



# DESIGN, INSTALLATION AND MAINTENANCE MANUAL

**ROTAREX NORTH AMERICA, INC.**  
FireDETEC / Indirect Low Pressure (ILP)  
Pre Engineered Fire Suppression Systems  
Featuring Linear Pneumatic Tubing



## FM-200® AGENT PRE-ENGINEERED FIRE SUPPRESSION SYSTEMS

### For Models

- B07014500: 3lb. System
- B07014501: 7lb. System
- B07014502: 14lb. System





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## FOREWORD

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Rotarex Design, Installation, & Maintenance Manual for FireDETEC FM-200® pre-engineered FireDETEC suppression systems incorporates the latest design requirements found in NFPA Standard 2001, as well as the most up-to-date information available for our products. This manual is a comprehensive guide of information compiled as a result of research, development and testing. It has been provided for those individuals that are responsible for the design, installation, and/or maintenance of Rotarex FM-200® hardware and systems. It is the responsibility of the designer and installer to remain within the parameters established in this design, installation and maintenance manual.

Sales and marketing personnel as well as architects, engineers, etc. will also find the information contained in this manual useful. Rotarex FireDETEC fire suppression systems are offered only in the Pre-Engineered format.

Pre-Engineered Systems are simple systems that operate within a predetermined set of design parameters with limitations that are pre established by testing. Rotarex fire suppression systems are tested and approved by underwriters Laboratories (UL) and Factory Mutual (FM). These systems do not require the designer to perform any hydraulic flow calculations and they are intended to provide a means of designing FM-200® fire suppression systems.

Rotarex pre-engineered FM-200® fire suppression systems must be installed and maintained in accordance with the limitations established in NFPA Standard 2001, Clean Agent Extinguishing Systems, as well as the limitations set forth by UL and FM. The information contained within this manual defines the established limitations in detail.

### IMPORTANT

Rotarex believes that the information incorporated into this manual is accurate as of the date this manual was prepared. It has been compiled to allow those responsible for designing and installing Rotarex FM-200® systems to properly do so, and for the parties responsible for verifying the system design to determine if the design parameters have been met. The data contained within this manual is provided for informational purposes only. Rotarex disclaims all liability for any other use that may be made of the data contained within this manual by any, and all, parties. Rotarex believes this data to be accurate; however, all dimensions are approximate and this document is presented without any guarantee or warranty whatsoever. Any questions concerning the information presented in this manual should be addressed to:

Rotarex North America,  
Inc. 221 Westec Drive  
Mount Pleasant, PA 15666



Rotarex fire suppression systems are to be designed, installed, inspected, maintained, tested, and recharged by qualified, trained fire protection personnel in accordance with the following:

- Standard of the National Fire Protection Association No 2001, titled "Clean Agent Extinguishing Systems"
- Instructions and Limitations in this manual, Rotarex Part Number 027650004
- Storage, handling, transportation, service, maintenance, recharge, and test of agent storage containers shall be performed only by qualified trained personnel in accordance with the information in this manual. Rotarex Part Number 027650004, chemical manufacturers instructions for Safe Handling & Transferring FM-200®.
- Compressed Gas Association\* (CGA) pamphlets:
  - C-1, "Methods for Hydrostatic testing of Compressed Gas Cylinders"
  - C-6, "Standards for Visual Inspection of Compressed gas cylinders"
  - P-1, "Safe Handling of Compressed Gases in Containers"
- All information contained on the system container (s) nameplate \* CGA pamphlets are published by and available for purchase from the Compressed Gas Association 4221 Walney Road, Fifth Floor, Chantilly, VA 20151-2923. Tel. (703)788-2700

## SAFETY

The following symbols are used in this manual. Wherever they appear it indicates a need to exercise caution and pay attention to the details. The symbols are relevant to the safe use of the equipment described in this manual.

1. Always treat a cylinder as though it were fully charged.
2. When working with fire suppression agents always wear safety glasses.
3. When working with cryogenic agents always wear leather gloves to avoid cryogenic burns.
4. Before removing a cylinder from an installation: ensure the ball valve(s) are secure on the top of the cylinder, that the valve assembly is closed and in the "off" position, then remove the tubing.



### CAUTION

Indicate[s] a hazardous situation which, if not avoided, could result in minor or moderate injury. CAUTION [signs] without a safety alert symbol may be used to alert against unsafe practices that can result in property damage only. (Triangular Sign)



### WARNING

Indicate[s] a hazardous situation which, if not avoided, could result in death or serious injury. WARNING [signs] should not be used for property damage hazards unless personal injury risk appropriate to this level is also involved (Circle Sign)



### DANGER

Indicate[s] a hazardous situation which, if not avoided, will result in death or serious injury. The signal word "DANGER" is to be limited to the most extreme situations. DANGER [signs] should not be used for property damage hazards unless personal injury risk appropriate to these levels is also involved. (Rectangle Sign)



### CAUTION

Read and understand this manual and all material referred to in this manual before attempting to install, maintain or recharge any rotarex ilp fire suppression system.

# 1.0 AGENT

This section covers the fire extinguishant utilized by Rotarex FM-200® Clean Agent Systems. All of the information contained herein is believed to be accurate and up-to-date. However, it should be noted that all dimensions shown are approximate and Rotarex reserves the right to make adjustments as necessary.

## 1.1. AGENT- HEPTAFLUOROPROPANE (FM-200®)

The extinguishing agent used in Rotarex Pre-engineered Fire-Suppression Systems is Heptafluoropropane, more commonly known by its ASHRAE designation: HFC 227 ea. FM-200® is a colorless, odorless, liquefied compressed gas. (See the Physical Properties Table below). It is stored as a liquid, but dispensed into the hazard as a colorless, electrically-nonconductive, gaseous vapor due to its relatively low boiling point. FM-200® has been tested and verified to be safe for use in occupied spaces when used as specified in the U.S. EPA Significant New Alternative Policy (SNAP) rules. Tests have proven that exposure to FM-200® is safe and effective in extinguishing fires at low concentrations; most of which are well below the EPA's maximum exposure levels. FM-200® is approved for use in occupied areas up to 10.5% concentration by volume with a mandated egress time of 5 minutes or less.

### 1.1.1. EXTINGUISHING MECHANISM

FM-200®'s mechanism of extinguishing fires is considered active. Its primary action is through physically cooling the fire at the molecular level. FM-200® is an efficient heat transfer agent. FM-200® removes the thermal energy from the fire to the extent that the combustion reaction cannot sustain itself. Additionally, there is a chemical action that provides a secondary means of suppressing the fire. Trace amounts of free radicals are released into the fire – thereby inhibiting the chain reaction of combustion. FM-200® does not significantly reduce oxygen levels and is safe for use in occupied spaces in accordance with the U.S. EPA guidelines. FM-200® can be removed from the protected space by simply ventilating the space after a system discharge.

## 1.2 PRE-ENGINEERED FIRE-SUPPRESSION SYSTEMS USES & LIMITATIONS

Rotarex Pre-engineered Fire-Suppression systems must be designed and installed in accordance with the requirements outlined in this manual, PN 027650004, and in accordance with the requirements of the NFPA 2001 Standard for Clean Agent Extinguishing Systems, latest edition, UL, & FM.

Rotarex FM-200® systems are used to protect hazards that are enclosed. An enclosed hazard area will provide a means to contain the FM-200® extinguishant. By containing the agent in the enclosure, when discharged it will establish and maintain an effective extinguishing concentration. Some typical hazards that can be protected with FM-200® fire suppression systems include but are not limited to the following:

- Laboratory fume/exhaust cabinets
- Machinery Spaces
- Small compartments
- Electrical and electronic hazards
- Paint lockers
- Telecommunication areas
- CNC & VMC Machining Centers
- UPS Units
- Transformer cabinets
- Other high value assets

### 1.1.2. PHYSICAL PROPERTIES OF FM-200®

Chemical Name	Heptafluoropropane (CF <sub>3</sub> CHFCF <sub>3</sub> )
Molecular Weight (g/mol)	170.03
Boiling Point @ 760 mm Hg	-16.4°C
Freezing Point	-131°C
Critical Temperature	101.7°C
Critical Pressure (bar)	29.1
Critical Volume (cc/mol)	274
Critical Density (kg/m <sup>3</sup> )	621
Specific Heat, Liquid (kJ/kg @ 25°C)	1.184
Specific Heat, Vapor (kJ/kg °C) @ constant pressure of 1 ATM @ 25°C	0.808
Heat of Vaporization (kJ/kg °C) at Boiling Point	132.6
Thermal Conductivity (W/m °C) of Liquid @ 25°C	0.069
Viscosity, Liquid @ 25°C (centipoises)	0.184
Global Warming Potential	2900
NOAEL (VOL %)	9
LOAEL (VOL %)	10.5
Ozone Depletion Potential	0
US EPA SNAP Approval	Accepted
Estimated Atmospheric Lifetime	31 – 42 years
LC50 (Rats; 4 hrs – ppm)	>800,000 ppm

\*FE-227 and FM-200® are registered trademarks of DuPont Corporation

### 1.2.1. FM-200® IS A GASEOUS FIRE SUPPRESSION AGENT THAT IS EFFECTIVE ON:

- Class A Fires - Surface Fires of Celluloid Materials.
- Class B Fires - Fires of Flammable Liquids and Gases.
- Class C Fires - Fires that involve energized electrical equipment.

### 1.2.2. ROTAREX FM-200® SYSTEMS SHALL NOT BE USED ON FIRES INVOLVING THE FOLLOWING MATERIALS.

- Self-oxidizing chemicals of rapid oxidizing chemicals  
**Examples:** Cellulose Nitrate and Gunpowder.
- Reactive metal compounds Examples: Sodium, Potassium, Barium, Magnesium, Lithium Titanium, Zirconium, Uranium, and Plutonium
- Metal hydrides Examples: Sodium Hydride and Lithium Aluminum Hydride
- Chemicals capable of undergoing auto-thermal decomposition.  
**Examples:** Organic Peroxides and Hydrazine. (Reference: NFPA 2001, latest edition)

# 1.0 AGENT (continued)

## 1.3. AGENT EXPOSURE

Although FM-200® is considered to be non-toxic, the EPA has established the guidelines for controlling the amount (concentration) of agent provided for the protected area. Based on PBPK modeling, the EPA allows FM-200® for use in normally occupied spaces up to a concentration of 10.5 % by volume with exposure limited to 5 minutes or less.

The requirement for pre-discharge alarms and time delays in occupied areas are intended to prevent unnecessary exposure to humans where their presence is not critical to the operation of the area being protected. Suitable safeguards shall be provided to ensure prompt evacuation of (and prevent entry into) protected areas after discharge.



### CAUTION

The discharge of clean agent systems to extinguish a fire can result in a potential hazard to personnel from the natural form of the clean agent or from the products of combustion and decomposition that result from exposure of the agent to the fire or hot surfaces. Unnecessary exposure of personnel either to the agent in its natural form or to the products of decomposition shall be avoided.

### 1.3.1. AGENT EXPOSURE LIMITS

Unnecessary exposure to FM-200® clean agent systems resulting in low oxygen atmospheres shall be avoided. The maximum exposure time in any case shall not exceed 5 minutes. Table 1.3.1 shows the time for safe human exposure at stated concentrations of FM-200®.

**time for safe human exposure at stated concentrations for FM-200®**

% v/v	ppm	Maximum Permitted Human Exposure Time (min)
10.0	100,000	5.00
10.5	105,000	5.00
11.0	110,000	5.00
11.5	115,000	5.00
12.0	120,000	5.00
12.5	125,000	5.00
13.0	130,000	1.65
13.5	135,000	0.92
14.0	140,000	0.79
14.5	145,000	0.64
15.0	150,000	0.49

#### 1.3.1.1. Spaces not normally occupied

Most Rotarex suppression systems will be used to provide protection for hazards and compartments that are too small or too remote to be occupied. FM-200® systems can be designed for concentrations exceeding the LOAEL if the space is not normally occupied or that personnel in the hazard area can escape within 30 seconds.



### CAUTION

Rotarex does not recommend FM-200® systems to be used in any normally occupied spaces where the design concentration required is above 10.5%.

### 1.3.2. TOXICITY

FM-200® has been extensively tested and is approved for use in fire suppression systems around the world. The LC50 toxicity rating for FM-200® is greater than 780,000 ppm. When one considers that most FM-200® systems are designed for concentrations providing less than 105,000 ppm, it is evident that FM-200® is safe to use. FM-200® will decompose to form halogen acids when exposed to extremely high temperatures. The formation of these acids is minimized by using fast acting detection and control systems, and proper system design and installation for rapid discharge of the agent into the hazard area. Generation of by-products (decomposition) from the FM-200® discharge will be minimal when properly applied. As with all HFC agents used as fire suppressants, human exposure to concentrations above the NOAEL is limited to 5 minutes.

Although FM-200® has been shown that it is safe to use, there can be some health effects caused by its combustion. Hydrogen fluoride (HF) vapor can be produced in fires as a breakdown product of FM-200® and other fluorocarbon fire extinguishing agents and in the combustion of fluoropolymers. The significant toxicological effects of HF exposure occur at the site of contact. As such one should know what to expect when dealing with this toxic vapor. Table 1.3.2.1, on the following page, shows the health problems caused by exposure to HF vapors.

**Potential Human Health Effects of Hydrogen Fluoride in Healthy Individuals**

Exposure Time	Hydrogen Fluoride (ppm)	Reaction
2 minutes	<50	Slight eye and nasal irritation
	50-100	Mild eye and upper respiratory tract irritation
	100-200	Moderate eye and upper respiratory tract irritation; slight skin irritation
5 minutes	>200	Moderate irritation of all body surfaces; increasing concentration may be escape impairing
	<50	Mild eye and nasal irritation
	50-100	Increasing eye and nasal irritation; slight skin irritation
10 minutes	100-200	Moderate irritation of skin, eyes, and respiratory tract
	>200	Definite irritation of tissue surfaces; will cause escape impairing at increasing concentrations
	<50	Definite eye, skin, and upper respiratory tract irritation
10 minutes	50-100	Moderate irritation of all body surfaces; increasing concentration may be escape impairing
	100-200	Moderate irritation of all body surfaces; escape impairing effects likely
	>200	Escape-impairing effects will occur; increasing concentrations can be lethal without medical intervention

## 1.0 AGENT (continued)

### 1.4. CHILLING & VISIBILITY

Liquid FM-200® discharging from the nozzles will have a chilling effect on objects and can cause frostbite burns to the skin. The liquid phase vaporizes rapidly when mixed with air. Discharging the agent into an area with a humid

atmosphere may cause a reduction in visibility due to condensation of water vapor normally present in the hazard area.

### 1.5. PRESSURE

The normal operating pressure of a Rotarex FM-200® clean agent suppression system is 240 psig @ 70°F (16.5 bar @ 21°C). This is accomplished by super pressurizing the system with a charge of nitrogen added to the FM-200® agent. All Rotarex Fire-Suppression cylinders are pressurized vessels, care must be observed when handling, filling and transporting storage containers. The anti-recoil devices SHALL be in place whenever the charged container is removed from the piping network.

of the FM-200® is complete. This process is referred to as super pressurization. Super pressurization is applied to the container for any of the following:

#### 1.5.1. SUPERPRESSURIZATION

To increase the available pressure above the vapor pressure of FM-200® nitrogen is added to the fire suppression system container after the transfer

- To increase the total pressure available for flow from the fire suppression system container through the downstream piping network.
- To provide a “pressure pad” for the liquid in order to keep the liquid compressed in the liquid phase during flow through piping systems.
- To stabilize the container pressure over a wide temperature range or to maintain significant storage pressures at low temperatures.

### 1.6. AGENT STORAGE CONTAINERS

Agent Storage Containers are steel pressure vessels designed to hold the FM-200® under pressure until it is discharged. All FM-200® containers are suitable for use at storage temperatures of 32°F to 130 °F (0°C to 54.4°C). Each container is manufactured in strict accordance with DOT regulations and undergoes extensive pressure and leak testing before shipment to the field.

### 1.7. FILL DENSITY

Each Rotarex fire suppression cylinder has been designed for a minimum and maximum fill density as shown in table 1.7. Fill Density and temperature affect the pressure in the system cylinder. As the temperature elevates the pressure increases significantly. Should the maximum fill density be exceeded, the cylinder pressure will increase significantly and may present a hazard to personnel as well as the equipment being protected. Adhering to the maximum fill requirements will minimize the possibility of an inadvertent discharge and or the possibility of the system pressure relief device rupturing.

#### Cylinder Data

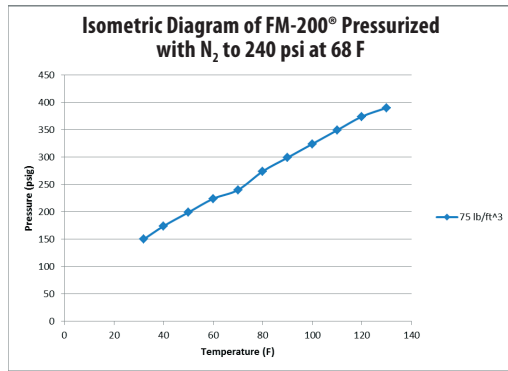
PN	Max Fill (Pounds)	Max Fill (Kilograms)	Operating Pressure (PSI)	Operating Pressure (Bar)
B07014500	3	1.36	240	16.5
B07014501	7	3.18	240	16.5
B07014502	14	6.35	240	16.5

### 1.8. CYLINDER TEMPERATURE & PRESSURE RELATIONSHIP

Rotarex Fire suppression systems are designed to operate between 32 °F and 130 °F (0 °C to 54.4 °C). Chart 1.8 shows the internal cylinder pressure as indicated on the cylinder gauge. The temperature pressure relationship is based on a maximum fill density of 75 pounds of agent per cubic foot at 70 °F (21.1 °C) and a charging pressure of 240 PSI.

TEMPERATURE		PRESSURE	
°F	°C	PSIG	KPA
32	0	150	1034.21
40	4.54	174	1199.69
50	10.0	199	1372.06
60	15.5	224	1544.43
70	21.1	240	1654.74
80	26.7	274	1889.16
90	32.2	299	2061.53
100	37.8	324	2233.90
110	43.3	349	2406.27
120	48.9	374	2578.64
130	54.4	390	2688.96

## 1.0 AGENT (continued)



## 2.0 EQUIPMENT

### 2.1. DESCRIPTION

The FireDETEC Automatic Indirect System is available in three sizes; each size is assigned a model number:

- Model B07014500 charged with 3 lb (1.36 kg) of FM-200®
- Model B07014501 charged with 7 lb (3.18 kg) of FM-200®
- Model B07014502 charged with 14 lb (6.35 kg) of FM-200®

The FireDETEC pre-engineered fire suppression system utilizes proprietary FireDETEC flexible pneumatic, thermally sensitive tubing that is used as a detection device. The tubing is pressurized with dry nitrogen when it is put into service. The thermally activated tubing is temperature sensitive. The tubing is installed in the hazard area as a continuous linear detector that will rupture from flame impingement or when the temperature reaches the release point. These systems are developed for use in total flooding applications, where the hazard area is not normally occupied. Please refer to NFPA 2001 for use of FM-200® in occupied areas. NFPA 2001 section 1-6 outlines personnel safety exposure limits for FM-200®.

See paragraph 1.2. in this manual for areas where FireDETEC Indirect Low Pressure Systems may be applied to protect the hazard. Should an occasion arise where the hazard is not identified in paragraph 1.2 of this manual please review NFPA 2001, contact Rotarex, or the applicable governmental or regulatory authority.



#### CAUTION

FireDETEC Fire Suppression Systems have been developed to protect a single hazard. It is a SINGLE automatic unit. There are no electric, manual or pneumatic actuators that can be used to discharge multiple cylinders.

### 2.2. AGENT STORAGE CONTAINERS - PN 028800011, PN 028800012, & PN 028800013

All agent storage containers are steel pressure vessels designed to hold the FM-200® under pressure until the agent is discharged. All Rotarex containers are suitable for use at storage temperatures between 32°F to 130 °F (0 °C to

54.4 °C). Each container is manufactured to DOT regulations and undergoes extensive pressure and leak testing before shipment to the field.

#### Cylinder Data

Nom / Size	PN	Diameter		Height		Volume		Agent Fill	
		IN	CM	IN	CM	IN <sup>3</sup>	L	LB	KG
3	028800011	2.93	7.44	12.43	31.57	75	1.23	3	1.36
7	028800012	4.99	12.67	11.17	28.37	174	2.85	7	3.18
14	028800013	6.14	15.60	14.14	35.92	350	5.74	14	6.35

#### 2.2.1. Cylinder DOT Specifications

Nom Size	DOT Spec	Service Pressure		Test Pressure	
		(PSI)	(BAR)	(PSI)	(BAR)
3	DOT-4B240	240	16.55	480	33.09
7	DOT-4B360	240	16.55	720	49.64
14	DOT-4B360	240	16.55	720	49.64

## 2.0 EQUIPMENT (continued)

### 2.3. VALVES - PN B07010208, PN B07010303

The Indirect Low Pressure valve(s) used on FireDETEC systems were invented and developed by Rotarex for use in fire suppression systems that are actuated by a linear thermal detector. The valve is nickel plated brass equipped with a pressure gauge to monitor the system pressure, a quarter turn ball valve that is the interface between the tubing and the cylinder, and a pressure relief device.

The feature options of the Indirect Low Pressure Valves include:

1. Filling connector with integrated test valve
2. Pressure relief device

Each valve is equipped with 2 discharge ports. Each discharge port is fitted with a safety plug that must be installed in the discharge outlet whenever the cylinder is being transported or is not in service. The safety plugs are intended to prevent uncontrolled discharge of a cylinder in the event of accidental system activation.

Activation of the discharge valve is accomplished by any one of the following:

- A. Manual actuation via manual release valve
- B. Electric actuation via electric solenoid
- C. Automatic actuation via FireDETEC tubing

Rotarex Indirect Low Pressure Valves are not suitable for any other installation or other purpose. If the user of the product has any questions concerning the correct use or purpose of this product, they should call Rotarex at (724) 696-4340. A non-authorized use or application and/or a non-authorized modification of the product or its use or application can result in serious accidents or injuries. Rotarex North America, Inc. is not responsible for a non-authorized use or application.

### 2.4. MOUNTING BRACKETS - 3LB PN 029900169, 7LB PN 029900170, 14 LB PN 029900171

The cylinder wall mounting bracket is epoxy powder coated and is used to mount the cylinder in the vertical position. Each system comes equipped with two stainless steel clamps to hold the cylinder in place.

### 2.5. BURST DISC - 3 LB (480PSI) PN 029200091, 7 & 14 LB (600PSI) PN 029200088

To protect the cylinder against overpressure.

#### 2.5.1. PRESSURE SWITCH PN 029900168

The pressure switch is connected on to the valve assembly to provide additional electrical functions that may be required. Rotarex recommends that a pressure switch be connected to some audio or audio visual device to alert personnel that a system has discharged.

### 2.6. PRESSURE GAUGE - PN 028200190

Pressure gauge indicates internal cylinder pressure. The pressure gauge is color coded to display the acceptable operating range, under pressure range, and over pressure range.

TABLE 2.3

Valve technical data	
Approval	FM & UL
Product Group	B0701
Connection to gas container	1" 14 UNS 2A, 1.5" 14 UNS 2A
Valve outlet	¼" NPT, ½" NPT
Ascending tube connection	⅝" 24 UNEF 2B, 1" 20 UNEF 2B
Top connection	G ⅜"
Pressure Gauge	⅜" NPT
Extinguishing Agent	FM-200®
Propellants	Nitrogen
Minimum opening cross-section at valve outlet	2 x 6.5 mm
Working Pressure	240 psi
Operating Temperature Range	30 °F to 130 °F
Leakage Rate	10 <sup>-4</sup> mbar l/s
Materials	
Valve body and cover	Brass, nickel-plated
Primary seals (membrane)	Special polymer
Screw-in connections	Brass with NBR seals
Test Valve	Brass, nickel-plated
Pressure Gauge	Brass, nickel-plated
Secondary Seals	NBR, hybrid seal metal nitrile

Remark: the switch would still be options for units that have the manual actuator, but required for units that have the solenoid actuator.

#### 2.6.1. END OF LINE ADAPTOR (EOL) - PN B07810026

The EOL is required to pressurize the thermal activation tubing.



## 2.0 EQUIPMENT (continued)

### 2.7. FIREDETEC LINEAR THERMAL DETECTOR & ACTUATION TUBING PN - B07800002 (RED TUBING), PN B07800200 (BLACK TUBING)

When the FireDETEC tubing is used in the indirect low Pressure system it is only used as a linear thermal detector and activation device. The thermally activated tubing is heat sensitive. Heat from a fire or direct flame impingement during a fire situation will cause the tubing to rupture. The tubing will rupture at any point along its entire length. If the temperature reaches approximately

240°F or 115°C, the release of pressure in the tubing then activates the fire suppression system, resulting in discharge of agent through the piping network and nozzles.

REM: red tubing is FM approved and UL listed, black tubing is only FM.

### 2.8. CYLINDER NAME PLATE

All FireDETEC cylinders are furnished with a nameplate that provides the following information that is specific to that container:

- Assembly number
- Weight information
- Tare weight
- Agent weight
- Gross weight
- Installation Instructions

### 2.9. MANUAL RELEASE - PN B04420128

The manual release is an inline device. When the push type valve is activated it releases the nitrogen in the tubing allowing the pressure differential valve to open and release the agent into the hazard area. This device mounted in line with the thermally activated tubing provides an independent means of operating the FireDETEC system without the need for external power. To

operate the manual actuator, simply pull the yellow safety device and push the red handle.

### 2.10. SOLENOID ACTUATOR PN B04420127

The solenoid actuator is an electro mechanical device that allows the FireDETEC fire suppression system to be actuated electrically from a control panel or other electric signal.

The solenoid valve comes equipped with a supervisory pressure switch that gets connected to the control panel's supervisory circuit. Please refer to the control panel's installation manual for proper wiring information.

### 2.11. PIPING

#### 2.11.1. PIPING REQUIREMENTS

Piping must be Schedule 40 steel pipe, either galvanized or black. Specifications ASTM A-53 or A-106, ANSI B36.10 must be used for steel pipe. The piping must also meet the diameter and length requirements as set forth in this manual. The pipe length values and number of elbows as seen in chart 2.12.1 are listed as the maximum pipe length and number of elbows avail-

able for use. The pipe diameter as seen in chart 2.12.1 shall not be changed. Max Height refers to the maximum height differential between the cylinder and the nozzle.

Agent	System	Test Cell Volume	Test Cell Height	Max Area Coverage	Pipe Diameter	Pipe Length	Elbows
FM-200®	3 lb	92.2 ft <sup>3</sup>	8'	8' x 6.9'	¼"	198"	5
	7 lb	215.2 ft <sup>3</sup>	10'	12' x 10.8'	⅜"	303.5"	5
	14 lb	430.4 ft <sup>3</sup>	12'	16' x 16'	½"	300"	5
	7 lb. (2)	251.2 ft <sup>3</sup>	10'	12' x 10.8'	⅜" - Feed, ½" - T to Nozzle	Feed: 172.5" T to Nozzle: 39"	4 - Feed, 1 - T to Nozzle
	14 lb. (2)	430.4 ft <sup>3</sup>	12'	16' x 16'	Feed - ¾", T to Nozzle - ½"	Feed: 142" T to Nozzle: 60"	Feed - 4, T to Nozzle - 1

## 2.0 EQUIPMENT (continued)

### 2.11.2. PIPE FITTINGS

Piping joints shall be Malleable Iron 300 pound class only - ASTM-A197 and have a minimum working pressure of 620 psi (42 bars). Temperature ratings of the fittings must not be exceeded. All threaded joints must be in accordance with ANSI B-20.1 Ductile Iron 300-pound class or higher ASTM A-395, or Steel ASTM-234 is acceptable. Piping, fittings, and pipe supports shall be in accordance with the latest edition of NFPA 2001. Also consult ANSI B 31.1, The Power Piping Code. The method of joining all pipe must be in accordance with the latest requirements listed in NFPA 2001. Acceptable fittings include screwed, flanges, welded.

### 2.11.3. PIPE REDUCTIONS

All reductions in pipe size must be made by using concentric reducer fittings after the tee. Reducing bushings are not acceptable.

### 2.11.4. PIPE SUPPORTS

Pipe supports must be installed with allowance for expansion and contraction. They must be rated to support the dead weight of the piping and the thrust forces of the FM-200® discharge. The piping shall be installed in accordance with good commercial practices. Refer to ANSI B-21;1 for bracing requirements.

### 2.11.5. INSTALLATION OF PIPING

All piping must be installed in accordance with good commercial practices. Allowance for expansion and contraction of the piping must be taken into account. The piping system shall be securely supported hangers.

## 2.12 NOZZLES PN 026200102, PN 026200104, PN 026200107, PN 026200103, PN 026200105

The nozzle controls the flow of and distributes the agent into the hazard area. FireDETEC unique nozzles are available in brass 360° dispersal patterns; each nozzle has predetermined discharge orifices to meet the flow requirements of the pre-engineered systems.

Part Number	System	Nozzle Diameter	Orifice Diameter	Orifice Quantity	Max Height	Max Area Coverage
026200102	3 lb.	1/4"	0.085"	8	61"	55.3 ft <sup>2</sup>
026200104	7 lb.	3/8"	0.138"	8	86"	129.0 ft <sup>2</sup>
026200107	14 lb.	1/2"	0.2"	8	103.5"	258.2 ft <sup>2</sup>
026200103	7 lb./2 Nozzle	3/8"	0.085"	8	96"	129.0 ft <sup>2</sup>
026200105	14 lb./2 Nozzle	1/2"	0.138"	8	37"	258.2 ft <sup>2</sup>

MAXIMUM VOLUME - Please note that the maximum volume varies as a function of minimum design concentration and minimum temperature.

## 2.13 CONSTRUCTION FEATURES

### 2.13.1. EMERGENCY CONTROL

For normal operation, a system shall be either automatically controlled or operable from a manual control easily accessible to the hazard or both. All systems shall be provided with an alternate means of fully mechanical emergency control, regardless of their normal means of operation. Fully mechanical emergency controls shall not require an electric power source. These emergency controls shall be located at or near the device being controlled.

### 2.13.2. FM APPROVED SYSTEM

In addition to the manual actuator (B04420128), an FM Approved system also requires the use of the solenoid actuator (B04420127). The solenoid actuator shall be connected to an FM Approved detection device & control panel.

### 2.13.3 UL LISTED SYSTEM

An extinguishing system shall be provided with:

- An automatic and manual means of actuation
- A manual means of actuation could be either a mechanical type manual actuation like the end of line device (B04420128) or an electric type, that would operate the solenoid (B04420127) vice the control panel.

#### Control Panel additional detection:

When electronic monitoring and backup actuation is achieved using a control panel, the panel must be a UL Listed Fire Alarm and Control Panel, and compatible with the solenoid valve actuator. Additionally, when electronic pull stations, supplemental detection, and electronic notification devices are used in conjunction with a control panel, the devices must be compatible with the control panel. Reference the control panel installation manual for compatibility information.



## 3.0 ANCILLARY EQUIPMENT

### 3.1 CAUTION – AREA PROTECTED BY CLEAN AGENT FIRE SUPPRESSION SYSTEM SIGN (PN 028000060)

This sign is provided to alert personnel that the room is protected with clean agent fire suppression system and that they should not enter the area during or after discharge. The sign should be placed in a conspicuous location at the entrance to the protected hazard and or on the cabinet or machine that is being protected.

## 4.0 DESIGN

### 4.1. SYSTEM DESIGN CONCEPT

Pre-Engineered Systems are balanced flow configurations that are simple to design and easy to install. The Pre-Engineered concept minimizes the engineering effort required to design an effective system by utilizing a fixed series of nozzles and a tightly defined set of design criteria. As long as nozzle selection, pipe size, and pipe length limitations are adhered to, computerized flow calculations are not required.

### 4.2. HAZARD EVALUATION

Rotarex offers Pre Engineered FM-200® fire suppression systems. This section of the manual will detail the steps necessary to design a FireDETEC fire suppression system within the limitations established by NFPA 2001, FM, and UL approvals. The design of the system **MUST** be verified by following the steps outlined in this manual prior to installing any FireDETEC fire suppression system. When evaluating hazards one should record the following properties:

- Ambient temperature
- Minimum & Maximum temperature
- Hazard Class
- Enclosure integrity

Once the previous properties have been recorded, calculate the quantity of FM-200® required to provide the proper design concentration at the minimum anticipated ambient temperature in the hazard enclosure. An example calculation can be seen in Section 4.10.

FireDETEC pre-engineered fire suppression systems have been tested and all limitations have been pre-established.



#### CAUTION

If the specified limitations are not followed, the system may not supply the required quantity of extinguishing agent which may result in a fire not being suppressed.

to determine the correct design concentration, agent quantity, etc. The three Hazard Types are:

- Class "A" (wood, paper, cloth – anything that leaves an ash residue after combustion)
- Class "B" (Flammable liquid or gas)
- Class "C" (electrical)



CLASS A



CLASS B



CLASS C

#### 4.2.1. IDENTIFY HAZARD TYPE

The Hazard Type generally falls into one of or a combination of the three following categories. The designer must be aware of the Hazard Type

## 4.0 DESIGN (continued)

### 4.3. DETERMINE CONCENTRATION PERCENTAGE

The following is a guideline to be used to determine the proper agent concentration percentage for the hazard(s) being protected.

#### 4.3.1. FireDETEC FIRE SUPPRESSION SYSTEMS FOR CLASS A, B, OR C HAZARDS

Fire suppression systems utilizing FM-200® as the agent can be used to suppress Class A, B, & C fires. Table 4.3.1 shows minimum design concentrations for FM-200® on Class A & B hazards.

Hazard to protect	Design Concentration	Hazard to protect	Design Concentration
Acetone	10.0	Isopropanol	9.8
Benzene	9.5	JP 4	9.0
Crude Oil	8.5	JP 5	9.0
Cyclohexane	9.4	Kerosene	9.6
Diesel	8.7	Methanol	15.2
Ethanol	12.6	Methyl Ethyl Ketone	9.6
Gasoline	9.0	Toluene	7.6
N Heptane	9.6	Xylene	7.8
Hydraulic Fluid	8.5	Class C (Electrical)	7.5
Hydraulic Oils	7.7	Class A Surface fires	7.0
Hydraulic Oils	7.7		

\*Note: Design Concentration for Class B Fire are shown in the above table and includes a 30% safety factor from the minimum extinguishing concentration.

### 4.4. SAFETY RECOMMENDATIONS

The following are safety recommendations as outlined in NFPA 2001. The designer must be aware of the occupancy of the hazard(s) being protected in order to complete their evaluation of the project and make adjustments or recommendations as necessary.

#### 4.4.1. SPACES NOT NORMALLY OCCUPIED

Protected spaces that are considered to be Not Normally Occupied (e.g. flammable liquids storage room, cabinets, some machinery spaces, etc.) can be designed for concentrations above the LOAEL concentration. If there is a potential for personnel to be exposed, measures shall be taken to limit exposure.

### 4.5. DETERMINING AGENT QUANTITY

The following steps are necessary to determine the amount of FM-200® agent required to protect from a hazard(s).

#### 4.5.1. DETERMINE THE HAZARD VOLUME

When determining the hazard volume one must conduct a survey of the hazard to be protected. In doing so, one must review the hazard dimensions and verify the volume. This can be done by first determining the volume of the compartment(s) being protected. Volume is calculated by multiplying the Length by the Width by the Height ( $V = L \times W \times H$ ) of the hazard area(s). The volume used to calculate the quantity of agent required should be based on the empty (gross) volume. Additional considerations include:

- The volume taken by solid, non-permeable, and non-removable objects can be deducted from the protected volume.
- Any volume that is open to the space being protected must be added (i.e. undamped ductwork, uncloseable openings, etc.).

#### 4.5.2. EVALUATE COMPARTMENT (HAZARD) INTEGRITY

Evaluate the integrity of the hazard area and determine if additional agent will be required to offset leakage of agent. (Refer to NFPA 2001, Annex C latest edition for details).



#### CAUTION

Rotarex does not recommend FM-200® systems to be used in any normally occupied spaces where the required design concentration is above 10.5%.

### 4.5.3. DETERMINE DESIGN CONCENTRATION

**4.5.3.1.** Taking into consideration the type of fuels in the hazard area determine the design concentration. Design concentration increases the safety of a system when the hazard contains highly flammable material.

**4.5.3.2.** The flame extinguishing concentrations shall be used in determining the agent design concentration for a particular fuel.

#### 4.5.4. FLAME EXTINGUISHMENT

**4.5.4.1.** The flame extinguishing concentration for Class B fuels shall be determined by the cup burner method, refer to NFPA 2001 (Latest Edition) Annex B for more details.



#### CAUTION

Under certain conditions, it can be dangerous to extinguish a burning gas jet. As a first measure the gas supply shall be shut off.

**4.5.4.2.** The flame extinguishing concentration for Class A fuels shall be determined by test as part of a listing program. As a minimum, the listing program shall conform to UL 2127 or UL 2166 or equivalent.

## 4.0 DESIGN (continued)

4.5.4.3. Minimum design concentration for Class C hazards shall be at least that for Class A surface fire.

### 4.5.5. CALCULATE AGENT REQUIRED

Determine the quantity of agent required to provide the desired concentration within the hazard(s) being protected. This calculation must be based upon two important criteria: the lowest expected ambient temperature and the design concentration required to protect this type of hazard.

### 4.5.6. CALCULATE AGENT REQUIRED BY FORMULA

To determine the agent quantity needed to produce the design concentration level, the Hazard Volume is multiplied by the factors as determined in the formula below.

$$W = (V/S) * (C / (100 - C))$$

**Where:** W = Weight of clean agent [lb. (kg)]

V = Hazard Volume [ft<sup>3</sup> (m<sup>3</sup>)]

C = Design Concentration, % by volume

S = Specific volume of the superheated agent vapor at 1 atmosphere and the temperature, t [ft<sup>3</sup>/lb. (m<sup>3</sup>/kg)].

$$S = k_1 + k_2 (t)$$

Where: k<sub>1</sub> = 1.885, k<sub>2</sub> = 0.0046(t), t = temperature (°F)

Or k<sub>1</sub> = 0.1269, k<sub>2</sub> = 0.0005(t), t = temperature (°C)

The equation to calculate S is an approximation.

### 4.5.7. FLOODING FACTOR TABLE - ENGLISH UNITS

As an alternative, the following tables have been compiled to make it an easier process for the system designer. The information provided is derived from the formulas shown on the previous page.

Temp (t) (°F)	Specific Vapor Volume (s) (ft <sup>3</sup> /lb)	Weight Requirements of Hazard Volume, W/V (lb/ft <sup>3</sup> )									
		DESIGN CONCENTRATION (% BY VOLUME)									
		6	7	8	9	10	11	12	13	14	15
30	2.0210	0.0316	0.0372	0.0430	0.0489	0.0550	0.0612	0.0675	0.0739	0.0805	0.0873
40	2.0678	0.0309	0.0364	0.0421	0.0478	0.0537	0.0598	0.0659	0.0723	0.0787	0.0853
50	2.1146	0.0302	0.0356	0.0411	0.0468	0.0525	0.0584	0.0645	0.0707	0.0770	0.0835
60	2.1612	0.0295	0.0348	0.0402	0.0458	0.0514	0.0572	0.0631	0.0691	0.0753	0.0817
70	2.2075	0.0289	0.0341	0.0394	0.0448	0.0503	0.0560	0.0618	0.0677	0.0737	0.0799
80	2.2538	0.0283	0.0334	0.0386	0.0439	0.0493	0.0548	0.0605	0.0663	0.0722	0.0783
90	2.2994	0.0278	0.0327	0.0378	0.0430	0.0483	0.0538	0.0593	0.0650	0.0708	0.0767
100	2.3452	0.0272	0.0321	0.0371	0.0422	0.0474	0.0527	0.0581	0.0637	0.0694	0.0752
110	2.3912	0.0267	0.0315	0.0364	0.0414	0.0465	0.0517	0.0570	0.0625	0.0681	0.0738
120	2.4366	0.0262	0.0309	0.0357	0.0406	0.0456	0.0507	0.0560	0.0613	0.0668	0.0724
130	2.4820	0.0257	0.0303	0.0350	0.0398	0.0448	0.0498	0.0549	0.0602	0.0656	0.0711

The manufacturer's listing specifies the temperature range for operation.

- W/V [agent weight requirements (kg/m<sup>3</sup>)] = pounds of agent required per m<sup>3</sup> of protected volume needed to produce the indicated concentration at the temperature specified.
- t [temperature (°C)] = the design temperature in the hazard area.
- s [specific volume (m<sup>3</sup>/kg)] = specific volume of superheated FM-200® vapor as approximated by the formula:  $s = 0.1269 + 0.0005(t)$ , where t is in °C

C [concentration (%)] = volumetric concentration of FM-200® in air at the temperature indicated.

## 4.0 DESIGN (continued)

### 4.5.8. FLOODING FACTOR TABLE – METRIC UNITS

Temp (t) (°C)	Specific Vapor Volume (s) (m <sup>3</sup> / kg)	Weight Requirements of Hazard Volume, W/V (kg/m <sup>3</sup> )									
		Design Concentration (% by Volume)									
		6	7	8	9	10	11	12	13	14	15
0	0.1268	0.5034	0.5936	0.6858	0.7800	0.8763	0.9748	1.0755	1.1785	1.2839	1.3918
5	0.1294	0.4932	0.5816	0.6719	0.7642	0.8586	0.9550	1.0537	1.1546	1.2579	1.3636
10	0.1320	0.4834	0.5700	0.6585	0.7490	0.8414	0.9360	1.0327	1.1316	1.2328	1.3264
15	0.1347	0.4740	0.5589	0.6457	0.7344	0.8251	0.9178	1.0126	1.1096	1.2089	1.3105
20	0.1373	0.4650	0.5483	0.6335	0.7205	0.8094	0.9004	0.9934	1.0886	1.1859	1.2856
25	0.1399	0.4564	0.5382	0.6217	0.7071	0.7944	0.8837	0.9750	1.0684	1.1640	1.2618
30	0.1425	0.4481	0.5284	0.6104	0.6943	0.7800	0.8676	0.9573	1.0490	1.1428	1.2388
35	0.1450	0.4401	0.5190	0.5996	0.6819	0.7661	0.8522	0.9402	1.0303	1.1224	1.2168
40	0.1476	0.4324	0.5099	0.5891	0.6701	0.7528	0.8374	0.9230	1.0124	1.1029	1.1956
45	0.1502	0.4250	0.5012	0.5790	0.6586	0.7399	0.8230	0.9080	0.9950	1.0840	1.1751
50	0.1527	0.4180	0.4929	0.5694	0.6476	0.7276	0.8093	0.8929	0.9784	1.0660	1.1555
55	0.1553	0.4111	0.4847	0.5600	0.6369	0.7156	0.7960	0.8782	0.9623	1.0484	1.1365

The manufacturer's listing specifies the temperature range for operation.

- W/V [agent weight requirements (kg/m<sup>3</sup>)] = pounds of agent required per m<sup>3</sup> of protected volume needed to produce the indicated concentration at the temperature specified.
- t [temperature (°C)] = the design temperature in the hazard area.
- s [specific volume (m<sup>3</sup>/kg)] = specific volume of superheated FM-200® vapor as approximated by the formula:  $s = 0.1269 + 0.0005(t)$ , where t is in °C
- C [concentration (%)] = volumetric concentration of FM-200® in air at the temperature indicated.

### 4.6 DETERMINE ENCLOSURE INTEGRITY

Ensure all openings are capable of being closed at the time of agent discharge.



#### CAUTION

Only one cylinder may be used to protect a hazard

### 4.7 LOCATE THE CYLINDER

Determine the location of the system cylinder. Ensure that it is capable of being properly mounted and in a safe accessible location free from high traffic areas and damp or wet locations.

Storage containers and accessories shall be located and arranged so that inspection, testing, recharging, and other maintenance activities are facilitated and interruption of protection is held to a minimum.

#### 4.7.1. STORAGE CONTAINER SIZING

For FM-200® systems, all containers supplying the same manifold outlet for distribution of FM-200® shall be interchangeable and of one select size and charge.

## 4.0 DESIGN (continued)

### 4.8 DETERMINE THE LOCATION & PLACEMENT OF THE FIREDETEC TUBING

Determine the location of the linear thermal detection tubing; ensure that it is not subject to damage but located to detect a fire.

### 4.9 NOZZLE REQUIREMENTS

¼" Nozzles are available for use with the 3 pound unit. The small system may be configured to use 1 nozzle.

⅜" Nozzles are available for use with the 7 pound unit. These systems may be configured with 1 or 2 nozzles.

½" Nozzles are available for use with the 14 pound unit. These systems may be configured with 1 or 2 nozzles.

### 4.10 NOZZLE AREA & VOLUME COVERAGE

Rotarex nozzles shall only be used with the system with which they are listed. In chart 4.10 Max Height refers to the maximum amount of height differential between the cylinder and the nozzle. Area and Volume coverages shall not be exceeded.

Part Number	System	Nozzle Diameter	Orifice Diameter	Orifice Quantity	Max Height	Max Area Coverage
026200102	3 lb.	¼"	0.085"	8	61"	55.3 ft <sup>2</sup>
026200104	7 lb.	⅜"	0.138"	8	86"	129.0 ft <sup>2</sup>
026200107	14 lb.	½"	0.2"	8	103.5"	258.2 ft <sup>2</sup>
026200103	7 lb./2 Nozzle	⅜"	0.085"	8	96"	129.0 ft <sup>2</sup>
026200105	14 lb./2 Nozzle	½"	0.138"	8	37"	258.2 ft <sup>2</sup>

Note: Orifice Quantity measures the amount of holes per nozzle

**Maximum Volume** - Please note that the maximum volume varies as a function of minimum design concentration and minimum temperature.

#### 4.10.(a) MAXIMUM VOLUME THAT CAN BE PROTECTED BY THE 3.0LB FM-200® SYSTEM UNIT

Minimum anticipated design temperature °F	Maximum hazard volume ( ft <sup>3</sup> )									
	Design concentration, C (% by volume)									
	7.5	8	9	10	11	12	13	14	15	16
0	69.7	65.0	57.2	50.9	45.8	41.5	37.8	34.7	32.0	29.7
10	71.3	66.5	58.4	52.0	46.8	42.4	38.7	35.5	32.7	30.3
20	73.0	68.1	59.9	53.3	47.9	43.4	39.6	36.4	33.6	31.1
30	74.8	69.7	61.3	54.6	49.1	44.5	40.6	37.2	34.4	31.8
40	76.5	71.3	62.7	55.8	50.2	45.5	41.5	38.1	35.2	32.6
50	78.2	73.0	64.1	57.1	51.3	46.5	42.5	39.0	35.9	33.3
60	80.0	74.6	65.6	58.4	52.5	47.5	43.4	39.8	36.7	34.0
70	81.7	76.2	67.0	59.6	53.6	48.6	44.3	40.7	37.5	34.8
80	83.4	77.8	68.4	60.9	54.7	49.6	45.2	41.5	38.3	35.5
90	85.1	79.3	69.7	62.1	55.8	50.6	46.2	42.4	39.1	36.2
100	86.8	80.9	71.1	63.3	56.9	51.6	47.1	43.2	39.9	36.9
110	88.5	82.5	72.5	64.6	58.0	52.6	48.0	44.1	40.7	37.7
120	90.2	84.1	73.9	65.8	59.1	53.6	48.9	44.9	41.4	38.4
130	91.8	85.6	75.3	67.0	60.2	54.6	49.8	45.7	42.2	39.1

## 4.0 DESIGN (continued)

### 4.10.(b) MAXIMUM VOLUME THAT CAN BE PROTECTED BY THE 7.0LB FM-200® SYSTEM UNIT

Minimum anticipated design temperature °F	Maximum hazard volume ( ft <sup>3</sup> )									
	Design concentration, C (% by volume)									
	7.5	8	9	10	11	12	13	14	15	16
0	162.7	151.7	133.4	118.8	106.8	96.8	88.3	81.1	74.8	69.3
10	166.3	155.1	136.3	121.4	109.1	98.9	90.2	82.8	76.4	70.8
20	166.3	158.9	139.7	124.3	111.8	101.3	92.5	84.9	78.3	72.5
30	174.5	162.7	143.0	127.3	114.5	103.7	94.7	86.9	80.2	74.3
40	178.5	166.5	146.4	127.3	117.1	106.1	96.9	88.9	82.0	76.0
50	182.6	170.2	149.7	133.2	119.8	108.5	99.1	90.9	83.9	77.7
60	186.6	174.0	153.0	136.2	122.4	110.9	101.2	92.9	85.7	79.4
70	190.6	177.7	156.2	139.1	125.0	113.3	103.4	94.9	87.6	81.1
80	194.6	181.4	159.5	142.0	127.6	115.7	105.6	96.9	89.4	82.8
90	198.5	185.1	162.7	144.9	130.2	118.0	107.7	98.9	91.2	82.8
100	202.5	188.8	166.0	147.7	132.8	120.4	109.9	100.8	93.0	86.2
110	206.4	192.5	169.2	150.6	135.4	122.7	112.0	102.8	94.9	87.9
120	210.4	192.5	172.5	153.5	138.0	125.1	114.1	104.8	96.7	89.5
130	214.3	199.8	175.7	156.4	140.6	127.4	116.3	106.7	98.5	91.2

### 4.10.(c) MAXIMUM VOLUME THAT CAN BE PROTECTED BY THE 14.0LB FM-200® SYSTEM UNIT

Minimum anticipated design temperature °F	Maximum hazard volume ( ft <sup>3</sup> )									
	Design concentration, C (% by volume)									
	7.5	8	9	10	11	12	13	14	15	16
0	325.5	303.5	266.8	237.5	213.5	193.5	176.6	162.1	149.5	138.5
10	332.6	310.2	272.7	242.7	218.2	197.8	180.5	165.7	152.8	141.6
20	340.8	317.7	279.4	248.7	223.6	202.6	184.9	169.7	156.6	145.1
30	349.0	325.4	286.1	254.6	228.9	207.5	189.4	173.8	160.3	148.5
40	357.0	332.9	292.7	260.5	234.2	212.3	193.7	177.8	164.0	152.0
50	365.1	340.5	299.3	266.4	239.5	217.1	198.1	181.9	167.8	155.4
60	373.2	348.0	305.9	272.3	244.8	221.9	202.5	185.9	171.5	158.8
70	381.2	355.4	312.5	278.1	250.0	226.6	206.8	189.8	175.1	162.3
80	389.2	362.9	312.5	284.0	255.3	231.4	211.2	193.8	178.8	165.7
90	397.0	370.2	325.5	289.7	260.5	236.1	215.4	197.7	182.4	169.0
100	404.9	377.6	332.0	295.5	265.6	240.8	219.7	201.7	186.1	172.4
110	412.9	385.0	338.5	301.3	270.9	245.5	224.0	205.6	189.7	175.8
120	420.7	392.3	344.9	307.0	276.0	250.2	228.3	209.5	193.3	179.1
130	428.6	399.6	351.3	312.7	281.1	254.8	232.5	213.5	196.9	182.4

### 4.11. SAMPLE CALCULATIONS

The requirements given in Sections 4.1 – 4.10 describe the procedures to be used to design and size a Rotarex FireDETEC FM-200® Pre-Engineered Fire Suppression system. The following example provides guidelines following procedures.

#### EXAMPLE:

#### Given:

- Hazard – Small Room Housing ISO-Propanol
- Class B Hazard
- Room Size: W = 4 ft..., L = 8 ft..., H = 6'. One access door equipped with self closing apparatus.
- Minimum anticipated ambient temperature: 60 °F
- Maximum anticipated ambient temperature: 90 °F

#### Procedure:

- a. Determine minimum design concentration required (Refer to Table 4.3)  
Use 9.8% minimum design concentration for Class B Flammable Liquids Hazard
- b. Calculate Hazard Volume (V) and Area Coverage (A)  
 $V = W \times L \times H = 4 \times 8 \times 6 = 192 \text{ ft}^3$   
 $A = W \times L = 4 \times 8 = 32 \text{ ft}^2$
- c. Calculate minimum quantity (W) of FM-200® required  
 $W = (192 / (1.885 + .0046(60))) * (9.8 / (9.8 - 100))$   
 $W = 9.65$

This shows that a 14 lb FM-200® System is necessary to protect this Hazard

## 5.0 FIREDETEC INDIRECT LOW PRESSURE SYSTEM LIMITATIONS

FireDETEC fire suppression systems are limited in their application. Length of tubing, enclosure volume and shape can influence system capabilities and should be taken into account when selecting a system.

The maximum length of tubing limits the dimensions of the enclosure which can be protected. The volume of the hazard being protected varies as a function of the design concentration, fuel in the enclosure, and temperature.

The pre-engineered automatic unit concept minimizes the amount of engineering required when evaluating a design for a specific application. As long as the discharge piping, FireDETEC Tubing, & Nozzles are installed within the limits pre-

scribed in this manual, no calculations are required for pressure drop, flow rates, or discharge time. When the additional limitations of area coverage, hazard volume, maximum height, design concentration, agent quantity, tubing arrangement, etc. are also met, the unit installation may be understood to comply with the design requirements of NFPA 2001, UL & FM approvals. Therefore, no discharge tests or concentration measurements should be required.

### 5.1. TEMPERATURE LIMITATIONS

FireDETEC fire suppression systems are designed to be stored and operated between 32°F and 130°F (0°C and 54.4°C).



#### WARNING

FM-200® container and valve assemblies must be handled, installed, and serviced in accordance with the instructions contained in this manual and The Compressed Gas Association (CGA) pamphlets C-1, C-6, and P-1.

CGA pamphlets are available from the CGA, 4221 Walney Road, Chantilly, VA 20151-2923. Failure to follow these instructions can cause FM-200® containers to violently discharge; resulting in injury, death, and or property destruction.

### 5.2. OPERATING PRESSURE

The normal operating pressure of a FireDETEC fire suppression systems is 240 PSIG (16.5 BAR) at 70°F (21.1°C)

### 5.3. DISCHARGE TIME

The maximum discharge time of a FireDETEC Indirect Low Pressure system is based on the requirements of NFPA 2001. The system discharge must attain a 95% agent concentration level in the hazard area within 10 seconds or less; or as required by the applicable governmental or regulatory authority.

### 5.4. CLOSEABLE OPENINGS

Due to the nature of total flooding systems all openings in the hazard enclosure must be closed at the time of system discharge.

### 5.5. VENTILATION SHUTDOWN

Provisions must be made to shut off ventilation systems when the suppression system is actuated and discharging.

## 5.0 FIREDETEC INDIRECT LOW PRESSURE SYSTEM LIMITATIONS (continued)

### 5.6. SYSTEM SPECIFICATIONS

The numbers published in the table below are approved by UL and FM as the minimum values for the system to work properly. Rotarex Nozzles shall not to be altered. The pipe diameter corresponding with its system must be used. Pipe Length and Number of Elbows are maximum values.

Agent	System	Pipe Diameter	Pipe Length	Elbows	Max Height	Nozzle Size	Orifice Diameter	Orifice Quantity	Average Nozzle Pressure	Discharge Time
FM-200®	3 lb.	¼"	198"	5	61"	¼"	0.085"	8	32.7 psi	8.7 s
	7 lb.	⅜"	303.5"	5	86"	⅜"	0.138"	8	48.6 psi	8.8 s
	14 lb.	½"	300"	5	103.5"	½"	0.2"	8	53.7 psi	7.5 s
	7 lb./2	⅜"	Feed: 172.5" T to Nozzle: 39"	Feed: 4 T to Nozzle: 1	96"	⅜"	0.085"	8	57.7 psi	8.2 s
	14 lb./2	Feed: ¾" T to Nozzle: ½"	Feed: 142" T to Nozzle: 60"	Feed: 4 T to Nozzle: 1	37"	½"	0.138"	8	56 psi	7.6 s

### 5.7. FIREDETEC THERMAL DETECTION TUBING SYSTEM DESIGN

When an indirect low pressure system is used as fire suppression system the thermal tubing serves as the detection device. When the tubing ruptures due to flame impingement it releases the system and the agent is delivered to the hazard area via a piping or tubing network and nozzle. Placement of the tubing is important because it is heat sensitive, it should be placed above the hazard area being protected. In small enclosures it should be at ceiling level.

Maximum Length	Max. Distance Between Layers	Min. Distance off a Wall
120 ft... (36.5 m)	3.3 ft... (1 m)	18 in (.457 m)

#### 5.7.1. TABLE

Red Tubing	Black (UV Protected) Tubing	Tubing Lengths Available for Purchase	
		FEET	METERS
B07800017	B07800203	25	7.62
B07800018	B07800204	50	15.25
B07800019	B07800205	100	30.5
B07800002	B07800200	328	100

Note: The maximum length of tubing to use is 120 ft but the max length for purchase is 328 ft

### 5.8. FireDETEC DISCHARGE PIPE REQUIREMENTS

FireDETEC discharge piping, and fittings must conform to the requirements as outlined in NFPA 2001, section 2-2.1 latest edition. The thickness of the pipe or tubing wall shall be calculated in accordance with ASME B31.1 Power Piping Code. FireDETEC fire suppression systems use a minimum piping pressure of 240 PSI @70°F (16.5Bar @21°C).



## 6.0 FIREDETEC ILP SYSTEM INSTALLATION INSTRUCTIONS

### 6.1 CONTAINER LOCATION

The type and location(s) of the storage container(s) is based on several considerations.

- A. Agent Quantity – The agent storage container(s) selected must have the capacity to store the total quantity of agent required for the hazard area to be protected.
- B. Serviceability – In general, the larger the container, the more difficult it will be to remove it from the system for maintenance and service.
- C. Proximity – FM-200® -- system containers should be located close to the hazard (s) that they protect. In some cases the container may be mounted in the hazard area.
- D. Environmental Effects – Do not locate containers where they would be subject to excessive moisture, physical damage, exposure to corrosive chemicals, or harsh weather conditions.

### 6.2 STORAGE TEMPERATURE LIMITATIONS

FireDETEC FM-200® fire suppression systems have been tested and are approved for a service temperature range of 32°F to 130°F (0° C to 54.4°C).

#### WARNING

#### WARNING

FM-200® container and valve assemblies must be handled, installed, and serviced in accordance with the instructions contained in this manual and The Compressed Gas Association (CGA) pamphlets C-1, C-6, and P-1. CGA pamphlets are available from the CGA, 4221 Walney Road, Chantilly, VA 20151-2923. Failure to follow these instructions can cause FM-200® containers to violently discharge; resulting in injury, death, and or property destruction.

### 6.3 INSTALLATION OF 3, 7, & 14 POUND SYSTEMS

Position the FM-200® container in its designated location; container must be mounted in the vertical position. Mount the bracket so the FireDETEC fire suppression system will not be subject to accidental damage. Provide protection for the cylinder where necessary to prevent physical damage. The cylinder should be installed in a manner to facilitate maintenance, service, inspection and testing.

### 6.4 MOUNTING BRACKETS

#### 6.4.1. MOUNTING BRACKETS – 3lb PN 029900169, 7lb PN 029900170

Fix the bracket to a bulkhead, structural column or deck using four (4) ¼" bolts. Once cylinder is in place tighten the stainless steel bands, so that cylinder is secure.

#### 6.4.2. MOUNTING BRACKET - 14 lb PN 029900171

Fix the bracket to a bulkhead, structural column or deck using four (4) ¼" bolts. Once cylinder is in place tighten the stainless steel bands, so that cylinder is secure.

## 6.0 FIREDETEC ILP SYSTEM INSTALLATION INSTRUCTIONS (continued)

### 6.5 PHYSICAL MOUNTING OF FIREDETEC SYSTEMS

#### 6.5.1. SETTING THE CONTAINER


**WARNING**
**WARNING**

When mounting a fire suppression system the cylinder mounting bracket must be mounted on a structural column. If a secure location such as a structural column is not available the cylinder mounting bracket should be mounted on a backing plate. The backing plate can be constructed of ¾" marine grade plywood, aluminum or stainless plate designed to withstand the force associated with rough seas.

Upon completing the mounting of the bracket, place the FM-200® container in the bracket and secure it in place with the stainless steel straps provided. Orient the cylinder in the vertical position with the valve facing up and the gauge facing out and away from the wall or mounting bracket for ease of inspection.


**CAUTION**
**CAUTION**

Ensure the ball valve on top of the FireDETEC cylinder valve is in the off position during installation. Failure to follow instructions will result in the system discharging and may cause damage or injury.

#### 6.5.2. FIREDETEC LINEAR THERMAL DETECTION TUBING FOR ILP SUPPRESSION SYSTEMS

Ensure the tubing is installed in accordance with the guidelines in section 5.7

### 6.6 PRESSURIZING FIREDETEC TUBING

Ensure all connections to the end of line adapter and cylinder discharge valve are secured and tight

**6.6.1.** Attach the tubing fill adapter (Rotarex PN B07810005) to the tubing end of line adapter.

**6.6.2.** Using a portable on sight dry nitrogen cylinder with a regulator connected to the fill adapter, charge the tubing to 240 PSIG.

**6.6.3.** The tubing is pressurized to 240 PSIG at 70 °F if the temperature is higher the fill pressure may be higher (see the chart in section 1.7) when the proper pressure is attained (check the tubing pressure with a calibrated test gauge). This procedure will ensure that the tubing is pressurized to 240 PSI. Remove the fill adapter and fit the pressure gauge or the supervising pressure switch and "O" ring to the end of line device to ensure that the tubing is pressurized properly.

#### 6.6.4. ALLOW THE GAUGE TO REMAIN IN PLACE AND BEGIN LEAK TEST PROCEDURE.

6.6.4.1. Apply a soapy water solution to all connections, check all connections for bubbles.

6.6.4.2. Allow 30 to 45 minutes for all the connections to set in place and to ensure there are no leaks. Check the gauge to ensure the tubing is retaining the pressure, if the pressure drops it is indicative of a leak.

**6.5.3.** Do not install thermal detection tubing in an environment where the maximum ambient temperature exceeds 180 °F (82.2 °C)

**6.5.4.** Install clips every 18" to secure the linear flexible tubing in the hazard area.

**6.5.5.** Do not kink or crush the linear detection tubing to prevent leaks which may result in an accidental discharge.

**6.5.6.** Do not set the tubing on a surface that exceeds 150°F (65.6 °C)

**6.5.7.** When the tubing is routed through a wall or cabinet be sure to use the appropriate bulkhead adapter or grommet to prevent chafing or damage to the tubing.

**6.5.8.** The maximum length of the linear detection tubing shall not exceed 120 ft..... (36.5 meters)

**6.5.9.** Connect the end of line adapter to the tubing.

**6.5.10.** Install the tubing to the end of the discharge valve, ensure the tubing is fitted to the shoulder of the quick coupling.

**6.5.11.** Pressurize the tubing with nitrogen, refer to Appendix B for filling procedure

6.6.4.3. If a leak is present in the tubing or connections retrace steps 6.6.7 & 6.6.8.  
**6.6.5.** If an optional pressure switch is to be installed, remove the pressure gauge and install the pressure switch in the EOL adapter, and check the connection with soapy solution to detect any leaks.

**6.6.6.** Confirm that all connections and the tubing are leak free, then SLOWLY rotate the ball valve to the "ON" position (allow the cylinder pressure and tubing pressure to stabilize). The system is now active


**CAUTION**
**CAUTION**

Slowly rotate the ball valve to the open position by turning the handle counter clockwise. Opening the valve quickly may result in an accidental discharge

and ready for use.

**6.6.7.** Check all ancillary connections for functionality, pressure switch, shut downs etc.

**6.6.8.** Secure the ball valve in the on position by attaching a tamper seal.

## 6.0 FIREDETEC ILP SYSTEM INSTALLATION INSTRUCTIONS (continued)

### 6.7 DISCHARGE PIPE & NOZZLES

- 6.7.1. Determine the routing of the discharge pipe from the cylinder to the nozzle (s), follow the design guidelines.
- 6.7.2. Locate the nozzle(s) following the guidelines established in section 4.9
- 6.7.3. Remove one or two safety plugs from the discharge ports as required
- 6.7.4. Attach a male connection fitting to each open port.
- 6.7.5. Install the pipe or tubing from the cylinder to the nozzle location (s).
- 6.7.6. Secure the pipe or tubing to the structure with the appropriate size clamps as required.
- 6.7.7. Connect the pipe or tubing to the nozzle(s) and secure in place
- 6.7.8. Make all electrical connections to the cylinder valve pressure switch and to the EOL pressure switch to annunciate system discharge, shut down ventilation and other functions required by the applicable governmental or regulatory authority.
- 6.7.9. Mount all warning signs in their selected locations.

### 6.8 SYSTEM RECHARGE

- 6.8.1. Remove one safety plug from a discharge port and connect the FM-200® recharge adapter (Note: the other discharge port must be sealed).
- 6.8.2. With the system ball valve closed, connect a dry nitrogen supply to the system ball valve
- 6.8.3. Weigh and record the system empty weight.
- 6.8.4. Fill the cylinder with the appropriate amount of FM-200®
- 6.8.5. Once filled with FM-200®, open the system ball valve to allow the system to be super-pressurized with dry nitrogen to 240 psig at 70°F (10.3 bar at 21°C)(pressure may have to be adjusted for temperatures higher or lower than 70°F).
- 6.8.6. Close the system ball valve and disconnect the FM-200® recharge adapter, immediately threading the discharge port plug into the valve (Note: there will be FM-200® trapped in the valve and supply tube that will be vented. Venting will only occur for a short period of time until the valve and supply lines are clear.
- 6.8.7. Shake the system thoroughly to ensure complete absorption of the nitrogen into the FM-200®. (Note: nitrogen absorption will result in some pressure loss).
- 6.8.8. Open the system ball valve, pressurize back up to 240 psig at 70°F, and close the system ball valve.
- 6.8.9. Repeat steps 7 and 8 until shaking of the system does not result in any pressure (i.e., no further nitrogen absorption) and a pressure of 240 psig is reached
- 6.8.10. Disconnect the dry nitrogen supply.
- 6.8.11. Verify the system gross weight by checking it against what is printed on the label
- 6.8.12. Leak test the cylinder
- 6.8.13. The system is now ready to be transported to the installation site.

**DANGER**

**DANGER**

The system ball valve must be closed during removal of the FM-200® recharge adapter and installation of the safety plug to assure that the cylinder valve does not inadvertently actuate while the valve outlet port is wide open. Failure to follow this procedure could result in personal injury and damage to property.

**CAUTION**

**CAUTION**

Any prolonged hissing or discharge coming from vent valve indicates that the piston is not seated properly or has opened. If the occurs, repressurize with dry nitrogen to attempt to reseat the piston.

**CAUTION**

**NOTE**

- The pressure gauge attached to the extinguishing system is not to be used to determine when the intended changing pressure has been reached.
- A pressure regulator is to be used when the pressure source is a tank of high pressure gas.

## 7.0 FINAL SYSTEM CHECK OUT

The checkout procedures outlined in this section are intended to represent the minimum requirement for the extinguishing portion of the system. Additional procedures may be required by the applicable governmental or regulatory authority.

### 7.1 COMPARTMENT (HAZARD) AREA CHECK

#### 7.1.1. AREA CONFIGURATION

The hazard area dimensions should be checked against those shown on the system plan(s). If the area volume or geometry has changed, the agent weight should be recalculated and compared with the agent weight supplied. The area should also be checked for bulkheads or movable partitions, which have been added or changed. If partitions have been added, check to see that all areas within the compartment still receive adequate agent distribution.

#### 7.1.2. AREA LEAKAGE

The hazard area should be checked for openings which could allow agent leakage after system discharge. Openings, such as cable, pipe and duct penetrations into the area, should be permanently sealed. Other sources of leakage should be checked for and sealed. Doors entering and access panels in the hazard area should be checked for tightness. Seals and door sweeps should be installed to minimize leakage. Wall switch and receptacle boxes should be sealed. Drains must have "P"-traps and be sealed with a non-evaporating liquid, such as anti-freeze or mineral oil. All penetrations between walls and side panels must be sealed.

#### 7.1.3. CONTAINERS

Check to ensure all containers and brackets are securely fastened.

7.1.3.1. Check all pressure gauges. They should be reading 240 PSIG at 70°F (16.6 bar at 21°C). For temperatures other than 70°F (21°C), reference Section 1.8. Activate all ancillary system functions.

7.1.3.2. Verify that containers of correct weight and pressure are installed in accordance with the design drawings.

#### 7.1.4. AUXILIARY FUNCTIONS

Operation of auxiliary functions such as door closures, damper closures, air handling shutdown, etc. should be verified when the pressure switch is activated.



#### WARNING

If the air handling system is NOT shut down during system discharge, it must be of the recirculating type, and enough agent should have been added to compensate for the duct and plenum volumes. After all checkout functions have been performed, proceed with arming of the system, as outlined in Section 6.6

## 8.0 SYSTEM OPERATION

### 8.1 GENERAL

Compressed FM-200® liquid is held in the container by a discharge valve. When the discharge valve is actuated by an opening in the tubing due to flame impingement, the pressure drop in the tubing allows the valve to open and release the agent from the container to the hazard area through the piping network.

### 8.2 OPERATING PROCEDURES

Operating instructions are a critical part of the FireDETEC ILP fire suppression system installation. Instructions posted remotely from the cylinder storage area should indicate the location of the FM-200® cylinders.

## 8.0 SYSTEM OPERATION (continued)

### 8.3 POST FIRE OPERATION

After a FM-200® fire suppression system discharge, one must observe all posted warnings, (see below), before entering the hazard area. Integrity of the hazard area must be maintained to prevent the migration of products of decomposition to adjacent areas outside of the protected space. After extinguishment, a minimum agent hold time of 10 minutes must be maintained in accordance with NFPA 2001. No one should enter the area until it is cooled down and the person in charge deems it safe to enter the protected space. When ventilating the protected space of products of combustion, care should be taken to allow smoke, decomposition products, etc., to clear the area; away from personnel or critical equipment.

In the event of a fire and system operation the following procedures shall be put in place: Remove the cylinder assembly from the piping network.

**WARNING**

**WARNING**

1. Do not enter the compartment with an open flame or lit cigarette.
2. Flammable vapors, if present, may cause re-ignition or explosion.
3. Do not enter the compartment until the fire is completely extinguished.
4. Do not enter the compartment until it has been ventilated thoroughly.
5. If someone must enter the compartment after the fire has been extinguished, use self contained breathing apparatus.

**WARNING**

**WARNING**

Prior to removal of the valve from the cylinder ensure that all pressure has been released. Relieve any remaining pressure by loosening the safety caps (DO NOT REMOVE THE SAFETY CAPS). Open the ball valve; ensure it remains open (in the "ON" position) allowing any residual pressure to escape through and past the safety plugs.

### 8.4 CYLINDER RECHARGE

After a FM-200® fire suppression system discharges, all containers must be recharged and the fire suppression system returned to a full service condition in a reasonable amount of time.

**8.4.1.** Return all discharged cylinders to a Rotarex fire suppression system distributor to be recharged.

### 8.5 FIREDETEC TUBING

A fire condition causes the tubing to rupture; remove all tubing from the hazard area and replace with new FireDETEC tubing.

## 9.0 MAINTENANCE

The following maintenance procedures and intervals indicated are meant to represent the minimum requirements for FireDETEC FM-200® systems. These procedures do not preclude those required by NFPA 2001 and or the applicable governmental or regulatory authority. More frequent service intervals may be necessary if systems are installed in more severe service applications.

In order to disable any system that is connected to a fire alarm control panel for maintenance or repair, first remove the pressure switch from the end of line solenoid valve, which will cause a supervisory signal at the control panel.

**WARNING**

**WARNING**

FM-200® and Nitrogen cylinders must be handled, installed, inspected and serviced by qualified technicians who have attended a factory sponsored training program. Handling of FM-200® and nitrogen cylinders shall be by those trained personnel and accomplished in accordance with the instructions contained in this manual and compressed Gas Association (CGA) pamphlets C-1, C-6, and P-1. CGA pamphlets may be obtained from the Compressed Gas Association, 4221 Walney Road, Fifth floor, Chantilly, VA 20151-2923

### 9.1 MAINTENANCE PROGRAM

A regular maintenance program must be established for the continuous operation of all FM-200® fire suppression systems. A periodic maintenance program shall be established and followed. A maintenance log must be maintained for ready reference. The log must include the following accumulated data:

- A. Inspection Interval
- B. Inspection procedure performed

**WARNING**

**WARNING**

Failure to comply may result in system failure or personal injury.

- C. Maintenance performed as a result of the inspection
  - D. Name of inspector performing the task
- Any time rust or corrosion is found on a fire suppression cylinder it should be taken out of service and replaced.

## 9.0 MAINTENANCE (continued)

### 9.2 AGENT STORAGE CONTAINERS

#### 9.2.1. EVERY MONTH

- A. Check the container and discharge equipment for physical damage, deterioration or corrosion. If any deterioration or corrosion is evident replace the damaged parts.
- B. Check all support brackets. Tighten loose fittings; replace all damaged or corroded parts.
- C. Inspect the FireDETEC tubing ensure there is no abrasion, cuts, kinks, accumulation of dirt.
- D. Ensure the tubing is free of obstructions that would prevent detection of a fire.
- E. Check the pressure gauge to ensure that pressure is 240 PSIG at 70°F.
- F. Verify enclosure measurements and ensure there are no changes to size or volume.
- G. Check to verify that no changes have been made to the ventilation system.
- H. If any changes have been made or the gauge is not registering the correct pressure contact an authorized Rotarex service company to make the necessary changes or re-gauge the system if necessary.
- I. Check tamper devices on cylinder tubing ball valve and solenoid valve coil (if coil will use a tamper device)

#### 9.2.2. EVERY SIX MONTHS:

- A. Verify the weight of the agent in the container matches the agent weight stamped on the label. If the weight indicates a shortage exceeding five percent of required weight, the container must be removed from service for repair and/or recharge.
- B. To check the weight of the agent in the cylinder:
  - a. Remove the tamper seal from the ball valve and close the valve. Ensure it is in the "off" position.
  - b. De-pressurize the tubing by removing the pressure gauge or pressure switch from the end of line device, there will be a loss of pressure at this time.  
Remark: removal of the pressure switch from the solenoid valve will cause a supervisory signal at the control panel.
  - c. Disconnect the tubing at the ball valve.
  - d. Remove the cylinder from the bracket.
  - e. Weigh the cylinder with a certified scale. If there is a weight loss of more than 5% of the weight stamped on the cylinder label or if there is a 10% loss of pressure; remove and recharge or replace the cylinder assembly.
- C. Reinstall the cylinder and pressurize the tubing in accordance with Section 6.6 of this manual.

#### 9.2.3. FIVE YEAR MAINTENANCE PROCEDURE:

Fire suppression system cylinders in continuous service for 5 years shall be given a complete external visual inspection in place.

#### 9.2.4. CONTAINER TEST AND INSPECTION

ROTAREX FM-200® containers shall not be recharged without a retest if more than five years have elapsed since the last test. The retest consists of a complete external and internal visual inspection in accordance with the Code of Federal Regulations, Title 49, Section 173.34(e) (10). The CFR requirements also refer to the Compressed Gas Association (CGA) Pamphlet C-6, Section 3. Cylinders continuously in service without discharging shall receive a complete external [visual] inspection every five years. The cylinder does not need to be emptied for this inspection.

All visual inspections must be performed according to the regulations of CFR Title 49 and CGA Pamphlet C-6, Section 3. All inspections are to be done by CGA / DOT approved inspectors only. (Reference: NFPA No. 2001, Section 4-2). Note that transporting charged containers that have not been tested within 5 years could be illegal. Federal and local regulations should be consulted before transporting. Refer to National Fire Protection pamphlet 2001, Section 4-2.1.8.1

#### 9.2.5. MAINTENANCE GUIDELINES

Rotarex pre-engineered FM-200® fire suppression systems must be installed and maintained in accordance with the limitations established in NFPA Standard 2001, Clean Agent Extinguishing Systems, as well as the limitations set forth by UL and FM and the applicable governmental or regulatory authority. The information contained within this manual defines the established limitations in detail.

This maintenance guideline has been provided for those individuals that are responsible for the design, installation, and/or maintenance of Rotarex FM-200® hardware and systems. It is the responsibility of the designer and installer to remain within the parameters established in this design, installation and maintenance manual.



#### WARNING

Failure to comply may result in system failure or personal injury.

The following circumstances are the responsibility of those individuals that are responsible for the maintenance of the system:

- Repair or replacement due to normal wear or damage within the scope of routine maintenance work
- Damage to parts whose fragility is a function of the construction of the product
- Damage which is the result of modifications which are not covered by the procedures in this manual PN 027650004.
- Damage resulting from the use of a non-approved part which has been supplied, manufactured or modified using procedures which are not covered by this manual PN 027650004.



## 10.0 POST FIRE SERVICE & MAINTENANCE

### 10.1 REPLACEMENT OF FIREDETEC TUBING

A fire condition causes the tubing to rupture; remove all tubing from the hazard area and replace with new FireDETEC tubing.

### 10.2 CYLINDER VALVE

Because FM-200® will dissolve lubricants it is necessary to disassemble the control valve to inspect, lubricate and service components prior to recharging the system. Prior to the removal of the valve from the container make certain that all pressure has been relieved. Prior to recharging the cylinder clean and lubricate (with Parker Super O-lube) all valve components and "O" rings.

#### WARNING

#### WARNING

FM-200® and Nitrogen cylinders must be handled, installed, inspected and serviced by qualified technicians who have attended a factory sponsored training program. Handling of FM-200® and nitrogen cylinders shall be by those trained personnel.

#### WARNING

#### WARNING

Prior to removal of the valve from the cylinder ensure that all pressure has been released. Relieve any remaining pressure by making sure the ball valve remains open (in the "ON" position) allowing any residual pressure to escape.

#### 10.2.1. DISASSEMBLY OF THE CYLINDER VALVE

- a. MAKE SURE the cylinder pressure has been relieved
- b. When the cylinder pressure has been relieved, remove the valve from the cylinder.
- c. Unscrew the valve cap; inspect it and the "O" ring for damage. Replace if necessary, otherwise lubricate the "O" ring.
- d. Pull the piston out; inspect it and the "O" ring for damage. Replace if necessary, otherwise lubricate the "O" ring.
- e. Clean the valve seat, lubricate lightly.
- f. Place the piston in the valve and screw the valve cap on the valve body; tighten
- g. Inspect "O" ring on the cylinder neck, Lubricate or replace and lubricate if necessary.
- h. Fit the valve to the cylinder and refill cylinder with FM-200®.

## 11.0 WARRANTY STATEMENT

### ROTAREX LIMITED WARRANTY

Rotarex North America, Inc. warrants to the original purchasers that the products manufactured by it shall be free from defects in materials and workmanship under normal use for a period of one (1) year from the date of manufacture.

### CONDITIONS

The limited warranty is based upon the customer satisfying the following conditions:

- A. The product must be supplied and installed by an authorized Rotarex distributor, in accordance with the written instructions contained in this manual or other data supplied with Rotarex products.
- B. The Rotarex products have not been altered or modified.
- C. The original purchaser must maintain a semi-annual maintenance agreement with an authorized Rotarex distributor, commencing with the date the Rotarex product was accepted by the purchaser and placed into service. The service agreement must remain in effect for the duration of the warranty.
- D. The Rotarex warranty registration card must be completed and returned to: Rotarex North America, Inc. 221 Westec Drive, Mt. Pleasant, PA 15666

- E. Within thirty (30) days after the buyer's discovery of what the buyer believes is a defect, the purchaser must notify Rotarex in writing and ship the product to Rotarex North America, Inc., 221 Westec Dr., Mt. Pleasant PA, 15666. Rotarex, at its option, and within forty-five (45) days of receipt, will repair, replace or refund the purchase price of that part or product found by Rotarex to be defective. Failure of the buyer to give such written notice and ship the product within thirty (30) days shall be deemed absolute and unconditional waiver of any and all claims of the buyer arising out of such defect.

#### WARNING

#### WARNING

Failure to comply may result in system failure or personal injury.

## 11.0 WARRANTY STATEMENT (continued)

### LIMITATIONS

This warranty does not extend to any product or parts that is not installed and used continuously after installation in accordance with Rotarex's instructions in this manual, all applicable state and local regulations, and all applicable national standards, such as those promulgated by NFPA, DOT and ANSI. This warranty does not extend to any product or part that has been damaged by accident, misuse, abuse, failure to maintain, or neglect, nor does it extend to any product or part which has been modified, altered, disassembled, or repaired in the field.

This warranty does not cover any cosmetic issues, such as scratches, dents, marring, fading of colors or discoloration. In no event shall Rotarex be liable for consequential or incidental damages arising from the purchase and or use of Rotarex products, including but not limited to: damages resulting from loss of use of Rotarex products, the costs of replacing discharge suppression agent, damages for lost profits or

income, or damages for resulting harm to property other than the Rotarex products. Furthermore, Rotarex is not liable for variations in product performance due to normal wear of parts, which by their nature, are subject to continuous wear.

Except as expressly set forth above, and subject to the limitation of liability below, Rotarex MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, with respect to its products and parts, whether used alone or in combination with others. Rotarex disclaims all warranties not stated herein.

### LIMITATION OF LIABILITY

The parties agree that the total liability of Rotarex for any and all claim for losses and/or damages allegedly arising out of the use of any Rotarex product, or arising out of any alleged breach of this warranty, shall in no event exceed the purchase price of the products or parts involved, whether such claim be based on theories of contract, negligence, strict liability, tort or otherwise.

Rotarex shall not be liable for incidental, consequential, lost profit or punitive damages or other losses arising out of or alleged caused by the use of any Rotarex product. Rotarex shall not be liable for, and the purchaser assumes any liability for, all personal injury and property damage connected with the handling, transportation, possession, further manufacture, other use

or resale of products, whether used alone or in combination with any other products or materials..

NOTE: Some States do not allow the exclusion or limitation of incidental, consequential, or punitive damages, so the above limitation or exclusion may not apply to you. The warranty gives you specific legal rights, and you may have other rights that vary from state to state. The portions of this limited warranty and limitation of liability shall be considered severable and all portions which are not disallowed by applicable law shall remain in full force and effect.



### WARNING

All Rotarex products are mechanical devices that will eventually become inoperative due to wear, corrosion and aging of components made of materials such as rubber, etc. The environment and conditions of use will determine the safe service of these products. Periodic inspection and maintenance are essential to avoid serious injury and property damage.

Many Rotarex products are manufactured components which are incorporated by others on or in other products or systems used for storage, transport and transfer and otherwise for use of toxic, flammable and dangerous liquids and gases. Such substances must be handled by experienced and trained personnel only, using accepted governmental and industrial safety procedures.

All Rotarex products are furnished using all Rotarex components. All units must exclusively use Rotarex components, especially for connection (s) to the tubing. Failure to use Rotarex components exclusively voids all warranties and will release Rotarex of any and all liability on the performance of the Rotarex components and unit.

Because of a policy of continuous improvement, Rotarex reserves the right to change designs, materials or specifications without notice. FAILURE TO FOLLOW THESE INSTRUCTIONS AND THE OTHER INSTRUCTIONS IN THE USER MANUAL MAY RESULT IN SEVERE PERSONAL INJURY OR DEATH.

### NON-ASSIGNMENT OF WARRANTY

The limited warranty set forth herein may not be assigned, transferred or sold in any way and extends only to the original purchaser.

Because of a policy of continuous improvement, Rotarex reserves the right to change designs, materials or specifications without notice.



## APPENDIX A | SYSTEM & PARTS LIST

### FIREDETEC® SENSOR TUBING

Spool of FireDETEC® sensor tubing in various lengths

#### KEY FEATURES

- Choice of standard or heavy duty versions
- Available in various lengths

#### STANDARD SENSOR TUBING



**25 feet:** B0780017  
**50 feet:** B0780018  
**100 feet:** B0780019  
**328 feet:** B0780002

<b>Outside Diameter</b>	Ø: 0.234" / 6 mm
<b>Inside Diameter</b>	Ø: 0.156" / 4 mm
<b>Color</b>	Red RAL 3000
<b>Min. bend radius</b>	4" / 100 mm

#### HEAVY DUTY SENSOR TUBING



**25 feet:** B0780203  
**50 feet:** B0780204  
**100 feet:** B0780205  
**328 feet:** B0780200

<b>Outside Diameter</b>	Ø: 0.234" / 6 mm
<b>Inside Diameter</b>	Ø: 0.156" / 4 mm
<b>Color</b>	Black RAL 9005
<b>Min. bend radius</b>	5.9" / 150 mm

### B07850030 | PROTECTION SPRING

To protect the sensor tubing from damage



#### KEY FEATURES

- Coils around the entire length of the sensor tube to provide a protective casing

<b>Length</b>	19.4' / 5,8 meters
<b>Material</b>	Stainless Steel

# APPENDIX A | SYSTEM & PARTS LIST (continued)

## END OF LINE DEVICES

To seal and/or charge the far end of the sensor tube

### KEY FEATURES

- Nickel plated brass body

### END OF LINE PLUG

029510056



Basic plug to seal the end of line

### END OF LINE GAUGE

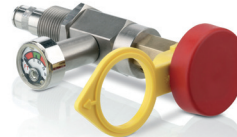
B07810026



Includes: check valve, pressure gauge & fittings to connect to sensor tubing

### MANUAL ACTUATOR

B04420128



Includes: pressure gauge, connection for filling adaptor and fittings to connect to sensor tubing  
Large, easily visible knob  
Yellow safety collar

### SOLENOID ACTUATOR

B04420127



Includes: pressure gauge, connection for filling adaptor, fittings to connect to sensor tubing.  
For supplemental actuation via electronic sensor or control room

	End of line plug	End of line gauge	Manual actuator	Solenoid actuator
<b>Tube connection</b>	6mm Compression fitting	6mm Quick Connect fitting	6mm Quick Connect fitting	6mm Quick Connect fitting
<b>Length</b>	1.13" / 29 mm	2.77" / 71 mm	4.95" / 106 mm	3.9" / 100 mm
<b>Hex flats</b>	SW 12	SW 12	SW 12	9W / 24V
<b>Gauge scale</b>		0 to 400 psi	0 to 400 psi	0 to 400 psi
<b>Charging port</b>	NO	YES	YES	YES

## B07810005 | FILLING ADAPTOR

Allows connection of a charging cylinder to an end-of-line device to pressurize the sensor tube



### KEY FEATURES

- Includes: quick coupling connector and threaded end-of-line connection

## APPENDIX A | SYSTEM & PARTS LIST (continued)

### NOZZLES FOR HFC 227 EA

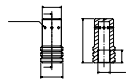
Dispersion nozzles for FireDETEC® pre-engineered Kits using FM-200® extinguishing agent.

#### KEY FEATURES

- Corresponds to NFPA 2001 guidelines regarding diameter, orifice size and orifice quantity
- Raw brass

#### 3 LB. KIT

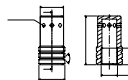
026200102



1 Nozzle only

#### 7 LB. KIT

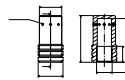
026200104



1 Nozzle configuration

#### 7 LB. KIT

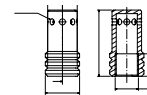
026200103



2 Nozzle configuration

#### 14 LB. KIT

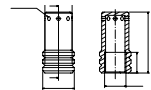
026200107



1 Nozzle configuration

#### 14 LB. KIT

026200105



2 Nozzle configuration

	3 lb. kit	7 lb. kit	7 lb. kit	14 lb. kit	14 lb. kit
<b>Nozzle Diameter</b>	¼" NPT	⅜" NPT	⅜" NPT	½" NPT	½" NPT
<b>Orifice Diameter</b>	0.085"	0.138"	0.085"	0.200"	0.138"
<b>Orifice Quantity</b>	8	8	8	8	8
<b>Nozzle Pressure</b>	32.7 psi	48.6 psi	57.7 psi	53.7 psi	56 psi
<b>Discharge time</b>	8.7 seconds	8.8 seconds	8.2 seconds	7.5 seconds	7.6 seconds
<b>Nozzle O.D.</b>	Ø: 0.74" / 19 mm	Ø: 0.875" / 22,5 mm	Ø: 0.875" / 22,5 mm	Ø: 0.975" / 25 mm	Ø: 0.975" / 25 mm

# APPENDIX A | SYSTEM & PARTS LIST (continued)

## QUICK CONNECTION FITTINGS FOR SENSOR TUBING

Fittings to connect FireDETEC® sensor tubing

### KEY FEATURES

- Plug-in connections for quick, secure and leak-free installations
- Nickel plated brass

### STRAIGHT COUPLING

B07831010



### ELBOW

B07831006



### TEE

B07830007



### END ELBOW

B07831008



	Straight coupling	Elbow	Tee	End elbow
<b>Connections</b>	25" / Ø 6 mm G½ male	25" / Ø 6 mm	25" / Ø 6 mm	25" / Ø 6 mm G½ male
<b>Length</b>	0.195" / 5mm	0.195" / 5mm	0.195" / 5mm	0.195" / 5mm

## CROSS PANEL PROTECTIVE FITTINGS

Fittings to attach and/or protect sensor tubing through a panel

### KEY FEATURES

- Polymer construction to protect from sharp metal edges

### THROUGH - PANEL FASTENER

B07830005



Exerts radial compression when tightened to securely hold tubing in place

<b>Material</b>	Nylon
<b>Orifice Diameter</b>	Ø 0.25" / 6mm
<b>Max. panel thickness</b>	0.95" / 2.4mm
<b>Length</b>	1.18" / 30mm

### THROUGH PANEL PROTECTOR

B07860001



Protects the sensor tubing from sharp edges

<b>Material</b>	Rubber
<b>Orifice Diameter</b>	Ø 0.25" / 6.3mm
<b>Max. panel thickness</b>	0.07" / 1.8mm
<b>Length</b>	0.20" / 5mm

## APPENDIX A | SYSTEM & PARTS LIST (continued)

### B07860000 | SELF ADHESIVE CLIPS FOR SENSOR TUBE ATTACHMENT

Self-adhesive clips to secure  
Ø 6mm  
FireDETEC® sensor tubing



#### KEY FEATURES

- Self-adhesive
- Clip-in/Clip out design

<b>Material</b>	Polyamide
<b>Dimensions</b>	0.75" x 0.75" / 19 x 19mm
<b>Attachment</b>	Self-adhesive base

### B07860005 | CABLE BINDER STRIPS FOR SENSOR TUBE ATTACHMENT

Cable tie to bundle sensor  
tubing together with  
electrical cables and bind  
onto supports



#### KEY FEATURES

- Self-adhesive base
- Ratchet design stays securely fastened

<b>Material</b>	Polyamide
<b>Dimensions</b>	1.10" x 1.10" / 28 x 28mm
<b>Attachment</b>	Self-adhesive base

### B07860002 | SCREWED CLIPS FOR SENSOR TUBE ATTACHMENT

Screwed attachment clip  
to secure 6mm sensor or  
discharge tubing



#### KEY FEATURES

- Includes protective rubber sleeve

<b>Material</b>	Aluminium and chloroprene
<b>Dimensions</b>	0.20" / 5,2 mm hole
<b>Attachment</b>	screws (not included)

## APPENDIX A | SYSTEM & PARTS LIST (continued)

### 029900168 | PRESSURE SWITCH – 5 BAR

For supplemental functionalities when the system actuates such as sounding an alarm, closing ventilator ducts or cutting power supply.



#### KEY FEATURES

Switch type	SPST
Fixture	1/8" NPT
Proof Pressure	400 psi
Type	Normally open
Electrical rating	120 / 240 VAC - 375 VA

### 029900178 | PRESSURE SWITCH – 5 BAR

For supplemental functionalities when the system actuates such as sounding an alarm, closing ventilator ducts or cutting power supply.



#### KEY FEATURES

Switch type	SPST
Fixture	1/8" NPT
Proof Pressure	400 psi
Type	Normally closed
Electrical rating	120 / 240 VAC - 375 VA

### B07850006 | ALARM 110-220 V AC

Audio alarm for connection to pressure switches to warn if system actuates.



#### KEY FEATURES

Audible signal	87d
Power supply	110-220 V AC / 6 mA
Frequency	3kHz

### PRESSURE RELIEF DEVICE

#### PRESSURE RELIEF DEVICE



(Clean Agent) 400 psi, 3lb

#### PRESSURE RELIEF DEVICE



(Clean Agent) 600 psi, 7lb & 14 lb

Product code	029200091	029200088
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# PARTS & ACCESSORIES | QUICK GUIDE

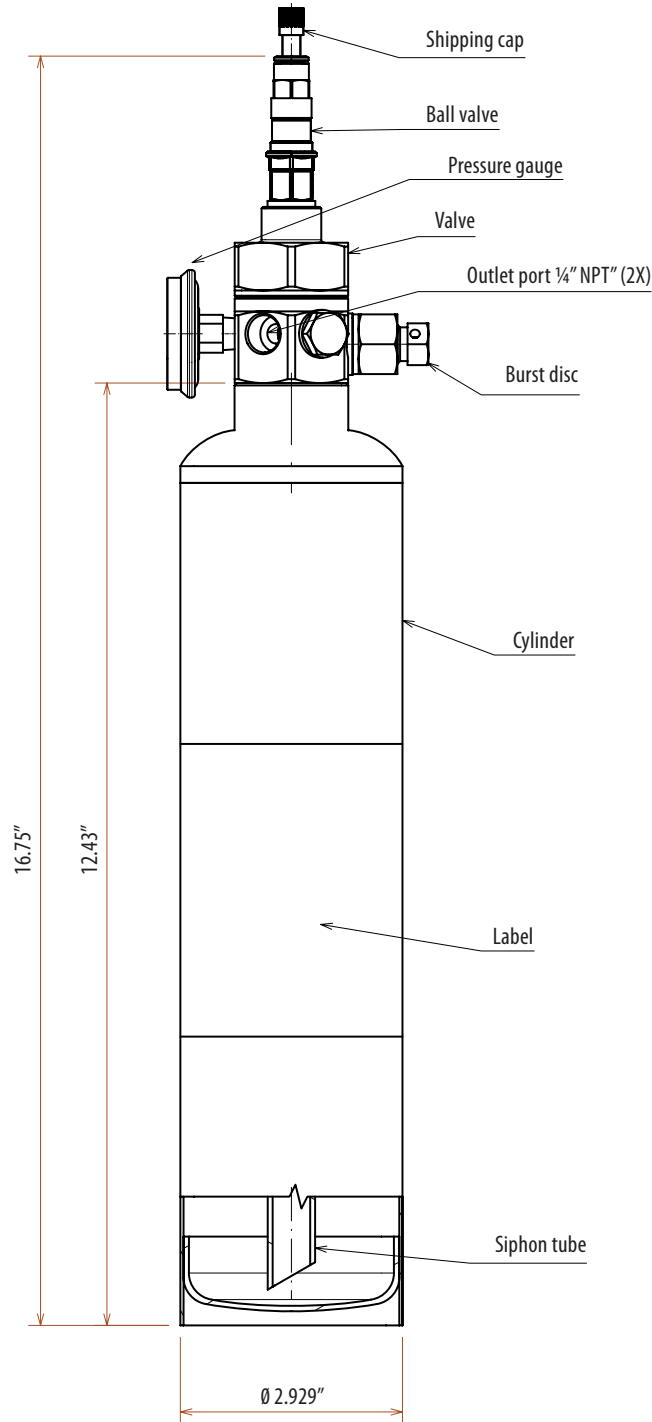
## PRE-ENGINEERED CLEAN AGENT FIRE SUPPRESSION SYSTEMS

FILLED & PRESSURIZED SYSTEMS. Includes bracket & straps	
<b>B07014500</b>	3 POUND SYSTEM FM-200®
<b>B07014501</b>	7 POUND SYSTEM FM-200®
<b>B07014502</b>	14 POUND SYSTEM FM-200®
RED TUBING	
<b>B07800017</b>	25 Feet
<b>B07800018</b>	50 Feet
<b>B07800019</b>	100 Feet
<b>B07800002</b>	328 Feet
BLACK TUBING (UV PROTECTED)	
<b>B07800203</b>	25 Feet
<b>B07800204</b>	50 Feet
<b>B07800205</b>	100 Feet
<b>B07800200</b>	328 Feet
TUBE CONNECTORS	
<b>B07831000</b>	STRAIGHT COUPLING
<b>B07831006</b>	ELBOW
<b>B07831007</b>	T CONNECTION
<b>B07831008</b>	TURNING END QUICK COUPLING
END OF LINE DEVICES	
<b>029510056</b>	EOL PLUG
<b>B07810026</b>	EOL ADAPTER W/GAUGE
<b>B04420128</b>	EOL W/MANUAL RELEASE/GAUGE
<b>B04420127</b>	EOL W/SOLENOID/GAUGE
DISCHARGE NOZZLES FM-200®	
<b>026200102</b>	¼" Nozzle (3 lb FM-200® systems)
<b>026200104</b>	⅜" Nozzle ( 7 lb FM-200® systems)
<b>026200107</b>	½" Nozzle (14 lb FM-200® systems)
<b>026200103</b>	¾" Nozzle (7 lb 2 Nozzle FM-200® systems)
<b>026200105</b>	½" Nozzle (14 lb 2 Nozzle FM-200® systems)
ADAPTORS	
<b>B07810005</b>	Quick Connect Tube Pressurizing Adaptor
CYLINDER BRACKETS	
<b>029900169</b>	Cylinder bracket & SS Straps 3 pound cylinder
<b>029900170</b>	Cylinder bracket & SS Straps 7 pound cylinder
<b>029900171</b>	Cylinder bracket & SS Straps 14 pound cylinder
VALVE ASSEMBLIES	
<b>B07010208</b>	Valve assembly 3 pound (1 in.) FM-200®
<b>B07010303</b>	Valve assembly 7 & 14 pound (1.5 in.) FM-200®
ADDITIONAL ITEMS	
<b>029200088</b>	PRESSURE RELIEF DEVICE (Clean Agent) 600 psi 7 lb & 14 lb
<b>029200091</b>	PRESSURE RELIEF DEVICE (Clean Agent) 480 psi 3 lb
<b>022200040</b>	PROTECTION SPRING 5.9 M (19.4FEET)
<b>B07850006</b>	9 VOLT SOUNDER (No Battery)
<b>B07860002</b>	SCREWED METAL CLIP for Tube Attachment
<b>B07860001</b>	THROUGH PANEL PROTECTOR
<b>B07830005</b>	THROUGH PANEL FASTENER
<b>B07860000</b>	SELF ADHESIVE CLIP FOR SENSOR TUBE ATTACHMENT
<b>B07860005</b>	CABLE BINDER STRIPS FOR SENSOR TUBE ATTACHMENT
<b>024920014</b>	SENSOR TUBE GRIPPING TOOL
<b>B07850001</b>	TUBE CUTTER
<b>029900168</b>	PRESSURE SWITCH with adaptor
<b>028200190</b>	PRESSURE GAUGE FM-200®
<b>027650004</b>	FM-200® DESIGN, INSTALLATION & MAINTENANCE MANUAL

# APPENDIX B | COMPONENT DRAWINGS

## CYLINDER & VALVE ASSEMBLY | FM-200®

Product code | B07014509

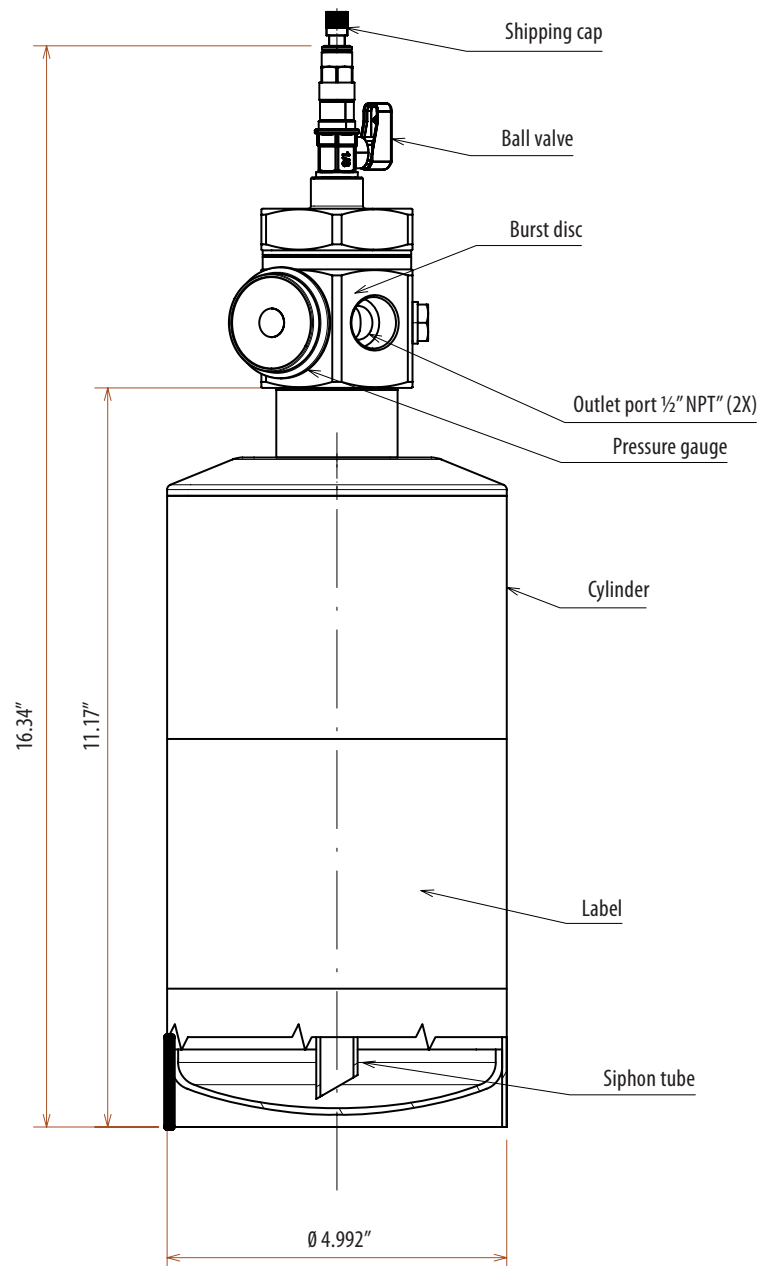




## APPENDIX B | COMPONENT DRAWINGS (continued)

### CYLINDER & VALVE ASSEMBLY | FM-200®

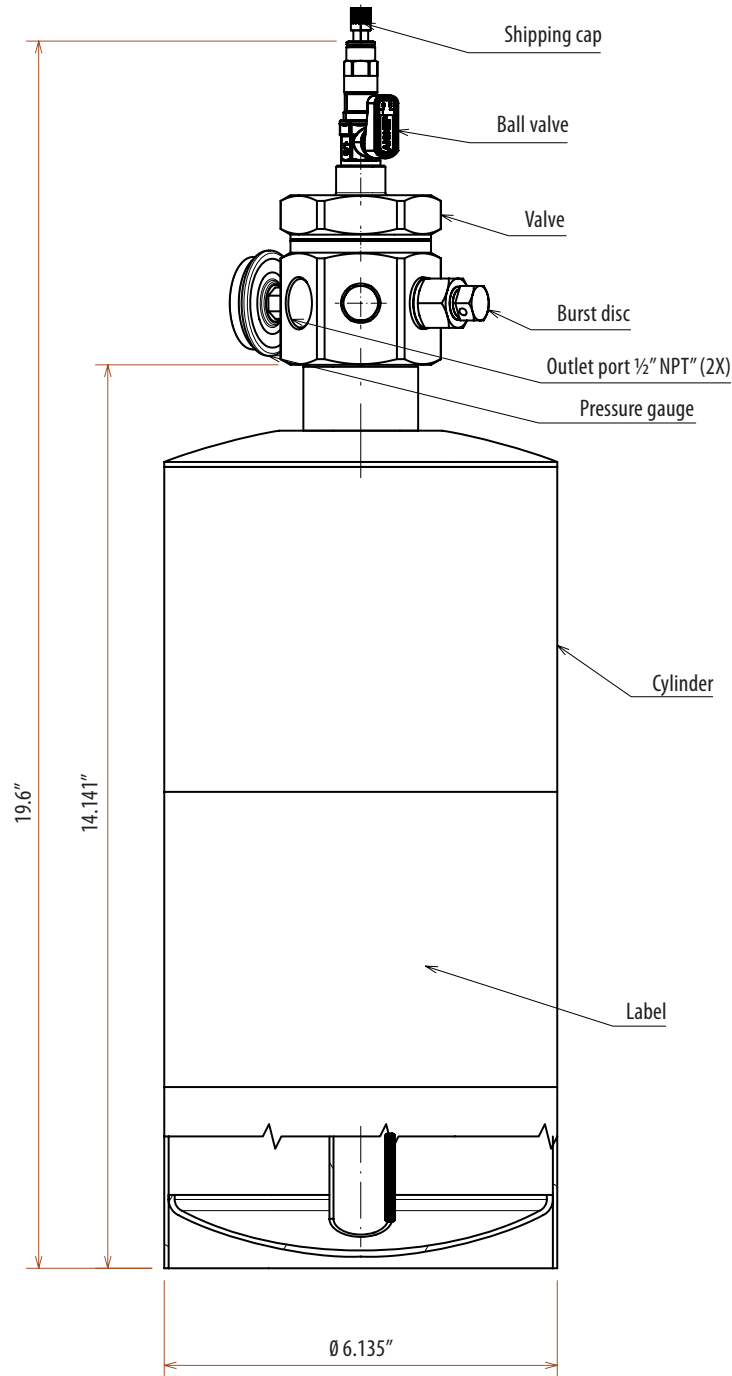
Product code B07014510



# APPENDIX B | COMPONENT DRAWINGS (continued)

## CYLINDER & VALVE ASSEMBLY | FM-200®

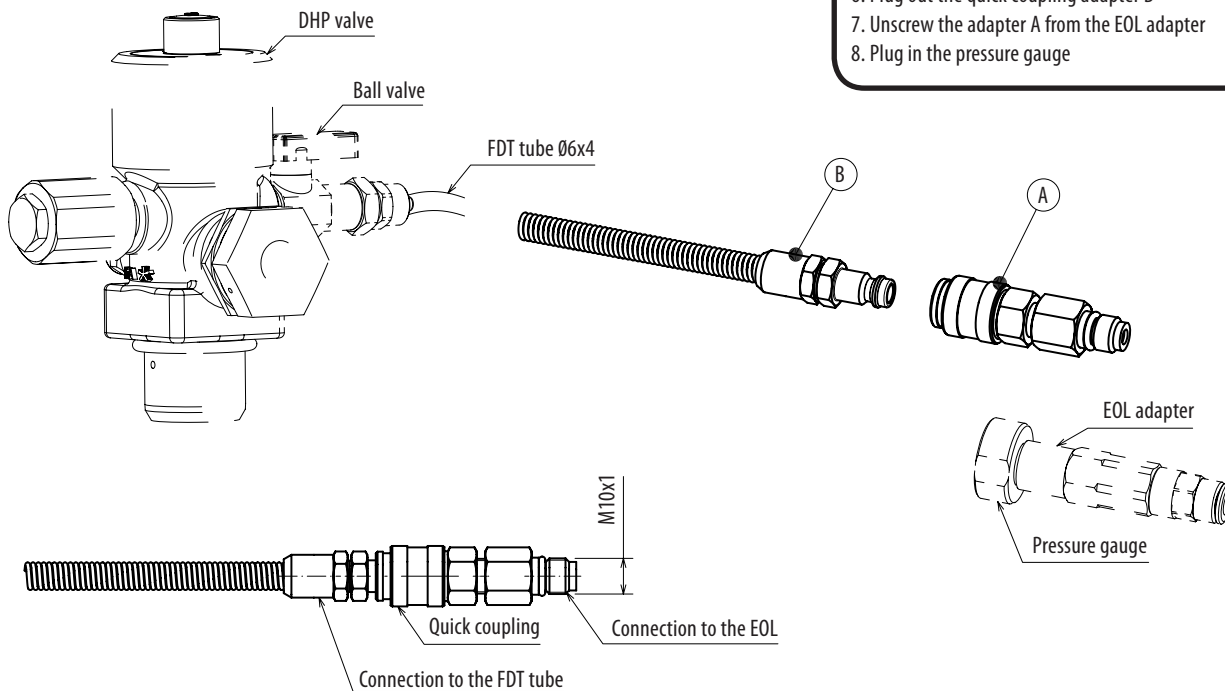
Product code | B07014511



## APPENDIX B | COMPONENT DRAWINGS (continued)

### FILLING ADAPTOR

Product code | B07810005

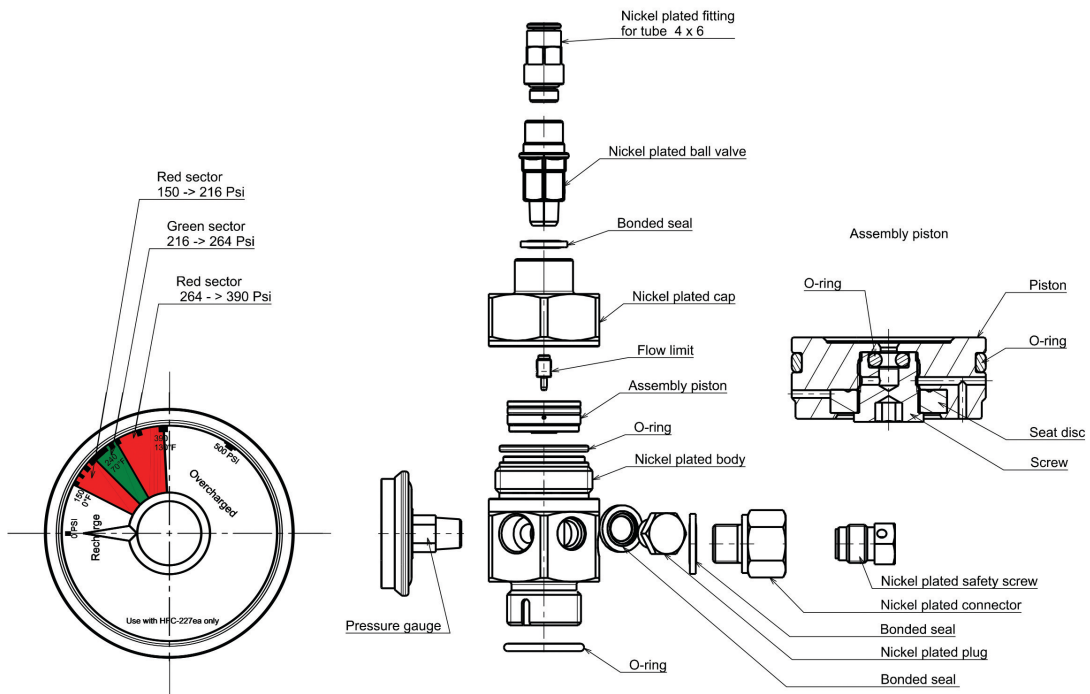
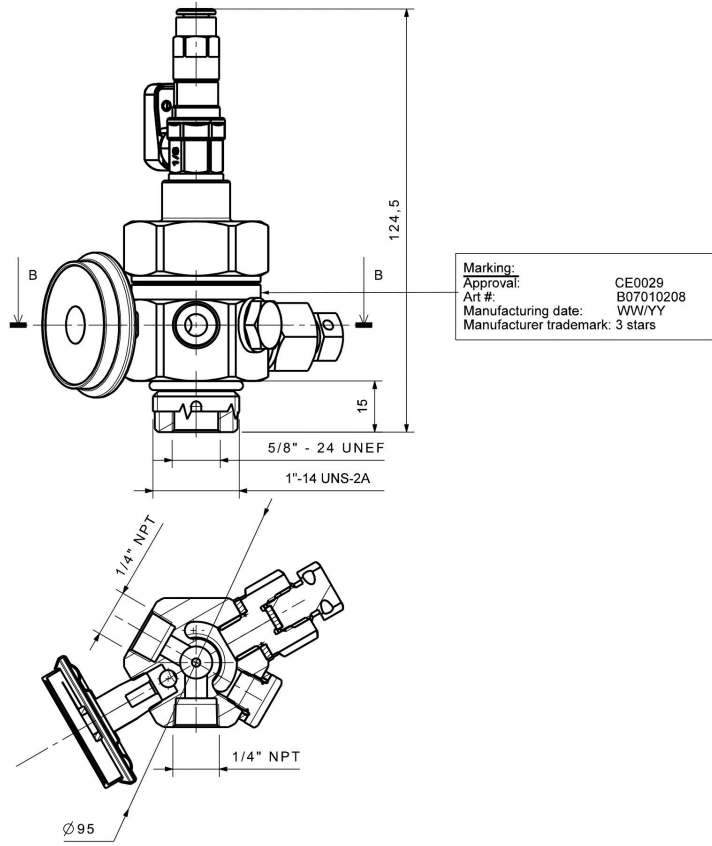


#### FDT line filling procedure:

1. Unscrew the pressure gauge out of the end of line (EOL) adapter
2. Screw adapter A into the EOL adapter
3. Plug the quick coupling B into EOL adapter A
4. Open the ball valve from DHP valve
5. When pressure has been built up in the FDT tube, close the ball valve
6. Plug out the quick coupling adapter B
7. Unscrew the adapter A from the EOL adapter
8. Plug in the pressure gauge

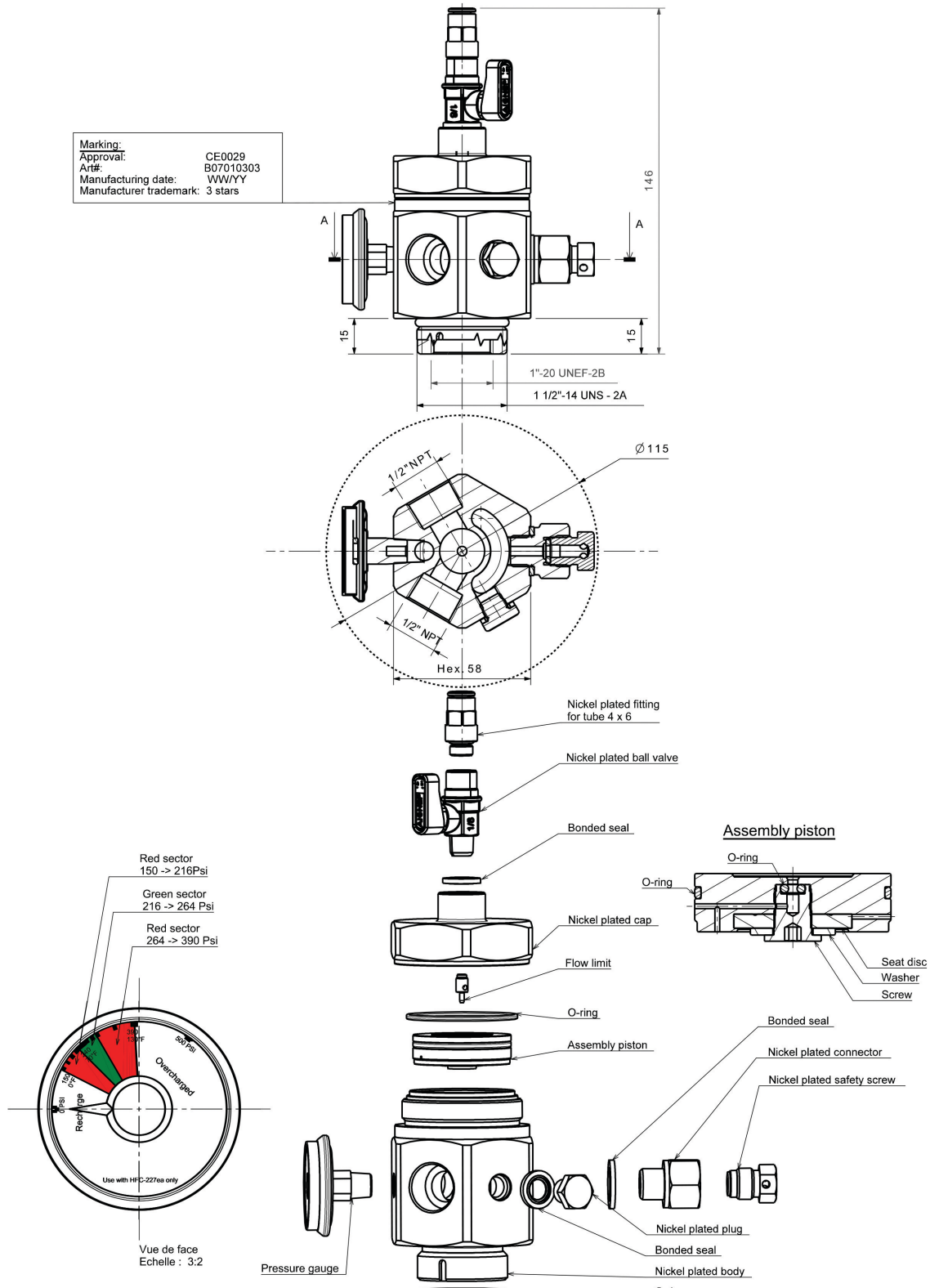
# APPENDIX B | COMPONENT DRAWINGS (continued)

## VALVE | B07010208



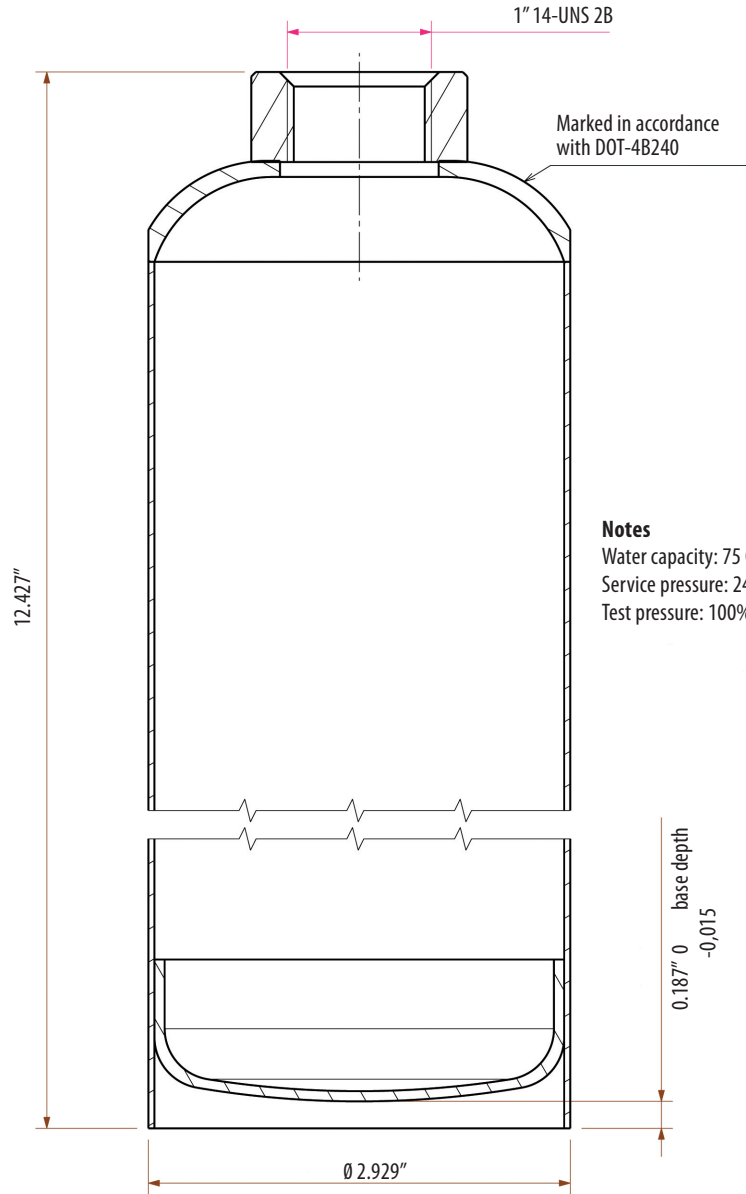
# APPENDIX B | COMPONENT DRAWINGS (continued)

## VALVE | B07010303



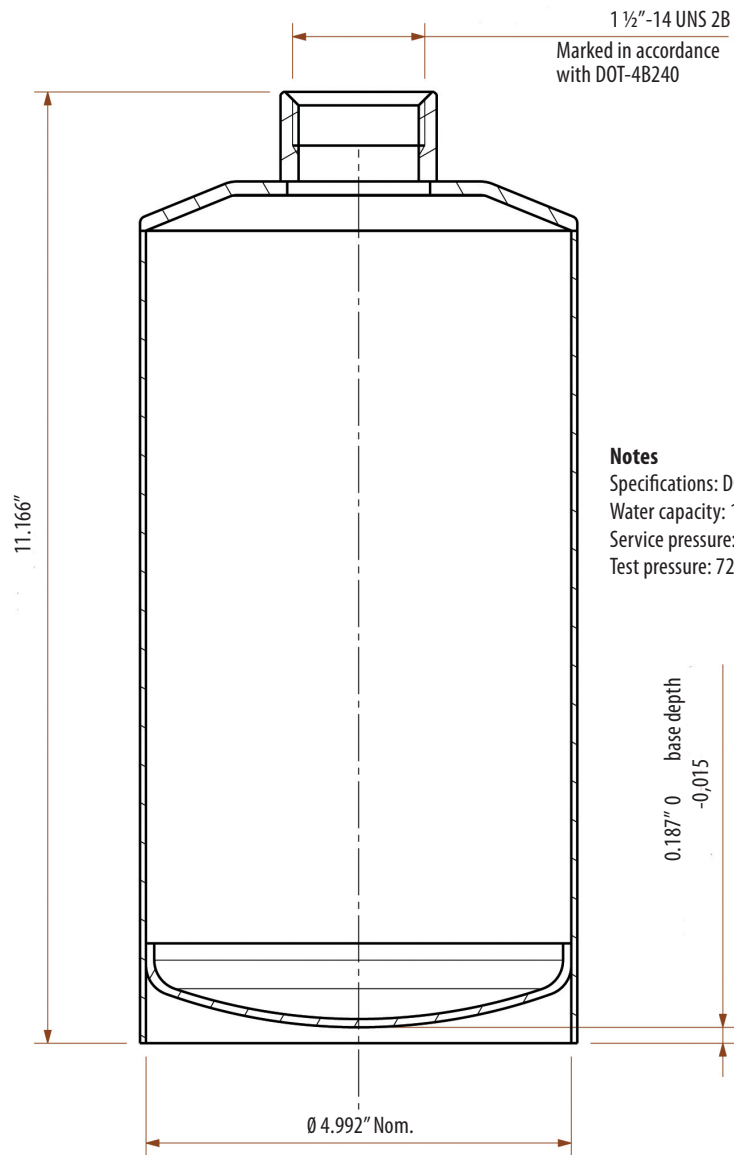
# APPENDIX B | COMPONENT DRAWINGS (continued)

## CYLINDER | 028800011



# APPENDIX B | COMPONENT DRAWINGS (continued)

## CYLINDER | 028800012



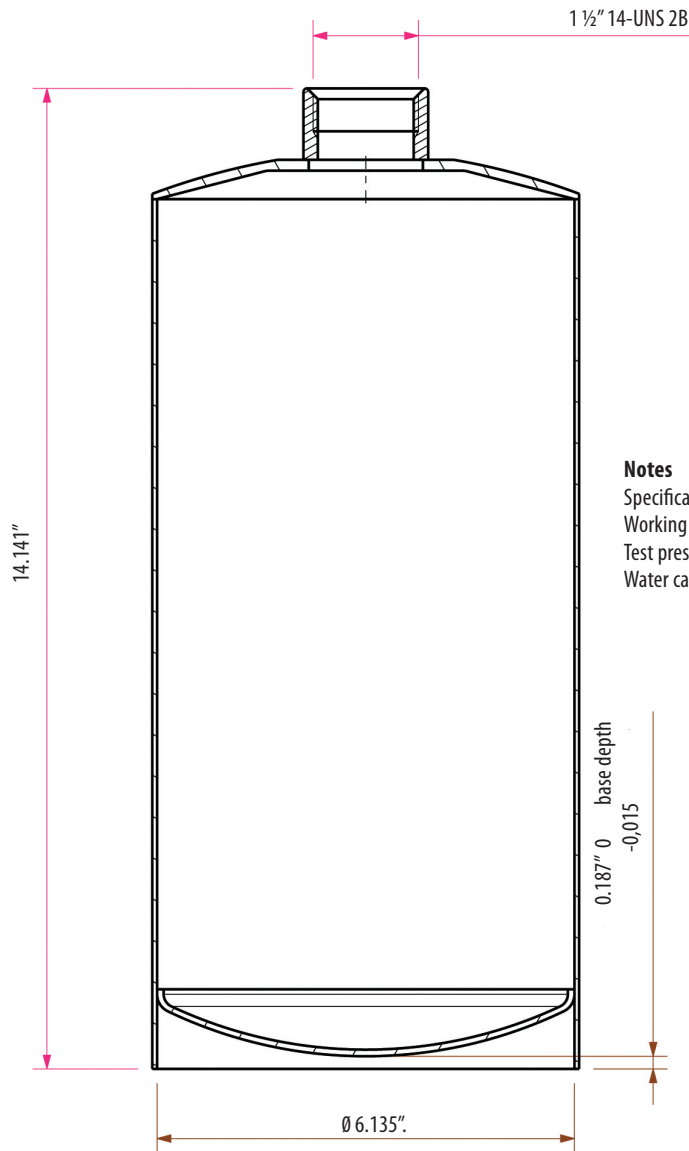
**Notes**

Specifications: DOT-4B360  
Water capacity: 174 CU. IN.  
Service pressure: 360 psi  
Test pressure: 720 psi



# APPENDIX B | COMPONENT DRAWINGS (continued)

## CYLINDER | 028800013

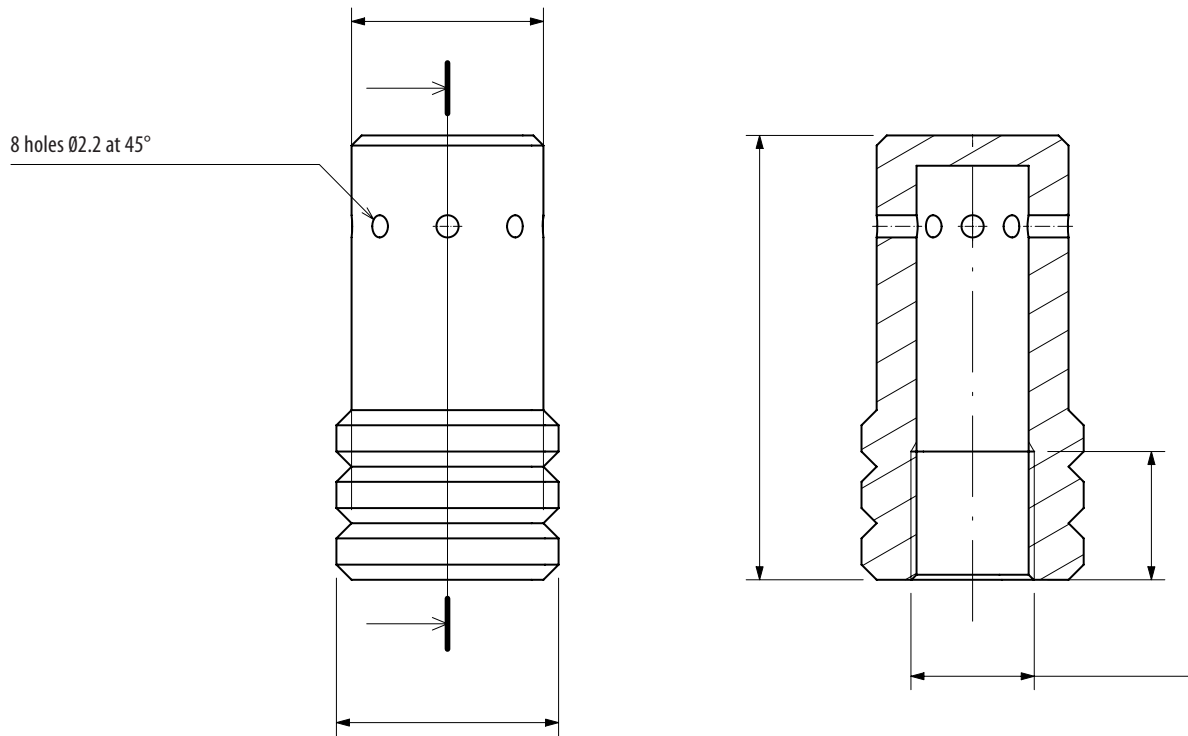


**Notes**  
Specifications: DOT-4B360  
Working pressure: 360 psi  
Test pressure: 720 psi  
Water capacity: 350 CU IN

# APPENDIX B | COMPONENT DRAWINGS (continued)

## BRASS 1/4" NOZZLE (3LB FM-200® SYSTEMS) | 026200110

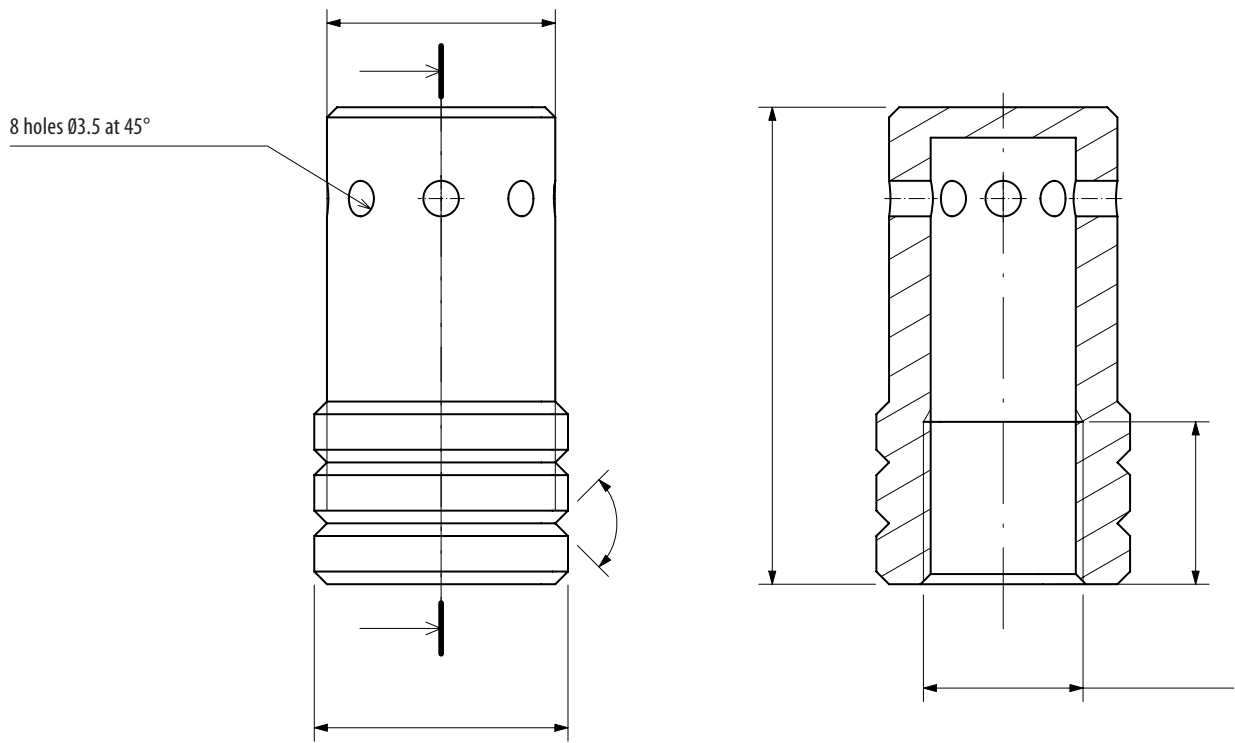
Product code | 026200013



# APPENDIX B | COMPONENT DRAWINGS (continued)

## BRASS 3/8" NOZZLE (7LB FM-200® SYSTEMS) | 026200111

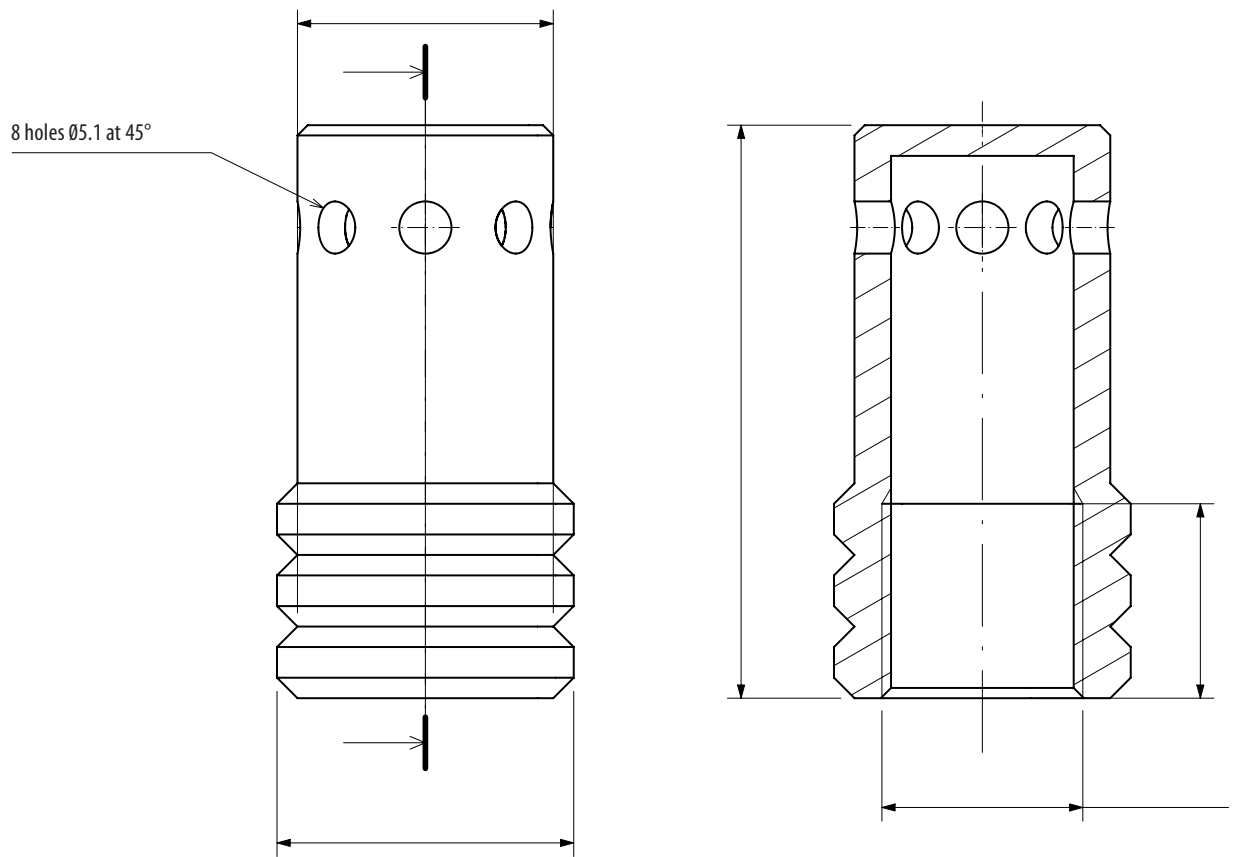
Product code	026200111
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# APPENDIX B | COMPONENT DRAWINGS (continued)

## BRASS 1/2" NOZZLE (14LB FM-200® SYSTEMS) | 026200108

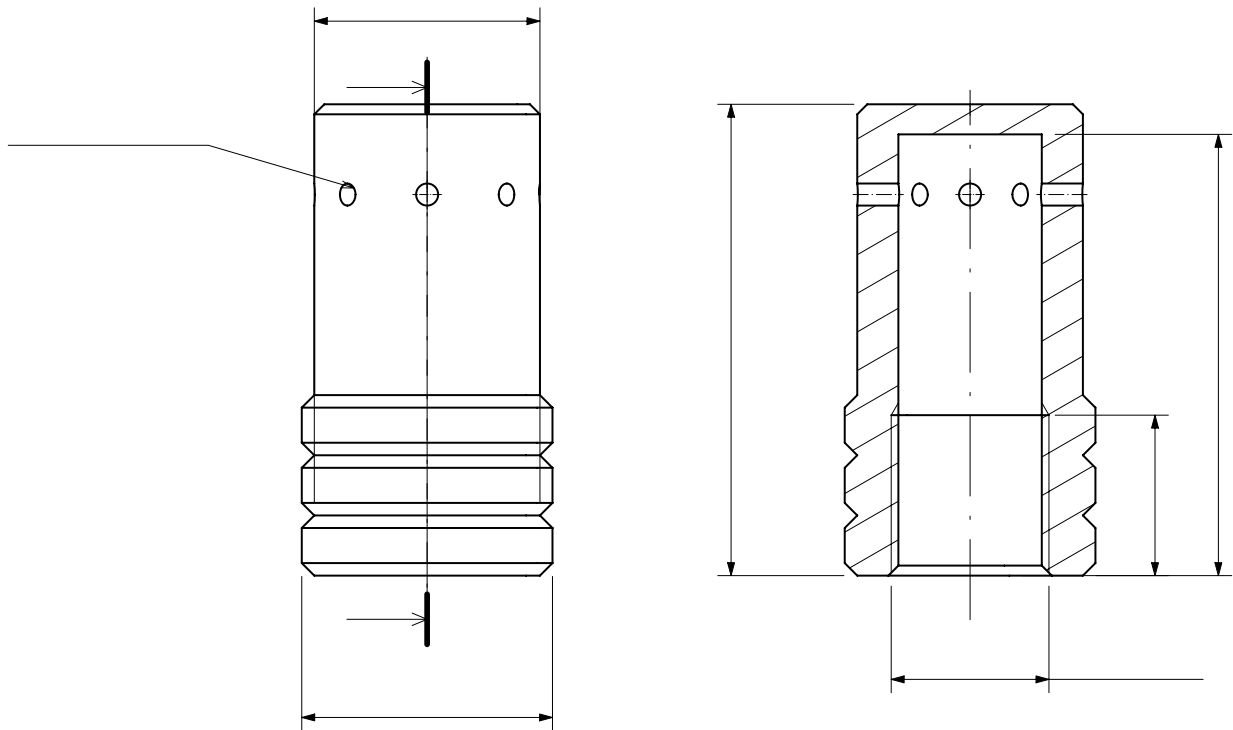
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# APPENDIX B | COMPONENT DRAWINGS (continued)

## BRASS 3/8" NOZZLE (7LB, 2 NOZZLE FM-200® SYSTEMS) | 026200106

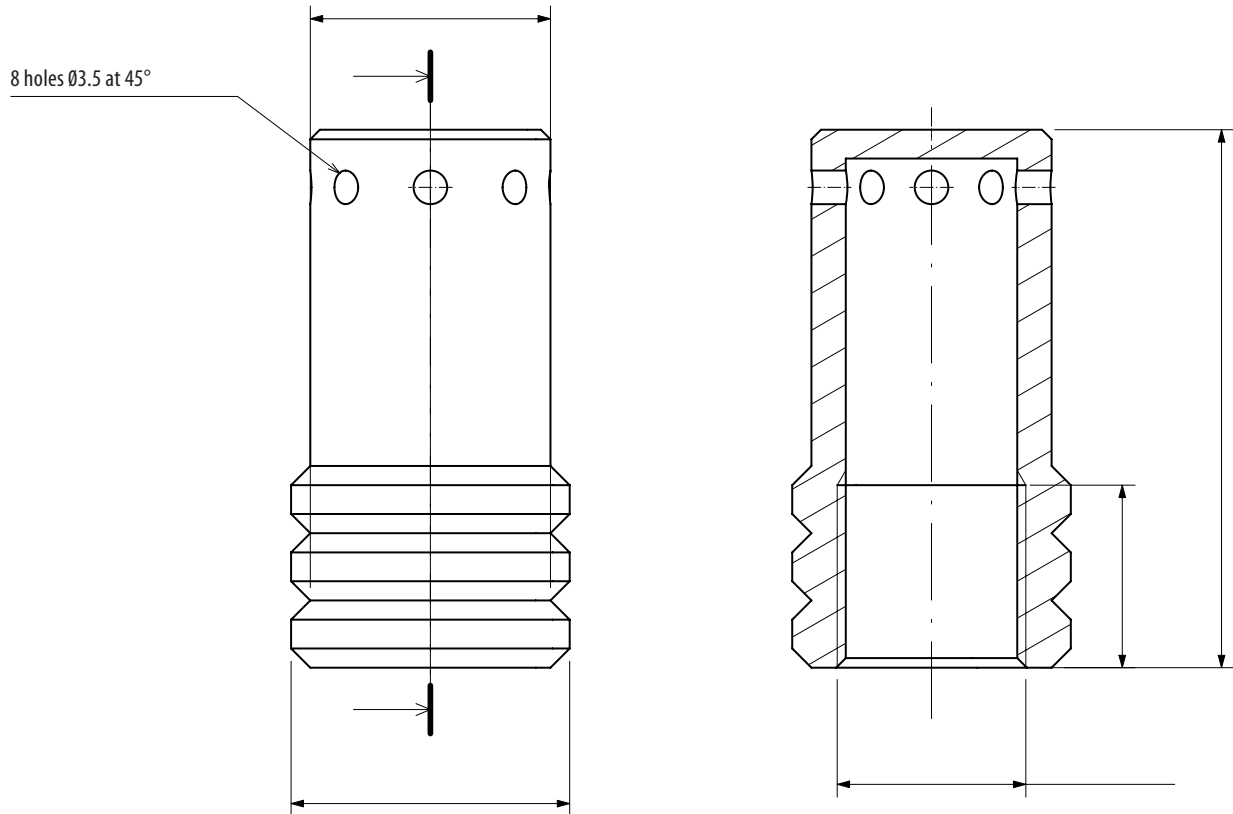
Product code | 026200106



# APPENDIX B | COMPONENT DRAWINGS (continued)

## BRASS 1/2" NOZZLE (14LB, 2 NOZZLE FM-200® SYSTEMS) | 026200109

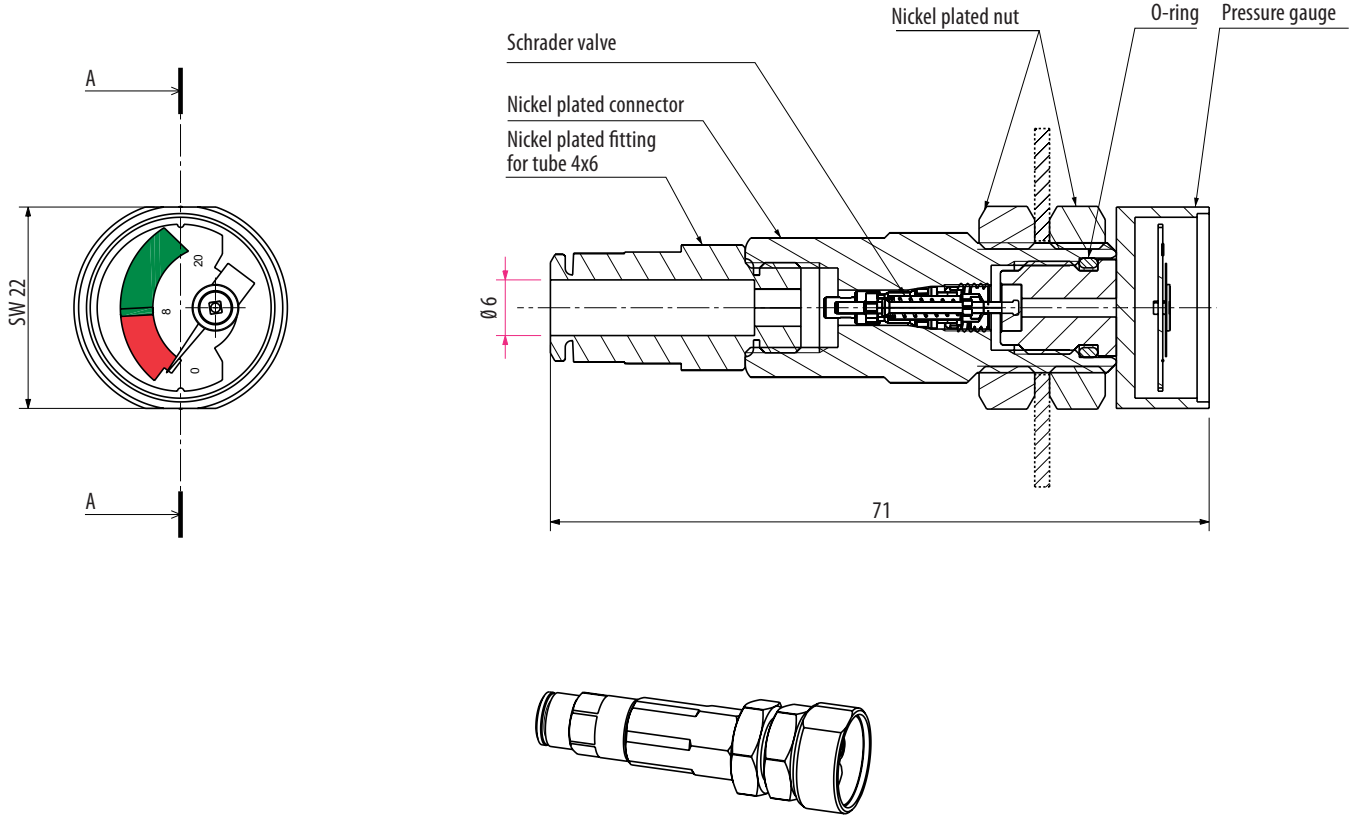
Product code | 026200109



# APPENDIX B | COMPONENT DRAWINGS (continued)

## END OF LINE WITH QUICK COUPLING FITTING | B07810026

Product code	B07810026
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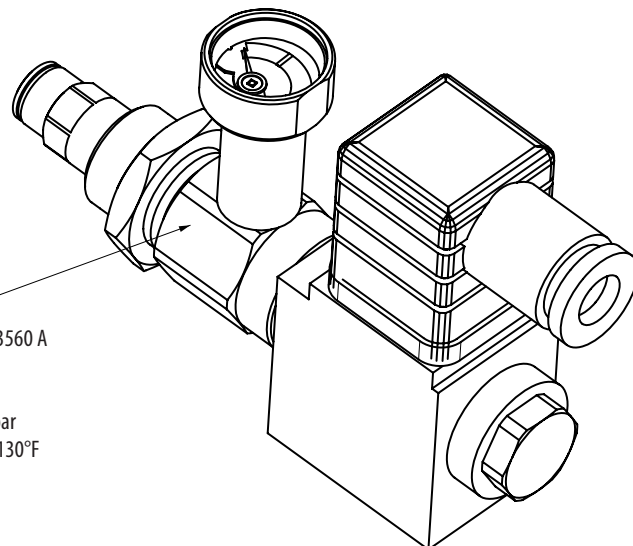
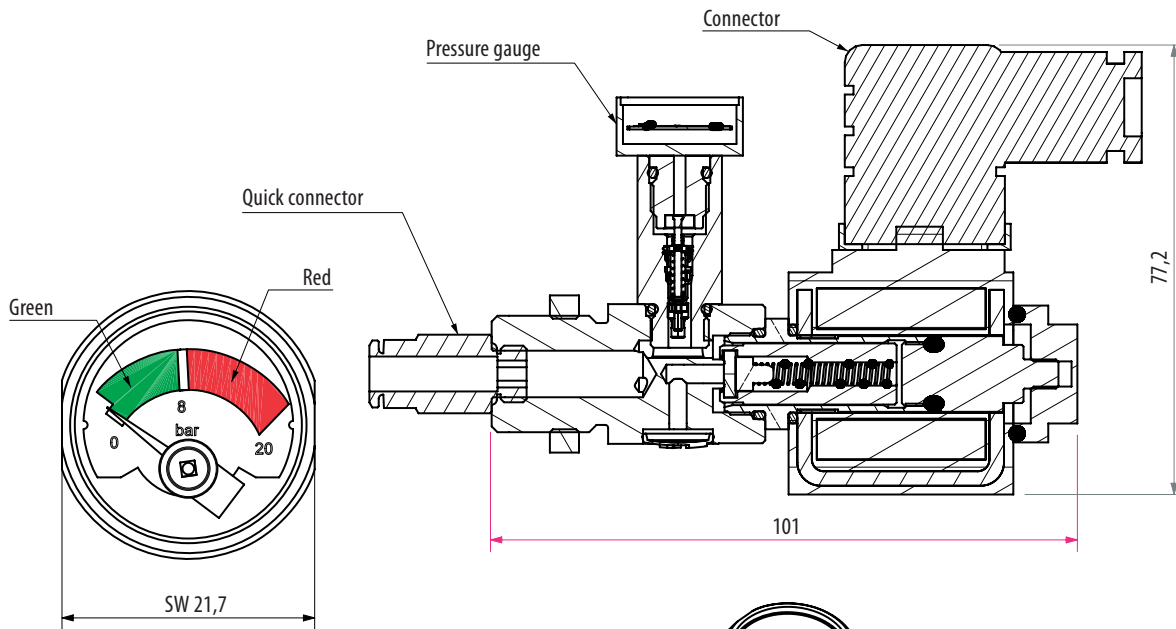
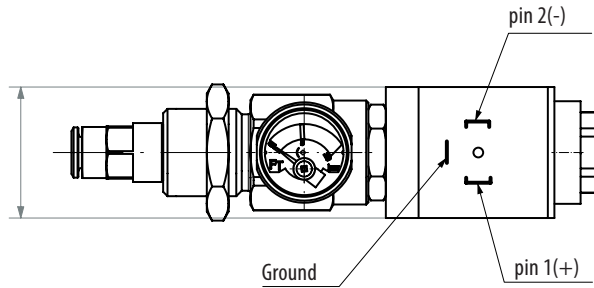


# APPENDIX B | COMPONENT DRAWINGS (continued)

## SOLENOID ACTUATOR | B04420127

Product code | B04420127

Wiring diagram

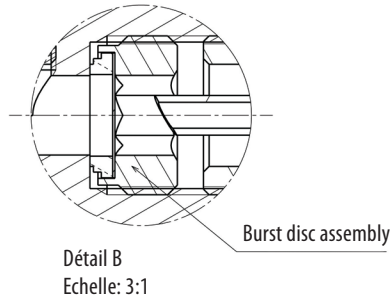
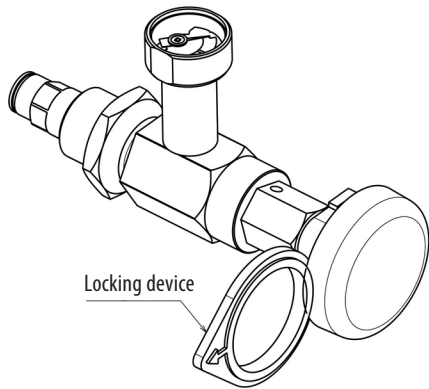
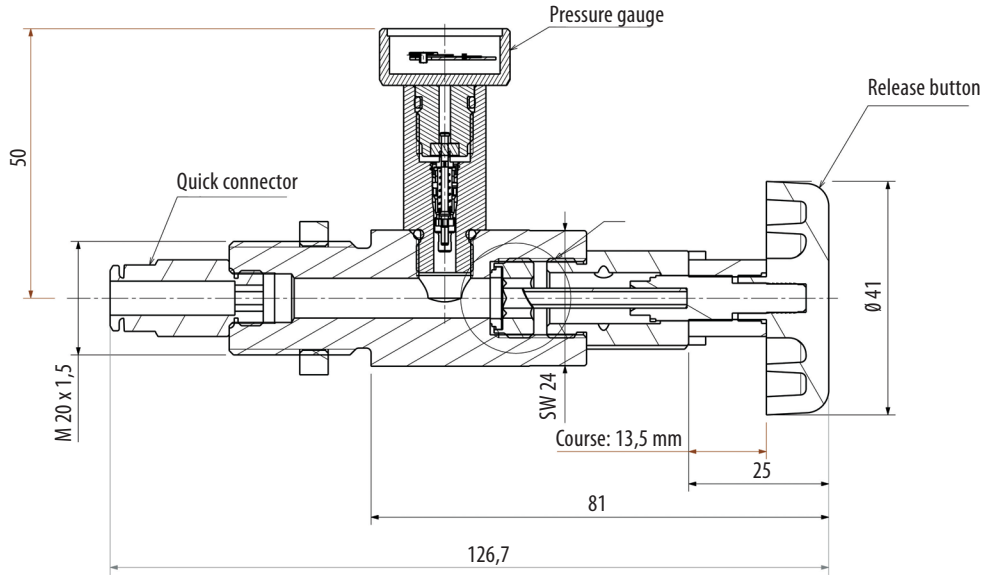


**Technical datas:**  
 Electrical connection: DIN 43560 A  
 Voltage: 24 V DC  
 Power: 9 W  
 Max. working pressure: 30 bar  
 Temperature range: 0°F -> 130°F

# APPENDIX B | COMPONENT DRAWINGS (continued)

## MANUAL RELEASE | B04420128

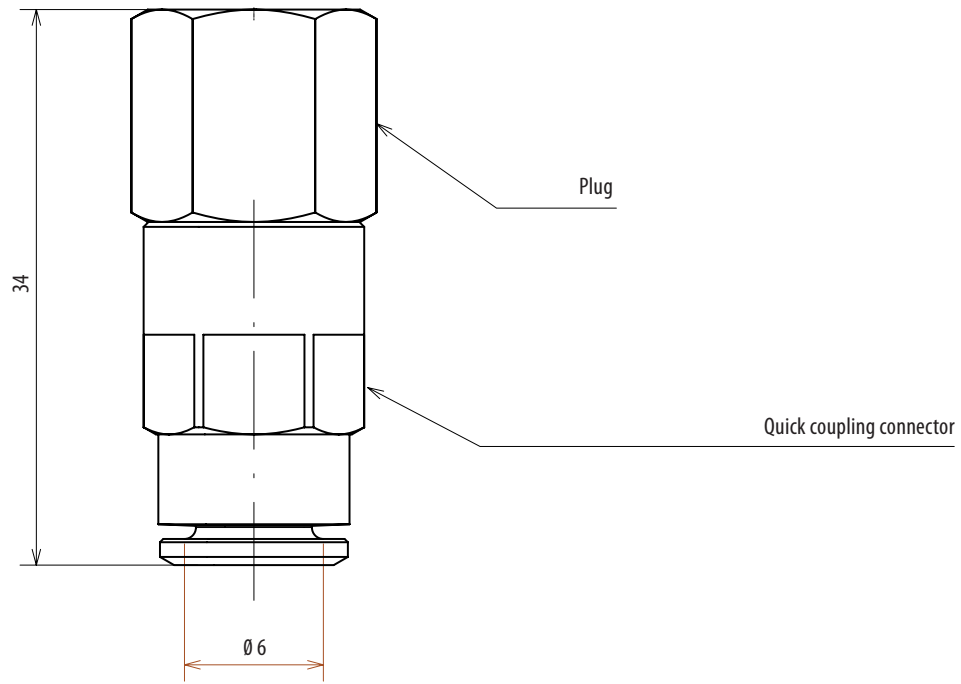
Product code | B04420128



## APPENDIX B | COMPONENT DRAWINGS (continued)

### END OF LINE PLUG | 029510056

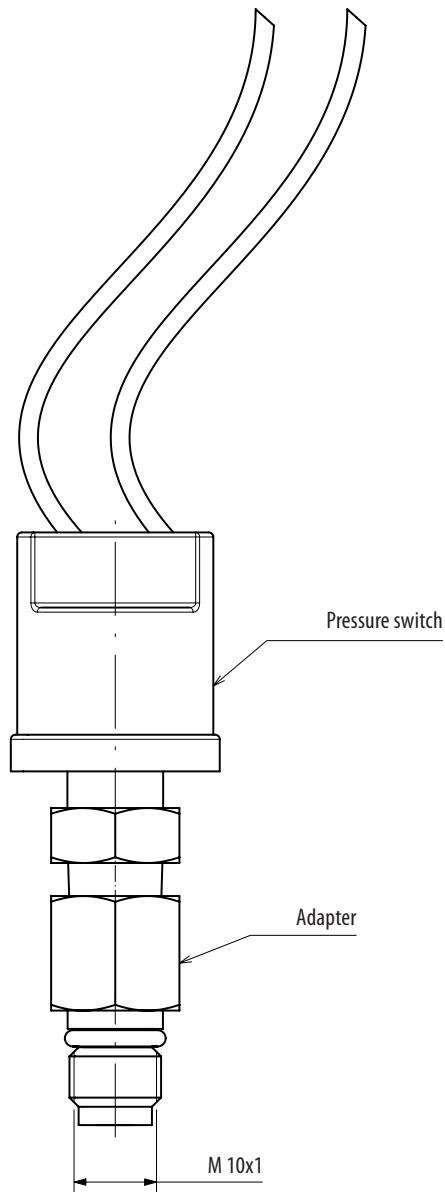
Product code | 029510056



## APPENDIX B | COMPONENT DRAWINGS (continued)

### ASSEMBLY PRESSURE SWITCH WITH ADAPTOR | 029900168 & 029900178

Product code	029900168	029900178
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#### SPECIFICATIONS 029900168

1. Auto-reset pressure switch (SPST)
2. Type: Normally open (N/O) at atmospheric conditions (0 psig)
3. Operation:
  - Open:  $160 \pm 7$  psig
  - Close:  $185 \pm 5$  psig
4. Proof pressure: 400 psig
5. Burst disc: 5000 psig
6. Electrical ratings: 120/240 VAC-375 VA  
24 VAC - 125 VA
7. Cycle life: 100.000 minimum
8. Ambient temperature:  $-30$  to  $+70^{\circ}\text{C}$
9. Fluid temperature:  $-45$  to  $+135^{\circ}\text{C}$
10. Agency recognition:
  - CE0035
  - UL us E196928

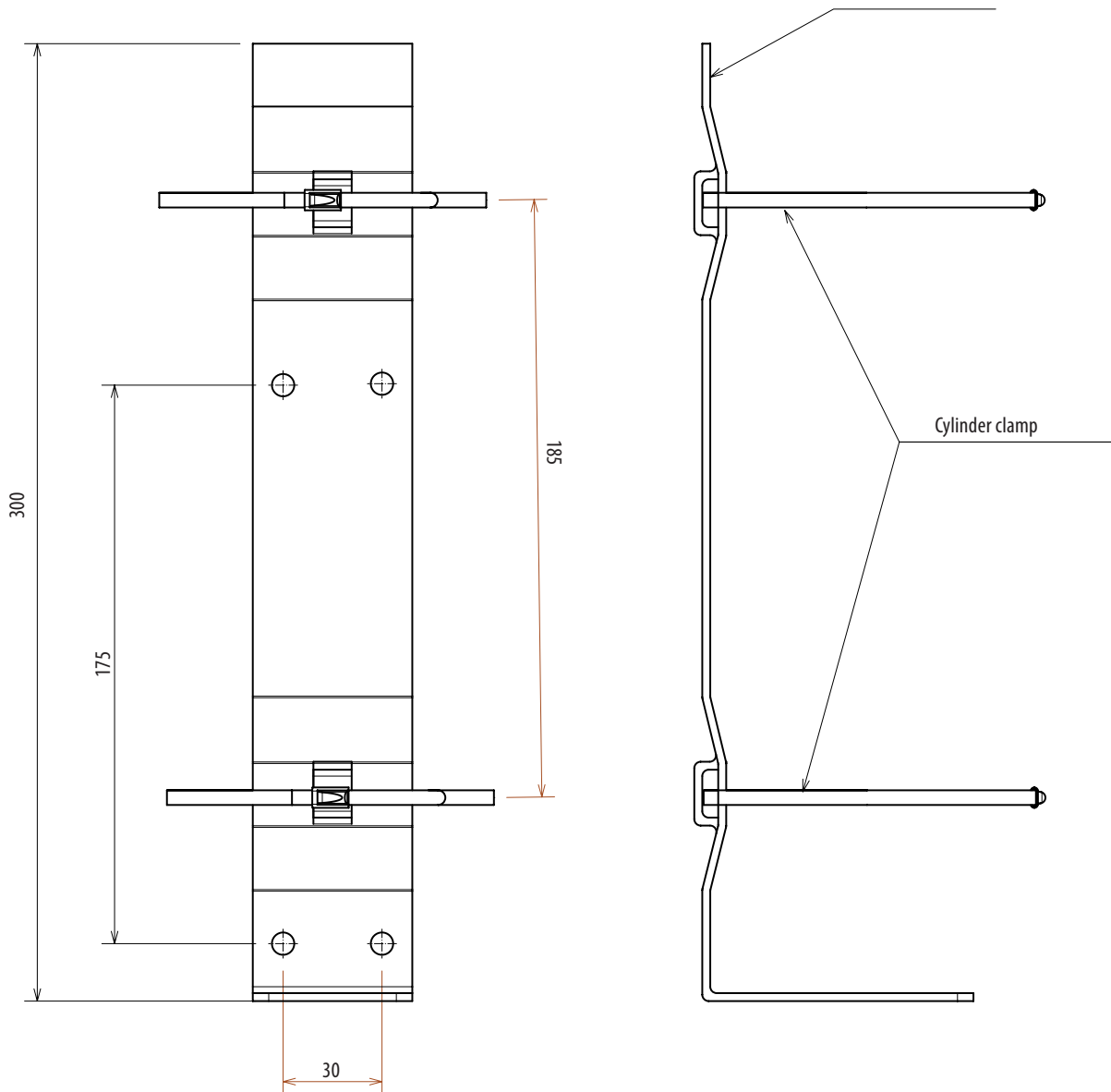
#### SPECIFICATIONS 029900178

1. Auto-reset pressure switch (SPST)
2. Type: Normally closed (N/C) at atmospheric conditions (0 psig)
3. Operation:
  - Open:  $160 \pm 7$  psig
  - Close:  $185 \pm 5$  psig
4. Proof pressure: 400 psig
5. Burst disc: 5000 psig
6. Electrical ratings: 120/240 VAC-375 VA  
24 VAC - 125 VA
7. Cycle life: 100.000 minimum
8. Ambient temperature:  $-30$  to  $+70^{\circ}\text{C}$
9. Fluid temperature:  $-45$  to  $+135^{\circ}\text{C}$
10. Agency recognition:
  - CE0035
  - UL us E196928

## APPENDIX B | COMPONENT DRAWINGS (continued)

### 3 LB BRACKET & 7 LB BRACKET | 029900169 & 029900170

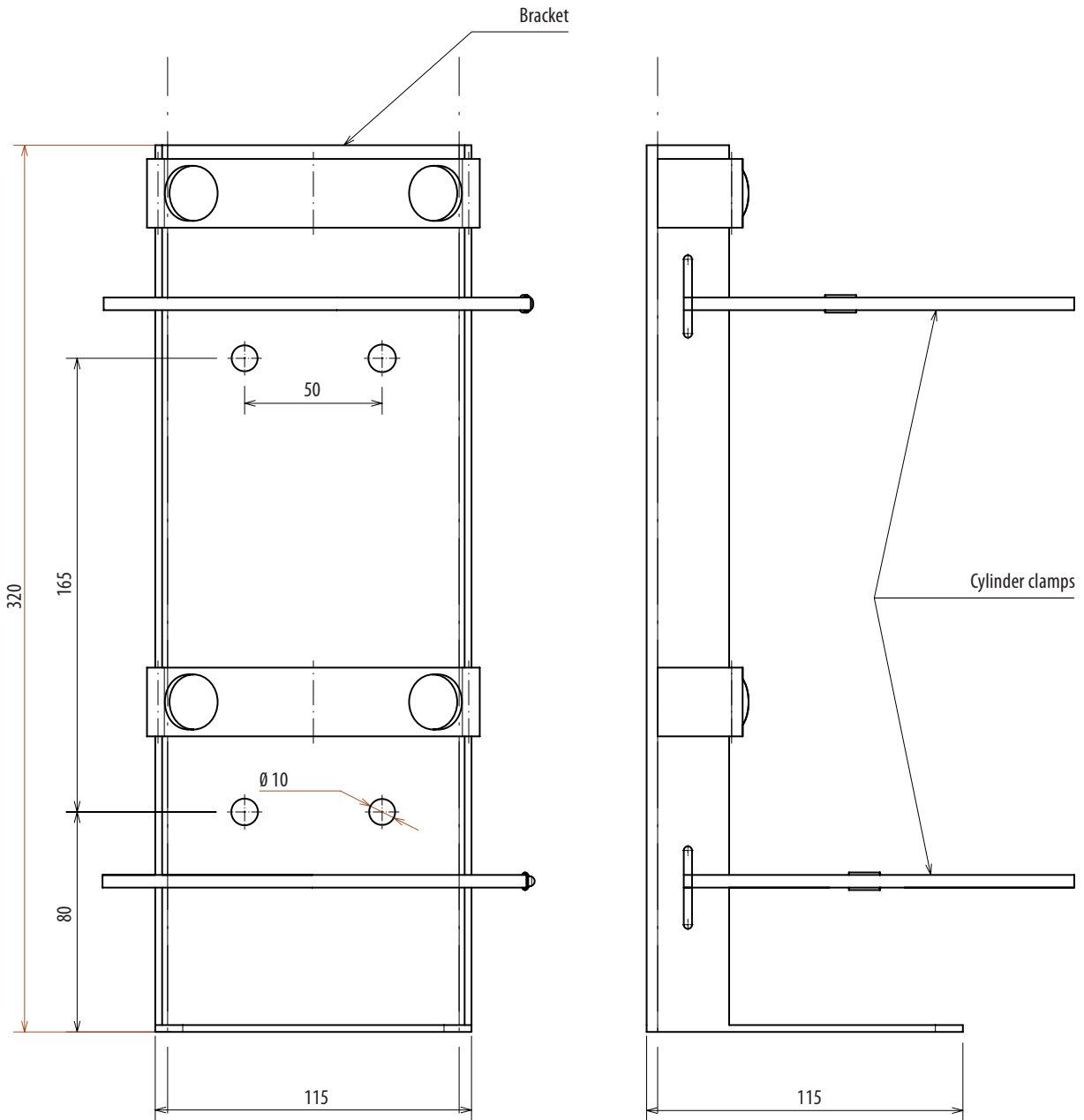
	3 lb bracket	7 lb bracket
Product code	029900169	029900170



# APPENDIX B | COMPONENT DRAWINGS (continued)

## 14 LB BRACKET | 029900171

Product code | 029900171



## APPENDIX C | FILL PROCEDURE

### FILLING PROCEDURE FIREDETEC INDIRECT LOW PRESSURE CYLINDERS

All FM-200® containers shall be filled by an authorized Rotarex system distributor in accordance with fill procedures outlined in this section of the manual. PN- 027650004.

01. Weigh the cylinder and check the Tare weight against that listed on the label. Record the tare weight.
02. Remove one safety plug from a discharge port and connect the appropriate recharge adapter
03. With the cylinder on the scale connect the agent supply to the adapter. Record weight and zero the scale.
04. Open the cylinder ball valve and open the agent supply valve on the bulk tank.
05. Fill the cylinder to the desired weight. (Fill Weight)
06. Close the agent supply valve but maintain the connection
07. Close the cylinder ball valve but maintain the connection
08. Attach the spring top unit with tubing to the top of the cylinder valve as outlined in section
09. Using the quick connect adapter connect the FireDETEC tubing.
10. Regulate the nitrogen regulator to 240 PSIG, connect the nitrogen supply to the fill adapter
11. Open the ball valve and super pressurize the cylinder to 240 PSIG.
12. Close the ball valve and shake the cylinder allowing the nitrogen to be absorbed into the agent.
13. Check the cylinder pressure, absorption of nitrogen results in a loss of pressure, open the ball valve and allow the pressure to build back up to 240 PSIG.
14. Repeat the last two steps until shaking the cylinder does not result in a loss of cylinder pressure and the cylinder pressure stabilizes at 240 PSI.
15. Slowly open the vent on the agent recharge line. Trapped agent in the valve and supply line WILL VENT. Constant discharge from the vent valve indicates that the piston is not seated properly or has opened. If this occurs repeat steps 12 and 13
16. Disconnect the agent source, remove the recharge adapter and fit a safety plug in the discharge port.
17. Close the ball valve and close the nitrogen supply valve. Vent the nitrogen line.
18. Remove the nitrogen supply hose.
19. Unscrew the spring top from the ball valve.
20. Attach a tamper seal to the ball valve to ensure it is in the "OFF" position.
21. Verify and record the cylinder Full weight. (Gross weight)
22. Leak test the cylinder with a calibrated leak detector
23. Cylinder is now ready for installation.



# APPENDIX D | MATERIAL SAFETY DATA SHEET FM-200®

## SECTION 1: IDENTIFICATION OF THE MATERIAL AND SUPPLIER

<b>Product Name</b>	FM-200®	<b>Other Names</b>	HFC-227 ea, FE-227
<b>Recommended Use</b>	Fire protection agent for total flooding of rooms containing electrical equipment such as computer rooms as well as flammable liquid storage and Class A risks such as records rooms and libraries.		

## SECTION 2: HAZARDS IDENTIFICATION

<b>Hazard Classification</b>	DANGEROUS GOODS. NON HAZARDOUS SUBSTANCE		
<b>Safety Phrase(s)</b>	Not available	<b>Risk Phrase(s)</b>	Not available

## SECTION 3: COMPOSITION / INFORMATION ON INGREDIENTS

SUBSTANCE		
Chemical Identity of the Pure Substance	Common Name / Synonyms	CAS Number
Heptafluoropropane	FM-200®	431-89-0
MIXTURE		
Chemical Identity of Ingredients	Proportion of Ingredients	CAS Number
Not applicable	Not applicable	Not applicable

## SECTION 4: FIRST AID MEASURES

<b>Description of Necessary First Aid Measures</b>	<b>EYE CONTACT</b>	Flush with water immediately for 15 minutes. Get medical attention.
	<b>SKIN CONTACT</b>	Remove clothes. Wash skin with soap and water. If frostbite occurs get medical attention.
	<b>INHALATION</b>	Remove person to fresh air and get medical attention.
	<b>INGESTION</b>	Not applicable.
<b>Medical Attention and Special Treatment</b>	See above	
<b>Aggravated Medical Conditions Caused by Exposure</b>	None	

## SECTION 5: FIRE FIGHTING MEASURES

<b>Suitable Extinguishing Media</b>	This is an extinguishing agent	<b>Hazards From Combustion Products</b>	Decomposition by elevated temperatures may generate hazardous decomposition products common to other CFCs, HCFCs or HBFCs. These can include hydrogen fluoride, carbon monoxide and carbon dioxide.
<b>Special Protective Precautions and Equipment for Fire Fighters</b>	Wear full protective equipment and a self-contained breathing apparatus	<b>Hazchem Code</b>	2RE

## SECTION 6: ACCIDENTAL RELEASE MEASURES

<b>Emergency Procedures</b>	Evacuate the area and ventilate. Do not enter areas where high concentrations may exist without appropriate protective equipment including a self-contained breathing apparatus.
<b>Methods and Materials for Containment and Clean Up</b>	Not applicable – agent is a gas

## SECTION 7: HANDLING AND STORAGE

<b>Precautions for Safe Handling</b>	Protect the cylinder from damage. Handle in well-ventilated areas.
<b>Conditions for Safe Storage, Including any Incompatibilities</b>	Store in a cool, dry, well-ventilated area away from incompatible materials. Keep container tightly closed.

## SECTION 8: EXPOSURE CONTROLS / PERSONAL PROTECTION

<b>National Exposure Standards</b>	Not available	<b>Biological Limit Controls</b>	No biological limit allocated
<b>Engineering Controls</b>	Not available	<b>Personal Protection Equipment</b>	Safety glasses, gloves, a self-contained breathing apparatus

**SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES**

<b>Appearance</b>	Colourless liquefied compressed gas.	<b>Odour</b>	No odour
<b>pH</b>	Not available	<b>Vapour Pressure</b>	405 kPa @ 21°C
<b>Vapour Density (air = 1)</b>	6.04	<b>Boiling Point / Range</b>	-16.4°C
<b>Freezing / Melting Point (specify)</b>	-131°C	<b>Solubility in Water</b>	0.026
<b>Specific Gravity or Density</b>	1.46	<b>Flash Point</b>	None
<b>Upper and Lower Flammable (explosive) Limits in Air</b>	Not explosive	<b>Ignition Temperature</b>	Does not ignite

**SECTION 10: STABILITY AND REACTIVITY**

<b>Chemical Stability</b>	Stable under normal conditions of handling and use.	<b>Conditions to Avoid</b>	Direct sunlight, ultraviolet light
<b>Incompatible Materials</b>	Powdered metals and strong alkalis, oxidizers or reducing agents are not compatible with FM-200®.	<b>Hazardous Decomposition Products</b>	Thermal decomposition may produce the following: Hydrogen fluoride, carbon monoxide and carbon dioxide.
<b>Hazardous Reactions</b>	Will not occur		

**SECTION 11: TOXICOLOGICAL INFORMATION**

<b>Health Effects From the Likely Routes of Exposure</b>	<b>EYE CONTACT</b>	May cause discomfort
	<b>SKIN CONTACT</b>	May cause frostbite
	<b>INHALATION</b>	May cause difficulty in breathing
	<b>INGESTION</b>	Not applicable, as FM-200® is a gas.
<b>Acute Overexposure</b>	Contact with the liquid or cold gas may cause frostbite. Has a central nervous systems effect.	
<b>Chronic Overexposure</b>	In cases of severe exposure, narcosis may develop.	

**SECTION 12: ECOLOGICAL INFORMATION**

<b>Ecotoxicity</b>	Not available	<b>Persistence and Degradability</b>	Not available
<b>Mobility</b>	Not available	<b>Environmental Fate (Exposure)</b>	Not available
<b>Bioaccumulative Potential</b>	Not available		

**SECTION 13: DISPOSAL CONSIDERATIONS**

<b>Disposal Methods and Containers</b>	This material should be incinerated at a high temperature chemical waste incinerator fitted with acid gas scrubbing systems. All disposals should be in accordance with local, state and Commonwealth law.
<b>Special Precautions for Landfill or Incineration</b>	For incineration, see above.

**SECTION 14: TRANSPORT INFORMATION**

<b>UN Number</b>	UN 3296	<b>UN Proper Shipping Name</b>	FM-200®
<b>Class and Subsidiary Risk</b>	D. G. Class 2.2	<b>Packing Group</b>	Packing Group III
<b>Special Precautions for User</b>	None	<b>Hazchem Code</b>	2RE



**US HEADQUARTERS**

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