FIRETRACE™ International

DESIGN, INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

FOR

PRE-ENGINEERED AUTOMATIC DIRECT CLEAN AGENT EXTINGUISHER UNIT

Designed for use with:

3M™ Novec™ 1230 Fire Protection Fluid

Models:

920205 / 898001 - 2.5 lb / 1 kg Novec 1230

920505 / 898002 - 5 lb / 2 kg Novec 1230

921005 / 898003 - 10 lb / 5 kg Novec 1230

Manual P/N 800035

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FOREWORD

This manual is written for authorized fire protection professionals that install and maintain Firetrace Pre-Engineered Automatic Direct Clean Agent Extinguisher Units with 3M™ Novec™ 1230 Fire Protection Fluid.

Firetrace Pre-Engineered Automatic Direct Clean Agent Extinguisher Units with 3M™ Novec™ 1230 Fire Protection Fluid are to be 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 800035
- All information contained on the agent cylinder nameplate(s)
- Applicable parts of NFPA 2001, Standard on Clean Agent Fire Extinguishing Systems
- Local authority having jurisdiction

Warnings

Safety precautions are essential when any electrical or mechanical equipment is involved. These precautions should be followed when handling, servicing, and recharging Firetrace Pre-Engineered Automatic Direct Clean Agent Extinguisher Units and equipment. If safety precautions are overlooked or ignored, personal injury, or property damage may occur.

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 the correct PPE before unit installation, servicing, or other general handling.

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.

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 the correct PPE before unit installation, servicing, or other general handling.

Safety Precautions

The following safety precautions should always be followed:

1. Read and understand this manual and the other documents referenced herein.
2. Wear safety glasses when working with pressurized cylinders and charging equipment. It is recommended to wear leather gloves to avoid any cryogenic burns.
3. Before removing the unit from installation and before performing any charging, leak tests, or salvage operations, ensure that the ball valve (installed to the top of the cylinder valve) is closed (lever is in "OFF" position) and the detection tubing has been removed from the cylinder valve.
4. Follow all the safety procedures included on the cylinder nameplate and in this manual.
5. Never assume that a cylinder is empty. Treat all cylinders as if they are fully charged.

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

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

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1 GENERAL INFORMATION

1.1 Introduction

The Firetrace Pre-Engineered Automatic Direct Clean Agent Extinguisher Units with 3M™ Novec™ 1230 Fire Protection Fluid are designed to be used in a Local Application manner providing the system is designed within the limitations outlined in the manual.

The pre-engineered concept minimizes the amount of engineering involved in system design. When the enclosure meets the specifications outlined in this manual and the Firetrace detection tubing is installed within the limitations stated in this manual, no hydraulic calculations are required to determine pressure drop, agent flow, or discharge time.

The hazard being protected by the Firetrace system can be any size, shape, or volume; provided that it is reasonably sealed and 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 all the components necessary to detect and extinguish Class A, B, and C (Class E for Europe) fires.

Each installed Firetrace pre-engineered extinguisher unit is used in tandem with its own pneumatic Firetrace Detection Tubing (FDT).

Upon direct flame impingement of the FDT, the tubing will rupture forming a burst hole. This burst hole will act as a nozzle directly applying the agent onto the flame source, extinguishing the fire and flooding the enclosure to prevent re-flash.

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 (1) 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.

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

1.2 3M™ Novec™ 1230 Fire Protection Fluid

Firetrace Pre-Engineered Automatic Direct Clean Agent Extinguisher Units utilize 3M™ Novec™ 1230 Fire Protection Fluid, referenced as Novec 1230 or FK-5-1-12.

Novec 1230 is a fluorinated ketone depicted by the chemical formula $CF_3CF_2C(O)CF(CF_3)_2$ (1,1,1,2,2,4,5,5,5-nonafluoro-4-(trifluoromethyl)-3-pentanone). Novec 1230 is a colorless low odor fluid, low in toxicity, electrically non-conductive, which leaves no residue, and is an extremely effect fire suppression agent.

Novec 1230 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.

1.2.1 Cleanliness

Novec 1230 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, aluminium, stainless steel, brass, plastics, rubber, and electronic components, are not affected by exposure to Novec 1230. The agent is also environmentally friendly, having an ozone depletion potential (ODP) of 0.00.

1.2.2 Thermal Decomposition Products

When exposed to extreme temperatures Novec 1230 will form thermal decomposition products, which include halogen acids. Test results have shown that when the agent is rapidly discharged, causing rapid extinguishment of flames, the amount of thermal decomposition products formed is minimal.

1.2.3 Agent Properties

For hazard information, decomposition information, and physical properties of Novec 1230 please refer to the Safety Data sheet located in APPENDIX C.

2 SYSTEM DESCRIPTION

2.1 General

The Firetrace Pre-Engineered Automatic Direct Novec 1230 Clean Agent Extinguisher Units are available in multiple sizes:

920205 / 898001	**Charged with 2.5 lb / 1 kg of Novec 1230**
920505 / 898002	**Charged with 5.0 lb / 2 kg of Novec 1230**
921005 / 898003	**Charged with 10.0 lb / 5 kg of Novec 1230**

These units are designed for use in local applications only, where the hazard is normally unoccupied, and are rated for use in the following fire classifications:

- Class A – Surface type fires
- Class B – Flammable liquid fires
- Class C (Class E for Europe) – Electrical equipment fires

Novec 1230 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 auto thermal decomposition, such as certain organic peroxides and hydrazine
- Deep Seated or burrowing fires in ordinary combustibles where the clean agent cannot reach the point of combustion

The Firetrace Pre-Engineered Automatic Direct Clean Agent Extinguisher Units can be used, but are not limited, to protect the following:

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

For hazards beyond the scope described above, it is recommended that the designer consult with Firetrace and the local authority having jurisdiction as to the suitability on the use of these agents for particular hazards, for personnel exposure effects from the design concentration, and for installation requirements.

Firetrace Pre-Engineered Automatic Direct Clean Agent Extinguisher Units consists of the following major components:

- Cylinder/Valve assembly
- Cylinder Mounting Bracket (Heavy duty bracket optional)
- Firetrace Detection Tubing (FDT) and fittings (No substitute)
- Pressure Supervisory Switch
- Pressure Operated Switch (Optional)
- EU Pressure Operated Switch (Optional)

Once installed, the Firetrace Pre-Engineered Automatic Direct Clean Agent Extinguisher Unit becomes a self-contained, self-actuating unit that does not require an external power source.

The unit utilizes a UL recognized (per UL Standard 521) linear heat detector (see Certificate of Compliance 20140705-S35465) known as Firetrace Detection Tubing. This tubing is pressurized with dry nitrogen, is temperature sensitive, and acts as a continuous linear thermal detector that ruptures upon direct flame impingement or at temperatures above 383 °F [195 °C]. Once the Firetrace detection tubing is ruptured, it forms a nozzle at the rupture point, allowing the Novec 1230 clean agent to flow through, distributing the agent through the nozzle and into the protected area.

Upon system actuation, the pressure switch can be used to indicate system discharge, sound an alarm, shutdown ventilation, shut-off electrical power, or provide additional electrical functions as may be required.

2.2 Component Descriptions

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

2.2.1 Cylinder/Valve Assemblies

The Novec 1230 clean agent is stored in aluminum or steel cylinders and is super-pressurized with nitrogen. Each cylinder is equipped with a nickel plated brass valve assembly.

Each valve assembly is equipped with a pressure gauge to monitor cylinder pressure, and a quarter turn ball valve that interfaces with the Firetrace detection tubing (FDT). The valve assembly utilizes a straight siphon tube only for the unit to only be mounted in a vertical (upright) position.

NOTE: The ball valve must be kept closed at all times when the cylinder is not in service.

2.2.2 Firetrace Detection Tubing

The Firetrace Detection Tubing is available in a 4/6 mm (P/N 200005) size. The Firetrace Detection Tubing is a linear, pneumatic, fire detection device that responds to a combination of the heat and radiant energy from a fire. The tubing is a UL recognized component per UL Standard 521 (see Certificate of Compliance 20140705-S35465). The Firetrace detection tubing performs three functions: heat detection, system activation, and agent discharge. One end of the tubing is installed to the top of the cylinder valve. The tubing is then installed throughout the hazard volume and finally pressurized with nitrogen.

The Firetrace detection tubing is heat sensitive and in a fire situation is designed to rupture at any point along its length upon direct flame impingement or when the temperature reaches above 383 °F [195 °C]. The rupture of the tubing releases the nitrogen pressure causing the unit to actuate. The portion of the tubing nearest the fire ruptures, resulting in a formation of a discharge nozzle that will perform a complete discharge of the Novec 1230 clean agent. For additional information on tubing properties and material compatibility, please see Table 1 - Firetrace Detection Tubing Properties and APPENDIX B.

Table 1 - Firetrace Detection Tubing Properties

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

2.2.3 Firetrace Tubing Cutter

The Firetrace Tubing Cutter (P/N 600210) is used to ensure that the Firetrace Detection Tubing is cut with a square, clean finish, free of debris.

2.2.4 Filling Adapter

The filling adapter (P/N 900007) is used for the pressurization of the Firetrace Detection Tubing. One end of the filling adapter is equipped with M10 x 1 threads, allowing for easy installation to the End of Line Adapter. The opposite end of the filling adapter is equipped with G1/8 threads.

2.2.5 Pressure Supervisory Switch

The pressure supervisory switch (P/N 400150) is used to monitor the pressure inside the unit cylinder. The pressure supervisory switch is factory installed into the pressure switch port located on the valve assembly. If the unit loses pressure and reaches a pressure of 150 psig ± 10 psi [10.3 ± 0.7 bar] or below, the switch contacts will activate, providing a signal to indicate that the unit has lost pressure.

The pressure supervisory switch is single pole, double throw (SPDT) and can be wired in either the normally open (NO) or normally closed (NC) configurations, where the normal condition is at atmospheric pressure. When the unit is pressurized, the contacts switch over. The pressure supervisory switch shall be installed in accordance with NFPA 70 and NFPA 72.

2.2.6 Pressure Operated Switch

The pressure operated switch (P/N 400004) is available as an optional part for the DOT system detection line. The pressure operated switch is installed into an End of Line Adapter. The pressure operated switch is used to monitor unit actuation. Additionally, the pressure operated switch can be wired to energize electrically operated equipment, shut down electrically operated equipment, sound an alarm, or provide additional electrical functions as may be required. If the detection line reaches a pressure of 70 ± 10 psig [4.8 ± 0.7 bar] or below, the switch contacts will activate, providing a signal to indicate that the unit has been activated.

The pressure operated switch is single pole, double throw (SPDT) and can be wired in either the normally open (NO) or normally closed (NC) configurations, where the normal condition is at atmospheric pressure. The pressure switch shall be installed in accordance with NFPA 70 and NFPA 72.

2.2.7 EU Pressure Operated Switch

The EU pressure operated switch (P/N 400034) is available as an optional part for the CE system detection line. It is also available as an alternate for DOT system detection line. The EU pressure operated switch set point is factory set during production. The EU pressure operated switch is installed into an End of Line Adapter. The EU pressure operated switch is used to monitor unit actuation. Additionally, the EU pressure operated switch can be wired to energize electrically operated equipment, shut down electrically operated equipment, sound an alarm, or provide additional electrical functions as may be required. If the detection line reaches a pressure below the set point of the EU pressure operated switch, the switch contacts will activate, providing a signal to indicate that the unit has been activated.

The EU pressure operated switch is single pole, double throw (SPDT) and can be wired in either the normally open (NO) or normally closed (NC) configurations, where the normal condition is at atmospheric pressure. The pressure switch shall be installed in accordance with NFPA 70 and NFPA 72.

Firetrace recommends that all units use a pressure switch coupled with a device to alert personnel in the event of discharge.

NOTE: Due to the nature of the Firetrace direct clean agent extinguishing unit, it provides for an extended discharge. Due to the extended discharge, the pressure within the system slowly drops, which could provide a delay in the actuation of the pressure switch. The pressure switch shall be installed as part of the detection line, at the end of the detection network.

Table 2 - Pressure Switch Properties

Operating Parameters	Pressure Supervisory Switch P/N 400150	Pressure Operated Switch P/N 400004		EU Pressure Operated Switch P/N 400034
Electrical Rating	36 VDC – 6 AMP 240 VAC – 3 AMP	28 VDC – 15 AMP		250 V – 5 AMP – 50 Hz
		NO: 120 VAC – 10 AMP 240 VAC – 5 AMP	NC: 120 VAC – 25 AMP 240 VAC – 25 AMP	
Temperature Range	-5 °F to 175 °F [-20.6 °C to 79.4 °C]	-20 °F to 150 °F [-28.9 °C to 65.6 °C]		14 °F to 176 °F [-10 °C to 80 °C]

NOTE: Do not use the pressure supervisory switch as a handle when handling the extinguishing unit. Doing so can result in pressure leakage, damage to the pressure switch, and/or system discharge.

3 SYSTEM DESIGN AND LIMITATIONS

3.1 General

The pre-engineered system concept minimizes the amount of engineering required when evaluating a design for a specific application. Provided that the volume of the hazard, surface area coverage, agent quantity, and Firetrace Detection Tubing (FDT) is installed within the limitations outlined in this manual, no calculations are required for pressure drop, flow rates, or discharge time.

NOTE: The basis for determining the agent quantity and concentration levels is derived from NFPA 2001, 2015 edition and is deemed to be compliant with the standard in this aspect.

3.2 Specifications

3.2.1 Storage and Operating Temperature Range

The Firetrace Pre-Engineered Automatic Direct Novec 1230 Clean Agent Extinguishing Units and equipment are designed to be stored and operated at the ambient temperature range of -4 °F to 140 °F [-20 °C to 60 °C].

3.2.2 System Operating Pressure

The normal operating pressure for the unit is 195 psig at 70 °F [13.5 bar at 21.1 °C].

The Firetrace Pre-Engineered Automatic Direct Novec 1230 Clean Agent Extinguishing Units are designed for an operating temperature range of -4 °F to 140 °F [-20 °C to 60 °C]. Table 3 - Cylinder Pressure-Temperature Relationship shows the cylinder gauge pressure-temperature relationship based on a charging pressure of 195 psig at 70 °F [13.5 bar at 21.1 °C].

Table 3 - Cylinder Pressure-Temperature Relationship

Temperature		Pressure	
°F	°C	psig	bar
-4	-20.0	136	9.4
0	-17.8	139	9.6
5	-15.0	143	9.9
10	-12.2	147	10.1
15	-9.4	151	10.4
20	-6.7	155	10.7
25	-3.9	159	11.0
30	-1.1	163	11.2
35	1.7	167	11.5
40	4.4	171	11.8
45	7.2	175	12.1
50	10.0	179	12.3
55	12.8	183	12.6
60	15.6	187	12.9
65	18.3	191	13.2
70	21.1	195	13.5
75	23.9	199	13.7
80	26.7	203	14.0
85	29.4	207	14.3
90	32.2	211	14.5
95	35.0	215	14.8
100	37.8	219	15.1
105	40.6	223	15.4
110	43.3	227	15.6
115	46.1	231	15.9
120	48.9	235	16.2
125	51.7	239	16.5
130	54.4	243	16.7
135	57.2	247	17.0
140	60.0	251	17.3

3.3 Design Procedure

The following procedures should be used to design a Firetrace Pre-Engineered Automatic Direct Novec 1230 Clean Agent Extinguisher Unit:

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.)
c. Determine the anticipated minimum and maximum ambient temperatures expected within the enclosure to be protected. (These must be within the recommend minimum and maximum service temperatures of the system.)
d. Determine the integrity of the enclosure and if any openings must be closed at the time of agent discharge.
e. Determine the cylinder size required based on the hazard volume limitations.
f. Based on the total quantity of agent being used at the maximum ambient temperature expected within the enclosure, evaluate personnel safety exposure limits.
g. Determine the location of the system cylinder.
h. Determine the arrangement and placement of the Firetrace detection tubing.
i. Determine any auxiliary equipment requirements such as a pressure switch(es) to sound alarms, shut down ventilation, shut off electrical power, etc.

3.4 Minimum Design Concentrations

The minimum design concentration to be used with Firetrace Pre-Engineered Automatic Direct Novec 1230 Clean Agent Extinguisher Units include a minimum safety factor (SF), as specified in NFPA 2001, 2015 edition.

A minimum design concentration of 6.7% was established using the minimum design concentration of commercial grade heptane. Minimum design concentrations will vary for different Class B fuels.

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 Novec 1230 for a particular hazard, for personnel exposure effects from the design concentrations, and for installation requirements.

3.5 System Limitations

LPCB approval applies for systems with:

- A single container heat detection tube installation run protecting a maximum volume of 2 m^3 *.
- Up to 4 heat detection tube runs connected to a single container where no single protected volume exceeds a 2 m^3 * volume.
- A maximum heat detection tube length of 10 m from the container outlet to the end of any single detection tube run.

***The 2 m^3 volume limitation applies only to 5 lb [2 kg] and 10 lb [5 kg] systems. For the 2.5 lb [1 kg] system, the volume is limited to 1 m^3.**

3.5.1 Enclosure Volume Limitations

The Firetrace Pre-Engineered Automatic Direct Novec 1230 Clean Agent Extinguisher Units are designed to enable a single cylinder heat detection tube installation run to protect an enclosure of any size or shape, provided that the volume does not exceed the maximum volume limitations. Additionally, the overall height of the enclosure shall not exceed 12 ft [3.65 m]. Table 4 below lists the maximum enclosure volume for each unit size.

Table 4 - Maximum Enclosure Volume Limitations

Model Number	Agent Amount	Maximum Enclosure Volume
920205 / 898001	2.5 lb [1 kg]	35.31 ft^3 [1 m^3]
920505 / 898002	5 lb [2 kg]	70.63 ft^3 [2 m^3]
921005 / 898003	10 lb [5 kg]	70.63 ft^3 [2 m^3]

3.5.2 Ventilation 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, if feasible. If openings are determined to be unclosable or ventilation is unable to be shut down, the volume of airflow for a reasonable amount of time due to these impediments must be included in the overall volume calculations/survey.

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

3.5.3 Fire Detection Tubing Limitations

The Firetrace Pre-Engineered Automatic Direct Novec 1230 Clean Agent Extinguishing units are designed to detect and extinguish fires within small enclosures using Firetrace Detection Tubing. The tubing is used to perform three functions, heat detection, system activation, and agent discharge.

To ensure that the entire height of an enclosure is protected, the tubing must be installed in layers. The maximum height between layers shall not exceed 1.64 ft [0.5 m].

To ensure that the entire area of each layer is protected, the tubing must be installed in passes. The maximum distance between each pass shall not exceed 10.22 in [25.96 cm].

The maximum distance from any wall to the tubing shall not exceed 5.11 in [12.98 cm]. The maximum bend radius shall not exceed 6 in [15.24 cm].

The tubing may be installed in runs to protect segmented areas within an enclosure. The maximum tube length from the container outlet to the end of any single tube run shall not exceed 32.8 ft [10 m]. Up to 4 tube runs may be connected to a single cylinder, provided that the volume of each segmented area does not exceed the maximum volume limitations.

The MAH is the maximum activation height of the tubing above the protected risk. The MAH for 4/6 mm tubing is 3.94 in [100 mm]. For better response time in the event of a fire, the tubing should be placed at a height less than the MAH above the hazard.

3.5.3.1 Tubing Limitations Example

An example of a system configuration is shown below:

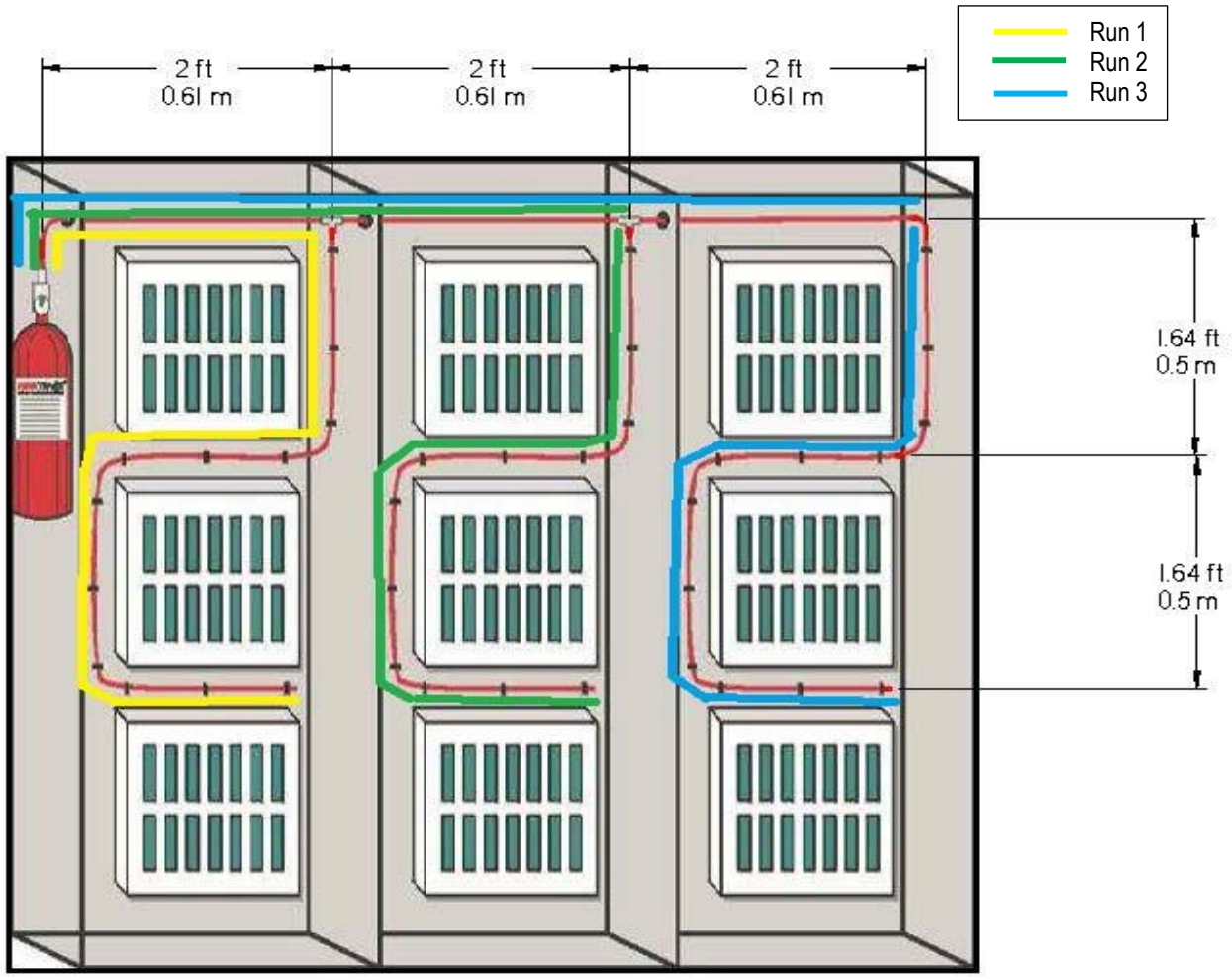


Figure 1 - Example System Configuration

The tubing is installed in three different runs in order to protect the segmented sections within the enclosure. The total length of Run 1 is 9.28 ft [2.83 m]. The total length of Run 2 is 11.28 ft [3.44 m]. The total length of Run 3 is 13.28 ft [4.05 m]. Each tubing run is less than the maximum tube run length of 32.8 ft [10 m].

The tubing is also installed in layers to protect the overall height of the enclosure. Each layer does not exceed the maximum height between layers of 1.64 ft [0.5 m].

The tubing is fastened on the sides of the walls, ensuring the distance between the tubing to any wall does not exceed 5.11 in [12.98 cm].

4 INSTALLATION INSTRUCTIONS

Firetrace Pre-Engineered Automatic Direct Novec 1230 Clean Agent Extinguishing Units must be handled, installed, inspected, and serviced only by qualified and trained personnel in accordance with the instructions contained in the appropriate manual, unit nameplate, and any other regulations and codes that may apply.

4.1 Extinguisher Unit Installation

The extinguisher unit should be installed as close as possible to the protected enclosure. In some cases, the extinguisher unit can be mounted inside the protected enclosure. The unit shall be installed in a readily accessible location to allow for ease of inspection, service, and maintenance. The unit shall be located in an environment protected from the weather and where the temperature range is -4 °F to 140 °F [-20 °C to 60 °C]. Additionally, a label shall be affixed to the enclosure, stating that the enclosure is fitted with a pre-engineered extinguisher unit.

The extinguisher unit and bracket must be mounted in the vertical plane and oriented so that the pressure gauge is facing out and away from the mounting wall to facilitate visual inspection.

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

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.

WARNING

During transportation, ensure the ball valve, located on the top of the cylinder valve, is maintained in the "OFF" position. Failure to follow these instructions will result in actuation and discharge of the cylinder contents.

WARNING

Do not use the pressure supervisory switch on the valve as a handle when during transportation of the unit. Doing so can result in damage to the pressure switch, leakage to the unit, and/or unit discharge.

CAUTION

This unit is designed 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.

4.2 Component Installation

All components should be installed to facilitate proper inspection, maintenance, testing, recharging, and any other required service 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.

4.2.1 Firetrace Detection Tubing

Location and spacing of the tubing is critical to the response time in the event of a fire. The tubing should be placed above the hazard areas being protected. It is recommended that the tubing be placed in a manner such that it is situated horizontally above potential fire sources. It is not recommended that the FDT is oriented vertically adjacent to a potential fire source. Tubing installation should always be inspected to ensure the tubing is not kinked, crushed, or vulnerable to damage. Tubing shall not be installed on any galvanic surfaces.

1. Secure the detection tubing using Mounting Tabs at no more than 6 in [15.24 cm] intervals.
2. All FDT fittings at joints must be secured.
3. FDT must be secured within 6 in [15.24 cm] of all joints or fittings, to prevent leakage due to bends near joints.
4. Use the appropriate rubber/plastic grommets when the detection tubing is routed through sharp holes, in order to prevent damage to the tubing.
5. When mounting to metal surfaces, rubber P-clips or a small piece of copper/rubber hosing is required to mount to the metal surface.
6. All FDT fittings and joints are to be inspected for leaks with a solution of liquid soap and water.

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 300 °F [148.9 °C].**

4.2.2 Slip-On Fittings

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

1. Cut the tube end (using a Firetrace detection tube cutter P/N 600210), ensuring the cut is square, clean, and free from burrs. Verify that no debris is left in the tube.
2. Thoroughly clean the tubing with a clean cloth (no cleaning agent) to a distance of at least 2 in [5.08 cm] from 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 comprehensive list of Slip-On Fittings, refer to APPENDIX A.

4.2.3 End of Line Accessories

All 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 4.2.2.

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

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

NOTE: Without installation of the included washer, the Operational Pressure Switch will not be active. For rapid activation, Pressure Operated Switch shall be installed as part of the detection line, at the end of the detection network.

EU Pressure Operated Switch:
The EU pressure operated switch must be installed in the End of Line Adapter with its included O-ring. Thread the EU pressure operated switch until an audible “click” can be heard. The EU pressure operated switch is now active.

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

4.3 System Activation

1. Ensure the detection tubing, fittings, and accessories are installed according the procedures specified in Section 4.2 of this manual.
2. Attach the filling adapter to the End of Line Adapter
3. Using a regulated dry nitrogen supply, pressurize the detection tubing through the filling adapter. It is recommended to have a portable dry nitrogen cylinder or Firetrace Nitrogen Fill Kit for on-site use.
4. Remove the filling adapter and thread the pressure gauge into the End of Line Adapter. Verify that the tubing is pressurized to the correct pressure reading.
5. With the gauge still installed to the EOL, 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.
   - After 30 minutes, check the pressure gauge reading. Any decrease in pressure is an indication of a leak.
   - In the event of a leak go back to Section 4.2 and verify the installation of all fittings and accessories.
6. If the pressure operated switch is to be installed, remove the pressure gauge and install the pressure switch according to the procedures in Section 4.2.3.
   a. Check pressure switch connection for bubble leaks using soapy water solution.
   b. Ensure proper electrical connections are made to annunciate unit discharge, shut down ventilation, etc., as may be required by the end user or the authority having jurisdiction. (All electrical connections are to be in accordance with NFPA 70 National Electric Code and NFPA 72 National Fire Alarm and Signaling Code.)

   NOTE: It shall not be possible for the user to isolate any power supply or alarm connections to the unit without also isolating the power supply to the enclosure or placing the system into an alarm status.

7. Ensure the pressure supervisory switch electrical connections are properly installed to annunciate low pressure within the extinguisher unit. (All electrical connections are to be in accordance with NFPA 70 National Electric Code and NFPA 72 National Fire Alarm and Signaling Code.)
8. With the system fully installed and all components properly affixed within the hazard area, **SLOWLY** rotate the lever on the ball valve counter clockwise to the “ON” position.
9. Remover the ball valve lever with a small Phillips head screw driver.
10. Install the Anti-Tamper device (P/N 201132) in accordance with APPENDIX B.

5 SERVICE AND MAINTENANCE INSTRUCTIONS

Firetrace Pre-Engineered Automatic Direct Novec 1230 Clean Agent Extinguishing Units must be handled, installed, inspected, and serviced only by qualified and trained personnel in accordance with the instructions contained in the appropriate manual, unit nameplate, and any other regulations and codes that may apply.

5.1 General

A regular program of systematic maintenance must be established for continuous, proper operation of all Firetrace Extinguisher Units and to avoid violating the warranty. A periodic maintenance schedule must be followed and an inspection log maintained for ready reference. Each unit is provided with a service record log. 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.

NOTE: Operational shut down during equipment maintenance is not required. It shall not be possible for the user to isolate any electrical power supply or alarm connections to the system without also isolating power supply to the enclosure, or placing the system into an alarm status.

5.2 Periodic Service and Maintenance Procedures

5.2.1 Monthly Inspection

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

1. The Extinguisher Unit is in its proper location.
2. The Tamper Indicator is intact.
3. The Maintenance Tag or Certificate is in place and legible.
4. The Extinguisher Unit shows no physical damage or degradation that might prevent operation such as:
   a. Cuts or abrasions to the Firetrace Detection Tubing
   b. Color distortion of the FDT or extinguisher unit
   c. Dirt accumulation along the FDT
   d. Dirt accumulation along any of the fittings
5. The Pressure Gauge is in the operable range.
6. Verify the Protected Equipment nor the Hazard has been replaced, modified, or relocated.
7. If the pressure operated switch is installed:
   i. Check pressure switch connection for bubble leaks using soapy water solution.
   ii. Ensure the proper electrical connections are made. (All electrical connections are to be in accordance with NFPA 70 National Electric Code and NFPA 72 National Fire Alarm and Signaling Code.)
8. Ensure the pressure supervisory switch electrical connections are properly installed to annunciate low pressure within the extinguisher unit. (All electrical connections are to be in accordance with NFPA 70 National Electric Code and NFPPA 72 National Fire Alarm and Signaling Code.)

5.2.2 Semi-Annual Inspection

Semiannual Inspection is to be performed only by a Certified Firetrace Distributor. Inspection should include a repetition of the monthly inspection as well as verification of extinguisher unit weight. Extinguisher unit weight should be verified using the following steps:

1. Close the ball valve by turning the ball valve lever clockwise to the “OFF” position.
2. Depressurize the Firetrace detection tubing by removing any components installed into the End of Line Adapter and threading the fill kit adapter into the End of Line Adapter.
3. Disconnect the Firetrace detection tubing from the ball valve.
4. Remove the cylinder from the cylinder bracket.
5. Weigh the extinguisher unit. Compare the measured weight with the weight found on the nameplate. If the extinguisher unit 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 unit shall be refilled or replaced.
6. Reinstall the extinguisher unit and pressurize the detection tubing with nitrogen, see Section 4 for instructions.

⚠ 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 during unit installation, servicing, or other general handling.

WARNING

Firetrace 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 and any other regulations and codes that may apply.

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 Warranty. Please contact Firetrace directly for a list of Authorized Firetrace Service Locations.

5.2.3 Cylinder Maintenance

Novec 1230 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 visual inspection guidelines detailed in BS EN 1968:2002, BS EN 1802:2002, and NFPA 2001 (2015 Edition).

DOT-4B, 4BA, and 4BW cylinders used exclusively in Novec 1230 systems are required to follow DOT regulations. DOT regulations require cylinders which have discharged to be retested and stamped prior to recharge, if more than 5 years have passed since the date of the last test.

Firetrace Novec 1230 systems equipped with DOT cylinders 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 tester 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. Only the water jacket volumetric expansion method or the direct expansion methods are acceptable because volumetric expansion of the container must be measured.

As an alternate option, Novec 1230 system equipped with DOT cylinders may be given a complete visual inspection, as detailed in section 173.34(e) (13), in lieu of hydrostatic testing. 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 identification number.

Firetrace Novec 1230 systems equipped with CE cylinders requiring retest must be hydrostatically tested in accordance with BS EN 1968:2002, for steel cylinders, and BS EN 1802:2002, for aluminum cylinders. This periodic retest must be performed only by competent personnel, and must include an internal and external examination in accordance with BS EN 1968:2002 and BS EN 1802:2002, as applicable. The test procedures are described in the appendix of BS EN 1968:2002 and BS EN 1802:2002. Only the water jacket volumetric expansion method is acceptable because volumetric expansion of the container must be measured.

For DOT cylinders requiring hydrostatic testing, testing can be performed by either of the following methods:

Test Method	First Retest Due (Years)	Subsequent Retest Due (Years)	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”

6 SYSTEM DEPRESSURIZATION AND CHARGING

Firetrace Pre-Engineered Automatic Direct Novec 1230 Clean Agent Extinguishing Units must be handled, installed, inspected, and serviced only by qualified and trained personnel in accordance with the instructions contained in the appropriate manual, unit nameplate, and any other regulations and codes that may apply.

WARNING

Pressurized (charged) cylinders are extremely hazardous and if not handled properly are capable of causing bodily injury, property damage, or death. Always wear safety glasses during 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. Please contact Firetrace directly for a list of Authorized Firetrace Service Locations.

6.1 Depressurizing the Unit

1. Turn the ball valve lever to the "OFF" position (perpendicular to the valve.)
2. Depressurize the Firetrace detection tubing by removing any components installed into the End of Line Adapter and threading the fill kit adapter (P/N 200173) into the End of Line Adapter.
3. Remove the Firetrace detection tubing from the top of the ball valve.
4. SLOWLY, open the ball valve SLIGHTLY so only a small amount of nitrogen can be heard being released from the unit.
5. Ensure the unit is depressurized by verifying the pressure gauge reads 0 psig.
6. SLOWLY open the ball valve completely.

CAUTION

Opening the ball valve too far, or too fast, will bring Novec 1230 into the valve assembly.

6.2 System Recharge

Use the following steps to recharge an empty Firetrace Pre-Engineered Automatic Direct Novec 1230 Clean Agent Extinguisher Unit:

1. Weigh and record the empty weight of the cylinder and valve assembly.
2. Install the Firetrace Detection Tubing to the top of the valve assembly.
3. Connect the filling adapter to the end of line adapter.
4. Connect the Novec 1230 fill line to the fill adapter and record the weight shown on the scale.
5. Zero the scale.
6. Ensure the ball valve is open and open the Novec 1230 fill line.
7. Once the required weight is reached, close the Novec 1230 fill line.
8. Close the ball valve.
9. Open the valve vent to bleed the excess Novec 1230 from the fill line and disconnect the Novec 1230 fill line from the fill adapter.
10. Connect the dry nitrogen fill line to the fill adapter. Ensure it is regulated to 195 psig at 70 °F [13.5 bar at 21 °C] (pressure may have to be adjusted for temperatures higher or lower than 70°F).
11. Open the ball valve and pressurize the cylinder with dry nitrogen.
12. Close the ball valve and shake the cylinder to allow the nitrogen to be absorbed by the Novec 1230. (Some pressure loss will be observed.)
13. Open the ball valve and pressurize back up to 195 psig at 70 °F, as will be indicated on the system pressure gauge.
14. Repeat steps 11 thru 13 until shaking of the system does not result in any pressure loss (i.e., no further nitrogen absorption) and a pressure of 195 psig is reached.
15. Disconnect the dry nitrogen fill line.
16. Verify the system gross weight by checking it against what is printed on the label.
17. Leak test the unit by using a calibrated leak detector.
18. The unit 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 FITTNESS 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 affect 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 Novec 1230 and/or CO_2, 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.

APPENDIX A

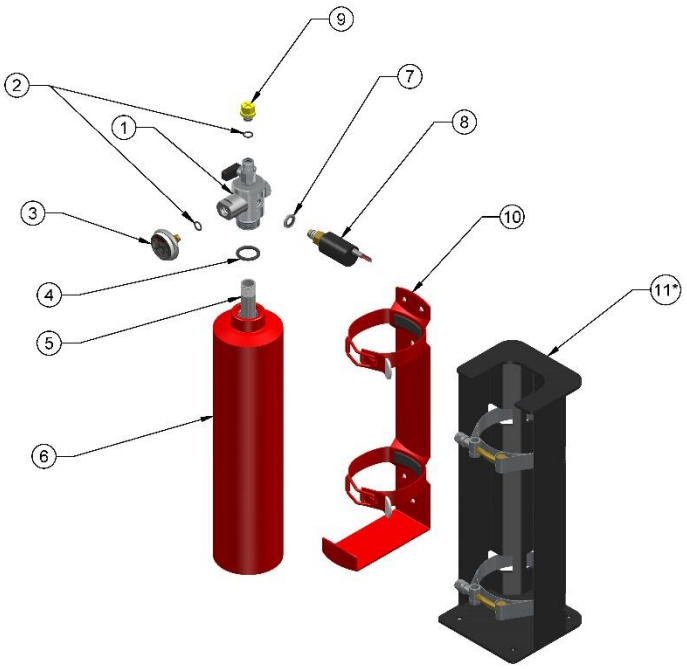
System Parts List

Discharge Line Parts List

System Parts List: DOT System

MODELS:
920205 2.5 lb Novec 1230 DLP
920505 5 lb Novec 1230 DLP
921005 10 lb Novec 1230 DLP

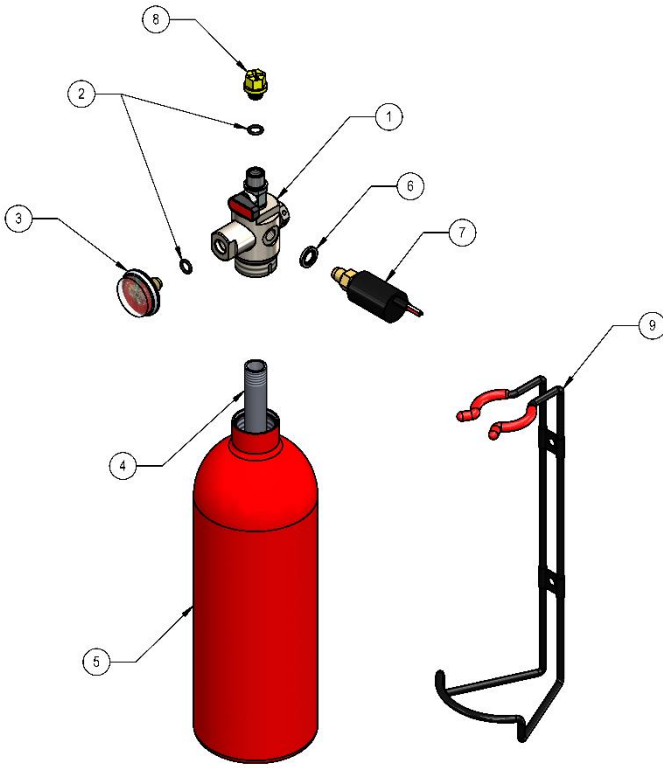
ITEM	P/N	DESCRIPTION	SYSTEM
1	300109	DOT DLP Valve	All Systems
2	400002	O-Ring, Gauge/Transport Cap	All Systems
3	400029	Gauge, Generic	All Systems
4	300200	O-Ring, Cylinder Connection	All Systems
5	600029	Siphon Tube	All Systems
6	100301	Small DLP Cylinder	3 LB
6	100601	Medium DLP Cylinder	6 LB
6	101201	Large DLP Cylinder	12 LB
7	600033	Bonded Seal	All Systems
8	400150	Pressure Supervisory Switch, Novec 1230	All Systems
9	200103	Transport Cap	All Systems
NP	200179	Slip-on Union	All Systems
10	100003	Small Bracket	3 LB
10	100006	Medium Bracket	6 LB
10	111206	Large Bracket	12 LB
11*	111404	ASM, Small Heavy Duty Bracket	3 LB (OPTIONAL)
11*	111403	ASM, Medium Heavy Duty Bracket	6 LB (OPTIONAL)
11*	111402	ASM, Large Heavy Duty Bracket	12 LB (OPTIONAL)
* OPTIONAL PARTS NP PARTS NOT PICTURES			



System Parts List: CE System

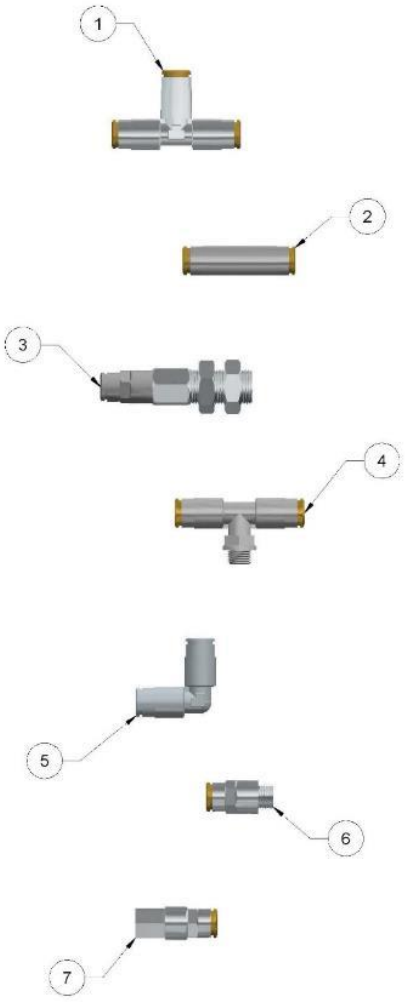
MODELS:
898001 1 kg Novec 1230 DLP
898002 2 kg Novec 1230 DLP
898003 5 kg Novec 1230 DLP

ITEM	P/N	DESCRIPTION	SYSTEM
1	831211	CE DLP Valve	All Systems
2	400002	O-Ring, Gauge/Transport Cap	All Systems
3	400029	Gauge, Generic CE	All Systems
4	860010	1 kg Siphon Tube	1 kg
4	600029	2 kg Siphon Tube	2 kg
4	860012	5 kg Siphon Tube	5 kg
5	810100	1 kg Cylinder	1 kg
5	810200	2 kg Cylinder	2 kg
5	810500	5 kg Cylinder	5 kg
NP	200179	Slip-On Union	All Systems
6	600033	Bonded Seal	All Systems
7	400150	Pressure Supervisory Switch, Novec 1230	All Systems
8	200103	Transport Cap	All Systems
9	810101	1 kg bracket	1 kg
9	810202	2 kg Bracket	2 kg
9	810505	5 kg Bracket	5 kg
NP – PARTS NOT PICTURED			



Detection Line Parts List

ITEM	P/N	DESCRIPTION
NP	200005	Firetrace Detection Tubing (4/6)
NP	200150	Rubber Grommets (Qty. 2)
NP	200151	Plastic Grommets (Qty. 2)
NP	200171	Mounting Tabs (4/6) (Qty. 12)
NP	201006	Magnetic Mounting Clips (4/6) (Qty. 6)
1	200157	Tube Tee (4/6)
2	200158	Tube Union (4/6)
NP	200159	Tube to Threads Elbow (4/6)
3	200168	Tube to End of Line Adapter (4/6)
NP	200169	Tube Tee to In Line Adapter (4/6)
4	200177	Tube Tee to Threads (4/6)
5	200178	Tube Elbow (4/6)
6	200179	Tube to Threads Union (4/6)
7	200203	Tube Plug (4/6)
NP	310303	End of Line Adapter Plug with O-Ring
NP	400004	Pressure Operated Switch
NP	400028	Pressure Gauge with O-Ring
NP	400034	EU Pressure Operated Switch
NP	900007	Filling Adapter
NP – PARTS NOT PICTURED		

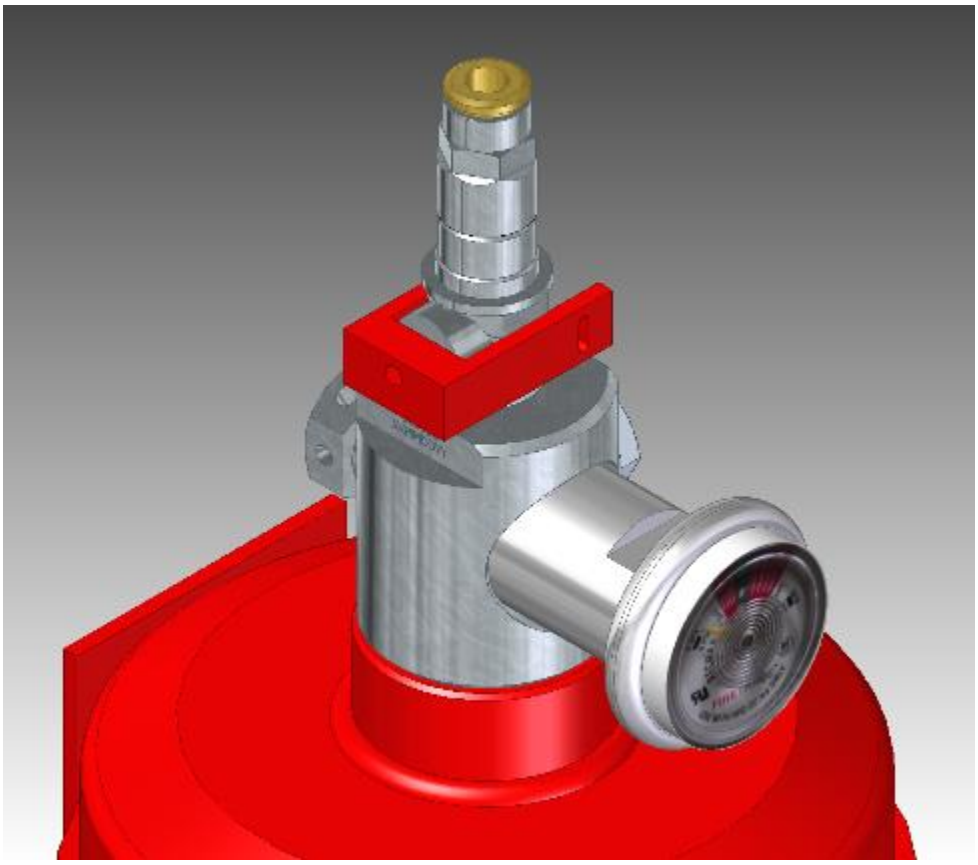


APPENDIX B

Tamper Proof Instructions

Firetrace Detection Tube Compatibility

Tamper Proof Instruction



1. Verify that the ball lever is in the “ON” position
2. Remove the lever
3. Install the sleeve (as pictured above)
4. Apply the plastic tie wrap and record the serial number stamped on the wrap.

Firetrace Detection Tubing Compatibility

Results of chemical testing of Firetrace Detection Tubing undertake by Oxford University.

Solvent	Vapor	Liquid
Ether	No Action	Loss of black type/slightly harder
THF	No Action	Loss of black type/slightly harder
Toluene	No Action	Slightly harder
Ethyl Acetate	No Action	No action
N-methylmorpholine	No Action	Loss of color
Petrol	No Action	No action
Acetone	No Action	No action
Methanol	No Action	No action
Dichloromethane	No Action	No action
Triethylamine	No Action	Loss of black type
Chloroform	No Action	No action
Pyridine	No Action	Slight loss of color
Acetyl Chloride	No Action	Slight attack
Sodium Hydroxide	No Action	No action
Dimethylformamide	No Action	Slight attack
Acetonitrile	No Action	Loss of black type
Butyl Ethyl Ether	No Action	Loss of shine on surface
Carbon Tetrachloride	No Action	Loss of black type
Benzene	No Action	No action
Benzyl Bromide	No Action	Pitted the plastic
T-butanol	No Action	No action
Trifluoroacetic Acid	Plastic Attacked	Soup
Formic Acid	No Action	Soup
Dimethyl Sulphoxide	No Action	Hardened Plastic
Acetic Anhydride	No Action	No action
Diglyme	No Action	No action
Trimethylsilyl Chloride	No Action	No action
Styrene	No Action	Hardened Plastic
Methyl Acrylate	No Action	Hardened Plastic
Diisopropylamine	No Action	Hardened Plastic
Nitric Acid (70%)	Eaten Away	Soup
Hydrochloric Acid (35%)	Eaten Away	Soup
Acetic Acid/Hydrogen Bromide	Eaten Away	Soup
Thionyl Chloride	Eaten Away	Not quite soup
Phosgene in Toluene	No Action	Slightly harder plastic
Ammonia (35% Aqueous)	No Action	No action
Hydrogen Peroxide	No Action	Plastic softened

*All chemicals were in contact with the tubing for five days (vapor and liquid)

APPENDIX C

Safety Data Sheets

Safety Data Sheet: Novec 1230

Safety Data Sheet

Document Group:	16-3425-2	**Version Number:**	28.03
Issue Date:	06/06/16	**Supercedes Date:**	11/02/15

SECTION 1: Identification

1.1. Product identifier
3M™ Novec™ 1230 Fire Protection Fluid

Product Identification Numbers

ID Number	UPC	ID NUMBER	UPC
98-0212-3203-2		98-0212-3217-2	0 00 51135 71645 8
98-0212-3414-5			

1.2. Recommended use and restrictions on use

Recommended use
Streaming and Flooding Fire Protection

1.3. Supplier's details

MANUFACTURER:	3M
DIVISION:	Electronics Materials Solutions Division
ADDRESS:	3M Center, St. Paul, MN 55144-1000, USA
Telephone:	1-888-3M HELPS (1-888-364-3577)

1.4. Emergency telephone number
1-800-364-3577 or (651) 737-6501 (24 hours)

SECTION 2: Hazard identification

2.1. Hazard classification
Not classified as hazardous according to OSHA Hazard Communication Standard, 29 CFR 1910.1200.

2.2. Label elements
Signal word
Not applicable.

Symbols
Not applicable.

Pictograms
Not applicable.

2.3. Hazards not otherwise classified
None.

SECTION 3: Composition/information on ingredients

Ingredient	C.A.S. No.	% by Wt
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	756-13-8	>99.5

SECTION 4: First aid measures

4.1. Description of first aid measures

Inhalation:
Remove person to fresh air. If you are concerned, get medical advice.

Skin Contact:
Wash with soap and water. If signs/symptoms develop, get medical attention.

Eye Contact:
Flush with large amounts of water. Remove contact lenses if easy to do. Continue rinsing. If signs/symptoms persist, get medical attention.

If swallowed:
Rinse mouth. If you feel unwell, get medical attention.

4.2. Most important symptoms and effects, both acute and delayed
See Section 11.1. Information on toxicological effects.

4.3. Indication of any immediate medical attention and special treatment required
Not applicable

SECTION 5: Fire-fighting measures

5.1. Suitable extinguishing media
Product is a fire-extinguishing agent. Material will not burn. Use a fire fighting agent suitable for the surrounding fire.

5.2. Special hazards arising from the substance or mixture
Exposure to extreme heat can give rise to thermal decomposition.

Hazardous Decomposition or By-Products

Substance	Condition
Carbon monoxide	During Combustion
Carbon dioxide	During Combustion
Toxic Vapor/Gas	During Combustion

5.3. Special protective actions for fire-fighters
When fire fighting conditions are severe and total thermal decomposition of the product is possible, wear full protective clothing, including helmet, self-contained, positive pressure or pressure demand breathing apparatus, bunker coat and pants, bands around arms, waist and legs, face mask, and protective covering for exposed areas of the head.

SECTION 6: Accidental release measures

6.1. Personal Precautions, protective equipment and emergency procedures
Evacuate area. Ventilate the area with fresh air. For large spill, or spills in confined spaces, provide mechanical ventilation to disperse or exhaust vapors, in accordance with good industrial hygiene practice. Refer to other sections of this SDS for information regarding physical and health hazards, respiratory protection, ventilation, and personal protective equipment.

6.2. Environmental precautions
Avoid release to the environment. For larger spills, cover drains and build dikes to prevent entry into sewer systems or bodies of water.

6.3. Methods and material for containment and cleaning up
Contain spill. Working from around the edges of the spill inward, cover with bentonite, vermiculite, or commercially available inorganic absorbent material. Mix in sufficient absorbent until it appears dry remember, adding an absorbent material does not remove a physical health, or environmental hazard. Collect as much of the spilled material as possible. Place in a closed container approved for transportation by appropriate authorities. Seal the container. Dispose of collected material as soon as possible.

SECTION 7: Handling and storage

7.1. Precautions for safe handling
Contents may be under pressure, open carefully. Do not breathe thermal decomposition products. For industrial or professional use only. Do not use in a confined area with minimal air exchange. Do not eat, drink or smoke when using this product. Wash thoroughly after handling. Avoid release to the environment.

7.2. Conditions for safe storage including any incompatibilities
Protect from sunlight. Store in a well-ventilated place. Store at temperatures not exceeding 38C/100F Store away from strong bases. Store away from other materials. Store away from amines.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Occupational exposure limits
If a component is disclosed in section 3 but does not appear in the table below, an occupational exposure limit is not available for the component.

Ingredient	C.A.S. No.	Agency	Limit type	Additional Comments
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	756-13-8	Manufacturer determined	TWA:150 ppm(1940 mg/m3)	

ACGIH : American Conference of Governmental Industrial Hygienists
AIHA : American Industrial Hygiene Association
CMRG : Chemical Manufacturer's Recommended Guidelines
OSHA : United States Department of Labor – Occupational Safety and Health Administration
TWA : Time-Weighted-Average
STEL : Short Term Exposure Limit
CEIL : Ceiling

8.2. Exposure controls

8.2.1. Engineering controls
Provide appropriate local exhaust when product is heated. For those situation where the material might be exposed to extreme overheating due to misuse or equipment failure, use with appropriate local exhaust ventilation sufficient to maintain levels of thermal decomposition products below their exposure guidelines. Use general dilution ventilation and/or local exhaust ventilation to control airborne exposures to below relevant Exposure Limits and/or control dust/fume/gas/mist/vapors/spray. If ventilation is not adequate, use respiratory protection equipment.

8.2.2. Personal protective equipment (PPE)

Eye/Face protection

Eye protection not required

Skin/hand protection
No protective gloves required.

Respiratory protection

Use a positive pressure supplied-air respirator if there is a potential for over exposure from an uncontrolled release, exposure levels are not known, or under any other circumstances where air-purifying respirators may not provide adequate protection. if thermal degradation products are expected, use a full facepiece supplied-air respirator.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

General Physical Form:	Liquid
Specific Physical Form:	Liquid
Odor, Color, Grade:	Clear colorless liquid with low odor
Odor threshold	*No Data Available*
pH	*Not Applicable*
Melting point	-108 °C
Boiling Point	49 176C [@ 760 mmHg]
Flash Point	No flash point
Evaporation rate	>1 [*Ref Std:* BUOAC=1]
Flammability (solid, gas)	Not Applicable
Flammable Limits(LEL)	None detected
Flammable Limits(UEL)	None detected
Vapor Pressure	40.4 kPa [@25 °C]
Vapor Density	11.6 [*Ref Std:* AIR=1]
Specific Gravity	1.6 [@ 68 °F][*Ref Std:* WATER =1]
Solubility in Water	Nil
Solubility- non-water	*No Data Available*
Partition coefficient: n-octanol/water	*No Data Available*
Autoignition temperature	*Not Applicable*
Decomposition temperature	*No Data Available*
Viscosity	0.6 centipoise [@ 25 °C]
Molecular weight	*No Data Available*
Volatile Organic Compounds	1600 g/l [*Test Method:* calculated SCAQMD rule 443.1]
Percent volatile	100 %
VOC Less H2O & Exempt Solvents	1600 g/l [*Test Method:* calculated SCAQMD rule 443.1]

SECTION 10: Stability and reactivity

10.1. Reactivity
This material may be reactive with certain agents under certain conditions – see the remaining headings in this section.

10.2. Chemical stability
Stable

10.3. Possibility of hazardous reactions
Hazardous polymerization will not occur.

10.4. Eye/Face protection
Light

10.5. Incompatible materials
Strong bases
Amines
Alcohols

10.6. Hazardous decomposition products

Substance	Condition
Hydrogen Fluoride	At Elevated Temperatures – extreme conditions of heat

Refer to section 5.2 for hazardous decomposition products during combustion.

If the product is exposed to extreme condition of heat from misuse or equipment failure, toxic decomposition products that include hydrogen fluoride and perfluoroisobutylene can occur. Extreme heat arising from situations such as misuse or equipment failure can generate hydrogen fluoride as a decomposition product.

SECTION 11: Toxicological Information

The information below may not be consistent with the material classification in Section 2 if specific ingredient classifications are mandated by a competent authority. In addition, toxicological data on ingredients may not be reflected in the material classification and/or the signs and symptoms of exposure, because an ingredient may be present below the threshold for labeling, an ingredient may not be available for exposure, or the data may not be relevant to the material as a whole.

11.1. Information on Toxicological effects

Signs and symptoms of Exposure

Based on test data and/or information on the components, this material may produce the following health effects:

Inhalation:
No known health effects.

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

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

Ingestion:
May be harmful if swallowed.

Toxicological Data:
If a component is disclosed in section 3 but does not appear in a table below, either no data are available for that endpoint or the data are not sufficient for classification.

Acute Toxicity

Name	Route	Species	Value
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Dermal	Rat	LD50>2,000 mg/kg
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Inhalation-Vapor (4 hours)	Rat	LC50>1,227 mg/l

1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Ingestion	Rat	LD50>2,000 mg/kg

ATE – acute toxicity estimate

Skin Corrosion/Irritation

Name	Species	Value
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Rabbit	No significant irritation

Serious Eye Damage/Irritation

Name	Species	Value
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Rabbit	No significant irritation

Skin Sensitization

Name	Species	Value
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Guinea pig	Not sensitizing

Respiratory Sensitization

For the component/components, either no data are currently available or the data are not sufficient for classification.

Germ Cell Mutagenicity

Name	Species	Value
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	In Vitro	Not mutagenic
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	In vivo	Not mutagenic

Carcinogenicity

For the component/components, either no data are currently available or the data are not sufficient for classification.

Reproductive Toxicity

Reproductive and/or Developmental Effects

Name	Route	Value	Species	Test Result	Exposure Duration
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Inhalation	Not toxic to female reproduction	Rat	NOAEL 3,000 ppm	premating & during gestation
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Inhalation	Not toxic to male reproduction	Rat	NOAEL 3,000 ppm	premating & during gestation
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Inhalation	Not toxic to development	Rat	NOAEL 3,000 ppm	premating & during gestation

Target Organ(s)

Specific Target Organ Toxicity – single exposure

Name	Route	Target Organ(s)	Value	Species	Test Result	Exposure Duration
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Inhalation	nervous system	All data are negative	Rat	NOAEL 100,000 ppm	2 hours
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Inhalation	cardiac sensitization	All data are negative	Dog	Sensitization Negative	17 minutes

Specific Target Organ Toxicity – repeated exposure

Name	Route	Target Organ(s)	Value	Species	Test Result	Exposure

						Duration
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Inhalation	liver | kidney and/or bladder	Some positive data exist, but the data are not sufficient for classification	Rat	NOAEL 3,000 ppm	90 days
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Inhalation	heart | endocrine system | hematopoietic system | muscles | nervous system | respiratory system | vascular system	All data are negative	Rat	NOAEL 3,000 ppm	90 days

Aspiration Hazard
For the component/components, either no data are currently available or the data are not sufficient for classification.

Please contact the address or phone number listed on the first page of the SDS for additional toxicological information on this material and/or its components.

SECTION 12: Ecological information

Ecotoxicological information

Test Organism	Test Type	Result
Green algae, Selenastrum capricornutum	72 hours Effect Concentration 50%	7.7 mg/l
Zebra Fish, Brachydanio rerio	96 hours Lethal Concentration 50%	>1200 mg/l
Water flea, Daphnia magna	48 hours Effect Concentration 50%	>1200 mg/l
Green algae, Selenastrum capricornutum	72 hours No obs Effect Conc	1.2 mg/l

Please contact the address or phone number listed on the first page of the SDS for additional Ecotoxicological information on this material
and/or its components.
Chemical fate information

Please contact the address or phone number listed on the first page of the SDS for additional chemical fate information on this material and/or its components.

SECTION 13: Disposal considerations

13.1. Disposal methods
Dispose of contents/ container in accordance with the local/regional/national/international regulations.

Dispose of waster product in a permitted industrial waste facility. As a disposal alternative, incinerate in a permitted waste incineration facility. Proper destruction may require the use of additional fuel during incineration processes. Combustion products will include HF. Facility must be capable of handling halogenated materials.
Empty drums/barrels/containers used for transporting and handling hazardous chemicals (chemical substances/mixtures/preparations classified as Hazardous as per applicable regulations) shall be considered, stored, treated & disposed of as hazardous wastes unless otherwise defined by applicable waste regulations. Consult with the respective regulating authorities to determine the available treatment and disposal facilities.

EPA Hazardous Waste Number (RCRA): Not regulated

SECTION 14: Transport Information

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

SECTION 15: Regulatory information

15.1. US Federal Regulations
Contact 3M for more information.

15.2. State Regulations

Fire Hazard – No Pressure Hazard – No Reactivity Hazard – No Immediate Hazard – No Delayed Hazard – No

15.3. Chemical Inventories
The components of this product are in compliance with the new substance notification requirements of CEPA.

The components of this material are in compliance with the China "Measures on Environmental Management of New Chemical Substance". Certain restrictions may apply. Contact the selling division for additional information.

The components of this material are in compliance with the provisions of the Korean Toxic Chemical Control Law. Certain restrictions may apply. Contact the selling division for additional information.

The components of this material are in compliance with the provisions of Japan Chemical Substance Control Law. Certain restrictions may apply. Concoct the selling division for additional information.

The components of this material are in compliance with the provision of Philippines RA 6969 requirements. Certain restrictions may apply. Contact the selling division for additional information.

The components of this product are in compliance with the chemical notification requirements of TSCA.

Contact 3M for more information.

15.4. International Regulations
Contact 3M for more information.

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

SECTION 16: Other information

NFPA Hazard Classification
Health: 3 **Flammability:** 0 **Instability:** 1 **Special Hazards:** None

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

HMIS Hazard Classification
Health: 1 **Flammability:** 0 **Physical Hazard:** 1 **Personal Protection:** X – See PPE section.

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

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Conversion to GHS format SDS.

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Safety Data Sheet: Nitrogen

PRAXAIR
Making our planet more productive

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	N2
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

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 labeling

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-PG00 - 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

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.

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

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/m³
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.

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.

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

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

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.

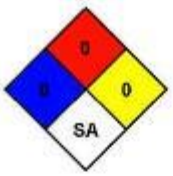
Praxair SDSs are furnished on sale or delivery by Praxair or the independent distributors and suppliers who package and sell our products. To obtain current SDSs for these products, contact your Praxair sales representative, local distributor, or supplier, or download from www.praxair.com. If you have questions regarding Praxair SDSs, would like the document number and date of the latest SDS, or would like the names of the Praxair suppliers in your area, phone or write the Praxair Call Center (Phone: 1-800-PRAXAIR/1-800-772-9247; Address: Praxair Call Center, Praxair, Inc., P.O. Box 44, Tonawanda, NY 14151-0044).

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.