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## **DESIGN, INSTALLATION, OPERATION, AND MAINTENANCE MANUAL**

FOR

## **PRE - ENGINEERED AUTOMATIC INDIRECT HFC-227EA CLEAN AGENT EXTINGUISHER UNIT**

Models: 940301 – 3 lbs  
940601 – 6 lbs  
941201 – 12 lbs

P/N 800022  
UL EX 5323  
FM Approvals Project 3039890

### **Firetrace USA LLC.**

8435 N. 90<sup>th</sup> St, Suite 2  
Scottsdale, AZ 85258 USA

Telephone: 480-607-1218  
Fax: 480-315-1316

Web site: [www.firetrace.com](http://www.firetrace.com)  
E-mail: [firetrace@firetrace.com](mailto:firetrace@firetrace.com)

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# 1 FOREWORD

## 1.1 General

This manual is written for the fire protection professional that designs, installs, and maintains Firetrace Pre-engineered Automatic Indirect HFC-227ea Clean Agent Extinguisher Unit.

Firetrace HFC-227ea Automatic Indirect Fire Suppression Units 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 P/N 800022
- All information contained on the agent cylinder nameplate(s)
- NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*
- Underwriters Laboratories Inc. Listing
- FM Approvals Listing (please refer to Appendix B for the FM Approval system specifications and limitations)
- Local Authority having jurisdiction

## 1.2 Warnings

Safety precautions are essential when any electrical or mechanical equipment is involved. These precautions should be followed when handling, servicing, and recharging Firetrace HFC-227ea Fire Suppression Unit cylinders and equipment. If safety precautions are overlooked or ignored, personal injury or property damage may occur.

The following symbols are used throughout this manual. Always heed these precautions. They are essential to the safe use of the equipment described in this manual.



### **DANGER:**

This danger symbol identifies immediate hazards and provides specific instructions or procedures, which if not correctly followed **WILL** result in severe personal injury or death.



### **WARNING:**

This warning symbol identifies specific instructions or procedures, which if not correctly followed, **COULD** result in severe personal injury or death.



### **CAUTION:**

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

## 1.3 Safety Precautions

The following safety precautions should always be followed:



### **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 make sure the discharge plugs are properly in place before unit installation, servicing, or other general handling.**

1. Read and understand this manual and the other documents referenced herein.
2. The valve discharge outlet safety plugs **MUST** be installed on the cylinder valve at all times and only removed when connected into the discharge tubing or when performing charging, testing, or salvaging operations in accordance with the procedures contained in this manual.
3. Wear safety glasses when working with pressurized cylinders and charging equipment. It is recommended to wear leather gloves to avoid any cryogenic burns if HFC-227ea is accidentally discharged on or near the skin.
4. Make sure that the ball valve (attached to the top of the cylinder valve) is closed (lever is in "OFF" position), the detection tubing has been removed from the cylinder valve, and the safety caps installed before removing the cylinder from the installation and before performing any charging, leak tests, or salvage operations.
5. Follow all of the safety procedures included on the cylinder nameplate and in this manual.
6. Never assume that a cylinder is empty. Treat all cylinders as if they are fully charged.

Any questions concerning the information contained in this Manual should be addressed to:

**Firetrace USA LLC.**  
8435 N. 90<sup>th</sup> St, Suite 2  
Scottsdale, AZ 85258 USA

Telephone: 480-607-1218  
Fax: 480-315-1316

Email: [firetrace@firetrace.com](mailto:firetrace@firetrace.com)

The following web site should be visited for frequent technical announcements

[www.firetrace.com](http://www.firetrace.com)

## 2 INTRODUCTION

The Firetrace Indirect HFC-227ea Clean Agent Automatic Fire Extinguisher Unit is UL Listed by Underwriters Laboratories Inc, ULC Listed by Underwriters' Laboratories of Canada, and approved with FM Approvals (please refer to Appendix B for the FM Approval system specifications and limitations). These units are designed for total flooding applications using HFC-227ea Clean Agent in accordance NFPA 2001: *Standard on Clean Agent Fire Extinguishing Systems*.

The Firetrace Pre-Engineered Automatic Units have been tested to limits established by UL/ULC/FM (please refer to Appendix B for the FM Approval system specifications and limitations) in compliance with the requirements specified in UL 2166: *Standard for Halocarbon Clean Agent Extinguishing System Units* and as detailed in this Manual.

Each installed pre-engineered unit is equipped with its own detection tubing, discharge piping, and nozzles. The pre-engineered concept minimizes the amount of engineering involved in the unit's 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 can be any size, shape, or volume provided that the hazard being protected is within the limitations described in this Manual. Each extinguisher unit, when installed, is a self-contained unit, meaning that it is equipped with its own automatic (non-electric) detection system, which when actuated, automatically releases the suppression agent into the hazard area.

Since the units are listed as automatic units (e.g. no simultaneous manual or electric actuation means is provided), only one (1) extinguisher unit can be used to protect one hazard. These extinguisher units **cannot** be combined to protect a larger size hazard, since they are not designed to provide for simultaneous actuation of (2) or more units.

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

### 2.1 HFC-227ea Extinguishing Agent

The extinguishing agent used in Firetrace pre-engineered automatic indirect fire suppression units is Heptafluoropropane, more commonly known as HFC-227ea.

HFC-227ea (1,1,1,2,3,3,3-heptafluoropropane,  $\text{CF}_3\text{CHFCF}_3$ ) is a colorless odorless gas, low in toxicity, electrically non-conductive, leaves no residue, and is an extremely effective fire suppression agent.

HFC-227ea is included in NFPA 2001 and 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.

#### 2.1.1 Cleanliness

HFC-227ea is clean and leaves no residue, thereby minimizing after fire clean up along with keeping expensive downtime to a minimum. Most materials such as steel, aluminum, stainless steel, brass, as well as plastics, rubber, and electronic components are not affected by exposure to HFC-227ea. This agent is also environmentally friendly, having an ozone depletion potential (ODP) of 0.00.

#### 2.1.2 Decomposition

When exposed to temperatures of 1300°F (700°C) HFC-227ea will form products of decomposition (halogen acids). Test results have shown that when the agent is rapidly discharged, causing rapid extinguishment of flames, the amount of decomposition products formed is minimal.

#### 2.1.3 Properties of HFC-227ea

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

# 3 SYSTEM DESCRIPTION

## 3.1 General

The Firetrace HFC-227ea Automatic Indirect Units are available in 3 sizes, namely:

940301	Charged with 3.0 Lbs (1.36 Kg) of HFC-227ea
940601	Charged with 6.0 Lbs (2.72 Kg) of HFC-227ea
941201	Charged with 12.0 Lbs (5.44 Kg) of HFC-227ea

These units are designed for use in Total Flooding applications only, where the hazard is normally unoccupied. (See NFPA 2001, Section 1.5 for personnel safety exposure limits for HFC-227ea)

The Firetrace Indirect Units can be used, but are not limited, to protect the following:

- Electrical and electronic cabinets
- Telecommunication areas
- Data Processing areas and cabinets
- Other high value assets
- Laboratory fume /exhaust cabinets
- Pump enclosures
- UPS units
- Flammable Chemicals storage cabinets
- Generator Enclosures
- Transformer Cabinets
- Computer/Data Storage Cabinets
- CNC & VMC Machining centers
- Many other applications

HFC-227ea is a gaseous fire-extinguishing agent that is effective for use on:

- Class A – Surface type fires
- Class B – Flammable liquid fires
- Class C – Electrical equipment fires

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

- Pyrotechnic chemicals containing their own oxygen supply
- Reactive metals such as lithium, sodium, potassium, magnesium, titanium, zirconium, uranium and plutonium
- Metal hydrides
- Chemicals capable of undergoing autothermal decomposition, such as certain organic peroxides and hydrazine

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.

Firetrace HFC-227ea Automatic Indirect Units consists of the following major components:

- Cylinder/Valve assembly
- Cylinder Bracket
- Heavy duty cylinder bracket (Optional)
- Firetrace detector/actuation tubing and fittings (No substitute)
- Discharge nozzles
- Pressure switch (Optional)
- Discharge piping and fittings (Furnished by others)

Once installed, the Firetrace Automatic Unit becomes a self-contained, self-actuating unit that does not require an external source of power or electricity.

The unit utilizes a UL recognized component (per UL standard 521), a Linear Heat Detector (See Certificate of Compliance 20140705-S35465) known as Firetrace Automatic Fire Detection Tubing, which when pressurized with Dry Nitrogen, will allow the fire suppression valve to remain in the closed position. This tubing acts as a continuous linear thermal detector that ruptures upon direct flame impingement

or at temperatures above 383°F (195°C). Once the detector tubing is ruptured, the fire suppression valve automatically opens, allowing the HFC-227ea agent to flow through the discharge piping, distributing the extinguishing agent through the nozzle(s) into the protected area. Upon actuation, the pressure switch can be used to indicate discharge, shutdown ventilation, close all openings, shut-off electrical power, etc. as may be required.

### 3.2 Component Descriptions

For a more comprehensive list of technical illustrations and part numbers, please see Appendix A.

#### 3.2.1 HFC-227ea Cylinder/Valve Assemblies

HFC-227ea is stored in steel cylinders super-pressurized with nitrogen to 150 psig at 70°F (10.3 bar at 21°C). Table 3-1 describes the 3, 6, and 12 Lb system assemblies. Each cylinder is equipped with a straight siphon tube and can only be mounted in a vertical (upright) position.

Nom Size	Asm Part #	Outside Dia		Height		Volume		Agent	
		In.	Cm	In.	Cm	In <sup>3</sup>	Cm <sup>3</sup>	Lb	Kg
3	940301	3.0	7.62	17.38	44.15	75	1229	3	1.36
6	940601	4.25	10.80	17.49	44.42	145	2376	6	2.72
12	941201	6.32	16.05	17.68	44.91	300	4,916	12	5.44

Table 3-1:  
HFC-227ea Cylinder / Valve Assemblies

Each cylinder is equipped with a nickel plated brass valve, a pressure gauge to monitor cylinder pressure, and a quarter turn ball valve that interfaces with the Firetrace detector tubing. The ball valve must be kept closed at all times when the cylinder is not in service.

Each valve is also equipped with (2) discharge outlet ports. Each outlet port is provided with a safety plug that must be installed in the discharge outlet whenever a system is not in service. These plugs are safety devices designed to prevent uncontrolled discharge of the system in the event that the valve is accidentally actuated.


WARNING

**The safety plugs must be installed in the valve discharge outlets at all times, except when connected into the units discharge tubing or when filling. Failure to follow these instructions could result in property damage, personal injury, or death.**

Table 3-2 describes the Specifications used for the manufacturing of the HFC-227ea cylinders.

Nominal Size	Cylinder Specification	Cylinder Service Pressure (psig)	Cylinder Specification Test Pressure	
			psig	kPa
3	DOT 4B240	240	480	3,310
6	DOT 4B240	240	480	3,310
12	DOT 4B360	360	720	4,964

Table 3-2:  
Cylinder Specifications

#### 3.2.2 Firetrace Flexible Detection/Actuation Tubing

The Firetrace detection/activation tubing is a UL recognized component per UL standard 521 (See Certificate of Compliance 20140705-S35465). The Firetrace tubing is used as a combination linear heat detector and unit activation device to cause actuation of the HFC-227ea unit. It is installed throughout the hazard volume with one end connected to the top of the cylinder valve, then pressurized with nitrogen to 150 psig. The detector tubing is heat sensitive and in a fire situation is designed to rupture upon direct flame impingement or at



any point along the tube when the temperature reaches 383°F (195°C). The rupture of the tube releases the nitrogen pressure causing the cylinder valve to actuate, resulting in complete discharge of the HFC-227ea agent through the nozzles.

### 3.2.3 Pressure Switch

A pressure switch is available as an optional part of the cylinder valve assembly and is connected directly into the pressurized portion of the cylinder valve (P/N 400001). This pressure switch is used to monitor unit actuation or to energize or de-energize electrically operated equipment.

An additional pressure switch (P/N 400004) is available and can be connected to an End of Line Adapter to provide additional electrical functions as may be required. Firetrace recommends that all units use a pressure switch coupled with some device to alert personnel in the event of discharge.

## 4 SYSTEM DESIGN AND LIMITATIONS

### 4.1 General

The Firetrace series of HFC-227ea Pre-Engineered Automatic Indirect Units' design limits were established and tested by Firetrace. The units are Listed by Underwriters Laboratories Inc, Underwriters' Laboratories of Canada, and Approved by FM Approvals (please refer to Appendix B for the FM Approval system specifications and limitations).

These units were subjected to numerous performance and fire tests (as specified in UL 2166), in order to verify their suitability and to establish design limitations for:

- Hazard volume
- Nozzle area coverage and heights
- Nozzle placement
- Discharge time and flow rates
- Design concentrations & design factors
- Detector tubing placement

The pre-engineered automatic unit concept minimizes the amount of engineering required when evaluating a design for a specific application. So long as the discharge piping and nozzles are installed within the limits prescribed in this Manual, no calculations are required for pressure drop, flow rates, or discharge time. When the additional limitations of hazard volume, area coverage, maximum height, design concentration, agent quantity, detector arrangement, etc., are also met, the unit installation can be understood to comply with the design requirements, NFPA 2001, the UL/ULC Listings, and FM Approvals (please refer to Appendix B for the FM Approval system specifications and limitations). Therefore, no discharge tests or concentration measurements should be required.

### 4.2 Specifications

#### 4.2.1 Storage and Operating Temperature Range

The Firetrace HFC-227ea 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).

#### 4.2.2 System Operating Pressure

The normal operating pressure for the unit is 150 psig at 70°F (10.3 bar at 21°C).

The Firetrace HFC-227ea Units are designed for an operating temperature range of 0°F to +130°F. Table 4-1 shows the cylinder gauge pressure-temperature relationship based on a charging pressure of 150 psig at 70°F.

Cylinder Pressure			
Temperature		Pressure	
°F	°C	psig	kPa
0	-17.8	91	627
10	-12.2	97	689
20	-6.7	104	717
30	-1.1	111	765
40	4.4	119	820
50	10.0	128	883
60	15.5	139	958
70	21.1	150	1,034
80	26.7	163	1,124
90	32.2	177	1,220
100	37.8	192	1,324
110	43.3	209	1,441
120	48.9	228	1,572
130	54.4	249	1,717

Table 4-1:  
Cylinder Pressure-Temperature Relationship

### 4.3 Design Procedure

The following procedures should be used to design a Firetrace HFC-227ea Pre-Engineered Automatic Indirect Fire Suppression Unit. In addition, the applicable requirements specified in Chapter 5 of NFPA 2001 should be followed.

- a. Conduct a survey and analysis of the hazard to be protected.
- b. Determine the height, length, and width of the enclosure. Calculate the volume. All of these parameters must be within the dimensional limits specified in this Manual. (See Section 4.4.1)
- c. Determine the anticipated minimum and maximum ambient temperatures expected within the enclosure to be protected. (See Section 4.2.1)
- d. Determine the minimum design concentration required for the hazard. (See Section 4.5 and Tables 4-3 and 4-4).
- e. Determine the integrity of the enclosure and if any openings must be closed at the time of agent discharge. (See Section 4.4.2)
- f. Determine the cylinder size required based on the hazard volume limitations and enclosure size. **Remember, as cautioned in Section 2 of this Manual, only one (1) extinguisher unit can be used to protect one (1) hazard.**
- g. Based on the total quantity of HFC-227ea agent being used at the maximum ambient temperature expected within the enclosure, evaluate personnel safety exposure limits as specified in NFPA 2001.
- h. Determine the location of the HFC-227ea cylinder.
- i. Determine the location and quantity of nozzles required based on the size and configuration of the enclosure. (See Section 4.6)
- j. Determine the routing and quantity of discharge pipe required. The discharge pipe and fitting limitations must not be exceeded. (See Section 4.6)
- k. Determine the arrangement and placement of the Firetrace detection tubing. (See Section 4.7)
- l. Determine any auxiliary equipment requirements such as a pressure switch(s) to sound alarms, shut-down ventilation, shut-off electrical power, etc.
- m. Prepare system drawings, bill of materials list, etc.; following the applicable sections of Chapter 5 of NFPA 2001, 2015 Edition, as needed.

### 4.4 Hazard Enclosure Limitations

#### 4.4.1 Enclosure Size

The maximum dimensions and area coverage for each size unit are shown in Table 4-2. The protected enclosure can be any size, shape, or volume, provided that the dimensions do not exceed the limitations shown in Table 4-2.

Model	HFC-227ea	Discharge Ports Used (DP)	Nozzles Per DP	Total Number of Nozzles Per Unit	Max. Area Coverage Per Nozzle	Total Area Coverage Per Unit	Maximum Height	Total Volume Coverage Per Unit
940301	3 lb (1.36 Kg)	1	1	1	6'x6' = 36 Ft <sup>2</sup> (1.83x1.83 = 3.34m <sup>2</sup> )	36 Ft <sup>2</sup> (3.34m <sup>2</sup> )	12 Ft (3.33 m)	(a)
		2	1	2	3'x6' = 18 Ft <sup>2</sup> (0.91 x1.83 = 1.67 m <sup>2</sup> )			
			2	4	3'x3' = 9 Ft <sup>2</sup> (0.91 x0.91 = 0.84m <sup>2</sup> )			
940601	6 lb (2.72 Kg)	2	1	2	3'x6' = 18 Ft <sup>2</sup> (0.91 x1.83 = 1.67 m <sup>2</sup> )	36 Ft <sup>2</sup> (3.34m <sup>2</sup> )	12 Ft (3.33 m)	(a)
			2	4	3'x3' = 9 Ft <sup>2</sup> (0.91 x0.91 = 0.84m <sup>2</sup> )			
941201	12 lb (5.44 Kg)	2	1	2	3'x6' = 18 Ft <sup>2</sup> (0.91 x1.83 = 1.67 m <sup>2</sup> )	36 Ft <sup>2</sup> (3.34m <sup>2</sup> )	12 Ft (3.33 m)	(a)
			2	4	3'x3' = 9 Ft <sup>2</sup> (0.91 x0.91 = 0.84m <sup>2</sup> )			

(a) The maximum volume varies as a function of the minimum design concentration and minimum anticipated design temperature requirement for the enclosure being protected. Refer to Table 4-4.

See Figure 4-1 for typical examples of configurations that meet the maximum area coverage limitations.

Table 4-2:  
Enclosure Size and Nozzle Limitations


CAUTION

**This unit is designed and Listed as an Automatic unit. No Manual or electric means is provided for simultaneous actuation of multiple units. Only one (1) unit can be used to protect one hazard. These extinguisher units cannot be combined to protect a larger size hazard since they are not designed to provide for simultaneous actuation of two (2) or more units.**

#### 4.4.2 Ventilation Shut-Down and Unclosable Openings

Provisions must be made to provide means to close all openings in the hazard enclosure and shut-off ventilation at the time of discharge.

### 4.5 Required Amounts of Agent

#### 4.5.1 Minimum Design Concentrations

The minimum design concentrations to be used with Firetrace HFC-227ea units include a minimum safety factor (SF), as specified in NFPA-2001, Year 2015 edition.

A 9.72% commercial grade heptane design concentration was used for all of the Class B Automatic Extinguisher fire tests conducted per Section 36 of UL 2166. Since this value exceeded the limit specified in Section 61.2(c) of UL 2166, an additional multiplication factor (MF) of 1.116 must be added to establish the minimum design concentration for all other Class B fuels.

Table 4-3 lists HFC-227ea minimum design concentrations that must be used with Firetrace HFC-227ea units for Class A, B, and C hazards and the various Class B fuels shown.

Consult the Firetrace website, or contact Firetrace if the hazard you desire to protect is not listed.

Fuel	Extinguishing Concentration %	Minimum Safety Factor	Minimum Design Concentration %
<b>Class A (surface fires) <sup>(a)</sup></b> Including plastic materials typically found in electrical/electronic equip.	6.23	1.2	7.48
<b>Class B fuels <sup>(b)</sup></b>		1.3	
Acetone	6.9		10.01
Ethanol	8.7		12.62
Commercial Grade Heptane	6.7		9.72
Methanol	10.5		15.23
2-propanol	7.4		10.74
Toluene	5.2		7.55
<b>Class C (Electrical) <sup>(c)</sup></b>	6.23	1.35	8.41
Notes:			
(a) The value for the Class A surface fuels and Class B commercial grade heptane are based upon requirements of UL 2166			
(b) The Class B extinguishing concentration values were derived using the cup burner test method			
(c) The Class C extinguishing concentration values must be at least that of Class A surface fired, according to NFPA 2001, 2015 Edition - Section 5.4.2.5.			

**Table 4-3:  
HFC-227ea Extinguishing and Design Concentrations**

For all other Class B fuels not shown in Table 4-3, the minimum design concentrations shall be calculated as follows:

$$\begin{aligned} \text{Min. Design Conc.} &= \text{cup burner value} \times 1.3 \text{ (SF)} \times 1.116 \text{ (MF)} \\ &= 1.452 \times \text{cup burner value} \end{aligned}$$

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

- Pyrotechnic chemicals containing their own oxygen supply
- Reactive metals such as lithium, sodium, potassium, magnesium, titanium, zirconium, uranium and plutonium
- Metal hydrides
- Chemicals capable of undergoing autothermal decomposition, such as certain organic peroxides and hydrazine

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.

### 4.5.2 Maximum Volume Coverage

The maximum volume that can be protected by the Firetrace HFC-227ea units is dependent on the design concentration and the minimum ambient design temperature specified for a given hazard.

Table 4-4 lists the maximum volumes that can be protected by each size unit.

System Size LBS	Minimum Anticipated Design Temp.	Maximum Hazard Volume (ft <sup>3</sup> )
		Design Concentration, C (% by volume)
	°F	9.72
3	0	52
	10	53
	20	54
	30	56
	40	57
	50	58
	60	60
	70	61
6	0	105
	10	107
	20	109
	30	112
	40	115
	50	117
	60	120
	70	123
12	0	210
	10	214
	20	219
	30	225
	40	230
	50	235
	60	240
	70	246

Table 4-4:

Maximum Volumes That Can Be Protected By Firetrace HFC-227ea ILP System Units

Note: Figures in table above are for reference purpose only. All values must be checked and meet the requirements of NFPA 2001

### 4.5.3 Minimum Volume



## CAUTION

Care must be taken to see that the calculated concentration of HFC-227ea at the highest anticipated ambient temperature in the protected space does not exceed the values specified in Section 1.5.2.1 and Table 1.5.1.2.1(a) of NFPA 2001, 2015 Edition.

To check the actual concentration ( $C_{tmax}$ ) of HFC-227ea achieved in the protected space at the maximum anticipated ambient temperature use the following equation:

$$C_{tmax} = 100 / [(V/W \times 1/S) + 1]$$

Where: **W** = agent being used (lbs)

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

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

**S** can be approximated by use of the following formula: **S = 1.885 + 0.0046t**

Where: **t** = maximum temperature of the enclosure (°F)

## 4.6 Nozzle and Discharge Pipe Requirements

### 4.6.1 Discharge Nozzle Limitations

Two nozzle sizes are available for use with the Firetrace ILP Units.

The small nozzle, P/N 500015, is only used with the 3 Lb. (940301) units. The 3 Lb. size unit can be designed using 1, 2, or 4 nozzles to suit the hazard configuration.

The medium nozzle, P/N 500016 and 500017, are only used with the 6 Lb. (940601) and 12 Lb. (941201) size units. The 6 & 12 Lb. size units can be designed using 2 or 4 nozzles to suit the hazard configuration.

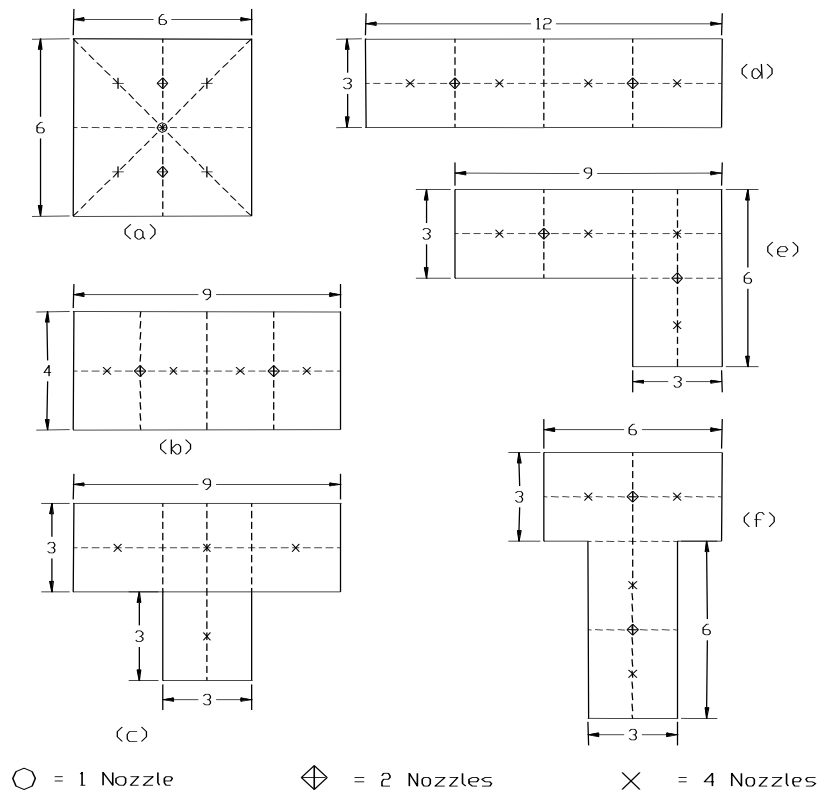
The maximum enclosure height for nozzle installation is 12 feet. The minimum enclosure height for nozzle installation is 1.7 feet. Each nozzle is to be installed at the top of the hazard enclosure facing down in a pendant position and centered in the area to be protected by that particular nozzle.

Each cylinder valve is equipped with (2) discharge ports (DP). Whether (1) or (2) discharge ports are used is dependant on the size and shape of the enclosure, and the number of nozzles required to cover the specific hazard.

See Figure 4-1 for typical examples of configurations that meet the maximum area coverage limitations.

### 4.6.2 Nozzle Area Coverage

Please refer to Table 4-2 for the maximum area coverage (regardless of the number of nozzles used) and maximum nozzle arrangement limitations, respectively, for each size system. Figure 4-1 displays some typical examples of configurations that meet these limitations.



**FIGURE 4-1**  
**Typical Examples of Enclosure Configurations**  
**That Meet the Area Coverage Limitations**  
**(All dimensions in feet)**

### 4.6.3 Discharge Piping and Fitting Specifications

All Firetrace ILP Units shall use copper tubing for the HFC-227ea distribution system. The following tubing and fittings shall be used. Refer to NFPA 2001, 2015 Edition - Section 4.2 for alternate discharge network options.

**Tubing Specifications:**

- Material:** Soft Annealed Copper Tubing (in coils)  
AS B-280, for air conditioning and refrigeration service.
- Size:** 5/16" OD x .032" wall, for the 3 lb. size unit.  
1/2" OD x .032" wall, for the 6 & 12 lb. size units.

**Note:** The AS B-280 soft annealed copper tubing, in the sizes and wall thickness specified for use in the Firetrace HFC-227ea units complies with the ASME B-31.1 Power Piping Code requirements of NFPA 2001.

**Tubing Fitting Specifications:**

- Material:** Brass
- Type:** Flareless Bite Type (Parker Intru-Lok, Camozzi, or equivalent)

**Manufacturer's Pressure Rating:** Parker Intru-Lok Fittings (1500 PSI in all sizes thru 1/2".)

**Min Pressure Rating for Use with Firetrace Units:** 1000 psig

### 4.6.4 Maximum Discharge Piping and Fitting Limitations

The maximum piping and fitting limitations are shown in Table 4-5.

Unit Size	No. of Cyl. Valve Discharge Ports Used (DP)	Total Nozzles Used	Quantity Of Nozzles Per DP	Max. Length Of Piping Per DP	Max. No. Of Elbows Per DP	Max. No. Of Tees Per DP
3 Lb	1	1	1	3 Ft	0	0
	2	2	1	10 Ft	2	0
		4	2	10 Ft	3	1
6 & 12 Lb.	2	2	1	10 Ft	2	0
		4	2	11 Ft	3	1

Table 4-5:  
Maximum Piping and Fitting Limitations

### 4.6.5 Piping Bends

Wherever possible, pipe bends should be used in lieu of 90° pipe elbows. It is recommended that a pipe bender be used when forming the 90° bends. The following minimum bend radii should be used when forming the pipe bends in order to minimize the chance of flattening the pipe.

Pipe OD	Min. Bend Radius To Pipe Centerline	Equiv. Length Of Piping For 90° Bend (a), (b)
5/16"	1 1/16" R	1-1/8"
1/2"	1-1/2" R	2-3/8"
<b>Notes:</b> (a) The equivalent length of pipe is to be counted as part of the maximum length of pipe shown in Table 4-5. (b) 90° pipe bends are not required to be subtracted from the maximum number of elbows allowed in Table 4-5. (c) Min. Bend Radii were taken from Parker Industrial Tube Fittings Catalog 4300 March 1991		

Table 4-6:  
Minimum Pipe Bend Radius and Equivalent Length

## 4.7 Firetrace Detection/Activation Tubing

The Firetrace detection/activation tubing is a UL recognized component per UL standard 521 (See Certificate of Compliance 20140705-S35465). For the Indirect HFC-227ea Units, the Firetrace tubing is used as a combination heat detector and unit activation device to cause actuation of the Clean Agent System.

The detection/actuation tubing is heat sensitive and in a fire situation is designed to rupture at any point along the tube upon direct flame impingement or the temperature of the tube reaches approximately 383°F (195°C).

The maximum length of tubing that can be used for any ILP unit is 120 feet (36.58 m). Refer to Section 5.3 for installation instructions.

**NOTE:** It is recommended that the tubing **not** be placed horizontally adjacent to potential fire sources as this may significantly delay response time.

## 5 INSTALLATION INSTRUCTIONS

This section provides installation instructions covering components and limitations described in Section 3 and Section 4 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 or mechanical, chemical, or other damage which could render the equipment inoperative. The equipment must be installed in accordance with instructions in this Manual and NFPA 2001.



### WARNING

**HFC-227ea cylinder/valve assemblies must be handled, installed and service in accordance with the instruction contained in this Manual and on the cylinder nameplate. Failure to follow these instructions could result in property damage, severe injury, or death.**



### 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 make sure the discharge plugs are properly in place before unit installation, servicing, or other general handling.**

### 5.1 HFC-227ea Cylinder/Valve and Bracket Assemblies

The HFC-227ea cylinders should be located as close as possible to the protected enclosure. In some cases, the cylinder can be mounted inside the protected enclosure. The assemblies shall be located in a readily accessible location to allow for ease of inspection, service, and maintenance. The cylinders 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 facing up 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.



### WARNING

**Make sure that the ball valve, located on the top of the cylinder valve, is maintained in the “OFF” position and the discharge port safety plugs are kept in place until the system is secured in place and ready for connection of the discharge piping. Failure to follow these instructions will result in actuation and discharge of the cylinder contents.**



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

## 5.2 Discharge Piping and Nozzles

1. Install the nozzle(s) following the guidelines and limitations described in Section 4.6.
2. Determine the routing of the discharge pipe and whether one (1) or two (2) discharge ports will be used following the guidelines and limitations described in Section 4.6. If two (2) discharge ports are used, verify that the pipe length from each discharge port does not exceed a 10% imbalance.
3. Mount the tubing to the nearest surface using standard 5/16" or 1/2" (depending on system size) rubber cushioned p-clips in intervals no larger than two feet.
4. Remove one or two safety plugs from the valve discharge ports as required. Attach male connection fittings into discharge port(s) as applicable.
5. Install the discharge pipe and fittings between the cylinder and nozzle(s). Secure the pipe with the appropriate size pipe clamps as required.

## 5.3 Firetrace Detection/Actuation 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. The Typical Tubing Placement diagram, located in Appendix B, provides general guidelines for placement of the detection tubing along with the maximum spacing and height limitations. Depending on the configuration of specific hazards, the guidelines shown in the Typical Tubing Placement diagram may, or may not, be applicable. The maximum height that is allowed between layers is 3.28 feet (1 m), the maximum distance between passes is 21.12 inches (53.34 cm), and the maximum distance allowed from any wall to the tubing is 10.56 inches (26.82 cm). Refer to the Typical Tubing Placement diagram in Appendix B for further clarification.



### CAUTION

1. Do not kink, bend, or crush Firetrace tubing in order to prevent leakage which could result in accidental unit discharge.
2. Do not install tubing in a hazardous environment where the maximum ambient temperature exceeds 176°F (80°C)
3. Maximum length of detection tubing shall not exceed 120 Feet (36.58 m).

1. Secure the detection tubing using Mounting Tabs 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.

## 5.4 Detection Tubing Fittings and Accessories

### 5.4.1 Spring Top Support Fittings

All compression fittings must be secured in the following manner:

1. Cut the tube end, ensuring the cut is square, clean, and free from burrs. Check that no debris is left in the tube.
2. Place the nut/spring top over the end of the tube with its threaded section towards the end of the tube.
3. Push the tube fully home onto the nipple fitting.
4. The nut should then be fastened finger tight and then using a 12mm wrench, fastened to a torque of 3-4.5 lbf\*ft (4-6 N\*m).
5. Loosen the connection and inspect the end to ensure a proper flange has formed. Reconnect and tighten down to ensure an effective seal.

For a more comprehensive list of Spring Top Support Fittings, refer to Appendix A.

## 5.4.2 Slip-On Fittings

All high pressure slip-on fittings must be secured in the following manner:

1. Cut the tube end, ensuring the cut is square, clean, and free from burrs. Check that no debris is left in the tube.
2. Thoroughly clean the tubing to a distance of at least 2 in. (5.08 cm) above the cut end, removing all dirt, grease, or grime. This will ensure a good seal inside the fitting.
3. Slide the tubing into the opening until it butts up against the inner wall. Pull lightly on the tubing and the brass outer ring should move outward slightly.

For a more comprehensive list of Slip-On Fittings, refer to Appendix A.

## 5.4.3 End of Line Accessories

All of the following accessories will connect to an End of Line Adapter. The End of Line Adapter can be installed by following the appropriate procedures in Section 5.4.1 or Section 5.4.2.

NOTE: End of Line Adapters are not designed to provide a lasting seal without the use of one of the following items:

### **HFC-227ea 150 psig Pressure Gauge (P/N 400011):**

The HFC-227ea psig Pressure Gauge must be installed with its included o-ring. Thread the pressure gauge into the End of Line Adapter so that the gauge indicates the tubing pressure.

### **Pressure Switch for End of Line Adapter (P/N 400004):**

The Pressure Switch for the End of Line Adapter must be installed with its included o-ring and washer. Insert the washer into the End of Line Adapter, and then thread the Pressure Switch in until an audible “click” can be heard. The Pressure Switch is now active.

NOTE: Without installation of the included washer, the Pressure Switch will not be active.

### **End of Line Adapter Plug (P/N 310303):**

The End of Line Adapter Plug must be installed with its included o-ring. Thread the plug into the End of Line Adapter.

## 5.5 System Activation

1. Install the detection tubing, fittings, and accessories according to the procedures specified in Section 5.3 and Section 5.4.
2. With the system ball valve still closed, connect the detection tubing to the system using the appropriate procedure in Section 5.4.1 or Section 5.4.2.
3. Attach the filling adapter (P/N 600023 or 600028) to the End of Line Adapter. Refer to Section 5.4.3.
4. Using a regulated dry nitrogen supply, pressurize the detection tubing through the filling adapter to 150 psig (10.3 bar). It is recommended to have a portable dry nitrogen cylinder or Firetrace Nitrogen Fill Kit for on-site use.
5. Remove the filling adapter and thread the pressure gauge & O-ring (Firetrace P/N 400011) into its place to verify that the tubing is pressurized to at least 150 psig at 70°F (10.3 bar at 21°C) (pressure may have to be adjusted for temperatures higher or lower than 70°F). Refer to Section 5.4.3 for further instructions.
6. With the gauge still attached to the filling adapter, test for leakage:
  - Apply soapy water solution to the cylinder valve connection, end of line adapter connection, and the pressure gauge connection. Observe for bubble leaks.
  - Wait 30 minutes, and then observe the pressure gauge. Any decrease in pressure is an indication of a leak.
  - In the event of a leak go back to Section 5.4 and check the installation of all fittings and accessories.
7. If an optional pressure switch is to be installed in the EOL adapter, remove the pressure gauge and install the pressure switch according to the procedures in Section 5.4.3. Check pressure switch connection for bubble leaks using soapy water solution.
8. After confirming that there is no leakage within the detector tubing, **SLOWLY** rotate the ball valve lever counter clock wise to the “ON” position.



## CAUTION

If the ball valve lever is opened abruptly, activation of the cylinder valve may occur, causing the unit to discharge.

9. Tamper proof the unit by removing the ball valve lever face and securing the lever in the "ON" position with a zip tie. Refer to the Tamper Proof Instruction in Appendix B.
10. If the optional Pressure Switch is installed on the valve or on the EOL, ensure that the proper electrical connections are made to annunciate unit discharge, shut down ventilation, etc., as may be required by the end user or the AHJ. (All electrical connections are to be in accordance to NFPA 70 National Electric Code)
11. The unit is now fully armed and ready for use.

## 6 SERVICE AND MAINTENANCE INSTRUCTIONS



### WARNING

1. HFC-227ea cylinder/valve assemblies must be handled, installed, inspected and serviced only by qualified and trained personnel in accordance with the instructions contained in this Manual, the cylinder nameplate, NFPA 2001, and any other regulations and codes that may apply.
2. Before performing maintenance or refilling procedures refer to the material safety data sheets in Appendix C.



### WARNING

Pressurized (charged) cylinders are extremely hazardous and if not handled properly are capable of causing bodily injury, death or property damage. Always wear safety glasses and make sure the discharge plugs are properly in place before unit installation, servicing, or other general handling.

### ATTENTION

Any maintenance requiring depressurization, filling, or pressurization should only be performed at an Authorized Firetrace Service Location. Service at any other location will void the FM Approval and UL/ULC Listing. Please contact Firetrace directly for a list of Authorized Firetrace Service Locations.

### 6.1 General

A regular program of systematic maintenance must be established for continuous, proper operation of all HFC-227ea units and to avoid violating the warranty. A periodic maintenance schedule must be followed and an inspection log maintained for ready reference. As 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.

### 6.2 Periodic Service and Maintenance Procedures

#### 6.2.1 Monthly Inspection

Inspection by the owner or end user should verify the following:

1. The Suppression Unit is in its proper location.
2. The Manual Actuators are unobstructed.
3. The Tamper Indicator is intact.
4. The Maintenance Tag or Certificate is in place.

5. The Suppression Unit shows no physical damage or condition that might prevent operation.
  - a. This includes inspecting the detection tubing in the hazard area for abrasion, distortion, cuts, or dirt accumulation.
6. The Pressure Gauge is in the operable range.
7. The Nozzle Blowoff Caps are intact and undamaged.
8. Neither the Protected Equipment nor the Hazard has been replaced, modified, or relocated.

## 6.2.2 Semiannual Inspection

Semiannual Inspection is to be performed only by a Certified Firetrace Distributor

1. Remove the cylinder from the installation as follows:
  - Close the ball valve by turning the ball valve lever clockwise to the "OFF" position
  - Disconnect the detection tubing at the ball valve  
Note: There will be a loss of nitrogen pressure out of the tubing
  - Disconnect the copper tubing and fittings from the cylinder valve discharge port(s)
  - Immediately install the safety plugs(s) into the valve discharge port(s)
  - Remove the cylinder from the bracket
2. Weigh the cylinder. Compare the measured weight with the weight found on the cylinder nameplate. If the container shows a loss in agent quantity of more than 5 percent or a loss in pressure (adjusted for temperature) of more than 10 percent, the cylinder shall be refilled or replaced.
3. Remove the nozzle(s) and inspect for obstructions. Reinstall the nozzles.
4. Reinstall the cylinder and re-pressurize the detection tubing with nitrogen following the applicable procedures outlined in Section 5.

## 6.2.3 Five Year Inspection

HFC-227ea cylinders continuously in service without discharging shall be given a complete external visual inspection in place, every 5 years or more frequently if required.

Follow external visual inspection guidelines detailed in Section 7 of NFPA 2001 (2015 edition)

## 6.2.4 Hydrostatic Testing

Firetrace HFC-227ea cylinders are built to DOT-4B specifications and therefore fall under DOT regulations for retest prior to refill.

DOT-4B, 4BA and 4BW cylinders used exclusively in HFC-227ea service are required to be retested and restamped prior to recharge and shipment if the last retest date has expired.

Firetrace HFC-227ea (DOT-4B) containers requiring retest must be hydrostatically tested in accordance with DOT CFR Title 49, section 173.34(e). This periodic retest must be performed by an authorized retester having a current identification number issued by the Associated Administrator for Hazardous Material Safety of DOT and must include an internal and external examination in accordance with CGA pamphlet C-6, C-6.1, C-6.2, or C-6.3, as applicable. The test procedures are described in CGA pamphlet C-1. Because volumetric expansion of the container must be measured, only the water jacket volumetric expansion method or the direct expansion methods are acceptable.

As an alternate option, HFC-227ea agent containers may be given a complete external visual inspection, as detailed in section 173.34(e)(13), in lieu of hydrostatic test. The visual inspection shall be made only by competent persons. A person who performs the visual examination specified in 173.34(e)(13) is not required to have a retester's identification number.

Retest can be performed by either of the following methods:

Retest Method	First Retest Due (Yrs)	Subsequent Retest Due (Yrs)	Special Marking
Full hydrostatic test including determination of cylinder expansion.	5	5	Retest Date Month/Year
External visual inspection per paragraph 173.34(e)(13) and CGA pamphlet C-6, section 3.	5	5	Retest Date followed by "E"

## 7 SYSTEM DISSASSEMBLY, ASSEMBLY, AND CHARGING



### WARNING

Pressurized (charged) cylinders are extremely hazardous and if not handled properly are capable of causing bodily injury, property damage, or death. Always wear safety glasses and make sure the discharge plugs are properly in place before unit installation, servicing, or other general handling.

### ATTENTION

Any maintenance requiring depressurization, filling, or pressurization should only be performed at an Authorized Firetrace Service Location. Service at any other location will void the FM Approval and UL/ULC Listing. Please contact Firetrace directly for a list of Authorized Firetrace Service Locations.

### 7.1 Depressurizing the Unit

1. Turn the ball valve lever to the "off" position (perpendicular to the valve).
2. Depressurize the detection/actuation tubing by depressing the Schrader valve inside of the End of Line Adapter.
3. Remove the detection/actuation tubing from the top of the ball valve.
4. Remove the discharge piping from the discharge ports.
5. Install discharge plugs into both discharge ports.
6. Slowly, slightly open the ball valve so only a small amount of nitrogen can be heard leaving the unit.



### CAUTION

Opening the ball valve too far, or too fast, will unseat the piston and bring HFC-227es into the valve assembly.

7. Once the pressure gauge has reached 0 psig, slowly open the ball valve completely
8. Carefully remove the discharge plugs from the valve to ensure system depressurization.

### 7.2 System Recharge

1. Remove one safety plug from a discharge port and connect the HFC-227ea recharge adapter (Note: the other discharge port must be sealed).
2. With the system ball valve closed, connect a dry nitrogen supply to the system ball valve.
3. Weigh and record the system empty weight.
4. Fill the cylinder with the appropriate amount of HFC-227ea. Refer to Table 4-2 for the correct amounts for each system.
5. Once filled with HFC-227ea, open the system ball valve to allow the system to be super-pressurized with dry nitrogen to 150 psig at 70°F (10.3 bar at 21°C) (pressure may have to be adjusted for temperatures higher or lower than 70°F).

Note: A calibrated pressure regulator is to be used when the pressure source is a tank of high pressure gas

Note: The pressure gauge attached to the extinguishing system is not to be used to determine when the intended charging pressure has been reached

6. Close the system ball valve and disconnect the HFC-227ea recharge adapter, immediately threading the discharge port plug into the valve (Note: there will be HFC-227ea trapped in the valve and supply tube that will be vented. Venting will only occur for a short period of time until the valve and supply lines are clear).



### DANGER

The system ball valve must be closed during removal of the HFC-227ea recharge adapter and installation of the safety plug to assure that the cylinder valve does not inadvertently actuate while the valve outlet port is wide open. Failure to follow this procedure could result in personal injury and damage to property.



## CAUTION

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

7. Shake the system thoroughly to ensure complete absorption of the nitrogen into the HFC-227ea (Note: nitrogen absorption will result in some pressure loss).
8. Open the system ball valve, pressurize back up to 150 psig at 70°F, and close the system ball valve.
9. Repeat steps 7 and 8 until shaking of the system does not result in any pressure loss (i.e., no further nitrogen absorption) and a pressure of 150 psig is reached).
10. Disconnect the dry nitrogen supply.
11. Verify the system gross weight by checking it against what is printed on the label.
12. Leak test the cylinder by using a calibrated leak detector.
13. The system is now ready to be transported to the installation site.

# WARRANTY

Firetrace USA, LLC.  
Limited Warranty & Purchaser's Exclusive Remedy

\*\*\*\*\*

## LIMITED WARRANTY & PURCHASER'S EXCLUSIVE REMEDY

### Purchaser's Limited Warranty

Firetrace USA, LLC (hereafter referred to as Firetrace) provides the following **Limited Warranty** only to the original purchaser, who purchases the Firetrace unit from an Authorized Firetrace Distributor. The **Limited Warranty** includes all Firetrace units and its component parts supplied by Firetrace. Hereafter these products will be referred to as "Firetrace Products". When the Firetrace Products are properly installed by an authorized Firetrace distributor, **in complete** accordance with the written instructions contained in the instruction Manuals, or other data supplied with Firetrace products, and when the Firetrace products have not subsequently been modified or altered, unless by express written instructions from Firetrace, then the Firetrace products are warranted to be free of defects in materials and workmanship for a period of three (3) years from the date of shipment from Firetrace, Scottsdale Arizona, as long as the following conditions are met:

- (1) The **original** purchaser must maintain a semi-annual maintenance service agreement with an authorized Firetrace distributor, commencing with the date the Firetrace product was accepted by the purchaser and placed into service. The service agreement **shall** remain in effect for the duration of the warranty.
- (2) The Firetrace Warranty Registration Card (P/N 800100) must be completed and returned to Firetrace within thirty (30) days of the installation of the Firetrace unit.

Firetrace products that are not certified, as specified in the paragraphs 1 and 2 above, will carry a maximum limited warranty of one (1) year from the date of shipment from Firetrace.

### Purchaser's Exclusive Remedy

The original purchaser's sole and exclusive remedy, unless varied by express written agreement with Firetrace, is as follows: Repair or replacement, at Firetrace's option, of any defective part which is returned to Firetrace within ninety (90) days of discovery of the defect.

Because of the deleterious effects of corrosion, heat, rust, dirt, debris and other factors of use and installation over which Firetrace has no control, **FIRETRACE MAKES NO OTHER WARRANTIES OF ANY KIND, WHETHER EXPRESSED OR IMPLIED, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, BEYOND THOSE EXPRESSLY PROVIDED FOR IN THIS LIMITED WARRANTY.** These warranties shall be void where defects occur due to improper maintenance, installation, service, alterations and/or modifications subsequent to installation, not expressly authorized in writing by Firetrace or due to intentional or negligent acts of the original purchaser or third parties.

### Non-Assignability of Warranty

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

### Disclaimer of Consequential Damages

In no event shall Firetrace be liable for any consequential or incidental damages arising from the purchase and/or use of Firetrace products, including but not limited to: damages resulting from loss of use of Firetrace products, the costs of replacing discharged suppression agent, damages for lost profits or income, or damages for resulting harm to property other than the Firetrace products.

## Use of Non-Firetrace Components

All Firetrace units must exclusively use Firetrace components, especially for connections made to the Firetrace tubing. Failure to exclusively use Firetrace components will void this limited warranty and release Firetrace of any and all liability on the performance of the Firetrace components and unit.

## SOME FACTORS INFLUENCING ENGINEERING DESIGN AND PRODUCT APPLICATION OF FIRETRACE UNITS

The following are some of the factors that influence engineering design and application of Firetrace units. In many cases, these factors are difficult to accurately estimate, and it is for these reasons that Firetrace makes **no** warranties other than those specifically stated in this **Limited Warranty**.

1. The Firetrace unit has been designed to provide protection against fire, both existing and imminent, for a limited duration of time when: the unit is fully operational; used in its normal, expected environment; the unit and its component parts are properly installed, maintained, and operated in **complete** accordance with written instructions supplied with the unit.
2. The duration of the protection against fires dependent upon a sufficient concentration of agent being maintained in the protected hazard area for a pre-determined period of time. This duration will be shortened by conditions or circumstances which may ventilate, cause the agent concentration dilution within the protected hazard area thereby causing an insufficient concentration of agent as is needed to extinguish or prevent the existence or re-ignition of combustion or fire. All hazard areas have different rate of ventilation, leakage, or agent dilution that, in many cases, may be impossible to predict or determine. Air vents, air conditioning units, gaps and cracks in the enclosure, windows, cable and pipe penetrations, etc., all may effect the agent concentration and the duration of the protection against fire. Also, unforeseen changes in the configuration of a hazard area such as removal of a wall, an explosion or fire external to the protected space, changes in the enclosures configuration, etc. can influence the duration of the fire protection. It is because of these many, and varied, circumstances and conditions that Firetrace makes **no** warranty as to the duration of the protection against fire.
3. The effectiveness of an agent, such as HFC-227ea and/or CO<sub>2</sub>, as a fire extinguishant is directly related to the concentration of the agent required to extinguish various substances. Not all substances require the same agent concentration to be extinguished. Therefore, Firetrace can only assume that the customer has properly defined the hazard area(s) being protected.
4. The effectiveness of the Firetrace unit is dependent upon the timely discharge of the agent fire extinguishant in to the protected area. If unforeseen circumstances such as an explosion, failure of the detection system to activate the Firetrace unit, failure to Manually activate the unit, etc. occur, they can prevent the unit discharge from being accomplished in a timely manner, and the fire may become deep seated or out of control and completely destroy the hazard area. Since Firetrace has no control over these circumstances, there are **no** warranties as to the effectiveness of extinguishment of the fire other than those specifically stated in this **Limited Warranty**.
5. Even if the Firetrace unit is completely effective in suppressing a fire, failure to remove the ignition source of the fire could result in a re-ignition of the fire. If possible, the source of the fire should immediately be eliminated to prevent re-ignition. Protection against re-ignition only exists when a sufficient concentration of agent remains in the hazard area, as stated above.

Since the effectiveness of the Firetrace unit depends on when, under what circumstances, it is used, the judgment of operating personnel as to when to activate a Firetrace unit, in an emergency, affects the protection provided by the unit. Because of the widely carrying conditions and circumstances under which the Firetrace unit can be used, some conditions can cause its effectiveness to be unpredictable. Therefore, evacuation of personnel from the protected areas **must** be accomplished without delay.



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# **APPENDIX A**

## **System Parts List**

### **Discharge Line Parts List**

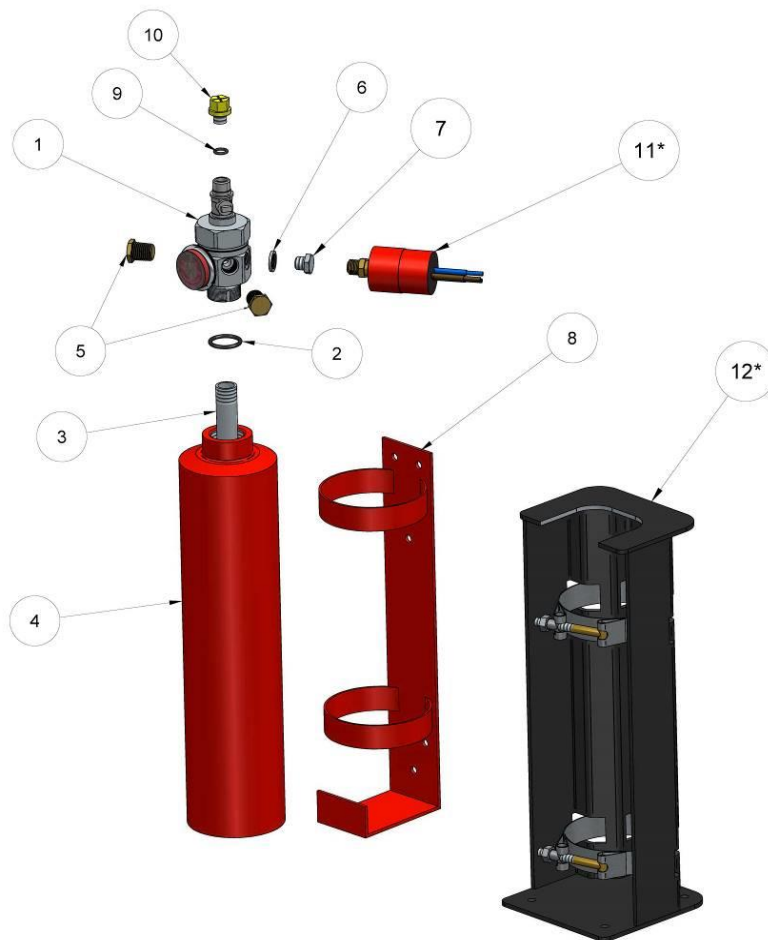
### **Detection Line Parts List**

# System Parts List

3, 6, & 12 LB.  
 PRE-ENGINEERED  
 AUTOMATIC INDIRECT  
 HFC-227ea EXTINGUISHER UNIT

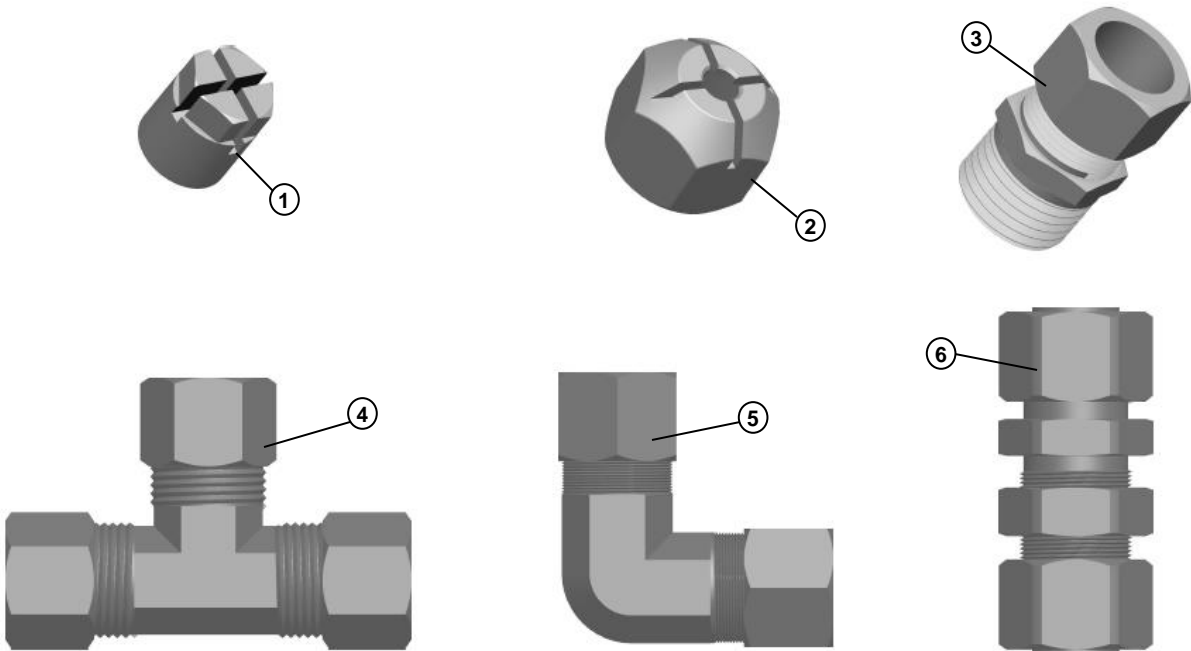
MODELS 940301 3 LB. HFC-227ea ILP  
 940601 6 LB. HFC-227ea ILP  
 941201 12 LB. HFC-227ea ILP

ITEM	PART NO.	DESCRIPTION	SYSTEM
1	300110	Small HFC-227ea ILP Valve	3 LB.
1	300116	Medium HFC-227ea ILP Valve	6, 12 LB.
2	300220	Collar O-Ring Small ILP	3 LB.
2	300221	Collar O-Ring Medium ILP	6, 12 LB.
3	600022	Siphon Tube 5/8"x11.75"	3 LB.
3	600003	Siphon Tube 1"x12"	6, 12 LB.
4	100300	Small Cylinder	3 LB.
4	100600	Medium Cylinder	6 LB.
4	101200	Large Cylinder	12 LB.
5	310300	Small Discharge Port Plug	3 LB.
5	310301	Medium Discharge Port Plug	6, 12 LB.
6	600033	Bonded Seal	All Systems
7	600081	Pressure Switch Port Plug	All Systems
8	100003	Small Bracket	3 LB.
8	100006	Medium Bracket	6 LB.
8	111206	Large Bracket	12 LB.
9	400002	O-Ring, M1x10	All Systems
10	200103	Yellow Ball Valve Transport Cap	All Systems
11*	400005	Pressure Switch	All Systems (OPTIONAL)
12*	111404	ASM, Small Heavy Duty Bracket	3 LB. (OPTIONAL)
12*	111403	ASM, Medium Heavy Duty Bracket	6 LB. (OPTIONAL)
12*	111402	ASM, Large Heavy Duty Bracket	12 LB. (OPTIONAL)
NP	600100	Nameplate: ILP HFC-227ea	All Systems
NP	600103	Label: HFC-227ea Approvals	All Systems
NP	800100	Warranty/Registration Card	All Systems
* OPTIONAL PARTS NP NOT PICTURED			



# Discharge Line Parts List

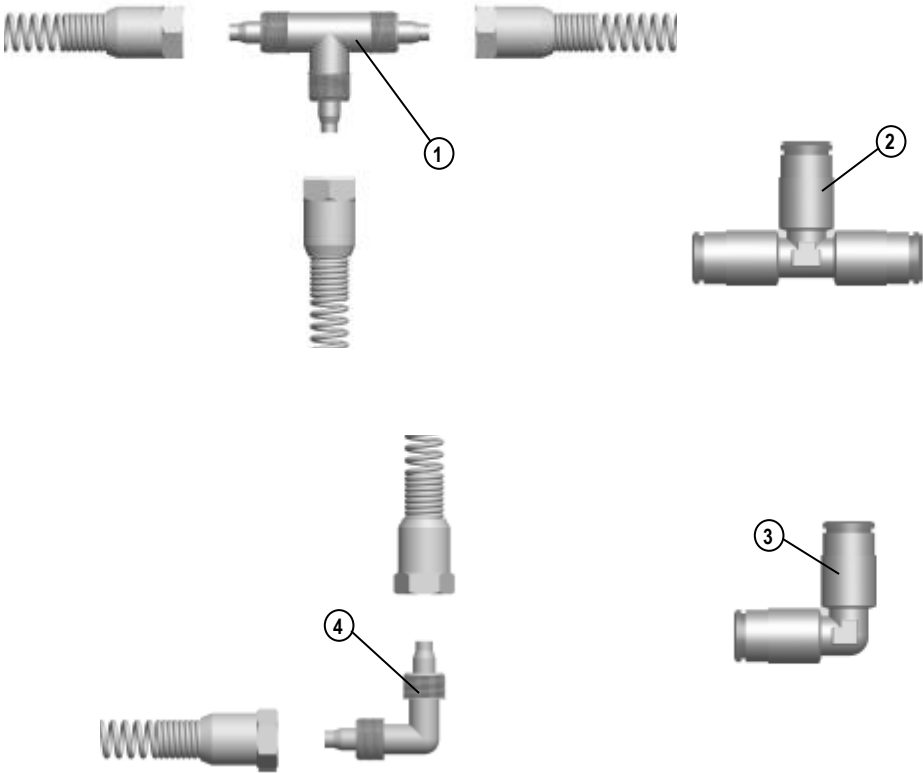
ITEM NUMBER	PART NUMBER	DESCRIPTION	SYSTEM
*	200143	Valve to 5/16" Copper Compression Fitting	3 LB.
*	200101	5/16" Copper Compression Bulkhead	3 LB.
*	200111	5/16" Copper Compression Elbow	3 LB.
*	200121	5/16" Copper Compression Tee	3 LB.
1	500015	Small Clean Agent Total Flooding Nozzle	3 LB.
3	200144	Valve to 1/2" Copper Compression Fitting	6, 12 LB.
6	200145	1/2" Copper Compression Bulkhead	6, 12 LB.
*	200147	1/2" Copper Compression Union	6, 12 LB.
5	200112	1/2" Copper Compression Elbow	6, 12 LB.
4	200122	1/2" Copper Compression Tee	6, 12 LB.
*	500016	Medium Clean Agent Total Flooding Nozzle (1/2" Compression)	6, 12 LB.
2	500017	Medium Clean Agent Total Flooding Nozzle (1/2" NPT)	6, 12 LB.
* PART NOT PICTURED			



# Detection Line Parts List

ITEM NUMBER	PART NUMBER	DESCRIPTION	SYSTEM
*	200005	Firetrace Detection/Actuation Tubing (by the foot)	All Systems
*	200125	Tube Union With Spring Tops	All Systems
1	200126	Tube Tee With Spring Tops	All Systems
*	200136	Bulkhead With Spring Tops	All Systems
4	200155	Tube Elbow With Spring Tops	All Systems
*	200160	Spring Top	All Systems
*	200158	Tube Union Slip On Fitting	All Systems
2	200157	Tube Tee Slip On Fitting	All Systems
3	200178	Tube Elbow Slip On Fitting	All Systems
*	200179	Tube to Threads Union Slip On Fitting	All Systems
*	200177	Tube to Threads Tee Slip On Fitting	All Systems
*	200159	Tube to Threads Elbow Slip On Fitting	All Systems
*	200133	Tube Plug	All Systems
*	200168	End Of Line Adapter With Slip-On Union	All Systems
*	200169	In Line Adapter With Slip-On Tee	All Systems
*	310303	Plug With O-Ring For End Of Line Adapter	All Systems
*	400011	HFC-227ea Pressure Gauge	All Systems
*	400004	Pressure Switch With Washer for End Of Line Adapter	All Systems
*	200171	Mounting Tabs (Qty. 12)	All Systems
*	200150	Rubber Grommets (Qty. 2)	All Systems
*	200151	Plastic Grommets (Qty. 2)	All Systems

\* PART NOT PICTURED



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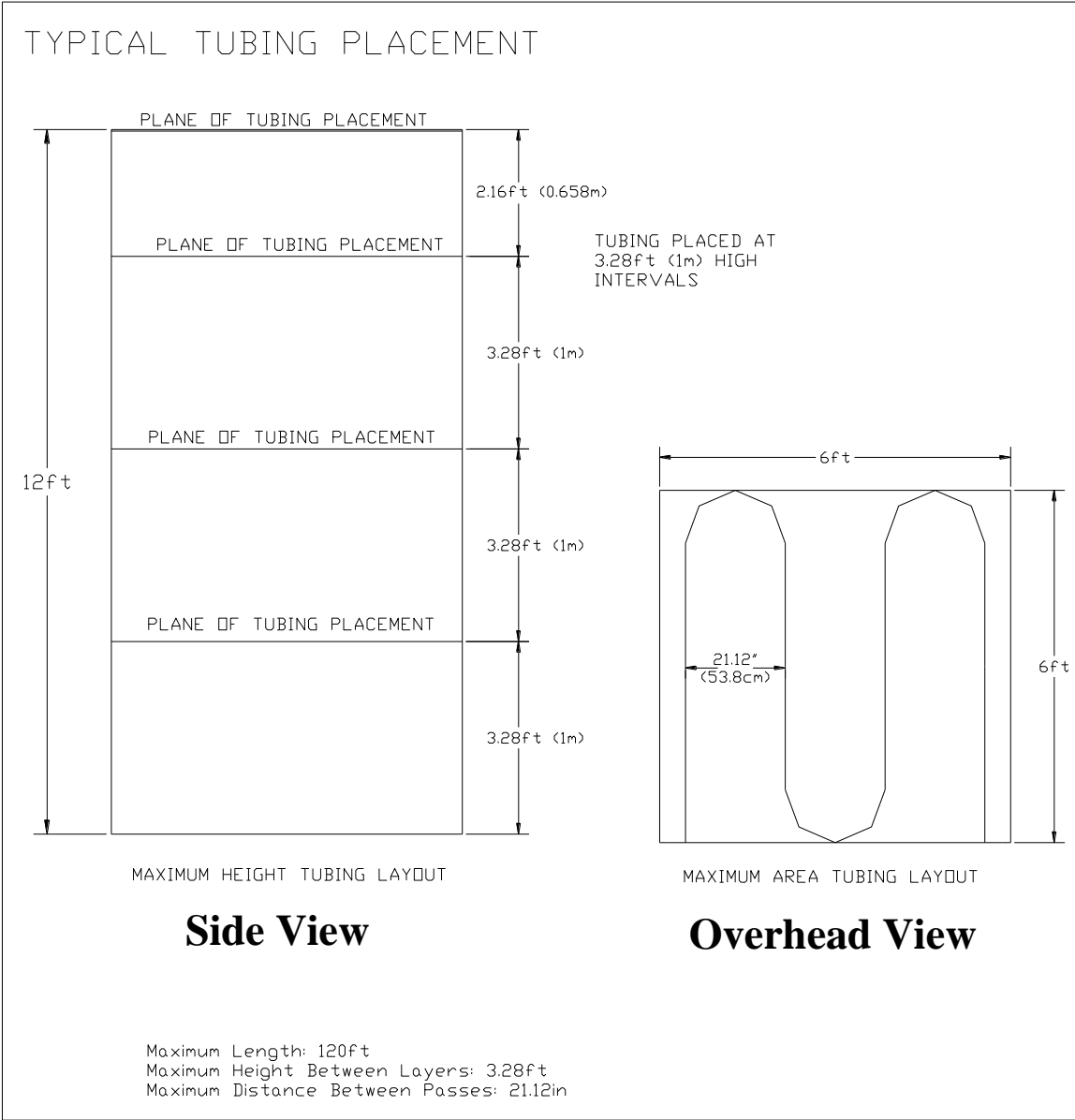
## **APPENDIX B**

**Typical Tubing Placement**

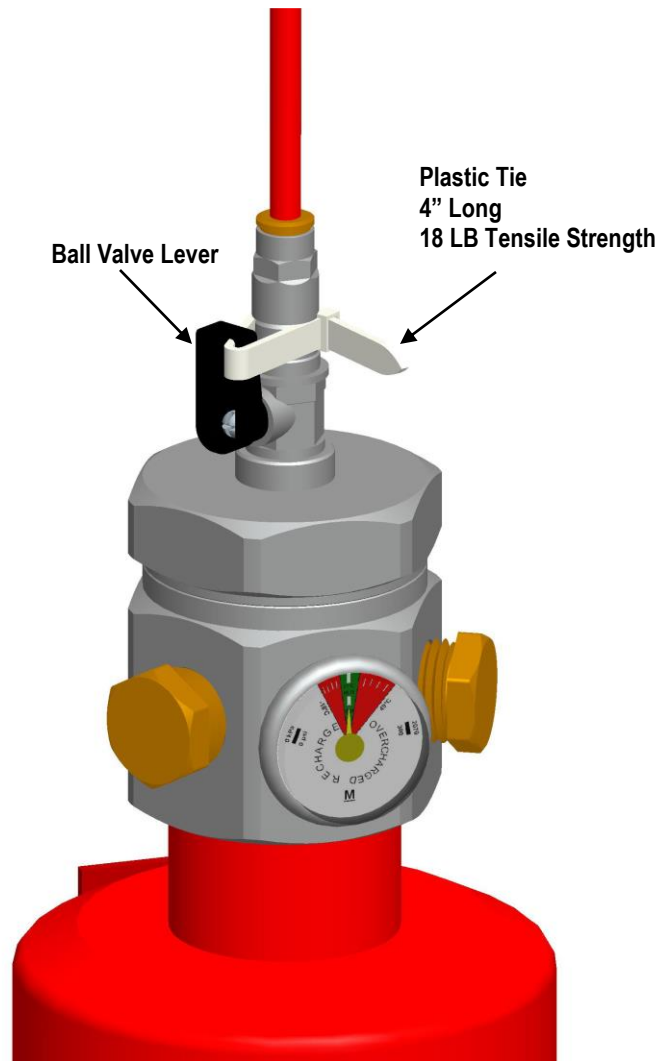
**Tamp Proof Options**

**FM Approval Guide Listing**

# Typical Tubing Placement



# Tamper Proof Instruction



1. Check to see that the ball valve lever is set to the "ON" position.
2. Remove the ON/OFF faceplate.
3. Pull the tie through the hole in the ball valve lever.
4. Wrap the tie around the ball valve assembly.
5. Firmly pull on the tie to tighten and secure the lever.
6. If desired, cut off the excess tie.

# FM Approval Guide Listing

## Pre-Engineered, Automatic Indirect FM-200® Fire Detection and Extinguishing System

System Designation:	Model ILP Automatic Indirect Fire Detection and Extinguishing System
System Type:	Pre-Engineered for the Protection of Class B Hazards
Agent Identification:	Dupont™ FM-200® or FE-227™
Ambient Temperature Installation Range:	0°F to 130°F (-18°F to 54°C)
Amount of Agent per System:	ILP-300: 3.0 lb (1.36 kg) of FM-200® or FE-227™ ILP-600: 6.0 lb (2.72 kg) of FM-200® or FE-227™ ILP-1200: 12.0 lb (5.44 kg) of FM-200® or FE-227™
Maximum Area of Coverage:	36 ft² (3.3 m²)
Minimum and Maximum Enclosure Heights:	1.6 ft (0.5 m) to 12 ft (3.7 m)
Maximum Enclosure Volume Protection per Unit:	ILP-300: 62.5 ft³ (1.8 m³) ILP-600: 125 ft³ (3.5 m³) ILP-1200: 250 ft³ (7.1 m³)
Maximum Tubing Height Above Hazard:	3.3 ft (1 m)
Maximum Length of Tubing:	120 ft (36.6 m)
Design, Installation, Operation, and Maintenance Manual:	<i>Design, Installation, Operation, and Maintenance Manual for Pre-Engineered Automatic Indirect HFC-227ea Clean Agent Extinguisher Unit, P/N 800022, Rev 07, May 08, 2009</i>
Approved Filling Stations:	Firetrace International LLC 8435 N 90 <sup>th</sup> Street, Suite 2 Scottsdale, AZ 85258 USA  Firetrace International Ltd Unit 12, Fairlawn Enterprise Park Bonehurst Road Salfords, Redhill, Surrey RH1 5GH United Kingdom

<b>Company Name:</b>	Firetrace International LLC
<b>Company Address:</b>	8435 N. 90th Street, Suite 2, Scottsdale, Arizona 85258, USA
<b>Company Website:</b>	<a href="http://www.firetrace.com">http://www.firetrace.com</a>
<b>Listing Country:</b>	United States of America
<b>Certification Type:</b>	FM Approved



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# **APPENDIX C**

## **SAFETY DATA SHEETS**

**HFC-227ea**

**Nitrogen**

# HFC-227ea

## 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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**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.

# Safety Data Sheet



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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

## Safety Data Sheet



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Ref. 130000036866

Vapor pressure	: 4.547 hPa at 25 °C (77 °F)
Vapour 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 reactions	: 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**

FM-200™

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 sensitisation., Not tested on animals  
Not expected to cause sensitization based on expert review of the properties of the substance.

Repeated dose toxicity : Inhalation  
Rat  
-  
Did not cause sensitisation on laboratory animals. There are no reports of human respiratory sensitization.  
No toxicologically significant effects were found.

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Further information	: Cardiac sensitisation 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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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

Safety Data Sheet



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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**

Chemours™ 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.

Revision Date : 01/15/2016

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.

# Nitrogen MSDS



## Nitrogen, compressed

Safety Data Sheet P-4631

according to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Date of issue: 01/01/1980 Revision date: 06/24/2015 Supersedes: 04/23/2015

### SECTION 1: Product and company identification

#### 1.1. Product identifier

Product form : Substance  
Name : Nitrogen, compressed  
CAS No : 7727-37-9  
Formula : N<sub>2</sub>  
Other means of identification : Dinitrogen, Refrigerant R728, Nitrogen, Medipure Nitrogen, Extendapak Nitrogen, Nitrogen - Diving Grade

#### 1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture : Industrial use  
Medical applications.  
Food applications.  
Diving Gas (Underwater Breathing)

#### 1.3. Details of the supplier of the safety data sheet

Praxair, Inc.  
39 Old Ridgebury Road  
Danbury, CT 06810-5113 - USA  
T 1-800-772-9247 (1-800-PRAXAIR) - F 1-716-879-2146  
[www.praxair.com](http://www.praxair.com)

#### 1.4. Emergency telephone number

Emergency number : Onsite Emergency: 1-800-645-4633

CHEMTREC, 24hr/day 7days/week — Within USA: 1-800-424-9300, Outside USA: 001-703-527-3887 (collect calls accepted, Contract 17729)

### SECTION 2: Hazards identification

#### 2.1. Classification of the substance or mixture

##### Classification (GHS-US)

Compressed gas H280

#### 2.2. Label elements

##### GHS-US labelling

Hazard pictograms (GHS-US) :



GHS04

Signal word (GHS-US) :

WARNING

Hazard statements (GHS-US) :

H280 - CONTAINS GAS UNDER PRESSURE; MAY EXPLODE IF HEATED  
OSHA-H01 - MAY DISPLACE OXYGEN AND CAUSE RAPID SUFFOCATION.

Precautionary statements (GHS-US) :

P202 - Do not handle until all safety precautions have been read and understood  
P271+P403 - Use and store only outdoors or in a well-ventilated place.  
CGA-PG05 - Use a back flow preventive device in the piping.  
CGA-PG10 - Use only with equipment rated for cylinder pressure.  
CGA-PG06 - Close valve after each use and when empty.  
CGA-PG02 - Protect from sunlight when ambient temperature exceeds 52°C (125°F).

#### 2.3. Other hazards

No additional information available

EN (English US)

SDS ID: P-4631

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# Nitrogen, compressed

## Safety Data Sheet P-4631

according to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.  
Date of issue: 01/01/1980 Revision date: 06/24/2015 Supersedes: 04/23/2015

### 2.4. Unknown acute toxicity (GHS-US)

No data available

## SECTION 3: Composition/information on ingredients

### 3.1. Substance

Name : Nitrogen, compressed  
CAS No : 7727-37-9

Name	Product identifier	%
Nitrogen	(CAS No) 7727-37-9	99.5 - 100

### 3.2. Mixture

Not applicable

## SECTION 4: First aid measures

### 4.1. Description of first aid measures

- First-aid measures after inhalation : Immediately remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, qualified personnel may give oxygen. Call a physician.
- First-aid measures after skin contact : Adverse effects not expected from this product.
- First-aid measures after eye contact : Adverse effects not expected from this product. In case of eye irritation: Rinse immediately with plenty of water. Consult an ophthalmologist if irritation persists.
- First-aid measures after ingestion : Ingestion is not considered a potential route of exposure.

### 4.2. Most important symptoms and effects, both acute and delayed

No additional information available

### 4.3. Indication of any immediate medical attention and special treatment needed

None.

## SECTION 5: Firefighting measures

### 5.1. Extinguishing media

Suitable extinguishing media : Use extinguishing media appropriate for surrounding fire.

### 5.2. Special hazards arising from the substance or mixture

Reactivity : Under certain conditions, nitrogen can react violently with lithium, neodymium, titanium (above 1472°F/800°C), and magnesium to form nitrides. At high temperature, it can also combine with oxygen and hydrogen.

### 5.3. Advice for firefighters

- Firefighting instructions : Evacuate all personnel from the danger area. Use self-contained breathing apparatus (SCBA) and protective clothing. Immediately cool containers with water from maximum distance. Stop flow of gas if safe to do so, while continuing cooling water spray. Remove ignition sources if safe to do so. Remove containers from area of fire if safe to do so. On-site fire brigades must comply with OSHA 29 CFR 1910.156 and applicable standards under 29 CFR 1910 Subpart L—Fire Protection.
- Protection during firefighting : Compressed gas: asphyxiant. Suffocation hazard by lack of oxygen.
- Special protective equipment for fire fighters : Standard protective clothing and equipment (Self Contained Breathing Apparatus) for fire fighters.
- Specific methods : Use fire control measures appropriate for the surrounding fire. Exposure to fire and heat radiation may cause gas containers to rupture. Cool endangered containers with water spray jet from a protected position. Prevent water used in emergency cases from entering sewers and drainage systems.  
  
Stop flow of product if safe to do so.  
  
Use water spray or fog to knock down fire fumes if possible.

## SECTION 6: Accidental release measures

### 6.1. Personal precautions, protective equipment and emergency procedures

General measures : Evacuate area. Ensure adequate air ventilation. Wear self-contained breathing apparatus when entering area unless atmosphere is proven to be safe. Stop leak if safe to do so.

EN (English US)

SDS ID: P-4631

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# Nitrogen, compressed

## Safety Data Sheet P-4631

according to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Date of issue: 01/01/1980 Revision date: 06/24/2015 Supersedes: 04/23/2015

6.1.1. For non-emergency personnel	No additional information available
6.1.2. For emergency responders	No additional information available
6.2. Environmental precautions	No additional information available
6.3. Methods and material for containment and cleaning up	No additional information available
6.4. Reference to other sections	See also sections 8 and 13.

### SECTION 7: Handling and storage

#### 7.1. Precautions for safe handling

Precautions for safe handling : Wear leather safety gloves and safety shoes when handling cylinders. Protect cylinders from physical damage; do not drag, roll, slide or drop. While moving cylinder, always keep in place removable valve cover. Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve. When moving cylinders, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport cylinders. Never insert an object (e.g., wrench, screwdriver, pry bar) into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to remove over-tight or rusted caps. Slowly open the valve. If the valve is hard to open, discontinue use and contact your supplier. Close the container valve after each use; keep closed even when empty. Never apply flame or localized heat directly to any part of the container. High temperatures may damage the container and could cause the pressure relief device to fail prematurely, venting the container contents. For other precautions in using this product, see section 16.

Safe use of the product : **The suitability of this product as a component in underwater breathing gas mixtures** is to be determined by or under the supervision of personnel experienced in the use of underwater breathing gas mixtures and familiar with the physiological effects, methods employed, frequency and duration of use, hazards, side effects, and precautions to be taken.

#### 7.2. Conditions for safe storage, including any incompatibilities

Storage conditions : Store in a cool, well-ventilated place. Store and use with adequate ventilation. Store only where temperature will not exceed 125°F (52°C). Firmly secure containers upright to keep them from falling or being knocked over. Install valve protection cap, if provided, firmly in place by hand. Store full and empty containers separately. Use a first-in, first-out inventory system to prevent storing full containers for long periods.

OTHER PRECAUTIONS FOR HANDLING, STORAGE, AND USE: When handling product under pressure, use piping and equipment adequately designed to withstand the pressures to be encountered. Never work on a pressurized system. Use a back flow preventive device in the piping. Gases can cause rapid suffocation because of oxygen deficiency; store and use with adequate ventilation. If a leak occurs, close the container valve and blow down the system in a safe and environmentally correct manner in compliance with all international, federal/national, state/provincial, and local laws; then repair the leak. Never place a container where it may become part of an electrical circuit.

#### 7.3. Specific end use(s)

None.

### SECTION 8: Exposure controls/personal protection

#### 8.1. Control parameters

Nitrogen, compressed (7727-37-9)	
ACGIH	Not established
USA OSHA	Not established
Nitrogen (7727-37-9)	
ACGIH	Not established
USA OSHA	Not established

EN (English US)

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### 8.2. Exposure controls

Appropriate engineering controls	: Use a local exhaust system with sufficient flow velocity to maintain an adequate supply of air in the worker's breathing zone. Mechanical (general): General exhaust ventilation may be acceptable if it can maintain an adequate supply of air.
Eye protection	: Wear safety glasses with side shields.
Skin and body protection	: Wear metatarsal shoes and work gloves for cylinder handling, and protective clothing where needed. Wear appropriate chemical gloves during cylinder changeout or wherever contact with product is possible. Select per OSHA 29 CFR 1910.132, 1910.136, and 1910.138.
Respiratory protection	: When workplace conditions warrant respirator use, follow a respiratory protection program that meets OSHA 29 CFR 1910.134, ANSI Z88.2, or MSHA 30 CFR 72.710 (where applicable). Use an air-supplied or air-purifying cartridge if the action level is exceeded. Ensure that the respirator has the appropriate protection factor for the exposure level. If cartridge type respirators are used, the cartridge must be appropriate for the chemical exposure (e.g., an organic vapor cartridge). For emergencies or instances with unknown exposure levels, use a self-contained breathing apparatus (SCBA).

## SECTION 9: Physical and chemical properties

### 9.1. Information on basic physical and chemical properties

Physical state	: Gas
Appearance	: Colorless gas.
Molecular mass	: 28 g/mol
Color	: Colorless.
Odor	: No odor warning properties.
Odor threshold	: No data available
pH	: Not applicable.
Relative evaporation rate (butyl acetate=1)	: No data available
Relative evaporation rate (ether=1)	: Not applicable.
Melting point	: -210 °C
Freezing point	: No data available
Boiling point	: -195.8 °C
Flash point	: No data available
Critical temperature	: -149.9 °C
Auto-ignition temperature	: Not applicable.
Decomposition temperature	: No data available
Flammability (solid, gas)	: No data available
Vapor pressure	: Not applicable.
Critical pressure	: 3390 kPa
Relative vapor density at 20 °C	: No data available
Relative density	: No data available
Density	: 1.16 kg/m <sup>3</sup>
Relative gas density	: 0.97
Solubility	: Water: 20 mg/l
Log Pow	: Not applicable.
Log Kow	: Not applicable.
Viscosity, kinematic	: Not applicable.
Viscosity, dynamic	: Not applicable.
Explosive properties	: Not applicable.
Oxidizing properties	: None.
Explosion limits	: No data available

### 9.2. Other information

Gas group	: Compressed gas
Additional information	: None.

EN (English US)

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### SECTION 10: Stability and reactivity

#### 10.1. Reactivity

Under certain conditions, nitrogen can react violently with lithium, neodymium, titanium (above 1472°F/800°C), and magnesium to form nitrides. At high temperature, it can also combine with oxygen and hydrogen.

#### 10.2. Chemical stability

Stable under normal conditions.

#### 10.3. Possibility of hazardous reactions

May occur.

#### 10.4. Conditions to avoid

None under recommended storage and handling conditions (see section 7).

#### 10.5. Incompatible materials

None.

#### 10.6. Hazardous decomposition products

None.

### SECTION 11: Toxicological information

#### 11.1. Information on toxicological effects

Acute toxicity	:	Not classified
Skin corrosion/irritation	:	Not classified
		pH: Not applicable.
Serious eye damage/irritation	:	Not classified
		pH: Not applicable.
Respiratory or skin sensitization	:	Not classified
Germ cell mutagenicity	:	Not classified
Carcinogenicity	:	Not classified
Reproductive toxicity	:	Not classified
Specific target organ toxicity (single exposure)	:	Not classified
Specific target organ toxicity (repeated exposure)	:	Not classified
Aspiration hazard	:	Not classified

### SECTION 12: Ecological information

#### 12.1. Toxicity

Ecology - general : No ecological damage caused by this product.

#### 12.2. Persistence and degradability

Nitrogen, compressed (7727-37-9)	
Persistence and degradability	No ecological damage caused by this product.
Nitrogen (7727-37-9)	
Persistence and degradability	No ecological damage caused by this product.

#### 12.3. Bioaccumulative potential

Nitrogen, compressed (7727-37-9)	
Log Pow	Not applicable.
Log Kow	Not applicable.
Bioaccumulative potential	No ecological damage caused by this product.

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Nitrogen (7727-37-9)	
Log Pow	Not applicable for inorganic gases.
Log Kow	Not applicable.
Bioaccumulative potential	No ecological damage caused by this product.

### 12.4. Mobility in soil

Nitrogen, compressed (7727-37-9)	
Mobility in soil	No data available.
Ecology - soil	No ecological damage caused by this product.

Nitrogen (7727-37-9)	
Mobility in soil	No data available.
Ecology - soil	No ecological damage caused by this product.

### 12.5. Other adverse effects

Effect on ozone layer : None.

Effect on the global warming : None.

## SECTION 13: Disposal considerations

### 13.1. Waste treatment methods

Waste disposal recommendations : Dispose of contents/container in accordance with local/regional/national/international regulations. Contact supplier for any special requirements.

## SECTION 14: Transport information

In accordance with DOT

Transport document description : UN1066 Nitrogen, compressed, 2.2  
 UN-No.(DOT) : UN1066  
 Proper Shipping Name (DOT) : Nitrogen, compressed  
 Transport hazard class(es) (DOT) : 2.2 - Class 2.2 - Non-flammable compressed gas 49 CFR 173.115  
 Hazard labels (DOT) : 2.2 - Non-flammable gas



### Additional information

Emergency Response Guide (ERG) Number : 121 (UN1066);120 (UN1977)

Other information : No supplementary information available.

Special transport precautions : Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency. Before transporting product containers:  
 - Ensure there is adequate ventilation. - Ensure that containers are firmly secured. - Ensure cylinder valve is closed and not leaking. - Ensure valve outlet cap nut or plug (where provided) is correctly fitted. - Ensure valve protection device (where provided) is correctly fitted.

### Transport by sea

UN-No. (IMDG) : 1066  
 Proper Shipping Name (IMDG) : NITROGEN, COMPRESSED  
 Class (IMDG) : 2 - Gases  
 MFAG-No : 121

### Air transport

UN-No.(IATA) : 1066  
 Proper Shipping Name (IATA) : Nitrogen, compressed



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Class (IATA)	: 2
Civil Aeronautics Law	: Gases under pressure/Gases nonflammable nontoxic under pressure

### SECTION 15: Regulatory information

#### 15.1. US Federal regulations

##### Nitrogen, compressed (7727-37-9)

Listed on the United States TSCA (Toxic Substances Control Act) inventory	
SARA Section 311/312 Hazard Classes	Sudden release of pressure hazard

#### 15.2. International regulations

##### CANADA

##### Nitrogen, compressed (7727-37-9)

Listed on the Canadian DSL (Domestic Substances List)

##### Nitrogen (7727-37-9)

Listed on the Canadian DSL (Domestic Substances List)

#### EU-Regulations

##### Nitrogen, compressed (7727-37-9)

Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances)

#### 15.2.2. National regulations

##### Nitrogen, compressed (7727-37-9)

Listed on the AICS (Australian Inventory of Chemical Substances)  
 Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China)  
 Listed on the Korean ECL (Existing Chemicals List)  
 Listed on NZIoC (New Zealand Inventory of Chemicals)  
 Listed on PICCS (Philippines Inventory of Chemicals and Chemical Substances)

#### 15.3. US State regulations

##### Nitrogen, compressed(7727-37-9)

U.S. - California - Proposition 65 - Carcinogens List	No
U.S. - California - Proposition 65 - Developmental Toxicity	No
U.S. - California - Proposition 65 - Reproductive Toxicity - Female	No
U.S. - California - Proposition 65 - Reproductive Toxicity - Male	No
State or local regulations	U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List

##### Nitrogen (7727-37-9)

U.S. - California - Proposition 65 - Carcinogens List	U.S. - California - Proposition 65 - Developmental Toxicity	U.S. - California - Proposition 65 - Reproductive Toxicity - Female	U.S. - California - Proposition 65 - Reproductive Toxicity - Male	No significance risk level (NSRL)
No	No	No	No	

##### Nitrogen (7727-37-9)

U.S. - Massachusetts - Right To Know List  
 U.S. - New Jersey - Right to Know Hazardous Substance List  
 U.S. - Pennsylvania - RTK (Right to Know) List

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### SECTION 16: Other information

Revision date : 6/24/2015 12:00:00 AM  
 Other information : When you mix two or more chemicals, you can create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an industrial hygienist or other trained person when you evaluate the end product. Before using any plastics, confirm their compatibility with this product.

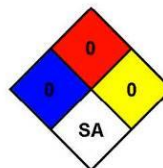
Praxair asks users of this product to study this SDS and become aware of the product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents, and contractors of the information in this SDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information.

The opinions expressed herein are those of qualified experts within Praxair, Inc. We believe that the information contained herein is current as of the date of this Safety Data Sheet. Since the use of this information and the conditions of use are not within the control of Praxair, Inc., it is the user's obligation to determine the conditions of safe use of the product.

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NFPA health hazard : 0 - Exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials.  
 NFPA fire hazard : 0 - Materials that will not burn.  
 NFPA reactivity : 0 - Normally stable, even under fire exposure conditions, and are not reactive with water.  
 NFPA specific hazard : SA - This denotes gases which are simple asphyxiants.



#### HMIS III Rating

Health : 0 Minimal Hazard - No significant risk to health  
 Flammability : 0 Minimal Hazard  
 Physical : 3 Serious Hazard

SDS US (GHS HazCom 2012) - Praxair

*This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.*