



# Pre-Engineered ILP Automatic Suppression Unit

*Designed for use with:*  
**HFC-227ea Clean Agent**

## DESIGN, INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

**Firetrace International**

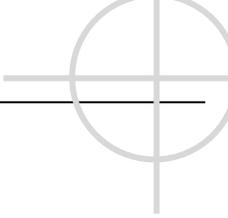
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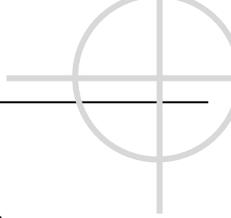


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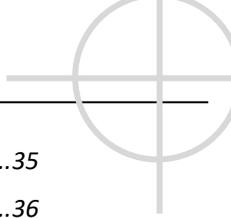


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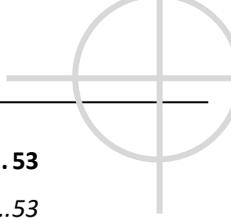


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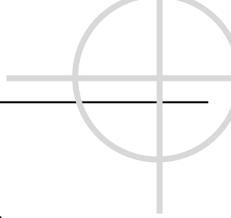


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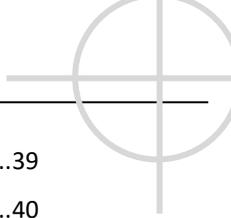
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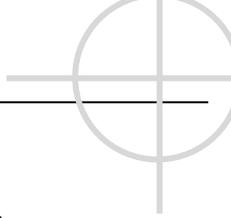
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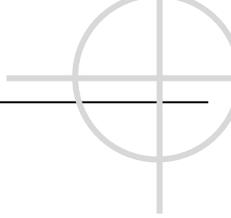
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# FOREWARD

## General

This manual is written for the fire protection professional that designs, installs, and maintains Firetrace Pre-Engineered ILP Automatic Suppression Units with HFC-227ea Clean Agent. It is intended to communicate details and procedures required for proper design, installation, operation, and maintenance.

Firetrace assumes no responsibility for the design or function of any systems other than those addressed in this manual. The technical data contained herein is limited strictly for informational purposes only.

Pre-Engineered ILP Automatic Suppression Units with HFC-227ea Clean Agent are to be designed, installed, inspected, tested, maintained, and recharged by qualified trained personnel in accordance with the following:

- All instructions, limitations, etc. contained in this manual, DIOM 800021
- All information contained on the agent cylinder nameplate(s)
- NFPA 2001: Standard on Clean Agent Fire Extinguishing Systems
- FM Approvals Listing
- Local authority having jurisdiction

## Safety Messages

The following notations are used throughout this manual. Always read and obey all safety messages. They are essential to the safe use of the equipment described in this manual.

### **DANGER**

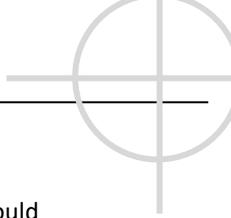
Identifies immediate hazards and provides specific instructions or procedures, which if not correctly followed **COULD** result in severe personal injury or death.

### **WARNING**

Identifies specific instructions or procedures, which if not correctly followed, **COULD** result in severe personal injury or death.

### **CAUTION**

Identifies specific instructions or procedures, which if not correctly followed, **COULD** result in minor personal injury or equipment or property damage.



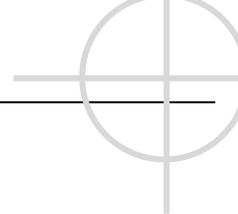
## Safety Precautions

Safety precautions are essential when any electrical or mechanical equipment is involved. These precautions should be followed when handling, servicing, and recharging Firetrace Pre-Engineered ILP Automatic Suppression Units and equipment. The following safety precautions should always be followed:

- Read and understand this entire manual and any other documents referenced herein.
- Secure the manual near the Firetrace fire suppression unit after installation.
- Periodic checks by trained personnel are required to ensure safe operation.
- All Firetrace Pre-Engineered ILP Automatic Suppression Units are factory equipped with discharge port plugs. The discharge port plugs are only to be removed when the Firetrace ILP Unit is connected into the discharge piping or when performing charging, testing, or salvaging operations in accordance with the procedures contained in this manual.
- Ensure the lever on the Firetrace ILP Unit ball valve is in the “OFF” position when not connected into the discharge piping or when performing charging, testing, or salvaging operations in accordance with the procedures contained in this manual.
- Never assume that a cylinder is empty. Treat all cylinders as if they are fully charged.
- Wear safety glasses when working with pressurized cylinders and charging equipment.
- It is recommended to wear leather gloves to avoid any cryogenic burns.
- Follow all safety procedures included on the cylinder nameplate and in this manual.

Questions regarding the information contained in this manual can be addressed to:

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Scottsdale, AZ 85258 USA  
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Fax: +1.480.315.1316  
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## Section 1: General Information

### 1.1 Introduction

The Firetrace Pre-Engineered ILP Automatic Suppression Units with HFC-227ea Clean Agent are approved by FM Approvals. These units are designed for total flooding applications using HFC-227ea Clean Agent in accordance with NFPA 2001: Standard on Clean Agent Fire Extinguishing Systems.

The Firetrace Pre-Engineered ILP Automatic Suppression Units with HFC-227ea Clean Agent have been tested to limits established by FM Approvals in compliance with the requirements specified in FM 5600 Approval Standard for Clean Agent Extinguishing Systems and as detailed in this manual.

The pre-engineered concept of automatic fire suppression systems minimizes the amount of engineering involved in system design. When the discharge piping and nozzles are installed within the limitations stated in this manual, no hydraulic calculations are required to determine pressure drop, agent flow, or discharge time.

The hazard being protected by a Firetrace Pre-Engineered ILP Automatic Suppression Unit can be any size, shape, or volume; provided that the protected enclosure is within the limitations described in this manual. Once fully installed, the Firetrace Pre-Engineered ILP Automatic Suppression Unit becomes a self-contained unit, meaning that it is equipped with all the components necessary to detect and suppress Class B fires.

Since the units are listed as automatic units (e.g. no manual or electric means is necessary for activation), only one extinguisher unit can be used to protect one enclosure. The listed automatic units are not designed to provide simultaneous actuation of two or more units, therefore listed extinguisher units **cannot** be combined to protect a larger enclosure.

Local authorities having jurisdiction should be consulted as to the acceptability for particular hazards and requirements covering installation.

### 1.2 HFC-227ea Clean Agent

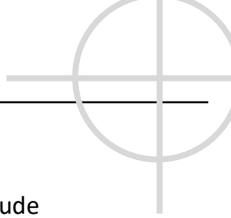
Firetrace Pre-Engineered ILP Automatic Suppression Units utilize heptafluoropropane, more commonly known as HFC-227ea Clean Agent, FM-200™ or HFC-227ea.

HFC-227ea is depicted by the chemical formula  $CF_3CH_2CF_3$  (1,1,1,2,3,3,3-heptafluoropropane). HFC-227ea is a colorless odorless gas which leaves no residue, and is an extremely effective fire suppression agent. HFC-227ea is low in toxicity and electrically non-conductive.

HFC-227ea is included in NFPA 2001. It has been evaluated and approved for use in occupied areas as a total flooding agent (when used as specified under the U.S. Environmental Protection Agency (EPA) SNAP Program rules). Refer to the SNAP Program rules for more information.

#### 1.2.1 Cleanliness

HFC-227ea is a colorless gas which leaves no residue. This minimizes downtime and clean up after a unit discharge. Most materials such as steel, aluminum, stainless steel, brass, plastics, rubber, and electronic components, are not affected by exposure to HFC-227ea. The agent is also environmentally friendly, having an ozone depletion potential (ODP) of 0.00.



## 1.2.2 Thermal Decomposition Products

When exposed to extreme temperatures, HFC-227ea will form thermal decomposition products, which include halogen acids. There is a direct correlation between agent discharge time and the quantity of thermal decomposition products (TDP) created. The type of fire and the amount of agent exposed to open flame are also critical factors in creation of TDP. Test results have shown that when the agent is rapidly discharged, the amount of thermal decomposition products formed is minimal. See Table 1 – Thermal Decomposition Products for a list of thermal decomposition products.

**Table 1 – Thermal Decomposition Products**

Substance	Condition
Carbon Monoxide	During Combustion
Carbon Dioxide	During Combustion
Hydrogen Fluoride	During Combustion

## 1.2.3 Quality Requirements

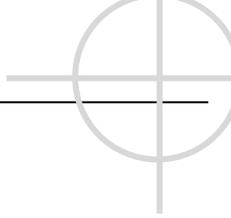
Strict agent quality specifications must be maintained, see Table 2 – Agent Quality Specifications.

**Table 2 – Agent Quality Specifications**

<b>HFC-227ea - Mole % (Minimum)</b>	99
<b>Acidity - PPM by Weight (Maximum)</b>	3
<b>Water Content - % by Weight (Maximum)</b>	0.001

## 1.2.4 Agent Properties

For hazard information, decomposition information, and physical properties of HFC-227ea, please refer to the Safety Data Sheet located in Appendix C.



## Section 2: System Description

### 2.1 General Description

Firetrace Pre-Engineered ILP Automatic Suppression Units are intended to be designed and installed to protect hazards within the limitations as stated in this manual ONLY. The equipment described in this manual is approved by FM Approvals, in accordance with FM 5600 Approval Standard for Clean Agent Extinguishing Systems. The authority having jurisdiction should follow the information specified by this manual, NFPA 2001: Standard on Clean Agent Fire Extinguishing Systems, and any other applicable standards.

Firetrace Pre-Engineered ILP Automatic Suppression Units consists of the following major components:

- Cylinder/Valve Assembly
- Cylinder Mounting Bracket
- Firetrace Detection Tubing (FDT) and fittings (no substitute)
- Pressure Switch
- Discharge Piping and Fittings (furnished by others)

Once installed, the Pre-Engineered ILP Automatic Suppression Unit becomes a self-contained, self-actuating unit that does not require an external source of power.

The unit utilizes a UL recognized component (per UL standard 521) Linear Heat Detector (See Certificate of Compliance 20140705-S35465) known as Firetrace Automatic Fire Detection Tubing. When pressurized with dry nitrogen, it will allow the fire suppression valve to remain in the closed position. The tubing acts as a continuous linear thermal detector that ruptures upon direct flame impingement or at temperatures above 383 °F (195 °C). Once the detection tubing is ruptured, the valve automatically opens, allowing the HFC-227ea clean agent to flow through the discharge piping, distributing the extinguishing agent through the nozzle(s) into the protected enclosure.

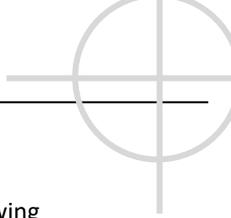
Firetrace Pre-Engineered ILP Automatic Suppression Units are designed for use in total flooding applications only, where the hazard is normally unoccupied. Firetrace Pre-Engineered ILP Automatic Suppression Units can be used, but are not limited, to protect the following:

- Electrical and electronic cabinets
- Data processing areas and cabinets
- Exhaust cabinets
- UPS units
- Generator enclosures
- Computer/data storage cabinets
- Telecommunication areas
- Laboratory fume hoods
- Pump enclosures
- Flammable chemicals storage cabinets
- Transformer cabinets
- CNC & VMC machining centers
- Many other applications

HFC-227ea should not be used where the following materials may be present:

- Pyrotechnic chemicals containing their own oxygen supply
- Reactive metals
- Metal hydrides
- Chemicals capable of undergoing autothermal decompositions

For hazards beyond the scope described above, it is recommended that the designer consult with Firetrace, NFPA 2001, and the local authority having jurisdiction as to the suitability on the use of HFC-227ea for a particular hazard, for personnel exposure effects from the design concentration, and for installation requirements.

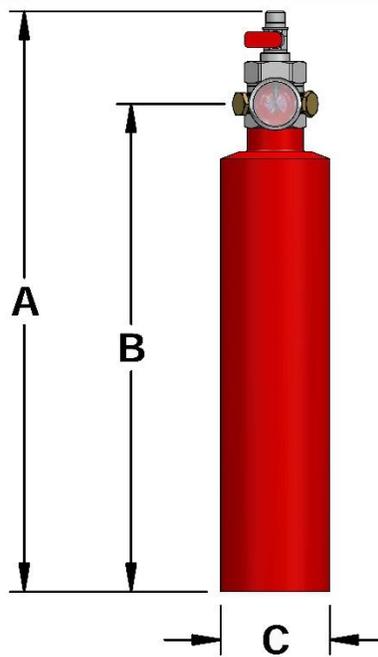


## 2.2 Cylinders

HFC-227ea is stored in the pre-engineered clean agent unit cylinders. The steel cylinders are available in the following nominal capacities: 3 lb, 6 lb, and 12 lb. Additionally, an enhanced durability coating is available for the exterior of the unit cylinders. Refer to Table 3 – Cylinder Specifications, Figure 1 – Unit Assembly, and Table 4 – Unit Assembly Dimensions for additional details.

**Table 3 – Cylinder Specifications**

Nominal Capacity	Volume		Cylinder Specification	Cylinder Service Pressure		Cylinder Test Pressure	
	in <sup>3</sup>	cm <sup>3</sup>		psig	kPa	psig	kPa
3 lb	75	1229	DOT 4B240	240	1,655	480	3,310
6 lb	145	2376	DOT 4B240	240	1,655	480	3,310
12 lb	300	4916	DOT 4B360	360	2,482	720	4,964

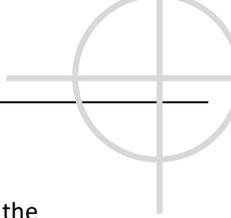


**Figure 1 – Unit Assembly**

**Table 4 – Unit Assembly Dimensions**

Unit Assembly Part Number	Agent		Dimension "A"		Dimension "B"		Dimension "C"	
	lb	kg	in	cm	in	cm	in	cm
940301	3	1.36	15.6	39.6	13.1	33.3	2.9	7.4
940601	6	2.72	16.6	42.2	13.5	34.3	4.3	10.9
941201	12	5.44	16.7	42.4	13.7	34.8	6.3	16.0





## 2.4 Firetrace Detection Tubing

The Firetrace Detection Tubing is a linear, pneumatic, fire detection device that responds to a combination of the heat and radiant energy from a fire. The tubing is a UL recognized component per UL Standard 521 (see Certificate of Compliance 20140705-S35465). The Firetrace detection tubing performs two functions: heat detection and system activation. One end of the tubing is installed to the top of the cylinder valve. The tubing is then installed throughout the enclosure and finally pressurized with nitrogen.

The Firetrace detection tubing is heat sensitive and in a fire situation, is designed to rupture at any point along its length upon direct flame impingement or when the temperature reaches above 383 °F [195 °C]. The rupture of the tubing releases the nitrogen pressure causing the unit to actuate. The actuation results in a complete discharge of the HFC-227ea clean agent through the discharge piping and is distributed by the nozzle(s) throughout the protected enclosure. Refer to Table 5 - Firetrace Detection Tubing Properties and Table 6 – Firetrace Detection Tube Part Numbers for additional information.

**Table 5 - Firetrace Detection Tubing Properties**

Hydrostatic Burst Pressure	Minimum Burst Pressure	1100 psig [75 bar]
	Typical Burst Pressure	1300 psig [88 bar]
Electrical Properties	Volume Resistivity	1014 (per DIN 53481)
	Dielectric Strength	40k V/mm (per DIN 53481)

**Table 6 – Firetrace Detection Tube Part Numbers**

Firetrace Detection Tubing Part Number	Description
200005	Firetrace Detection Tubing, 4/6 mm, 1 ft
204025	Firetrace Detection Tubing, 4/6 mm, 25 ft
204050	Firetrace Detection Tubing, 4/6 mm, 50 ft
204100	Firetrace Detection Tubing, 4/6 mm, 100 ft
204328	Firetrace Detection Tubing, 4/6 mm, 328 ft

## 2.5 Manual Releases

The manual release is used as an optional part of the system detection line network. The manual release is used to manually release the nitrogen pressure in the tubing, causing the system to actuate. The actuation results in a complete discharge of the unit assembly.

The tube fitting on the body of the manual release allows for easy installation onto the system detection line network. The pull tab on the plunger prevents accidental activation of the manual release. The port on the body of the manual release is used to pressurize the tubing and allows for installation of a pressure gauge to monitor system pressure, refer to Figure 3 – Manual Releases for additional information.

**CAUTION**

Do not remove the pull tab until ready to actuate system discharge.

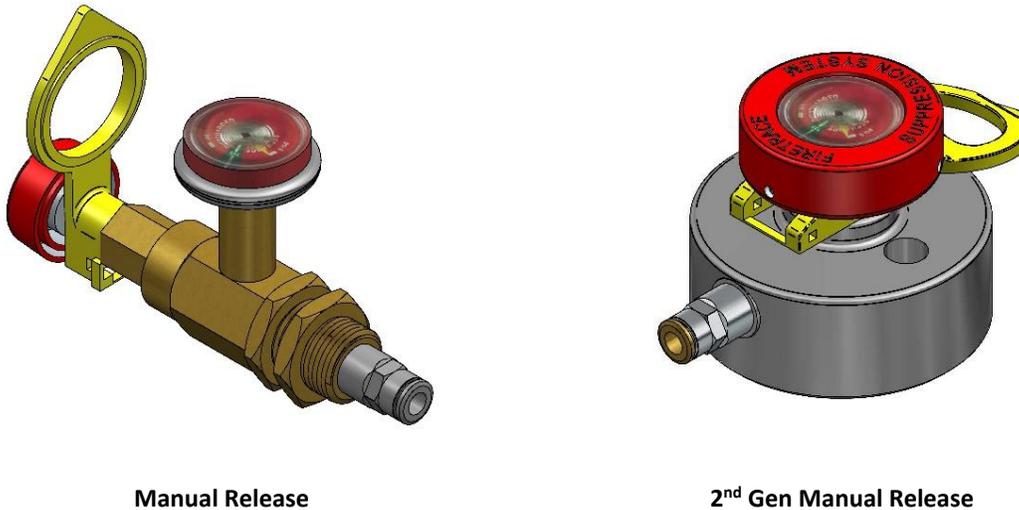
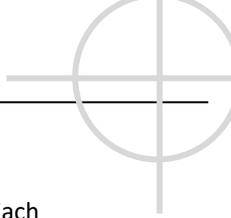


Figure 3 – Manual Releases

Table 7 – Manual Release Part Numbers

Manual Release Part Numbers	Description
600060*	Manual Release, HFC-227ea
601013	2 <sup>nd</sup> Gen Manual Release, HFC-227ea

\* This is an optional component and is not part of an FM Approved System.



## 2.6 Cylinder Mounting Bracket

The cylinder mounting brackets are manufactured from steel with a primed and powder coated paint finish. Each cylinder mounting bracket is designed to fit properly around the cylinder. The cylinder mounting bracket is equipped with finger tabs which allow easy access. The cylinder mounting bracket must be secured to a surface appropriate for retaining the weight of the cylinder in the event of a discharge. This precaution is intended to safely support the weight of the cylinder and the reaction force of the HFC-227ea discharge.

All cylinders must be mounted vertically only, with the valve on top. Please refer to Figure 4 – Cylinder Mounting Bracket Bolt Pattern, Table 8 – 940301 Cylinder Mounting Bracket Dimensions, Table 9 – 940601 Cylinder Mounting Bracket Dimensions, and Table 10 – 941201 Cylinder Mounting Bracket Dimensions for cylinder mounting bracket dimensions.

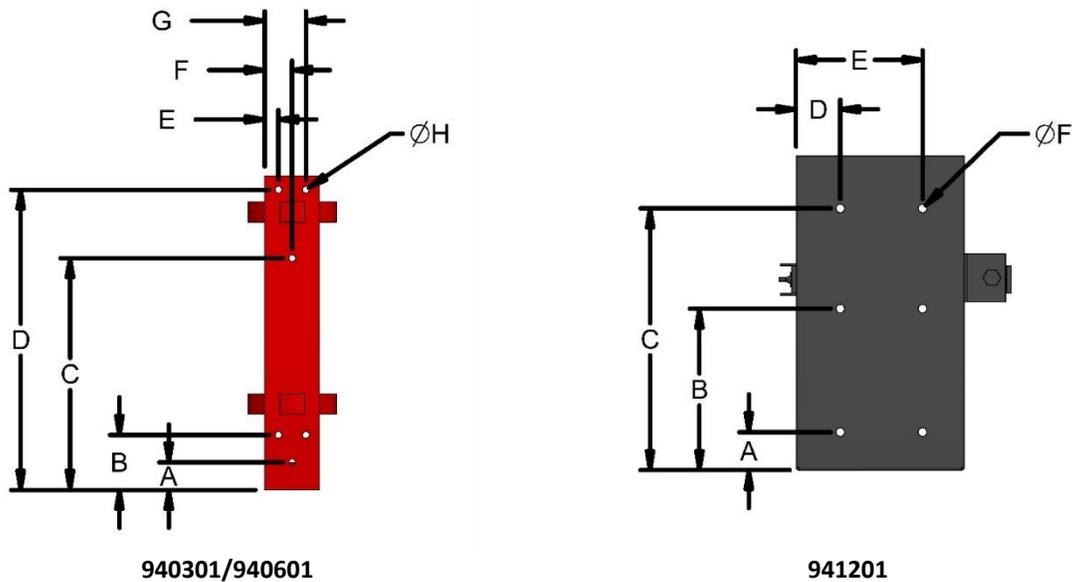


Figure 4 – Cylinder Mounting Bracket Bolt Pattern

Table 8 – 940301 Cylinder Mounting Bracket Dimensions

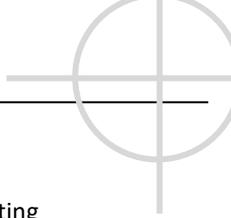
"A"		"B"		"C"		"D"		"E"		"F"		"G"		"H"	
in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
1.0	2.7	2.0	5.2	8.4	23.0	10.9	28.0	.5	1.3	1.0	2.7	1.5	3.8	1/4	0.6

Table 9 – 940601 Cylinder Mounting Bracket Dimensions

"A"		"B"		"C"		"D"		"E"		"F"		"G"		"H"	
in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
1.0	2.7	2.0	5.2	8.4	23.0	10.9	28.0	.5	1.3	1.0	2.7	1.5	3.8	1/4	0.6

Table 10 – 941201 Cylinder Mounting Bracket Dimensions

"A"		"B"		"C"		"D"		"E"		"F"	
in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
1.4	3.6	5.9	15.0	9.4	23.9	1.6	4.1	4.6	11.7	7/16	0.8



## 2.7 Heavy Duty Mounting Bracket

Additionally, the cylinder mounting brackets are available in a heavy duty configuration. The heavy duty mounting brackets are manufactured of higher strength steel with a primed and powder coated paint finish. The heavy duty mounting brackets provide greater stability against vibration.

The heavy duty mounting brackets are equipped with band clamps designed to fit properly around the cylinder. The heavy duty mounting bracket must be secured to a surface appropriate for retaining the weight of the cylinder in the event of a discharge. This precaution is intended to safely support the weight of the cylinder and the reaction force of the HFC-227ea discharge.

All cylinders must be mounted vertically only, with the valve up. Please refer to Figure 5 – Heavy Duty Mounting Bracket Bolt Pattern and Table 11 – Heavy Duty Mounting Bracket Dimensions for cylinder mounting bracket dimensions.

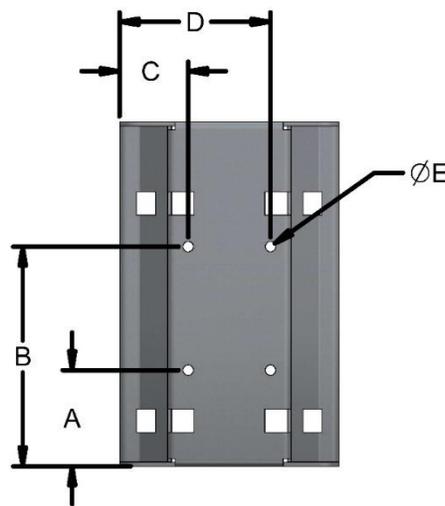


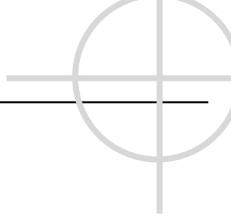
Figure 5 – Heavy Duty Mounting Bracket Bolt Pattern

Table 11 – Heavy Duty Mounting Bracket Dimensions

Part Number	Dimension "A"		Dimension "B"		Dimension "C"		Dimension "D"		Dimension "E"	
	in	cm	in	cm	in	cm	in	cm	in	cm
111404	4.1	10.4	8.1	20.6	1.9	4.8	2.6	6.6	.3	0.8
111403	4.1	10.4	8.1	20.6	2.1	5.3	3.8	9.7	.4	1.0
111402	3.5	8.9	8.0	20.3	2.5	6.4	5.5	14.0	.4	1.0

NOTE: All systems come equipped with a standard bracket. The Heavy Duty Mounting Brackets are available as an optional accessory for all systems.

NOTE: The heavy duty mounting bracket assembly includes the clamps necessary for strapping the unit into the bracket.



## 2.8 Discharge Network

### 2.8.1 Pipe, Fittings, and Pipe Supports

All piping must be installed in accordance with good commercial practices and applicable national standards.

#### 2.8.1.1 Pipe Requirements

Piping used for Firetrace ILP Units must be copper. Piping shall be in accordance with the requirements of NFPA 2001 or the local authority having jurisdiction.

**NOTE:** All piping must be thoroughly cleaned to remove burrs and swabbed with a degreasing solvent to remove all traces of cutting oils and chips.

#### 2.8.1.2 Pipe Fittings and Pipe Joining

Piping, fittings, and pipe supports shall be in accordance with the latest edition of NFPA 2001 available from National Fire Protection Association. Temperature and pressure ratings of the fittings must not be exceeded. The method of joining all pipe must be in accordance with the latest requirements listed in NFPA 2001. Refer to Table 12 – Copper Fitting Part Numbers for 940301 Unit Assembly and Table 13 – Copper Fitting Part Numbers for 940601/941201 Unit Assembly for acceptable fittings.

**Table 12 – Copper Fitting Part Numbers for 940301 Unit Assembly**

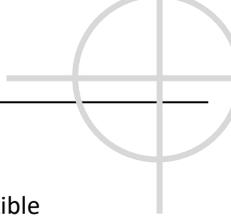
Copper Fitting Part Number	Description
200143	Copper Compression Fitting, Valve/Nozzle to 5/16 in Pipe
200101	Copper Compression Fitting, 5/16 in Pipe Bulkhead
200111	Copper Compression Fitting, 5/16 in Pipe Elbow
200121	Copper Compression Fitting, 5/16 in Pipe in Tee

**Table 13 – Copper Fitting Part Numbers for 940601/941201 Unit Assembly**

Copper Fitting Part Number	Description
200144	Copper Compression Fitting, Valve/Nozzle to 1/2 in Pipe
200145	Copper Compression Fitting, 1/2 in Pipe Bulkhead
200112	Copper Compression Fitting, 1/2 in Pipe Elbow
200122	Copper Compression Fitting, 1/2 in Pipe in Tee

#### 2.8.1.3 Pipe Supports

Piping shall be securely supported by listed and/or approved hangers. Pipe supports must be installed with allowance for expansion and contraction and must be rated to support the dead weight of the piping and the thrust forces of the HFC-227ea discharge.



## 2.8.2 Flexible Hoses and Fittings

Flexible hoses and flexible hose fittings are available as an optional part for the system discharge network. Flexible hoses and flexible hose fittings shall be in accordance with the latest edition of NFPA 2001 or the local authority having jurisdiction. Temperature and pressure rating of the flexible hoses and flexible hose fittings shall not be exceeded.

### 2.8.2.1 Flexible Hoses

The flexible hoses are constructed with synthetic, high tensile textile cord reinforcement. Both ends are fitted with swivel adapters for easy installation. The flexible hoses have a maximum operating pressure of 300 psig [20.7 bar] and a minimum bend radius of 4 in [10.2 cm]. The 940301 unit assembly use 3/8 in flexible hoses. The 940601 and 941201 unit assemblies use 1/2 in flexible hoses. Refer to Figure 6 – Flexible Hoses, Table 14 – Flexible Hose Part Numbers for 940301 Unit Assembly, and Table 15 – Flexible Hose Part Numbers for 940601/941201 Unit Assembly for additional information.

**NOTE:** This is an optional component and is not part of an FM Approved System.

**NOTE:** When using flexible hoses for the discharge network, the total length of piping shall not exceed the maximum length found in Section 3.6.

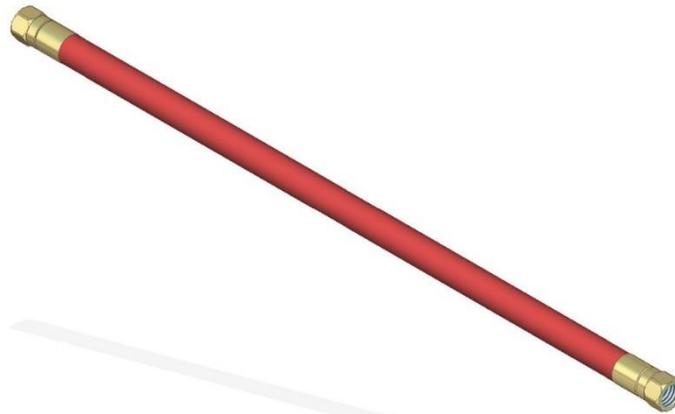
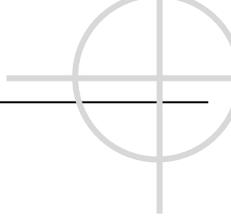


Figure 6 – Flexible Hoses

Table 14 – Flexible Hose Part Numbers for 940301 Unit Assembly

Flexible Hose Part Number	Description
202816 <sup>†</sup>	3/8 in Flexible Hose, 1 ft
201816 <sup>†</sup>	3/8 in Flexible Hose, 2 ft
201817 <sup>†</sup>	3/8 in Flexible Hose, 3 ft
201818 <sup>†</sup>	3/8 in Flexible Hose, 4 ft
201819 <sup>†</sup>	3/8 in Flexible Hose, 7 ft

<sup>†</sup> This is an optional component and is not part of an FM Approved System.



**Table 15 – Flexible Hose Part Numbers for 940601/941201 Unit Assembly**

Flexible Hose Part Number	Description
202820 <sup>‡</sup>	1/2 in Flexible Hose, 1 ft
201820 <sup>‡</sup>	1/2 in Flexible Hose, 2 ft
201821 <sup>‡</sup>	1/2 in Flexible Hose, 4 ft
201822 <sup>‡</sup>	1/2 in Flexible Hose, 6 ft
201823 <sup>‡</sup>	1/2 in Flexible Hose, 8 ft
201824 <sup>‡</sup>	1/2 in Flexible Hose, 10 ft

### 2.8.2.2 Flexible Hose Fittings

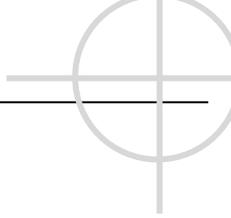
The flexible hose fittings are constructed of zinc plated steel. The flexible hose fittings allow for easy installation between the Firetrace HFC-227ea ILP Units, the flexible hoses, and the system nozzles. The flexible hose fittings have a minimum burst rating of 3000 psig [206.8 bar]. Refer to Figure 7 – Flexible Hose Fittings, Table 16 – Flexible Hose Fitting Part Numbers for 940301 Unit Assembly, and Table 17 – Flexible Hose Fitting Part Numbers for 940601/941201 Unit Assembly for additional information.

**NOTE: This is an optional component and is not part of an FM Approved System.**



**Figure 7 – Flexible Hose Fittings**

<sup>‡</sup> This is an optional component and is not part of an FM Approved System.



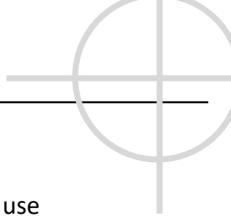
**Table 16 – Flexible Hose Fitting Part Numbers for 940301 Unit Assembly**

<b>Flexible Hose Fitting Part Number</b>	<b>Description</b>
850016 <sup>§</sup>	Fitting, 3/8 in Hose to Valve Union
850017 <sup>§</sup>	Fitting, 3/8 in Hose Union
850018 <sup>§</sup>	Fitting, 3/8 in Hose Elbow
850019 <sup>§</sup>	Fitting, 3/8 in Hose Tee
850020 <sup>§</sup>	Fitting, 3/8 in Hose to Nozzle Union Bulkhead
850021 <sup>§</sup>	Fitting, 3/8 in Hose to Nozzle Elbow Bulkhead

**Table 17 – Flexible Hose Fitting Part Numbers for 940601/941201 Unit Assembly**

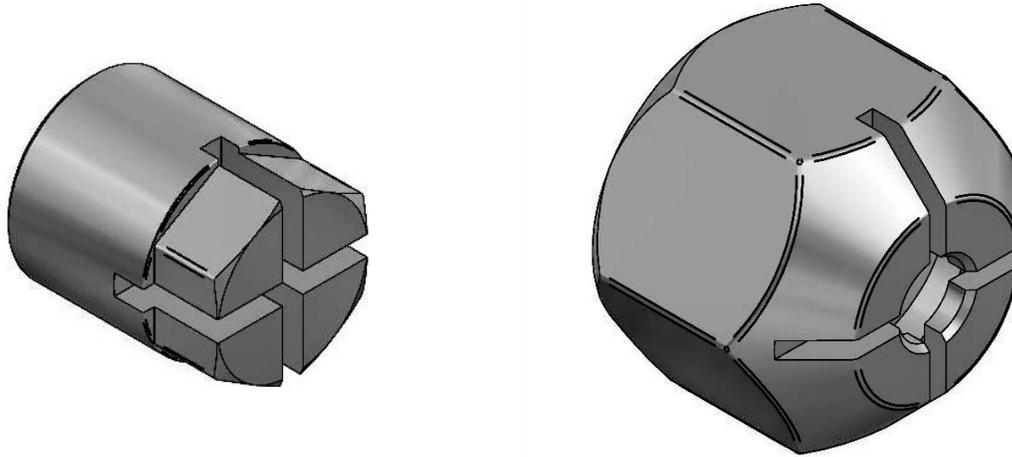
<b>Flexible Hose Fitting Part Number</b>	<b>Description</b>
850022 <sup>§</sup>	Fitting, 1/2 in Hose to Valve Union
850023 <sup>§</sup>	Fitting, 1/2 in Hose Union
850024 <sup>§</sup>	Fitting, 1/2 in Hose Elbow
850025 <sup>§</sup>	Fitting, 1/2 in Hose Tee
850026 <sup>§</sup>	Fitting, 1/2 in Hose to Nozzle Union Bulkhead
850027 <sup>§</sup>	Fitting, 1/2 in Hose to Nozzle Elbow Bulkhead

<sup>§</sup> This is an optional component and is not part of an FM Approved System.



### 2.8.3 Nozzles

Discharge nozzles are made of nickel plated brass with female pipe threads. Nozzles are available in two sizes for use with Firetrace ILP HFC-227ea Units. The small nozzles contain a G1/4 thread. The medium nozzles contain a 1/2 in NPT thread. The 940301 unit assembly uses the small nozzle, see Figure 8 – Nozzles. The 940301 unit assembly can be designed using 1, 2, or 4 small nozzles. The 940601 and 941201 unit assemblies use the medium nozzles, see Figure 8 – Nozzles. The 940601 and 941201 unit assemblies can be designed using 2 or 4 medium nozzles. The coverage for each nozzle must not exceed its maximum length and area of coverage. Refer to Section 3 for nozzle coverage information.



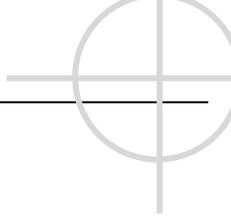
Small Nozzle

Medium Nozzle

Figure 8 – Nozzles

Table 18 – Nozzle Part Numbers

Nozzle Part Number	Connection Size	Unit Assembly
500015	G1/4	940301
500017	1/2 in NPT	940601/941201



## 2.9 Pressure Switches

### 2.9.1 Valve Mounted Pressure Switch

The valve mounted pressure switch is an optional part of the unit assembly. It is factory installed into the pressure switch port of the cylinder valve. The valve mounted pressure switch is used to monitor unit pressure, unit actuation, or it can be used to energize or de-energize electrically operated equipment. If the unit to which the pressure switch is attached to loses pressure and reaches a pressure of  $135 \pm 10$  psig [ $9.3 \pm 0.7$  bar] or below, the switch contacts will operate. Refer to Figure 9 – Valve Mounted Pressure Switch, Table 19 – Valve Mounted Pressure Switch Part Number, Figure 10 – Valve Mounted Pressure Switch Wiring Schematic, and Table 20 – Pressure Switch Properties for additional information.

The pressure switch is single pole, double throw (SPDT) and can be wired in either the normally open (NO), normally closed (NC) configurations, where the normal condition is at atmospheric pressure. When the unit is pressurized, the contacts switch over.

When the pressure switch is used on a standard supervisory input circuit, there will be no distinction between a wiring fault and device actuation. The pressure switch shall be installed onto a circuit suitable for unit supervision in accordance with NFPA 70 National Electric Code and NFPA 72 National Fire Alarm and Signaling Code.

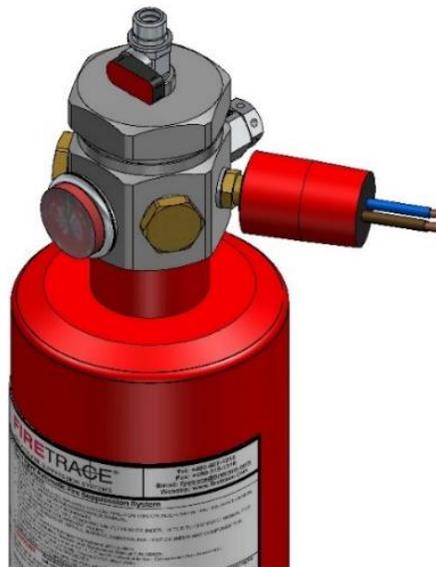
This device is only to be utilized when accepted by the authority having jurisdiction. All other uses of this switch should be approved by the authority having jurisdiction.

**NOTE: All detection devices and auxiliary alarm and control devices must be electrically compatible with each other. They must be approved by the authority having jurisdiction.**

**NOTE: Firetrace recommends that all units be equipped with a pressure switch and connected into a notification or shutdown device, in the event of a discharge.**

#### **CAUTION**

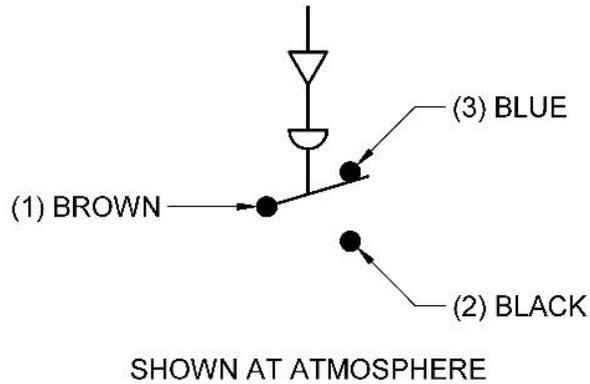
**Never use the pressure switch as a handle to transport the unit.**



**Figure 9 – Valve Mounted Pressure Switch**

**Table 19 – Valve Mounted Pressure Switch Part Number**

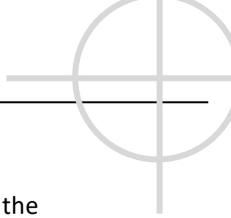
Pressure Switch Part Number	Description
400001	Valve Mounted Pressure Switch



**Figure 10 – Valve Mounted Pressure Switch Wiring Schematic**

**Table 20 – Pressure Switch Properties**

Electrical Rating		Temperature Range
28 VDC – 15 A		-20 °F to 150 °F [-28.9 °C to 65.6 °C]
NO (1 and 3): 120 VAC – 10 A 240 VAC – 5 A	NC (1 and 2): 120 VAC – 25 A 240 VAC – 5 A	



## 2.9.2 End of Line Pressure Switch

The end of line pressure switch is available as an optional part for the system detection network. The thread on the end of the pressure switch allows for easy installation into the threads of the end of line adapter. The provided washer ensures that the pressure switch will fully depress the Schrader core installed within the end of line adapter. The provided O-ring ensures that there will be an adequate seal between the pressure switch and the end of line adapter.

The end of line pressure switch is used to monitor system pressure, system discharge, or it can be used to energize or de-energize electrically operated equipment. If the detection network to which the pressure switch is attached to loses pressure and reaches a pressure of  $135 \pm 10$  psig [ $9.3 \pm 0.7$  bar] or below, the switch contacts will operate. Refer to Figure 11 – End of Line Pressure Switch, Table 21 – End of Line Pressure Switch Part Number, Figure 12 – End of Line Pressure Switch Wiring Schematic, and Table 22 – End of Line Pressure Switch Properties for additional information.

The pressure switch is single pole, double throw (SPDT) and can be wired in either the normally open (NO), normally closed (NC) configurations, where the normal condition is at atmospheric pressure. When the unit is pressurized, the contacts switch over.

When the pressure switch is used on a standard supervisory input circuit, there will be no distinction between a wiring fault and device actuation. The pressure switch shall be installed onto a circuit suitable for unit supervision in accordance with NFPA 70 National Electric Code and NFPA 72 National Fire Alarm and Signaling Code.

This device is only to be utilized when accepted by the authority having jurisdiction. All other uses of this switch should be approved by the authority having jurisdiction.

**NOTE: All detection devices and auxiliary alarm and control devices must be electrically compatible with each other. They must be listed by the authority having jurisdiction.**

**NOTE: Firetrace recommends that all units be equipped with a pressure switch and connected into a notification or shutdown device, in the event of a discharge.**

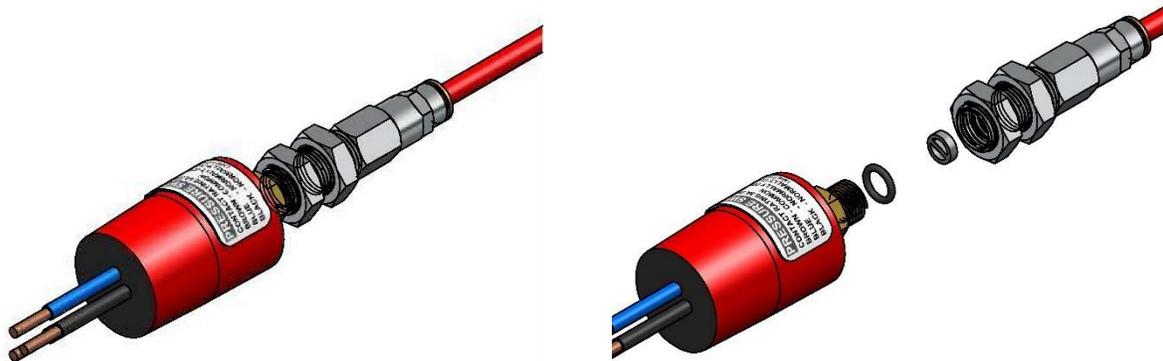
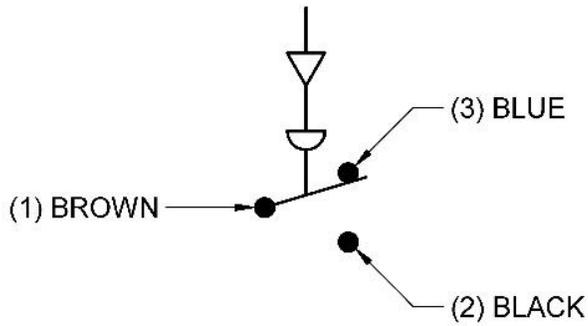


Figure 11 – End of Line Pressure Switch

**Table 21 – End of Line Pressure Switch Part Number**

Pressure Switch Part Number	Description
400004	End of Line Pressure Switch

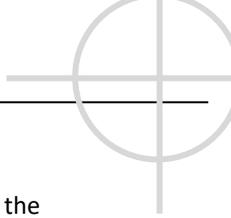


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**Figure 12 – End of Line Pressure Switch Wiring Schematic**

**Table 22 – End of Line Pressure Switch Properties**

Electrical Rating		Temperature Range
28 VDC – 15 A		-20 °F to 150 °F [-28.9 °C to 65.6 °C]
NO (1 and 3): 120 VAC – 10 A 240 VAC – 5 A	NC (1 and 2): 120 VAC – 25 A 240 VAC – 5 A	



### 2.9.3 Pressure Switch Assembly

The pressure switch assembly is available as an optional part for the system detection network. The fitting on the exterior of the pressure switch assembly enclosure allows for the detection tubing to be easily installed into the assembly.

The pressure switch assembly is used to monitor system pressure, system discharge, or it can be used to energize or de-energize electrically operated equipment. If the detection network to which the pressure switch is attached to loses pressure and reaches a pressure of  $135 \pm 10$  psig [ $9.3 \pm 0.7$  bar] or below, the switch contacts will operate. Refer to Figure 13 – Pressure Switch Assembly, Table 23 –Pressure Switch Assembly Part Number, Figure 14 – Pressure Switch Assembly Wiring Schematic, and Table 24 – Pressure Switch Assembly Properties for additional information.

The pressure switch is single pole, double throw (SPDT) and can be wired in either the normally open (NO), normally closed (NC) configurations, where the normal condition is at atmospheric pressure. When the unit is pressurized, the contacts switch over.

When the pressure switch is used on a standard supervisory input circuit, there will be no distinction between a wiring fault and device actuation. The pressure switch shall be installed onto a circuit suitable for unit supervision in accordance with NFPA 70 National Electric Code and NFPA 72 National Fire Alarm and Signaling Code.

This device is only to be utilized when accepted by the authority having jurisdiction. All other uses of this switch should be approved by the authority having jurisdiction.

**NOTE: All detection devices and auxiliary alarm and control devices must be electrically compatible with each other. They must be approved by the authority having jurisdiction.**

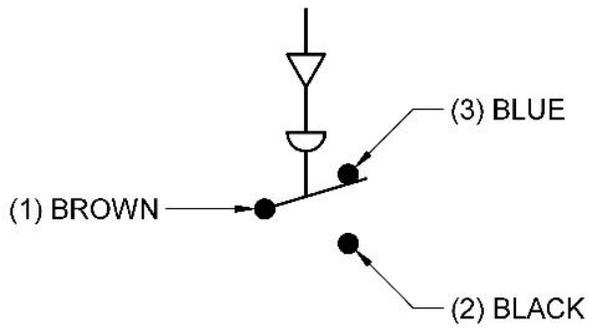
**NOTE: Firetrace recommends that all units be equipped with a pressure switch and connected into a notification or shutdown device, in the event of a discharge.**



Figure 13 – Pressure Switch Assembly

Table 23 –Pressure Switch Assembly Part Number

Pressure Switch Part Number	Description
400441	Pressure Switch Assembly



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Figure 14 – Pressure Switch Assembly Wiring Schematic

Table 24 – Pressure Switch Assembly Properties

Electrical Rating		Temperature Range
28 VDC – 15 A		-20 °F to 150 °F [-28.9 °C to 65.6 °C]
NO (1 and 3): 120 VAC – 10 A 240 VAC – 5 A	NC (1 and 2): 120 VAC – 25 A 240 VAC – 5 A	

NOTE: All detection devices and auxiliary alarm and control devices must be electrically compatible with each other. They must be listed by the authority having jurisdiction.

NOTE: Firetrace recommends that all units be equipped with a pressure switch and connected into a notification or shutdown device, in the event of a discharge.

## 2.10 Electric Solenoid Assembly

The electric solenoid assembly is available as an optional part for the system detection network. The fitting attached to the electric solenoid allows for the detection tubing to be easily installed into the electric solenoid assembly.

The electric solenoid assembly is used to release pressure from the detection tubing, resulting in actuation of the Firetrace HFC-227ea ILP Unit. Refer to Figure 15 – Electric Solenoid Assembly, Table 25 – Electric Solenoid Assembly Part Number, Figure 16 – Electric Solenoid Assembly Wiring Schematic, and Table 26 – Electric Solenoid Assembly Properties for additional information.

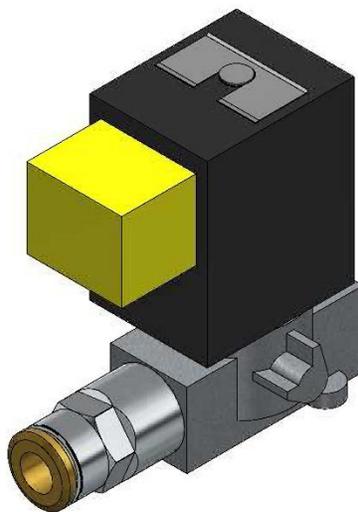
The electric solenoid is normally closed and requires electrical energy to remain open. The electric solenoid assembly is available in 12 VDC, 24 VDC, 120 VAC, and 240 VAC configurations.

The electric solenoid assembly shall be installed in accordance with NFPA 70 National Electric Code and NFPA 72 National Fire Alarm and Signaling Code.

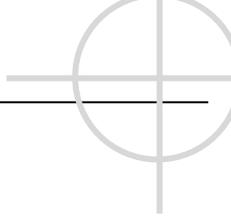
This device is only to be utilized when accepted by the authority having jurisdiction. All other uses of this electric solenoid assembly should be approved by the authority having jurisdiction.

**NOTE: All detection devices and auxiliary alarm and control devices must be electrically compatible with each other. They must be approved by the authority having jurisdiction.**

**NOTE: Detection networks equipped with an electric solenoid assembly, require the use of a solenoid connector cable.**

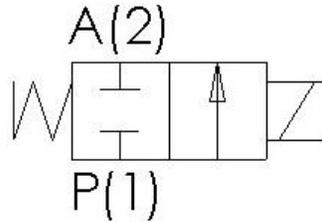


**Figure 15 – Electric Solenoid Assembly**



**Table 25 – Electric Solenoid Assembly Part Number**

Electric Solenoid Assembly Part Number	Description
400312**	12 VDC Electric Solenoid Assembly
400324**	24 VDC Electric Solenoid Assembly
400316**	120 VAC Electric Solenoid Assembly
400327**	240 VAC Electric Solenoid Assembly

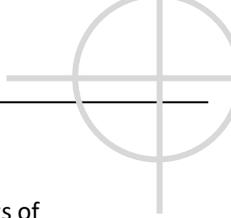


**Figure 16 – Electric Solenoid Assembly Wiring Schematic**

**Table 26 – Electric Solenoid Assembly Properties**

Maximum Allowable Pressure	725 psig [50 bar]
Opening Time	10 ms
Closing Time	10 ms
Fluid Temperature	32 °F to 266 °F [0 °C to 130 °C]

\*\* This is an optional component and is not part of an FM Approved System.



## 2.11 Indication and Activation Kit

The indication and activation kit is available as an optional part for the system detection network. The kit consists of a notification module with a system activation switch and a system interface module. The notification module provides indication for “Fire/Activation” (Red LED and Audible Alarm), “Service” (Yellow LED), and “Power” (Green LED). The system interface module is equipped with a fitting that allows for the detection tubing to be easily installed into the system interface module. The system activation switch is used to release pressure from the detection tubing, resulting in actuation of the Firetrace HFC-227ea ILP Unit. Refer to Figure 17 – Indication and Activation Kit and Table 27 – Indication and Activation Kit Part Number for additional information.

The indication and activation kit is available in 12 VDC or 24 VDC configurations.

**NOTE: The indication and activation kit requires the use of a 2 amp fuse box. Fuse box is not included as part of the kit.**

The indication and activation kit shall be installed in accordance with NFPA 70 National Electric Code and NFPA 72 National Fire Alarm and Signaling Code.

This device is only to be utilized when accepted by the authority having jurisdiction. All other uses of the indication and activation kit should be approved by the authority having jurisdiction.

**NOTE: All detection devices and auxiliary alarm and control devices must be electrically compatible with each other. They must be approved by the authority having jurisdiction.**

**NOTE: Detection networks equipped with an indication and activation kit require the use of a 2 amp fuse box.**

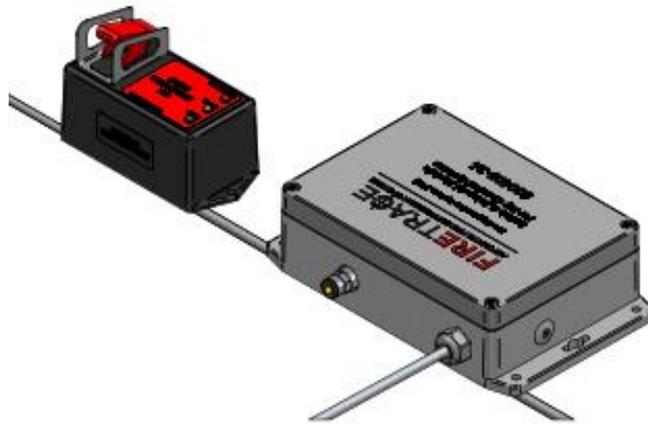
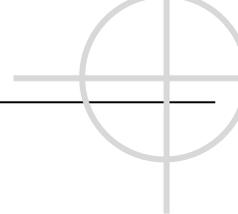


Figure 17 – Indication and Activation Kit

Table 27 – Indication and Activation Kit Part Number

Indication and Activation Kit Part Number	Description
600432-12 <sup>††</sup>	12 VDC Indication and Activation Kit, 150 psig, Rear Cable
600433-12 <sup>††</sup>	12 VDC Indication and Activation Kit, 150 psig, Bottom Cable
600432-24 <sup>††</sup>	24 VDC Indication and Activation Kit, 150 psig, Rear Cable
600433-24 <sup>††</sup>	24 VDC Indication and Activation Kit, 150 psig, Bottom Cable

<sup>††</sup> This is an optional component and is not part of an FM Approved System.



## Section 3: Design

### 3.1 Introduction

The Firetrace Pre-Engineered HFC-227ea ILP Automatic Suppression Units design limitations were established and tested by Firetrace. The ILP units are Approved by FM Approvals.

These units were subjected to numerous performance and fire tests (as specified in FM 5600), in order to verify the suitability of the fire suppression units and to establish design limitations for the following parameters:

- Enclosure volume
- Nozzle height
- Discharge time and flow rates
- Nozzle area coverage
- Nozzle placement
- Design concentrations and design factors
- Firetrace detection tube placement

The Pre-Engineered concept minimizes the amount of engineering required when evaluating a design for a specific application. Provided that the discharge piping and nozzles are installed within the limits outlined in this manual, no calculations are required for pressure drop, flow rates, or discharge time. When the additional limitations (enclosure volume, area coverage, maximum height, design concentration, agent quantity, detection tubing placement) are also met, the system installation can be understood to comply with the design requirements, NFPA 2001, and FM Approvals. Therefore, no discharge tests or concentration measurements should be required for evaluating a system design.

Systems shall be installed and maintained in accordance with NFPA 2001, all applicable codes and regulations, and this manual. It is important that the limitations stated in this manual are followed.

**NOTE:** Firetrace Pre-Engineered ILP Automatic Suppression Units are designed and approved as an automatic unit. Firetrace ILP Units are not designed to provide simultaneous actuation of two or more units. Under the approval, only one Firetrace Pre-Engineered ILP Automatic Suppression Unit can be used to protect one enclosure, units shall not be combined to protect a larger enclosure.

#### **CAUTION**

Clean agent shall NOT be used on fires involving the following materials:

1. Certain chemicals or mixtures of chemicals, such as cellulose nitrate and gunpowder, which are capable of rapid oxidation in the absence of air.
2. Reactive metals.
3. Metal hydrides.
4. Chemicals capable of undergoing autothermal decomposition.

### 3.2 Operating Specifications

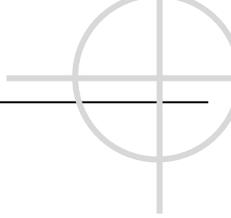
#### 3.2.1 Temperature Range

Firetrace Pre-Engineered HFC-227ea ILP Automatic Suppression Units and equipment are designed to be stored and operated at the ambient temperature range of 0 °F to 130 °F [-17.8 °C to 54.4 °C].

#### 3.2.2 Operating Pressure

The normal operating pressure for Firetrace Pre-Engineered HFC-227ea ILP Automatic Suppression Units is 150 psig at 70 °F [10.3 bar at 21.1 °C].

Firetrace Pre-Engineered HFC-227ea ILP Automatic Suppression Units are designed for an operating temperature range of 0 °F to 130 °F [-17.8 °C to 54.4 °C]. Table 28 – Pressure-Temperature Relationship, shows the pressure gauge reading based on a charging pressure of 150 psig at 70 °F [10.3 bar at 21.1 °C].



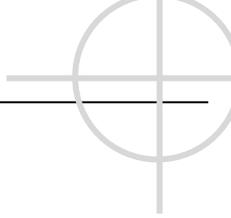
**Table 28 – Pressure-Temperature Relationship**

Temperature		Pressure	
°F	°C	psig	bar
0	-17.8	91	6.27
10	-12.2	97	6.69
20	-6.7	104	7.17
30	-1.1	111	7.65
40	4.4	119	8.20
50	10.0	128	8.83
60	15.5	139	9.58
70	21.1	150	10.3
80	26.7	163	11.24
90	32.2	177	12.20
100	37.8	192	13.24
110	43.3	209	14.41
120	48.9	228	15.72
130	54.4	249	17.17

### 3.3 Design Procedure

In addition to the applicable requirements specified in Chapter 5 of NFPA 2001, the following steps should be used to design a system utilizing a Firetrace Pre-Engineered HFC-227ea ILP Automatic Suppression Unit:

- a. Conduct a survey and analysis of the hazard to be protected.
- b. Determine the length, width, and height of the enclosure and calculate the volume. All of these parameters must be within the dimensional limitations specified in this manual.
- c. Determine the anticipated minimum and maximum ambient temperatures within the enclosure.
- d. Determine the minimum design concentration required for the hazard.
- e. Determine the integrity of the enclosure and if any openings must be closed at the time of agent discharge.
- f. Determine the cylinder size required, based on enclosure volume limitations and enclosure size.
- g. Evaluate personnel safety exposure limitations as specified in NFPA 2001, based on the total quantity of HFC-227ea clean agent being used at the maximum ambient temperature expected within the enclosure.
- h. Determine the quantity of nozzles required, based on the size and configuration of the enclosure.
- i. Determine the location where the Firetrace HFC-227ea ILP Unit and nozzles will be installed.
- j. Determine the routing and quantity of discharge piping required. Discharge piping and fittings used in the design must be within the limitations specified in this manual.
- k. Determine the arrangement and placement of the Firetrace detection tubing. Tubing parameters must be within the limitations specified in this manual.
- l. Determine any auxiliary equipment required to ensure proper protection of the enclosure.
- m. Prepare system drawings, bill of materials, and any additional documentation deemed necessary, following the applicable section of Chapter 5 of NFPA 2001.



### 3.4 Design Concentration

#### 3.4.1 Minimum Design Concentrations

The minimum design concentrations to be used with Firetrace Pre-Engineered HFC-227ea ILP Automatic Suppression Units include a minimum safety factor (SF), as specified in NFPA 2001. A 12.74% commercial grade heptane design concentration was used for all of the Class B fire tests conducted. An additional multiplication factor (MF) of 1.463 must be used to establish minimum design concentrations for all other Class B fuels.

Minimum design concentrations to be used with Firetrace Pre-Engineered HFC-227ea ILP Automatic Suppression Units can be found in Table 29 – Class A Minimum Design Concentrations and Table 30 – Class B Minimum Design Concentrations. For all other Class B fuels not shown in Table 30 – Class B Minimum Design Concentrations, the minimum design concentration can be calculated as follows:

$$MDC = EC * SF * MF$$

- where: MDC = minimum design concentration
- EC = minimum extinguishing concentration, determined using the cup burner test method
- SF = safety factor, 1.3
- MF = multiplication factor, 1.463 for Firetrace HFC-227ea ILP Units

The maximum volume limitations and minimum temperature specifications MUST be followed in order to maintain the correct safety factor. It is recommended that the designer consult with Firetrace, NFPA 2001, and the local authority having jurisdiction, as to the suitability on the use of HFC-227ea for a particular hazard, for personnel exposure effects from the design concentrations, and for installation requirements.

**Table 29 – Class A Minimum Design Concentrations**

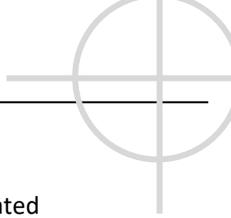
Fuel	Extinguishing Concentration (%)	Minimum Design Concentration (%)
Class A	5.2	6.7

NOTE: FM Approved system is only approved for Class B hazards.

**Table 30 – Class B Minimum Design Concentrations**

Fuel	Extinguishing Concentration* (%)	Minimum Safety Factor	Multiplication Factor	Minimum Design Concentration (%)
Acetone	6.9	1.3	1.463	13.12
Ethanol	8.7	1.3	1.463	16.55
n-Heptane	6.7	1.3	1.463	12.74
Methanol	10.5	1.3	1.463	19.97
2-Propanol	7.4	1.3	1.463	14.07
Toluene	5.2	1.3	1.463	9.89

\*Class B extinguishing concentration values were derived using the cup burner test method



### 3.4.2 Actual Concentration

To calculate the actual concentration ( $C_{tmax}$ ) achieved in the protected enclosure, at the maximum anticipated ambient temperature, the following equation should be used:

$$C_{tmax} = \frac{100}{(V/W * 1/s) + 1}$$

where: W = agent being used (lb)

V = volume of the protected enclosure (ft<sup>3</sup>)

s = specific volume of superheated HFC-227ea vapor (ft<sup>3</sup>/lb)

s can be approximated by using the following formula:

$$s = 1.885 + .0046 * t$$

Where: t = maximum anticipated ambient temperature (°F)

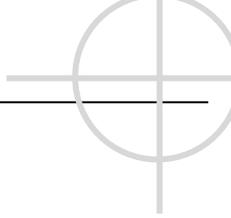
#### **CAUTION**

Care must be taken to ensure that the actual concentration, at the maximum anticipated ambient temperature in the protected enclosure does not exceed the values specified in NFPA 2001.

### 3.5 Protected Enclosure

Firetrace Pre-Engineered HFC-227ea ILP Automatic Suppression Units are designed to enable a single cylinder to protect an enclosure of any size or shape, provided that the enclosure parameters do not exceed the limitations stated in the manual. Table 31 – Enclosure Volume Limitations for 940301 Unit Assembly, Table 32 – Enclosure Volume Limitations for 940601 Unit Assembly, and Table 33 – Enclosure Volume Limitations for 941201 Unit Assembly list the enclosure volume limitations for Firetrace Pre-Engineered HFC-227ea ILP Automatic Suppression Units.

**NOTE: Firetrace Pre-Engineered ILP Automatic Suppression Units are designed and approved as an automatic unit. Firetrace ILP Units are not designed to provide simultaneous actuation of two or more units. Under the approval, only one Firetrace Pre-Engineered ILP Automatic Suppression Unit can be used to protect one enclosure, units shall not be combined to protect a larger enclosure.**

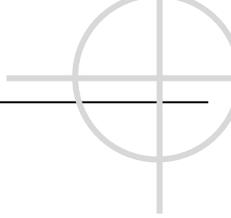


**Table 31 – Enclosure Volume Limitations for 940301 Unit Assembly**

Design Temperature		Maximum Enclosure Volume		Concentration
°F	°C	ft <sup>3</sup>	m <sup>3</sup>	%
0	-17.8	38	1.08	12.74
10	-12.2	39	1.10	12.74
20	-6.7	40	1.13	12.74
30	-1.1	41	1.16	12.74
40	4.4	42	1.19	12.74
50	10.0	43	1.22	12.74
60	15.5	44	1.25	12.74
70	21.1	45	1.27	12.74
80	26.7	46	1.30	12.74
90	32.2	47	1.33	12.74
100	37.8	48	1.36	12.74
110	43.3	49	1.39	12.74
120	48.9	50	1.42	12.74
130	54.4	51	1.44	12.74

**Table 32 – Enclosure Volume Limitations for 940601 Unit Assembly**

Design Temperature		Maximum Enclosure Volume		Concentration
°F	°C	ft <sup>3</sup>	m <sup>3</sup>	%
0	-17.8	77	2.18	12.74
10	-12.2	79	2.24	12.74
20	-6.7	81	2.29	12.74
30	-1.1	83	2.35	12.74
40	4.4	85	2.41	12.74
50	10.0	86	2.44	12.74
60	15.5	88	2.49	12.74
70	21.1	90	2.55	12.74
80	26.7	92	2.61	12.74
90	32.2	94	2.66	12.74
100	37.8	96	2.72	12.74
110	43.3	98	2.78	12.74
120	48.9	100	2.83	12.74
130	54.4	102	2.89	12.74



**Table 33 – Enclosure Volume Limitations for 941201 Unit Assembly**

Design Temperature		Maximum Enclosure Volume		Concentration
°F	°C	ft <sup>3</sup>	m <sup>3</sup>	%
0	-17.8	154	4.36	12.74
10	-12.2	158	4.47	12.74
20	-6.7	162	4.59	12.74
30	-1.1	166	4.70	12.74
40	4.4	170	4.81	12.74
50	10.0	173	4.90	12.74
60	15.5	177	5.01	12.74
70	21.1	181	5.13	12.74
80	26.7	185	5.24	12.74
90	32.2	188	5.32	12.74
100	37.8	192	5.44	12.74
110	43.3	196	5.55	12.74
120	48.9	200	5.66	12.74
130	54.4	204	5.78	12.74

### 3.5.1 Enclosure Size

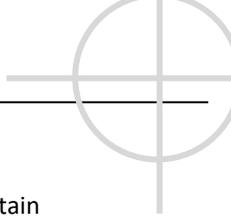
Table 34 – Enclosure Size Limitations for Firetrace HFC-227ea ILP Units below list the enclosure volume limitations for Firetrace Pre-Engineered HFC-227ea ILP Automatic Suppression Units.

**Table 34 – Enclosure Size Limitations for Firetrace HFC-227ea ILP Units**

Unit Assembly	Total Area Coverage		Maximum Height	
	ft <sup>2</sup>	m <sup>2</sup>	ft	m
940301	36	3.34	12	3.33
940601	36	3.34	12	3.33
941201	36	3.34	12	3.33

### 3.5.2 Ventilation and Unclosable Openings

Openings in the protected enclosure must be sealed. When the unit is discharged into an enclosure, normal gaps and openings under doorways must not impact system performance. Doors and normal vents that are required in the enclosure must be closed prior to, or at the time of unit discharge. Doors or closures that normally swing to a closed position and are not held open do not require a system generated mechanism to operate. Doors and closures, including ventilation, which are held open while operating must have devices installed to close at the start or prior to unit discharge. All doors should be closed and ventilation fans shut down prior to discharge.



### 3.5.3 Pressure Relief Vent Area

In the event of a discharge, the protected enclosure must have sufficient structural strength and integrity to contain the agent discharge. If the pressure difference across the enclosure boundaries presents a threat to the hazard enclosure, venting shall be provided to prevent excessive pressures.

Guidance to determine the pressure relief vent area can be found in the FSSA Application Guide to Estimating Enclosure Pressure & Pressure Relief Vent Area for Use with Clean Agent Fire Extinguishing Systems and shall be in accordance with NFPA 2001 requirements.

## 3.6 Discharge Network

### 3.6.1 Discharge Piping and Pipe Fitting Specifications

All Firetrace Pre-Engineered HFC-227ea ILP Automatic Suppression Units shall use copper tubing for the agent distribution system. See Table 35 – Discharge Piping Specifications and Table 36 – Discharge Pipe Fitting Specifications for specifications of the discharge piping and pipe fittings to be used with Firetrace HFC-227ea ILP Units. Refer to Section 4.2 of NFPA 2001 for alternate discharge network options.

**Table 35 – Discharge Piping Specifications**

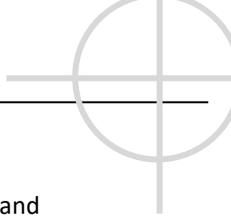
Unit Assembly	Material	Outer Diameter	Wall Thickness
940301	soft annealed copper (AS B-280*, for air conditioning and refrigeration service)	5/16 in	.032 in
940601		1/2 in	.032 in
941201		1/2 in	.032 in

\*The use of AS B-280 soft annealed copper, as specified in this manual, complies with ASME B 31.1 requirements of NFPA 2001.

**Table 36 – Discharge Pipe Fitting Specifications**

Material	Connection Type	Minimum Pressure Rating**
Brass	Flareless Bite*	1000 psig

\*Use Parker Intru-Lok, Camozzi, or equivalent  
\*\*Minimum pressure rating for use with Firetrace HFC-227ea ILP Units



### 3.6.2 Discharge Piping and Pipe Fitting Limitations

Table 37 – Discharge Piping Limitations and Table 38 – Pipe Fitting Limitations below show the discharge piping and pipe fitting limitations for Firetrace Pre-Engineered HFC-227ea ILP Automatic Suppression Units.

**Table 37 – Discharge Piping Limitations**

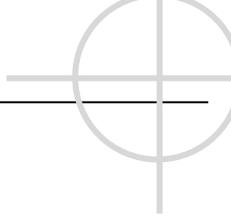
Unit Assembly	Discharge Ports Used	Nozzles per Discharge Port	Total Nozzles Used	Maximum Length of Discharge Piping	
				ft	m
940301	1	1	1	3	0.91
	2	1	2	10	3.05
	2	2	4	10	3.05
940601	2	1	2	10	3.05
	2	2	4	11	3.35
941201	2	1	2	10	3.05
	2	2	4	11	3.35

**Table 38 – Pipe Fitting Limitations**

Unit Assembly	Discharge Ports Used	Nozzles per Discharge Port	Total Nozzles Used	Maximum Elbows per Discharge Port	Maximum Tees per Discharge Port
940301	1	1	1	0	0
	2	1	2	2	0
	2	2	4	3	1
940601	2	1	2	2	0
	2	2	4	3	1
941201	2	1	2	2	0
	2	2	4	3	1

### 3.6.3 Discharge Pipe Bends

Wherever possible, pipe bends should be used in lieu of 90° elbows. It is recommended that a pipe bender be used when forming the 90° bends. Refer to Table 39 – Pipe Bend Radius and Equivalent Length when forming pipe bends, to minimize the chance of flattening the pipe.



**Table 39 – Pipe Bend Radius and Equivalent Length**

Pipe Outer Diameter (OD)	Minimum Bend Radius* to Pipe Centerline	Equivalent Length** for 90° Bend***
5/16 in	11/16 in	1-1/8 in
1/2 in	1-1/2 in	2-3/8 in

\* The minimum bend radii were derived from Parker Industrial Tube Fittings Catalogue 4300, dated March 1991.  
 \*\* The equivalent length is to be subtracted from the maximum length of piping as stated under Table 37 – Discharge Piping Limitations.  
 \*\*\*90° pipe bends are not required to be subtracted from the maximum number of elbows stated under Table 38 – Pipe Fitting Limitations.

### 3.6.4 Nozzle Area Coverage

The 940301 unit assembly can be installed using 1, 2, or 4 nozzles to suit the hazard configuration. The 940601 and 941201 unit assemblies can be designed using 2 or 4 nozzles to suit the hazard configuration. Table 40 – Nozzle Area Coverage Limitations below shows the nozzle area coverage limitations for Firetrace Pre-Engineered HFC-227ea ILP Automatic Suppression Units. The maximum enclosure height for nozzle installation is 10 ft [3.05 m]. The minimum enclosure height for nozzle installation is 1.6 ft [0.3 m].

Each Firetrace ILP unit is equipped with two discharge ports, whether one or both discharge ports are used is dependent on the size and shape of the enclosure, and the number of nozzles required to cover the protected hazard. See Figure 18 – Typical Nozzle Configuration Guideline for typical examples of configurations that meet the stated limitations.

**Table 40 – Nozzle Area Coverage Limitations**

Unit Assembly	Discharge Ports Used	Nozzles per Discharge Port	Total Nozzles Used	Maximum Area Coverage per Nozzle		Maximum Height	
				ft	m	ft	m
940301	1	1	1	6 ft x 6 ft 36 ft <sup>2</sup>	1.83 m x 1.83 m 3.34 m <sup>2</sup>	12	3.33
	2	1	2	6 ft x 3 ft 18 ft <sup>2</sup>	1.83 m x 0.91 m 1.67 m <sup>2</sup>	12	3.33
	2	2	4	3 ft x 3 ft 9 ft <sup>2</sup>	0.91 m x 0.91 m 0.84 m <sup>2</sup>	12	3.33
940601	2	1	2	6 ft x 3 ft 18 ft <sup>2</sup>	1.83 m x 0.91 m 1.67 m <sup>2</sup>	12	3.33
	2	2	4	3 ft x 3 ft 9 ft <sup>2</sup>	0.91 m x 0.91 m 0.84 m <sup>2</sup>	12	3.33
941201	2	1	2	6 ft x 3 ft 18 ft <sup>2</sup>	1.83 m x 0.91 m 1.67 m <sup>2</sup>	12	3.33
	2	2	4	3 ft x 3 ft 9 ft <sup>2</sup>	0.91 m x 0.91 m 0.84 m <sup>2</sup>	12	3.33

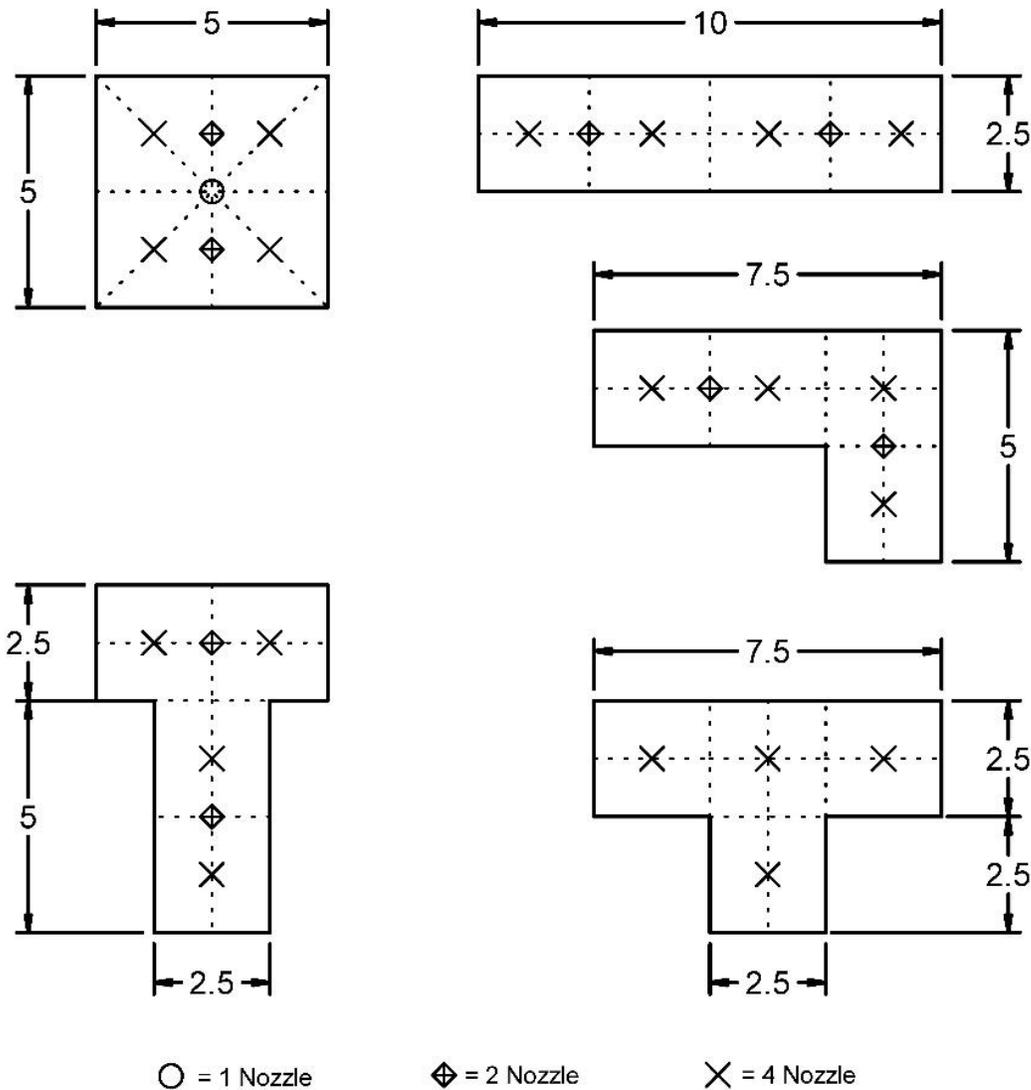
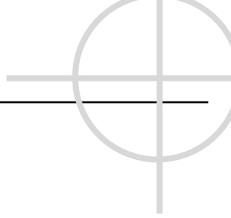
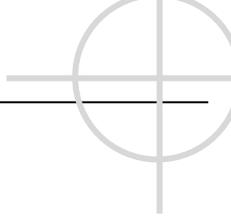


Figure 18 – Typical Nozzle Configuration Guideline

### 3.7 Firetrace Detection Tubing

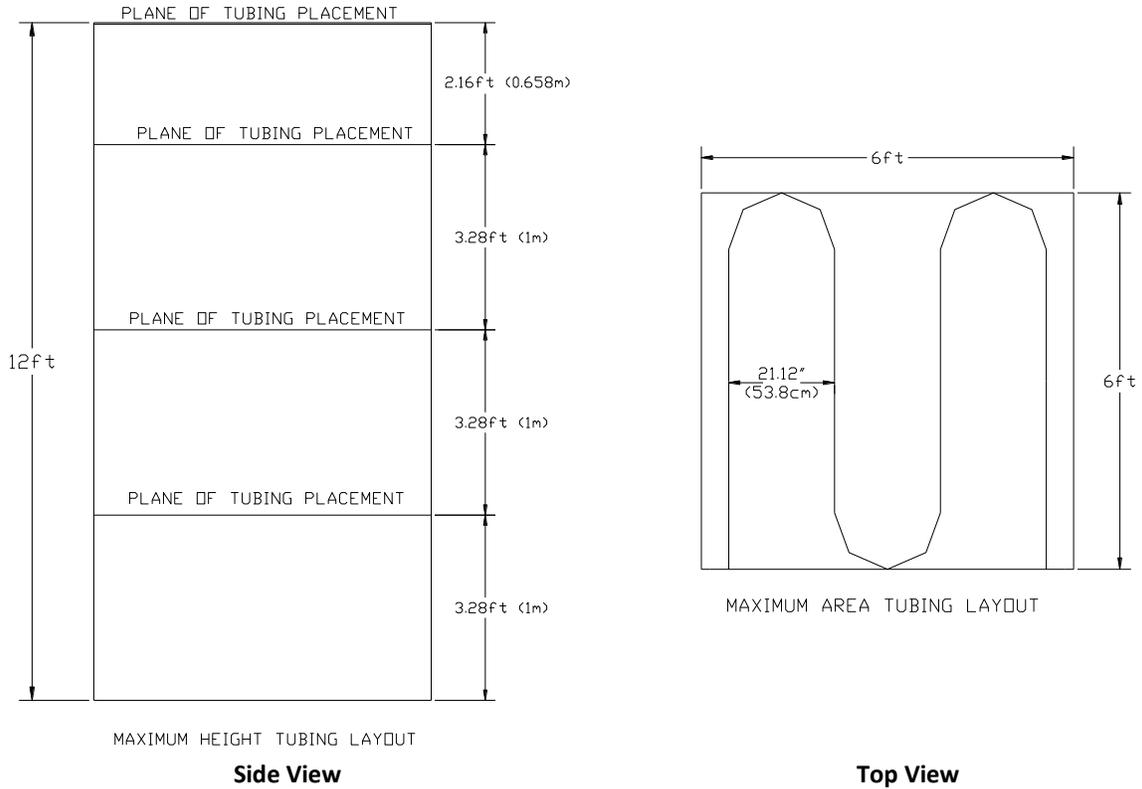
Location of the Firetrace detection tubing is critical to the response time in the event of a fire. The Firetrace detection tubing should be installed throughout the enclosure and routed in close proximity to all potential fire sources. The Firetrace detection tubing should not be placed horizontally adjacent to a potential fire source.

In order to protect the overall height of a protected enclosure, the tubing must be installed in height increments of 3.28 ft [1 m]. In order to protect the overall area of a protected enclosure, the tubing must be installed in passes. The maximum distance between passes is 21.12 in [53.8 cm]. The maximum distance allowed from any wall to the tubing is 10.56 in [26.82 cm]. The minimum bend radius shall not exceed 6 in [15.24 cm]. The maximum length of Firetrace detection tubing that can be used for Firetrace HFC-227ea ILP Units is 120 ft [36.58 m]. Refer to Table 41 – Firetrace Detection Tubing Limitations and Figure 19 – Tubing Configuration Guideline below for Firetrace detection tubing limitations and a guideline for typical tubing configurations.



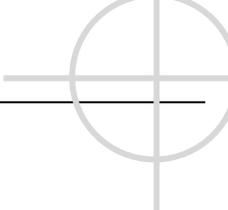
**Table 41 – Firetrace Detection Tubing Limitations**

Description	Limitation	
Maximum length of tubing runs	120 ft	36.58 m
Maximum height between layers	3.28 ft	1 m
Maximum distance between passes	21.12 in	53.8 cm
Maximum distance from wall	10.56 in	26.82 cm
Minimum bend radius	6 in	15.24 cm



**Figure 19 – Tubing Configuration Guideline**

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## Section 4: Installation

### 4.1 Introduction

This section provides installation instructions for components and limitations described in Section 2: System Description and Section 3: Design of this manual. All components should be installed to facilitate proper inspection, testing, recharging, and any other required service or maintenance, as may be necessary. Equipment must not be subjected to severe weather conditions, mechanical damage, chemical damage, or other damage which could render the equipment inoperative.

Firetrace Pre-Engineered HFC-227ea ILP Suppression Units and equipment must be handled, installed, and serviced only by qualified and trained personnel, in accordance with the instructions contained in this manual and on the cylinder nameplate, as well as NFPA 2001, FM 5600, and any other regulations and codes that may apply.

#### **WARNING**

**Pressurized (charged) cylinders are extremely hazardous and if not handled properly are capable of causing property damage, bodily injury, or death. Always wear safety glasses and ensure the discharge port plugs are properly installed before installing, servicing, or other general handling of ILP Units.**

### 4.2 Firetrace HFC-227ea ILP Unit

#### **WARNING**

**Ensure the ball valve, located on the top of the cylinder valve, is maintained in the “OFF” position. Ensure that the discharge port plugs are installed until the unit is mounted and ready for connection to the discharge piping.**

The Firetrace HFC-227ea ILP Unit should be located as close as possible to the protected enclosure. In some cases, the unit can be mounted inside the protected enclosure. The unit shall be located in a readily accessible location to allow for ease of inspection, service, and maintenance. The unit shall be located in an environment protected from the weather and where the temperature range is between 0 °F to 130 °F [-17.8 °C to 54.4 °C].

The cylinder and bracket must be mounted in the vertical plane with the cylinder valve on top, and oriented so that the pressure gauge is facing out and away from the mounting wall to facilitate visual inspection.

Mount the cylinder where it will not be subjected to accidental damage or movement. Suitable protection must be installed, where necessary, to prevent damage or movement.

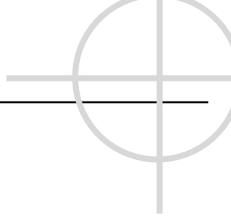
The steps below should be followed to ensure proper installation of the Firetrace HFC-227ea ILP Unit:

1. Install the cylinder mounting bracket to a structural support using two or more mounting holes.
2. Position the cylinder in the bracket with the pressure gauge facing out.
3. Secure the cylinder in place using the bracket straps or band clamps.

### 4.3 Discharge Network

The steps below should be followed to ensure proper installation of the discharge network:

1. Following the guidelines and limitations outlined in Section 3.6, determine whether one or two discharge ports will be used. If two discharge ports are to be used, verify that the pipe length from each discharge port does not exceed a 10% imbalance.
2. Following the guidelines and limitations outlined in Section 3, determine whether one, two, or four nozzles will be used and install the nozzles.
3. Remove the discharge port plug(s), as required, and install male connection fittings in the discharge port(s), as required.
4. Install the discharge piping and fittings between the discharge port(s) and nozzle(s). Secure the discharge network with the appropriate clamps, as required.



## 4.4 Detection Network

### 4.4.1 Firetrace Detection Tubing

Location and spacing of the tubing is critical to the response time in the event of a fire. The tubing should be placed above the hazard areas being protected. In addition to the guidelines and limitations outlined in Section 3.7, the steps below should be followed to ensure proper installation of the detection network:

1. Secure the Firetrace detection tubing by using mounting tabs. The mounting tabs should be placed at 1.5 ft [0.46 m] intervals.
2. Use the appropriate rubber/plastic grommets when the detection tubing is routed through sharp holes in order to prevent damage to the tubing.

**NOTE: Do not kink, bend, or crush Firetrace detection tubing. Damage to the tubing can result in leakage and/or accidental discharge of the Firetrace HFC-227ea ILP Unit.**

**NOTE: Do not install tubing in extreme environments where the maximum ambient temperature exceeds 176 °F [80 °C].**

### 4.4.2 Tube Fittings

All detection tube fittings must be secured in the following manner:

1. Cut the tube end, ensuring the cut is clean, square, and free from burrs.
2. Thoroughly clean the tubing, starting from the cut end, to approximately 2 in [5.08 cm] from the cut end. Remove all dirt, grease, or grime and ensure no debris is left in the tube. This will ensure a proper seal inside the fitting.
3. Slide the tubing into the opening of the fitting, until it reaches the inner wall.
4. Lightly pull on the tubing. The brass outer ring should move outward slightly.

### 4.4.3 End of Line Accessories

The end of line adapter is used to install auxiliary accessories to the detection network. One end of the end of line adapter contains a tube fitting. Install the end of line adapter to the end of the Firetrace detection tubing using the instructions outlined in Section 4.4.2.

**NOTE: End of line Adapters are not designed to provide a lasting seal without the use of auxiliary accessories.**

#### 4.4.3.1 Pressure Gauge

Verify that the threaded connection of the pressure gauge contains a lubricated O-ring. The pressure gauge is then installed into the inner threads of the end of line adapter. Hand tighten until the O-ring is completely inside.

**NOTE: The pressure gauge must be installed with its included O-ring to ensure a proper seal.**

#### 4.4.3.2 Pressure Switch

Verify that the threaded connection of the pressure switch contains a lubricated O-ring. Insert the pressure switch washer into the inner threads of the end of line adapter. Install the pressure switch into the inner threads of the end of line adapter. Hand tighten until an audible “click” can be heard.

**NOTE: The pressure switch washer must be installed into the inner threads of the end of line adapter. Without properly installing the pressure switch washer, the pressure switch will not be active.**

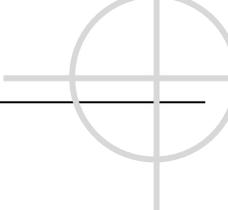
**NOTE: The pressure switch must be installed with its included O-ring to ensure a proper seal.**

#### 4.4.3.3 Plug

Verify that that threaded connection of the plug contains a lubricated O-ring. Install the plug into the inner threads of the end of line adapter. Hand tighten until the O-ring is completely inside.

**NOTE: The plug must be installed with its included O-ring to ensure a proper seal.**

---



## Section 5: Operation

### 5.1 System Activation

#### **WARNING**

Ensure the ball valve, located on the top of the cylinder valve, is maintained in the “OFF” position.

The steps below should be followed to ensure proper system activation of the Firetrace HFC-227ea ILP Unit:

1. Install the detection tubing throughout the enclosure. Ensure all necessary fittings and accessories are installed in accordance with the procedures specified in Section 4.
2. With the unit ball valve in the closed position, thread the tube fitting into the ball valve attached to the top of the cylinder valve.
3. Install one end of the Firetrace detection tubing into the fitting in accordance with the procedures specified in Section 4.
4. Ensure the end of line adapter is installed in the opposite end of the detection tubing. Verify no accessories are installed in the end of line adapter.
5. Attach the filling adapter into the end of line adapter.
6. Attach a regulated nitrogen supply onto the filling adapter.
7. Pressurize the detection tubing to 150 psig [10.3 bar].
8. Remove the nitrogen supply and filling adapter from the end of line adapter.
9. Thread the pressure gauge into the end of line adapter and verify that the tubing is pressurized to at least 150 psig at 70 °F [10.3 bar at 21.1 °C]. (Pressure may have to be adjusted for temperatures higher or lower than 70 °F [21.1 °C]).
10. With the gauge still installed in the end of line adapter, test for leakage:
  - a) Apply a soapy water solution to the cylinder valve connection, end of line adapter connection, and the pressure gauge connection.
  - b) Observe for bubble leaks.
  - c) After approximately 30 minutes, verify the pressure gauge reading. Any decrease in pressure is an indication of a leak.
  - d) If the system is determined to contain a leak, refer to Section 4: Installation and verify that installation procedures were properly followed for all fittings and accessories.
11. If the end of line pressure switch is to be installed, remove the pressure gauge from the end of line adapter and install the end of line pressure switch in accordance with the procedures specified in Section 4.
12. After confirming that there is no leakage within the detection tubing, SLOWLY rotate the ball valve lever counter clockwise, to the “ON” position.
13. Tamperproof the Firetrace HFC-227ea ILP Unit by removing the ball valve lever face and securing the ball valve lever in the “ON” position with the tamperproof device.
14. If a pressure switch is installed on the valve or on the end of line adapter, ensure the proper electrical connections are made, in accordance with NFPA 70 National Electric Code, NFPA 72 National Fire Alarm and Signaling Code, and any other applicable codes and regulations that may apply.
15. The Firetrace Pre-Engineered HFC-227ea ILP Automatic Suppression Unit is now ready for use.

**NOTE:** All detection devices and auxiliary alarm and control devices must be electrically compatible with each other. They must be listed by the authority having jurisdiction.

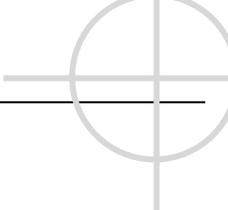
#### **WARNING**

Only open the ball valve AFTER the tubing has been pressurized. Opening the ball valve without pressurizing the tubing may cause actuation of the unit, resulting in system discharge.

#### **WARNING**

Ball valve must SLOWLY be opened. Opening the ball valve abruptly, may cause actuation of the unit, resulting in system discharge.

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## Section 6: Maintenance

### 6.1 General

Firetrace Pre-Engineered HFC-227ea ILP Automatic Suppression Units must be handled, installed, inspected, and serviced only by qualified and trained personnel in accordance with the instructions contained in this manual, cylinder nameplates, NFPA 2001, FM 5600, and any other codes and regulations that may apply.

A regular program of systematic maintenance must be established for continuous, proper operation of all Firetrace HFC-227ea ILP units. A periodic maintenance schedule must be followed and an inspection log maintained. At a minimum, the log must record: (1) inspection interval, (2) inspection procedure performed, (3) maintenance performed, if any, as a result of inspection, and (4) name of inspector performing task.

For any deficiencies that are found, appropriate corrective actions shall be taken immediately.

**NOTE: Any maintenance requiring depressurization, filling, or pressurization shall only be performed at an authorized Firetrace service location. Service at any other location will void any warranty. Please contact Firetrace directly for a list of authorized Firetrace service locations.**

#### **WARNING**

**Pressurized (charged) cylinders are extremely hazardous and if not handled properly are capable of causing property damage, bodily injury, or death. Always wear safety glasses and ensure the discharge port plugs are properly installed before installing, servicing, or other general handling of ILP Units.**

### 6.2 Maintenance Schedule

#### 6.2.1 Monthly

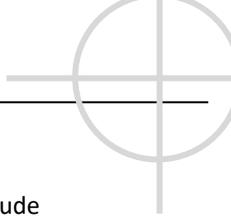
The following are to be performed on a monthly basis by the owner or designated personnel:

1. Verify the Firetrace HFC-227ea ILP Unit is in its proper location.
2. Verify the tamperproof device is intact.
3. Confirm the maintenance tag or certificate is in its proper location.
4. Verify that the Firetrace HFC-227ea ILP Unit shows no physical damage or degradation that might prevent operation.
5. Verify the pressure gauge is in the operable range.
6. Verify nozzle blow off caps (if used) are intact and undamaged.
7. Verify the protected equipment and hazard has not been replaced, modified, or relocated.
8. If a pressure switch is installed:
  - a) Check connection for any leakage.
  - b) Verify the proper electrical connections are made.

**NOTE: All electrical connections are to be in accordance with NFPA 70 National Electric Code and NFPA 72 National Fire Alarm and Signaling Code, and any other applicable codes and regulations.**

**NOTE: This system consists of components tested within limitations contained in this manual. The designer of this system must be consulted prior to any planned changes to either the system or the area being protected. An authorized Firetrace distributor must be consulted after the system has discharged.**

**NOTE: Firetrace recommends replacement of the tubing at various intervals, depending on the application and exposure.**



## 6.2.2 Semi-Annual

The semi-annual maintenance is to be performed by an authorized Firetrace distributor. Maintenance should include a repetition of the monthly maintenance as well as verification of the Firetrace HFC-227ea ILP Unit weight. The Firetrace HFC-227ea ILP unit weight should be verified using the following steps:

1. Remove the tamperproof device from the ball valve lever.
2. Rotate the ball valve lever clockwise, to the "OFF" position.
3. Depressurize the Firetrace detection tubing:
  - a) Remove accessory installed into the end of line adapter.
  - b) Attach the filling adapter into the end of line adapter.
4. Remove the Firetrace detection tubing from the tube fitting attached to the top of the cylinder valve.
5. Remove the discharge piping from the discharge outlet ports.
6. Install the discharge outlet port plugs into both discharge outlet ports.
7. Remove the cylinder from the cylinder mounting bracket.
8. Weigh the Firetrace HFC-227ea ILP Unit.
  - a) Compare the measured weight with the weight specified on the cylinder labels. If the Firetrace HFC-227ea ILP Unit shows a loss in agent quantity of more than 5 percent, the unit shall be refilled or replaced.
9. Verify pressure reading on the pressure gauge installed to the Firetrace HFC-227ea ILP Unit.
  - a) If the Firetrace HFC-227ea ILP Unit shows a pressure loss (adjusted for temperature) of more than 10 percent, the unit shall be refilled or replaced.
  - b) Reinstall the Firetrace HFC-227ea ILP Unit and pressurize the detection tubing, see Section 4 and Section 5 for instructions.

**NOTE:** This system consists of components tested within limitations contained in this manual. The designer of this system must be consulted prior to any planned changes to either the system or the area being protected. An authorized Firetrace distributor must be consulted after the system has discharged.

**NOTE:** Any maintenance requiring depressurization, filling, or pressurization shall only be performed at an authorized Firetrace service location. Service at any other location will void any warranty. Please contact Firetrace directly for a list of authorized Firetrace service locations.

### **WARNING**

Only depressurize tubing **AFTER** the ball valve has been closed. Depressurizing the tubing without closing the ball valve may cause actuation of the unit, resulting in system discharge.

### **WARNING**

Only open the ball valve **AFTER** the tubing has been pressurized. Opening the ball valve without pressurizing the tubing may cause actuation of the unit, resulting in system discharge.

### **WARNING**

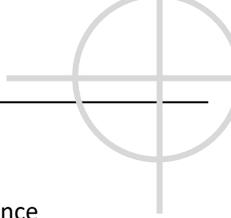
Ball valve must **SLOWLY** be opened. Opening the ball valve abruptly, may cause actuation of the unit, resulting in system discharge.

### **WARNING**

Pressurized (charged) cylinders are extremely hazardous and if not handled properly are capable of causing property damage, bodily injury, or death. Always wear safety glasses and ensure the discharge port plugs are properly installed before installing, servicing, or other general handling of ILP Units.

## 6.2.3 Five-Year

The five-year maintenance is to be performed by an authorized Firetrace distributor. Maintenance should include a repetition of the monthly and semi-annual maintenance, a complete external visual inspection of the cylinder, per the guidelines detailed in Section 7 of NFPA 2001, and evaluation of the Firetrace detection tubing for damage and pliability.



### 6.3 Firetrace Detection Tubing Maintenance

Firetrace detection tubing maintenance is to be performed by an authorized Firetrace distributor. Maintenance should include a complete external visual inspection of the tubing during every monthly inspection. The tubing shall show no signs of physical damage or degradation, including but not limited to abrasion, distortion, cuts, dirt accumulation. For any deficiencies that are found, appropriate corrective actions shall be taken immediately.

In addition to a monthly visual inspection, a five-year inspection is to be performed to evaluate the tubing for damage and pliability. If any concerns are noted, replacement of the Firetrace detection tubing would be recommended.

After 10 years of continuous use, the Firetrace detection tubing should be replaced in its entirety. However, if all routine maintenance is followed and inspection of the tubing determines the tubing to be in good condition and does not show signs of damage or degradation, the tubing can remain in service.

**NOTE: If a fire situation is experienced, any sections of tubing that have ruptured or have been damaged during a fire must be replaced. Sections can be replaced by splice connections.**

### 6.4 Cylinder Maintenance

Firetrace Pre-Engineered HFC-227ea ILP Automatic Suppression Units are assembled with cylinders manufactured to DOT-4B specifications, and therefore fall under DOT regulations for retest, prior to any refilling procedures.

Under DOT regulations, cylinders manufactured to DOT-4B specifications are required to be hydrostatically tested and stamped prior to recharge and shipment, if the last hydrostatic test date has expired.

Cylinders requiring hydrostatic testing must be tested in accordance with 49 CFR 173.34. The periodic hydrostatic test must be performed by an authorized tester, having a current identification number issued by the Associated Administrator for Hazardous Material Safety of DOT. The periodic hydrostatic test must also include an internal and external examination, in accordance with CGA pamphlet C-6, C-6.1, C-6.2, and C-6.3, as applicable. The periodic hydrostatic test procedures also require measurement of the volumetric expansion of the container. As a result, only the water jacket volumetric expansion method or the direct expansion method are acceptable.

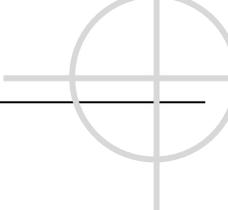
As an alternate to the periodic hydrostatic test, cylinders may be given a complete external visual inspection, in accordance with 49 CFR 173.34(e)(13). The visual inspection shall be made only by competent persons. A person who performs the visual examination specified in 49 CFR 173.34(e)(13) is not required to have an identification number issued by the Associated Administrator for Hazardous Material Safety of DOT.

Table 42 – Cylinder Maintenance below outlines the testing that can be performed to meet DOT regulations.

**Table 42 – Cylinder Maintenance**

Test Method	First Test Due	Subsequent Test Due	Special Marking
Full hydrostatic test. Including determination of cylinder expansion.	5 years	5 years	Test Date Month/Year
External visual inspection per 49 CFR 173.34(e)(13) AND CGA pamphlet C-6, Section 3.	5 years	5 years	Test date Month/Year followed by "E"

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## Section 7: Recharge

### 7.1 General

Firetrace Pre-Engineered HFC-227ea ILP Automatic Suppression Units must be handled, installed, inspected, and serviced only by qualified and trained personnel in accordance with the instructions contained in this manual, cylinder nameplates, NFPA 2001, FM 5600, and any other codes and regulations that may apply.

**NOTE:** Any maintenance requiring depressurization, filling, or pressurization shall only be performed at an authorized Firetrace service location. Service at any other location will void any warranty. Please contact Firetrace directly for a list of authorized Firetrace service locations.

#### **WARNING**

Pressurized (charged) cylinders are extremely hazardous and if not handled properly are capable of causing property damage, bodily injury, or death. Always wear safety glasses and ensure the discharge port plugs are properly installed before installing, servicing, or other general handling of ILP Units.

### 7.2 Recharge

The steps below should be followed to ensure proper recharge of an empty Firetrace HFC-227ea ILP Unit:

1. Fill the cylinder with the appropriate amount of agent. Refer to Table 4, for correct agent amount.
2. Clean the threads of the cylinder with a small brush or dry cloth.
3. Thread the siphon tube into the bottom of the valve.
4. Insert bottom end of siphon tube into the cylinder, and thread the valve into the cylinder.
5. With the discharge port plugs in place, use the ball valve attached to the top of the valve to pressurize the Firetrace HFC-227ea ILP Unit to 150 psig at 70 °F [10.3 bar at 21.1 °C].
6. Shake the system thoroughly to ensure the nitrogen is absorbed by the HFC-227ea.
7. Close the ball valve and leak test the Firetrace HFC-227ea ILP Unit. If a leak detector is unavailable, a 48-hour holding period should be used to evaluate whether there is a leak.
8. The Firetrace HFC-227ea ILP Unit is now ready to be transported to the installation site.

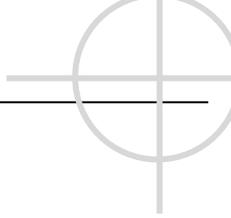
**NOTE:** Any maintenance requiring depressurization, filling, or pressurization shall only be performed at an authorized Firetrace service location. Service at any other location will void any warranty. Please contact Firetrace directly for a list of authorized Firetrace service locations.

#### **WARNING**

Only depressurize tubing **AFTER** the ball valve has been closed. Depressurizing the tubing without closing the ball valve may cause actuation of the unit, resulting in system discharge.

#### **WARNING**

Ball valve must **SLOWLY** be opened. Opening the ball valve abruptly, may cause actuation of the unit, resulting in system discharge.



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## Section 8: Post Discharge

### 8.1 Ventilation

Before inspecting the enclosure after a Firetrace HFC-227ea ILP Unit discharge, ventilate the enclosure thoroughly. Ventilation paths should be examined to prevent exposure to high concentrations of agent. Additionally, the proper safety equipment shall be utilized to prevent unnecessary exposure.

HFC-227ea does not leave a residue, thus, there are no clean-up operations resulting from Firetrace HFC-227ea ILP Unit discharge.

### 8.2 Remove from Service

An authorized Firetrace distributor must be consulted after a system has discharged. The Firetrace HFC-227ea ILP Unit must be removed and recharged. The Firetrace HFC-227ea ILP unit should be removed using the following steps:

1. Remove the Firetrace detection tubing from the tube fitting attached to the top of the cylinder valve.
2. Remove the discharge piping from the discharge outlet ports.
3. Install the discharge outlet port plugs into both discharge outlet ports.
4. Remove the cylinder from the cylinder mounting bracket.
5. Have Firetrace HFC-227ea ILP Unit recharged by a qualified Firetrace service location.

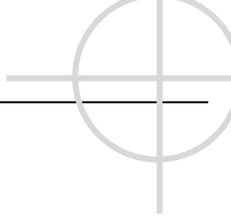
**NOTE: Any maintenance requiring depressurization, filling, or pressurization shall only be performed at an authorized Firetrace service location. Service at any other location will void any warranty. Please contact Firetrace directly for a list of authorized Firetrace service locations.**

### 8.3 Recharge

For Firetrace Pre-Engineered HFC-227ea ILP Automatic Suppression Unit recharge instructions, refer to Section 7.

### 8.4 Return to Service

Please follow guidelines provided in Section 4 and Section 5 for returning a system to service.



## Appendix A – Parts List

### Firetrace HFC-227ea ILP Automatic Suppression Unit Assemblies

Table 43 – Firetrace HFC-227ea ILP Units

Part Number	Description
940301	Small HFC-227ea ILP Suppression Unit (3 lb)
940601	Medium HFC-227ea ILP Suppression Unit (6 lb)
941201	Large HFC-227ea ILP Suppression Unit (12 lb)

### Heavy Duty Brackets

Table 44 – Heavy Duty Brackets

Part Number	Description
111404	Small Heavy Duty Bracket
111403	Medium Heavy Duty Bracket
111402	Large Heavy Duty Bracket

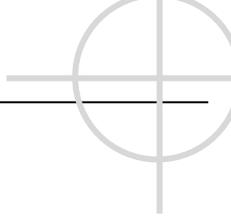
### Discharge Network

Table 45 – Small ILP Discharge Network Copper Fittings

Part Number	Description
200143	Copper Compression Fitting, Valve/Nozzle to 5/16 in Pipe
200101	Copper Compression Fitting, 5/16 in Pipe Bulkhead
200111	Copper Compression Fitting, 5/16 in Pipe Elbow
200121	Copper Compression Fitting, 5/16 in Pipe Tee

Table 46 – Medium/Large ILP Discharge Network Copper Fittings

Part Number	Description
200144	Copper Compression Fitting, Valve/Nozzle to 1/2 in Pipe
200145	Copper Compression Fitting, 1/2 in Pipe Bulkhead
200112	Copper Compression Fitting, 1/2 in Pipe Elbow
200122	Copper Compression Fitting, 1/2 in Pipe Tee



**Table 47 – Small ILP Discharge Network Flexible Hoses**

Part Number	Description
202816 <sup>**</sup>	3/8 in Flexible Hose, 1 ft
201816 <sup>**</sup>	3/8 in Flexible Hose, 2 ft
201817 <sup>**</sup>	3/8 in Flexible Hose, 3 ft
201818 <sup>**</sup>	3/8 in Flexible Hose, 4 ft
201819 <sup>**</sup>	3/8 in Flexible Hose, 7 ft

**Table 48 – Medium/Large ILP Discharge Network Flexible Hoses**

Part Number	Description
202820 <sup>**</sup>	1/2 in Flexible Hose, 1 ft
201820 <sup>**</sup>	1/2 in Flexible Hose, 2 ft
201821 <sup>**</sup>	1/2 in Flexible Hose, 4 ft
201822 <sup>**</sup>	1/2 in Flexible Hose, 6 ft
201823 <sup>**</sup>	1/2 in Flexible Hose, 8 ft
201824 <sup>**</sup>	1/2 in Flexible Hose, 10 ft

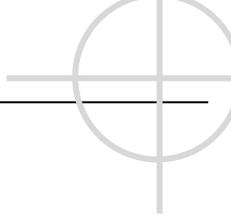
**Table 49 – Small ILP Discharge Network Flexible Hose Fittings**

Part Number	Description
850016 <sup>**</sup>	Fitting, 3/8 in Hose to Valve Union
850017 <sup>**</sup>	Fitting, 3/8 in Hose Union
850018 <sup>**</sup>	Fitting, 3/8 in Hose Elbow
850019 <sup>**</sup>	Fitting, 3/8 in Hose Tee
850020 <sup>**</sup>	Fitting, 3/8 in Hose to Nozzle Union Bulkhead
850021 <sup>**</sup>	Fitting, 3/8 in Hose to Nozzle Elbow Bulkhead

**Table 50 – Medium/Large ILP Discharge Network Flexible Hose Fittings**

Part Number	Description
850022 <sup>**</sup>	Fitting, 1/2 in Hose to Valve Union
850023 <sup>**</sup>	Fitting, 1/2 in Hose Union
850024 <sup>**</sup>	Fitting, 1/2 in Hose Elbow
850025 <sup>**</sup>	Fitting, 1/2 in Hose Tee
850026 <sup>**</sup>	Fitting, 1/2 in Hose to Nozzle Union Bulkhead
850027 <sup>**</sup>	Fitting, 1/2 in Hose to Nozzle Elbow Bulkhead

<sup>\*\*</sup> Not part of an FM Approved System



**Table 51 – Nozzles**

<b>Part Number</b>	<b>Description</b>
500015	Small Clean Agent Nozzle, G1/4
500017	Medium Clean Agent Nozzle, 1/2 NPT
510017 <sup>§§</sup>	Small Nozzle Cap
510018 <sup>§§</sup>	Medium Nozzle Cap
510019 <sup>§§</sup>	Medium Blow-Off Cap

## Detection Network

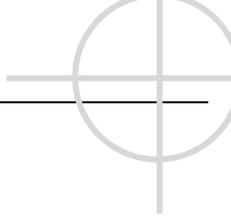
**Table 52 – Firetrace Detection Tubing**

<b>Part Number</b>	<b>Description</b>
200005	Firetrace Detection Tubing, 4/6 mm, 1 ft
204025	Firetrace Detection Tubing, 4/6 mm, 25 ft
204050	Firetrace Detection Tubing, 4/6 mm, 50 ft
204100	Firetrace Detection Tubing, 4/6 mm, 100 ft
204328	Firetrace Detection Tubing, 4/6 mm, 328 ft

**Table 53 – Tube Fittings**

<b>Part Number</b>	<b>Description</b>
200157	Fitting, Tube Tee, 4/6 mm
200158	Fitting, Tube Union, 4/6 mm
200159	Fitting, Tube to Threads Elbow, 4/6 mm
200177	Fitting, Tube Tee to Threads, 4/6 mm
200178	Fitting, Tube Elbow, 4/6 mm
200179	Fitting, Tube to Threads Union, 4/6 mm
200203 <sup>§§</sup>	Fitting, Tube Plug, 4/6 mm
200169	In Line Adapter w/ Tube Tee, 4/6 mm

<sup>§§</sup> Not part of an FM Approved System



**Table 54 – End of Line Accessories**

Part Number	Description
200168	End of Line Adapter w/ Tube Union, 4/6 mm
400011	Pressure Gauge w/ O-Ring, 150 psig
310303	End of Line Adapter Plug
400004	End of Line Pressure Switch
600060***	Manual Release w/ 150 psig Gauge and Tube Union, 4/6 mm
601013	2 <sup>nd</sup> Gen Manual Release w/ 150 psig Gauge and Tube Union, 4/6 mm

## Miscellaneous

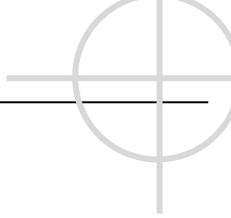
**Table 55 – Installation Accessories**

Part Number	Description
200150	Rubber Grommets for Detection Tubing (Qty. 2)
200151	Plastic Grommets for Detection Tubing (Qty. 2)
200171	Mounting tabs for Detection Tubing, 4/6 mm (Qty. 12)
201006***	Magnetic Mounting Clips for Detection Tubing, 4/6 mm (Qty. 6)
201133***	Heavy Duty Mounting Clips for Detection Tubing (Qty. 6)
600213***	Detection Tubing Charge Kit
600210***	Tube Cutter
201132***	Tamperproof Device, "ON" position
201137***	Tamperproof Device, "OFF" position
120305***	Accessory Mounting Brackets

**Table 56 – Auxiliary Accessories**

Part Number	Description
400001	Valve Mounted Pressure Switch
400441***	Pressure Switch Assembly Box
400312***	12 VDC Electric Solenoid Assembly
400324***	24 VDC Electric Solenoid Assembly
400316***	120 VAC Electric Solenoid Assembly
400327***	240 VAC Electric Solenoid Assembly
600096***	Black Audible Alarm, Battery Operated (requires pressure switch)

\*\*\* Not part of an FM Approved System

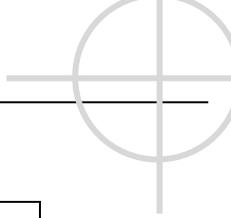


**Table 57 – Indication and Activation Kits**

<b>Part Number</b>	<b>Description</b>
600432-12 <sup>+++</sup>	12 VDC Indication and Activation Kit, 150 psig, Rear Cable
600433-12 <sup>+++</sup>	12 VDC Indication and Activation Kit, 150 psig, Bottom Cable
600432-24 <sup>+++</sup>	24 VDC Indication and Activation Kit, 150 psig, Rear Cable
600433-24 <sup>+++</sup>	24 VDC Indication and Activation Kit, 150 psig, Bottom Cable

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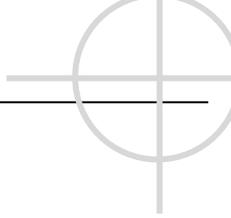
<sup>+++</sup> Not part of an FM Approved System.



## Appendix B – System Commissioning Form

<h1 style="margin: 0;">FIRETRACE<sup>®</sup></h1> <p style="margin: 0;">POWER TO INNOVATE. FLEXIBILITY TO ADAPT.</p> <p style="margin: 0; font-size: small;">8435 N. 90<sup>th</sup> Street, Suite 2, Scottsdale, AZ 85258 USA · +1.480.607.1218 · +1.480.315.1316 · www.firetrace.com</p>			
<b>Firetrace Pre-Engineered HFC-227ea ILP Automatic Suppression Unit</b>			
<b>System Commissioning Form</b>			
<b>System Serial Number:</b>		<b>Installation Date:</b>	
<b>Installed by:</b>		<b>Company:</b>	
<hr/>			
<b>Description</b>	<b>Performed by</b>		<b>Date</b>
Mounting Bracket installed using two or more mounting holes.			
Cylinder positioned in mounting bracket with the pressure gauge facing out.			
Cylinder secured in place using bracket straps or band clamps.			
Nozzle(s) secured in optimal location.			
Nozzle(s) within limitations outlined in Section 3 of DIOM manual.			
Necessary Discharge port plug(s) removed and adapters installed.			
Discharge piping installed between discharge port(s) and nozzle(s).			
Discharge piping secured in place.			
Discharge piping is within limitations outlined in Section 3 of DIOM manual.			
Tubing and fittings installed and secured throughout the protected enclosure.			
Tube fitting threaded into ball valve attached to the top of the cylinder valve.			
Detection tubing inserted into tube fitting.			
Detection network is within limitations outlined in section 3 of DIOM manual.			
Detection network pressurized to 150 psig.			
Pressure gauge or equivalent installed into end of line adapter.			
Leak check conducted on detection network.			
Ball valve on top of cylinder valve rotated to "ON" position.			
Tamperproof device installed on ball valve lever.			
Electrical connections properly made in accordance with NFPA 70 and NFPA 72.			

# Appendix C – SDS



## Safety Data Sheet



### **FM-200™**

Version 3.0

Revision Date 01/15/2016

Ref. 130000036866

This SDS adheres to the standards and regulatory requirements of the United States and may not meet the regulatory requirements in other countries.

#### **SECTION 1. PRODUCT AND COMPANY IDENTIFICATION**

Product Name	: FM-200™
Tradename/Synonym	: FE-227 2-Hydroperfluoropropane Propane, 1,1,1,2,3,3,3-Heptafluoro- HFC-227eaHP 2-Hydroheptafluoropropane Heptafluoropropane 2-H-heptafluoropropane 1,1,1,2,3,3,3-Heptafluoropropane R-227 R227 HFC-227ea
Product Use	: Fire extinguishing agent, For professional users only
Restrictions on use	: Do not use product for anything outside of the above specified uses
Manufacturer/Supplier	: The Chemours Company FC, LLC 1007 Market Street Wilmington, DE 19899 United States of America
Product Information	: 1-844-773-CHEM (outside the U.S. 1-302-773-1000)
Medical Emergency	: 1-866-595-1473 (outside the U.S. 1-302-773-2000)
Transport Emergency	: CHEMTREC: +1-800-424-9300 (outside the U.S. +1-703-527-3887)

#### **SECTION 2. HAZARDS IDENTIFICATION**

##### **Product hazard category**

Gases under pressure                      Liquefied gas

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### Label content

Pictogram :



Signal Word : Warning

Hazardous warnings : Contains gas under pressure; may explode if heated.

Hazardous prevention measures : Protect from sunlight. Store in a well-ventilated place.

### Other hazards

Misuse or intentional inhalation abuse may lead to death without warning.

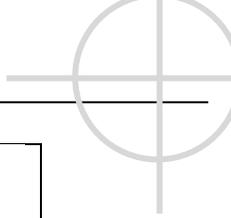
Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.

Rapid evaporation of the liquid may cause frostbite.

### SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS-No.	Concentration
1,1,1,2,3,3,3-Heptafluoropropane	431-89-0	100 %

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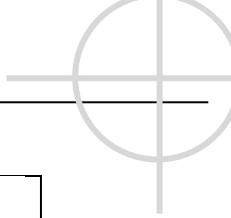
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### **SECTION 4. FIRST AID MEASURES**

General Advice	:	Never give anything by mouth to an unconscious person. When symptoms persist or in all cases of doubt seek medical advice.
Inhalation	:	Remove from exposure, lie down. Move to fresh air. Keep patient warm and at rest. Artificial respiration and/or oxygen may be necessary. Consult a physician.
Skin contact	:	In case of contact, immediately flush skin with plenty of water for at least 15 minutes. Take off all contaminated clothing immediately. Consult a physician. Wash contaminated clothing before re-use. Treat for frostbite if necessary by gently warming affected area.
Eye contact	:	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Consult a physician if necessary.
Ingestion	:	Is not considered a potential route of exposure.
Most important symptoms/effects, acute and delayed	:	No applicable data available.
Protection of first-aiders	:	If potential for exposure exists refer to Section 8 for specific personal protective equipment.
Notes to physician	:	Because of possible disturbances of cardiac rhythm, catecholamine drugs, such as epinephrine, that may be used in situations of emergency life support should be used with special caution.

### **SECTION 5. FIREFIGHTING MEASURES**

Suitable extinguishing media	:	This material is a fire extinguishing agent.
Unsuitable extinguishing media	:	No applicable data available.



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- Specific hazards : The product is not flammable.
- Special protective equipment for firefighters : No applicable data available.
- Further information : No applicable data available.

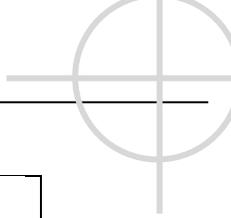
### **SECTION 6. ACCIDENTAL RELEASE MEASURES**

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

- Safeguards (Personnel) : Evacuate personnel, thoroughly ventilate area, use self-contained breathing apparatus. Keep upwind of leak – evacuate until gas has dispersed.
- Environmental precautions : Should not be released into the environment. In accordance with local and national regulations.
- Spill Cleanup : Evaporates. Ventilate area using forced ventilation, especially low or enclosed places where heavy vapors might collect.
- Accidental release measures : No applicable data available.

### **SECTION 7. HANDLING AND STORAGE**

- Handling (Personnel) : Do not breathe gas. Avoid contact with skin, eyes and clothing. Provide sufficient air exchange and/or exhaust in work rooms. For personal protection see section 8. Wash hands thoroughly after handling. Wash clothing after use. Decomposition will occur when product comes in contact with open flame or electrical heating elements. Handle in accordance with good industrial hygiene and safety practice.
- Handling (Physical Aspects) : No applicable data available.
- Dust explosion class : No applicable data available.
- Storage : Valve protection caps and valve outlet threaded plugs must remain in place



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unless container is secured with valve outlet piped to use point.  
Do not drag, slide or roll cylinders.  
Never attempt to lift cylinder by its cap.  
Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder.  
Cylinders should be stored upright and firmly secured to prevent falling or being knocked over.

Separate full containers from empty containers.  
Keep at temperature not exceeding 52°C.  
Do not store near combustible materials.  
Keep container tightly closed in a dry and well-ventilated place.  
Store in original container.  
Protect from contamination.  
Avoid area where salt or other corrosive materials are present.  
The product has an indefinite shelf life when stored properly.

Storage period : > 10 yr  
Storage temperature : < 52 °C (< 126 °F)

### **SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION**

Engineering Controls : Use only with adequate ventilation. Keep container tightly closed.

Personal protective equipment

Respiratory protection : Wear NIOSH approved respiratory protection as appropriate.

Hand protection : Additional protection: Impervious gloves

Eye protection : Safety glasses with side-shields Additionally wear a face shield where the possibility exists for face contact due to splashing, spraying or airborne contact with this material.

Skin and body protection : Where there is potential for skin contact, have available and wear as appropriate, impervious gloves, apron, pants, jacket, hood and boots.

Protective measures : Self-contained breathing apparatus (SCBA) is required if a large release occurs.

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### Exposure Guidelines

#### Exposure Limit Values

1,1,1,2,3,3,3-Heptafluoropropane

No applicable data available.

## SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

### Appearance

Physical State	:	gaseous
Form	:	Liquefied gas
Color	:	No applicable data available.
Odor	:	none
Odor threshold	:	No applicable data available.
pH	:	No applicable data available.
Melting point/freezing point	:	Melting point/range -131 °C (-204 °F)
Boiling point/boiling range	:	Boiling point -16.3 °C (2.7 °F)
Flash point	:	No applicable data available.
Evaporation rate	:	No applicable data available.
Flammability (solid, gas)	:	The product is not flammable.
Upper explosion limit	:	Method: None per ASTM E681-98
Lower explosion limit	:	Method: None per ASTM E681-98

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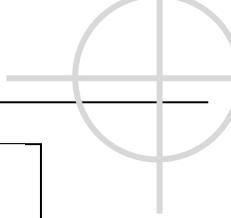
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Vapor pressure	:	4.547 hPa at 25 °C (77 °F)
Vapor density	:	No applicable data available.
Density	:	1.388 g/cm <sup>3</sup> at 25 °C (77 °F) (as liquid)
Specific gravity (Relative density)	:	No applicable data available.
Water solubility	:	No applicable data available.
Solubility(ies)	:	No applicable data available.
Partition coefficient: n-octanol/water	:	No applicable data available.
Auto-ignition temperature	:	No applicable data available.
Decomposition temperature	:	No applicable data available.
Viscosity, kinematic	:	No applicable data available.
Viscosity, dynamic	:	No applicable data available.

### **SECTION 10. STABILITY AND REACTIVITY**

Reactivity	:	Decomposes on heating.
Chemical stability	:	Stable at normal temperatures and storage conditions
Possibility of hazardous reaction	:	Polymerization will not occur.
Conditions to avoid	:	The product is not flammable in air under ambient conditions of temperature and pressure. When pressurised with air or oxygen, the mixture may become flammable. Certain mixtures of HCFCs or HFCs with chlorine may become flammable or reactive under certain conditions. To avoid thermal decomposition, do not overheat.

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Incompatible materials : No applicable data available.

Hazardous decomposition products : Hazardous decomposition products formed under fire conditions.: Hazardous thermal decomposition products may include:  
Hydrogen halides, Carbon oxides, Fluorocarbons, Carbonyl halides

### **SECTION 11. TOXICOLOGICAL INFORMATION**

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Inhalation 4 h LC50 : > 788698 ppm, Rat

Inhalation : Dog  
Cardiac sensitization

Dermal : Not applicable

Oral : Not applicable

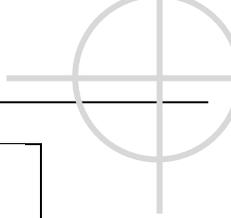
Skin irritation : No skin irritation, Not tested on animals  
Not expected to cause skin irritation based on expert review of the properties of the substance.

Eye irritation : No eye irritation, Not tested on animals  
Not expected to cause eye irritation based on expert review of the properties of the substance.

Sensitisation : Does not cause skin sensitization., Not tested on animals  
Not expected to cause sensitization based on expert review of the properties of the substance.  
  
Did not cause sensitization on laboratory animals. There are no reports of human respiratory sensitization.

Repeated dose toxicity : Inhalation  
Rat  
-  
No toxicologically significant effects were found.

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- Further information : Cardiac sensitization threshold limit: 730190 mg/m3
- 1,1,1,2,3,3,3-Heptafluoropropane  
Carcinogenicity : Not classifiable as a human carcinogen.  
Animal testing did not show any carcinogenic effects.
- Mutagenicity : Animal testing did not show any mutagenic effects.  
Tests on bacterial or mammalian cell cultures did not show mutagenic effects.
- Reproductive toxicity : No toxicity to reproduction  
Animal testing showed no reproductive toxicity.
- Teratogenicity : Animal testing showed no developmental toxicity.

### Carcinogenicity

The carcinogenicity classifications for this product and/or its ingredients have been determined according to Hazcom 2012, Appendix A.6. The classifications may differ from those listed in the National Toxicology Program (NTP) Report on Carcinogens (latest edition) or those found to be a potential carcinogen in the International Agency for Research on Cancer (IARC) Monographs (latest edition).

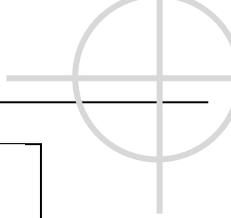
None of the components present in this material at concentrations equal to or greater than 0.1% are listed by IARC, NTP, or OSHA, as a carcinogen.

## **SECTION 12. ECOLOGICAL INFORMATION**

### Aquatic Toxicity

- 1,1,1,2,3,3,3-Heptafluoropropane
- 96 h LC50 : Danio rerio (zebra fish) > 200 mg/l OECD Test Guideline 203  
Information given is based on data obtained from similar substances.
- 72 h ErC50 : Pseudokirchneriella subcapitata (green algae) > 114 mg/l OECD Test Guideline 201  
Information given is based on data obtained from similar substances.
- 72 h NOEC : Pseudokirchneriella subcapitata (green algae) 13.2 mg/l OECD Test

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48 h EC50 : Guideline 201  
Information given is based on data obtained from similar substances.

48 h EC50 : Daphnia magna (Water flea) > 200 mg/l OECD Test Guideline 202  
Information given is based on data obtained from similar substances.

### **SECTION 13. DISPOSAL CONSIDERATIONS**

Waste disposal methods – Product : Can be used after re-conditioning. Recover by distillation or remove to a permitted waste disposal facility. Comply with applicable Federal, State/Provincial and Local Regulations.

Contaminated packaging : Empty pressure vessels should be returned to the supplier.

### **SECTION 14. TRANSPORT INFORMATION**

DOT UN number : 3296  
Proper shipping name : Heptafluoropropane  
Class : 2.2  
Labelling No. : 2.2

IATA\_C UN number : 3296  
Proper shipping name : Heptafluoropropane  
Class : 2.2  
Labelling No. : 2.2

IMDG UN number : 3296  
Proper shipping name : HEPTAFLUOROPROPANE  
Class : 2.2  
Labelling No. : 2.2

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### **SECTION 15. REGULATORY INFORMATION**

- |                                |   |   |
|--------------------------------|---|---|
| TSCA                           | : | On the inventory, or in compliance with the inventory   |
| SARA 313 Regulated Chemical(s) | : | This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313. |
| California Prop. 65            | : | Chemicals known to the State of California to cause cancer, birth defects or any other harm: none known   |

### **SECTION 16. OTHER INFORMATION**

Chemour™ and the Chemours Logo are trademarks of The Chemours Company. Before use read Chemours safety information. For further information contact the local Chemours office or nominated distributors.

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The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Significant change from previous version is denoted with a double bar.