FM-200® Refill Manual

Sv Series, Mv Series, Lv Series

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JANUS FIRE SYSTEMS®

Contents

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Revision History

Revision	Description of Change	Date
---	Initial Printing	16-Aug-2010
A	Caution beginning "Ensure that the pilot actuation port pipe plug" added to Sections 2.3.1, 2.3.2, 2.3.3, and 4.2. All references to "Dow Corning No. 4" replaced with "Molykote 55 by Dow Corning (P/N 19056)".	31-May-2011
B	Appendix C added.	02-Apr-2012
C	Section 4.3.2 added. Sentence beginning "For a fill station to be UL Listed," and Table 1.1 added to Section 1.1. Note added to Section 1.2. Sentence beginning "An accurate thermometer" added to Note in Section 4.2. Phrase "400 psig" in Section 4.2.1 changed to "100 psig". Note and Warning added to Section 4.3.1.	02-Oct-2013
D	All applicable references to 'fill' changed to 'refill' for clarity. Sentence beginning "For a fill station to be UL Listed," and Table 1.1 removed from Section 1.1. Section 4.3.2 rewritten. Figure 4.3.2 added. Section 5 rewritten.	23-Jun-2020

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Preface

This manual is intended for use with the Janus Fire Systems® Sv Series, Mv Series, and Lv Series FM-200® Engineered Fire Extinguishing Systems. Those responsible for the agent fill or agent refill of these systems should read this entire manual.

All design, implementation, and maintenance of the Janus Fire Systems® Engineered Fire Extinguishing Systems must be performed in compliance with the National Fire Protection Association (NFPA) 2001 - Standard on Clean Agent Fire Extinguishing Systems, NFPA 70 - The National Electrical Code, NFPA 72 - The National Fire Alarm Code, and the guidelines outlined in this 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, DOC106.

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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Section 1 General Information

1 GENERAL INFORMATION

This manual describes the procedure for recharging/refilling Janus Fire Systems® Sv Series, Mv Series, and Lv Series cylinder assemblies with FM-200® agent.

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

FM-200® (HFC-227ea) is a colorless, non-toxic gas and a clean, effective, environmentally acceptable, electrically non-conductive fire suppression agent. It is formed from the elements carbon, fluorine and hydrogen (CF3CHFCF3 - heptafluoropropane). The primary extinguishing mechanism of FM-200® is heat absorption, with a secondary chemical contribution from the thermal decomposition of FM-200® in the flame.

Most metals, such as aluminum, brass, steel, and stainless steel, as well as plastics, rubber, and electronic components, are not affected by exposure to FM-200®.

In Janus Fire Systems® FM-200® Fire Suppression Systems, the FM-200® agent is stored as a liquid in steel cylinders and superpressurized with nitrogen to 360 psig (24.8 bar) at 70˚F (21.1˚C) to improve its flow characteristics. When discharged, FM-200® vaporizes at the discharge nozzles and becomes thoroughly mixed with the air throughout the protected area reaching a predetermined design concentration.

NOTE: Bulk FM-200® must be purchased from Janus Fire Systems and must bear the UL and FM marks on the container.

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® FM-200® cylinder assembly must be trained.

Section 1 General Information

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.

Cylinder filling must be performed in a well ventilated area.

⚠WARNING

When FM-200® 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 FM-200® can be found in Appendix A of this manual and shall be read and understood before working with the agent. Refer also to DuPont FM-200® Fire Extinguishing Agent Properties, Uses, Storage and Handling document K23261 found at www2.dupont.com/FE/en_US/tech_info/index.html for specific agent handling procedure.

⚠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 in is 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.

⚠WARNING

The filling station or pump designated for use with FM-200® 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 FM-200® agent 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/ft^3 (561 kg/m^3) and a maximum fill density of 70 lb/ft^3 (1121 kg/m^3). The capacity of a cylinder varies according to the design requirements and the Series designation (See Table 2.1 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 Canada[1] (TC) for compressed gas and are fitted with an identification label indicating the fill quantity of FM-200®. Each cylinder has internal neck threads to allow for connection to the cylinder valve.

Table 2.1 Cylinder Capacities

Valve Series	Nominal Cylinder Size	P/N	Fill Capacity				Empty Weight	
			Minimum		Maximum			
			lb	kg	lb	kg	lb	kg
Sv	40 lb	18583	22	10.0	49	19.5	36	16.3
Sv	80 lb	18584	41	18.6	81	36.7	65	29.5
Sv	130 lb	18585	66	29.9	131	59.4	77	35.0
Mv	250 lb	18525	126	57.2	252	114.3	213	96.6
Mv	420 lb	18526	211	95.7	422	191.4	279	126.6
Lv	600 lb	18527	304	137.9	609	275.3	346	157.0
Lv	900 lb	18528	455	206.4	910	412.7	471	213.6
Lv	1000 lb	18529	561	254.5	1000	453.6	766	346.5

Ordering Instructions: Specify the Cylinder Assembly P/N followed by a dash and the fill weight in pounds expressed in three digits.

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 FM-200® liquid. 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

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 FM-200® 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.

⚠ 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.

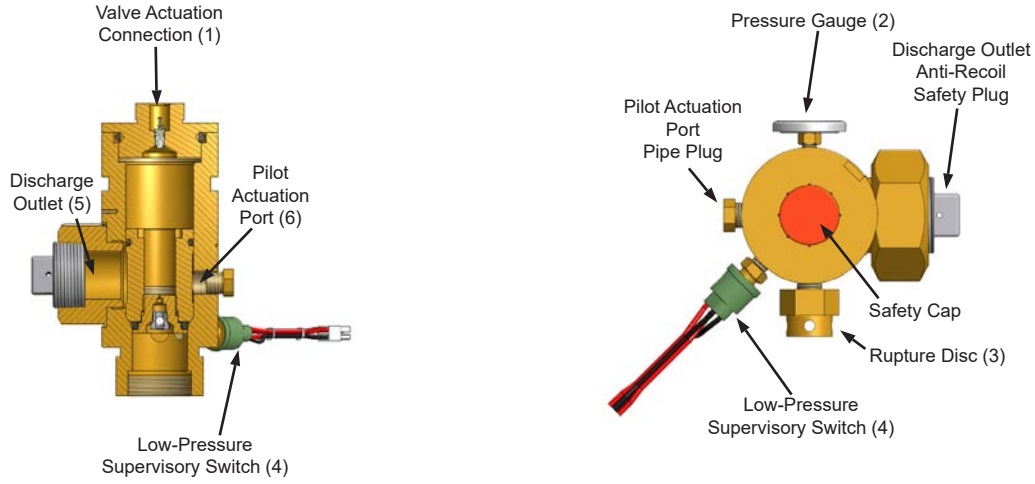


Figure 2.3.1 Sv Cylinder Valve Assembly

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.

⚠ 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.

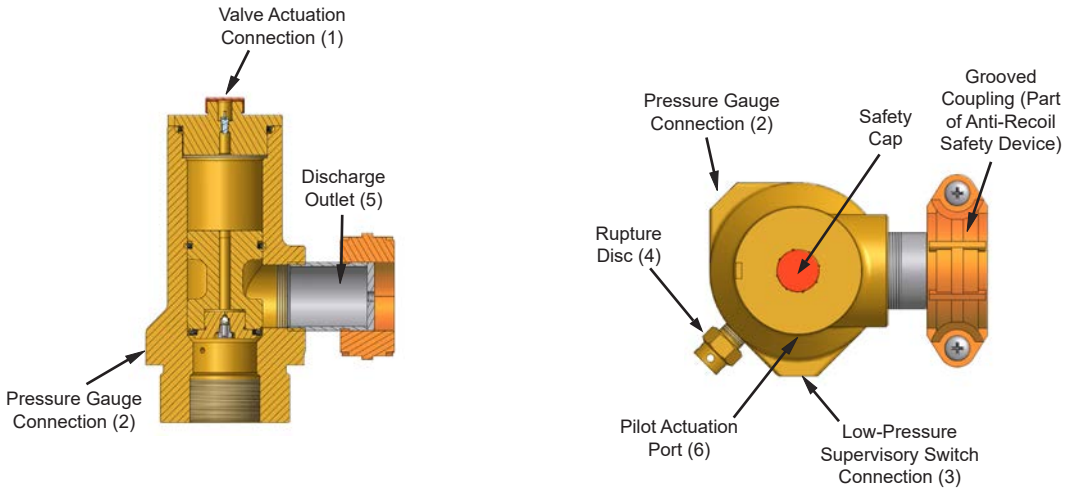


Figure 2.3.2 Mv Cylinder Valve Assembly

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.

⚠ 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.

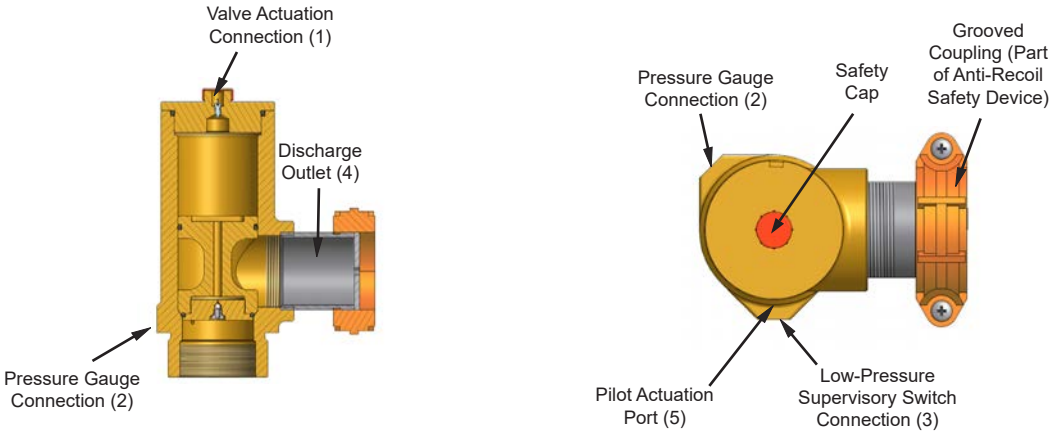


Figure 2.3.3 Lv Cylinder Valve Assembly

Section 2 Cylinder Assembly

3 FILL COMPONENTS

The following components are necessary to fill a Janus Fire Systems® cylinder assembly with FM-200®.

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.

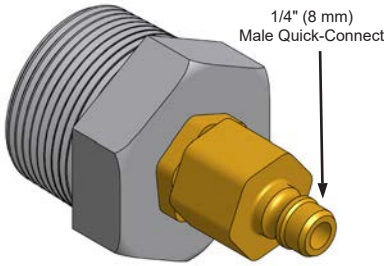


Figure 3.1.1 Sv Series Fill Adapter

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.

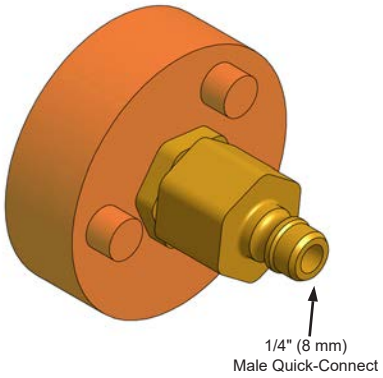


Figure 3.1.2 Mv Series Fill Adapter

3.1.3 Lv Series Fill Adapter

P/N 99513 (See Figure 3.1.3)

The Lv 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 Lv 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.

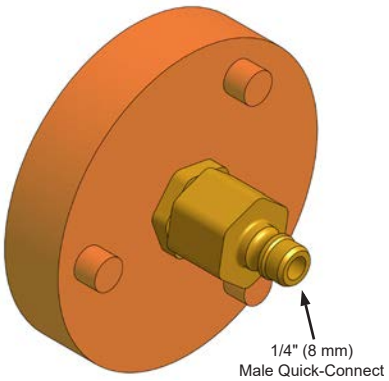


Figure 3.1.3 Lv Series Fill Adapter

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.

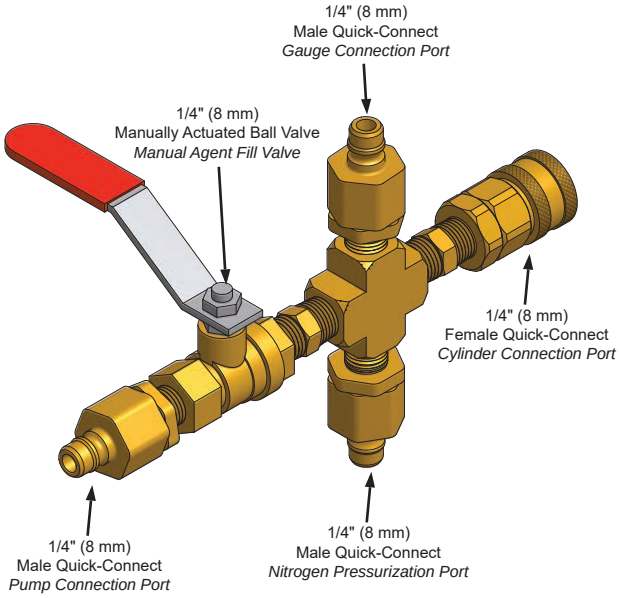


Figure 3.2 Cylinder Fill Assembly

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.

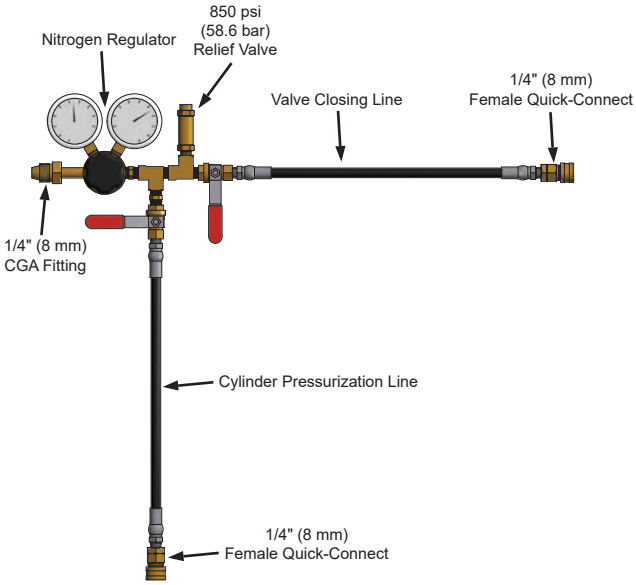


Figure 3.3 Nitrogen Regulator/Hose Assembly

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 connect 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.

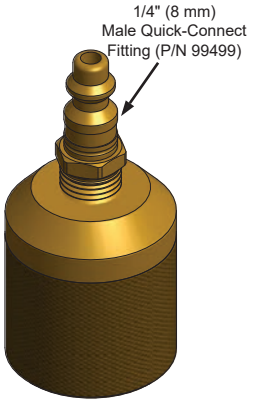


Figure 3.4 Valve Closing Adapter

3.5 Agent Supply Tank

FM-200® agent is supplied in tanks of 160 lb (73 kg), 1200 lb (544 kg), and 34,000 lb (15,422 kg) capacities. Each supply tank has a valve marked as the vapor fill line and a valve marked as the liquid fill line. The liquid fill line shall be utilized in filling a cylinder assembly.

3.6 Agent Fill Station

P/N 99502 (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.

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.

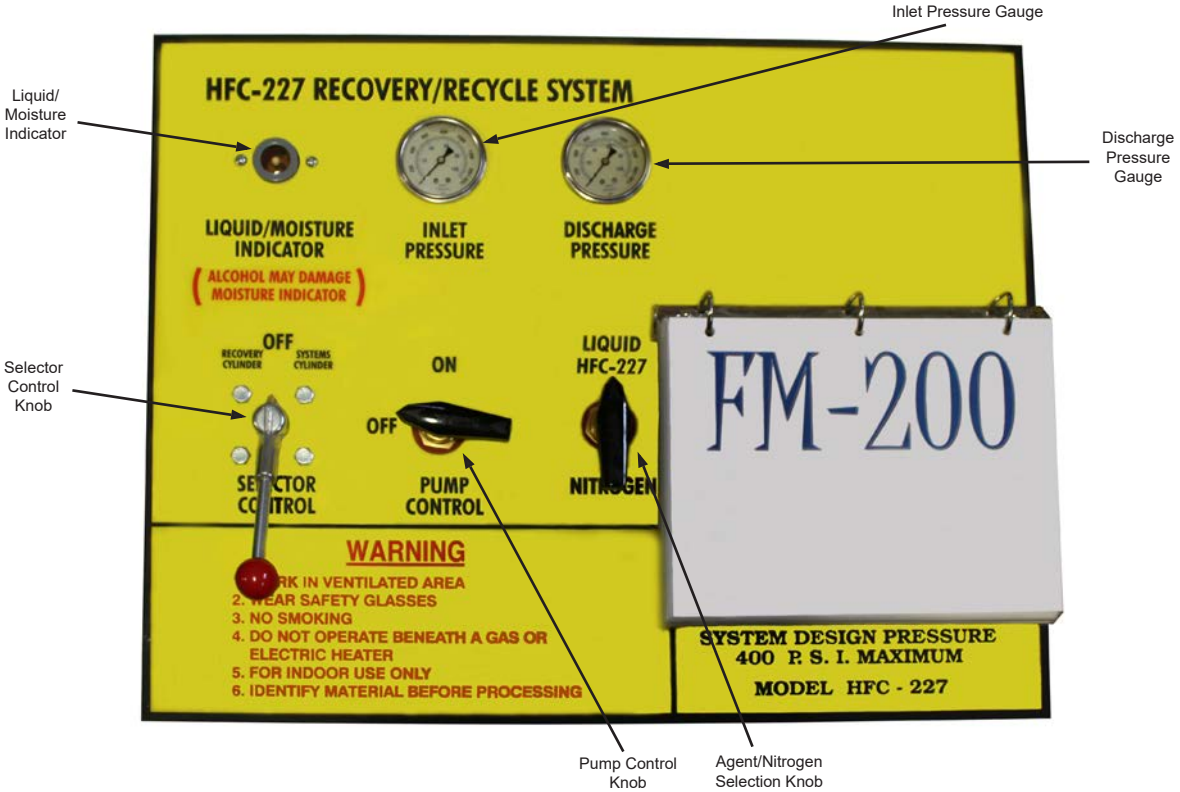


Figure 3.6 Agent Fill Station

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 HFC-227" throughout the course of the fill procedure.

Section 3 Fill Components

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.

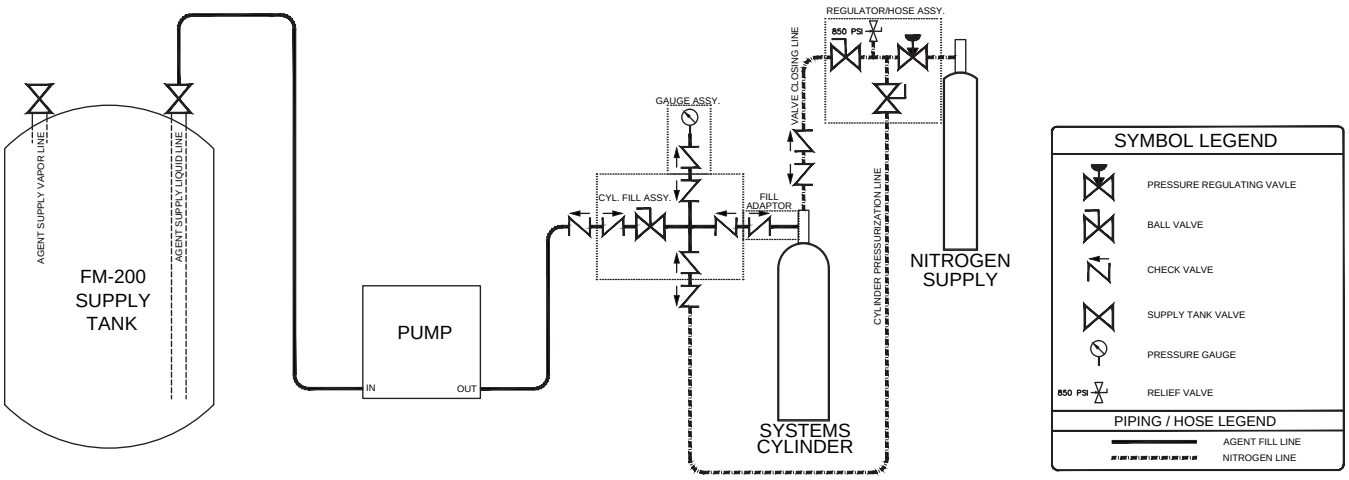


Figure 4 Cylinder Fill P&ID Diagram

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 FM-200®, 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. An accurate thermometer must be provided in fill area with no greater than 2˚F (1˚C) increments.

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 HFC-227".
- 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.

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 100 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.

- 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.

⚠ WARNING

Attaching the electric valve actuator to the cylinder valve when the actuation pin is not fully locked into the "up" position may cause the cylinder valve to actuate, resulting in potential injury and/or property damage.

- Reset the electric valve actuator by pushing the pin up until it latches. If the pin is not reset, the valve core stem could be depressed when the electric valve actuator is threaded onto the valve top causing the cylinder valve to actuate.
- The electric valve actuator is to be installed **hand tight** to the valve actuation connection located at the top of the cylinder valve until contact is made between the actuator and valve top. A small gap will be present between the bottom of the actuator and the valve body.

⚠ WARNING

Attaching the manual valve actuator to the electric valve actuator when the actuation pin is not fully locked into the "up" position may cause the cylinder valve to actuate, resulting in potential injury and/or property damage.

- Reset the manual valve actuator by pulling up on the palm button and inserting the ring pin. The actuation pin should be in the full up position before installing on the electric valve actuator. If the pin is not reset the valve could open when the manual valve actuator is threaded onto the electric valve actuator.
- The manual valve actuator is to be installed **hand tight** to the top of the electric valve actuator until contact is made between the manual valve actuator and the top of the electric valve actuator. A small gap may be present between the bottom of the manual valve actuator and the top of the electric valve actuator.
- Remove the manual valve actuator ring pin and depress the emergency release button. This will open the cylinder valve.
- 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.
- Remove the electric valve actuator and manual valve actuator. Follows the steps described in Sections 4.2.1 and 4.2.2 to close the cylinder valve and weigh the cylinder assembly.

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.

Section 4 Fill Procedure

- Connect the cylinder fill hose of the fill station to the pump connection port of the cylinder fill assembly.
- Open the 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 leakage. Refer to Section 4.3.2.
- 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.

NOTE: The final weights and fill information should be recorded on the cylinder label using a permanent-type fine point marker and protected with a clear overlay label (P/N 17021).

⚠WARNING

No metal stamps of any type should be used to mark cylinder labels.

4.3.2 Leak Checking

Required Tools:

- Accu-Flow R227 Calibrated Leak Standard - Leak Rate: 0.48 oz/yr Maximum
- Bacharach H-10 PRO, H25-IR PRO, or Equivalent

All cylinder assemblies must be tested for leakage and shall have a leak rate of no greater than 0.139 percent of the total amount of the agent fill in a cylinder, per year. Janus Fire Systems specifies the use of Bacharach Industrial Refrigerant Leak Detector Model H-10 PRO, H25-IR PRO, or equivalent in conjunction with R227 calibrated leak standard with a leak rate of 0.48 oz/yr maximum to verify that the refrigerant leak detector can find or detect cylinder leaks not exceeding the 0.48 oz/yr leak rate established by third party testing agencies.

NOTE: Submerging H-10 PRO probe in liquid will damage the pump. Exposing the probe to pure agent will severely reduce the life or destroy the sensor. Exposure to high concentrations of agent may require adjustment of sensor heat as indicated in H-10 PRO manual

Consult the H-10 PRO Configuration, Operation, and Troubleshooting Manual shipped with the H-10 PRO for instructions on using the leak detector and follow the additional steps below.

1. The units shall be pressurized with Clean Agent and nitrogen as previously indicated.
2. Allow units to stand not less than 10 minutes.
3. Be familiar with and refer to the instruction manual for the H-10 PRO during the leak testing process.

4. Turn the H-10 PRO switch to the ON position (the leak detector should warm-up for a minimum 2 minutes, after which the flashing probe light and sound indicator will idle at approximately one click per second). Set the leak size switch to MEDIUM and the manual/automatic switch to AUTOMATIC.

5. Pass the leak detector over the certified leak standard to confirm response to certified leak standard.

   NOTE: Exposing the sensor to large amounts of refrigerant or holding the probe over a leak for a long period of time will significantly shorten sensor life.

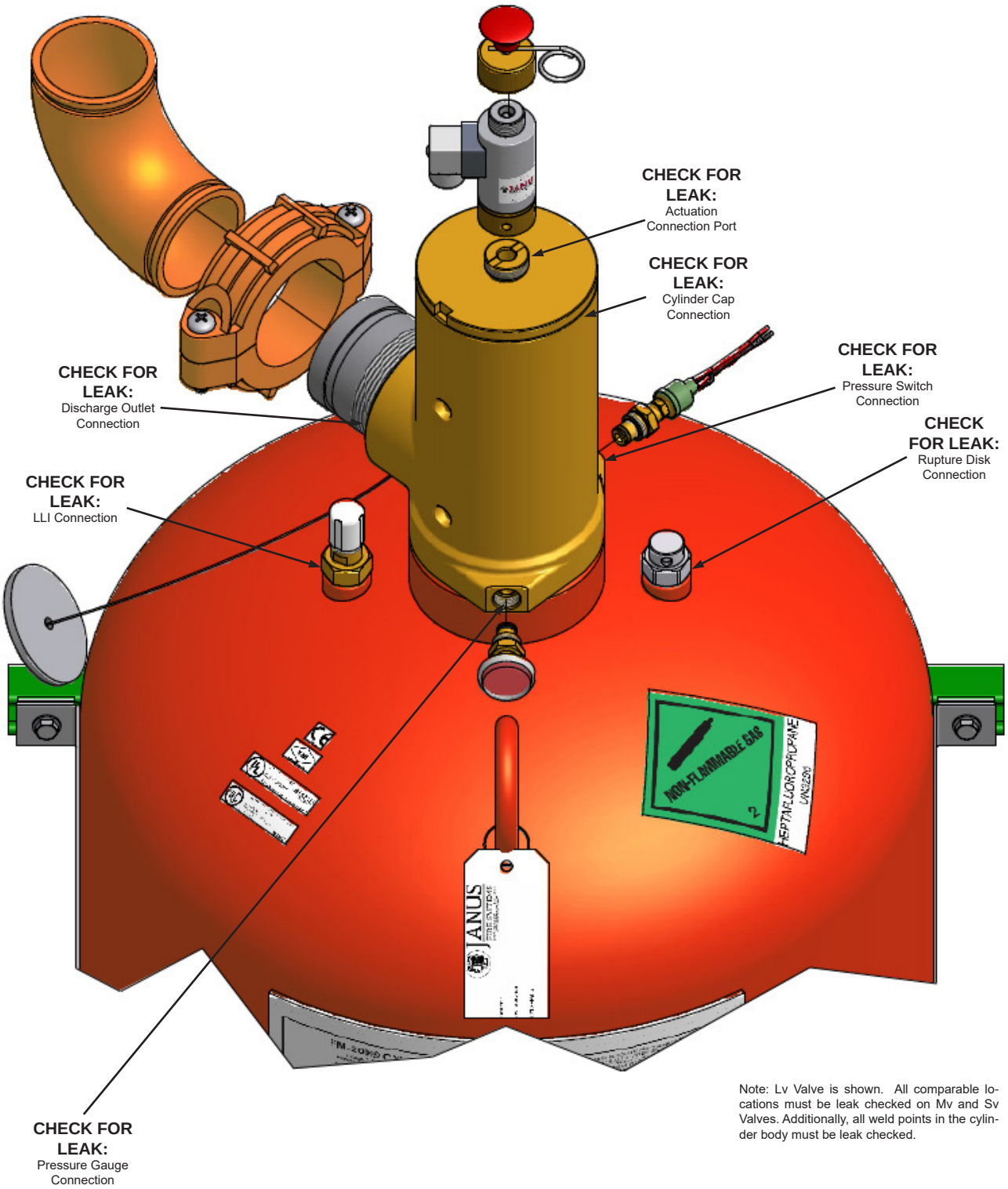
6. Probe the cylinder/valve assembly at all joints and openings. The points to be checked for leaks are any connection point on the cylinder valve (refer to Figure 4.3.2) and every weld in the cylinder body. Leakage is determined by the H-10 PRO. Consult the H-10 PRO Configuration, Operation, and Troubleshooting Manual for more information.

   NOTE: If surfaces are dirty or wet, wipe them off with a clean, dry cloth to reduce filter clogging and extend sensor life. DO NOT allow the unit to draw in moisture.

7. System units in which leakage was detected may be set aside for an additional 24 hours, and then recheck them with the H-10 PRO in the above manner. Those samples which do not show evidence of leakage will then be considered acceptable.

8. The leak standards used must be calibrated and certified yearly to verify performance and accuracy.

   NOTE: The leak detectors specified in this procedure do not require annual calibration or recertification. Validation of the leak detector performance is determined in Step 5 above. A response by the detector to the certified leak standard is required. The leak standard must be certified once a year at a minimum.



Note: Lv Valve is shown. All comparable locations must be leak checked on Mv and Sv Valves. Additionally, all weld points in the cylinder body must be leak checked.

Figure 4.3.2 Connection Points to Check for Leaks

5 SYSTEM RECHARGE AND RESET

Those individuals responsible for maintenance of a Janus Fire Systems® fire extinguishing system utilizing FM-200® agent 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 and nozzles, and possibly 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. All removable trim components shall be removed before transportation.
Do not apply excessive force to the low-pressure supervisory switch or pressure gauge or attempt to carry the cylinder assembly or valve assembly by the low-pressure switch or pressure gauge. The low-pressure supervisory switch and pressure gauge are not designed or intended to be used to carry the cylinder or valve. If the low-pressure supervisory switch or pressure gauge breaks at the fitting, agent will discharge through the port causing possible personal injury or property damage, and 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 removing the discharge pipe 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 from the cylinder valve.

⚠ 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.

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):

⚠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 top cap.
- Pull the piston assembly up and out of the top of the valve body using the piston removal tool (P/N 97642) 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 (i.e., appropriate Piston Key as shown in Table. 5.2.2). 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.
- Reinstall the low-pressure supervisory switch and pressure gauge assemblies on Mv and Lv Series valve assemblies.

Table 5.2.2 Clean Agent Valve Replacement Components			
Part Description	**Sv P/N**	**Mv P/N**	**Lv P/N**
Collar O-ring	**17551**	**18400**	**18400**
Upper Piston O-ring	**17552**	**18475**	**18398**
Lower Piston O-ring	**17553**	**18476**	**18399**
Valve Cap O-ring	**17551**	**18399**	**18397**
Valve Core	**16999**	**16999**	**16999**
Piston Removal Tool	**97642**	**97642**	**97642**
Piston Key	**97609**	**97608**	**97607**
Piston Assembly	**17335**	**18471**	**18393**
Valve Rebuild Kit[1]	**17030**	**19019**	**19020**

[1] Valve Rebuild Kit includes the appropriate collar O-ring, valve cap O-ring, piston assembly (with upper and lower piston o-ring), and valve core for the cylinder valve indicated by the kit part number.

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, DOC102, to reinstall the system.
- Inform appropriate personnel that the system is back in service.

Appendix A

Material Safety Datasheet

Appendix A

The MSDS format adheres to the standards and regulatory requirements of the United States and may not meet regulatory requirements in other countries.

Janus Fire Systems Page 1
Material Safety Data Sheet

FM-200
MSDS101 Revised 29-JUN-2009

CHEMICAL PRODUCT/COMPANY IDENTIFICATION

Material Identification

FM-200 is a registered trademark of DuPont.

CAS Number	: 431-89-0
Formula	: CF3 CHF CF3
Molecular Weight	: 170.03
CAS Name	: Propane, 1,1,1,2,3,3,3-Heptafluoro-

Tradenames and Synonyms

FM200
FE-227
2-Hydroperfluoropropane
Propane, 1,1,1,2,3,3,3-Heptafluoro-
HFC-227eaHP
2-Hydroheptafluoropropane
Heptafluoropropane
2-H-heptafluoropropane
1,1,1,2,3,3,3-Heptafluoropropane
R-227
R227
HFC-227ea

Company Identification

MANUFACTURER/DISTRIBUTOR
DuPont Fluoroproducts
1007 Market Street
Wilmington, DE 19898

PHONE NUMBERS

Product Information	: 1-800-441-7515 (outside the U.S. 302-774-1000)
Transport Emergency	: CHEMTREC 1-800-424-9300(outside U.S. 703-527-3887)
Medical Emergency	: 1-800-441-3637 (outside the U.S. 302-774-1000)

COMPOSITION/INFORMATION ON INGREDIENTS

Components

Material	CAS Number	%
1,1,1,2,3,3,3-Heptafluoropropane	431-89-0	99.95

HAZARDS IDENTIFICATION

Potential Health Effects

Based on animal data, overexposure to FM-200 by inhalation may cause suffocation, if air is displaced by vapors, and irregular heart beat with a strange sensation in the chest, "heart thumping," apprehension, lightheadedness, feeling of fainting, dizziness, weakness, sometimes progressing to loss of consciousness and death.

FM-200 may cause frostbite if liquid or escaping vapor contacts the skin.

FM-200 may cause "frostbite-like" effects if the liquid or escaping vapors contact the eyes.

In one study, human volunteers were selected to inhale FM-200 at a concentration of 6000 ppm but the study was terminated due to a rise in pulse rate that was believed to be unrelated to the chemical. In a subsequent study with human volunteers inhaling concentrations up to 8000 ppm no clinically significant effects were observed for any of the measured laboratory parameters.

Individuals with preexisting diseases of the cardiovascular system or nervous system may have increased susceptibility from excessive exposures.

Carcinogenicity Information

None of the components present in this material at concentrations equal to or greater than 0.1% are listed by IARC, NTP, OSHA or ACGIH as a carcinogen.

FIRST AID MEASURES

First Aid

INHALATION

If inhaled, immediately remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

SKIN CONTACT

Treat for frostbite if necessary by gently warming affected area.

EYE CONTACT

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

Appendix A

(FIRST AID MEASURES - Continued)

INGESTION

Ingestion is not considered a potential route of exposure.

FIRE FIGHTING MEASURES

Flammable Properties

1,1,1,2,3,3,3-Heptafluoropropane is not flammable, however in the presence of a flame or ignition source it may decompose to form toxic hydrogen fluoride or carbonyl fluoride.

Non-flammable.

Extinguishing Media

Use media appropriate for surrounding material.

Fire Fighting Instructions

Self-contained breathing apparatus (SCBA) may be required if cylinders rupture or release under fire conditions.

Keep cylinders cool with water spray applied from a safe distance.

ACCIDENTAL RELEASE MEASURES

Safeguards (Personnel)

NOTE: Review FIRE FIGHTING MEASURES and HANDLING (PERSONNEL) sections before proceeding with clean-up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean-up.

Evacuate personnel, thoroughly ventilate area, use self-contained breathing apparatus. Keep upwind of leak - evacuate until gas has dispersed.

Initial Containment

Use forced ventilation to disperse vapors.

MSDS101 Janus Fire Systems Page 4
Material Safety Data Sheet

HANDLING AND STORAGE

Handling (Personnel)

Do not breathe gas. Avoid contact with eyes, skin, or clothing. Wash thoroughly after handling. Wash clothing after use.

Storage

Store in a clean, dry place. Store below 52 C (126 F).

EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls

Use only with adequate ventilation. Keep container tightly closed.

Personal Protective Equipment

EYE/FACE PROTECTION

Wear safety glasses or coverall chemical splash goggles.

RESPIRATORS

Wear NIOSH approved respiratory protection, as appropriate.

PROTECTIVE CLOTHING

Where there is potential for skin contact have available and wear as appropriate impervious gloves, apron, pants, and jacket.

Exposure Guidelines

Exposure Limits
FM-200
AEL * (DuPont) : 1000 ppm, 8 & 12 Hr. TWA

* AEL is DuPont's Acceptable Exposure Limit. Where governmentally imposed occupational exposure limits which are lower than the AEL are in effect, such limits shall take precedence.

PHYSICAL AND CHEMICAL PROPERTIES

Physical Data

Boiling Point	: -16.4 C (2.5 F)
Melting Point	: -131 C (-204 F)
Vapor Pressure	: 65.7 psia @ 25 C (77 F) (453.3 kPa)
Liquid Density	: 1.386 g/cm3 @ 25 C (77 F) (86.53 lb/ft3)
Critical temperature	: 101.6 C (214.9 F)
Critical pressure	: 424.7 psia (2930 kPa)
Odor	: None.

Appendix A

(PHYSICAL AND CHEMICAL PROPERTIES - Continued)

Form : Liquified Gas

STABILITY AND REACTIVITY

Chemical Stability

Stable at normal temperatures and storage conditions.

Avoid sources of heat or open flame.

Incompatibility with Other Materials

Incompatible with strong reducing agents such as alkali metals (e.g., sodium, potassium), alkali-earth metals (e.g., magnesium, calcium), and powdered aluminum or zinc.

Decomposition

Decomposes by reaction with high temperature (open flames, glowing metal surfaces, etc.) forming hydrofluoric acid, carbonyl fluorides, carbon monoxide and carbon dioxide.

Polymerization

Polymerization will not occur.

TOXICOLOGICAL INFORMATION

Animal Data

FM-200:

Inhalation 4 hour LC50: > 788,698 ppm in rats

Repeated exposure of rats by inhalation for 4 weeks at concentrations up to 50,000 ppm revealed no toxicologically significants effects. The NOEL for this study was 50,000 ppm. A 90-day inhalation study in rats did not find any exposure related effects at 105,000 ppm. The NOEL for this study was 105,000 ppm.

Cardiac sensitization, a potentially fatal disturbance of heart rhythm associated with a heightened sensitivity to the action of epinephrine, occurred in dogs at 105,000 ppm. The NOAEL for cardiac sensitization was 90,000 ppm. In a different study to evaluate cardiac sensitization in dogs, concentrations of 90,000, 105,000, and 140,000 ppm caused a dose-related increase in incidence and severity; at 90,000 ppm efffects were minimal or mild in nature.

Inhalation studies in rabbits and rats do not suggest developmental toxicity at concentrations up to

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Material Safety Data Sheet

(TOXICOLOGICAL INFORMATION - Continued)

105,000 ppm. Tests have shown that FM-200 does not cause genetic damage in bacterial or mammalian cell cultures. Tests in animals for carcinogenicity or reproductive toxicity have not been conducted.

DISPOSAL CONSIDERATIONS

Waste Disposal

Treatment, storage, transportation, and disposal must be in accordance with applicable Federal, State/Provincial, and Local regulations. Incinerate material in accordance with Federal, State/Provincial and Local requirements.

TRANSPORTATION INFORMATION

Shipping Information

DOT		DOT	
Proper Shipping Name	: Heptafluoropropane	Proper Shipping Name	: Fire Extinguishers
Hazard Class	: 2.2	Hazard Class	: 2.2
I.D. No. (UN/NA)	: UN 3296	I.D. No. (UN/NA)	: UN 1044
DOT Label(s)	: Nonflammable Gas	DOT Label(s)	: Nonflammable Gas

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REGULATORY INFORMATION

U.S. Federal Regulations

TSCA Inventory Status : Listed.

TITLE III HAZARD CLASSIFICATIONS SECTIONS 311, 312

Acute : Yes
Chronic : No
Fire : No
Reactivity : No
Pressure : No

OTHER INFORMATION

NFPA, NPCA-HMIS

NFPA Rating
Health : 1
Flammability : 0
Reactivity : 1

NPCA-HMIS Rating
Health : 1
Flammability : 0

Appendix A

(Continued)

Reactivity : 0

Personal Protection rating to be supplied by user depending on use conditions.

The data in this Material Safety Data Sheet relates only to the specific material designated herein and does not relate to use in combination with any other material or in any process.

Responsibility for MSDS : MSDS Coordinator
> : Janus Fire Systems
Address : Crown Point, IN 46307
Telephone : (219) 663-1600

This information is based upon technical information believed to be reliable. It is subject to revision as additional knowledge and experience is gained.

End of MSDS

Appendix B

Assorted Charts

Appendix B

Table B.1 - Approximate Container Pressure vs. Temperature					
Temperature		Pressure		90% Pressure	
°F	°C	psig	bar	psig	bar
32	0.0	288 (284)	19.86 (19.56)	259 (256)	17.87 (17.62)
40	4.4	303	20.89	273	18.80
50	10	321	22.13	289	19.92
60	15.6	340	23.44	306	21.10
70	21.1	360	24.82	324	22.34
80	26.7	381	26.27	343	23.64
90	32.2	402	27.72	362	24.95
100	37.8	425	29.30	383	26.37
110	43.3	449	30.96	404	27.86
120	48.9	475	32.75	428	29.48

Appendix B

Table B.2a U.S. Standard to Metric Conversion Factors (Approximate)			
Measure	**U.S. Standard**	**Multiply By**	**Metric**
Length	inches (in)	25.4	millimeters (mm)
	feet (ft)	304.8	millimeters (mm)
	feet (ft)	0.3048	meters (m)
Area	square inches (in^2)	645.16	square millimeters (mm^2)
	square feet (ft^2)	0.0929	square meters (m^2)
Weight (mass)	ounces (oz)	28.349	grams (g)
	pounds (lb)	0.4536	kilograms (kg)
Volume	cubic inches (in^3)	16387.06	cubic millimeters (mm^3)
	fluid ounces (fl oz)	29.57	milliliters (mL)
	cubic feet (ft^3)	0.0283	cubic meters (m^3)
Pressure	inches of mercury (inHG)	3.453	kilopascals (kPa)
	pounds per square inch (psi)	6.895	kilopascals (kPa)
	pounds per square inch (psi)	0.0689	bar (bar)
Temperature	degrees Fahrenheit (°F)	5/9 (after subtracting 32)	degrees Celsius (°C)

Table B.2b Metric to U.S. Standard Conversion Factors (Approximate)			
Measure	**Metric**	**Multiply By**	**U.S. Standard**
Length	millimeters (mm)	0.0394	inches (in)
	millimeters (mm)	0.00328	feet (ft)
	meters (m)	3.2808	feet (ft)
Area	square millimeters (mm^2)	0.00155	square inches (in^2)
	square meters (m^2)	10.764	square feet (ft^2)
Weight (mass)	grams (g)	0.03527	ounces (oz)
	kilograms (kg)	2.205	pounds (lb)
Volume	cubic millimeters (mm^3)	0.00006102	cubic inches (in^3)
	milliliters (mL)	0.0338	fluid ounces (fl oz)
	cubic meters (m^3)	35.336	cubic feet (ft^3)
Pressure	kilopascals (kPa)	0.2896	inches of mercury (inHG)
	kilopascals (kPa)	0.1450	pounds per square inch (psi)
	bar (bar)	14.5138	pounds per square inch (psi)
Temperature	degrees Celsius (°C)	9/5 (after adding 32)	degrees Fahrenheit (°F)

Appendix B

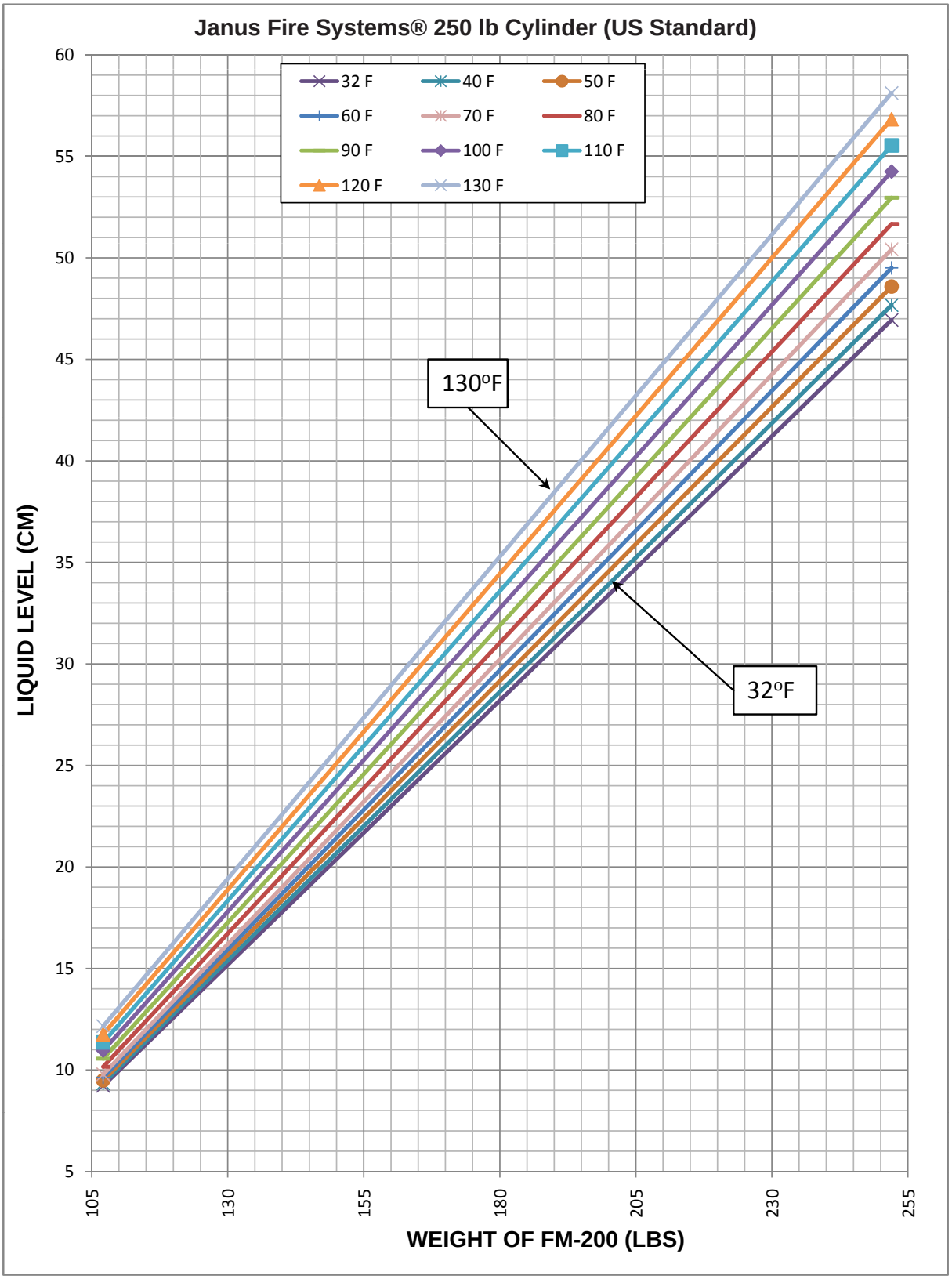

Table B.3a Liquid Level Chart – 250 lb Cylinder (U.S. Standard)

Appendix B

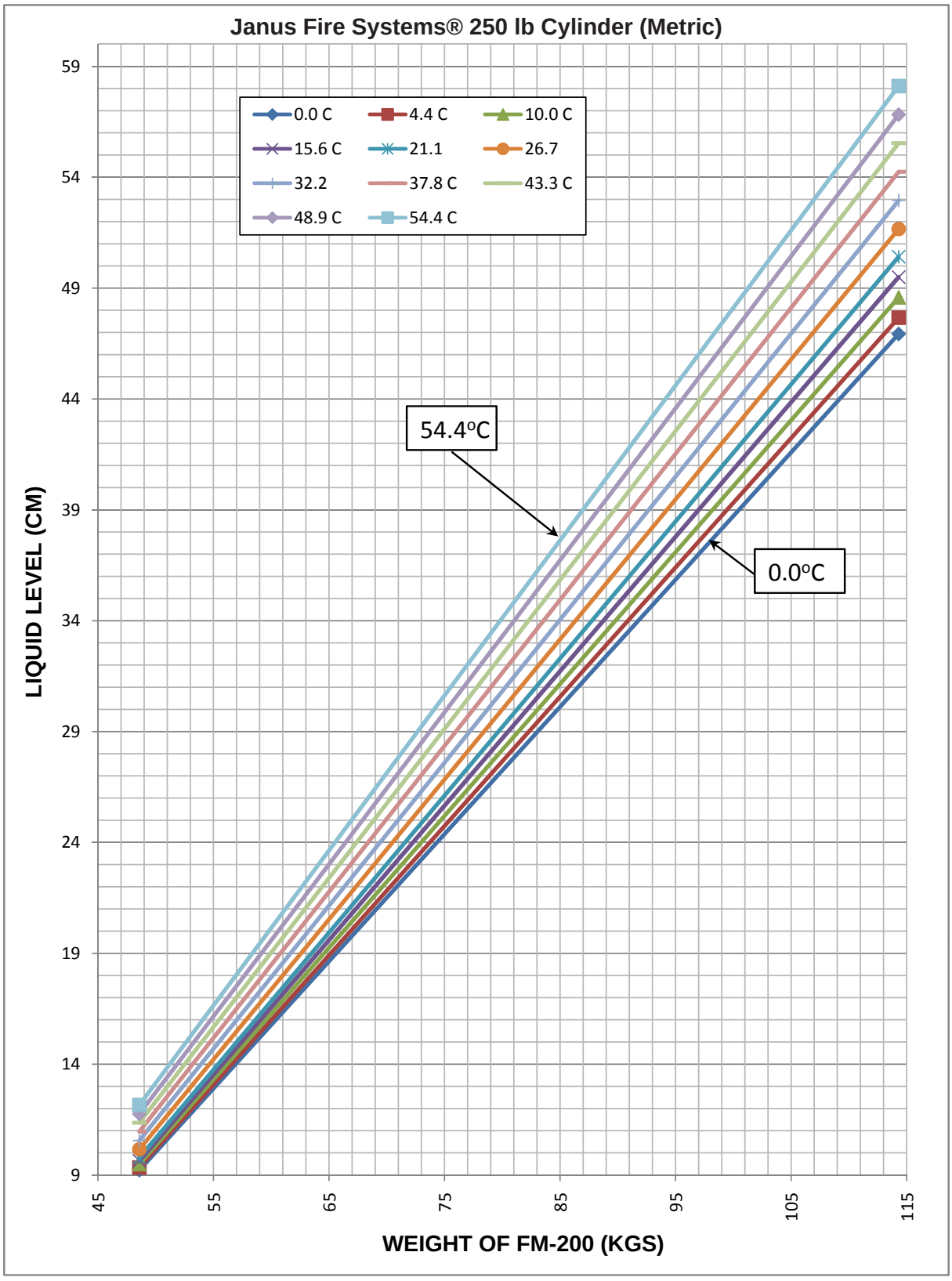

Table B.3b Liquid Level Chart – 250 lb Cylinder (Metric)

Appendix B

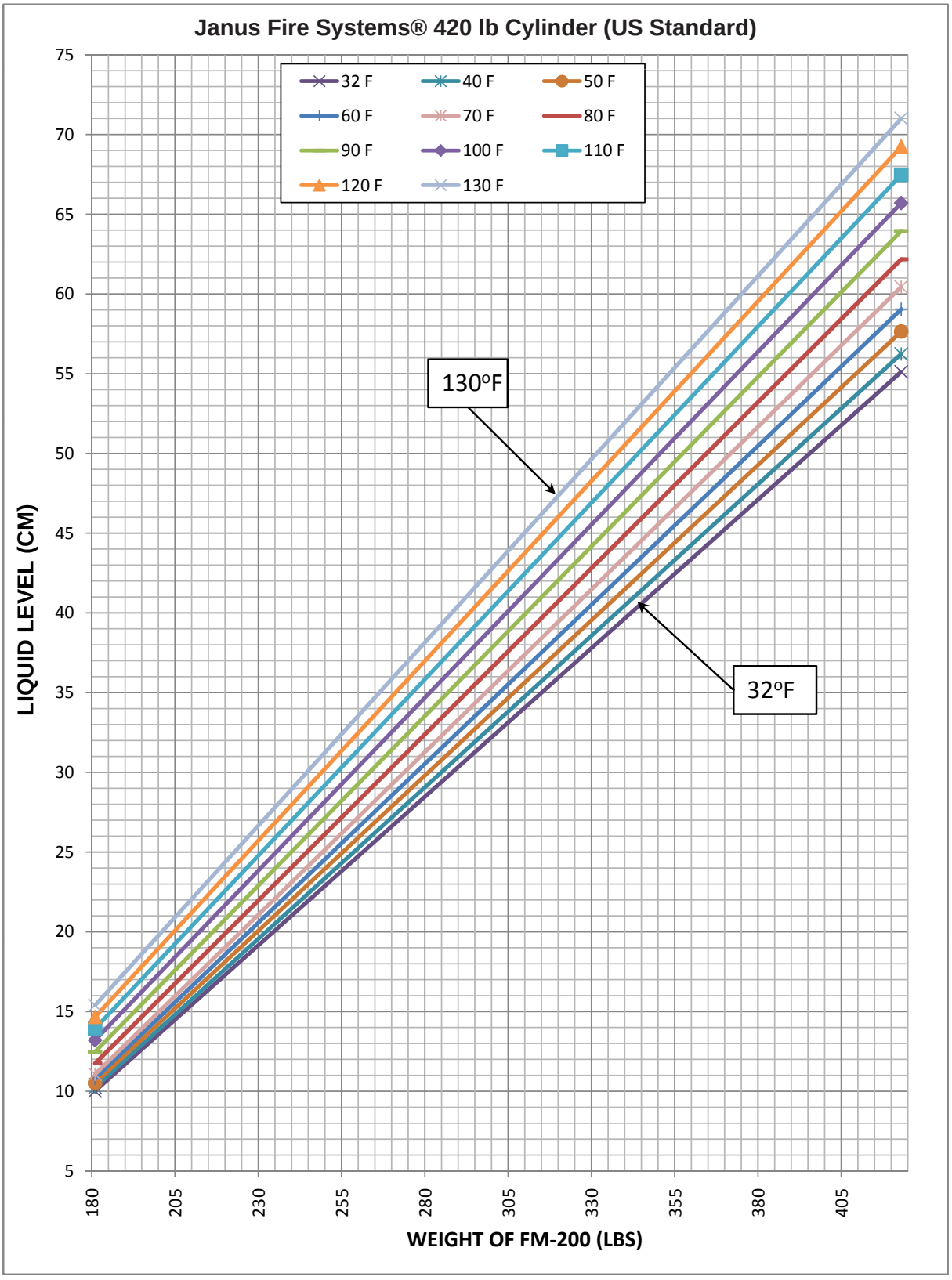

Table B.4a Liquid Level Chart – 420 lb Cylinder (U.S. Standard)

Appendix B

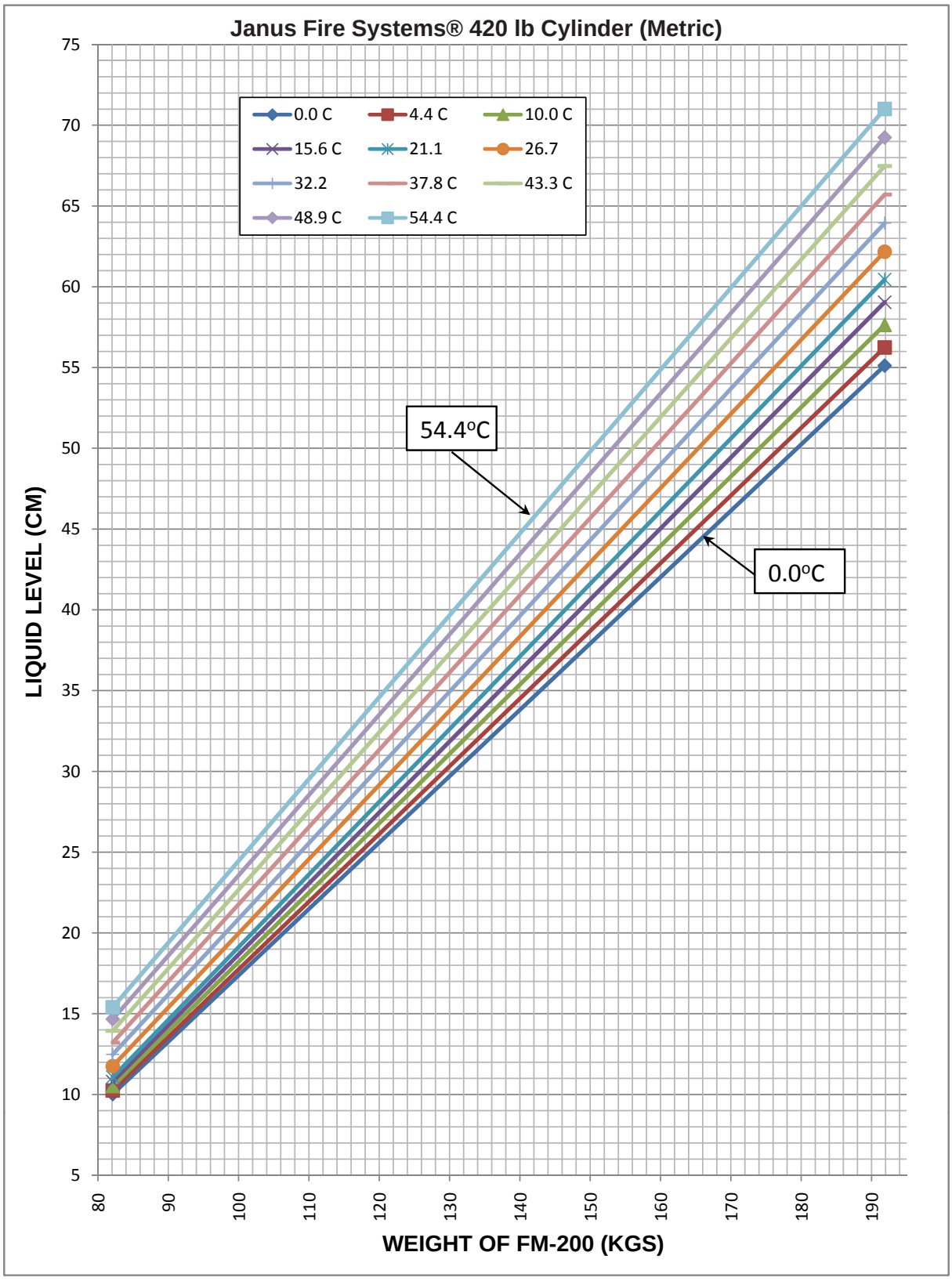

Table B.4b Liquid Level Chart – 420 lb Cylinder (Metric)

Appendix B

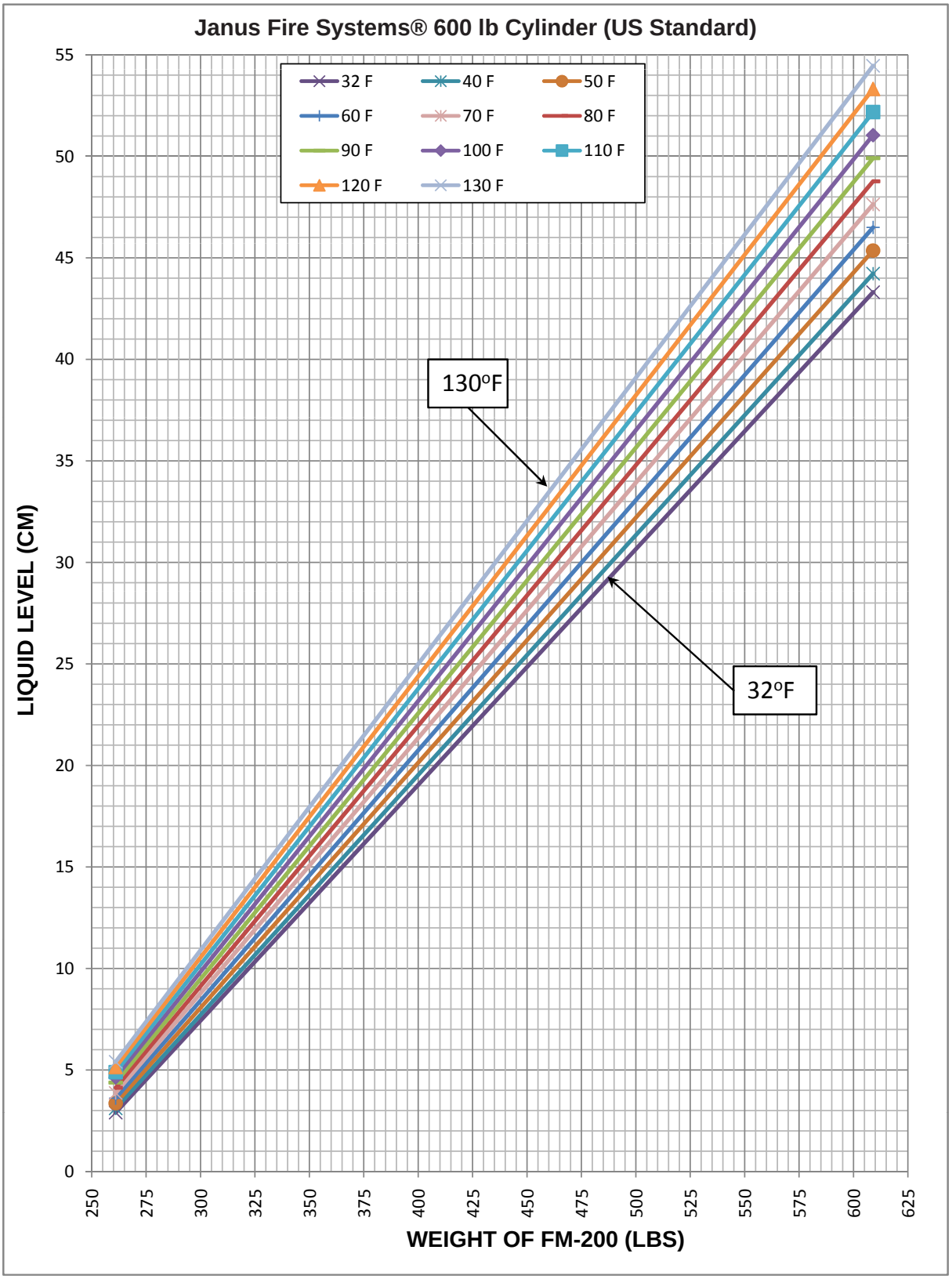

Table B.5a Liquid Level Chart – 600 lb Cylinder (U.S. Standard)

Appendix B

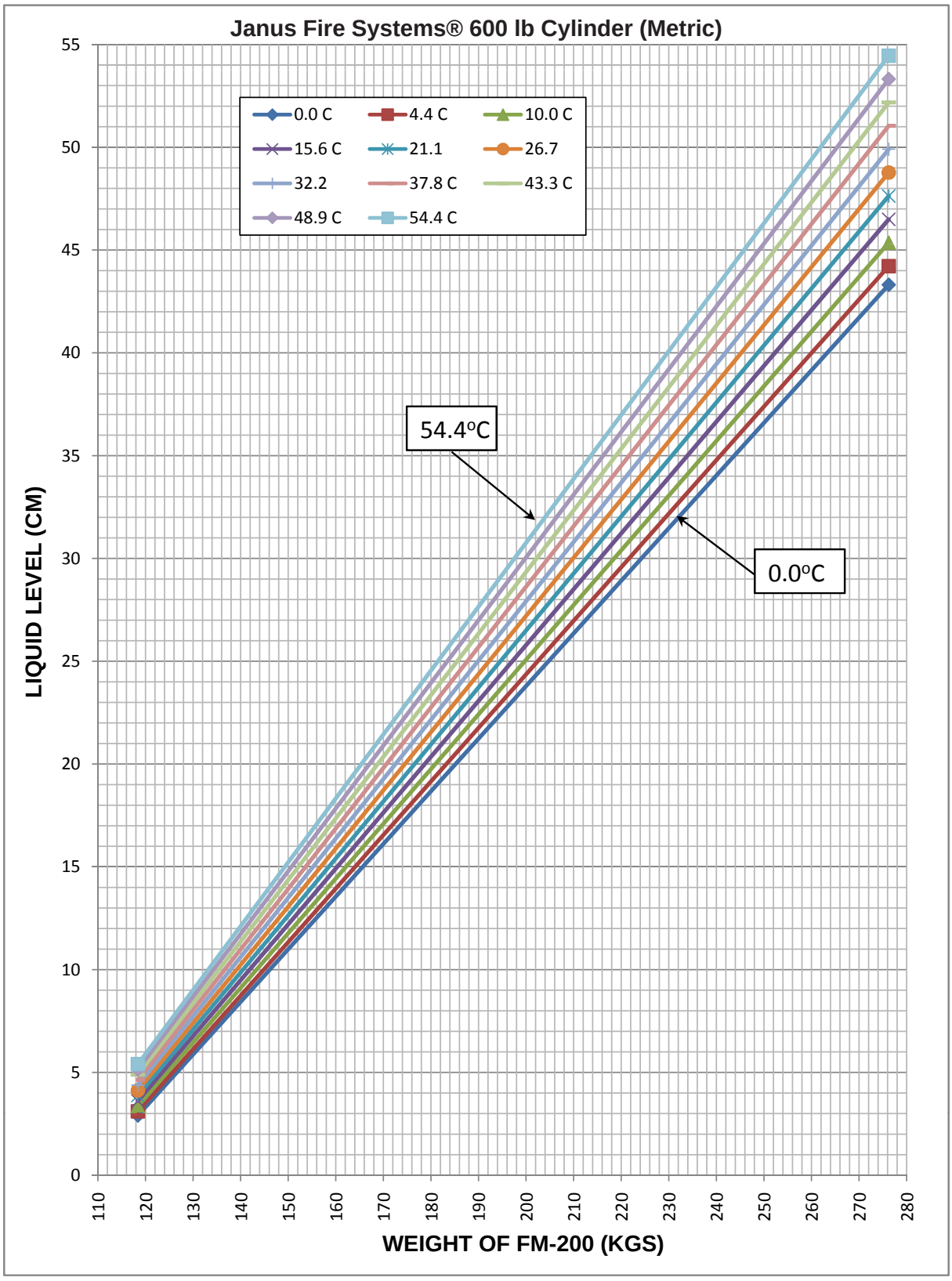

Table B.5b Liquid Level Chart – 600 lb Cylinder (Metric)

Appendix B

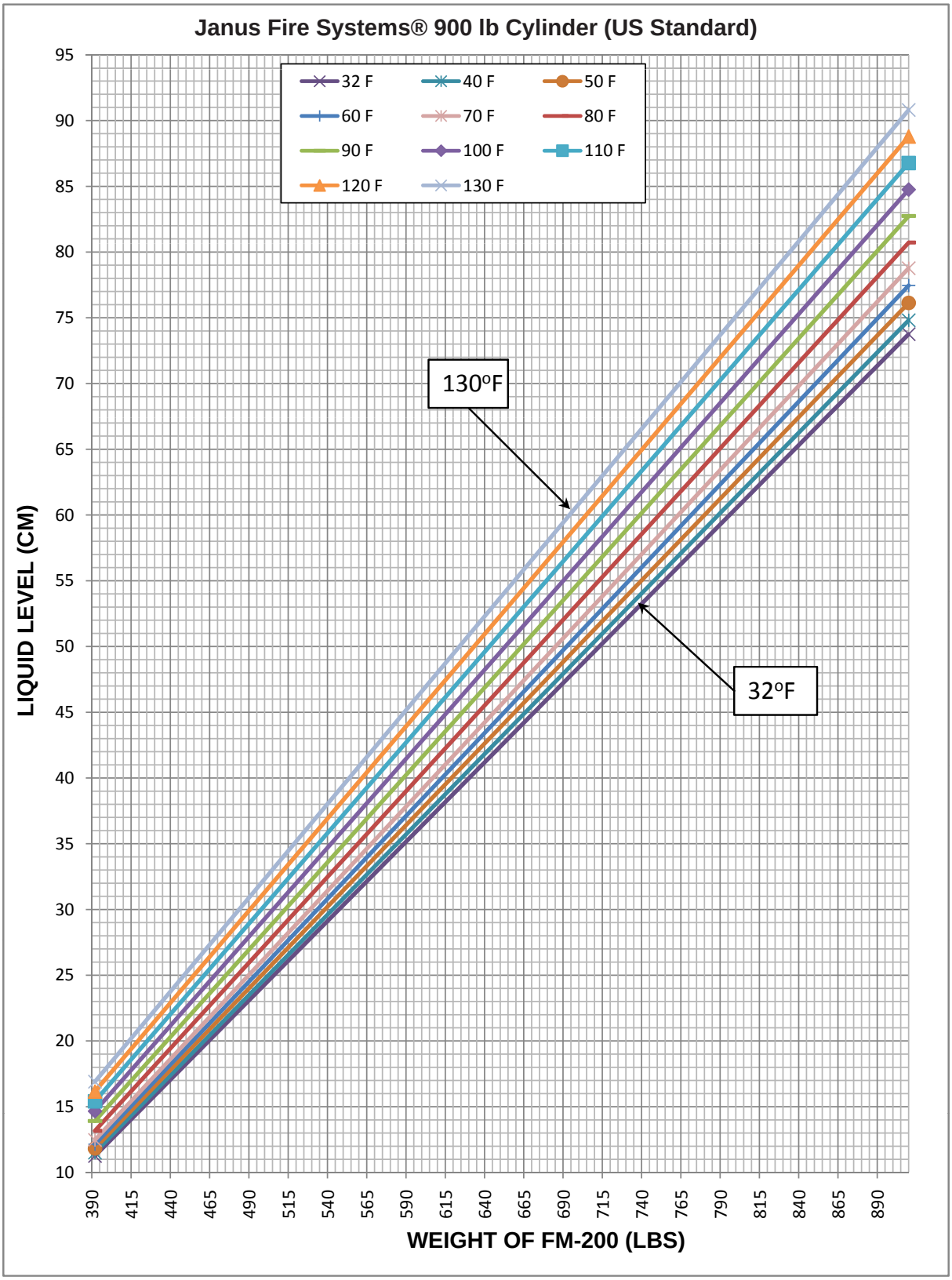

Table B.6a Liquid Level Chart – 900 lb Cylinder (U.S. Standard)

Appendix B

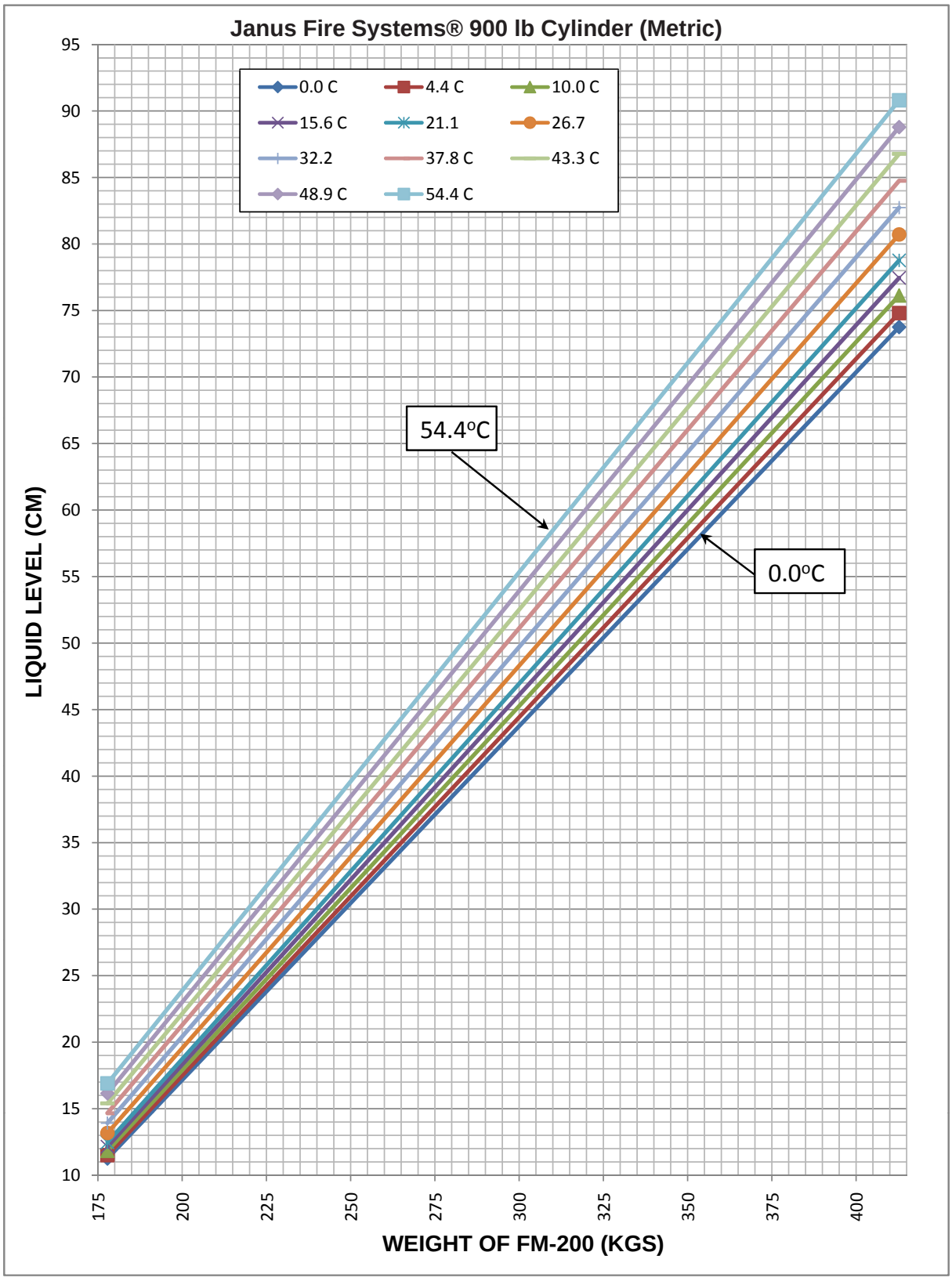

Table B.6b Liquid Level Chart – 900 lb Cylinder (Metric)

Appendix B

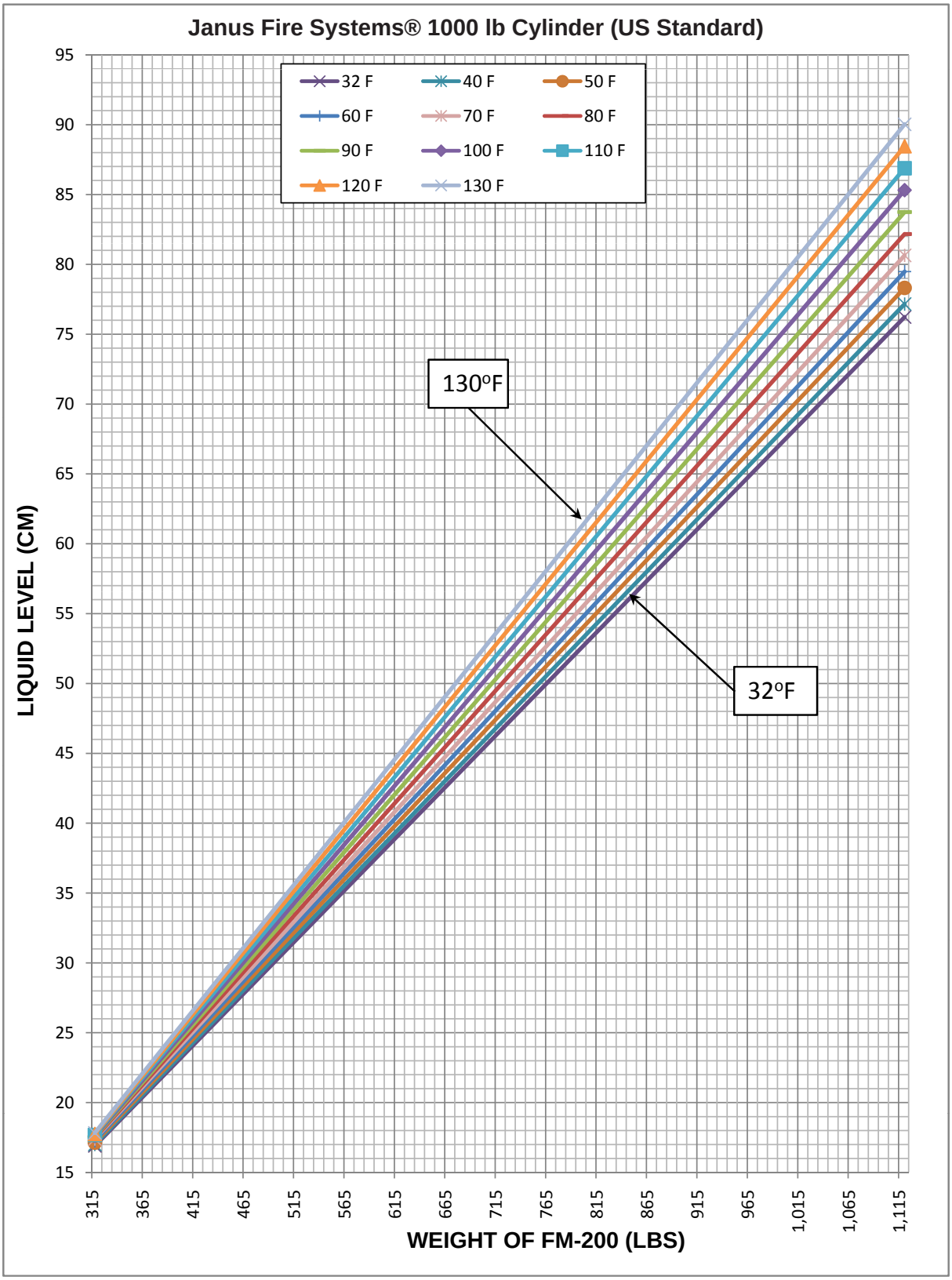

Table B.7a Liquid Level Chart – 1000 lb Cylinder (U.S. Standard)

Appendix B

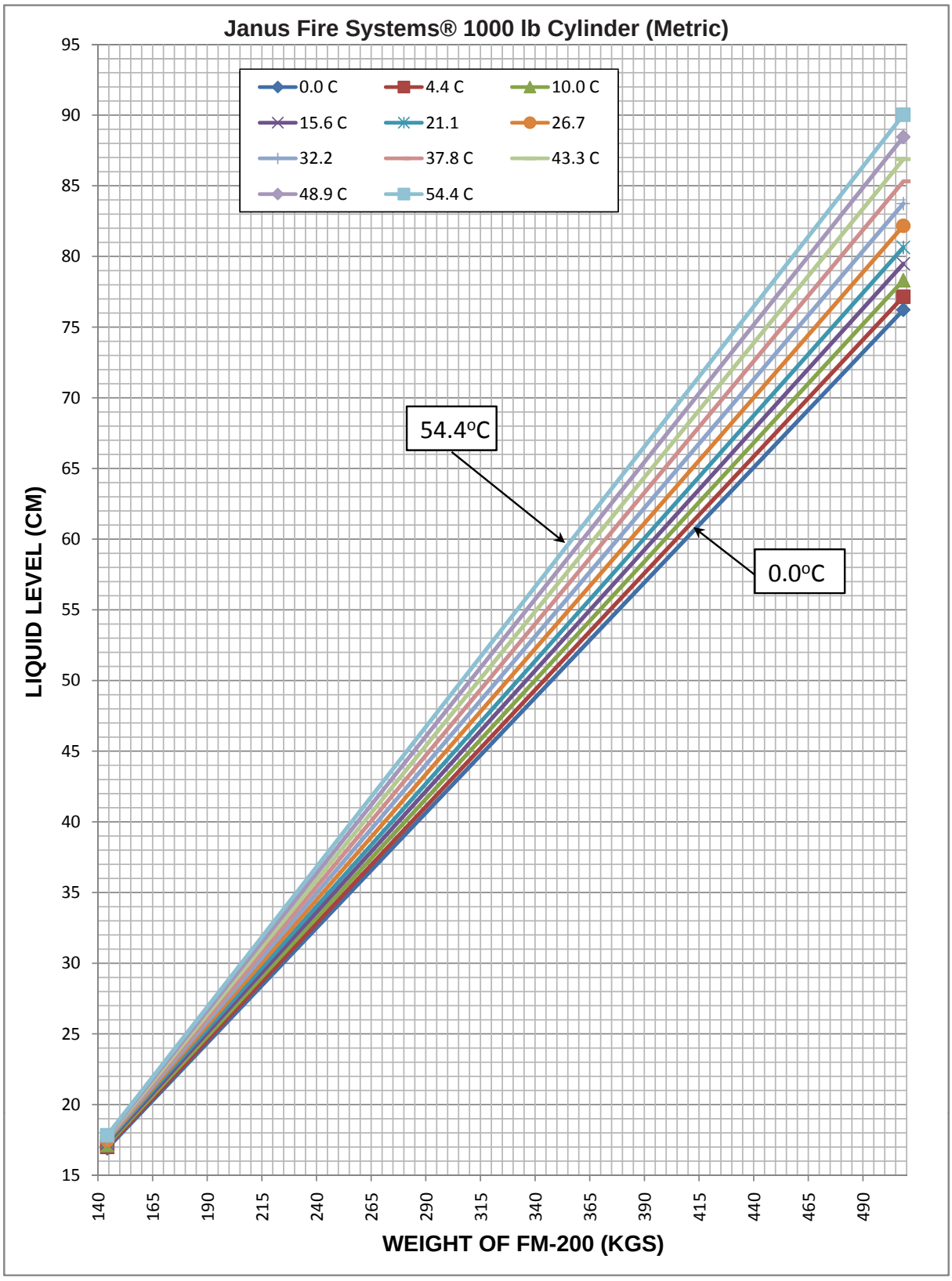

Table B.7b Liquid Level Chart – 1000 lb Cylinder (Metric)

Appendix C

Liquid Level Indicator Replacement

Appendix C

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)

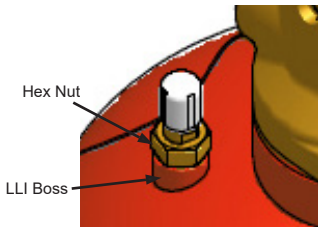

Figure C.1 LLI Exterior

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.

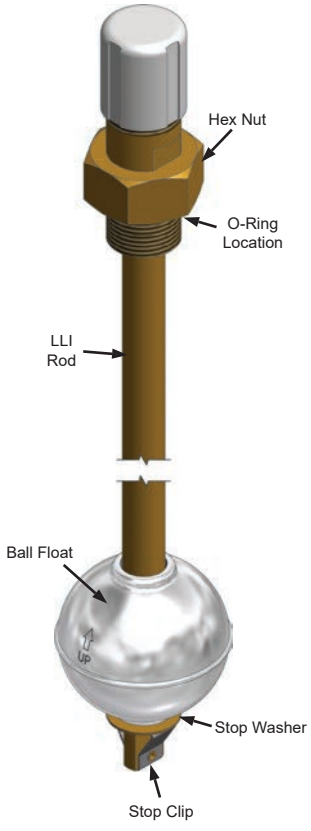

Figure C.2 LLI Interior

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.

Figure C.3 Ball Float

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 (DOC102) to ensure the LLI is operating correctly.

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