Fill Manual for
3M™ Novec™ 1230 Fire Protection Fluid
Sv Series, Mv Series, Lv Series

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JANUS FIRE SYSTEMS®
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Preface

This manual is intended for use with the Janus Fire Systems® Sv Series, Mv Series, and Lv Series Clean Agent Engineered Fire Extinguishing Systems utilizing 3M™ Novec™ 1230 Fire Protection Fluid. Those responsible for the agent fill or agent refill of these systems should read this entire manual.


All system designs are preformed in conjunction with the Janus Design Suite® hydraulic flow calculation software and in compliance with the Janus Design Suite® Flow Calculation Software Manual For Use with 3M™ Novec™ 1230 Fire Protection Fluid, DOC173.

Janus Fire Systems® reserves the right to revise and improve its products as it deems necessary without prior notification. This manual describes the state of Janus Fire Systems® products at the time of its publication and may not reflect those products at all times in the future.

All references to Codes or Standards in this manual refer to the latest edition of that Code or Standard unless otherwise indicated.

Compressed gases shall be handled and used only by persons properly trained in accordance with Compressed Gas Association, Inc. (CGA) pamphlets C-1, C-6, and P-1.

CGA pamphlets are published by the Compressed Gas Association Inc. (www.cganet.com).

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1 GENERAL INFORMATION


1.1 Listings and Approvals

To maintain FM Approval for Janus Fire Systems® Fire Suppression Systems, cylinder recharge must be performed at a Janus Fire Systems® recognized facility.

1.2 Extinguishing Agent

Novec 1230 fluid (FK-5-1-12) is formed from the elements carbon, fluorine and oxygen (CF3CF2C(O)CF(CF3)2 - dodecafluoro-2-methylpentan-3-one). The primary extinguishing mechanism of Novec 1230 fluid is heat absorption, with a secondary chemical contribution from the thermal decomposition of Novec 1230 fluid in the flame. Novec 1230 fluid leaves no residue and is safe for use in occupied spaces.

Novec 1230 fluid is a highly fluorinated ketone containing no chlorine or bromine. As a result, the Ozone Depletion Potential (ODP) for Novec 1230 fluid is zero, meaning it has no effect on stratospheric ozone. Novec 1230 fluid has an atmospheric lifetime of 0.014 years. It has a Global Warning Potential of 1.

Janus Fire Systems® Engineered Fire Suppression Systems store Novec 1230 fluid as a liquid in steel cylinders. The liquid Novec 1230 fluid is superpressurized with nitrogen to 360 psig (24.8 bar) at 70°F (21.1°C). When discharged, Novec 1230 fluid is atomized at the discharge nozzles and becomes thoroughly mixed with the air throughout the protected area reaching a predetermined design concentration.

1.3 Safety Considerations

All safety guidelines contained in this manual must be read and understood before filling any Janus Fire Systems® cylinder. All applicable guidelines shall be followed before, during, and after the fill procedure including any additional local standards or regulations determined by the authority having jurisdiction (AHJ). Where the guidelines in this manual and local guidelines or regulations conflict, the most stringent requirement should be followed.

Those individuals responsible for the filling of a Janus Fire Systems® cylinder assembly with Novec 1230 Fire Protection Fluid must be trained.

At a minimum, Janus Fire Systems recommends the following safety equipment be worn at all times during the fill procedure:

- Work boots with protective toe guards
- Safety glasses or goggles
- Gloves to prevent injury of the hands or fingers.
- Properly fitting clothing.
- Properly fitting ear plugs or other hearing protection.
Section 1 General Information

Cylinder filling must be performed in a well ventilated area.

⚠️ WARNING
When Novec 1230 fluid is exposed to temperatures greater than 1300°F (700°C), the potentially hazardous byproduct hydrogen fluoride (HF) will be formed during agent decomposition. Heat sources such as space heaters, torches, welding equipment, or lit cigarettes are capable of reaching temperatures that initiate agent decomposition. All such potential heat sources must be cleared from the work area before beginning fill process. Smoking in the vicinity of the filling equipment or agent storage containers shall be prohibited.

The Material Safety Data Sheet (MSDS) on Novec 1230 Fire Protection Fluid can be found in Appendix A of this manual and shall be read and understood before working with the agent.

⚠️ WARNING
Accidental discharge of an unsecured cylinder may result in property damage, injury, or death from violent cylinder movement. Cylinder assemblies must be restrained at all times during the fill procedure. Anti-recoil safety plugs and devices must be in place at all times the cylinder assembly is not connected to agent fill lines or discharge piping. Do not transport the cylinder unless the anti-recoil safety device is in place. Handle the cylinder assembly with care even when the safety device is in place.

The technical manual supplied with the fill station or pump must be read and understood prior to filling cylinder assemblies. All procedures contained in the aforementioned manual must be followed and all warnings or safety guidelines noted. Refer also to 3M™ Novec™ 1230 Fire Protection Fluid Storage and Handling document 60-5002-0131-8.

⚠️ WARNING
The filling station or pump designated for use with Novec 1230 fluid shall not be used with any other agents. Each agent stored at a fill facility must have its own separate filling station or pump. Use of multiple agents with a single filling station may result in contamination of agent and dilute its effectiveness as a means of suppression.
2 CYLINDER ASSEMBLY

The cylinder assembly consists of the cylinder, dip tube, and cylinder valve.

2.1 Cylinder

The Novec 1230 fluid is stored as a liquid inside a welded steel cylinder. The cylinders are superpressurized with dry nitrogen to a pressure of 360 psig (24.8 bar) at 70°F (21°C). Every cylinder has a minimum fill density of 35 lb/ft³ (561 kg/m³) and a maximum fill density of 70 lb/ft³ (1121 kg/m³). The capacity of a cylinder varies according to the design requirements and the Series designation (See Table 2.1.1 for a list of available capacities).

Standard domestic cylinders are manufactured according to the requirements of the U.S. Department of Transportation (USDOT) and Transport Canada¹ (TC) for compressed gas and are fitted with an identification label indicating the fill quantity of Novec 1230 fluid. Each cylinder has internal neck threads to allow for connection to the cylinder valve.

2.1.1 Rupture Disc

A frangible rupture disc is fitted to the Lv Series cylinder body. It functions as an emergency relief device in the event of excessive internal pressure within the cylinder. Its rupture point is between 850 psi (58.6 bar) and 1000 psi (68.9 bar).

This feature is not found on the Sv Series or Mv Series cylinder. Instead, a rupture disc is located on the side of Sv Series and Mv Series cylinder valve as detailed in sections 2.3.1 and 2.3.2.

2.1.2 Liquid Level Indicator

The liquid level indicator consists of a sealed non-magnetic tube containing an external measurement tape fitted with a magnet. A second magnet with an opposing polarity is installed on the outside of the tube and is exposed to the liquid Novec 1230 fluid. As the tape is extracted from the tube, it will engage with the second magnet creating a noticeable change in tension. The measure on the tape when this change in tension occurs indicates the current liquid level inside the cylinder and can then be compared to a chart located in Appendix B of this manual to determine the current fill weight of the cylinder.

The liquid level indicator assembly is threaded into an outlet on the head (top) of the Mv Series and Lv Series cylinders.

This feature is not found on the Sv Series cylinder.

¹ 1000 lb Cylinders are not Transport Canada approved.
Section 2 Cylinder Assembly

2.2 Dip Tube (Siphon Tube)

A rigid dip tube is threaded into the cylinder valve and extends down the entire length of the cylinder.

2.3 Cylinder Valve

A differential pressure operated cylinder valve controls the release of Novec 1230 fluid from the cylinder. It is made of forged brass and is threaded onto the cylinder neck. The features and design of each valve vary according to the Series designation.
2.3.1 Sv Series Valve Features
(See Figure 2.3.1)

The Sv Series valve has six key features:

1. **Valve Actuation Connection**: A threaded connection located on top of the cylinder valve serves as the attachment point for the electric (primary) or pneumatic (slave) valve actuator.

2. **Pressure Gauge**: A pressure gauge is mounted to the cylinder valve exterior to provide a visual measure of the cylinder's internal pressure. The gauge shall not be removed while the cylinder is under pressure.

3. **Rupture Disc**: A frangible rupture disc is fitted to the valve body opposite the pressure gauge. It functions as an emergency relief device in the event of excessive internal pressure within the cylinder. Its rupture point is between 850 psi (58.6 bar) and 1000 psi (68.9 bar). The rupture disc shall not be removed while the cylinder is under pressure.

4. **Low-Pressure Supervisory Switch**: A low-pressure supervisory switch is mounted to the cylinder valve and continuously monitors the internal pressure of the cylinder. It shall not be removed while the cylinder is under pressure.

5. **Discharge Outlet**: A 1 1/4 in (32 mm) FNPT connection serves as the attachment point for the discharge piping.

6. **Pilot Actuation Port**: A 3/8 in (10 mm) FNPT connection (shipped with a pipe plug) serves as the attachment point for the pilot actuation piping in multiple cylinder systems, providing the actuation pressure used to open the slave cylinder valve(s). This can also be used for attachment of the discharge pressure switch in single cylinder arrangements. The pipe plug shall remain in place at all times when the port is not connected to pilot actuation piping or a discharge pressure switch.

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**CAUTION**

Ensure that the pilot actuation port pipe plug is in place before attempting to fill the cylinder assembly. Failure to do so may result in agent leaking out of the pilot actuation port during the fill procedure.
Section 2 Cylinder Assembly

2.3.2 Mv Series Valve Features

(See Figure 2.3.2)

The Mv Series cylinder valve has six key features:

1. **Valve Actuation Connection**: A threaded connection located on top of the cylinder valve serves as the attachment point for the electric (primary) or pneumatic (slave) valve actuator.

2. **Pressure Gauge Connection**: A female connection serves as the attachment point for the pressure gauge. It is fitted with a Schrader valve to allow the removal of the gauge while the cylinder is pressurized.

3. **Low-Pressure Supervisory Switch Connection**: A female connection serves as the attachment point for the low-pressure supervisory switch. A Schrader valve allows for the removal of the pressure switch while the cylinder is pressurized.

4. **Rupture Disc**: A frangible rupture disc is fitted to the valve body opposite the discharge outlet. It functions as an emergency relief device in the event of excessive internal pressure within the cylinder. Its rupture point is between 850 psi (58.6 bar) and 1000 psi (68.9 bar). The rupture disc shall not be removed while the cylinder is under pressure.

5. **Discharge Outlet**: A 2 in (50 mm) grooved connection serves as the attachment point for discharge piping.

6. **Pilot Actuation Port**: A 1/4 in (8 mm) NPT connection (shipped with a pipe plug) serves as the attachment point for the pilot actuation piping in multiple cylinder systems, providing the actuation pressure used to open the slave cylinder valve(s). This can also be used for attachment of the discharge pressure switch in single cylinder arrangements. The pipe plug shall remain in place at all times when the port is not connected to pilot actuation piping or a discharge pressure switch.

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**CAUTION**

Ensure that the pilot actuation port pipe plug is in place before attempting to fill the cylinder assembly. Failure to do so may result in agent leaking out of the pilot actuation port during the fill procedure.

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![Figure 2.3.2 Mv Cylinder Valve Assembly](image)
2.3.3 Lv Series Valve Features

(See Figure 2.3.3)

The Lv Series cylinder valve has five key features:

1. **Valve Actuation Connection:** A threaded connection located on top of the cylinder valve serves as the attachment point for the electric (primary) or pneumatic (slave) valve actuator.

2. **Pressure Gauge Connection:** A female connection serves as the attachment point for the pressure gauge. It is fitted with a Schrader valve to allow the removal of the gauge while the cylinder is pressurized.

3. **Low-Pressure Supervisory Switch Connection:** A female connection serves as the attachment point for the low-pressure supervisory switch. A Schrader valve allows for the removal of the pressure switch while the cylinder is pressurized.

4. **Discharge Outlet:** A 3 in (80 mm) grooved connection serves as the attachment point for discharge piping.

5. **Pilot Actuation Port:** A 1/4 in (8 mm) NPT connection (shipped with a pipe plug) serves as the attachment point for the pilot actuation piping in multiple cylinder systems, providing the actuation pressure used to open the slave cylinder valve(s). This can also be used for attachment of the discharge pressure switch in single cylinder arrangements. The pipe plug shall remain in place at all times when the port is not connected to pilot actuation piping or a discharge pressure switch.

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**CAUTION**

Ensure that the pilot actuation port pipe plug is in place before attempting to fill the cylinder assembly. Failure to do so may result in agent leaking out of the pilot actuation port during the fill procedure.
3 FILL COMPONENTS

The following components are necessary to fill a Janus Fire Systems® cylinder assembly with Novec 1230 fluid.

3.1 Fill Adapter

A fill adapter is installed into the discharge outlet of the cylinder valve during the fill procedure to accommodate the attachment of the cylinder fill assembly. Each Series valve requires a different type of fill adapter.

3.1.1 Sv Series Fill Adapter

P/N 99515 (See Figure 3.1.1)

The Sv Series fill adapter consists of a 1-1/4 in (32 mm) MNPT pipe plug fitted with a 1/4 in (8 mm) male quick-connect fitting. The 1-1/4 in (32 mm) MNPT connection attaches to the Sv Series discharge valve in place of the anti-safety recoil device. The 1/4 in (8 mm) male quick-connect fitting attaches to a 1/4 in (8 mm) female quick-connect fitting on the cylinder fill assembly. The male quick-connect fitting contains an internal check valve that prevents agent from flowing through the fitting unless it is connected to the cylinder fill assembly.

3.1.2 Mv Series Fill Adapter

P/N 99514 (See Figure 3.1.2)

The Mv Series fill adapter consists of a 2 in (50 mm) grooved pipe plug fitted with a 1/4 in (8 mm) male quick-connect fitting. Pipe plug attaches to the Mv Series discharge valve using the 2 in (50 mm) grooved coupling shipped with the cylinder assembly as part of the anti-safety recoil device. The 1/4 in (8 mm) male quick-connect fitting attaches to a 1/4 in (8 mm) female quick-connect fitting on the cylinder fill assembly. The male quick-connect fitting contains an internal check valve that prevents agent from flowing through the fitting unless it is connected to the cylinder fill assembly.

3.1.3 Ls Series Fill Adapter

P/N 99513 (See Figure 3.1.3)

The Ls Series fill adapter consists of a 3 in (80 mm) grooved pipe plug fitted with a 1/4 in (8 mm) male quick-connect fitting. Pipe plug attaches to the Ls Series discharge valve using the 3 in (80 mm) grooved coupling shipped with the cylinder assembly as part of the anti-safety recoil device. The 1/4 in (8 mm) male quick-connect fitting attaches to a 1/4 in (8 mm) female quick-connect fitting on the cylinder fill assembly. The male quick-connect fitting contains an internal check valve that prevents agent from flowing through the fitting unless it is connected to the cylinder fill assembly.
Section 3 Fill Components

3.2 Cylinder Fill Assembly
P/N 99517 (See Figure 3.2)

The cylinder fill assembly is formed from a series of interconnected fittings and valves to serve as a connection point between the agent fill station and the cylinder assembly.

The manual agent fill valve is a 1/4 in (8 mm) manually actuated ball valve used to open and close the cylinder fill assembly, allowing agent to flow from the fill station into the cylinder assembly.

The cylinder fill assembly has four connection points. When connected to the cylinder valve and fill station as recommended, two connection points are oriented vertically and two connection points are oriented horizontally as depicted in Figure 3.2. The vertical connection points are referred to as the gauge connection port and the nitrogen pressurization port. The horizontal connection points are referred to as the pump connection port and cylinder connection port.

3.2.1 Pump Connection Port

The pump connection port is a 1/4 in (8 mm) male quick-connect fitting attached directly to the manual agent fill valve and serves as the connection point for the agent fill station. The male quick-connect fitting of the pump connection port contains an internal check valve that prevents agent from flowing through the fitting unless it is connected to the fill station.

3.2.2 Cylinder Connection Port

The cylinder connection port is located opposite of the pump connection port and is a 1/4 in (8 mm) female quick-connect fitting that serves as the connection point for the 1/4 in (8 mm) male quick-connect fitting on the fill adapter (refer to section 3.1). The female quick-connect fitting of the cylinder connection port contains an internal check valve that prevents agent from flowing through the fitting unless it is connected to the fill adapter.

3.2.3 Gauge Connection Port

The gauge connection port is a 1/4 in (8 mm) male quick-connect fitting that serves as the connection point for the fill pressure gauge. It is located on the same side of the cylinder fill assembly as the handle for the manual agent fill valve. When connected to the cylinder valve, the cylinder fill assembly must be oriented so that the gauge connection port is perpendicular to the ground and pointing upwards. The male quick-connect fitting of the gauge connection port contains an internal check valve that prevents agent from flowing through the fitting unless the fill pressure gauge has been installed to it.
3.2.4 Nitrogen Pressurization Port

The nitrogen pressurization port is located opposite of the gauge connection port and is a 1/4 in (8 mm) male quick-connect fitting that serves as the connection point for the nitrogen supply used to superpressurize the cylinder assembly. When connected to the cylinder valve, the cylinder fill assembly must be oriented so that the nitrogen pressurization port is perpendicular to the ground and pointing downwards. The male quick-connect fitting of the gauge connection port contains an internal check valve that prevents agent from flowing through the fitting unless it is connected to the nitrogen supply.

3.3 Nitrogen Regulator/Hose Assembly

P/N 99516 (See Figure 3.3)

The nitrogen regulator/hose assembly is comprised of a self-relieving pressure regulator, a safety relief valve, and two manually actuated ball valves connected to hose lines ending in female quick-connect fittings. The regulator-hose assembly serves as a connection point between the nitrogen supply and both the nitrogen pressurization port of the cylinder fill assembly and the inlet port of the valve closing adapter. The regulator has a CGA fitting for attaching to the nitrogen supply.

3.3.1 Valve Closing Line

The valve closing line refers to the flex hose and manually actuated ball valve in line with the pressure regulator. The valve closing line ends with a 1/4 in (8 mm) female quick-connect fitting that attaches to the 1/4 in (8 mm) male quick-connect fitting located on the inlet of the valve closing adapter (see Section 3.4). It is used to close the cylinder valve by applying pressure to the top of the cylinder valve piston. The valve closing line quick-connect fitting contains an internal check valve that prevents nitrogen from flowing through the fitting unless it is connected to the valve closing adapter.

3.3.2 Cylinder Pressurization Line

The cylinder pressurization line refers to the flex hose and manually actuated ball valve branching off from the valve closing line and is perpendicular to the outlet of the pressure regulator. The cylinder pressurization line ends with a 1/4 in (8 mm) female quick-connect fitting that attaches to the nitrogen pressurization port of the cylinder fill assembly. It is used to supply the nitrogen required to superpressurize the cylinder assembly following agent fill. The cylinder pressurization line quick-connect fitting contains an internal check valve that prevents the nitrogen from flowing through the fitting unless it is connected to the nitrogen pressurization port.
Section 3 Fill Components

3.4 Valve Closing Adapter

P/N 17292 (See Figure 3.4)

The valve closing adapter is threaded onto the valve actuation connection of the cylinder valve and receives pressure from the nitrogen supply at the end of the filling procedure to close the cylinder valve. A 1/4 inch (8 mm) male quick-connect fitting (P/N 99499) is installed in the 1/4 inch (8 mm) FNPT inlet port of the valve closing adapter and is utilized to facilitate connection to the valve closing line of the nitrogen regulator-hose assembly.

3.5 Agent Supply Tank

Novec 1230 fluid is supplied in drums of 661 lb (300 kg) capacity or IBC containers of 2425 lb (1100 kg) capacity.

3.5.1 IBC Container

Because Novec 1230 fluid is a liquid at typical ambient temperatures and pressure, pumping agent from an IBC container in a closed system can create a vacuum detrimental to the structural integrity of the IBC container. To counter this effect, a dry nitrogen supply is regulated into a port at the top of the IBC container at approximately 5 psig (0.35 bar). Refer to 3M™ Novec™ 1230 Fire Protection Fluid Storage and Handling document 60-5002-0131-8 for additional information.

3.5.1.1 IBC Coupler Kit

P/N 99501 (See Figure 3.5.1.1)

The IBC coupler kit is utilized to connect a dry nitrogen supply to the top port of the IBC container during the agent fill procedure. The top port of IBC container ships fitted with a check valve that upsets when the coupler kit is installed to it. The coupler fill head is a quick connect fitting that is attached to the top port valve and turned clockwise 1/4 turn to lock into place. The coupler supply connection is a 1 in (25 mm) MNPT connection fitted to a nitrogen coupler hose line that attaches to the outlet of the low pressure nitrogen regulator. The coupler kit controls the flow of nitrogen into the IBC container through a manually actuated piston valve. It is fitted with a pressure relief valve set at 10 psi (0.70 bar). Refer to 3M™ Novec™ 1230 Fire Protection Fluid Storage and Handling document 60-5002-0131-8 for additional information.

3.5.1.2 Low Pressure Nitrogen Regulator

P/N 99951 (See Figure 3.5.1.2)

A low pressure nitrogen regulator is installed in the nitrogen vapor line between the nitrogen supply and IBC coupler. It regulates the nitrogen pressure entering the IBC container down to approximately 5 psig (0.35 bar). The inlet port is a CGA 580 fitting. Refer to 3M™ Novec™ 1230 Fire Protection Fluid Storage and Handling document 60-5002-0131-8 for additional information.
3.5.2 Supply Drum

Because Novec 1230 fluid is a liquid at typical ambient temperatures and pressure, pumping agent from a supply drum in a closed system can create a vacuum detrimental to the structural integrity of the IBC container. To counter this effect, ventilated air is filtered into drums using a vent drier employing disposable or refillable desiccant cartridges. These materials can be obtained from Drierite Company, Ltd (www.drierite.com).

The Drierite part numbers for the appropriate cartridges and adapter are listed below.

- Drierite 40451 – Disposable cartridge
- Drierite 50068 – Refillable cartridge
- Drierite 50001 – Drier adapter

Refer to 3M™ Novec™ 1230 Fire Protection Fluid Storage and Handling document 60-5002-0131-8 for additional information.

3.6 Agent Fill Station

P/N 99168 (See Figure 3.6)

The agent fill station is necessary to pump the liquid agent from the agent supply tank into the empty cylinder assembly. The station pump requires a dry compressed air supply capable of pressure between 100 and 120 psi (6.89 and 8.27 bar) at a minimum of 13 cubic feet per minute.

![Figure 3.6 Agent Fill Station](image-url)
Section 3 Fill Components

The agent fill station has an inlet hose (agent supply tank hose) designed to connect to the agent supply tank and an outlet hose (cylinder fill hose) designed to connect to the cylinder fill assembly.

The face of the agent fill station contains three displays (liquid/moisture indicator, inlet pressure gauge, discharge pressure gauge) and three controls (selector control knob, pump control knob, agent/nitrogen selection knob). These displays and controls are described below. Refer to the manual provided with the agent fill station for more information on any of these features.

3.6.1 Fill Station Displays

The liquid/moisture indicator is used to verify a liquid agent flow through the fill station pump. The inlet pressure gauge displays the pressure on the agent supply tank side of the fill station pump. The discharge pressure gauge displays the pressure on the cylinder fill side of the fill station pump.

3.6.2 Selector Control Knob

The selector control knob changes the direction of flow for the fill station. Setting this knob to "systems cylinder" directs the flow toward the cylinder fill hose. Setting the knob to "recovery cylinder" directs the flow toward the agent supply tank hose. Setting the selector control knob to "off" places the pump in a neutral position, stopping the flow to either direction. The selector control knob shall be set to "off" whenever connecting or disconnecting the agent supply tank hose or cylinder fill hose.

3.6.3 Pump Control Knob

The pump control knob is utilized to adjust the speed of the fill station pump. Turning the knob clockwise increases the speed and turning the knob counterclockwise decreases the speed. The pump control knob shall be set to "off" whenever connecting or disconnecting the agent supply tank hose or cylinder fill hose.

3.6.4 Agent/Nitrogen Selection Knob

The agent/nitrogen selection knob changes the fill station pump from agent fill mode to nitrogen fill mode. The recommended fill procedure as detailed in this manual does not utilize the agent fill station for nitrogen therefore the agent/nitrogen selection knob should remain set to "liquid Novec 1230" throughout the course of the fill procedure.
Section 4 Fill Procedure

4 FILL PROCEDURE

This section contains a step-by-step procedure for weighing, filling, pressurizing, and closing the cylinder assembly. Refer to Figure 4 for a P&ID diagram that illustrates how each cylinder fill component connects to the agent fill station, nitrogen supply, and cylinder assembly. Each component should be only installed when indicated in the sections that follow. Refer to 3M™ Novec™ 1230 Fire Protection Fluid Storage and Handling document 60-5002-0131-8 for additional information.

![Figure 4 Cylinder Fill P&ID Diagram (IBC)](image)

4.1 Log and Weigh Empty Cylinder

- Record the serial number of the cylinder assembly in the appropriate section of the fill log. Record the agent lot number from the supply of Novec 1230 fluid, the fill station number from the agent fill station, and the date of the fill in the appropriate sections of the fill log and cylinder label.

- Place the empty cylinder assembly on a calibrated scale. Record the weight displayed on the scale in the appropriate section of the cylinder label and fill log as the empty weight. NOTE: The anti-recoil safety device shall remain installed in the empty cylinder assembly during weighing. The fill adapter, cylinder fill assembly, or valve closing adapter shall not be installed during weighing; do not include the weight of any fill component in determining the empty cylinder weight.

**CAUTION**

Any trim components installed in the empty cylinder assembly prior to the initial weighing (including anti-recoil safety device, pressure gauge, and/or low-pressure supervisory switch) shall be installed and included in all proceeding weight measurements during the course of the fill procedure. Any trim components not installed on the empty cylinder assembly during the initial weighing shall not be installed or included in any proceeding weight measurements. Failure to maintain a consistent hardware base for weighing purposes may cause inaccuracy when using these weights to determine the amount of agent contained in the cylinder assembly.

4.2 Agent Fill Procedure

NOTE: Prior to initiating the agent fill procedure, determine the ambient temperature of the filling location. Compare this temperature to the values listed in Table B.1 located in Appendix B to determine the final cylinder pressure required to provide a cylinder pressure of 360 psig at 70°F.
Section 4 Fill Procedure

- Restrain the cylinder assembly securely. It is recommended the cylinder assembly remain placed on the calibrated scale during the fill procedure.

**WARNING**

Do not attempt to fill a cylinder assembly unless the cylinder has been properly restrained. **Accidental discharge of an unsecured cylinder may result in property damage, injury, or death from violent cylinder movement.**

- Replace the anti-recoil safety device with the appropriate Series fill adapter for the cylinder assembly being filled.
- Connect the fill pressure gauge to the gauge connection port of the cylinder fill assembly.
- Connect the cylinder connection port of the cylinder fill assembly to the male quick-connect fitting of the fill adapter. Ensure the manual agent fill valve of the cylinder fill assembly is in the closed position before proceeding.
- Ensure that the pump control knob and selector control knob on the agent fill station are set to "off" and that the agent/nitrogen selection knob is set to "liquid Novec 1230".
- Connect the agent supply tank hose of the fill station to the liquid fill line of the agent supply tank.
- Connect the cylinder fill hose of the fill station to the pump connection port of the cylinder fill assembly.

**CAUTION**

Ensure that the pilot actuation port pipe plug is in place before attempting to fill the cylinder assembly. Failure to do so may result in agent leaking out of the pilot actuation port during the fill procedure.

- Open the supply tank liquid line valve.
- Set the direction of flow for the fill station towards the discharge outlet. Do this by setting the pump selector knob to "systems cylinder".
- Slowly open the manual agent fill valve of the cylinder fill assembly.
- Liquid agent flow should be observed in the liquid/moisture indicator window. Once liquid flow is confirmed, gradually increase the pump speed using the pump control knob.
- Monitor the scale to determine when the cylinder assembly approaches the target fill weight. The target weight will be approximately the cylinder empty weight plus the intended agent fill weight. Utilize the pump control knob to increase or decrease the pump speed as necessary.
- Upon reaching the target cylinder weight, close the manual agent fill valve of the cylinder fill assembly and turn the pump control knob into the off position.
Section 4 Fill Procedure

4.2.1 Seating Cylinder Valve

The piston inside the cylinder valve must be seated using nitrogen before proceeding to ensure agent does not escape from the open cylinder valve.

- After ensuring that the valve set line ball valve and cylinder pressurization line ball valve of the nitrogen regulator/hose assembly are closed, connect the regulator CGA fitting to the nitrogen supply valve.

- Open the nitrogen supply valve and set the regulator to no higher than 400 psig at 70°F.

- Install the valve closing adapter hand tight to the valve actuation connection located on the top of the cylinder valve.

- Connect the valve closing line of the nitrogen regulator/hose assembly to the valve closing adapter.

- Open the ball valve of the valve closing line for no more than 1 or 2 seconds and then close the ball valve. A slight popping noise should be heard as the piston of the cylinder valve is seated, closing the cylinder valve.

- Set the nitrogen regulator to 0 psi. Pressure within the valve closing line will be relieved through the regulator. Close the nitrogen supply valve on top of the nitrogen supply cylinder.

It must be verified that the cylinder valve piston has fully seated before any of the fill components are disconnected. Pressure must also be depleted from within the cylinder fill assembly before disconnecting the cylinder fill hose. The following method shall be used to achieve both tasks.

- Set the direction of flow for the fill station towards the agent supply tank. Do this by setting the pump selector knob to "recovery cylinder".

- Open the manual agent fill valve and set the fill station pump to a low speed using the pump control knob. If a pressure drop is not immediately observable on the fill pressure gauge, the cylinder valve piston has not fully seated. Close the manual agent fill valve and repeat the process for seating the cylinder valve piston using nitrogen.

- Once a pressure drop has been observed on the fill pressure gauge, continue pumping until the pressure gauge indicates 0 psig. Close the manual agent fill valve, turn off the pump by setting the pump control knob to off, and set the pump selector knob to the neutral or off position.

4.2.2 Cylinder Weighing

To determine the exact amount of agent that has been pumped into the cylinder assembly, all fill component hardware must be disconnected from the cylinder assembly and the cylinder assembly must be weighed a second time.

- Remove the valve closing line from the valve closing adapter. If the valve closing line quick-connect fitting is difficult to remove, this indicates the valve closing line is still under pressure. Ensure the ball valve on the cylinder pressurization line and nitrogen supply valve on top of the nitrogen supply valve are closed. Set the nitrogen regulator to 0 psi and then open the valve closing line ball valve. Pressure will bleed out of the self-relieving nitrogen regulator. Once pressure has been bled to 0 psi, close the valve closing line ball valve and remove the valve closing line from the valve closing adapter.
Section 4 Fill Procedure

- Remove the valve closing adapter from the cylinder valve.
- Remove the cylinder fill hose from the pump connection port. If the cylinder fill hose quick-connect fitting is difficult to remove, this indicates the cylinder fill hose is still under pressure. Repeat the above steps to depressurize the cylinder fill hose.
- Disconnect the cylinder fill assembly from the fill adapter.
- Remove the fill adapter and immediately install the anti-recoil safety device into the cylinder discharge outlet.
- Observe the weight displayed on the scale. Subtract from this weight the previously recorded empty cylinder weight to determine the actual weight of the agent currently stored within the cylinder. The actual weight of the agent should equal the intended fill weight. If the actual weight of the agent is less than the intended fill weight, the agent fill procedure must be repeated. If the actual weight of the agent is more than the intended fill weight, the overfill retrieval procedure must be followed as detailed below.
- If the intended agent fill weight has been achieved, record the agent weight in the appropriate location on the cylinder label and fill log. Follow the steps outlined in Section 4.3 to superpressurize the cylinder.

4.2.3 Overfill Retrieval Procedure

To retrieve agent from a cylinder assembly due to an overfill, it will be necessary to open the cylinder valve. Both a manual and electric valve actuator will be required for this purpose.

- Replace the anti-recoil safety device with the appropriate Series fill adapter for the cylinder assembly being filled.
- Ensure that the fill pressure gauge is connected to the gauge connection port of the cylinder fill assembly.
- Connect the cylinder connection port of the cylinder fill assembly to the male quick-connect fitting of the fill adapter. Ensure the manual agent fill valve of the cylinder fill assembly is in the closed position before proceeding.
- Ensure that the agent supply tank hose of the fill station is connected to the liquid fill line of the agent supply tank.
- Connect the cylinder fill hose of the fill station to the pump connection port of the cylinder fill assembly.
- Open the supply tank liquid line valve.
- Set the direction of flow for the fill station towards the agent supply tank. Do this by setting the pump selector knob to "recovery cylinder".
- Open the manual agent fill valve and set the fill station pump to a low speed using the pump control knob.
Section 4 Fill Procedure

4.3 Pressurization Procedure

Once the target agent fill weight has been confirmed, the cylinder assembly must be pressurized with nitrogen to 360 psi at 70°F.

• Replace the anti-recoil safety device with the appropriate Series fill adapter for the cylinder assembly being filled.
Section 4 Fill Procedure

- Ensure that the fill pressure gauge is connected to the gauge connection port of the cylinder fill assembly.

- Connect the cylinder connection port of the cylinder fill assembly to the male quick-connect fitting of the fill adapter. Ensure the manual agent fill valve of the cylinder fill assembly is in the closed position before proceeding.

- After ensuring that the valve set line and cylinder pressurization line valves of the nitrogen regulator/hose assembly are closed, open the nitrogen supply valve and set the regulator to no higher than 20 psig above the intended pressure at the ambient temperature (e.g. for the intended cylinder pressure of 360 psig at 70°F, set regulator to 380 psig).

- Connect the female quick-connect fitting at the end of the cylinder pressurization line to the nitrogen pressurization port of the cylinder fill assembly.

- Open the cylinder pressurization line valve slowly. Allow nitrogen to pressurize the cylinder assembly until the flow of nitrogen ceases. This can be noted by the pressure displayed on fill pressure gauge ceasing to increase and/or by a noticeable difference in sound produced from the nitrogen regulator.

- Close the cylinder pressurization line valve.

- Close the nitrogen supply valve on the nitrogen supply cylinder.

Once nitrogen has been added to the cylinder assembly, the cylinder valve must be closed by seating the cylinder valve piston with nitrogen.

- After ensuring that the valve set line and cylinder pressurization line valves of the nitrogen regulator/hose assembly are closed, open the nitrogen supply valve and set the regulator to no higher than 400 psig at 70°F.

- Install the valve closing adapter hand tight to the valve actuation connection located on the top of the cylinder valve.

- Connect the valve closing line of the nitrogen regulator/hose assembly to the valve closing adapter.

- Open the ball valve of the valve closing line for no more than 1 or 2 seconds and then close the ball valve. A slight popping noise should be heard as the piston of the cylinder valve is seated, closing the cylinder valve.

- Set the nitrogen regulator to 0 psi. Pressure within the valve closing line will be relieved through the regulator. Close the nitrogen supply valve on the nitrogen supply cylinder.

It must be verified that the cylinder valve piston has fully seated before any of the fill components are disconnected. Pressure must also be depleted from within the cylinder fill assembly before disconnecting the cylinder fill hose. The following method shall be used to achieve both tasks.

- Ensure the agent supply tank hose of the fill station is connected to the liquid fill line of the agent supply tank.

- Connect the cylinder fill hose of the fill station to the pump connection port of the cylinder fill assembly.
Section 4 Fill Procedure

- Open the supply tank liquid valve.

- Set the direction of flow for the fill station towards the agent supply tank. Do this by setting the pump selector knob to "recovery cylinder".

- Slowly open the manual agent fill valve and set the fill station pump to a low speed using the pump control knob. If a pressure drop is not immediately observable on the fill pressure gauge, the cylinder valve piston has not fully seated. Close the manual agent fill valve and repeat the process for seating the cylinder valve piston using nitrogen.

- Once a pressure drop has been observed on the fill pressure gauge, continue pumping until the pressure gauge indicates 0 psig. Close the manual agent fill valve, turn off the pump by setting the pump control knob to off, and set the pump selector knob to the neutral or off position.

Once the cylinder valve piston has been seated and the cylinder fill assembly has been depressurized, all fill component hardware must be removed as described below.

- Remove the valve closing line from the valve closing adapter. If the valve closing line quick-connect fitting is difficult to remove, this indicates the valve closing line is still under pressure. Ensure the ball valve on the cylinder pressurization line and nitrogen supply valve on top of the nitrogen supply valve are closed. Set the nitrogen regulator to 0 psi and then open the valve closing line ball valve. Pressure will bleed out of the self-relieving nitrogen regulator. Once pressure has been bled to 0 psi, close the valve closing line ball valve and remove the valve closing line from the valve closing adapter.

- Remove the valve closing adapter from the cylinder valve.

- Remove the cylinder fill hose from the pump connection port. If the cylinder fill hose quick-connect fitting is difficult to remove, this indicates the cylinder fill hose is still under pressure. Repeat the above steps to depressurize the cylinder fill hose.

- Disconnect the cylinder fill assembly from the fill adapter.

- Remove the fill adapter and immediately install the anti-recoil safety device into the cylinder discharge outlet.

To achieve a homogenous mixture of agent and nitrogen at a constant pressure of 360 psig at 70°F, the agent contained within the cylinder assembly must absorb the nitrogen that has been added to the cylinder. The cylinder assembly should be agitated to allow the agent to absorb the added nitrogen and then the pressurization procedure repeated. Alternately, the cylinder assembly may be allowed to sit overnight before repeating the pressurization procedure. This shall be continued until the intended cylinder pressure is reached and a pressure drop is not observed.

⚠️ CAUTION ⚠️

Failure to ensure that the nitrogen has achieved maximum saturation into the agent at the intended cylinder pressure will result in low pressure in the cylinder at the time of system installation.
Section 4 Fill Procedure

4.3.1 Finalization Procedure

Upon reaching an internal cylinder assembly pressure of 360 psig at 70°F (refer to Table B.1 located in Appendix B for intended cylinder pressures adjusted for ambient temperatures other than 70°F), the following steps shall be performed.

• Let the cylinder assembly stand for three hours. Once this three hour period has been completed, check the cylinder assembly for leak using a soap solution.

• Check the cylinder pressure gauge using the pressure/temperature chart located in the appendix of this manual.

• Weigh cylinder assembly and record this final weight on the cylinder label and fill log as full weight.

• Properly secure the cylinder assembly for storage or shipping.
5 SYSTEM RECHARGE AND RESET

Those individuals responsible for maintenance of a Janus Fire Systems® fire extinguishing system utilizing Novec 1230 fluid must be trained.

To maintain FM Approval cylinder recharge must be done at a Janus Fire Systems® recognized facility.

This chapter does not include instructions on resetting the automatic control system. Refer to the appropriate technical manual for this information.

5.1 Piping and Nozzles

High heat from a fire could damage piping, nozzles, and pipe support members. Check all pipe supports and fittings for any signs of damage or corrosion. Remove nozzles from pipe and inspect for damage, corrosion, or obstructions. Clean nozzles and reinstall making certain to tighten and aim properly.

5.2 Recharging

Recharge consists of removing the cylinder, reconditioning and cleaning the valve assembly, and refilling and pressurizing the cylinder.

![WARNING]

Do not transport the cylinder unless the anti-recoil safety device is in place. Handle the cylinder assembly with care even when the safety device is in place.

Do not apply excessive force to the low-pressure supervisory switch or attempt to carry the cylinder assembly or valve assembly by the low-pressure switch. The low-pressure supervisory switch is not designed or intended to be used to carry the cylinder or valve. If the low-pressure supervisory switch breaks at the fitting agent will discharge through the port causing possible personal injury or property damage and complete loss of agent.

5.2.1 Removing The Cylinder

- Remove the electric and pneumatic valve actuators and install the shipping cap onto the valve actuation connection.
- Remove the empty cylinders by disconnecting the discharge piping and installing the anti-recoil safety plug or device.
- Disconnect the low-pressure supervisory switch electrical connector.
- For Mv and Lv Series cylinders, remove the low-pressure supervisory switch and pressure gauge assemblies.

![WARNING]

Do not remove the pressure gauge or low-pressure supervisory switch from the Sv cylinder valve during the recharge process.

- Remove the cylinder from the bracket only after ensuring all appropriate safety measures have been complied with and all relevant warnings noted.
Section 5 System Recharge and Reset

5.2.2 Cleaning and Servicing The Valve Assembly

Janus Fire Systems recommends that the following steps be followed prior to refilling the cylinder(s):¹

**WARNING**

Check the pressure gauge and cylinder weight to verify the cylinder is empty and at atmospheric pressure before attempting to remove the valve. Failure to comply could result in personal injury or death from violent cylinder movement or over-exposure to high concentrations of agent.

- Remove the valve assembly from the cylinder.
- Remove the dip tube from the valve assembly.
- Remove the top cap.
- Push the piston assembly up and out of the top of the valve body and inspect both the piston and valve body bore for damage.
- Clean all internal valve surfaces using caution not to scratch or nick the seating surfaces.
- Hold the piston in place by carefully gripping the smaller diameter cylindrical surface with a strap wrench or similar device. Use a pin-style spanner wrench to remove the piston cap by turning it counter-clockwise.
- Replace the lower piston O-ring around the piston cap.
- Reinstall the piston cap using the strap wrench and spanner wrench. Tighten until the cap bottoms out on the piston body.
- Remove the upper piston O-ring on the piston body and discard.
- Lubricate the new upper piston O-ring with Molykote 55 by Dow Corning (P/N 19056) or equivalent and install the new upper piston O-ring onto the piston body.
- Lightly lubricate the internal valve bore with Molykote 55 by Dow Corning (P/N 19056) or equivalent and insert the valve piston into the valve body.
- Remove the valve cap O-ring and discard.
- To prevent damage to the new valve cap O-ring during installation cover the threads of the valve cap with masking tape.
- Lightly lubricate the new valve cap O-ring with Molykote 55 by Dow Corning (P/N 19056) or equivalent and install on the valve cap.
- Remove masking tape from valve cap threads and clean the threads on the valve cap. Carefully thread the top cap onto the valve assembly. Tighten securely, do not apply excessive force.

¹ – Refer to Appendix C for information on removing and replacing the Liquid Level Indicator.
Section 5 System Recharge and Reset

5.2.3 Recharge Procedure

• Follow the procedures outlined in Section 4 of this manual to fill the cylinder to the correct amount by weight and pressurize the cylinder assembly to 360 psig at 70°F. See the cylinder label for fill weight and fill to a minimum of the stamped fill weight and no more than ¼ pound (4 oz) (113 g) above the stamped fill weight. The pressure gauge on the cylinder shall not be used to determine when the proper charge pressure has been reached. A pressure regulator must be used when the pressure source is a tank of high pressure gas.

• Replace the charged cylinder in the bracket and follow procedures outlined in Section 4 and Section 5 of the Installation Manual, DOC108, to reinstall the system.

• Inform appropriate personnel that the system is back in service.
Appendix A

Material Safety Datasheet
Material Safety Data Sheet

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**SECTION 1: PRODUCT AND COMPANY IDENTIFICATION**

**PRODUCT NAME:** 3M™ Novec™ 1230 Fire Protection Fluid [FK-5-1-12]

**MANUFACTURER:** 3M

**DIVISION:** Electronics Markets Materials Division

**ADDRESS:** 3M Center
St. Paul, MN 55144-1000

**EMERGENCY PHONE:** 1-800-364-3577 or (651) 737-6501 (24 hours)

**Issue Date:** 01/21/11

**Supercedes Date:** 11/09/10

**Document Group:** 16-3425-2

**Product Use:**

**Intended Use:** Streaming and Flooding Fire Protection

**SECTION 2: INGREDIENTS**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>C.A.S. No.</th>
<th>% by Wt</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone</td>
<td>756-13-8</td>
<td>&gt; 99.9</td>
</tr>
</tbody>
</table>

**SECTION 3: HAZARDS IDENTIFICATION**

**3.1 EMERGENCY OVERVIEW**

**Specific Physical Form:** Liquid

**Odor, Color, Grade:** clear colorless, low odor

**General Physical Form:** Liquid

**Immediate health, physical, and environmental hazards:**

**3.2 POTENTIAL HEALTH EFFECTS**

**Eye Contact:**

Contact with the eyes during product use is not expected to result in significant irritation.
Skin Contact:
Contact with the skin during product use is not expected to result in significant irritation.

Inhalation:
If thermal decomposition occurs:
   May be harmful if inhaled.

Ingestion:
No health effects are expected.

3.3 POTENTIAL ENVIRONMENTAL EFFECTS

This substance has a high Henry's Law constant and therefore will be primarily found in the atmosphere where photolysis will be the dominant reaction pathway. The ultimate degradation products of the photolysis reaction are HF, CO2 and trifluoroacetic acid (TFA).

This substance does not contribute to ozone depletion; it has an atmospheric lifetime of approximately 5 days and a Global Warming Potential (GWP) of 1 (IPCC 2001 Method).

SECTION 4: FIRST AID MEASURES

4.1 FIRST AID PROCEDURES

The following first aid recommendations are based on an assumption that appropriate personal and industrial hygiene practices are followed.

Eye Contact: No need for first aid is anticipated.
Skin Contact: No need for first aid is anticipated.
Inhalation: If signs/symptoms develop, remove person to fresh air. If signs/symptoms persist, get medical attention.
If Swallowed: No need for first aid is anticipated.

SECTION 5: FIRE FIGHTING MEASURES

5.1 FLAMMABLE PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Not Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autoignition temperature</td>
<td></td>
</tr>
<tr>
<td>Flash Point</td>
<td>No flash point</td>
</tr>
<tr>
<td>Flammable Limits(LEL)</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Flammable Limits(UEL)</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Flammable Limits(UEL)</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>

5.2 EXTINGUISHING MEDIA
Appendix A

MATERIAL SAFETY DATA SHEET 3M™ Novec™ 1230 Fire Protection Fluid [FK-5-1-12] 01/21/11

Product is a fire-extinguishing agent.

5.3 PROTECTION OF FIRE FIGHTERS

Special Fire Fighting Procedures: Wear full protective equipment (Bunker Gear) and a self-contained breathing apparatus (SCBA).

Unusual Fire and Explosion Hazards: Not applicable.

Note: See STABILITY AND REACTIVITY (SECTION 10) for hazardous combustion and thermal decomposition information.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1. Personal precautions, protective equipment and emergency procedures
Ventilate the area with fresh air. For large spill, or spills in confined spaces, provide mechanical ventilation to disperse or exhaust vapors, in accordance with good industrial hygiene practice. Warning! A motor could be an ignition source and could cause flammable gases or vapors in the spill area to burn or explode.

6.2. Environmental precautions
For larger spills, cover drains and build dikes to prevent entry into sewer systems or bodies of water. Place in a metal container approved for transportation by appropriate authorities. Dispose of collected material as soon as possible.

Clean-up methods
Observe precautions from other sections. Call 3M-HELPS line (1-800-364-3577) for more information on handling and managing the spill. Contain spill. Working from around the edges of the spill inward, cover with bentonite, vermiculite, or commercially available inorganic absorbent material. Mix in sufficient absorbent until it appears dry. Collect as much of the spilled material as possible. Clean up residue. Seal the container.

In the event of a release of this material, the user should determine if the release qualifies as reportable according to local, state, and federal regulations.

SECTION 7: HANDLING AND STORAGE

7.1 HANDLING
For industrial or professional use only. Contents may be under pressure, open carefully. Do not breathe thermal decomposition products.

7.2 STORAGE
Keep container in well-ventilated area. Store out of direct sunlight. Store away from heat. Store away from strong bases, amines, and alcohols.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 ENGINEERING CONTROLS
Provide appropriate local exhaust ventilation on open containers. For those situations where the fluid might be exposed to extreme overheating due to misuse or equipment failure, use with appropriate local exhaust ventilation sufficient to maintain levels of thermal decomposition products below their exposure guidelines.
8.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)

8.2.1 Eye/Face Protection
Not applicable.

8.2.2 Skin Protection
Not applicable. Gloves are not required.

8.2.3 Respiratory Protection
As a good industrial hygiene practice:
Avoid breathing of vapors, mists or spray.
Under normal use conditions, airborne exposures are not expected to be significant enough to require respiratory protection.
If thermal decomposition occurs:
Do not breathe vapors.

Select one of the following NIOSH approved respirators based on airborne concentration of contaminants and in accordance with OSHA regulations: Half facepiece or fullface supplied-air respirator
. Consult the current 3M Respiratory Selection Guide for additional information or call 1-800-243-4630 for 3M technical assistance.
If thermal decomposition occurs, wear supplied air respiratory protection.

8.2.4 Prevention of Swallowing
Not applicable.

8.3 EXPOSURE GUIDELINES

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Authority</th>
<th>Type</th>
<th>Limit</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone</td>
<td>3M</td>
<td>TWA</td>
<td>150 ppm</td>
<td></td>
</tr>
</tbody>
</table>

SOURCE OF EXPOSURE LIMIT DATA:
ACGIH: American Conference of Governmental Industrial Hygienists
CMRG: Chemical Manufacturer Recommended Guideline
OSHA: Occupational Safety and Health Administration
AIHA: American Industrial Hygiene Association Workplace Environmental Exposure Level (WEEL)

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Specific Physical Form: Liquid
Odor, Color, Grade: clear colorless, low odor.
General Physical Form: Liquid
Autoignition temperature: Not Applicable
Flash Point: No flash point
Flammable Limits(LEL): Not Applicable
Flammable Limits(UEL): Not Applicable
Flammable Limits(UEL): Not Applicable
Flammable Limits(UEL): Not Applicable
Boiling Point: 49 ºC
Vapor Density: 11.6 [Ref Std: AIR=1]
Appendix A

MATERIAL SAFETY DATA SHEET 3M™ Novec™ 1230 Fire Protection Fluid [FK-5-1-12] 01/21/11

Vapor Pressure 244 mmHg [@ 20 ºC]
Specific Gravity 1.6 [Ref Std: WATER=1]
pH Not Applicable
Melting point -108 ºC
Solubility in Water Nil
Evaporation rate > 1 [Ref Std: BUOAC=1]
Volatile Organic Compounds 1600 g/l [Test Method: calculated SCAQMD rule 443.1]
Kow - Oct/Water partition coef No Data Available
Percent volatile 100 %
VOC Less H2O & Exempt Solvents 1600 g/l [Test Method: calculated SCAQMD rule 443.1]
Viscosity 0.6 centipoise [@ 25 ºC]
Materials to avoid Alcohols

SECTION 10: STABILITY AND REACTIVITY

Stability: Stable.

Materials and Conditions to Avoid:
10.1 Conditions to avoid
Light

10.2 Materials to avoid
Strong bases
Amines
Alcohols

Additional Information: Listed materials to avoid should not be mixed with liquid Novec 1230 fluid. Avoid direct sunlight and ultraviolet light.

Hazardous Polymerization: Hazardous polymerization will not occur.

Hazardous Decomposition or By-Products

<table>
<thead>
<tr>
<th>Substance</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon monoxide</td>
<td>During Combustion</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>During Combustion</td>
</tr>
<tr>
<td>Hydrogen fluoride</td>
<td>During Combustion</td>
</tr>
</tbody>
</table>

Hazardous Decomposition: Hydrogen fluoride has an ACGIH Threshold Limit Value of 3 parts per million (as fluoride) as a Ceiling Limit and an OSHA PEL of 3 ppm of fluoride as an eight hour Time-Weighted Average and 6 ppm of fluoride as a Short Term Exposure Limit. The odor threshold for HF is 0.04 ppm, providing good warning properties for exposure.

SECTION 11: TOXICOLOGICAL INFORMATION

Please contact the address listed on the first page of the MSDS for Toxicological Information on this material and/or its components.
SECTION 12: ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION

Not determined.
Please refer to existing literature on TFA

CHEMICAL FATE INFORMATION

Not determined.
Photolytic half-life: 3-5 days.
Photolytic degradation products may include Trifluoroacetic acid (TFA)
NOTE: Hydrolysis is not expected to be a significant degradation pathway. Product is highly insoluble in water and volatile, and use as a clean extinguishing agent would not typically result in releases to aquatic environments.

SECTION 13: DISPOSAL CONSIDERATIONS

Waste Disposal Method: Incinerate in an industrial or commercial facility in the presence of a combustible material. Combustion products will include HF. Facility must be capable of handling halogenated materials.
As a disposal alternative, dispose of waste product in a facility permitted to accept chemical waste. Reclaim if feasible. For information on product return, contact your distributor.

EPA Hazardous Waste Number (RCRA): Not regulated

Since regulations vary, consult applicable regulations or authorities before disposal.

SECTION 14: TRANSPORT INFORMATION

ID Number(s):

For Transport Information, please visit http://3M.com/Transportinfo or call 1-800-364-3577 or 651-737-6501.

SECTION 15: REGULATORY INFORMATION

US FEDERAL REGULATIONS
Contact 3M for more information.

311/312 Hazard Categories:
Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No Immediate Hazard - No Delayed Hazard - No

STATE REGULATIONS
Contact 3M for more information.
CHEMICAL INVENTORIES
The components of this product are in compliance with the chemical notification requirements of TSCA.

All the components of this product are listed on China's Inventory of Chemical Substances.

The components of this material are in compliance with the new chemical notification requirements for the Korean Existing Chemicals Inventory.

Contact 3M for more information.

Additional Information: The components of this product are in compliance with the chemical notification requirements of the National Industrial Chemical Notification and Assessment Scheme (NICNAS) of Australia, the Canadian Environmental Protection Act (CEPA) and the Ministry of Economy, Trade and Industry of Japan. This product is notified in the Philippines as PMPIN-2005-3.

INTERNATIONAL REGULATIONS
Contact 3M for more information.

ADDITIONAL INFORMATION
U.S. EPA. Significant New Alternatives Policy Program (SNAP) approved for uses is streaming and flooding fire protection application.

This MSDS has been prepared to meet the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200.

SECTION 16: OTHER INFORMATION

NFPA Hazard Classification

Health: 3  Flammability: 0  Reactivity: 1  Special Hazards: None

National Fire Protection Association (NFPA) hazard ratings are designed for use by emergency response personnel to address the hazards that are presented by short-term, acute exposure to a material under conditions of fire, spill, or similar emergencies. Hazard ratings are primarily based on the inherent physical and toxic properties of the material but also include the toxic properties of combustion or decomposition products that are known to be generated in significant quantities.

HMIS Hazard Classification

Health: 0  Flammability: 0  Reactivity: 1  Protection: X - See PPE section.

Hazardous Material Identification System (HMIS(r)) hazard ratings are designed to inform employees of chemical hazards in the workplace. These
ratings are based on the inherent properties of the material under expected conditions of normal use and are not intended for use in emergency situations. HMIS(r) ratings are to be used with a fully implemented HMIS(r) program. HMIS(r) is a registered mark of the National Paint and Coatings Association (NPCA).

Revision Changes:
Section 1: Product use information was modified.
Copyright was modified.
Section 15: Inventories information was modified.
Section 9: Boiling point information was modified.
Section 5: Flammable limits (UE) information was modified.
Section 5: Flammable limits (LEL) information was modified.
Section 5: Flash point information was modified.
Section 9: Flash point information was modified.
Section 9: Flammable limits (LEL) information was modified.
Section 9: Flammable limits (UEL) information was modified.
Section 2: Ingredient table was modified.
Section 8: Exposure guidelines ingredient information was modified.
Section 6: 6.1. Personal precautions, protective equipment and emergency procedures heading was modified.
Section 14: ID Number Heading Template 1 was added.
Section 14: ID Number(s) Template 1 was added.

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3M MSDSs are available at www.3M.com
Appendix B

Assorted Charts
## Appendix B

### Table B.1 - Approximate Container Pressure vs. Temperature

<table>
<thead>
<tr>
<th>Temperature °F</th>
<th>Temperature °C</th>
<th>Pressure psig</th>
<th>Pressure bar</th>
<th>90% Pressure psig</th>
<th>90% Pressure bar</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>0.0</td>
<td>288 (284)</td>
<td>19.86 (19.56)</td>
<td>259 (256)</td>
<td>17.87 (17.62)</td>
</tr>
<tr>
<td>40</td>
<td>4.4</td>
<td>303</td>
<td>20.89</td>
<td>273</td>
<td>18.80</td>
</tr>
<tr>
<td>50</td>
<td>10</td>
<td>321</td>
<td>22.13</td>
<td>289</td>
<td>19.92</td>
</tr>
<tr>
<td>60</td>
<td>15.6</td>
<td>340</td>
<td>23.44</td>
<td>306</td>
<td>21.10</td>
</tr>
<tr>
<td>70</td>
<td>21.1</td>
<td>360</td>
<td>24.82</td>
<td>324</td>
<td>22.34</td>
</tr>
<tr>
<td>80</td>
<td>26.7</td>
<td>381</td>
<td>26.27</td>
<td>343</td>
<td>23.64</td>
</tr>
<tr>
<td>90</td>
<td>32.2</td>
<td>402</td>
<td>27.72</td>
<td>362</td>
<td>24.95</td>
</tr>
<tr>
<td>100</td>
<td>37.8</td>
<td>425</td>
<td>29.30</td>
<td>383</td>
<td>26.37</td>
</tr>
<tr>
<td>110</td>
<td>43.3</td>
<td>449</td>
<td>30.96</td>
<td>404</td>
<td>27.86</td>
</tr>
<tr>
<td>120</td>
<td>48.9</td>
<td>475</td>
<td>32.75</td>
<td>428</td>
<td>29.48</td>
</tr>
</tbody>
</table>
### Appendix B

#### Table B.2a U.S. Standard to Metric Conversion Factors (Approximate)

<table>
<thead>
<tr>
<th>Measure</th>
<th>U.S. Standard</th>
<th>Multiply By</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Length</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>inches (in)</td>
<td>25.4</td>
<td>millimeters (mm)</td>
<td></td>
</tr>
<tr>
<td>feet (ft)</td>
<td>304.8</td>
<td>millimeters (mm)</td>
<td></td>
</tr>
<tr>
<td>feet (ft)</td>
<td>0.3048</td>
<td>meters (m)</td>
<td></td>
</tr>
<tr>
<td><strong>Area</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>square inches (in²)</td>
<td>645.16</td>
<td>square millimeters (mm²)</td>
<td></td>
</tr>
<tr>
<td>square feet (ft²)</td>
<td>0.0929</td>
<td>square meters (m²)</td>
<td></td>
</tr>
<tr>
<td><strong>Weight (mass)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ounces (oz)</td>
<td>28.349</td>
<td>grams (g)</td>
<td></td>
</tr>
<tr>
<td>pounds (lb)</td>
<td>0.4536</td>
<td>kilograms (kg)</td>
<td></td>
</tr>
<tr>
<td><strong>Volume</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cubic inches (in³)</td>
<td>16387.06</td>
<td>cubic millimeters (mm³)</td>
<td></td>
</tr>
<tr>
<td>fluid ounces (fl oz)</td>
<td>29.57</td>
<td>milliliters (mL)</td>
<td></td>
</tr>
<tr>
<td>cubic feet (ft³)</td>
<td>0.0283</td>
<td>cubic meters (m³)</td>
<td></td>
</tr>
<tr>
<td><strong>Pressure</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>inches of mercury (inHG)</td>
<td>3.453</td>
<td>kilopascals (kPa)</td>
<td></td>
</tr>
<tr>
<td>pounds per square inch (psi)</td>
<td>6.895</td>
<td>kilopascals (kPa)</td>
<td></td>
</tr>
<tr>
<td>pounds per square inch (psi)</td>
<td>0.0689</td>
<td>bar (bar)</td>
<td></td>
</tr>
<tr>
<td><strong>Temperature</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>degrees Fahrenheit (°F)</td>
<td>5/9</td>
<td>(after subtracting 32)</td>
<td></td>
</tr>
</tbody>
</table>

#### Table B.2b Metric to U.S. Standard Conversion Factors (Approximate)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Metric</th>
<th>Multiply By</th>
<th>U.S. Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Length</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>millimeters (mm)</td>
<td>0.0394</td>
<td>inches (in)</td>
<td></td>
</tr>
<tr>
<td>millimeters (mm)</td>
<td>0.00328</td>
<td>feet (ft)</td>
<td></td>
</tr>
<tr>
<td>meters (m)</td>
<td>3.2808</td>
<td>feet (ft)</td>
<td></td>
</tr>
<tr>
<td><strong>Area</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>square millimeters (mm²)</td>
<td>0.00155</td>
<td>square inches (in²)</td>
<td></td>
</tr>
<tr>
<td>square meters (m²)</td>
<td>10.764</td>
<td>square feet (ft²)</td>
<td></td>
</tr>
<tr>
<td><strong>Weight (mass)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>grams (g)</td>
<td>0.03527</td>
<td>ounces (oz)</td>
<td></td>
</tr>
<tr>
<td>kilograms (kg)</td>
<td>2.205</td>
<td>pounds (lb)</td>
<td></td>
</tr>
<tr>
<td><strong>Volume</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cubic millimeters (mm³)</td>
<td>0.00006102</td>
<td>cubic inches (in³)</td>
<td></td>
</tr>
<tr>
<td>milliliters (mL)</td>
<td>0.0338</td>
<td>fluid ounces (fl oz)</td>
<td></td>
</tr>
<tr>
<td>cubic meters (m³)</td>
<td>35.336</td>
<td>cubic feet (ft³)</td>
<td></td>
</tr>
<tr>
<td><strong>Pressure</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>kilopascals (kPa)</td>
<td>0.2896</td>
<td>inches of mercury (inHG)</td>
<td></td>
</tr>
<tr>
<td>kilopascals (kPa)</td>
<td>0.1450</td>
<td>pounds per square inch (psi)</td>
<td></td>
</tr>
<tr>
<td>bar (bar)</td>
<td>14.5138</td>
<td>pounds per square inch (psi)</td>
<td></td>
</tr>
<tr>
<td><strong>Temperature</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>degrees Celsius (°C)</td>
<td>9/5</td>
<td>(after adding 32)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>degrees Fahrenheit (°F)</td>
<td></td>
</tr>
</tbody>
</table>
### Appendix B

#### Table B.3a Liquid Level Chart – 250 lb Cylinder (U.S. Standard)

<table>
<thead>
<tr>
<th>QUID</th>
<th>LEVEL (CM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>32°F</td>
</tr>
<tr>
<td>30</td>
<td>40°F</td>
</tr>
<tr>
<td>35</td>
<td>50°F</td>
</tr>
<tr>
<td>40</td>
<td>60°F</td>
</tr>
<tr>
<td>45</td>
<td>70°F</td>
</tr>
<tr>
<td>50</td>
<td>80°F</td>
</tr>
<tr>
<td>60</td>
<td>90°F</td>
</tr>
<tr>
<td>70</td>
<td>100°F</td>
</tr>
<tr>
<td>80</td>
<td>110°F</td>
</tr>
<tr>
<td>90</td>
<td>120°F</td>
</tr>
<tr>
<td>100</td>
<td>130°F</td>
</tr>
<tr>
<td>120</td>
<td>130°F</td>
</tr>
<tr>
<td>130</td>
<td>155°F</td>
</tr>
<tr>
<td>155</td>
<td>180°F</td>
</tr>
<tr>
<td>180</td>
<td>205°F</td>
</tr>
<tr>
<td>205</td>
<td>230°F</td>
</tr>
<tr>
<td>230</td>
<td>255°F</td>
</tr>
</tbody>
</table>

---

**Graph**

The graph illustrates the liquid level chart for the Janus Fire Systems® 250 lb Cylinder (US Standard). The chart shows the relationship between the weight of NOVEC 1230 fluid and the liquid level in centimeters at different temperatures. The key points highlighted are:

- **32°F** at approximately 10 cm level
- **130°F** at approximately 45 cm level
Table B.3b Liquid Level Chart – 250 lb Cylinder (Metric)

<table>
<thead>
<tr>
<th>LIQUID LEVEL (CM)</th>
<th>0.0°C</th>
<th>4.4°C</th>
<th>10.0°C</th>
<th>15.6°C</th>
<th>21.1°C</th>
<th>26.7°C</th>
<th>32.2°C</th>
<th>37.8°C</th>
<th>43.3°C</th>
<th>48.9°C</th>
<th>54.4°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>43.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>48.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>54.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Janus Fire Systems® 250 lb Cylinder (Metric)
### Appendix B

#### Table B.5a Liquid Level Chart – 600 lb Cylinder (U.S. Standard)

<table>
<thead>
<tr>
<th>Level (F)</th>
<th>Weight of NOVEC 1230 Liquid (LBS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°F</td>
<td>260</td>
</tr>
<tr>
<td>5°F</td>
<td>285</td>
</tr>
<tr>
<td>10°F</td>
<td>310</td>
</tr>
<tr>
<td>15°F</td>
<td>335</td>
</tr>
<tr>
<td>20°F</td>
<td>360</td>
</tr>
<tr>
<td>25°F</td>
<td>385</td>
</tr>
<tr>
<td>30°F</td>
<td>410</td>
</tr>
<tr>
<td>35°F</td>
<td>435</td>
</tr>
<tr>
<td>40°F</td>
<td>460</td>
</tr>
<tr>
<td>45°F</td>
<td>485</td>
</tr>
<tr>
<td>50°F</td>
<td>510</td>
</tr>
<tr>
<td>55°F</td>
<td>535</td>
</tr>
<tr>
<td>60°F</td>
<td>560</td>
</tr>
<tr>
<td>65°F</td>
<td>585</td>
</tr>
<tr>
<td>70°F</td>
<td>610</td>
</tr>
</tbody>
</table>

![Graph showing liquid level chart for 600 lb cylinder](image-url)
Appendix B

Table B.5b Liquid Level Chart – 600 lb Cylinder (Metric)
Table B.6a Liquid Level Chart – 900 lb Cylinder (U.S. Standard)
Table B.6b Liquid Level Chart – 900 lb Cylinder (Metric)

- **54.4°C**
- **0.0°C**

```
<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Liquid Level (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>4.4</td>
<td>5</td>
</tr>
<tr>
<td>10.0</td>
<td>10</td>
</tr>
<tr>
<td>15.6</td>
<td>15</td>
</tr>
<tr>
<td>21.1</td>
<td>20</td>
</tr>
<tr>
<td>26.7</td>
<td>25</td>
</tr>
<tr>
<td>32.2</td>
<td>30</td>
</tr>
<tr>
<td>37.8</td>
<td>35</td>
</tr>
<tr>
<td>43.3</td>
<td>40</td>
</tr>
<tr>
<td>48.9</td>
<td>45</td>
</tr>
<tr>
<td>54.4</td>
<td>50</td>
</tr>
</tbody>
</table>

Janus Fire Systems® 900 lb Cylinder (Metric)

---

**Appendix B**
Table B.7a Liquid Level Chart – 1000 lb Cylinder (U.S. Standard)

Janus Fire Systems® 1000 lb Cylinder (US Standard)
Table B.7b Liquid Level Chart – 1000 lb Cylinder (Metric)
Appendix C

Liquid Level Indicator Replacement
C LIQUID LEVEL INDICATOR REPLACEMENT

The following steps detail the procedure for removing and replacing the liquid level indicator.

1. Pump down the cylinder. ENSURE THAT THE CYLINDER IS COMPLETELY EMPTY AND DEPRESSURIZED BEFORE CONTINUING.

1. Remove the cylinder valve and dip tube by lifting straight up and out. Be careful not to damage the cylinder valve threads. 
   Note: When removing the Lv Series cylinder valve and dip tube assembly, an overhead lift may be required for removal or else two people working together on an elevated platform.

2. Remove the liquid level indicator (LLI) by using a 1-1/8 inch wrench on the hex nut directly above the LLI boss on the cylinder. (Refer to Figure C.1)

3. Once the hex nut threads are backed out, SLOWLY pull the LLI out from the cylinder boss. The ball float at the base of the LLI rod will not allow for the LLI to be completely removed. Care should be taken to avoid damaging the ball float or the stop clip when withdrawing the LLI. (Refer to Figure C.2)

4. While the LLI rod is held extended from the LLI boss, reach into the cylinder through the cylinder collar to locate the ball float and stop washer at the base of the LLI rod. SEE NOTE 1.

5. Pinch the stop clip with forefinger and thumb with enough force to slide both the stop washer and ball float off of the LLI rod. Be careful not to drop the ball float or washer into the cylinder. If the stop washer cannot be removed easily, it can be cut with snips. A cut or damaged stop washer should be replaced with a new washer when reinstalling the LLI assembly.

6. Pull the ball float and stop washer out of the cylinder through the cylinder collar opening. The LLI rod should now be easily removed from the LLI boss.

7. Remove the old o-ring with a pick and destroy it to avoid reuse. Clean the LLI o-ring groove, making sure there is no debris that could score or cut the new o-ring. Any dust, dirt, weld slag, metal shavings, paint over-spray, etc., must be removed before reinstallation. Lightly lubricate the o-ring groove with Molykote 55 by Dow Corning or equivalent.

8. Lubricate the new o-ring with Molykote 55 by Dow Corning or equivalent. Use painters tape or masking tape around the LLI threads before installing the new o-ring to avoid any cutting or scoring of the new o-ring. Remove painting/masking tape after the o-ring is positioned correctly.

NOTE 1 – A washer may not be present depending on the date the LLI assembly was manufactured. If the LLI assembly does not have a washer, one should be obtained and placed onto the assembly when indicated during this procedure.
9. Once the o-ring is in place, reinsert the LLI rod through the LLI boss just enough so that the ball float can be reinstalled. Before replacing the ball float, locate the directional arrow that indicates proper positioning on the ball surface and ensure that the arrow is pointed up. (Refer to Figure C.3) Keeping the base of the LLI rod inside the LLI boss but near the top of the cylinder, slide the ball float back onto the LLI rod over the stop clip KEEPING THE DIRECTIONAL ARROW POINTED UP. The LLI will not read correctly if the ball float is installed upside-down.

10. The stop clip may become stretched after being spread/pinched several times. If the ball is dropped quickly down the LLI rod and into the cylinder, the force of the fall can lodge the ball onto the clip. The stop washer will prevent the ball from becoming wedged or stuck on the clip. Slide the washer over the stop clip after the ball float. Do not rapidly slide the ball float down the LLI rod or drop the rod into place. After installing the stop washer and while the rod is still held near the top of the cylinder, gently guide the float ball to its proper place at the base of the rod resting upon the stop washer.

11. Slowly lower the LLI rod into the cylinder until the hex nut is in place to be refastened. Fasten the LLI hex nut back into the boss tightly with a 1-1/8” wrench to ensure proper seal.

12. Prior to charging the cylinder with nitrogen or refilling with clean agent, exercise the LLI tape and ball actions as described in the Operations Manual (DOC108) to ensure the LLI is operating correctly.

13. Leak test the cylinder assembly by charging with nitrogen and applying a soap solution.