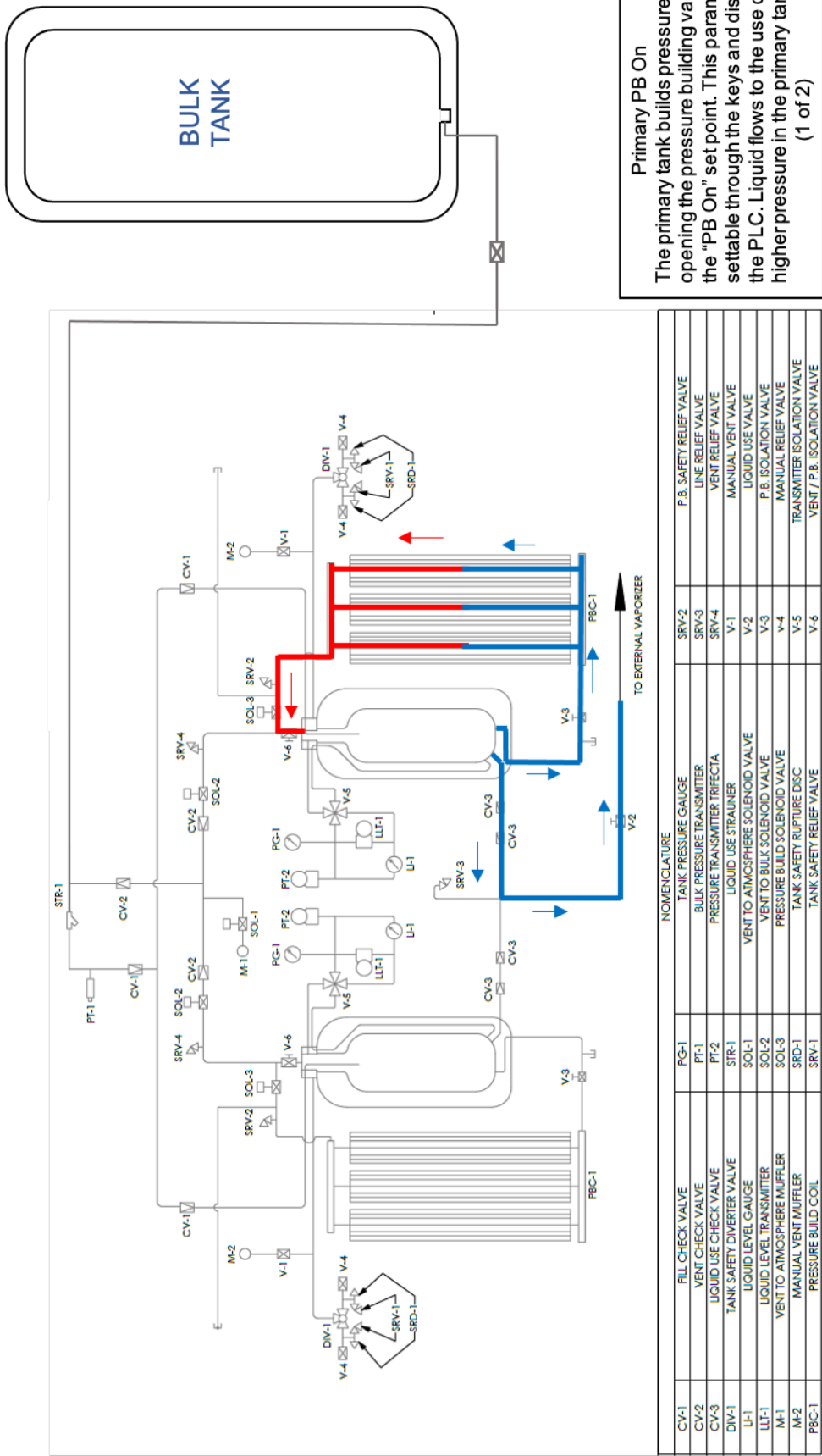
Initial Pressure Build



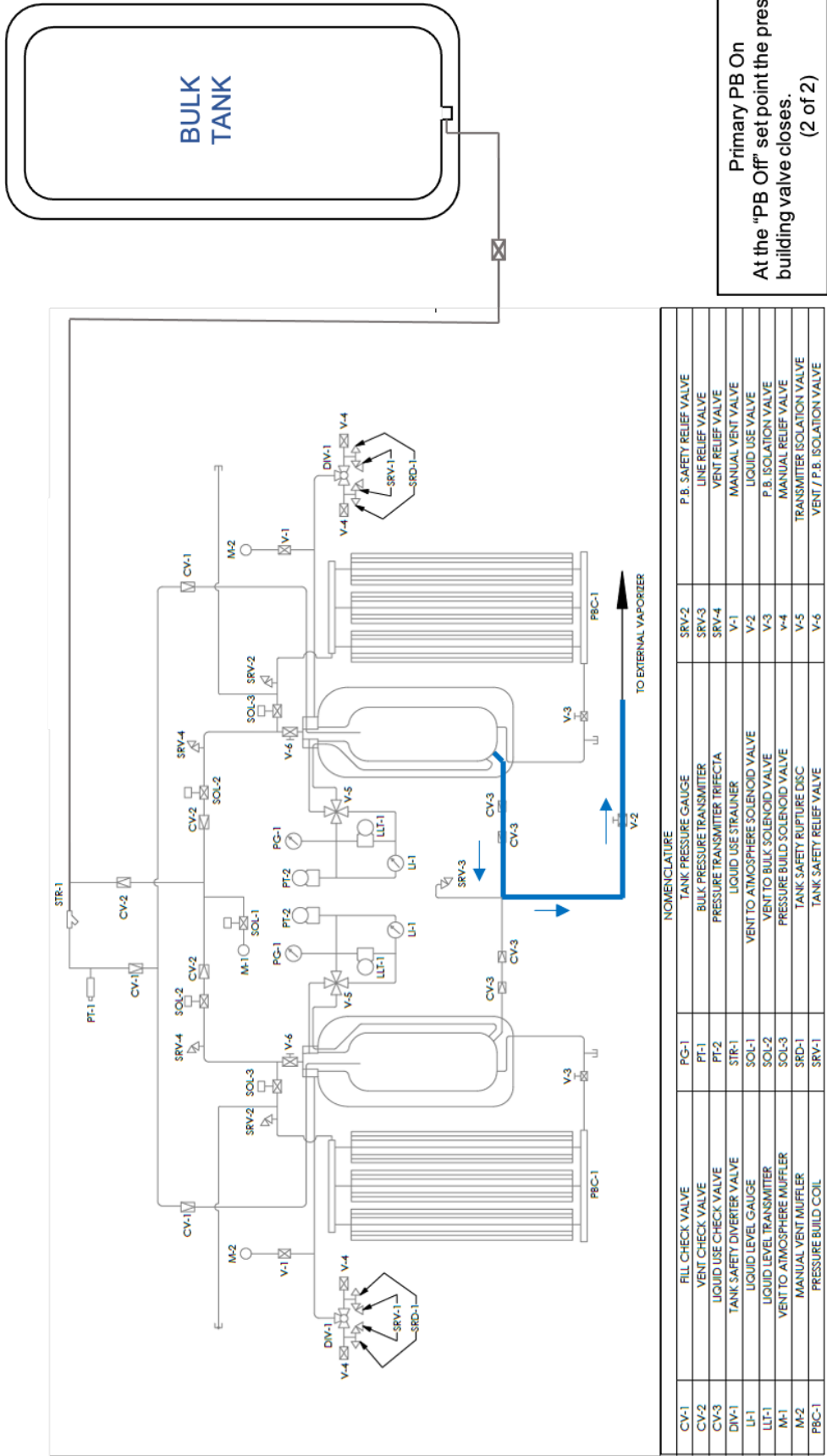
Initial Pressure Build
The secondary tank builds to a "Hold" pressure just below the operating pressure. The "Hold PB Off" is 25 psi below the primary PB On pressure. The "Hold PB On" is 50 psi below the primary PB on pressure

NOMENCLATURE					
CV-1	RILL CHECK VALVE	PG-1	TANK PRESSURE GAUGE	SRV-2	P.B. SAFETY RELIEF VALVE
CV-2	VENT CHECK VALVE	PT-1	BULK PRESSURE TRANSMITTER	SRV-3	LINE RELIEF VALVE
CV-3	LIQUID USE CHECK VALVE	PT-2	PRESSURE TRANSMITTER TRIFECTA	SRV-4	VENT RELIEF VALVE
DIV-1	LIQUID USE DIVERTER VALVE	SOL-1	LIQUID USE SOLENOID VALVE	V-1	MANUAL VENT VALVE
LH-1	LIQUID LEVEL GAUGE	SOL-2	VENT TO ATMOSPHERE SOLENOID VALVE	V-2	LIQUID USE VALVE
LH-2	LIQUID LEVEL TRANSMITTER	SOL-3	VENT TO BULK SOLENOID VALVE	V-3	P.B. ISOLATION VALVE
M-1	VENT TO ATMOSPHERE MUFFLER	SOL-4	PRESSURE BUILD SOLENOID VALVE	V-4	MANUAL RELIEF VALVE
M-2	MANUAL VENT MUFFLER	SRV-1	TANK SAFETY RUPTURE DISC	V-5	TRANSMITTER ISOLATION VALVE
PBC-1	PRESSURE BUILD COIL		TANK SAFETY RELIEF VALVE	V-6	VENT / P.B. ISOLATION VALVE

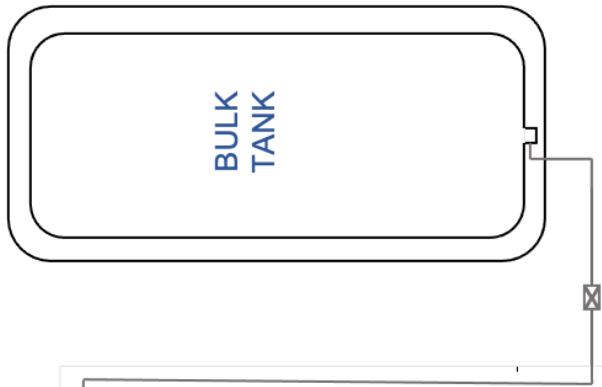
Primary Pressure Build On



Primary Pressure Build On



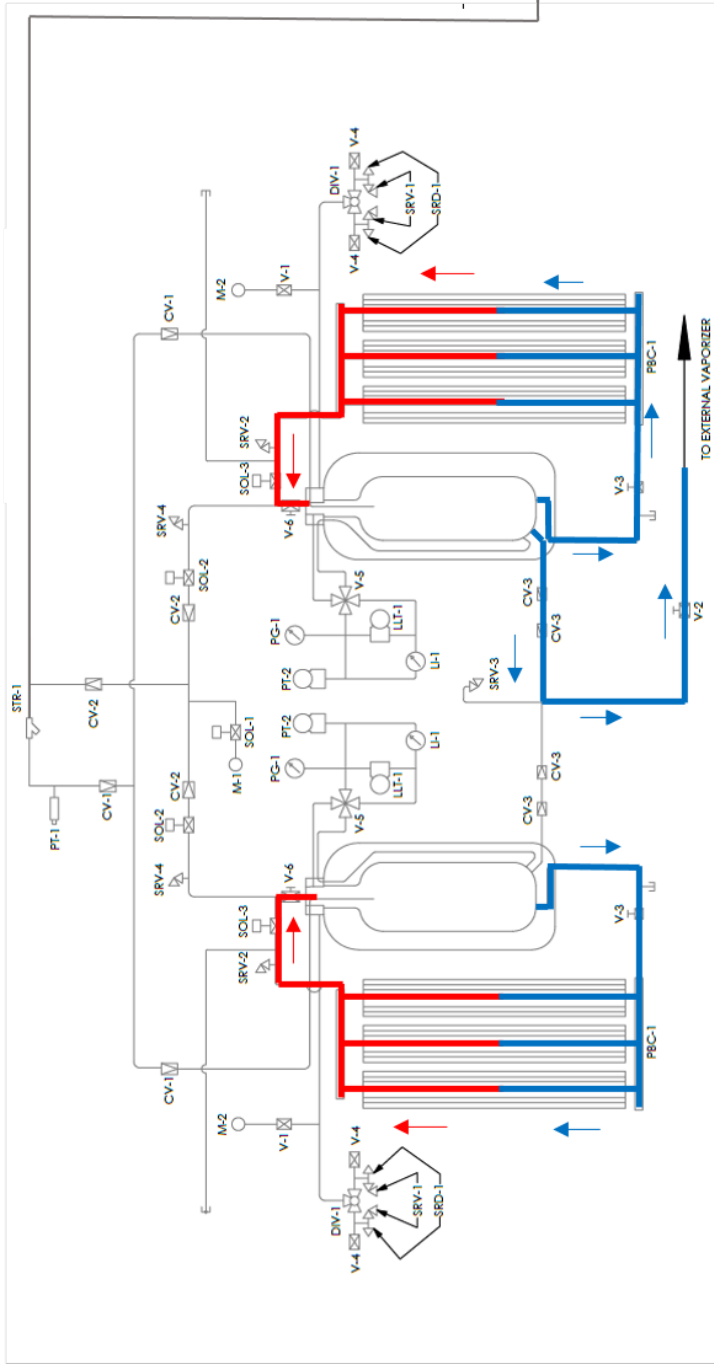
Call for Assist



Assist

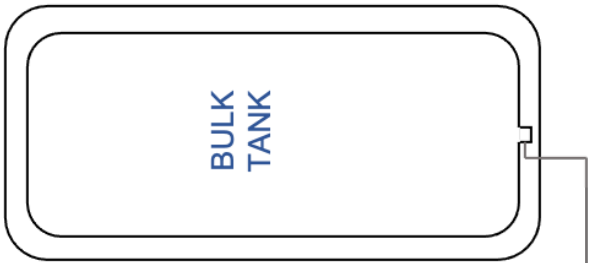
When the primary tank pressure drops below the "PB On" set point for 10 seconds, the secondary tank is full and at the reserve pressure. The primary side calls for a pressure assist from the secondary side. The secondary tank's pressure build valve turns on.

(1 of 3)



NOMENCLATURE					
CV-1	RIL CHECK VALVE	PG-1	TANK PRESSURE GAUGE	SRV-2	P.B. SAFETY RELIEF VALVE
CV-2	VENT CHECK VALVE	PT-1	BULK PRESSURE TRANSMITTER	SRV-3	LINE RELIEF VALVE
CV-3	LIQUID USE CHECK VALVE	PT-2	PRESSURE TRANSMITTER TRIFECTA	SRV-4	VENT RELIEF VALVE
DIV-1	TANK SAFETY DIVERTER VALVE	STR-1	LIQUID USE STRAINER	V-1	MANUAL VENT VALVE
LLT-1	LIQUID LEVEL GAUGE	SOL-1	VENT TO ATMOSPHERE SOLENOID VALVE	V-2	LIQUID USE VALVE
M-1	LIQUID LEVEL TRANSMITTER	SOL-2	VENT TO BULK SOLENOID VALVE	V-3	P.B. ISOLATION VALVE
M-2	VENT TO ATMOSPHERE MUFFLER	SOL-3	PRESSURE BUILD SOLENOID VALVE	V-4	MANUAL ISOLATION VALVE
PBC-1	MANUAL VENT MUFFLER	SRD-1	TANK SAFETY RUPTURE DISC	V-5	TRANSMITTER ISOLATION VALVE
	PRESSURE BUILD COIL	SRV-1	TANK SAFETY RELIEF VALVE	V-6	VENT / P.B. ISOLATION VALVE

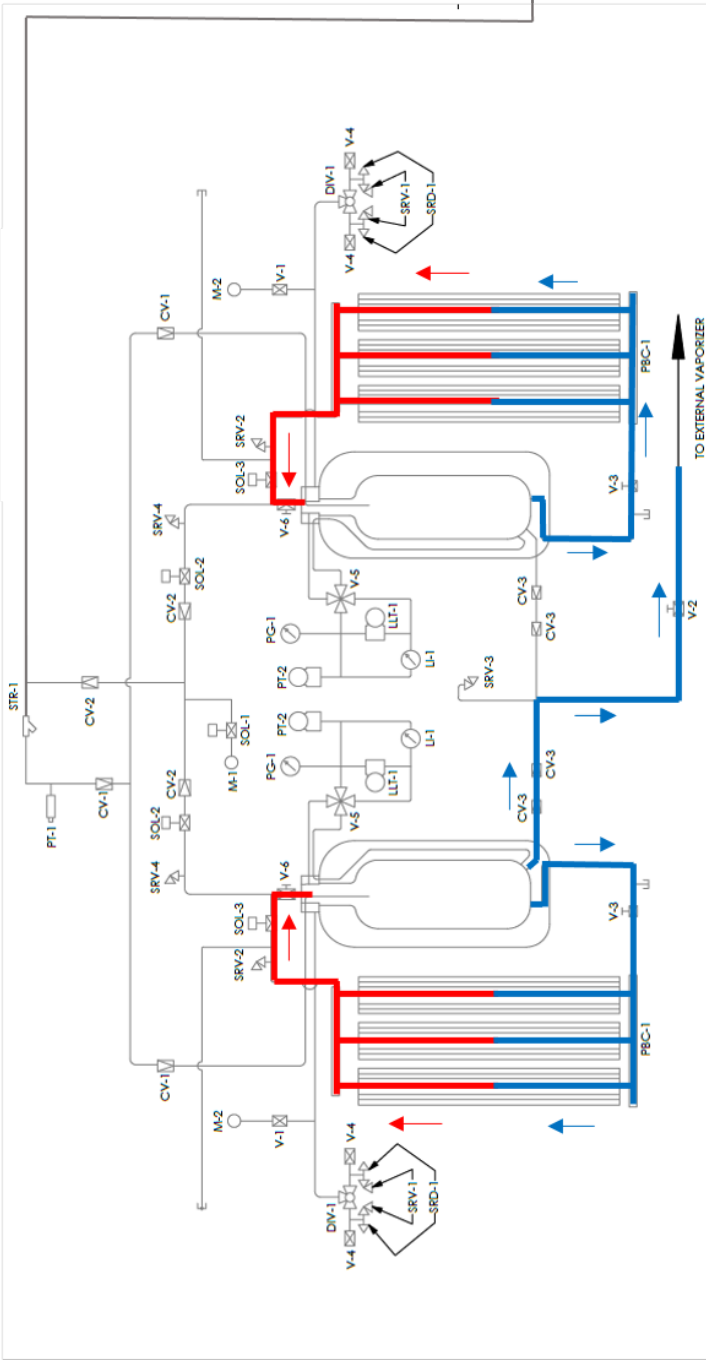
Assist



Assist

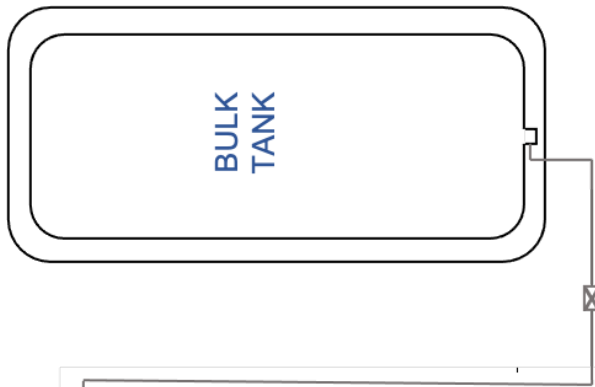
When the secondary tank's pressures exceed the primary tank's pressures flow switches to the secondary tank. While the secondary tank is supplying liquid to the use, the primary tank pressure is recovering.

(2 of 3)



NOMENCLATURE					
CV-1	RILL CHECK VALVE	PG-1	TANK PRESSURE GAUGE	SRV-2	P.B. SAFETY RELIEF VALVE
CV-2	VENT CHECK VALVE	PT-1	BULK PRESSURE TRANSMITTER	SRV-3	LINE RELIEF VALVE
CV-3	LIQUID USE CHECK VALVE	PT-2	PRESSURE TRANSMITTER TRIFECTA	SRV-4	VENT RELIEF VALVE
DIV-1	TANK SAFETY DIVERTER VALVE	SOL-1	LIQUID USE SOLENOID VALVE	V-1	MANUAL VENT VALVE
LLT-1	LIQUID LEVEL TRANSMITTER	SOL-2	VENT TO ATMOSPHERE SOLENOID VALVE	V-2	LIQUID USE VALVE
LLT-2	LIQUID LEVEL TRANSMITTER	SOL-3	VENT TO BULK SOLENOID VALVE	V-3	P.B. ISOLATION VALVE
M-1	VENT TO ATMOSPHERE MUFFLER	SOL-4	PRESSURE BUILD SOLENOID VALVE	V-4	MANUAL RELIEF VALVE
M-2	MANUAL VENT MUFFLER	SRD-1	TANK SAFETY RUPTURE DISC	V-5	TRANSMITTER ISOLATION VALVE
PBC-1	PRESSURE BUILD COIL	SRV-1	TANK SAFETY RELIEF VALVE	V-6	VENT / P.B. ISOLATION VALVE

Assist



Assist

When the secondary tank reaches the "PB Off" set point, the mode switches back to "ready". When the secondary tank pressure drops below the primary (3 of 3)

NOMENCLATURE					
CV-1	RILL CHECK VALVE	PG-1	TANK PRESSURE GAUGE	SRV-2	P.B. SAFETY RELIEF VALVE
CV-2	VENT CHECK VALVE	PT-1	BULK PRESSURE TRANSMITTER	SRV-3	LINE RELIEF VALVE
CV-3	LIQUID USE CHECK VALVE	PT-2	PRESSURE TRANSMITTER TRIFECTA	SRV-4	VENT RELIEF VALVE
DIV-1	TANK SAFETY DIVERTER VALVE	SOL-1	LIQUID USE STRAINER	V-1	MANUAL VENT VALVE
LLT-1	LIQUID LEVEL TRANSMITTER	SOL-2	VENT TO ATMOSPHERE SOLENOID VALVE	V-2	LIQUID USE VALVE
M-1	LIQUID LEVEL TRANSMITTER	SOL-3	VENT TO BULK SOLENOID VALVE	V-3	P.B. ISOLATION VALVE
M-2	VENT TO ATMOSPHERE MUFFLER	SOL-4	PRESSURE BUILD SOLENOID VALVE	V-4	MANUAL ISOLATION VALVE
PBC-1	MANUAL VENT MUFFLER	SRD-1	TANK SAFETY RUPTURE DISC	V-5	TRANSMITTER ISOLATION VALVE
	PRESSURE BUILD COIL	SRV-1	TANK SAFETY RELIEF VALVE	V-6	VENT / P.B. ISOLATION VALVE

Tank Switch

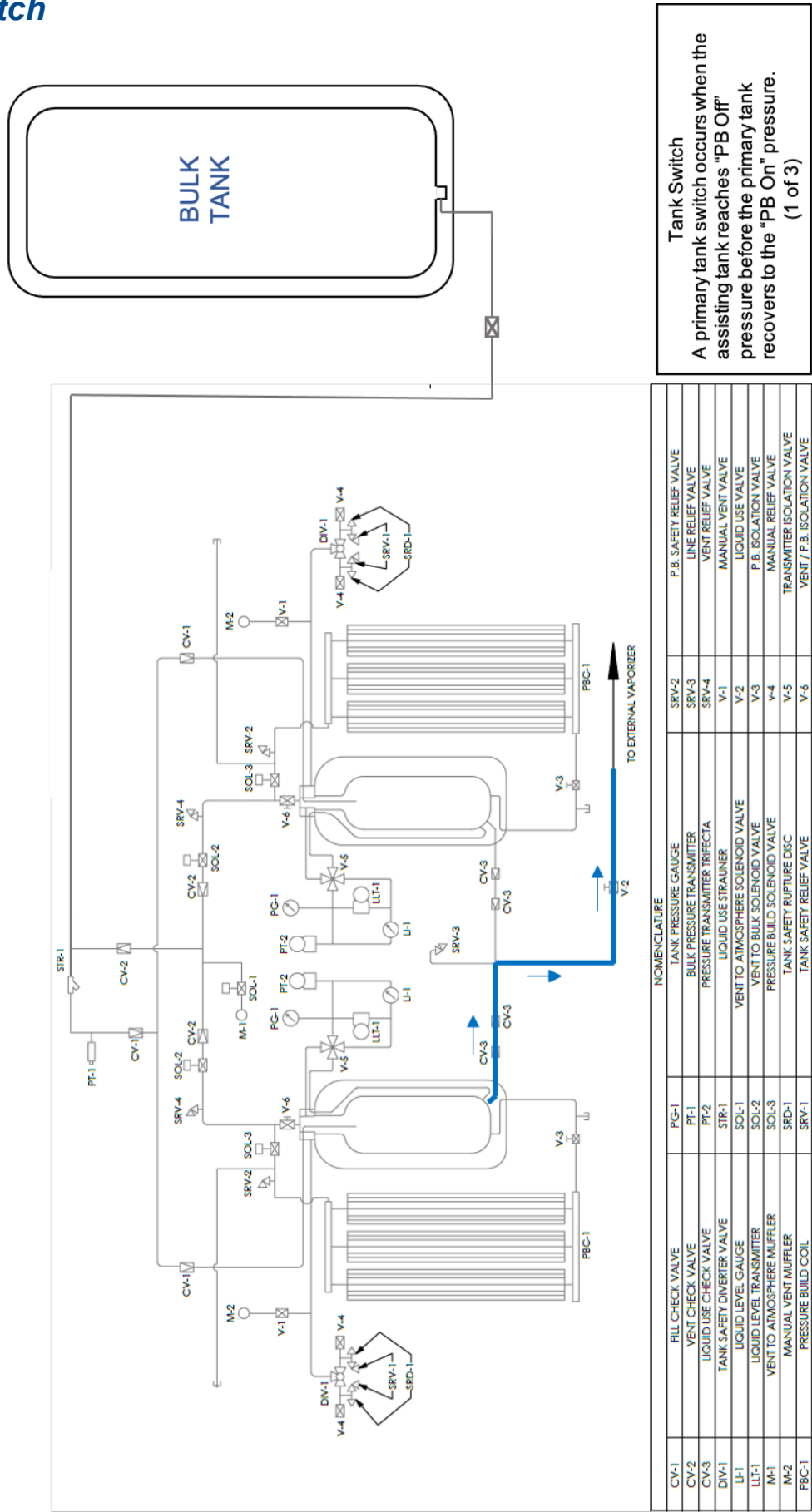


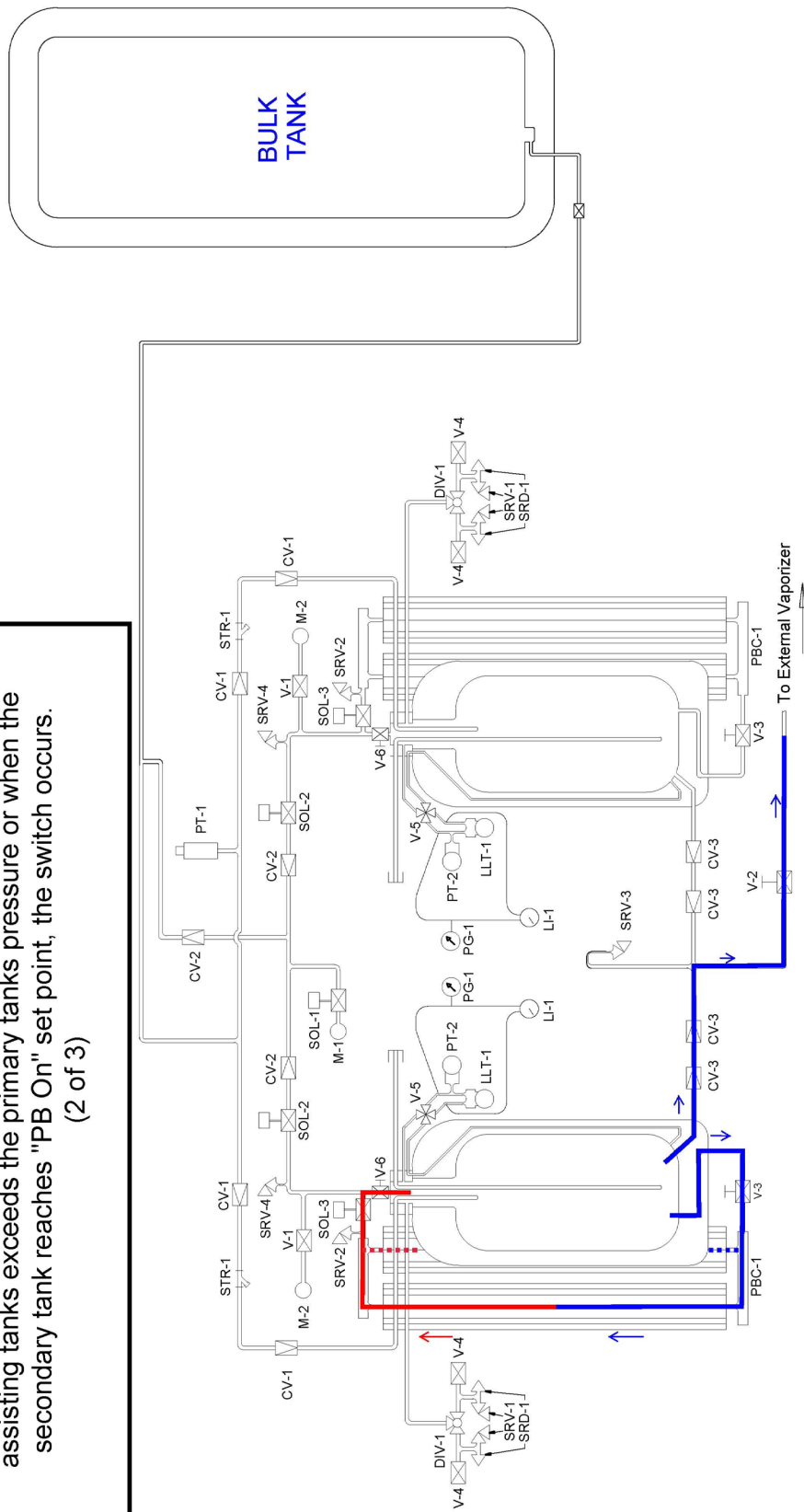
Figure 1 - Primary Unable to Recover (Switch Primary Side)

Tank Switch

Tank Switch

A primary tank switch occurs when the secondary tank reaches a "Too Low to Assist" level. At this level there is a call for an assist. When the assisting tanks exceeds the primary tanks pressure or when the secondary tank reaches "PB On" set point, the switch occurs.

(2 of 3)

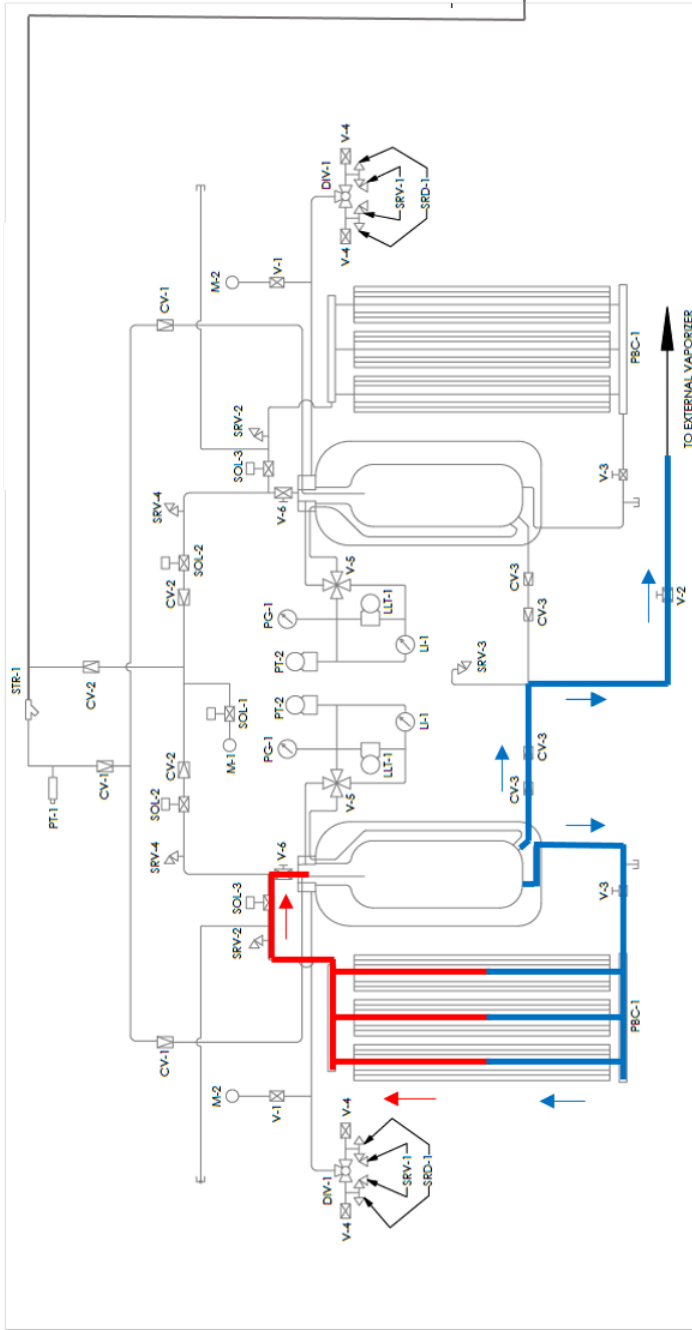


NOMENCLATURE					
CV-1	FILL CHECK VALVE	PG-1	TANK PRESSURE GAUGE	SRV-2	P.B. SAFETY RELIEF VALVE
CV-2	VENT CHECK VALVE	PT-1	BULK PRESSURE TRANSMITTER	SRV-3	LINE RELIEF VALVE
CV-3	LIQUID USE CHECK VALVE	PT-2	PRESSURE TRANSMITTER TRIFECTA	SRV-4	VENT RELIEF VALVE
DIV-1	TANK SAFETY DIVERter VALVE	STR-1	LIQUID USE STRAINER	V-1	MANUAL VENT VALVE
LL-1	LIQUID LEVEL GAUGE	SOL-1	VENT TO ATMOSPHERE SOLENOID VALVE	V-2	LIQUID USE VALVE
LLT-1	LIQUID LEVEL TRANSMITTER	SOL-2	VENT TO BULK SOLENOID VALVE	V-3	P.B. ISOLATION VALVE
M-1	VENT TO ATMOSPHERE MUFFLER	SOL-3	PRESSURE BUILD SOLENOID VALVE	V-4	MANUAL RELIEF VALVE
M-2	MANUAL VENT MUFFLER	SRD-1	TANK SAFETY RUPTURE DISC	V-5	TRANSMITTER ISOLATION VALVE
PBC-1	PRESSURE BUILD COIL	SRV-1	TANK SAFETY RELIEF VALVE	V-6	VENT / P.B. ISOLATION VALVE

Tank Switch



Tank Switch
A primary tank switch occurs when the secondary tank reaches "Too Low to Assist" level. The switch occurs at the call for an assist when the assisting tank exceeds the "PB On" set point.
(3 of 3)



NOMENCLATURE					
CV-1	FILL CHECK VALVE	PG-1	TANK PRESSURE GAUGE	SRV-2	P.B. SAFETY RELIEF VALVE
CV-2	VENT CHECK VALVE	PT-1	BULK PRESSURE TRANSMITTER	SRV-3	LINE RELIEF VALVE
CV-3	LIQUID USE CHECK VALVE	PT-2	PRESSURE TRANSMITTER TRIFECTA	SRV-4	VENT RELIEF VALVE
DIV-1	TANK SAFETY DIVERTER VALVE	STR-1	LIQUID USE STRAINER	V-1	MANUAL VENT VALVE
LL-1	LIQUID LEVEL GAUGE	SOL-1	VENT TO ATMOSPHERE SOLENOID VALVE	V-2	LIQUID USE VALVE
LLT-1	LIQUID LEVEL TRANSMITTER	SOL-2	VENT TO BULK SOLENOID VALVE	V-3	P.B. ISOLATION VALVE
M-1	VENT TO ATMOSPHERE MUFFLER	SOL-3	PRESSURE BUILD SOLENOID VALVE	V-4	MANUAL RELIEF VALVE
M-2	MANUAL VENT MUFFLER	SRD-1	TANK SAFETY RUPTURE DISC	V-5	TRANSMITTER ISOLATION VALVE
PBC-1	PRESSURE BUILD COIL	SRV-1	TANK SAFETY RELIEF VALVE	V-6	VENT / P.B. ISOLATION VALVE

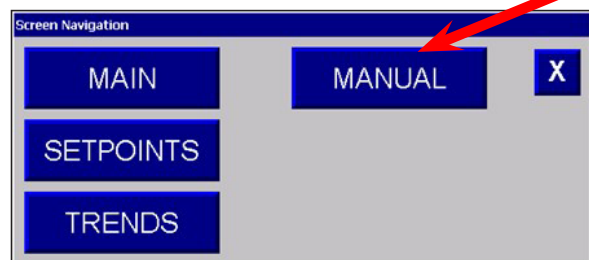
Service

Alerts & Alarms

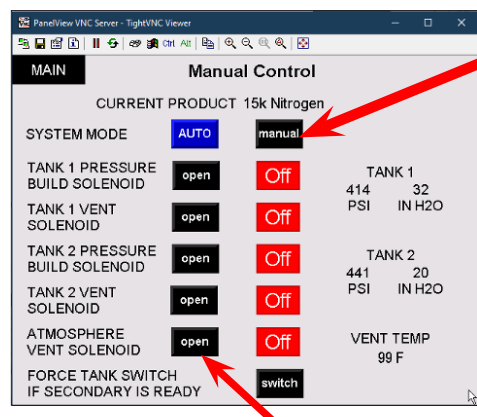
Code	Description	Action
ALERTS	Vent Temperature Alarm	Tank Overfill, liquid detected at vent outlet
ALERTS	Tank 1 Pressure High	Overpressure Condition
ALERTS	Tank 2 Pressure High	Overpressure Condition
ALERTS	Primary Tank Flow High	Instantaneous flowrates exceeding rating of unit
ALERTS	Fill Time Exceeds Flow Rating	Fill time is too slow to keep up with max flows
ALERTS	Primary Requested Assist Before Secondary Ready	Pressure in primary dropped below "PB ON" for 10 sec. Secondary not ready to assist.
ALERTS	Cycles Exceed Service Setting	Service Required (20,000 cycles)
ALERTS	Primary Press Less Than Secondary PB ON	When in Modes 0 or 2, Primary tank has fallen below secondary's PB on Setpoint.
ALERTS	Primary & Secondary Press Low Alert	Both Primary & Secondary have been pressure building for 10 Min. (in Auto)
ALERTS	Primary Pressure Less Than PB ON 10 seconds	Primary Pressure has dropped below PB ON for 10 sec. (Disabled)
ALARMS	Tank 1 Pressure Transmitter Out of Range High	Transmitter error
ALARMS	Tank 1 Pressure Transmitter Out of Range Low	Transmitter error
ALARMS	Tank 2 Pressure Transmitter Out of Range High	Transmitter error
ALARMS	Tank 2 Pressure Transmitter Out of Range Low	Transmitter error
ALARMS	Bulk Tank Pressure Transmitter Out of Range High	Transmitter error
ALARMS	Bulk Tank Pressure Transmitter Out of Range Low	Transmitter error
ALARMS	Tank 1 Level Sensor Out of Range High	Transmitter error
ALARMS	Tank 1 Level Sensor Out of Range Low	Transmitter error
ALARMS	Tank 2 Level Sensor Out of Range High	Transmitter error
ALARMS	Tank 2 Level Sensor Out of Range Low	Transmitter error

Manually Operating the Valves

From the Main Screen, you need to press "Menu" on the screen, this will bring up a pop-up box.



Here, press the "MANUAL" button, which will bring up the Manual Control screen.



Press the "manual" button. When the Trifecta is in manual control, "Manual" will be highlighted in blue. You can press the open button and the red "OFF" will turn to a green "ON" and the valve will open and stay open until you press the "CLOSE" button. You can view the tank pressure and liquid level on the right side.

Control Box

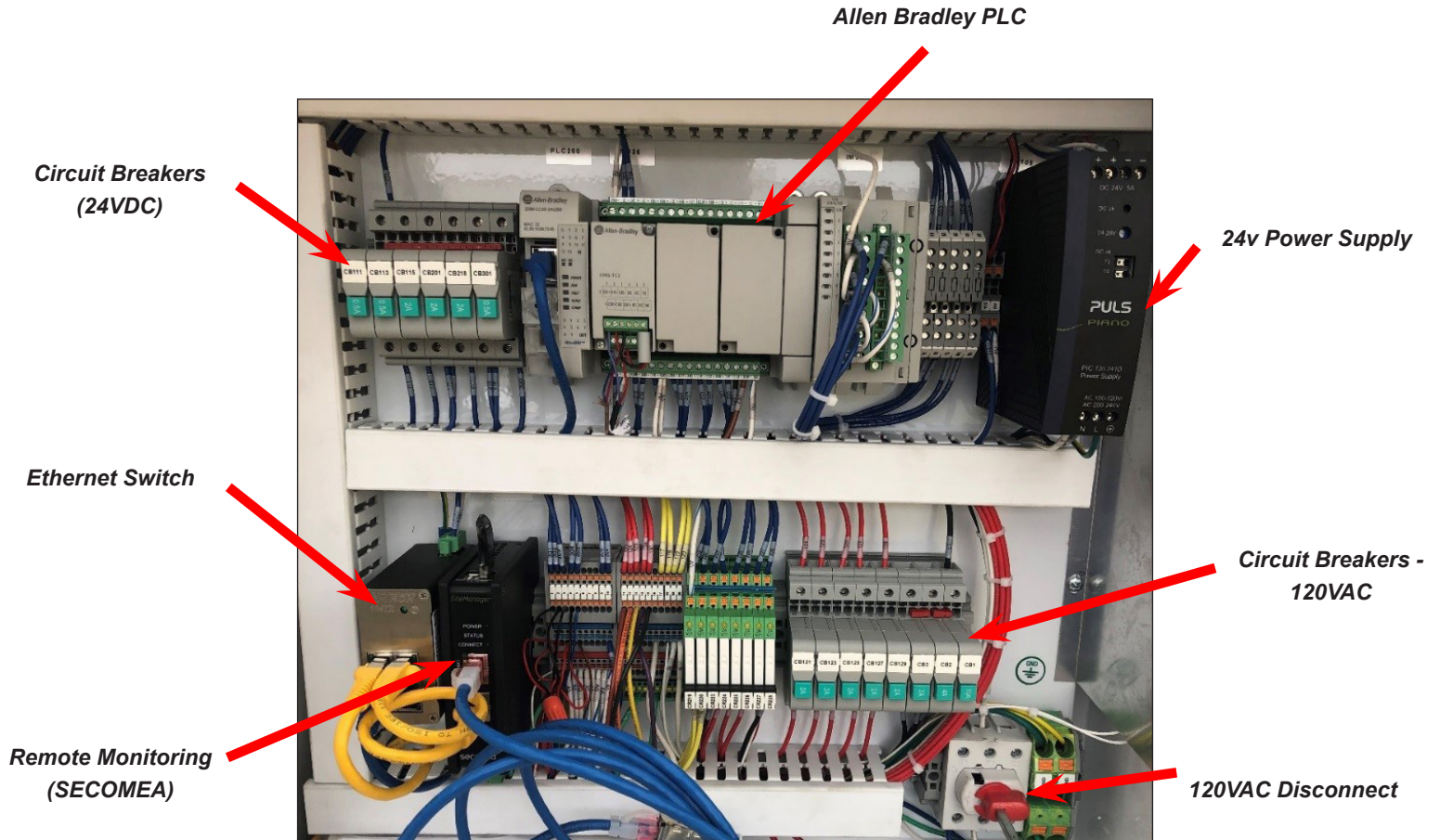


Figure - 5 Primary Components Inside Allen Bradley Control Box

Circuit Breakers (See Fig. 6 & 7)

Circuit Breaker No.	Description	Amps
CB111 (24 VDC)	Ethernet Switch	.5A
CB113 (24 VDC)	Remote Monitor Controller	.5A
CB115 (24 VDC)	HMI Interface	2A
CB201 (24 VDC)	Allen Bradley PLC	2A
CB218 (24 VDC)	Customer Alarm	2A
CB301 (24 VDC)	Transmitters	.5A
CB121 (120 VAC)	Tank #1 Pressure Build	2A
CB123 (120 VAC)	Tank #2 Pressure Build	2A
CB 125 (120 VAC)	Tank #1 Vent	2A
CB127 (120 VAC)	Tank #2 Vent	2A
CB129 (120 VAC)	Vent to Atmosphere	2A
CB3 (120 VAC)	Power Supply CB	2A
CB2 (120 VAC)	Enclosure Heater CB	4A
CB1 (120 VAC)	Main CB for all solenoids	10A



Fig. 6 - 120 VAC



Fig. 7 - 24 VDC

Circuit Breaker Detail



Note: Reset tripped circuit breaker by pushing in on square green button. Before resetting, it is best to have an understanding of why the circuit breaker tripped.

Repairs



Note: Any time plumbing is removed from the Trifecta Pro 30K system, take care not to allow any moisture to enter the system. This moisture can freeze and cause check valves and control valves to stick. Critical lines can freeze causing incorrect level and pressure readings.

Check Valve Leaking

If you find that there is a leaking check valve, the Trifecta Pro 30K will have to be emptied and depressurized. The check valve should then be replaced. Replacement parts can be found in the Preventive Maintenance section on this manual and ordered on www.chartparts.com.

Solenoids

If the solenoid appears to be malfunctioning, it could be for a few reasons:

- PLC is not sending signal to energize the solenoid
- Contaminants on solenoid seat
- Moisture in solenoid
- Solenoid failure

The most common symptoms of these failures and their remedies are described in the following sections:

Non-Energizing Solenoid

The PLC sends a signal to the solenoid to energize the coil during a particular operation of the Trifecta. When this signal is sent from the PLC, The solenoid valve shown on the HMI Screen turns green. If the solenoid turns green but the solenoid is not energized and does not open, check for loose wiring and voltage at the valve with a multi-meter. If there is power at the valve and the valve does not open, the coil will need to be replaced. If there is not power at the valve, trace wiring back to find out where disconnect is occurring. Contact www.chartparts.com for replacement parts.

Contaminants on Solenoid Seat

If the solenoid appears to be leaking, there are most likely contaminants on the seat of the piston. The seat or piston may also be damaged. In this case, remove the piston and replace. Also verify that the strainer is in place and replace if it has been six months prior to last replacement.

Moisture in Solenoid

Solenoid should be allowed to thaw. Once thawed, moisture may be removed from solenoid upon next use via the flow of new gas.

Solenoid Failure

If none of the above improves the situation, there has been a catastrophic failure within the solenoid coil. The entire solenoid must be replaced.

Leaking Components

If the leak cannot be fixed via tightening or re-plumbing a component, a new component will have to be fitted. Refer to the Preventive Maintenance section of this manual to locate the description and part number of this component.



Note: All replacement fittings should be cleaned for oxygen service. Refer to replacement part section for Chart part numbers for all plumbing components.

Pressure and Liquid Level Transmitters

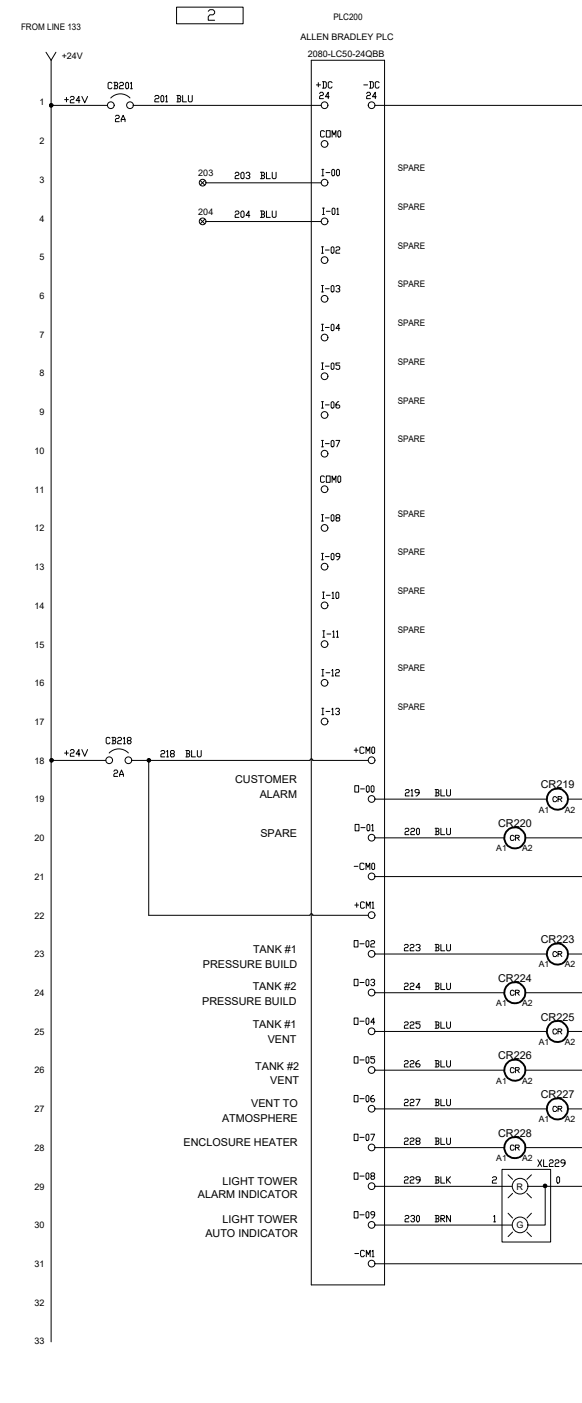
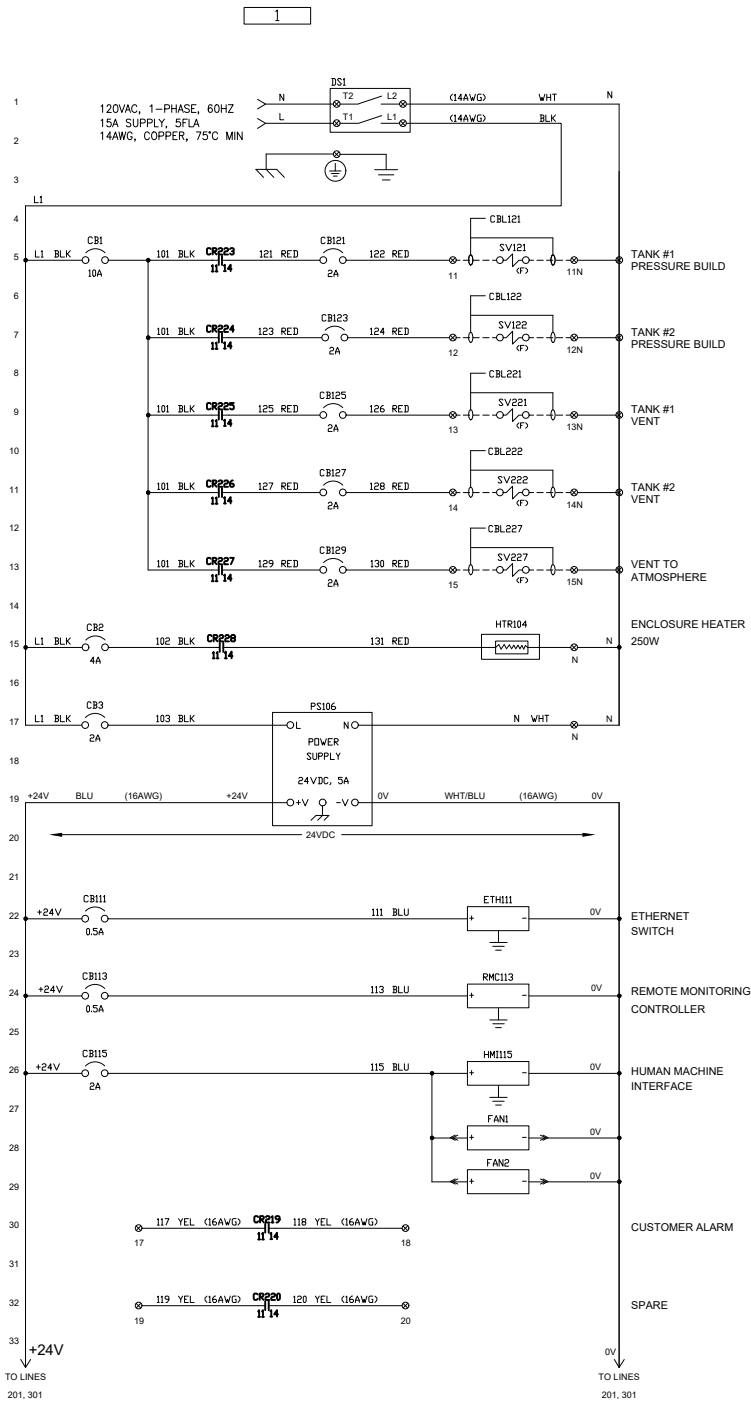
1. Leak check all fittings associated with the transmitter to verify the circuit has zero leaks. The sensor error check function is designed to find problems such as a wire coming disconnected, or a short in the transmitter. See the Service section of this manual for Alerts and Alarms.
2. Confirm that all wiring connection terminals are tight.
3. If all connections are made and the Alarm condition does not go away, check the transmitter output.
4. Recalibrate or replace the transmitter as necessary.
5. Also verify display readouts versus the analog gauges for both pressure and differential pressure.

Ball Valve Maintenance and Repair

Chart recommends that these ball valves have their stem seals checked and tightened at least every six months. Ball seals and actuator seals should also be checked and replaced at least once per year.

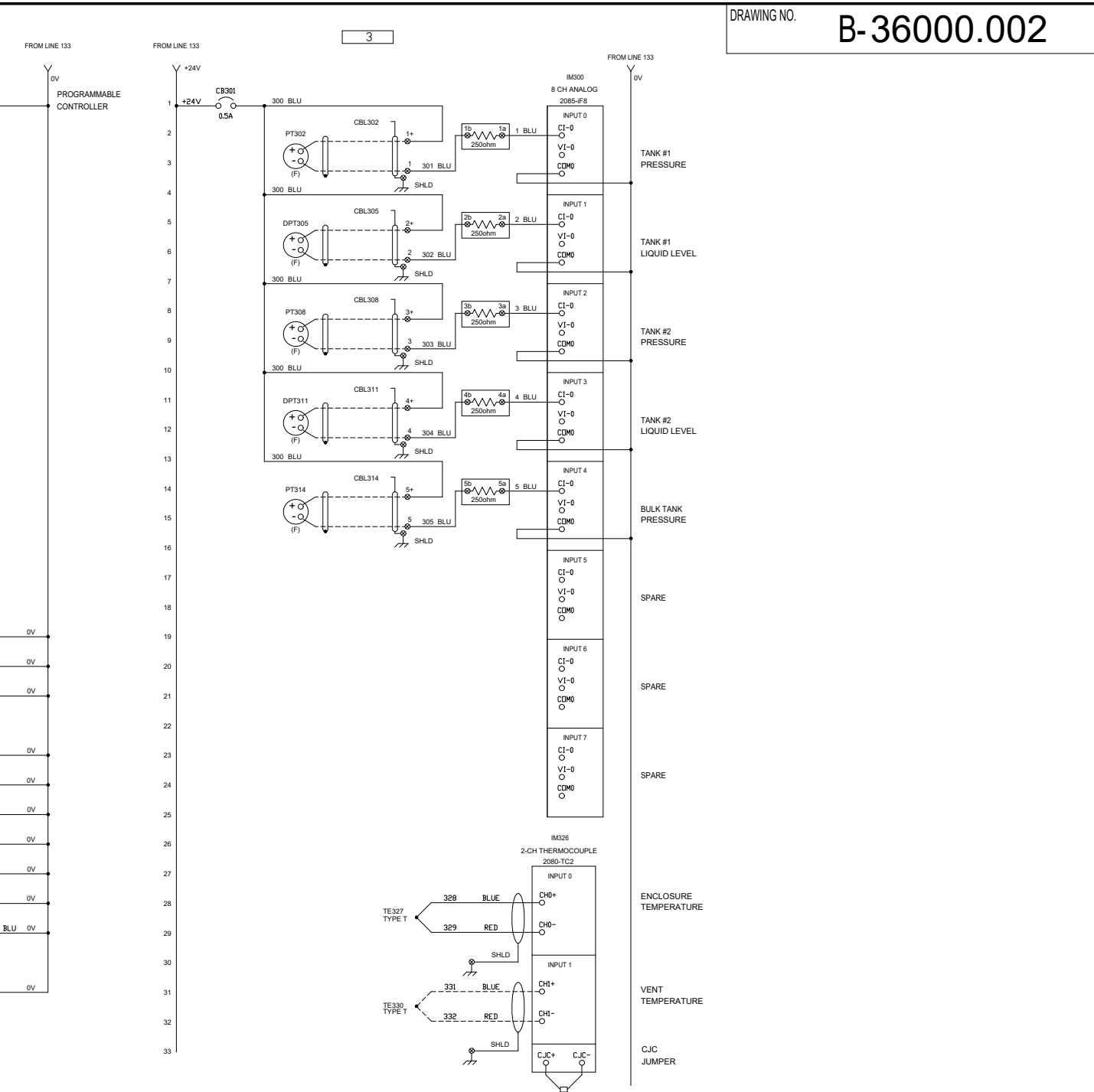
Extended stem and short stem Worcester cryogenically-rated ball valves are used for isolation valves. These valves, for the most part, stay in the open position. Chart recommends these ball valves have their stem seals checked and tightened at least every six months. Ball seals should also be checked at least once per year and replaced as required.

Electrical Schematic




- NOTES: UNLESS OTHERWISE SPECIFIED
- (1) BLACK, WHITE AND GREEN WIRES #16AWG, UL AWM 1007
 - (2) BLUE AND WHITE/BLUE WIRES #18AWG, UL AWM 1007
 - (3) ALL WIRE ENDS MARKED WITH WIRE NUMBER
 - (4) ALL WIRE ENDS TERMINATED WITH FERRULE OR TINNED LEADS

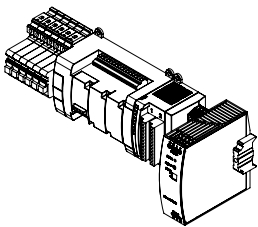
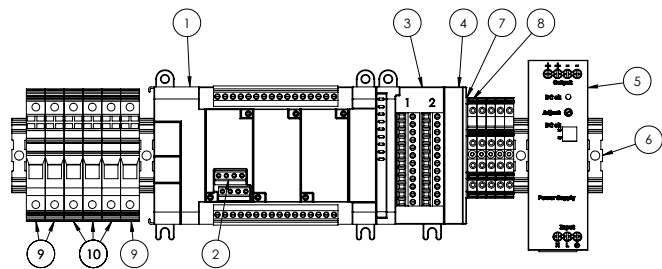
REV	APPV	ECR	REV
<p>THE MATERIALS AND INFORMATION, INCLUDING DESIGN PRESENTED BY THIS PRINT, IS THE PROPERTY OF CHART INC., AND IS CONFIDENTIAL. ACCORDINGLY, THIS INFORMATION IS SUBMITTED UNDER THE AGREEMENT THAT IT IS NOT TO BE REPRODUCED, OR LOANED, IN PART OR IN WHOLE, NOR IS IT TO BE RELAYED TO ANY COMPANY. ACCEPTANCE OF THIS WILL BE CONSTRUED AS AN AGREEMENT TO</p>			
<p># DESIGNATES A NOTE REFERENCE (XX) DESIGNATES A</p>			



DRAWING NO. B-36000.002

VISION DESCRIPTION			BY	DATE	APP'VD	DATE	ORIGINAL ECR / ER			
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					CHECKED BY					
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					UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES: FRACTIONS ± 1/16" ANGLES ± 1° 1 PLACE DECIMAL ± .030 2 PLACE DECIMAL ± .015 3 PLACE DECIMAL ± .005				TITLE: SCHEMATIC PROJECT: TRIFECTA PRO CONTROLLER	
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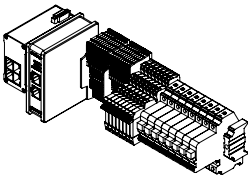
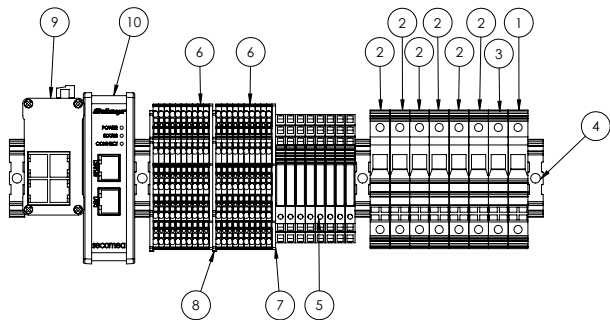
Rail Assemblies



RAIL ASSEMBLY 1

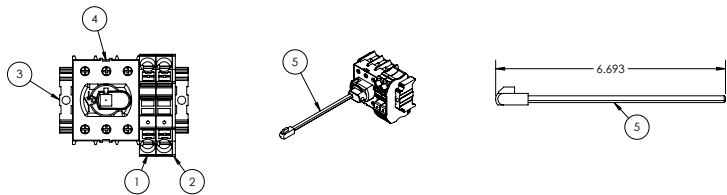
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1	351004.1201.0001	PLC CONTROLLER	1
2	351004.1202.0003	PLC TC MODULE	1
3	351004.1202.0002	PLC MODULE	1
4	351004.1202.0001	PLC TERMINATOR	1
5	351008.1101.0120	POWER SUPPLY	1
6	351007.1702.0001	DIN-RAIL ANCHOR	4
7	351007.2102.0001	TERMINAL BLOCK END PLATE	1
8	351007.2101.0001	RESISTOR BLOCK	5
9	351009.1101.0050	CIRCUIT BREAKER 0.5A	3
10	351009.1101.0200	CIRCUIT BREAKER 2A	3

RAIL ASSEMBLY 2



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	351007.1101.1000	CIRCUIT BREAKER 10A	1
2	351009.1101.0200	CIRCUIT BREAKER 2A	6
3	351009.1101.0400	CIRCUIT BREAKER 4A	1
4	351007.1702.0001	DIN-RAIL ANCHOR	4
5	351010.1101.001	RELAY MODULE	8
6	351007.1201.0001	TERMINAL BLOCK	20
7	351007.1200.0001	TERMINAL BLOCK END PLATE	2
8	351007.1701.0001	TERMINAL BLOCK PARTITION	2
9	351004.2101.0001	ETHERNET SWITCH	1
10	351004.3101.0001	GATEWAY MANAGER	1

RAIL ASSEMBLY 3



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	351007.1101.0006	GROUND BLOCK	2
2	351007.1100.001	TERMINAL BLOCK END PLATE	1
3	351007.1702.0001	DIN-RAIL ANCHOR	2
4	351009.2101.0016	DISCONNECT SWITCH	1
5	36000.001.XX	INTERLOCK SHAFT	1

Preventive Maintenance

Procedure

Over time components of the Trifecta Pro 30K (as in any mechanical system) can degrade and/or fail if not properly maintained. For this reason, a regular maintenance procedure is recommended to prevent any unexpected downtime.

The most common field failures are due to:

- Clogged fill line strainer or strainer having been completely removed by service technician permitting entry of debris to system.
- Malfunctioning solenoids and check valves (leaks) caused by:
 - Buildup of impurities of liquid fed to the system from the bulk tank
 - Introduction of moisture to the bulk system without proper purge process
 - Normal wear and tear of solenoids' pistons and seats due to cycling
 - Debris entering Trifecta Pro 30K from bulk station due to removed strainer
- Leaking fittings
 - All connections are leak checked from the factory and should be re-checked periodically
 - All replaced fittings in the field must be checked to ensure proper operation
- Malfunctioning cylinder reliefs
 - Relief valve opening at lower pressure than set point
 - Burst disc rupture (fatigue failure)

With a regular maintenance procedure, these possible failures and corresponding down times can be prevented. To ensure uninterrupted operation, it is recommended that the following maintenance procedures be followed:

- Every six months:
 - Clean/replace strainer on liquid feed line



Note: *DO NOT operate system without a fill line strainer in place.*

- Every year:
 - Verify two normal operation cycles.
 - Inspect integrity of all wire connections in control box. Tighten all loose connectors.
 - Verify accuracy of analog gauges against pressure transmitters and DP transmitters.
 - Leak check entire Trifecta Pro 30K system.
 - Inspect flex hoses for leaks and defects
- Every three years or at 20,000 cycle count limit:
 - Replace all check valves
 - Replace pistons and coils on all solenoid valves and rebuild cryogenic ball valves
 - Replace relief valves and burst discs on tanks 1 and 2
- Every three years or at 40,000 cycle count limit:
 - Replace flex hoses on bottom withdrawal lines



Note: *Reset cycle counter after servicing valves.*

Whenever solenoid piston assemblies are serviced, or valve is taken apart for cleaning, the bolts must be accurately torqued to 10 to 12 foot-pounds of torque in a normal cross pattern upon re-assembly. If they are over torqued, the body will become distorted, and “pinch” the piston, causing the valve to stick open or closed. It is also recommended that every time the valve is disassembled, that the gasket be replaced, as the gasket takes a permanent set each time the bolts are tightened and will not re-seal a second time.

Recommended Spare Parts

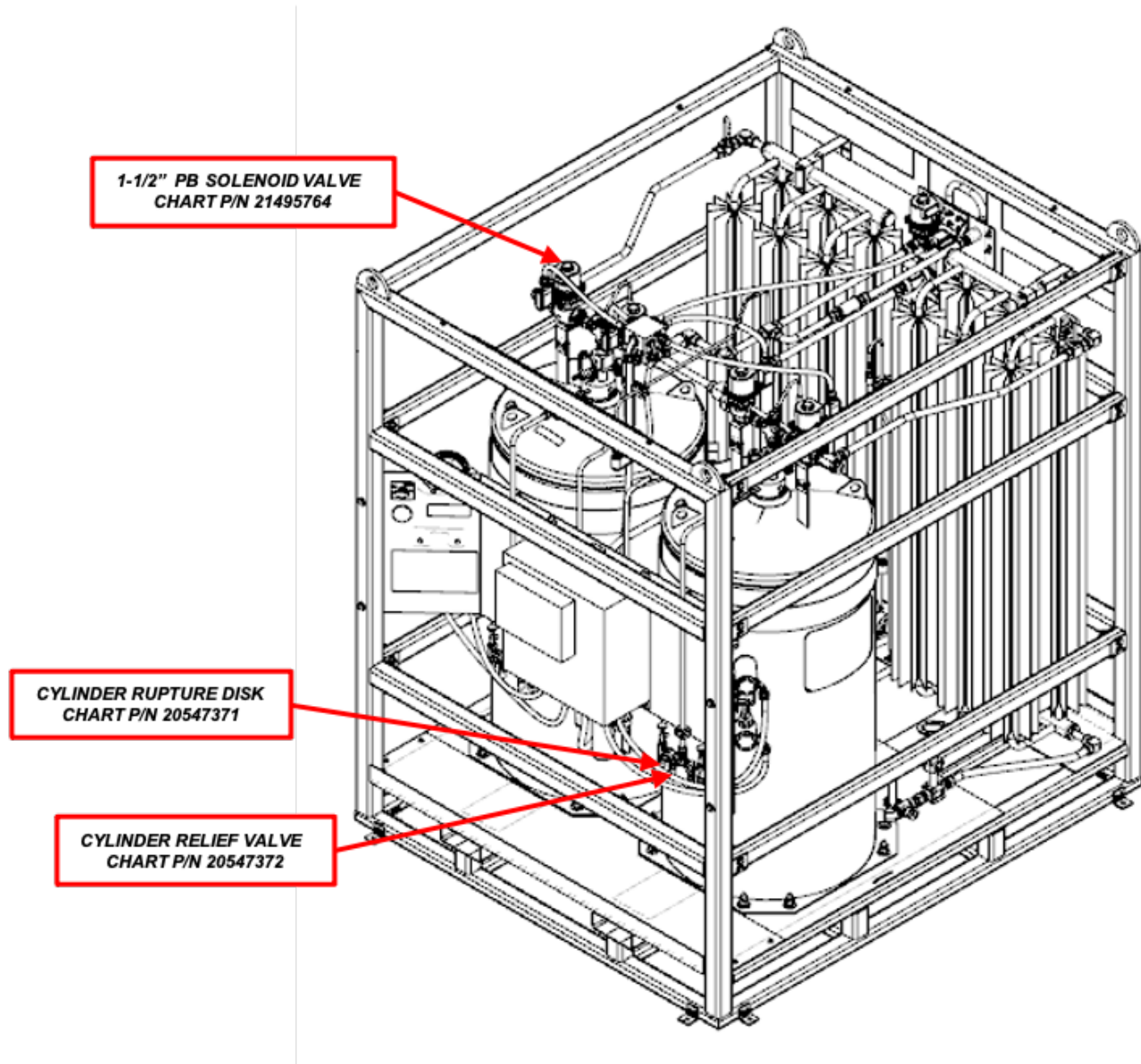
In the event that repair is necessary, Chart provides the following spare parts at www.chartparts.com.

Control Box		
Item Description 1	Item Description 2	Chart PN
HMI, PANELVIEW 7 PLUS GRAPHIC TERMINAL	ALLEN-BRADLEY	351004.1101.0001
PLC, MICRO-850 SERIES, CONTROLLER, 14 INPUTS, 10 SOURCE OUTPUTS	ALLEN-BRADLEY	351004.1201.0001
PLC, MICRO 850 SERIES, I/O TERMINATOR MODULE	ALLEN-BRADLEY	351004.1202.0001
PLC, MICRO 850 SERIES, ANALOG INPUT MODULE, 8-CHANNEL	ALLEN-BRADLEY	351004.1202.0002
PLC, MICRO 800 SERIES THERMOCOUPLE MODULE, 2-CHANNEL	ALLEN-BRADLEY	351004.1202.0003
GATEWAY, REMOTE ACCESS SITE MANAGER	SECOMEA	351004.3101.0001
ETHERNET SWITCH, UNMANAGED, 4-PORT	N-TRON	351004.2101.0001
POWER SUPPLY, 24V/5A OUT, 120W	PULS	351008.1101.0120
HEATER, 5"X10" 120VAC 250W, W/ THERMOSTAT AND MOUNTING PLATE	WATLOW	350800.1101.0250
THERMOCOUPLE, BOLT-ON ASSEMBLY, TYPE-T, 36IN WIRES, #10 BOLT HOLE	OMEGA	350800.2101.1036
CIRCUIT BREAKER, UT 6-TMC M SERIES, 1-POLE, 0.5A (UL1077)	PHOENIX CONTACT	351009.1101.0050
CIRCUIT BREAKER, UT 6-TMC M SERIES, 1-POLE, 2A (UL1077)	PHOENIX CONTACT	351009.1101.0200
CIRCUIT BREAKER, UT 6-TMC M SERIES, 1-POLE, 4A (UL1077)	PHOENIX CONTACT	351009.1101.0400
CIRCUIT BREAKER, UT 6-TMC M SERIES, 1-POLE, 10A (UL1077)	PHOENIX CONTACT	351009.1101.1000
OPERATOR, HW SERIES, SELECTOR SWITCH, 2-POSITION, NON ILLUMINATED	IDEC	351006.2101.0001
INDICATOR, TL50BL SERIES, TOWER LIGHT, R/Y/G, 12-30V AC/DC, 2M CABLE	BANNER	351006.1101.0001
RESISTOR, 250ohm	ABB	351007.2101.0001
THERMOCOUPLE TYPE T PROBE	THERMOCOUPLE TYPE T 60" LEADS	14271813

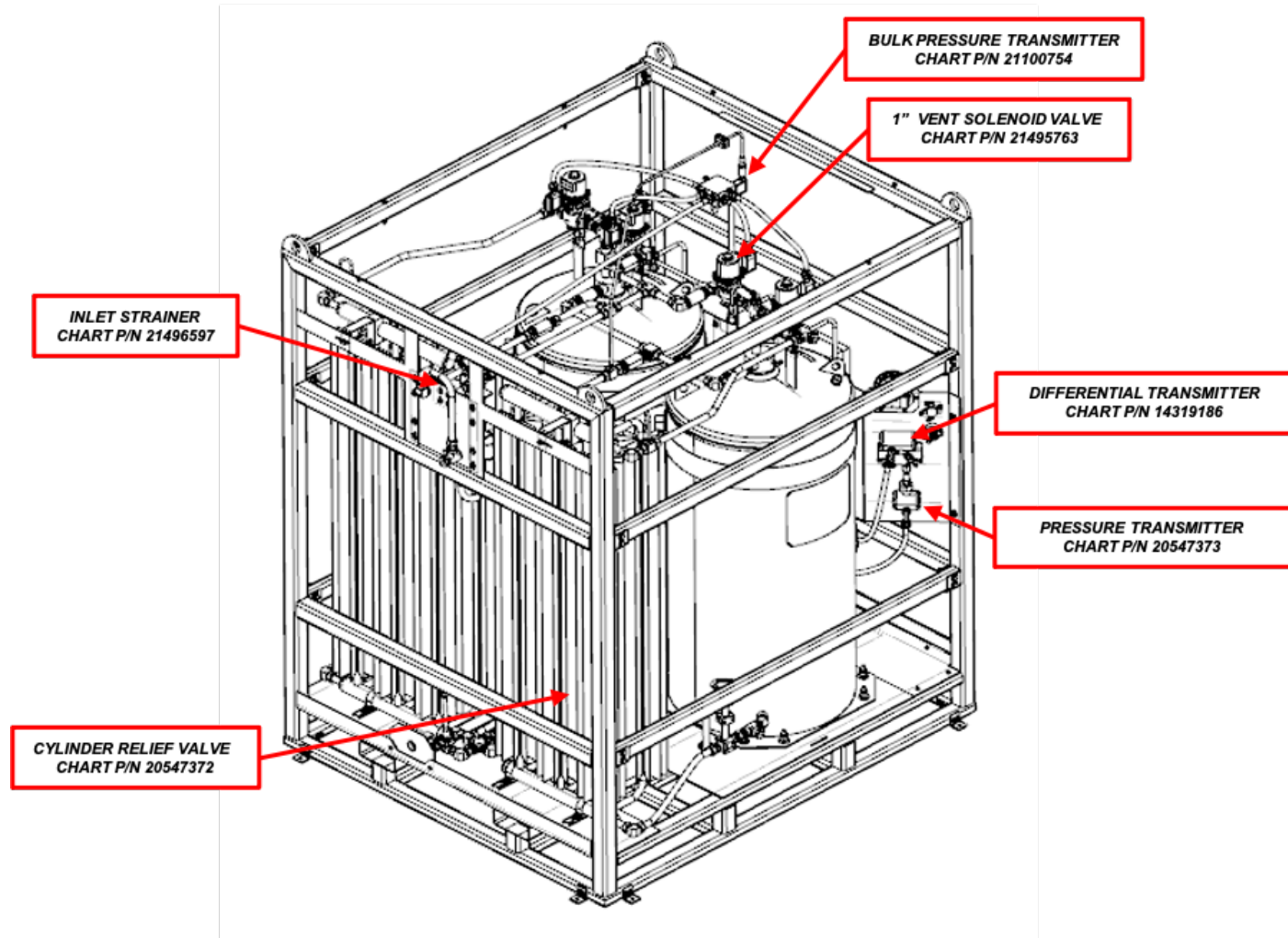
Safety Tree		
Item Description 1	Item Description 2	Chart PN
SAFETY RELIEF VALVE-CYLINDER (BRS ½"MPT 600 PSI)*	RV BRS 1/2MPT 600PSI	20547372
RUPTURE DISC-CYLINDER (RPD INLINE 1/2"MPT 800 PSI)*	RPD ASSY INLINE 1/2MPT 800PSI	20547371
VALVE NEEDLE BRS 1/4MPT (ANGLE)	VALVE NEEDLE BRS 1/4MPT	10907239
VALVE BALL DIV SS 1/2NPT	VALVE BALL DIV SS 1/2NPT	11773885

Regulators/Check Valves/Globe Valves/Ball Valves		
Item Description 1	Item Description 2	Chart PN
STRAINER-INLET	STRAINER 1"FPT Y-TYPE	21496597
STRAINER-INLET REPLACEMENT ELEMENT	STRAINER BASKET 1" 100 MESH	21673715
STRAINER-REPLACEMENT GASKET	STRAINER GASKET 1" SS STRAINER	21673914
CHECK VALVE GENERANT (1 PSI) 1"FPT X1"FPT	VALVE CHECK BRS 1FPTX1FPT	21494743
USE (VALVE GLOVE BRS 1") - REGO BB9408T	VALVE GLOBE BRS 1NPT	21494649
VALVE SHUTOFF BRZ 1/2FPT SHORT	VALVE BRZ 1/2FPT SHORT	10502848
RV BRS 1/4MPT GENERENT CRV-250B-K-720	RV BRS 1/4MPT 720 PSI	21191971
RV BRS 1/4MPT 660 PSI GENERANT	CRV-250B-K-660	12898487
MUFFLER ASSY SS 1"	MUFFLER ASSY SS 1"	21494891
MUFFLER OXY 7/8" - 14 UNF	MUFFLER	9710399
4-WAY INSTRUMENT ISOLATION VALVE	1/8 FPT SWAGELOK	20683719
PB RETURN/VENT ISOLATION VALVE	1 FPT WORCESTER SHORT STEM	21494494
BOTTOM WITHDRAWAL ISOLATION VALVE	1 FPT WORCESTER EXT STEM	21497072

Solenoid Valves		
<i>Item Description 1</i>	<i>Item Description 2</i>	<i>Chart PN</i>
VENT SOLENOID VALVE (120VAC-1")	VALVE SOLENOID 1FPT 120VAC	21495763
VENT VALVE SOLENOID COIL (120VAC-1")	COIL SOLENOID 120V 60HZ	21673716
VENT VALVE GASKET (1")	GASKET SOLENOID MAGNATROL	21673720
VENT VALVE PISTON ASSEMBLY (120VAC-1")	PISTON ASSY SOLENOID MAGNATROL	21673723
PB SOLENOID VALVE (120VAC – 1-1/2")	VALVE SOLENOID 1-1/2FPT 120VAC	21495764
PB SOLENOID VALVE COIL (120VAC – 1-1/2")	COIL SOLENOID MAGNATROL 120V	21673724
PB SOLENOID VALVE GASKET (1-1/2")	GASKET SOLENOID 1-1/2" TEFLON	21673725
PB SOLENOID VALVE PISTON ASSY. (120VAC – 1-1/2")	PISTON ASSY 1-1/2" SOLENOID	21673726
TRANSMITTERS		
<i>Item Description 1</i>	<i>Item Description 2</i>	<i>Chart PN</i>
DIFF PRESS CALIBRATED 0-100" YOKOGAWA	DIFF PRESS TRANS	21724841
TRANSMITTER PRESS 0-600PSIG	TRANSMITTER PRESS 0-600PSIG	21724843
PRESSURE TRANSDUCER (0-500 PSI S20 4-20mA)	TRANSDUCER PRESS 0-500 PSI	21100754
PRESSURE GAUGE (0-800 PSI)	PG 2-1/2" DIAL 0-800 PSI/BAR 1/8" MPT	21311482
LIQUID LEVEL GAUGE	DIFF PG 1.5" 0-60" H2O VITON	20923160
FLEX HOSE (1")	STAINLESS STEEL 1"OD, 26" LENGTH	21598203



Front Isometric View of Trifecta 30K 600 psig



Rear Iso view of nitrogen Trifecta 30K (600 psig)



Troubleshooting

If the regular maintenance procedure is followed, troubleshooting should not be necessary. If problems do occur, the following is a step-by-step troubleshooting guide. If you are not familiar with normal Trifecta Pro 30K operation, please read the Operation section of this manual before continuing. While troubleshooting the Trifecta Pro Series, there are five things that should be monitored or checked for inconsistency to aid in diagnosis:

1. Confirm all valves on the bulk tank and Trifecta Pro Series are in their normal operating position.
2. Confirm solenoids energize correctly by manually "firing" them per the instructions in the Operations section of the manual.
3. Check for frost formation on lines which should not have recently been active.
4. Leak check all plumbing components.
5. Check for discrepancies between analog gauges and controller parameters.

The above steps are described in greater detail below and will lead you to the root of the malfunction.

Confirm Valve Positions

- Confirm that the following manual override on all valves are in the correct position:
 - Bulk Tank Auxiliary Liquid Valve Open
 - Bulk Tank Pressure Building Valve Open
- Confirm that the system is in "Auto" mode.

Normal Activation of Solenoids

Open HMI cover giving you access to the PLC screen. Per the Operations section of this manual, switch the controller to "Manual" and open each solenoid. Make sure all valves energize accordingly.

Frost Formation

Frost forms on all lines that have cold vapor or liquid flowing through them. The frost will begin to thaw when product is no longer flowing through the lines.

The frost will be evident for any significant amount of flow through the lines. Simply by looking at the frost formation, a check valve and/or solenoid, which are leaking or inoperable, can often be detected.

Likewise, lack of frost on a line will indicate that product is not flowing through the line and that a solenoid is stuck shut or for some reason not firing properly.

Leak Check

- Leak check all plumbing components, with special attention to plumbing stack on tank and all connections to pressure transmitters.
- A leak at any point in the Trifecta Pro 30K system will result in loss of product.
- A leak in the plumbing within the plumbing stack or pressure transducers and transmitters can cause incorrect values to be translated by the PLC. These transducers provide the input to the Trifecta Pro 30K controller, which tell it when to open and close solenoids. Incorrect values will cause the Trifecta unit to operate in a random fashion and could cause supply issues downstream.

Data from Main Screen and Analog Pressure Gauges

Record Trifecta Pro 30K and bulk tank parameters as described in the Parameter Settings section of this manual. Compare these values to those on the analog gauges of the tanks and the bulk tank (an example form is on the next page).

Bulk Tank

Pressure (Analog Gauge)	_____	PSIG
Pressure (from PLC Display)	_____	PSIG

Tank 1

Pressure (Analog Gauge)	_____	PSIG
Pressure (from PLC Display)	_____	PSIG
Liquid Level (from PLC Display)	_____	"H ₂ O
Liquid Level (from Analog Gauge)	_____	"H ₂ O

Tank 2

Pressure (Analog Gauge)	_____	PSIG
Pressure (from PLC Display)	_____	PSIG
Liquid Level (from PLC Display)	_____	"H ₂ O
Liquid Level (from Analog Gauge)	_____	"H ₂ O

PLC Information

Press "Setpoints on main screen/record PB Set Point	_____	PSIG
Press Fill Set Point	_____	"H ₂ O
Press bulk critical	_____	PSIG
Cycle Count	_____	#cycles

Press Alarms, Alerts and Record and Active ALARMS/ALERTS to include times/record Error Codes and elapsed time since event.

Note that the transmitter and gauge readings may not match exactly. A discrepancy can be caused by either the analog gauge or by the transmitter.

In most cases, the result is an inaccurate analog gauge. Replace this gauge first.

Appendix 1

Introduction

The Trifecta Pro control system allows for multiple units to communicate if connected via common Ethernet network. When connected, one Trifecta is configured as the Master Trifecta, while up to four other units are configured as Slave Trifectas. The Trifecta units will cycle between Active and Standby in order to share the workload. When needed, the Master Trifecta can call upon the Standby units for assistance.

The Master will control which Trifectas are at the Active and which are at Standby. The pressures which Active and Standby units run at are controlled by the Master Trifecta. Standby units will run at a preset pressure below the PB On setpoint of the Master Trifecta. The Master will rotate which Trifectas are Active and which are Standby based on an adjustable amount of time.

The Master Trifecta will make any Standby Trifectas Active if any of the Active units request assistance or loses communications with a Slave Trifecta. If any Slave units lose communication with the Master, it will run as a standalone Trifecta, using its own pressure on setpoint.

If an Active unit requests assistance, all Standbys will remain active for a minimum of 30 minutes. The Previous Cycle Timer must be greater than the preset amount of time based on flow capacity of the Trifectas in order to release the Standby units back to Standby.

SECOMEA Setup

Before the communication between two or more Trifecta Pro units can occur, as described in the above Introduction, the on board SECOMEA device has to be properly programmed. The steps required to do this are listed below.

1. Identify the static IP address for each unit and send this IP address and corresponding Trifecta serial number to techservicemn@chartindustries.com and they will send you the appropriate configuration files for the SECOMEA.
2. Copy this configuration file, "SITEMANAGER.CFG", to the base directory of a USB memory device.
3. Power on and wait for the Status light to be steady red on the SECOMEA. As soon as it turns solid red then insert the USB memory device into one of the USB slots on the top of the SECOMEA.

4. Lights will flash and the status light will cycle between green and red, wait for status light to turn green (this will take some time).
 5. Once the light turns green, remove the USB memory device from the SECOMEA.
- You should not be able to program multiple Trifecta units as instructed.

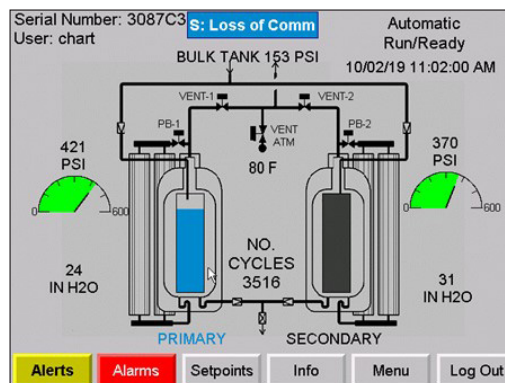
HMI Screens

The following screenshots describe changes to existing screens and screens which were added for when running in parallel with other Trifectas.

MAIN Screen - Master/Slave

M/S Mode field — Displays if the unit is a Master or Slave. It also indicates if the unit is Active, Standby or has lost communications

- **S: Active** — Slave Trifecta with PB on set to the Active Pressure
- **S: Standby** — Slave Trifecta with PB on set to the Standby Pressure
- **S: Loss of Comm** — Slave Trifecta which has lost communications with the Master. Will run using PB On Setpoint set locally until communications are restored.
- **M: Active** — Master Trifecta with PB on set to the Active Pressure
- **M: Standby** — Master Trifecta with PB on set to the Standby Pressure
- **M: Loss of Comm** — Master Trifecta has lost communications with the one or more Slave units. Will run using Active PB On until communication is restored



SETPOINT DATA ENTRY Popup - Master/Slave
Pressure Build (PB) On field

- **Master** — Displays the PB On setpoint to be used by all Active Trifectas
- **Slave** — Displays the PB On setpoint to be used upon loss of communications with the Master Trifecta

ACTIVE SETPOINT Screen - Master/Slave
Pressure Build (PB) On field

- **Master** — Displays the PB On setpoint to be used by all Active units
- **Standby** — Displays the PB On setpoint to be used upon loss of communications with the Master Trifecta

PB On Per Master Unit field — Displays the PB On pressure currently being used by the Trifecta

MS Offsets button (Master Trifecta Only) — Opens an additional setpoint screen for the Master Trifecta

ACTIVE SETPOINT MS Offsets Screen (Master Only)

Rotation Frequency field — Displays the number of hours between rotation of Active units

Offset fields — Allows the user to fine tune the balancing of the units, if necessary. When an offset is applied, the Master unit will instruct the respective Trifecta to run at the desired PB On plus the offset (+/- 10).



Note: The offset is meant to overcome difference in pressure drop. If the cycles for all the units are within an acceptable percentage (5-10%), it is recommended to leave the Offsets at 0 to minimize complexity.

PB On per Master Unit field — Displays the PB On pressure currently being used by the Trifecta.

MS Offsets button (Master Trifecta Only) — Opens an additional setpoint screen for the Master Trifecta

Reset Offsets to 0 button — Resets setpoints to default settings

Rotate button — Manually forces a rotation of which Trifectas are Active (Hours until next rotation will reset)

Hours Until Next Rotation field — Displays number of hours until the next rotation of Active Units.

Trifecta Pro HMI Email Screens

The Trifecta email is setup to send an alarm notification to email recipients in the TO, CC and Bcc fields. To add recipient email addresses, select the desired field and enter a single email address or multiple addresses. When entering multiple addresses add a comma between addresses (e.g. Jane.doe@chartindustries.com,john.doe@chartindustries.com). Each field has a maximum 82 characters, to get emails to everyone on your list use multiple fields.

When receiving an email from the Trifecta system it will be from NOREPLY@SECOMEA.com

The Subject field and Body field are user customizable, select the field to be edited and enter your desired text (max. 82 characters per field).

After entering recipients, you can use the “Send Sample Button” to test the email system.

After setting up the email recipients and subject/body text select the “Alarm Sel” button to select which alarms will send an email.

If the “Email Enable” check box is red the email system is disabled and will not send emails on alarm. To enable the alarm email system select the “Email Enable” box until the check box turns green.

Fault Alarms (Manual Mode) are alarms that switch the Trifecta unit into manual mode.

Email enabled alarms will have a green check box, gray check boxes are alarms that will not send an email.

Select the “Next” button to enable/disable additional alarms.

Warning Alarms indicate a condition that the system is not running as intended, the system will continue to run and try to self clear the alarm condition.

Email enabled alarms will have a green check box, gray check boxes are alarms that will not send an email. Select the “Next” button to enable/disable additional alarms.

Warning Alarms indicate a condition that the system is not running as intended, the system will continue to run and try to self clear the alarm condition.

Email enabled alarms will have a green check box, gray check boxes are alarms that will not send an email.

