

# Product Manual Trifecta XPro Series



Designed and Built by:

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## **Revision Log**

<b>Revision Level</b>	Date	Description
A	09/17/2019	Manual Creation



## Preface

#### General

The Trifecta XPro Series is the preferred solution for reliable and continuous laser assist gases for delivery pressures up to 550 psig and flow rates up to 15,000 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 highpressure 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, startup and continuous operation.
- Frame assembly features a protective top cover in a compact footprint with an elevated base for improved ventilation.
- Available for oxygen (500 MAWP), or nitrogen and argon (500 & 600 MAWP) service
- Inconel and copper material used where required on high pressure oxygen unit

#### **Product Manual**

The Trifecta XPro Series 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 <u>www.chartparts.com</u>.

#### 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.



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 XPro Series 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 XPro Series Skid

The Trifecta XPro Series has been designed for ease of installation and operation. An ideal install has the Trifecta XPro 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 XPro Series 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 XPro Series can supply liquid nitrogen and liquid argon in maximum allowable working pressures from 500 to 600 psi. It can supply liquid oxygen in maximum allowable working pressures of 500 psi.

Service	MAWP* (psig)	MAOP* (psig)	
	500	450	
LIN	600	550	
	500	450	
LAR	600	550	
LOX	500	450	

\*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 XPro Series was developed and tested by Chart's New Product Development group in the harsh New Prague, Minnesota winter conditions for optimal performance in the field.

For example: the Trifecta X10 is rated to deliver liquid nitrogen at 425 psi @ 10,000 SCFH in ambient conditions similar to Minnesota. If the end user can tolerate lower delivery pressures, the XPro Series can deliver even greater flow rates. If the rated flows are not needed, the system can be set to higher pressures.



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 subcool 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 sitespecific 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 warmup.

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.



Warning! Use only replacement parts that are compatible with liquid oxygen and have been cleaned for oxygen use.

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 (<u>www.nfpa.org</u>) 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 <u>www.cganet.com</u>.

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.

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## Installation

#### Installation Procedure

The installation of the Trifecta XPro Series should be done in the following order:

- 1. Place Trifecta XPro Series 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. Pipe Trifecta XPro Series liquid fill line to bulk tank labeled "From Bulk Tank."
  - a. Use liquid withdrawal line on bulk tank



Note: Do not use the dip tube line.

- 3. Pipe Trifecta XPro Series gas use line to external vaporizer labeled "To Vaporizer."
- 4. Connect power supply to dedicated 120V AC, 15 amp circuit.



Note: For older style 600 psig XPro units equipped with pneumatic actuated ball valves, a nitrogen gas line coming off the vapor space of the tank will need to be run to the Trifecta.

5. Commission Trifecta XPro Series System.

#### Placement of Trifecta XPro Series Skid

The Trifecta XPro Series 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 XPro Series assembly weighs almost 1900 lbs. empty (864 kg).

The Trifecta XPro Series 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 XPro Series skid. This process becomes less efficient with increasing transfer line length.



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.



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.



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

#### Liquid Line Piping to Bulk Tank

The Trifecta XPro Series 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 connecting multiple Trifectas to one bulk tank.

The backside (PB Side) of the XPro Series skid has two/three connection points.

- 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



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).



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

For earlier versions of the 600 psig Trifecta series, a gas line from the bulk tank needs to be run to the regulator, which supplies pneumatic pressure to the actuators on each ball valve. The regulator regulates the pressure from the bulk tank down to 125 psi. The actuators require a minimum of 80 psig. The maximum pressure for the gas line is 150 psi.

## Piping to Vaporizer

The Trifecta XPro Series 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 XPro Series. The vaporizer(s) should have a pressure rating of at least 600 psig - or 700 psig for the 600 psig Trifecta.



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 600 psig (or 700 psig for the 600 psi high pressure Trifecta Gas Supply System).



The relief device (SRV-3) on the Trifecta XPro Series is a fail-safe device and should not be relied upon as the only thermal relief. Operation of the Trifecta XPro Series "Gas Use" relief device may vent liquid, creating a noticeable vapor cloud.

The piping and components from the Trifecta XPro Series to the vaporizer must be at least 3/4" (19mm) 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.



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



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.



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 XPro Series 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 XPro Series control system. If 120 VAC is not available, an appropriately sized transformer may be necessary.

The Mitsubishi PLC is mounted within a NEMA 4 control box as shown in the following photograph.



It is important that care is taken to install the Trifecta XPro Series 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 XPro Series system and a clean, steady circuit must be used to power the Trifecta XPro Series 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 XPro Series 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.



On early versions of the 600 psig high pressure Trifecta, the solenoid valves are replaced with pneumatic actuated ball valves.

#### Purge and Pre-Charge of the Trifecta XPro Series (Ref. to Fig. 2, Pg. 19 for valve tags)

When all connections to the Trifecta XPro Series are made, purge the complete system using low-pressure nitrogen.

- Close the use valve (V-2)
- Open the liquid valve on the bulk tank and let the bulk tank equalize with the two trifecta tanks.
- Once the Trifecta XPro Series has equalized, close the liquid valve on the bulk tank.
- Let lines thaw.
- Leak check all plumbing connections.

# Purge and Pre-Charge of the Trifecta XPro Series Cont.

• Crack both of the ¼" 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 <sup>1</sup>/<sub>4</sub>" nut is tightened back up after purging.
- Open the purge valves on the safety circuit.



- Cycle the diverter valve (DIV-1) to purge out of both purge valves (V-4). (Do this for tank 1 and tank 2).
- Open both manual vent valves located below the control box (V-1).



- Purge for one minute.
- Close the manual vents (V-1).
- At any time during the purging process, if the pressure gets down to 20 PSI, stop purging and open the liquid line on the bulk tank to let the Trifecta equalize with the bulk tank again.



*Remember to shut the liquid line on the bulk tank before resuming purging.* 

• Close the PB Isolation valve on the bottom of tank 1 and tank 2 (V-3).



• Close VENT/PB Isolation valve on the top of tank 1 and tank 2 (V-6).



• Remove <sup>1</sup>/<sub>2</sub>" plug out of the cross on the upstream side of the 1" P.B. Magnatrol solenoid valve (SOL-3) on both tank 1 and tank 2 (See Note 1).



# Purge and Pre-Charge of the Trifecta XPro Series 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 1/2" 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 1 If isolation valves are present in place of the <sup>1</sup>/<sub>2</sub>" 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 <sup>1</sup>/<sub>2</sub>" 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 ½" plugs that were removed for purging.



- Turn the switch on the front of the control box to "MON" monitor.
- If "Reset Values" is flashing on the bottom of the screen, press the left arrow five times this will reset the factory default settings.
- Check your settings (see Operation).
- Slowly open the use valve (V-2).



# Purge and Pre-Charge of the Trifecta XPro Series 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), hold the "Esc" button on the PLC inside the control box.
- While still holding the "Esc" button, press the up and down arrows for 20 seconds. This will open the vent to bulk solenoid valves and the vent to atmosphere solenoid valve 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 XPro Series.

- Turn the switch on the front of the control box to run.
- 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 XPro Series Cylinder Relief Valves

Check each cylinder's main relief valves. During operation, the pressure in tank one and/or two will rise to approximately 450 psi (550 psig for the 600 psi Trifecta series). 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

#### **Parameter Settings**

Initial power up from the factory will require some parameters to be set. The display flashes "Reset Values" on the lower line of the main display. No valves will operate while this display is flashing. The Reset Values mode can occur if the power is left off the system for more than two weeks.



#### **Reset Values**

To set these parameters without running the system, switch the MON/OFF/RUN switch found on the front of the control panel to the "MON" position. "Monitor" will flash on the lower line of the main display. The valves will not be controlled by the PLC when "Monitor" is in the display.



*Note:* If power is off for two weeks, the volatile memory will be lost. In this case, parameters MUST be reset before operations continue. Reset parameters to default settings by switching to "Monitor" mode and pressing the left arrow five times. Reset parameters to site requirements prior to switching to "Run" position.

#### Setting Pressure Set Points

Three settable parameters are accessible from the PLC buttons. These parameters are key to setting all parameters.



- Pressing the "Left" arrow button accesses the pressure building set points.
- The "PBOff" set point is always 25 psi higher than the "PBOn" set point.
- At the "PBOn" pressure the system turns on the primary tanks PB valve.
- The "PBOff" set point is the pressure that the system turns off the primary PB valve.
- The secondary tanks PB "Hold" pressures are a function of these values.
- Pressing and holding the "Left" arrow and pressing the "+" button or the "-" button will adjust the set points.



#### Setting Fill Set Point



- Pressing the "Up" arrow button accesses the fill set point. The "Fill" set point terminates the filling of the secondary tank when the pressure of the secondary tank is between 80 and 130 psi.
- If the pressure is above 130 psi during the fill, the fill is terminated at the "Fill" set point -1.5". This allows for the liquid growth due to an increased saturation level.
- If the pressure is below 80 psi the fill is terminated at the "Fill" set point +1.5". Colder liquid takes up less volume. Adding to the fill set point will assure that the PB time will be consistent.
- Pressing and holding the "Up" arrow and pressing the "+" button or the "-" button will adjust the set point.



#### Setting Bulk Tank Critical Pressure



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



- Pressing the "Down" arrow button accesses the Bulk Critical set point. If the storage (bulk) tank is above the "BC" set point during the filling of the secondary tank, the secondary tank will vent to atmosphere to minimize the heat added back to the storage tank.
- If the storage tank pressure is below the "BC" set point the secondary tank will fill in the "Low Loss" fill mode.
- The "Low Loss" fill mode cycles the vent to atmosphere valve to minimize losses. The current "Bulk" pressure is also displayed on this screen.
- Pressing and holding the "Down" arrow and pressing the "+" button or the "-" button will adjust the set point.



#### Hard Sets

The Trifecta XPro Series operation is based on pressure first, and liquid level second. This logic assures that the system pressure is maintained as pressure is the primary concern. The following table is intended to give detailed information of the internal parameters. Hard sets vary slightly by product. The values in the table below are for nitrogen service.

HardSets		
Thresholds		
Factory		
Default	Adjustable	Description
29.0"	Yes (up arrow)	default fill level
7.3"	Yes (function of fill level)	primary to low to assist (.25 x fill level)
24.7"	Yes (function of fill level)	secondary to low for assist mode (.85 x fill level)
450 psi	Yes (function of PB On)	PBOff = PBOn + <b>25</b> psi
425 psi	Yes (left arrow)	default PBOn <b>425</b> psi
450 psi	No	PBOn upper limit is <b>450</b> psi
400 psi	Yes (function of PB On)	Reserve tank PBOFF = Primary PBOn - <b>25</b> psi
375 psi	Yes (function of PB On)	Reserve tank PBOn = Primary PBOn - <b>50</b> psi
375 psi	Yes (function of PB On)	Primary pressure extreme low pressure threshold
150 psi	Yes (down arrow)	default Bulk Critical <b>150</b> psi
495 psi	No	Side #1 relief to bulk or atmosphere at <b>495 psi</b>
495 psi	No	Side #2 relief to bulk or atmosphere at <b>495 psi</b>
-5 psi	No	Transmitter Pressure to low (system will not operate)
550 psi	No	Transmitter Pressure to high (system will not operate)
3 seconds	No	Liq present at temp switch for <b>3</b> seconds
120 seconds	No	Temp switch will disarm for <b>120 seconds</b> after over pressure relief
10 seconds	No	If the pressure drops to the fast drop PB set within <b>10</b> seconds
435 psi	Yes (function of PB On)	Fast drop on pb = PBOn + <b>10</b> psi
300 seconds	No	Fill time reaching <b>300</b> seconds results in the vent opening until full
140 psi		With bulk tank below critical pressure, the vent to atmosphere
(100 psi bulk tank)	No	valve will open at this set point = Bulkpsi(frozen) + <b>40</b> psi
55 psi		Low loss set point that turns of the vent to atmosphere
(100 psi bulk tank)	No	valve = Bulkpsi(frozen) - <b>45</b> psi (low loss)
70 psi		Low loss set point that turns of the vent to atmosphere
(100 psi bulk tank)	No	valve = Bulkpsi(frozen) - 45 psi (low loss)
		Fill level is reduced by 1.5" to account for liquid growth for
27.5"	Yes (function of fill level)	cylinder pressures above 130 psi
130 psi	No	Pressure threshold that takes subtracts 1.5" from the fill level
80 to 130 psi	No	Nominal cylinder pressure. Fill levels at fill set point.
80 psi	No	Pressure threshold that takes adds 1.5" from the fill level
		Fill level is increased by 1.5" to account for liquid growth
30.5"	Yes (function of fill level)	change for cylinder pressures below 80 psi
		Primary pressure below PB On set for <b>10</b> seconds will result
10 seconds	No	in the secondary assisting the primary tank.
		Primary pressures below the PB on threshold for <b>120</b> sec will
		activate the light/display message, freeze the error codes and start
120 seconds	No	the low pressure timer.
360 seconds	No	Alert code A1 is activated
128+A5 seconds	No	Flow timer - limit to deliver 4" of product. Activates E5 error
25.0"	No	Start flow timer at this liquid level.
18.0"	l No	Stop flow timer at this liquid level.

Hardsets (500 psig)

#### Hard Sets cont.

HardSets		
Thresholds		
Factory		
Default	Adjustable	Description
29.0"	Yes (up arrow)	default fill level
7.3"	Yes (function of fill level)	primary to low to assist (.25 x fill level)
24.7"	Yes (function of fill level)	secondary to low for assist mode (.85 x fill level)
550 psi	Yes (function of PB On)	PBOff = PBOn + <b>25</b> psi
525 psi	Yes (left arrow)	default PBOn <b>425</b> psi
550 psi	No	PBOn upper limit is <b>450</b> psi
500 psi	Yes (function of PB On)	Reserve tank PBOFF = Primary PBOn - <b>25</b> psi
475 psi	Yes (function of PB On)	Reserve tank PBOn = Primary PBOn - <b>50</b> psi
475 psi	Yes (function of PB On)	Primary pressure extreme low pressure threshold
150 psi	Yes (down arrow)	default Bulk Critical <b>150</b> psi
595 psi	No	Side #1 relief to bulk or atmosphere at <b>495 psi</b>
595 psi	No	Side #2 relief to bulk or atmosphere at <b>495 psi</b>
-5 psi	No	Transmitter Pressure to low (system will not operate)
650 psi	No	Transmitter Pressure to high (system will not operate)
3 seconds	No	Liq present at temp switch for <b>3</b> seconds
120 seconds	No	Temp switch will disarm for <b>120 seconds</b> after over pressure relief
10 seconds	No	If the pressure drops to the fast drop PB set within <b>10</b> seconds
535 psi	Yes (function of PB On)	Fast drop on pb = PBOn + <b>10</b> psi
300 seconds	No	Fill time reaching <b>300</b> seconds results in the vent opening until full
140 psi		With bulk tank below critical pressure, the vent to atmosphere
(100 psi bulk tank)	No	valve will open at this set point = Bulkpsi(frozen) + <b>40</b> psi
55 psi		Low loss set point that turns of the vent to atmosphere
(100 psi bulk tank)	No	valve = Bulkpsi(frozen) - <b>45</b> psi (low loss)
70 psi		Low loss set point that turns of the vent to atmosphere
(100 psi bulk tank)	No	valve = Bulkpsi(frozen) - 45 psi (low loss)
		Fill level is reduced by 1.5" to account for liquid growth for
27.5"	Yes (function of fill level)	cylinder pressures above 130 psi
130 psi	No	Pressure threshold that takes subtracts 1.5" from the fill level
80 to 130 psi	No	Nominal cylinder pressure. Fill levels at fill set point.
80 psi	No	Pressure threshold that takes adds 1.5" from the fill level
		Fill level is increased by 1.5" to account for liquid growth
30.5"	Yes (function of fill level)	change for cylinder pressures below 80 psi
		Primary pressure below PB On set for <b>10</b> seconds will result
10 seconds	No	in the secondary assisting the primary tank.
		Primary pressures below the PB on threshold for <b>120</b> sec will
		activate the light/display message, freeze the error codes and start
120 seconds	No	the low pressure timer.
360 seconds	No	Alert code A1 is activated
128+A5 seconds	No	How timer - limit to deliver 4" of product. Activates E5 error
25.0"	No	Start flow timer at this liquid level.
18.0"	No	Stop flow timer at this liquid level.

Hardsets (600 psig)

#### **Operation** 19

#### **Operation Details**

The Trifecta XPro Series logic keys on pressure instead of liquid level. The components have been minimized (reduced) yet the design has duplication of key components. See Table 1.



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
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

#### Schematic - Fig. 2

There are four key modes:

- Run/fill (mode 0)
- Initial pressure build (mode 1)
- Run/Ready (mode 2)
- Assist (mode 3)

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



Figure 1 - Filling Mode (Vent to Storage)

#### Mode "0"

![](_page_24_Figure_3.jpeg)

Figure 2 - Filling Mode (Vent to Atmosphere)

![](_page_25_Figure_2.jpeg)

Figure 3 - Filling Mode (Liquid Flow)

#### Mode "0"

![](_page_26_Figure_3.jpeg)

Figure 4 - Filling Mode (Low Loss)

![](_page_27_Figure_2.jpeg)

Figure 5 - Filling Mode (Low Loss Vent to Atmosphere)

#### Mode Switch "0" to "1"

![](_page_28_Figure_3.jpeg)

Figure 6 - Fill Mode Termination

![](_page_29_Figure_2.jpeg)

Figure 7 - Initial Pressure Build after Filling/Secondary Ready to Assist

#### Mode Switch "1" to "2"

![](_page_30_Figure_3.jpeg)

Figure 8 - Secondary Maintains "Hold" Pressure

![](_page_31_Figure_2.jpeg)

Figure 9 - Primary Pressure Build

#### Mode "2"

#### Mode Switch "2" to "3"

![](_page_33_Figure_3.jpeg)

Figure 11 - Call for Assist

## Assist Mode "3"

![](_page_34_Figure_2.jpeg)

Figure 12 - Secondary Assist of Primary

![](_page_35_Figure_2.jpeg)

Figure 13 - Assist Complete - Primary Restored

## Mode Switch "3" to "0"

![](_page_36_Figure_3.jpeg)

Figure 14 - Primary Unable to Recover (Switch Primary Side)

![](_page_37_Figure_2.jpeg)

Figure 15 - Primary too low to be assisted (Switch Primary Side)

## Mode Switch "3" to "0"

![](_page_38_Figure_3.jpeg)

Figure 16 - Secondary Tank too low to Assist (Switch Primary Side)

![](_page_39_Picture_2.jpeg)

## Service

#### Service Menus

The Trifecta XPro Series PLC has built into the program service information and error codes.

If the PLC determines that there is a service issue "Check Alert" will be displayed.

![](_page_40_Picture_5.jpeg)

Press the right arrow on the PLC controller to acces the service phone number (1-800-400-4683).

![](_page_40_Picture_7.jpeg)

Before calling for assistance note the current program revision (example: XS15080505\_5). The revision number will help in troubleshooting.

#### **Error Codes**

The PLC reviews timers, flows, values and counters to assure they are within reason. If the PLC determines that they are not within reason an error code will be displayed.

![](_page_40_Picture_11.jpeg)

Access the error codes by pressing and holding the "OK" button. Along with the error codes the current primary tank (example P1 - side 1 is primary) is indicated.

Also, the current mode is displayed (example M0 - Secondary filling).

The following is the summary of the error codes:

Code	Description	Action
P1	Primary Side 1	None
P2	Primary Side 2	None
M0	Filling Secondary	None
M1	Secondary PB after Fill	None
M2	Secondary Ready	None
М3	Secondary Assist of Primary	None
A0	OK!	None
A1	Fill time exceeds flow rating	Improve fill times by: Increasing sub-cool reduce bulk critical pressure reduce restrictions on liquid line.
B0	OK!	None
В2	The primary tank called for an assist before the secondary tank was ready to assist	Check fill levels. Check for leaks in the PB circuits. Check PB valve operation.
C0	OK!	None

Code	Description	Action
СЗ	The temperature switch has detected liquid at the vent muffler.	Reduce fill levels. Check DP Transmitter. Check thermocouple connection. Check termperature switch function.
D0	OK!	None
D4	Overpressure has occurred. Tank or Tanks have vent back to storage.	Check fill levels. Check PB valve function. Check DP transmitter accuracy.
E0	OK!	None
E5	System has exceeded the flow rating.	Check for house line leaks. Check for system leaks. Need additional or next size Trifecta XPro Series.
F0	OK!	None
F6	One of the systems transmitters has gone out of range	Check electrical connects. Replace faulty transmitter.

The alert light will flash when the system has seen a low pressure event. A low pressure event is when both primary and secondary tanks are below the PB On set point for 90 seconds. During the alert status the system will continue to attempt to recover. In the service menu activated by pressing the "OK" button a timer is displayed showing the running time from the alert event (example: 3 hours and 24 minutes since the low pressure event that activated the alert light). At the moment of the alert the error codes are frozen to assist in trouble shooting (alert codes during a non-alert events are reset at every fill). Reset the frozen codes by pressing the "OK" button and the "-" button simultaneously.

#### Manually Operating the Valves

With the system in the "Monitor" mode, valves and valve sets can be operated by pressing the "ESC" button and the arrow buttons (see Button Press Summary for details).

The solenoids have a manual over-ride hand wheel.

- Turning the red wheel in (clockwise) over-rides the solenoid locking the valve open.
- Turning the red wheel out (counter-clockwise) allows the solenoid to open and close the valve electrically.

	Button Press Summary
۲	Press 5 times to "Reset Values" factory settings
۲	Set Point PB On and PB Off
۲	Set Point Fill Level in Inches
۲	Set Point Bulk Critical and Display Bulk psi
•	Trifecta Version/800#/Copyright
®	Error Codes
8	Service Screen/Cycle count
€&⊕	Increase PB set points
0.80	Decrease PB set points
	Increase fill set point
<b>8</b>	Decrease fill set point
	Increase bulk critical set point
.8⊙	Decrease bulk critical set point
©&⊕&⊙	Manual Primary Switch
	Reset parameter counter (shipment)
€&@	Manual PB#1 valve on( manual only)
	Manual Vent#1&VentAtm valve on( manual only
880	Manual Vent#2&VentAtm valve on(manual only)
	Manual PB#2 valve on(manual only)
@&⊙	Reset Alerts

#### **Fuses**

![](_page_43_Figure_3.jpeg)

Fuse #	Voltage	Fuse Type (Amps)	Device(s) Protected	Chart Part Number
FU101	110AC	MDA-10 (10)	Main (Panel)	11832443
FU203	110AC	MDL-2 (2)	PB Valve/Light Side 1	11832398
FU205	110AC	MDL-2 (2)	PB Valve/Light Side 2	11832398
FU208	110AC	MDL-2 (2)	Vent Valves/Lights Side 1 & 2	11832398
FU212	110AC	MDL-4 (4)	Vent Atm. Valve/Light @ Muffler	12942935
FU225	110AC	MDL-2 (2)	Box Heater	11832378
FU108	24VDC	AGC - 2/10 (2)	Transmitter Power	12942978
FU202	24VDC	MDL - 1 (1)	PLC Power	12942943

Power down the panel before changing fuses.

Before replacing a fuse and powering back up it is best to have an understanding why the fuse failed.

#### Repairs

![](_page_43_Picture_8.jpeg)

Any time plumbing is removed from the Trifecta XPro Series 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 XPro Series 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 <u>www.chartparts.com</u>.

#### 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 XPro Series. When this signal is sent from the PLC, an LED on the front panel lights up. If the LED lights up 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. Contact <u>www.chartparts.com</u> for replacement parts.

#### Contaminants on Solenoid Seat

If the solenoid appears to be leaking, there are lost 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 catastophic 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.

![](_page_44_Picture_19.jpeg)

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**

- 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. "F6" will display in the error code section of the PLC if a pressure or liquid level transmitter is out of range. See the Service section of this manual for Error Codes.
- 2. Confirm that all wiring connection terminals are tight.
- 3. If all connections are made and the error condition does not go away, check the transmitter output.
- 4. Recalibrate or replace the transmitter as necessary.
- 5. Also verify display versus the analog gauges for both pressure, readouts and differential pressure.

#### Ball Valve Repair (Trifecta XPro Series - 600 psig only)

Early versions of the 600 psig Trifecta XPro Series used cryogenically rated ball valves in place of solenoid valves. 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.

### **Electrical Schematics**

DRWING NO. B-11940057	- )) )) - ))	يدير	8 0	O PLC ON DEEP DIN RAIL VITH	(®) ➡([PLC302 0  ⑤〔)➡			e' vire var gaga i		1000 10 1000 18										1 R R 2 R -			ANNG Bess Luc							CHART BLUE	•	REVERSE ENGRAVED UTE VITH BLACK TEXT			ECTA		LICATION ORIGINAL ECR/ER	CHART INC	CIHLAURIF BALL GROUND, GA 30107	TRIFECTA CENIO				51 (PCF)
		BRAC	•	20 TIC130 BBBB	8888	B (A) BAR (60)		× ,1		000 						8								)		) 			)	<b>v</b>		>		APP'VD DATE	19 DRAWN BY TTN 01-17-05 TRIF	CHECKED BY	3 18 PROJENGR. DJW 01/18/15 APPI			ULE:	UNLESS OTHERWISE SPECIFIED	DIMENSIONS ARE IN INCHES. TOLERANCES: DRAWI		2 PLACE DECIMAL 7 0.51
		0	\$   	<u> </u>		@]_ 			0					SO THERMOSTAT DISC	FACING UPEN AIK				כ		418		•	+	257 -		6238	-		C3		_			"DIA HOLFS CGT 6/20/1		S TO PHOENIX RLC 11/30/	CRIPTION BY DATE				E E	FINISH P/N	
				with the second								PLEGG PLEGG PLEGG PLEGG PLEGG											5				400088 (100 ) +								P CGT 210047 ADDED ADDITIONAL 88'	N COT 210010 100 100 100 100 100 100 100	M CGT 210068 CHG #29 VENU & FN,	REV APPV FCR REVISION DESC		ITTE MATERIALS AND INFORMATION, INCLODING THE FRINGELES OF DESIGN PRESENTED BY THEY PRINT, IS THE EXCLUSIVE DEDOREPTY OF CHART INDIFFIELS IND. AND IS CONFIDENTIAL	INFORMATION ACCORDINGLY, THIS INFORMATION IS SUBMITTED INFORMATION ACCORDINGLY, THIS INFORMATION IS SUBMITTED TO YOU WITH THE ASPERIMENT THAN IT IS NOT TO BE REPROVID	COPIED, OR LOANED, IN PART OR IN WHOLE, NOR IS THE INFORMATION TO BE RELAYED TO ANY COMPANY. ACCEPTANCE OF	THIS DRAWING WILL BE CONSTRUED AS AN AGREEMENT TO THE AROUE	ABOVE.
ateriai Description	Description and End Barrier	Red LED Red Plot Light	1 N.C. Contact Block	Contact Block 1NO ubishi PLC	Power Supply	erix 24VDC Fuse Holder	enix Raised Din Rail	enix Ground Terminal Block	enix End Anchor	enix 2 Level Terminal Block	Brit 3 Level I enfinited Boock	BRIXT ZUV FUSE MOXEF	enix Fuse Holder Jumper (2 point)	enix Fuse Holder Jumper (10 point)	in 120V Green Pilot Light	Libit Ferrip Controlmer practicet ark Precision 1 Watt 500 OHM Resistor	5, 16X18 SUB PAN. FOR CHART IND.	S. WINDOW KIT PAINTED BLUE FOR CHART	5. ENCL. 16X18X8 CUSTOM PAINTED BLUE FOR RT IND.	Engraving REV. ENGR. FACE PLATE FOR RT IND.	enix 10 Pole Jumper	omatox 75 Watt Heater	enix End Barrier for LD3	enix End Barrier for LTF3	sman Fuse 2/10A Ground Bar Kit 12-Position	3-Position Selector Switch	smann Time-Delay Fuse 10A	smann Fuse 1A	smann Fuse 2A	smann Fuse 4A enix Thermocoupleterminal Block	Lion Meter	enix Terminal Block	duit 1X2 Wire Duct	aurt 1- Duct Cover Conduit Bushing	enix End Barrier	enix 2 Pole Jumper		SUBPANEL	SEMBLY ALL CUMULT HUBS	DIREFTER RATING.		LL LUHU ANTS		
Bill Of Ma Ine Otv Deec Vandor Part Number Part D	Ine dy Lesc Verdor Part Number Part	2 1 EA 2000F1/ C-HF	3 1 EA M22-K01 C-H1	4 2 EA M22-K10 C-H ( 5 1 EA AL2-24MR-D Mitsul	6 1 EA PS5R-B24 ktec F	7 2 EA 3043414 Phoe	8 1 EA 5604188 Phoel	9 2 EA 3209536 Phoe	10 4 EA 0800886 Phoe	11 16 EA 3210567 Phose	12 10 EA 3210499 Pho8	13 0 EA 3040430 F106	15 1 EA 3030284 Phoer	16 1 EA 303023 Phoer	17 7 EA M22-L-G-230G Eaton	10 1 EA CHA-1001 19 5 EA PTF56500R00BYBF Newa	20 1 EA BLD2-18P16 SAG.	21 1 EA SCE-PWK53NF-CHA SAG.	22 1 EA BLD2-16H1808LP SAG. CHAR	23 1 EA WD-1001-CHA WD E CHAR	24 4 EA 3030213 Phoel	25 1 EA SLB-3-5-55P-36-120V-75W Chror	26 3 EA 3211634 Phoe	27 1 EA 3211647 Phoe	28 1 EA AGC-2/10 Buss. 29 1 EA EC2GB12 ITE G.	30 1 EA M22S-WRK3 C-H 3	31 1 EA MDA-10-R Bussr	32 2 EA MDL-1 Bussi	33 3 EA MDL-2 Bussi	34 1 EA MDL-4 Bussi 35 1 EA 310062 Phoer	36 1 EA T1610010 Red L	37 2 EA 3209510 Phoe	38 .25 EA F1X2LG6 Pand	39 .25 EA C'ILGO 40 3 EA CAT3211 34" C	41 1 EA 3101029 Phoer	42 1 EA 3030161 Phoe	ENCLOSURE: 16.0°H X 18.0°M X 7.0°D NFMA 4 CINNSTRIICTION	W/DNE 13.00*H X 15.00*V	EXTERIOR = CHART BLUE NITE: NEMA 4 PANEL ASS	MUST HAVE EQUAL	1 PH.	10 F 01		

![](_page_46_Figure_0.jpeg)

![](_page_47_Picture_2.jpeg)

# Preventive Maintenance

### Procedure

Over time components of the Trifecta XPro Series (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 XPro Series 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

![](_page_48_Picture_20.jpeg)

*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 XPro Series system.
  - Inspect flex hoses for leaks and defects
- Every three years or at cycle count limit: (10,000 cycles per tank)
  - Replace all check valves
  - Replace pistons on all solenoid valves and rebuild cryogenic ball valves
  - Replace relief valves and burst discs on tanks 1 and 2
- Every five years or at cycle count limit (20,000 cycles per tank)
  - Replace flex hoses on bottom withdrawal lines

![](_page_48_Picture_34.jpeg)

Reset cycle counter after servicing valves. If PLC has V-11 software, there is no cycle counter in the PLC. Note cycle count if equipped with an analog cycle counter.

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.

When the pneumatically actuated ball valves that are on the 600 psig Trifecta units get rebuilt, torque specs on these bolts are specified to be 9.38 foot pounds. Special care should also be taken to insure that the relief port in the ball is oriented so it vents on the upstream side of the valve. Failure to properly orient the vent port in the ball will cause the valve to leak by.

## **Recommended Spare Parts**

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

Control Box									
Item Description 1	Item Description 2	Chart PN							
FUSE FU101 MDA-10 (10 AMP MAIN PANEL)	FUSE MDL-1 1/2 AMP SLOW 250V	4614489							
FUSE FU-108 AGC-2/10 (2/10TH AMP TRANSMITTER POWER)	FUSE BUSSMANN #AGC-2/10-R	12942978							
FUSE FU202 MDL-1 (1 AMP PLC POWER)	FUSE BUSSMANN #MDL-1	12942943							
FUSE FU203 MDL-2 (2 AMP PB VALVE/LIGHT SIDE 1)	FUSE BUSSMAN #MDL-2-R	11832398							
FUSE FU212 MDL-4 (4 AMP VENT ATM. VALVE/LIGHT)	FUSE BUSSMANN #MDL-4-R	12942935							
SWITCH MON/OFF/RUN	KIT SWITCH TRIFECTA	20686433							
LIGHT BULB-LED	BULB LED GE GREEN	12942919							
TEMPERATURE CONTROLLER-RED LION - PXU100BO	TEMP CONTROLLER RED LION	21323109							
THERMOCOUPLE TYPE T PROBE	THERMOCOUPLE TYPE T 60" LEADS	14271813							
PLC MITSUBISHI CONTROLLER	AUTOMATION ALD-2YMR-D	11877019							
EEPROM Chi	ips								
Item Description 1	Item Description 2	Chart PN							
EEPROM (UNPROGRAMMED-REQUIRES EEPROM/SERVICE SPECIFIC)	IC EPROM FOR MITSUBISHI	13090017							
EEPROM (X-15 500 psi LIN ONLY)	EEPROM TRIFECTA 15X N2 500 PSI	21240345							
EEPROM (X-15 500 psi LOX ONLY)	EEPROM TRIFECTA 15X O2 500 PSI	21240350							
EEPROM (X-15 600 psi LIN ONLY)	EEPROM TRIFECTA 15X N2 600 PSI	21240355							

Safety Tree									
Item Description 1	Item Description 2	Chart PN							
SAFETY RELIEF VALVE-CYLINDER (BRS ½"MPT 500 PSI)	RV BRS 1/2MPT 500PSI W/O DRAIN	20894583							
SAFETY RELIEF VALVE-CYLINDER (BRS ½"MPT 600 PSI)*	RV BRS 1/2MPT 600PSI	20547372							
RUPTURE DISC-CYLINDER (RPD ASSY. INLINE 1/2"MPT 700 PSI)	RPD ASSY INLINE 1/2MPT 700PSI	11526622							
RUPTURE DISC-CYLINDER (RPD INLINE 1/2"MPT 800 PSI)*	RPD ASSY INLINE 1/2MPT 800PSI	20547371							
PRESSURE GAUGE (0-600 PSI)	PG 2"DIAL 0/600PSI/BAR/KPA	20827654							
PRESSURE GAUGE (0-800 PSI)	PG 2"DIAL 0-800 PSI/BAR	21311482							
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 .500ODT BRS BODY	13660471						
STRAINER-INLET REPLACEMENT ELEMENT	STRAINER ELEMENT KIT SWGLK 440	13729343						
CHECK VALVE GENERANT (1 PSI ) ½"FPT X ½"FPT	VALVE CHECK BRS 1/2FPTX1/2FPT	13620233						
PB INLET/MAUNAL MUFFLER VALVE - REGO T9454	VALVE BRS SH 1/2FPTX1/2FPT	10502848						
USE (VALVE GLOVE BRS ½") - REGO BB9404T	VALVE GLOBE BRS 1/2NPT SCRD	20915798						
RV BRS 1/4MPT GENERENT CRV-250B-K-720	RV BRS 1/4MPT 720 PSI	21191971						
MUFFLER ASSY SS 5/8" 45D FL	MUFFLER ASSY SS 5/8" 45D FL	13060248						
MUFFLER OXY 7/8" - 14 UNF	MUFFLER	9710399						
MUFFLER OXY TRIFECTA XPRO SERIES	MUFFLER OXY TRIFECTA XPro Series	13744164						
4-WAY INSTRUMENT ISOLATION VALVE	1/8 FPT SWAGELOK	20683719						
PB RETURN/VENT ISOLATION VALVE	1/2 FPT WORCESTER SHORT STEM	13088865						
BOTTOM WITHDRAWAL ISOLATION VALVE	1/2 FPT WORCESTER EXT STEM	20897965						

Solenoid Valves								
Item Description 1	Item Description 2	Chart PN						
VENT SOLENOID VALVE (120VAC-1/2")	VALVE SOLENOID 1/2FPT 120VAC	10925509						
VENT VALVE SOLENOID COIL (120VAC-1/2")	COIL SOLENOID 120V 60HZ	10963071						
VENT VALVE GASKET (1/2")	GASKET SOLENOID MAGNATROL	10963100						
VENT VALVE PISTON ASSEMBLY (120VAC-1/2")	PISTON ASSY SOLENOID MAGNATROL	10963062						
MANUAL OVER-RIDE ASSY (1/2")	MANUAL OVER-RIDE ASSY	11554877						
PB SOLENOID VALVE (120VAC – 1")	VALVE SOLENOID 1FPT 120VAC	14413113						
PB SOLENOID VALVE COIL (120VAC – 1")	COIL SOLENOID MAGNATROL 120V	11034011						
PB SOLENOID VALVE GASKET (1")	GASKET SOLENOID 1" TEFLON	20571792						
PB SOLENOID VALVE PISTON ASSY. (120VAC – 1")	PISTON ASSY 1" SOLENOID	20571789						
PB MANUAL OVERRIDE VALVE ASSY. (1")	MANUAL OVER-RIDE ASSY 1"	20571793						

600 PSI Valve and Actuator								
Item Description 1	Item Description 2	Chart PN						
PB BALL VALVE ASSY. (HABONIM VALVE 1/2"MPT W/MAX AIR ACTUATOR)	VALVE BALL SS 1/2FPT W/AOV HAB	20866318						
ACTUATOR MAX-AIR FOR EMC VALVE	ACTUATOR MAX-AIR FOR EMC VALVE	13931752						
VALVE BALL SS 1/2"NPT W/6"EXT	VALVE BALL SS 1/2"NPT W/6"EXT	21070662						
KIT REPAIR HABONIM 1/2" BALL	KIT REPAIR HABONIM 1/2" BALL	21077704						
KIT REPAIR ACTUATOR SEALS MAX AIR# UT21S70 SILICONE	KIT REPAIR ACTUATOR SEALS	13926988						
KIT REPAIR ACTUATOR SEALS MAX AIR# MT21SSR5 SILICONE								
VALVE SOLENOID AL 1/4NPT 120V	VALVE SOLENOID AL 1/4NPT 120V	14296295						

Air Actuator - Safeties and Regulators (600 psig Trifecta)								
Item Description 1	Item Description 2	Chart PN						
PB BALL VALVE ACTUATOR SAFETY RELIEF VALVE (BRS ¼" 125PSI)	RV BRS 1/4MPT 125PSI	1810652						
PB BALL VALVE ACTUATOR REGULATOR (90 PSI)	REGULATOR .250NPT @ 90PSI A-32	10852311						
PB BALL VALVE ACTUATOR SAFETY RELIEF VALVE (BRS ¼" 150 PSI)	RV BRS 1/4MPT 150PSI ASME	11915581						
REGULATOR-PB/VENT ACTUATING VALVE (125 PSI)	REGULATOR .500NPT @ 125PSI	11779806						
TRANSMITTERS								
Item Description 1	Item Description 2	Chart PN						
DIFF PRESS CALBRATED 0-40"RSMT	DIFF PRESS CALBRATED 0-40"RSMT	13963691						
DIFF PRESS CALIBRATED 0-100" RSMT	DIFF PRESS TRANS-ARGON	14319186						
TRANSMITTER PRESS 0-500PSIG	TRANSMITTER PRESS 0-500PSIG	12894574						
TRANSMITTER PRESS 0-600PSIG*	TRANSMITTER PRESS 0-600PSIG	20547373						
PRESSURE TRANSDUCER (BULK TANK PRESSURE - WIKA 0-500 PSI)	PRESSURE TRANS 0-500 PSI C-10	14877751						

Change from Honeywell to Rosemount DP								
Item Description 1	Item Description 2	Chart PN						
KIT TRIFECTA DIFF TRANSMITTER (Includes bracket)	KIT TRIFECTA DIFF TRANSMITTER	21176647						

Solenoid Valves (600 PSI Trifecta							
VALVE SOLENOID 1/2 FPT 120 VAC SS	VENT SOLENOID	21331409					
GASKET SOLENOID MAGNATROL	VENT SOLENOID	10963100					
MANUAL OVERRIDE ASSEMBLY	VENT SOLENOID	21360543					
PISTON ASSEMBLY 1/2"	VENT SOLENOID	21360544					
COIL SOLENOID 120VAC 60HZ	VENT SOLENOID	10963071					
VALVE SOLENOID 1"FPT 120VAC SS	PB SOLENOID	21334119					
GASKET SOLENOID MAGNATROL	PB SOLENOID	20571792					
MANUAL OVERRIDE ASSEMBLY	PB SOLENOID	21360540					
PISTON ASSEMBLY 1"	PB SOLENOID	21360542					
COIL SOLENOID 120 VAC 60HZ	PB SOLENOID	21360541					
KIT, TRIFECTA 600 PSI MAGNATROL	KIT TO REPLACE ACTUATORS WITH SOLENOID VALVES	21360639					

## Spare Parts Kits

X-15 500PSI (PN 21323	718)	X-15 600PSI (PN 21323720)					
Item Description	Chart PN	QTY	Item Description	Chart PN	QTY		
REGULATOR .250NPT @525PSI	13774101	1	REGULATOR .250NPT @625PSI	20553102	1		
VALVE SOLENOID 1/2FPT 120VAC	10925509	1	FUSE BUSSMANN #AGC-2/10-R	12942978	1		
GASKET SOLENOID MAGNATROL	10963100	2	FUSE BUSSMANN #MDL-2-R	11832398	2		
PISTON ASSY SOLENOID MAGNATROL	10963062	1	FUSE BUSSMANN #MDL-4-R	12942935	1		
FUSE BUSSMANN #AGC-2/10-R	12942978	1	RV BRS 1/2MPT 600PSI	20547372	2		
FUSE BUSSMANN #MDL-2-R	11832398	2	VALVE CHECK BRS 1/2FPTX1/2FPT	13620233	2		
FUSE BUSSMANN #MDL-4-R	12942935	1	VALVE CHECK BRS 1/2FPTX1/2FPT	11051090	1		
RV BRS 1/2MPT 500PSI	11385111	2	PLC PROGRAMMED X15 600PSI	21323462	1		
VALVE CHECK BRS 1/2FPTX1/2FPT	13620233	2	VALVE BALL SS 1/2FPT W/AOV HAB	20866318	1		
VALVE CHECK BRS 1/2FPTX1/2FPT	11051090	1	ACTUATOR MAX-AIR FOR EMC VALVE	13931752	1		
PLC PROGRAMMED X15 TRIFECA	13482011	1	VALVE SOLENOID AL 1/4NPT 120V	14296295	1		
VALVE SOLENOID 1FPT 120VAC	14413113	1	KIT TRIFECTA DIFF TRANSMITTER	21176647	1		
PISTON ASSY 1" SOLENOID	20571789	1	TRANSMITTER PRESS 0-600PSIG	20547373	1		
GASKET SOLENOID 1"TEFLON	20571792	1					
KIT TRIFECTA DIFF TRANSMITTER	21176647	1					
TRANSMITTER PRESS 0-500PSIG	12894574	1					

![](_page_52_Picture_2.jpeg)

Front Isometric view of Trifecta

![](_page_53_Picture_2.jpeg)

Inside picture of Control Box

![](_page_53_Picture_4.jpeg)

![](_page_53_Picture_5.jpeg)

## 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 XPro Series operation, please read the Operation section of this manual before continuing.

While troubleshooting the Trifecta XPro 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 XPro Series are in their normal operating position.
- 2. Confirm solenoids (and/or pneumatic actuated ball valves) 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
- All five solenoid (5k, 10k, 15k) valves on Trifecta XPro Series
- Manual override hand wheel in the "Out" position

#### Normal Activation of Solenoids

Dial main switch on front of the control panel to "Monitor." Open control panel door giving you access to the PLC controller. Per the Operations section of this manual, press the corresponding buttons on the controller to "fire" each cluster of solenoids. 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 XPro Series 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 XPro Series 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 XPro Series 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 <sub>2</sub> 0
Liquid Level (from Analog Gauge)	 "H <sub>2</sub> O

#### Tank 2

Pressure (Analog Gauge)	 PSIG
Pressure (from PLC Display)	 PSIG
Liquid Level (from PLC Display)	 "H <sub>2</sub> 0
Liquid Level (from Analog Gauge)	 "H <sub>2</sub> O

#### PLC Information

Press left arrow/record PB Set Point	 PSIG
Press up arrow/record Fill Set Point	 "H <sub>2</sub> 0
Press down arrow/record bulk critical	 PSIG
Cycle Count (if equipped with counter)	 #cycles

Press"OK"/record Error Codes and elapsed time since event:

![](_page_55_Figure_11.jpeg)

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.

![](_page_55_Picture_14.jpeg)