# DESIGN, INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

## FOR

## PRE-ENGINEERED AUTOMATIC DIRECT LOW PRESSURE CLEAN AGENT EXTINGUISHER UNIT

DESIGNED FOR USE WITH:

**FK-5-1-12 FIRE PROTECTION AGENT**

**CE Systems:**

**898001 CYLINDER ASSEMBLY, CE, DLP, FK-5-1-12, 1KG**
**898002 CYLINDER ASSEMBLY, CE, DLP, FK-5-1-12, 2KG**
**898003 CYLINDER ASSEMBLY, CE, DLP, FK-5-1-12, 5KG**

**DOT Systems:**

**920205 CYLINDER ASSEMBLY, DOT, DLP, FK-5-1-12, 2.5LB**
**920505 CYLINDER ASSEMBLY, DOT, DLP, FK-5-1-12, 5LB**
**921005 CYLINDER ASSEMBLY, DOT, DLP, FK-5-1-12, 10LB**

**Document Number: 800035 (DIOM, DLP, FK-5-1-12, LPCB)**

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# 1 FOREWORD

This manual is written for authorized fire protection professionals that install and maintain Firetrace Pre-Engineered DLP (Direct Low Pressure) Automatic Suppression Units with FK-5-1-12 Fire Protection Fluid. It is intended to communicate details and procedures required for proper design, installation, operation, and maintenance.

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

Firetrace Pre-Engineered Automatic Direct Clean Agent Extinguisher Units with FK-5-1-12 Fire Protection Fluid are to be designed, installed, inspected, tested, maintained, and recharged by qualified trained personnel in accordance with the following:

- All instructions, limitations, etc. contained in this manual, P/N 800035
- All information contained on the agent cylinder nameplate(s)
- Applicable parts of NFPA 2001, Standard on Clean Agent Fire Extinguishing Systems
- LPCB (Cert. No. 1400) according to LPS 1666
- Local authority having Jurisdiction (AHJ)

## 1.1 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 can cause property damage, bodily injury, or death. Always wear safety glasses and make sure the discharge port safety plug(s), cap(s), or anti-recoil device(s) are properly in place before system 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.

## 1.2 Safety Precautions

**WARNING**

***Pressurized (charged) cylinders are extremely hazardous and if not handled properly can cause property damage, bodily injury, or death. Always wear safety glasses and make sure the discharge port safety plug(s), cap(s), or anti-recoil device(s) are properly in place before system installation, servicing, or other general handling.***

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 if FK-5-1-12 is accidentally discharged on or near the skin.
3. Make sure that the ball valve (attached to the top of the cylinder valve) is closed (lever is in "OFF" position), the detection tubing has been removed from the cylinder valve and the safety caps installed **before removing** the cylinder from the installation and before performing any charging, leak tests or salvage operations.
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.

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

**Firetrace International, LLC**
**8435 N. 90TH St, Suite 2**
**Scottsdale, AZ 85258 USA**

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# 2 GENERAL INFORMATION

The Firetrace Pre-Engineered Direct Low Pressure (DLP) FK-5-1-12 Clean Agent Automatic Fire Extinguisher Unit is approved for use in Red Book Live by the Loss Prevention Certification Board. These Units are designed to be used in a total flooding application using FK-5-1-12 Clean Agent in accordance with NFPA 2001 (Standard on Clean Agent Fire Extinguishing Systems), and the limitations outlined in the manual.

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.

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.

## 2.1 Fire Suppression Agent

The suppression agent used in Firetrace self-contained automatic DLP fire suppression systems is dodecafluoro-2-methylpentan-3-one known as FK-5-1-12 which has been reviewed & tested by Firetrace.

FK-5-1-12, depicted by the chemical formula $CF_3CF_2C(O)CF(CF_3)_2$, is a colorless low odor fluid, low in toxicity, electrically non-conductive, and leaves no residue. It is a clean and effective fire suppression agent that can be used on type A, B, and C fires.

FK-5-1-12 is included in NFPA 2001 and has been evaluated and approved for use in occupied areas as a Total Flooding agent, when used as specified under the U.S. Environmental Protection Agency (EPA) SNAP Program rules. Refer to the SNAP Program rules for more information.

### 2.1.1 Cleanliness

FK-5-1-12 is clean and leaves no residue, thereby minimizing clean up after discharge along with keeping expensive downtime to a minimum.

Additionally, FK-5-1-12 is non-corrosive, therefore sensitive electronics, and materials such as steel, aluminum, stainless steel, brass, plastics, and rubber are not affected by exposure to FK-5-1-12. This agent is also environmentally friendly, having an ozone depletion potential (ODP) of 0.00 and an atmospheric lifetime of 5 days (the closest halocarbon alternative is 33 years).

### 2.1.2 Thermal Decomposition Products

Hazardous Decomposition or By-Products:

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

### 2.1.3 Properties of FK-5-1-12

For hazard information, decomposition information, and physical properties of FK-5-1-12 agents, please refer to the Safety Data Sheet located in **APPENDIX D – H**.

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# 3 SYSTEM DESCRIPTION

## 3.1 General

The Firetrace Pre-Engineered Automatic Direct Low Pressure (DLP) Clean Agent Extinguisher Systems with FK-5-1-12 Clean Agent noted in this manual include:

- CE Systems:
  - 898001 CYLINDER ASSEMBLY, CE, DLP, FK-5-1-12, 1KG
  - 898002 CYLINDER ASSEMBLY, CE, DLP, FK-5-1-12, 2KG
  - 898003 CYLINDER ASSEMBLY, CE, DLP, FK-5-1-12, 5KG
- DOT Systems:
  - 920205 CYLINDER ASSEMBLY, DOT, DLP, FK-5-1-12, 2.5LB
  - 920505 CYLINDER ASSEMBLY, DOT, DLP, FK-5-1-12, 5LB
  - 921005 CYLINDER ASSEMBLY, DOT, DLP, FK-5-1-12, 10LB

These units are designed for use in total flooding only, where the hazard is normally unoccupied. FK-5-1-12 is a gaseous fire-suppression agent that is effective for use on:

- Class A – Ordinary Combustibles surface fires
- Class B – Flammable liquid fires
- Class C (Class E for Europe) – Electrical equipment fires

**FK-5-1-12 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 Low Pressure (DLP) 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 (AHJ) 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 Low Pressure (DLP) Clean Agent Extinguisher Systems with FK-5-1-12 Clean Agent consists of the following major components:

- Cylinder/Valve assembly
- Cylinder Mounting Bracket
- Firetrace Detection Tubing (FDT) & fittings (No substitute)
- Pressure Switch

Once installed, the Firetrace Pre-Engineered Automatic Direct Low Pressure (DLP) 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 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 pseudo-discharge nozzle at the rupture point, allowing the FK-5-1-12 clean agent to flow through, distributing the agent through the burst hole 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.

## 3.2 Component Descriptions

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

### 3.2.1 FK-5-1-12 Cylinders

FK-5-1-12 is stored in steel cylinders pressurized with nitrogen to 195 psig at 70°F (13.4 bar at 21°C). Table 1 describes the 2.5, 5, and 10 lb for DOT system assemblies. Table 2 describes the 1, 2, and 5 kg for CE system assemblies. Each cylinder is equipped with a nickel-plated brass valve assembly, 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 for the unit to only be mounted in a vertical (upright) position.

| DOT Cylinder Part No. | Nominal Capacity | Volume | | Cylinder Specification | Cylinder Service Pressure | | Cylinder Test Pressure | |
|---|---|---|---|---|---|---|---|---|
| | | in³ | cm³ | | psig | kPa | psig | kPa |
| 100301 | 2.5 lb | 75 | 1229 | DOT 4B240 | 240 | 1,655 | 480 | 3,310 |
| 100601 | 5 lb | 145 | 2376 | DOT 4B240 | 240 | 1,655 | 480 | 3,310 |
| 101201 | 10 lb | 300 | 4,916 | DOT 4B360 | 360 | 2,482 | 720 | 4,964 |

*Table 1 - FK-5-1-12 DOT Cylinder Specifications*

| CE Cylinder Part No. | Nominal Capacity | Volume | | Cylinder Specification | Cylinder Service Pressure | | Cylinder Test Pressure | |
|---|---|---|---|---|---|---|---|---|
| | | in³ | L | | psig | kPa | psig | kPa |
| 810100 | 1 kg | 85.4 | 1.4 | PED 2014/68/EU | 273 | 1,882 | 392 | 2,703 |
| 810200 | 2 kg | 135.4 | 2.2 | PED 2014/68/EU | 273 | 1,882 | 392 | 2,703 |
| 810500 | 5 kg | 305.1 | 5 | PED 2014/68/EU | 290 | 1,999 | 435 | 2,999 |

*Table 2 - FK-5-1-12 CE Cylinder Specifications*


*Figure 1 – DOT Unit Assembly*

| Unit Assembly Part No. | Cylinder Part No. | Agent | | Dimension "A" | | Dimension "B" | | Dimension "C" | |
|---|---|---|---|---|---|---|---|---|---|
| | | lb | kg | in | cm | in | cm | in | cm |
| 920205 | 100301 | 2.5 | 1.13 | 15.7 | 39.8 | 13.3 | 33.8 | 3.4 | 8.6 |
| 920505 | 100601 | 5.0 | 2.27 | 15.3 | 38.9 | 13 | 33 | 4.4 | 10.9 |
| 921005 | 101201 | 10.0 | 4.54 | 15.5 | 39.4 | 13.2 | 33.5 | 8.2 | 20.8 |

*Table 3 – DOT Unit Assembly Dimensions*

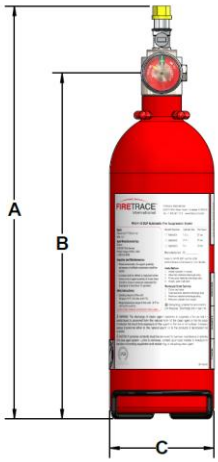



*Figure 2 – CE Unit Assembly*

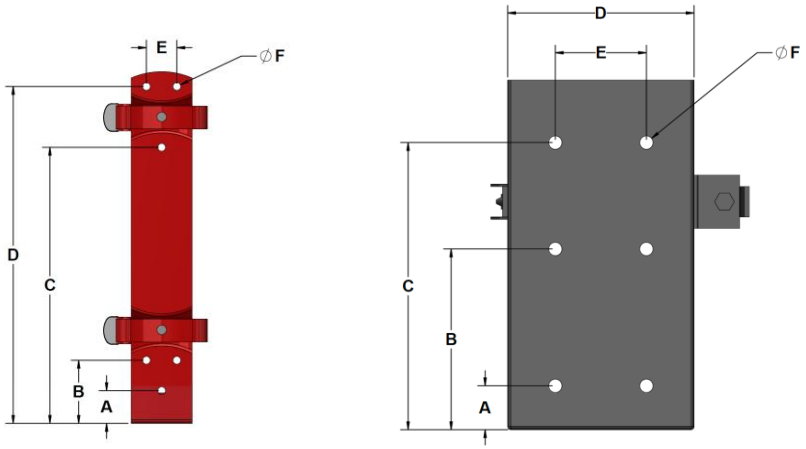
| Unit Assembly Part No. | Cylinder Part No. | Agent | | Dimension "A" | | Dimension "B" | | Dimension "C" | |
|---|---|---|---|---|---|---|---|---|---|
| | | kg | lb | in | cm | in | cm | in | cm |
| 898001 | 810100 | 1.0 | 2.2 | 14.1 | 35.8 | 11.8 | 30 | 3.5 | 8.9 |
| 898002 | 810200 | 2.0 | 4.4 | 15.4 | 39.1 | 13.1 | 33.3 | 4.3 | 10.9 |
| 898003 | 810500 | 5.0 | 11.0 | 16.2 | 41.1 | 13.9 | 35.3 | 8.5 | 21.6 |

*Table 4 – CE Unit Assembly Dimensions*

### 3.2.2 Cylinder Mounting Brackets

The cylinder mounting brackets are manufactured from steel with a primed and powder coated paint finish. Each cylinder mounting bracket is designed to fit properly around the cylinder. The cylinder mounting bracket is equipped with finger tabs which allow easy access. The cylinder mounting bracket must be secured to a surface appropriate for retaining the weight of the cylinder in the event of a discharge. This precaution is intended to safely support the weight of the cylinder and the reaction force of the FK-5-1-12 discharge.

All cylinders must be mounted vertically only, with the valve on top. Please refer to Figure 3: DOT Cylinder Mounting Bracket, Figure 4: CE Cylinder Mounting Bracket, Table 5: DOT Cylinder Mounting Bracket Dimensions, and Table 6: CE Cylinder Mounting Bracket Dimensions.

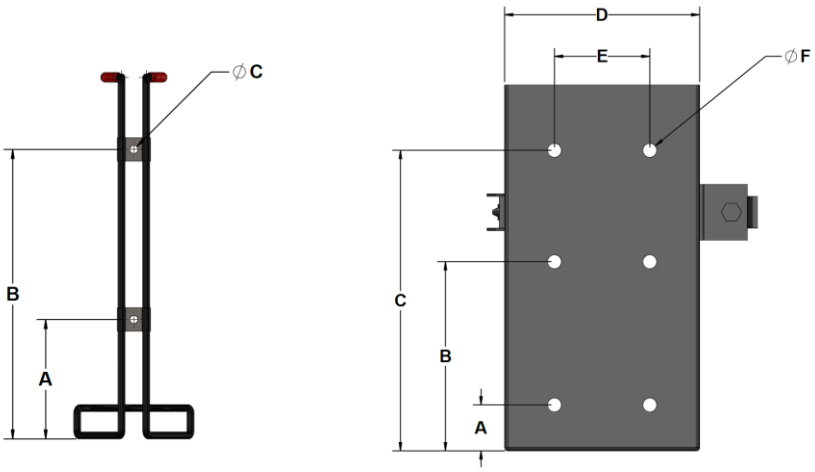



**(P/N: 100003 / 100006)** **(P/N: 111206)**

*Figure 3 – DOT Cylinder Mounting Bracket*

| DOT System | Bracket | "A" | | "B" | | "C" | | "D" | | "E" | | "F" | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | in | cm | in | cm | in | cm | in | cm | in | cm | in | cm |
| 920205 | 100003 | 1.0 | 2.5 | 2.0 | 5.08 | 9.0 | 22.9 | 11.0 | 28.0 | 1.0 | 1.3 | 1/4 | 0.63 |
| 920505 | 100006 | 1.0 | 2.5 | 2.0 | 5.08 | 9.0 | 22.9 | 11.0 | 28.0 | 1.0 | 1.3 | 1/4 | 0.63 |
| 921005 | 111206 | 1.4 | 3.6 | 5.9 | 15.1 | 9.4 | 23.9 | 6.13 | 15.6 | 3 | 7.6 | 7/16 | 1.1 |

*Table 5 – DOT Cylinder Mounting Bracket Dimensions*




**(P/N: 810101 / 810202)** **(P/N: 111206)**

*Figure 4 – CE Cylinder Mounting Bracket*

| CE System | Bracket | "A" | | "B" | | "C" | | "D" | | "E" | | "F" | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | in | cm | in | cm | in | cm | in | cm | in | cm | in | cm |
| 898001 | 810101 | 3.3 | 8.4 | 8.2 | 20.8 | 0.25 | 0.64 | | | | | | |
| 898002 | 810202 | 2.7 | 6.8 | 9.4 | 23.8 | 0.25 | 0.64 | | | | | | |
| 898003 | 111206 | 1.4 | 3.6 | 5.9 | 15.1 | 9.4 | 23.9 | 6.13 | 15.6 | 3 | 7.6 | 7/16 | 1.1 |

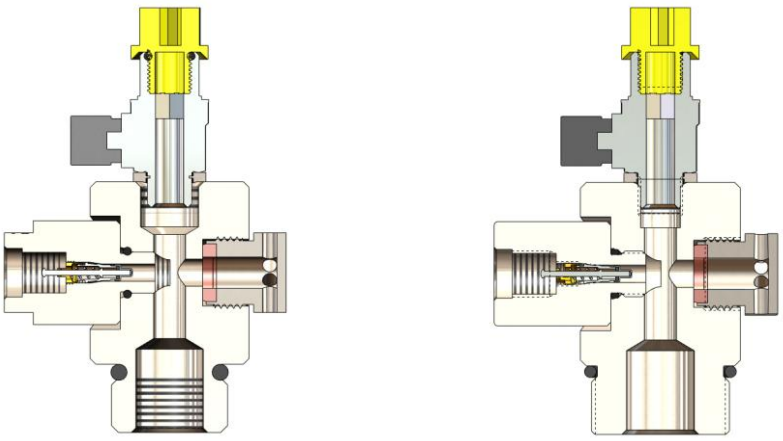
*Table 6 – CE Cylinder Mounting Bracket Dimensions*

### 3.2.3 Cylinder Valves

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

These Cylinder Valves may also be equipped with a Pressure Operated Switch for both DOT and CE Cylinder Valve Assemblies. The valve mounted pressure operated switch is an optional part of the unit assembly. It is factory installed into the pressure switch port of the cylinder valve. The valve mounted pressure switch is used to notify when there is change in unit pressure, unit actuation, or it can be used to energize or de-energize electrically operated equipment.

All **DOT** unit assembly are equipped with a DLP valve **(300109)**
All **CE** unit assembly are equipped with a DLP valve **(831211)**



**DOT Valve (300109)** **CE Valve (831211)**

*Figure 5* – Cylinder Valves

**NOTE: All Firetrace FK-5-1-12 DLP Units utilize a straight siphon tube and must be installed only in a vertical (valve on top) position.**

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

### 3.2.4 Firetrace Detection Tubing

The Firetrace Detection Tubing (FDT) is a UL recognized component per UL standard 521. The FDT is a linear, pneumatic fire detection device that responds to a combination of the heat and radiant energy from a fire. It is installed throughout the hazard volume with one end connected to the top of the cylinder valve and opposite end connected to an End of Line fitting, then pressurized with nitrogen to 195 psig.

The 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 portion of the tubing nearest the fire ruptures. The rupture of the tubing releases the nitrogen pressure causing the unit to actuate, resulting in a formation of a pseudo-discharge nozzle to perform a complete discharge of the FK-5-1-12 clean agent. For additional information on tubing properties and material compatibility, please see Table 7 – Firetrace Detection Tubing Properties and **APPENDIX B.**

| | | |
|---|---|---|
| **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) |

*Table 7 – Firetrace Detection Tubing Properties*

### 3.2.5 Filling Adapter (P/N 900007)

The filling adapter 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.

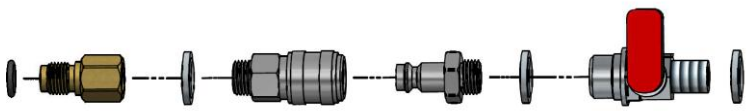


*Figure 6 – Firetrace* Filling Adapter

### 3.2.6 Firetrace Detection Tubing Fittings

The fittings specified in this DIOM manual are the only accepted fittings to be used on the FDT.

| ITEM | P/N | DESCRIPTION |
|---|---|---|
| NP | 200152 | Rubber Grommets (Qty. 2) |
| NP | 200153 | Plastic Grommets (Qty. 2) |
| NP | 200172 | Mounting Tabs (4/6) (Qty. 12) |
| NP | 200182 | 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 Discharge Switch with O-Ring & Washer |
| NP | 900007 | Filling Adapter |
| NP PARTS NOT PICTURED | | |

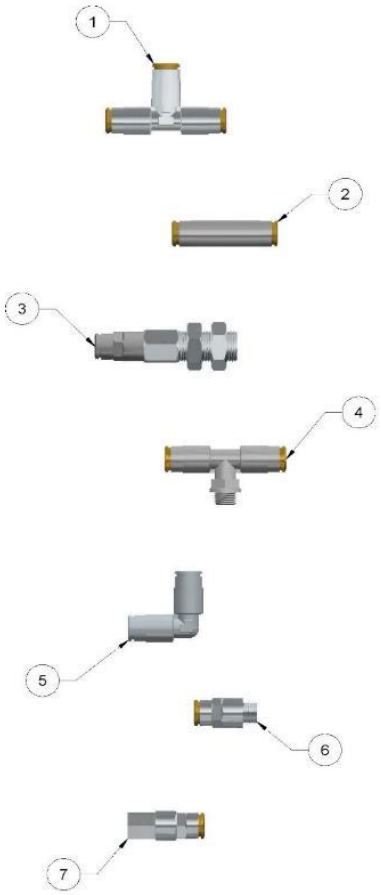



*Table 8 – Tube Fittings*

### 3.2.7 Firetrace FK-5-1-12 Pressure Gauge (P/N 400195)

The Firetrace FK-5-1-12 pressure gauge is used as part of the cylinder valve pressure gauge or End of Line mounted pressure gauge. This pressure gauge is supplied with an O-ring installed and has a M10x1 thread to allow for installation where a Schrader core is present. This enables the pressure gauge to be field serviceable in all the above applications (cylinder valve and End of Line mounted locations).

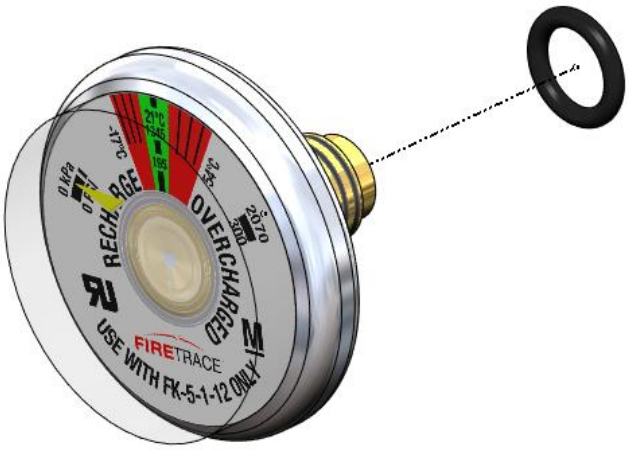



*Figure 7 – FK-5-1-12 Pressure Gauge*

## 3.3 Pressure Switch

**CAUTION**

***Never use the pressure switch as a handle to transport the unit. Doing so can result in pressure leakage, damage to the pressure switch, and/or system discharge.***

**CAUTION**

***Pressure Switches are NOT Serviceable while System is Pressurized***

### 3.3.1 Pressure Supervisory Switch (P/N 400150)

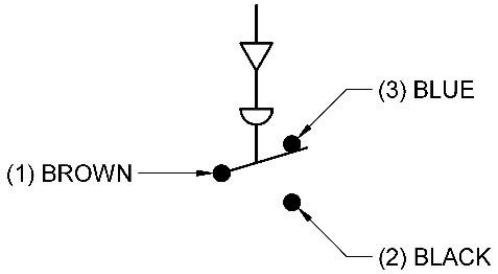
The pressure supervisory switch is used to monitor the pressure inside the unit cylinder. If the unit loses pressure and reaches a pressure of 150 ± 10 psig [10.34 ± 0.7 bar] or below, the switch contacts will activate, providing a signal to indicate that the unit has lost pressure.

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.

### 3.3.2 Pressure Operated Switch (P/N 400005)

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

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




SHOWN AT ATMOSPHERE

*Figure 8 – Pressure Switch Wiring Schematic*

| Operating Parameters | Pressure Supervisory Switch P/N 400150 | Pressure Operated Switch P/N 400005 | |
|---|---|---|---|
| Electrical Rating | 36 VDC – 6 AMP<br>240 VAC – 3 AMP | 28 VDC – 15 AMP | |
| | | NO:<br>120 VAC – 10 AMP<br>240 VAC – 5 AMP | NC:<br>120 VAC – 25 AMP<br>240 VAC – 25 AMP |
| Temperature Range | -5 °F to 175 °F<br>[-20.6 °C to 79.4 °C] | -20 °F to 150 °F<br>[-28.9 °C to 65.6 °C] | |

*Table 9 – Pressure Switch Properties*

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

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

### 3.3.2.1 Valve Mounted Pressure Switch

The valve mounted pressure switch is an optional part of the unit assembly. It is factory installed into the pressure switch port of the cylinder valve. The valve mounted pressure switch is used to notify unit actuation, or it can be used to energize or de-energize electrically operated equipment. If the unit to which the pressure switch is attached to loses pressure and reaches a pressure of 70 ± 10 psig [4.83 ± 0.7 bar] or below, the switch contacts will operate. Refer to Figure 9: Valve Mounted Pressure Switch, Figure 8: Pressure Switch Wiring Schematic, and Table 10: Pressure Switch Properties for additional information.

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

*Figure 9 – Valve Mounted Pressure Switch*

### 3.3.2.2 End of Line Pressure Switch

The end of line pressure switch assembly (400004) is available as an optional part for the system detection network. The thread on the end of the pressure switch allows for easy installation into the threads of the end of line adapter. The provided washer (400003) included in this assembly, ensures that the pressure switch will fully depress the Schrader core installed within the end of line adapter. The provided O-ring ensures that there will be an adequate seal between the pressure switch and the end of line adapter.

The pressure operated switch is available as an optional part for the DOT system detection line. The End of Line 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 or de-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 [4.83 ± 0.7 bar] or below, the switch contacts will activate, providing a signal to indicate that the unit has been activated. Refer to Figure 10: End of Line Pressure Switch with Washer, and Figure 8: Pressure Switch Wiring Schematic.

*Figure 10 – End of Line Pressure Switch with Washer (400004)*

| Pressure Switch Assembly Part Number | Pressure Switch Component Part Number | Description |
|---|---|---|
| 400004 | 400002 | O-Ring M10x1 |
| | 400003 | Pressure Switch Washer |
| | 400005 | Pressure Switch (70PSI Falling) |

*Table 10 – End of Line Pressure Switch Part Number*

**NOTE: Extended discharge is to be expected due to the nature of the Firetrace Pre-Engineered Automatic Direct Low Pressure (DLP) Clean Agent Extinguisher System. Pressure within the system can slowly drop, which could provide a delay in the actuation of the pressure switch due to this extended discharge. The pressure switch shall be installed as part of the detection line, at the end of the detection network.**

# 4 SYSTEM DESIGN AND LIMITATIONS

## 4.1 General

The Firetrace pre-engineered Direct Low Pressure (DLP) FK-5-1-12 Clean Agent Automatic Fire Extinguisher Unit is Red Book approved by the Loss Prevention Certification Board. These units are designed to be used in a Total Flooding application using FK-5-1-12 Clean Agent in accordance with NFPA 2001 (Standard on Clean Agent Fire Extinguishing Systems).

The Self-Contained Automatic DLP 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.

The Firetrace Pre-Engineered Automatic Direct Low Pressure (DLP) 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

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

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

## 4.2 Specifications

### 4.2.1 Storage and Operating Temperature Range

The Firetrace Pre-Engineered Automatic Direct Low Pressure (DLP) Clean Agent Extinguisher Systems with FK-5-1-12 Clean Agent 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)

### 4.2.2 System Operating Pressure

The nominal operating pressure for the unit is 195 psig at 70 °F [13.5 bar at 21.1 °C]. The Firetrace Pre-Engineered Automatic Direct FK-5-1-12 Clean Agent Extinguishing Units are designed for an operating temperature range of -4 °F to 140 °F [-20 °C to 60 °C]. Table 111 – 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].

| 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 |

*Table 111 – Cylinder Pressure-Temperature Relationship*

## 4.3 Design Procedure

**NOTE: As cautioned in Section 2 of this Manual, only one (1) extinguisher unit may be used to protect one (1) hazard.**

The following procedures should be used to design a Firetrace Pre-Engineered Automatic Direct FK-5-1-12 Clean Agent Extinguisher Unit. In addition, the applicable requirements specified in Chapter 5 of NFPA 2001 should be followed:

**a.** Conduct a survey and analysis of the hazard to be protected.
**b.** Determine the height, length, and width of the enclosure. Calculate the volume. All of these parameters must be within the dimensional limits specified in this Manual.
**c.** Determine the anticipated minimum and maximum ambient temperatures expected within the enclosure to be protected. (These must be within the recommended minimum and maximum service temperatures of the system.)
**d.** Determine the minimum design concentration required for the hazard.
**e.** Determine the integrity of the enclosure and if any openings must be closed at the time of agent discharge.
**f.** Determine the cylinder size required based on the hazard volume limitations and enclosure size.
**g.** Based on the total quantity of agent being used at the maximum ambient temperature expected within the enclosure, evaluate personnel safety exposure limits.
**h.** Determine the location of the FK-5-1-12 cylinder.
**i.** Determine the arrangement and placement of the Firetrace Detection Tubing (FDT).
**j.** Determine any auxiliary equipment requirements such as a pressure switch(es) to sound alarms, shut down ventilation, shut off electrical power, etc.
**k.** Prepare system drawings, bill of materials list, etc.; following the applicable sections of Chapter 5 of NFPA 2001, as needed.

## 4.4 Hazard Enclosure 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 **32.8ft [10 m]** from the container outlet to the end of any single detection tube run.

**NOTE: 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 $m^3$.**

### 4.4.1 Enclosure Volume Limitations

The Firetrace Pre-Engineered Automatic Direct FK-5-1-12 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 15** below lists the maximum enclosure volume for each unit size.

| Region | Model Number | Agent Amount | Maximum Enclosure Volume | Maximum Enclosure Height |
|---|---|---|---|---|
| DOT / CE | 920205 / 898001 | 2.5 lb [1 kg] | 35.31 ft³ [1 m³] | 12 ft [3.65 m] |
| | 920505 / 898002 | 5 lb [2 kg] | 70.63 ft³ [2 m³] | |
| | 921005 / 898003 | 10 lb [5 kg] | 70.63 ft³ [2 m³] | |

*Table 12 – Maximum Enclosure Volume Limitations*

### 4.4.2 Ventilation and Unclosable Openings

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

All doors should be closed and ventilation fans shut down prior to discharge. 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.

### 4.4.3 Pressure Relief Vent Area

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

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

### 4.4.4 Fire Detection Tubing Limitations

The Firetrace Pre-Engineered Automatic Direct FK-5-1-12 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.

| Description | Limitation | |
|---|---|---|
| Maximum Tube Run length | 32.8 ft | 10 m |
| Maximum Height between Layers | 1.64 ft | 0.5 m |
| Maximum Distance between Passes | 10.22 in | 25.96 cm |
| Maximum Distance from Wall | 5.11 in | 12.98 cm |
| Minimum Bend Radius | 6 in | 15.24 cm |
| Maximum Activation Height | 3.94 in | 10 cm |

*Table 13 – Firetrace Detection Tubing Configuration Limitations*

The location of the Firetrace detection tubing is critical to the response time in the event of a fire. The Firetrace Detection Tubing should be installed throughout the enclosure and routed in close proximity to all potential fire sources. The detection tubing should not be placed horizontally adjacent to a potential fire source. See Figure 14 and Table 17 for an example of a system configuration.

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 Maximum Activation Height (MAH) is 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.

### 4.4.4.1 Tubing Limitations Example

An example of a system configuration is shown below:

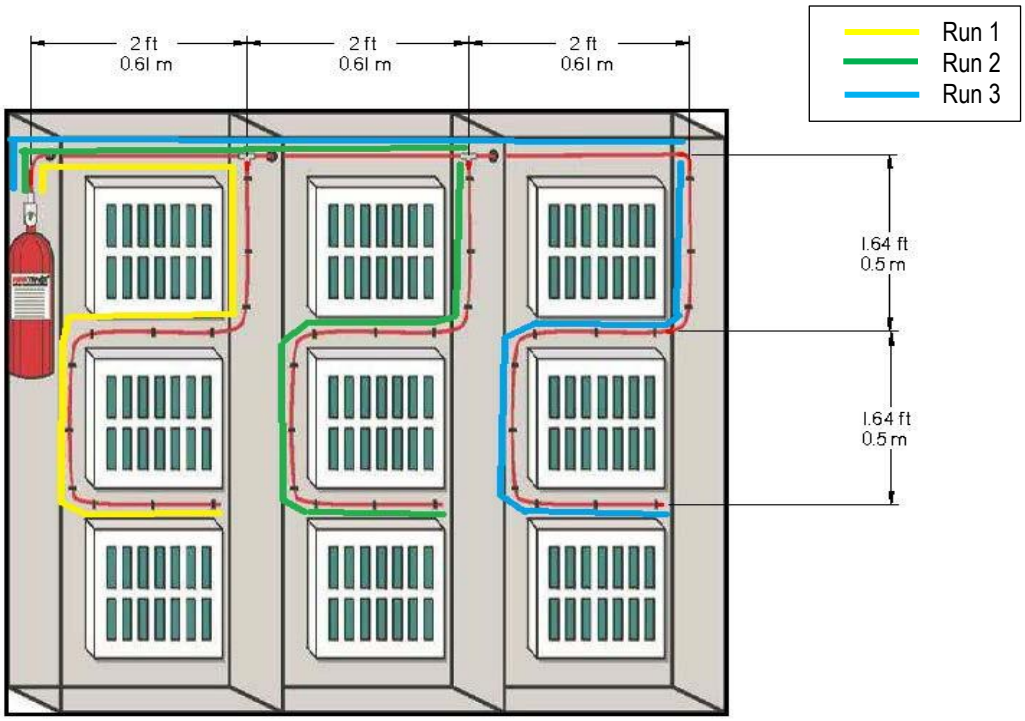



*Figure 11 – Example System Configuration*

The tubing is installed in three different runs in order to protect the segmented sections within the enclosure. Each tubing run is less than the maximum tube run length of 32.8 ft [10 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].

| Tubing Run | Total Length | |
|---|---|---|
| Run 1 | 9.28 ft | 2.83 m |
| Run 2 | 11.28 ft | 3.44 m |
| Run 3 | 13.28 ft | 4.05 m |

*Table 14 – Example System Configuration*

**⚠ CAUTION**

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

# 5 INSTALLATION INSTRUCTIONS

## 5.1 General

Firetrace Pre-Engineered Automatic Direct FK-5-1-12 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. This section provides installation instructions covering components and limitations described in Section 3 and Section 4 of this Manual.

## 5.2 FK-5-1-12 Cylinder/Valve and Bracket 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.

**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.***

**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**

***Never handle the systems by the pressure switches or pressure gauges during transportation of the unit. Doing so can result in damage to the pressure switch, leakage to the unit, and/or unit discharge.***

**WARNING**

***Pressurized (charged) cylinders are extremely hazardous and if not handled properly can cause property damage, bodily injury, or death. Always wear safety glasses and make sure the discharge port ball valve is in the close/disarmed position and any safety/shipping plug(s) are properly in place before system installation, servicing, or other general handling.***

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.

## 5.3 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 and NFPA 2001.

### 5.3.1 Firetrace Detection Tubing

**CAUTION**

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

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 rubber hosing or plastic corrugated wire loom 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.

### 5.3.2 Firetrace Tubing Cutter (P/N 600210)

The Firetrace Tubing Cutter is used to ensure that the Firetrace Detection Tubing is cut with a square, clean finish, free of debris.

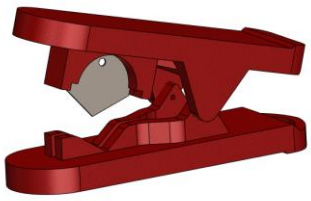


*Figure 12 – Firetrace Tubing Cutter*

### 5.3.3 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.**

### 5.3.4 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 5.3.3.**

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

#### 5.3.4.1 Pressure Gauge: (P/N 400195):

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.

#### 5.3.4.2 Pressure Operated Switch (P/N 400005):

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.

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

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

**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.**

#### 5.3.4.4 Nitrogen Charge Kit - FDT Charging (P/N 600213):

The FDT Nitrogen charge kit contains:

- Regulator (910550)
- 2x nitrogen cylinders (600214 quantity of two cylinders included in this part number)
- Nitrogen charge adapter to fit into EOL fitting (910600)
- Hard case with foam inserts

The FDT network must have an EOL fitting such as EOL (200168), a pressure switch module with EOL gauge fitting that can be used for charging the FDT network.

Using the nitrogen charge kit, to pressurize the FDT network follow the steps outlined here:

- Ensure the FDT network is complete (all terminations present – a closed loop)
- Prepare the EOL for installing the charging adapter (910600) by removing the component installed in the EOL position
- Ensure the ball valve is closed on the nitrogen regulator (910550)
- Install a nitrogen cylinder (600214) to the regulator (910550)
- Install the nitrogen charge adapter (910600) into the EOL fitting of the FDT network, ensuring the O-ring is in position, and the adapter fully engages with the Schrader core inside the EOL fitting
- Connect the regulator outlet (910550) quick disconnect into the installed charge adapter (910600) fitting
- Open the ball valve on the regulator (910550) to start the flow of nitrogen into the FDT network

Charging of the FDT network should only take a few seconds at the most. When the valve is first opened on the regulator, there will be an audible flow of nitrogen briefly – if you can hear nitrogen discharging from the FDT network at any point, close the regulator ball valve and check the FDT network for leaks or missing terminations.

Once the FDT network is charged, remove the regulator by pulling the quick disconnect fitting away from the regulator, releasing the charge adapter fitting.

Remove the nitrogen charge adapter fitting from the EOL fitting, the Schrader core will engage and keep the FDT network pressurized – there will be an audible pop as the O-ring seal of the nitrogen charge adapter is removed from the EOL fitting.

Perform a leak check of the FDT network once pressurized.

Install the fitting previously removed from the EOL fitting in order to seal the termination. EOL fittings should not be left with no fittings installed, as the Schrader core is not designed to be a permanent seal on its own.

Locate the pressure gauge on the FDT network and monitor the pressure for a minimum of 30 minutes, if no pressure drop is noted, proceed with the commissioning of the system.

If a decrease in pressure is noted, repeat the FDT leakage check using a leak indicator solution.
The following accessories will connect to an End of Line (EOL) Adapter. The EOL Adapter can be installed by following the appropriate procedures in **Section 5.3.3.**

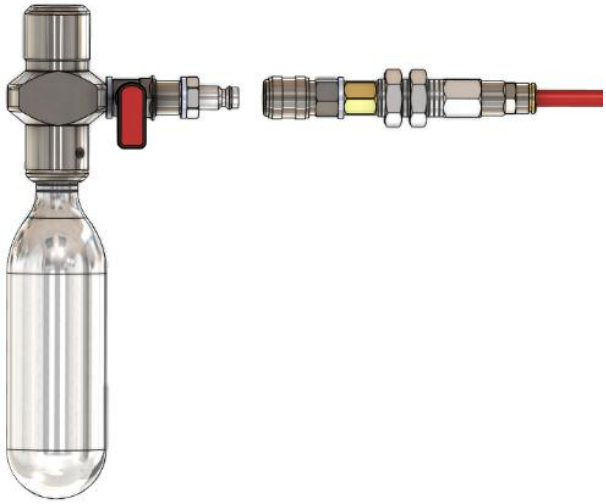


*Figure 13 – Firetrace Nitrogen Charge Kit 600213*

## 5.4 System Activation

**CAUTION**

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

1. Ensure the detection tubing, fittings, and accessories are installed according the procedures specified in **Section 5.3.3** and **Section 5.3.4** 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 (P/N 600213).
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 5.3.4.4** 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 5.3.4.**
   a. Check pressure switch connection for bubble leaks using soapy water solution.
   b. Ensure proper electrical connections are made to notify 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 notify 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.**

# 6 SERVICE AND MAINTENANCE INSTRUCTIONS

**WARNING**

***FK-5-1-12 cylinder/valve assemblies must be handled, installed, inspected, and serviced only by qualified and trained personnel in accordance with the instructions contained in this Manual, the cylinder nameplate, NFPA 2001, and any other regulations and codes that may apply.***

***Before performing maintenance or refilling procedures refer to the safety data sheets in Appendix C.***

**WARNING**

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

## 6.1 General

A regular program of systematic maintenance must be established for continuous, proper operation of all Firetrace Suppression 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.

The following includes the Firetrace recommendations for service and inspection of fire suppression systems. Local Authorities Having Jurisdiction (AHJ) may have additional service and maintenance requirements based on local codes and/or regulations. The requirements of the local AHJ must be followed.

**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.**

## 6.2 Periodic Service and Maintenance Procedures

### 6.2.1 Monthly Inspection

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

1. The Suppression Unit is in its proper location.
2. The Tamper Indicator is intact.
3. The Maintenance Tag or Certificate is in place and legible.
4. The Suppression Unit shows no physical damage or degradation that might prevent operation such as:
    i. Cuts or abrasions to the Firetrace Detection Tubing
    ii. Color distortion of the FDT or suppression unit
    iii. Dirt accumulation along the FDT
    iv. 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 notify 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.)

### 6.2.2 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. Remove the cylinder from the installation as follows:
   - Close the ball valve, by turning the ball valve lever clockwise to the “OFF” position.
   - 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.
   - Disconnect the Firetrace detection tubing from the ball valve.
   - Remove the cylinder from the cylinder bracket.
2. 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.
3. Reinstall the suppression unit and pressurize the detection tubing with nitrogen, see **Section 5.3.1** and **Section 5.3.4.4** for instructions.

### 6.2.3 Five Year Inspection

FK-5-1-12 cylinders continuously in service without discharging shall be given a complete external visual inspection in place, every 5 years or more frequently if required.

Follow external visual inspection guidelines detailed in **Section 8** of NFPA 2001 (2018 Edition)

### 6.2.4 Firetrace Detection Tubing Maintenance

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

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

If all routine maintenance is followed and inspection of the tubing determines the tubing to be in good condition and does not show signs of damage or degradation, the tubing can remain in service.

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

**CAUTION**

***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.***

## 6.3 Hydrostatic Testing

**Caution**

***DO NOT** assume that DLP cylinders have been completely discharged or are empty after a suspected or verified discharge event. Any remaining pressure in the system could be still considered extremely hazardous and if not handled properly can cause property damage, bodily injury, or death. Never handle the systems by the pressure switches or pressure gauges. Always wear safety glasses and make sure the discharge port ball valve is in the closed/disarmed position and any safety/shipping plug(s) are properly in place before system installation, servicing, or other general handling.*

### 6.3.1 DOT Systems

Firetrace Pre-Engineered Automatic Direct Low Pressure (DLP) Clean Agent Suppression Systems with FK-5-1-12 Clean Agent DOT cylinders are built to DOT-4B specifications and therefore fall under DOT CFR Title 49 & NFPA 2001 regulations for retest and reinspection.

All DOT-4B, cylinders used exclusively in FK-5-1-12 service are to be retested and reinspected per DOT CFR Title 49, Section 180.205 & 180.209 as well as NFPA 2001, Container Test Section at the prescribed intervals for the cylinder/agent type used. All retest/reinspection must be performed by an authorized retester having a current identification number issued by the Associated Administrator for Hazardous Material Safety of DOT and must follow the test procedures as described in the applicable CGA pamphlet.

A complete visual inspection can be used in lieu of hydrostatic testing if cylinders are undamaged following the guidelines in DOT CFR Title 49, Section 180.205 & 180.209 as well as NFPA 2001, Container Test Section. Subsequent inspections as described in DOT CFR Title 49, Section 180.205 & 180.209, NFPA 2001, Container Test Section, as well as the local regulating authority will be required. The visual inspection shall be conducted only by competent persons and in conformance with the applicable CGA pamphlet. Inspections must be made only by persons holding a current RIN and the results recorded and maintained in conformance with DOT CFR Title 49, Section 180.215 & NFPA 2001, Container Test Section. Where external visual inspection indicates that the container has been damaged, additional strength tests shall be required in accordance with applicable transportation regulations.

### 6.3.2 CE Systems

Firetrace Pre-Engineered Automatic Direct Low Pressure (DLP) Clean Agent Suppression Systems with FK-5-1-12 Clean Agent CE cylinders built to either BS EN 1928 or BS EN 1802 specifications fall under CE regulations for retest prior to refill.

BS EN 1928 or BS EN 1803 cylinders used exclusively in FK-5-1-12 service are required to be retested and restamped prior to recharge and shipment if the last retest date has expired.

Firetrace Pre-Engineered Automatic Direct Low Pressure (DLP) Clean Agent Suppression Systems with FK-5-1-12 Clean Agent (BS EN 1928/BS EN 1803) containers requiring retest must be hydrostatically tested in accordance with BS EN 1928/BS EN 1803 as applicable. This periodic retest must be performed by an authorized retester who is certified to the Transportable Pressure Equipment Directive (TPED) requirements and any additional applicable requirements per the standards.

**NOTE: Table B.1 (Table 15) gives a list of the intervals between periodic inspections for some gases which complies with the current RID/ADR regulations and also gives recommendations which could be subsequently adopted by the RID/ADR regulations.**

# Annex B
(normative)

# Inspection periods

**Table B.1 — Intervals between periodic inspections and test [a]**

| Description | Gas type (examples) [b] | Normative intervals [c] Period years | Informative recommendations for next revision of ADR Period years |
|---|---|---|---|
| Compressed gases | Ar, $N_2$, He etc. | 10 | 10 |
| | $H_2$ [d] | 10 | 10 |
| | Air, $O_2$ | 10 | 10 |
| | Self-contained breathing Air, $O_2$, etc | [e] | 5 |
| | Gases for underwater breathing apparatus | [e] | 2,5 (internal visual) and 5 (full) [f] |
| | CO [g] | 5 | 5 |
| Liquefied gases | $CO_2$, $N_2O$ etc. | 10 | 10 [h] |
| Corrosive gases | [i] | 3 | 3 (internal visual) and 5 (full) [k] |
| Toxic gases | $CH_3Br$ | 5 | 10 |
| Very toxic gases | $AsH_3$, $PH_3$ etc. | 5 | 5 |
| Gas mixtures | a) all mixtures except b) below<br>b) mixtures completely in the gaseous state containing toxic and/or very toxic components. | 3, 5 or 10 years according to classification<br>3 years for groups TC, TFC, TOC<br>5 years for groups T, TF, TO<br>10 years for groups A, O, F | a) Lowest test period of any component<br>b) For such mixtures, if the toxicity of the final mixture is such that $LC_{50} \geq$ a volume fraction of $200 \times 10^{-6}$, a 10 year period applies, and if the toxicity of the final mixture is such that $LC_{50} \leq$ a volume fraction of $200 \times 10^{-6}$ a 5 year period applies |

[a] At all times certain requirements may necessitate a shorter time interval e.g. the dew point of the gas, polymerization reactions and decomposition reactions, cylinder design specification, change of gas service.

[b] This list of gases is not exhaustive. A full list of gases can be found in RID/ADR.

[c] These intervals conform to the 1999 edition of RID/ADR.

[d] Pay particular attention to the requirements of clause 5 and possible additional testing in accordance with EN 1795 for change of service.

[e] Not currently listed in RID/ADR.

[f] For cylinders used for self-contained underwater breathing apparatus in addition to the full retest period of 5 years, an internal visual inspection need to be performed every 2,5 years.

[g] This product requires very dry gas (see EN ISO 11114-1).

[h] This test period may be used provided the dryness of the product and that of the filled cylinder are such that there is no free water, and that this condition is proven and documented within a quality system of the filler. If these conditions cannot be fulfilled alternative or more frequent testing may be appropriate.

[i] For RID/ADR purposes, corrosivity is with reference to human tissue and NOT cylinder material, as per annex I.

[k] For gas mixtures shown to be corrosive for the cylinder material, the time period for single corrosive gases applies.

*Table 15 – ANNEX B (EN 1928/1803)*

# 7 SYSTEM DEPRESSURIZATION AND CHARGING

## 7.1 General

Firetrace Pre-Engineered Automatic Direct FK-5-1-12 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. Please contact Firetrace directly for a list of Authorized Firetrace Service Locations.***

## 7.2 Depressurizing the Unit

**CAUTION**

***Do not kink, bend, or crush Firetrace tubing to prevent leakage which could result in accidental unit discharge. Do not install tubing in a hazardous environment where the maximum ambient temperature exceeds 300 °F [148.9 °C].***

1. Turn the ball valve lever to the “OFF” position (perpendicular to the valve).
2. Depressurize the Firetrace detection tubing by depressing the Schrader valve inside of EOL Adapter OR threading the fill kit adapter (P/N 200173) into the End of Line Adapter.
3. Remove the detection/actuation tubing from the top of the ball valve.
4. Loosen valve-mounted Pressure Switch or Plug to 1 ½ to 2 turns.
5. Ensure the unit is depressurized by verifying the pressure gauge reads 0 psig.
6. SLOWLY open the ball valve SLIGHTLY so only a small amount of nitrogen can be heard being released from the unit.
7. Once the pressure gauge has reached 0 psig,
8. SLOWLY open the ball valve completely.

**CAUTION**

***Opening the ball valve too far, or too fast, will bring FK-5-1-12 into the valve assembly.***

## 7.3 System Recharge

Use the following steps to recharge an empty Firetrace Pre-Engineered Automatic Direct Low Pressure (DLP) Clean Agent Extinguisher System with FK-5-1-12 Clean Agent:

1. Fill via the ball valve if using a pump, alternatively remove cylinder valve and siphon tube to fill directly into empty cylinder (if cylinder valve is removed, ensure the cylinder threads are clean and free of debris)
2. Weigh and record the empty weight of the cylinder (and valve assembly if using a pump).
3. Ensure the ball valve is open and the filling adapter is connected to the End of Line (EOL) Adapter.
4. Zero the scale.
5. Fill system to the correct agent fill level per the system size.

6. Once filled, either remove fill lines from cylinder valve (if using a pump) or install cylinder valve and siphon tube if agent was poured into cylinder (ensuring the cylinder valve is torqued to 40 ± 3 ft-lbs to the cylinder, and that the cylinder valve O-ring is lubricated and in good condition)
7. 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).
8. Open the ball valve and pressurize the cylinder with dry nitrogen.
9. Close the ball valve and shake the cylinder to allow the nitrogen to be absorbed by the FK-5-1-12. (Some pressure loss will be observed.)
10. Open the ball valve (with dry nitrogen fill line still connected) and pressurize back up to 195 psig at 70 °F, as will be indicated on the system pressure gauge.
11. Repeat steps 9 thru 10 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.
12. Disconnect the dry nitrogen fill line.
13. Verify the system gross weight by checking it against what is printed on the label.
14. Leak test the unit by using a calibrated leak detector. If a leak detector is unavailable, a 48-hour holding period should be used to evaluate whether the system has a slow leak.
15. The unit is now ready to be transported to the installation site.

**WARNING**

***DO NOT* assume that ILP cylinders have been completely discharged or are empty after a suspected or verified discharge event. Any remaining pressure in the system could be still considered extremely hazardous and if not handled properly can cause property damage, bodily injury, or death. Never handle the systems by the pressure switches, electric solenoids, or pressure gauges. Always wear safety glasses and make sure the discharge port safety plug(s), cap(s), or anti-recoil device(s) are properly in place before system installation, servicing, or other general handling.**

# 8 POST DISCHARGE

## 8.1 Ventilation

Before inspecting the enclosure after a Firetrace FK-5-1-12 DLP Unit discharge, ventilate the enclosure thoroughly. Ventilation paths should be examined to prevent exposure to high concentrations of agent. Additionally, the proper safety equipment shall be utilized to prevent unnecessary exposure.

FK-5-1-12 does not leave a residue, thus, there are no clean-up operations resulting from Firetrace FK-5-1-12 DLP Unit discharge.

## 8.2 Remove from Service

An authorized Firetrace distributor must be consulted after a system has discharged. The Firetrace FK-5-1-12 DLP Unit must be removed and recharged. The Firetrace FK-5-1-12 DLP unit should be removed using the following steps:

1. Remove the Firetrace detection tubing from the tube fitting attached to the top of the cylinder valve.
2. Remove the cylinder from the cylinder mounting bracket.
3. Have Firetrace FK-5-1-12 DLP Unit recharged by a qualified Firetrace service location.

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

# APPENDIX A

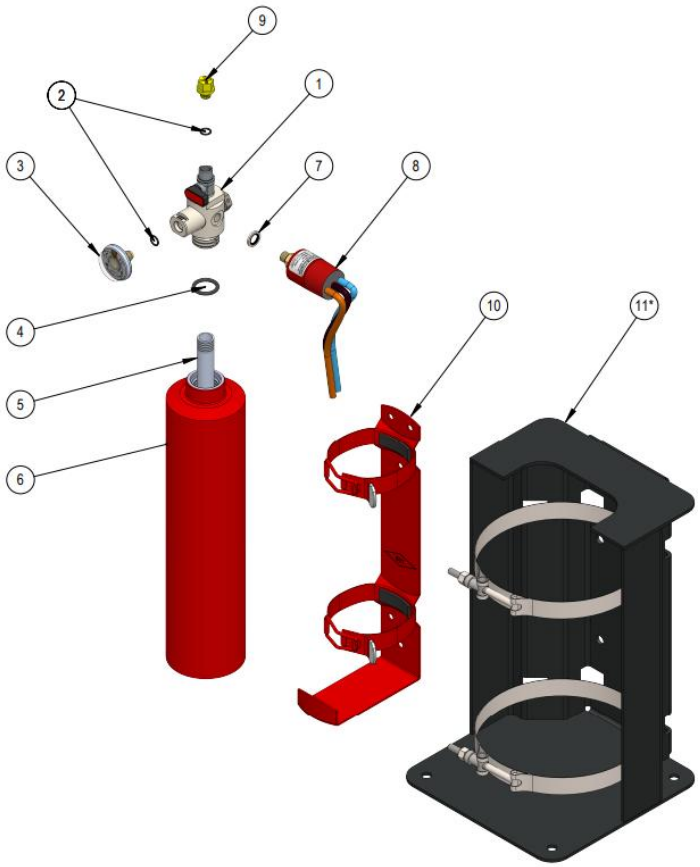
- System Parts List
- Discharge Line Parts List

## System Parts List: DOT System

| Part No. | Description |
|---|---|
| 920205 | Small FK-5-1-12 DLP Suppression Unit (2.5 lb) |
| 920505 | Medium FK-5-1-12 DLP Suppression Unit (5 lb) |
| 921005 | Large FK-5-1-12 DLP Suppression Unit (10 lb) |

| ITEM | P/N | DESCRIPTION | SYSTEM |
|---|---|---|---|
| 1 | 300310 | DOT DLP Valve | All Systems |
| 2 | 400002 | O-Ring, Gauge/Transport Cap | All Systems |
| 3 | RP | FK-5-1-12 Gauge, Generic | All Systems |
| 4 | RP | O-Ring, Cylinder Connection | All Systems |
| 5 | RP | 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 | All Systems |
| 8 | 400005 | Pressure Discharge Switch | All Systems |
| 9 | 200303 | Transport Cap w/ O-ring | 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* | 111402 | ASM, Large Heavy Duty Bracket | 12 LB (OPTIONAL) |

* OPTIONAL PARTS
RP PARTS REFERENCE PICTURED
NP PARTS NOT PICTURED

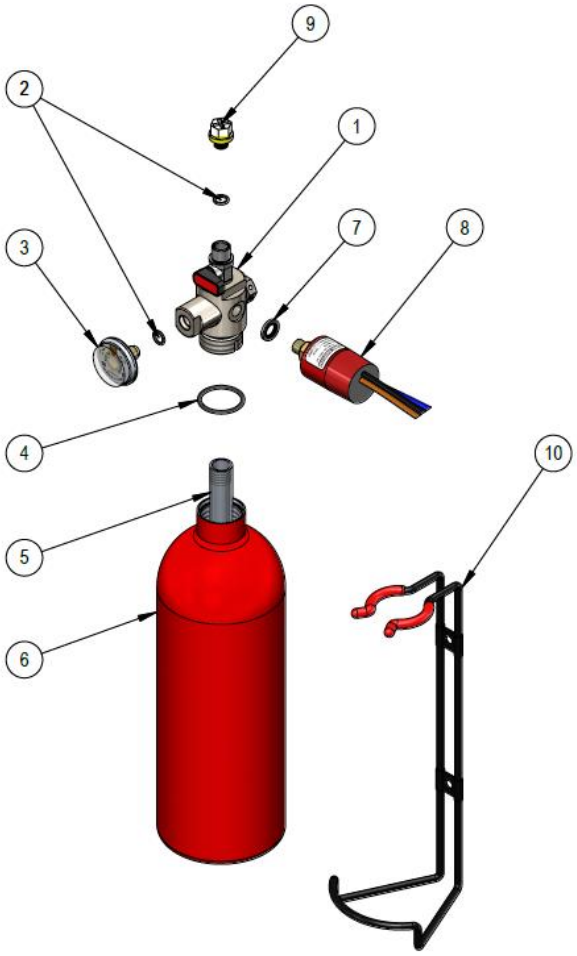


# System Parts List: CE System

| Part No. | Description |
|---|---|
| 898001 | Small FK-5-1-12 DLP Suppression Unit (1 kg) |
| 898002 | Medium FK-5-1-12 DLP Suppression Unit (2 kg) |
| 898003 | Large FK-5-1-12 DLP Suppression Unit (5 kg) |

| ITEM | P/N | DESCRIPTION | SYSTEM |
|---|---|---|---|
| 1 | 831214 | CE DLP Valve | All Systems |
| 2 | 400002 | O-Ring, Gauge/Transport Cap | All Systems |
| 3 | RP | FK-5-1-12 Gauge, Generic | All Systems |
| 4 | RP | O-Ring, Cylinder Connection | All Systems |
| 5 | RP | 1 kg Siphon Tube | 1 kg |
| 5 | RP | 2 kg Siphon Tube | 2 kg |
| 5 | RP | 5 kg Siphon Tube | 5 kg |
| 6 | 810100 | 1 kg Cylinder | 1 kg |
| 6 | 810200 | 2 kg Cylinder | 2 kg |
| 6 | 810500 | 5 kg Cylinder | 5 kg |
| NP | 200179 | Slip-On Union | All Systems |
| 7 | 600033 | Bonded Seal | All Systems |
| 8 | 400150 | Pressure Supervisory Switch | All Systems |
| 8 | 400005 | Pressure Discharge Switch | All Systems |
| 9 | 200303 | Transport Cap w/ O-ring | All Systems |
| 10 | 810101 | 1 kg bracket | 1 kg |
| 10 | 810202 | 2 kg Bracket | 2 kg |
| 10 | 111206 | 5 kg Bracket | 5 kg |

RP PARTS REFERENCE PICTURED
NP PARTS NOT PICTURED



# Detection Line Parts List

| ITEM | P/N | DESCRIPTION |
|---|---|---|
| NP | 200152 | Rubber Grommets (Qty. 2) |
| NP | 200153 | Plastic Grommets (Qty. 2) |
| NP | 200172 | Mounting Tabs (4/6) (Qty. 12) |
| NP | 200182 | 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 Discharge Switch with O-Ring & Washer |
| NP | 900007 | Filling Adapter |
| NP PARTS NOT PICTURED | | |

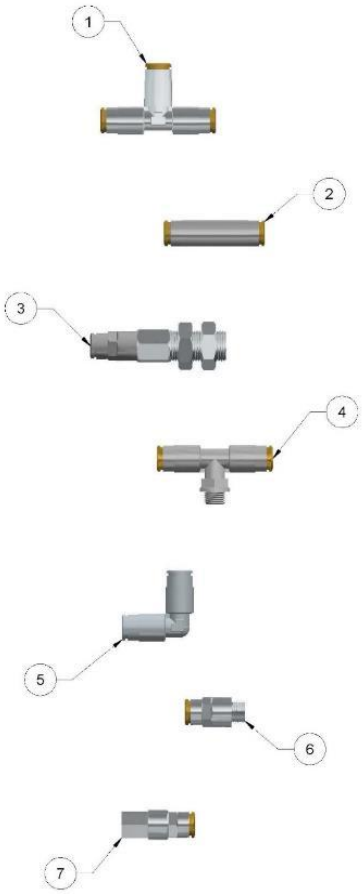



*Table 16 – Tube Fittings*

# Component Accessories

| Part No. | Description |
|---|---|
| 200150 | Rubber Grommets for Detection Tubing (Qty. 2) |
| 200151 | Plastic Grommets for Detection Tubing (Qty. 2) |
| 200171 | Mounting tabs for Detection Tubing, 4/6 mm (Qty. 12) |
| 201006 | Magnetic Mounting Clips for Detection Tubing, 4/6 mm (Qty. 6) |
| 201132 | Tamperproof Device, “ON” position |
| 201137 | Tamperproof Device, “OFF” position |
| 600210 | Tube Cutter |

*Table 17 – Installation Accessories*

| Part No. | Description |
|---|---|
| 400005 | Pressure Discharge Switch |
| 400150 | Pressure Supervisory Switch |

*Table 18 – Auxiliary Accessories*

| Part No. | Description |
|---|---|
| 200164 | Ball Valve for ILP and DLP Valves |
| 600033 | Washer, Bonded Seal, 1/8" |
| 600033 | Washer, Bonded Seal, 1/8" |

*Table 19 – Valve Accessories*

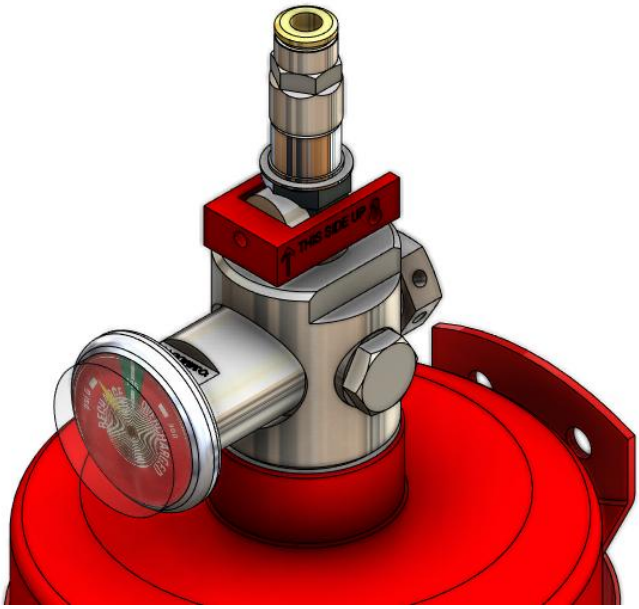
| Part No. | Description |
|---|---|
| 600213 | Tools, Detection Tube Nitrogen Charge Kit |
| 600214 | Tools, Replacement Cylinder for Nitrogen Charge Kit |
| 910550 | Nitrogen Regulator, 210psi |
| 910600 | Nitrogen Charge Adapter, EOL |
| 900007 | Tools, Charging Adapter, Use Your Own Nitrogen |

*Table 20 – Installation Tools*

# APPENDIX B

- Tamper Proof Instructions
- Firetrace Detection Tube Compatibility

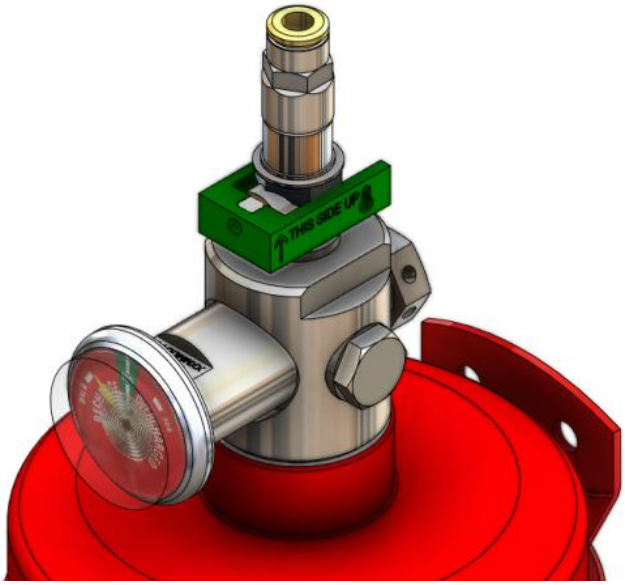
## Tamper Proof (Disarmed) Instruction (P/N 201137)




1. Verify that the ball lever is in the “OFF” 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.

*Figure 14 – Tamper Proof (Disarmed) Assembly*

## Tamper Proof (Armed) Instruction (P/N 201132)




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.

*Figure 15 – Tamper Proof (Armed) Assembly*

# 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 – COMMISSIONING DOCUMENT CHECKLIST

FIRETRACE International



| Customer Details: | | Installation Details: | |
|---|---|---|---|
| Company Name: | | Company Name: | |
| Point of Contact: | | Date of Installation: | |
| Site Address: | | | |

| System Details | | | |
|---|---|---|---|
| Agent: ◯ FK-5-1-12 ◯ FM-200 ◯ ABC Dry-Chem | | System Size: lbs kg | |
| Valve Serial Numbers (of installed systems): | | | |
| | | | |
| | | | |
| | | | |

| Installation Check | | System Check | |
|---|---|---|---|
| Cylinder Pressure Gauge | ☐ | System installed per respective DIOM (FK-5-1-12, FM-200 & ABC Dry-Chem) | ☐ |
| Cylinder Bracket | ☐ | Cylinder pressure in "Green Zone" | ☐ |
| Pressure Switch | ☐ | Detection Tubing Pressure in "Green Zone" | ☐ |
| End of Line | ☐ | | |
| Audible Alarm ( If Applicable ) | ☐ | | |
| Detection Tubing | ☐ | | |
| Mounting Tabs | ☐ | | |

| Testing & Commissioning Check | | |
|---|---|---|
| Detection Tubing Leakage Test Duration | ____ Hrs | |
| Detection Tubing Pressure/Leak Result | ◯ Pass ◯ Fail | |
| System Commissioned and Ready to be "armed" | ☐ | Date: |
| System "Armed" | ☐ | Date: |
| Installation photos taken? | ☐ | |

| Installation Notes |
|---|
| |
| |
| |
| |

| Installed By: | Inspected By: | Witnessed / Accepted By: |
|---|---|---|
| | | |
| Name: | Name: | Name: |
| Date: | Date: | Date: |

# APPENDIX D – SAFETY DATA SHEET 3M™ NOVEC™ 1230 FIRE PROTECTION FLUID



## Safety Data Sheet



| | | | |
|---|---|---|---|
| **Document Group:** | 16-3425-2 | **Version Number:** | 31.00 |
| **Issue Date:** | 04/20/22 | **Supercedes Date:** | 10/05/21 |

## SECTION 1: Identification

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

**Product Identification Numbers**
98-0212-3203-2, 98-0212-3217-2, 98-0212-3414-5
7100010142, 7100024956, 7010321413

**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.

## 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:**
No need for first aid is anticipated.

**Skin Contact:**
No need for first aid is anticipated.

**Eye Contact:**
No need for first aid is anticipated.

**If Swallowed:**
No need for first aid is anticipated.

**4.2. Most important symptoms and effects, both acute and delayed**
No critical symptoms or effects. 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**
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**
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**
Ventilate the area with fresh air. 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. Clean up residue with an appropriate solvent selected by a qualified and authorized person. Ventilate the area with fresh air. Read and follow safety precautions on the solvent label and SDS. Seal the container. Dispose of collected material as soon as possible in accordance with applicable local/regional/national/international regulations.

## 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/occupational use only. Not for consumer sale or use. Do not use in a confined area with minimal air exchange. 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 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**

For those situations 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**

Select and use gloves and/or protective clothing approved to relevant local standards to prevent skin contact based on the results of an exposure assessment. Selection should be based on use factors such as exposure levels, concentration of the

substance or mixture, frequency and duration, physical challenges such as temperature extremes, and other use conditions. Consult with your glove and/or protective clothing manufacturer for selection of appropriate compatible gloves/protective clothing.
Gloves made from the following material(s) are recommended: Neoprene
Nitrile Rubber

If this product is used in a manner that presents a higher potential for exposure (eg. spraying, high splash potential etc.), then use of protective coveralls may be necessary. Select and use body protection to prevent contact based on the results of an exposure assessment. The following protective clothing material(s) are recommended: Apron - Neoprene
Apron – Nitrile

**Respiratory protection**

For those situations where the material might be exposed to extreme overheating due to misuse or equipment failure, use a positive pressure supplied-air respirator.

## SECTION 9: Physical and chemical properties

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

| | |
|---|---|
| **Appearance** | |
| **Physical state** | Liquid |
| **Color** | Colorless |
| **Specific Physical Form:** | Liquid |
| **Odor** | Low Odor |
| **Odor threshold** | *No Data Available* |
| **pH** | *Not Applicable* |
| **Melting point** | -108 ºC |
| **Boiling Point** | 49 ºC [@ 760 mmHg] |
| **Flash Point** | No flash point |
| **Evaporation rate** | > 1 Units not avail. or not appl. [*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 ºC] |
| **Vapor Density** | 11.6 [*Ref Std:*AIR=1] |
| **Density** | 1.6 g/ml |
| **Specific Gravity** | 1.6 [@ 68 ºF] [*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 ºC ] |
| **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. Conditions to avoid**
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 health effects are expected.

**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:**
No known health effects.

**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 | Professional judgement | LD50 estimated to be > 5,000 mg/kg |
| 1,1,1,2,2,4,5,5,5-NONAFLUORO-4-(TRIFLUOROMETHYL)-3-PENTANONE | Ingestion | Professional judgement | LD50 estimated to be > 5,000 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 |

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 classified |

**Respiratory Sensitization**

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

**Germ Cell Mutagenicity**

| Name | Route | 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 classified for female reproduction | Rat | NOAEL 38.7 mg/l | premating & during gestation |
| 1,1,1,2,2,4,5,5,5-NONAFLUORO-4-(TRIFLUOROMETHYL)-3-PENTANONE | Inhalation | Not classified for male reproduction | Rat | NOAEL 38.7 mg/l | premating & during gestation |
| 1,1,1,2,2,4,5,5,5-NONAFLUORO-4-(TRIFLUOROMETHYL)-3-PENTANONE | Inhalation | Not classified for development | Rat | NOAEL 39.5 mg/l | 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 | Not classified | Rat | NOAEL 100,000 ppm | 2 hours |
| 1,1,1,2,2,4,5,5,5-NONAFLUORO-4-(TRIFLUOROMETHYL)-3-PENTANONE | Inhalation | cardiac sensitization | Not classified | 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 \| heart \| endocrine system \| hematopoietic system \| muscles \| nervous system \| respiratory system \| vascular system | Not classified | Rat | NOAEL 38.6 mg/l | 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

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 waste 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.

**EPCRA 311/312 Hazard Classifications:**

| Physical Hazards |
|---|
| Not applicable |

| Health Hazards |
|---|
| Not applicable |

### 15.2. State Regulations
Contact 3M for more information.

### 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. Contact the selling division for additional information.

The components of this product are in compliance with the chemical notification requirements of TSCA. All required components of this product are listed on the active portion of the TSCA Inventory.

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:** 1 **Instability:** 0 **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.

The NFPA Health code of 3 is due to emergency situations where the material may thermally decompose and release Hydrogen Fluoride. During normal use conditions, please reference Section 2 and Section 11 of the SDS for additional health hazard information.

**HMIS Hazard Classification**
**Health:** 0 **Flammability:** 1 **Physical Hazard:** 0 **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).

| | | | |
|---|---|---|---|
| **Document Group:** | 16-3425-2 | **Version Number:** | 31.00 |
| **Issue Date:** | 04/20/22 | **Supercedes Date:** | 10/05/21 |

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**3M USA SDSs are available at www.3M.com**

# APPENDIX E – SAFETY DATA SHEET WAYSMOS FK-5-1-12

## *Safety Data Sheet*

### Section 1 – Chemical Product and Company Identification

| | |
|---|---|
| **Product Name** | FK-5-1-12 |
| **Chemical Name** | 1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone |
| **Synonym** | FLUOROKETONE, Perfluoro(2-Methyl-3-Pentanone), NOVEC1230™ |
| **Product Use** | Fire extinguishing agent |
| **Manufacturer** | Shanghai Waysmos Fine Chemical Co., Ltd. |
| **Address** | 388 Liangle Road, Laogang, Pudong New Area, Shanghai, China |
| **Email** | sales@waysmos.com |
| **Telephone** | +86-571-85069383 |
| **Fax** | +86-571-85069385 |

### Section 2 –Hazard Identification

| | |
|---|---|
| **Hazard classification** | This material is not considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200) |
| **Hazard pictograms** |  |
| **Signal word** | Warning |
| **Hazard statements** | H412: Harmful to aquatic life with long lasting effects. |
| **Precautionary statements** | P261: Avoid breathing vapours.<br>P273: Avoid release to the environment.<br>P280: Wear protective gloves/protective clothing. |
| **Other Hazard** | Overheating and over pressurizing may cause gas release or violent container bursting. |

### Section 3 – Composition/Information on Ingredients

| Ingredient name | CAS No. | %(weight) |
|---|---|---|
| 1,1,1,2,2,4,5,5,5,-Nonafluoro-4-(trifluoromethyl)-3-pentanone | 756-13-8 | ≥99. 0 |

### Section 4 – First Aid Measures

| | |
|---|---|
| **Inhalation** | Remove victim to fresh air and keep at rest in a position comfortable for breathing.<br>If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel.<br>If unconscious, place in recovery position and get medical attention immediately |
| **Skin** | Remove and isolate contaminated clothing and shoes. Wash immediately with plenty of soap and water.<br>Get medical attention if frostbitten by liquid or if irritation persists |
| **Eyes** | Immediately flush with large amounts of water for at least 15 minutes<br>Get medical attention if irritation occurs |
| **Ingestion** | DO NOT induce vomiting unless instructed to do so by a physician. Get medical attention immediately if symptoms develop. |
| **Note to physician** | Immediate medical attention is not required<br>When symptoms persist or in all cases of doubt seek medical advice |

## Section 5 – Fire Fighting Measures

| | |
|---|---|
| **Extinguishing media** | Product is a fire extinguishing media. Use media appropriate for surrounding material |
| **Special hazards arising from the substance or mixture** | Thermal decomposition may cause toxic products<br>Containers may explode in heat of fire. |
| **Special protective equipment for firefighters** | Wear self-contained breathing apparatus with a full face-piece operated in positive pressure mode and chemical-protective clothing. Prevent fire extinguishing water from contaminating surface water or the ground water system |

## Section 6 – Accidental Release Measures

| | |
|---|---|
| **Personal precautions, protective equipment and emergency procedures** | Refer to section 8 of SDS for personal protection details. Wear mask and appropriate protective clothing for daily operation. Prevent skin and eye contact. Keep unprotected persons away. If outside do not approach from downwind. |
| **Environmental precautions** | Do not discharge into drains/surface waters/groundwater |
| **Methods and material for containment and cleaning up** | Evacuate area. Keep upwind. Stop leak if without risk. Ventilate area especially low places remove open flames and heating elements. Disperse it with floor level forced air |
| **Reference to other SECTIONs** | See SECTION 7 for information on safe handling<br>See SECTION 8 for information on personal protection equipment<br>See SECTION 13 for information on disposal |

## Section 7 – Handling and Storage

| | |
|---|---|
| **Handling** | Avoid direct contact with the substance. Wash thoroughly after handling. Ensure there is sufficient ventilation of the area. Do not handle in a confined space. Avoid the formation or spread of mists in the air. Contents may be under pressure, open carefully. Do not breathe thermal decomposition products. For industrial or professional use only. Do not eat, drink or smoke when using this product. Do not drag, slide or roll containers. Do not drop containers or permit them to strike against each other. Never apply flame or localized heat directly to any part of the container. |
| **Storage** | Store in dry, cool, well ventilated area. Keep container tightly closed. Keep out of direct sunlight and ultraviolet, keep away from incompatible materials, water, keep away from sources of heat or ignition. Containers should be properly stored and secured to prevent falling or being knocked over. |

## Section 8 –Exposure Controls/Personal Production

**8.1 Control parameters**

| | |
|---|---|
| **Occupational exposure limit values** | 150 ppm, 8 hr TWA |

**8.2 Exposure controls**

| | |
|---|---|
| **Appropriate engineering controls** | Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits |
| **Personal protective equipment** | |
| **Respiratory Protection** | Self-contained breathing apparatus or full facepiece supplied-air respirator must be available in case of emergency. |
| **Skin Protection** | Wear protective gloves/clothing to prevent contact |
| **Eye Protection** | Safety glasses/chemical splash goggles |
| **Environmental exposure controls** | Do not empty into drains |

## Section 9 – Physical and Chemical Properties

**9.1 Information on basic physical and chemical properties**

| | |
|---|---|
| **Appearance** | Liquid |
| **Color** | colorless |
| **Odour** | Low odor |
| **pH** | Not available |
| **Melting point** | -108°C |
| **Boiling point** | 49 °C |
| **Flash point** | Not available |
| **Evaporation rate** | > 1(BUOAC = 1.0) |
| **Flammability (solid, gas)** | Not flammable |
| **Upper/lower flammability or explosive limits** | Not available |
| **Vapour pressure** | 40.4 Kpa (25°C) |
| **Specific gravity（$H_2O$=1** | 1.6 g/cm$^3$ |
| **Solubility(ies)** | Not available |
| **Partition coefficient: n-octanol/water** | log Kow = 2.11 |

| | |
|---|---|
| **Auto-ignition temperature** | Not available |
| **Viscosity** | 0.6 mPa.s (25°C) |

## Section 10 – Stability and Reactivity

| | |
|---|---|
| **Reactivity** | Stable under recommended storage and handling conditions (see SECTION 7, handling and storage) |
| **Chemical stability** | Stable under normal conditions of use |
| **Possibility of hazardous reactions** | No known hazardous reactions |
| **Conditions to avoid** | Keep away from heat and ignition sources. Protect from sunlight |
| **Incompatible materials** | Strong oxidizing materials, Strong acids and bases |
| **Hazardous decomposition products** | Thermal decomposition can lead to release of irritating or toxic gases/vapors: carbon oxides, hydrogen fluoride |

## Section 11 – Toxicological Information

**11.1 Information on toxicological effects**

**Acute Toxicity**

| Ingredient name | LD50 Oral(rat) | LD50 Dermal (rat) | LC50 Inhalation (rat) |
|---|---|---|---|
| 1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone | > 2,000 mg/kg | > 2,000 mg/kg | >1,227 mg/l/4h (>10% by volume) |

| | |
|---|---|
| **Skin corrosion/irritation** | No information available |
| **Serious eye damage/irritation** | No information available |
| **Respiratory or skin sensitization** | No information available |
| **Germ cell mutagenicity** | No information available |
| **Reproductive toxicity** | No information available |
| **STOT-single exposure** | No information available |
| **STOT-repeated exposure** | No information available |
| **Aspiration hazard** | No information available |
| **Carcinogenicity** | Not listed as a carcinogen by NTP, IARC, or OSHA |

## Section 12 – Ecological Information

| | |
|---|---|
| **Toxicity (Ecotoxicity Fish, $LC_{50}$)** | >1200 mg/l (Zebra Fish, 96h) |
| **Degradability** | Atmospheric lifetime is approximately 0.014 years(5 days) |
| **Bioaccumulation/ Accumulation** | No data available |
| **Mobility in Environmental Media** | Not available |
| **Other adverse effects** | Ozone Depletion Potential (CFC 11 = 1.0): 0.00<br>Global Warming Potential ($CO_2$ = 1.0): 1.00 |

## Section 13 –Disposal Considerations

**Waste Disposal Method**

Disposal must be made according to local and national regulations. Empty containers should be taken for local recycling, recovery or waste disposal.

## Section 14—Transport Information

| ITEM | LAND<br>☐ EU: ADR/RID<br>☐ US: DOT | SEA<br>IMDG | AIR<br>ICAO / IATA |
|---|---|---|---|
| UN-Number | General cargo | General cargo | General cargo |
| Packaging Group | | | |

**Special precautions for user** None determined

## Section 15—Regulatory Information

**15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture**
**Listed in international inventories:**

| Ingredient name | TSCA | DSL | NDSL | ELINCS | ENCS | CHINA | KECL | PICCS | AICS |
|---|---|---|---|---|---|---|---|---|---|
| 1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone | YES | YES | NDA | YES | YES | YES | YES | YES | YES |

## Section 16 – Other Information

In accordance with good practices of personal cleanliness and hygiene handle with the care and avoid unnecessary contact with this product.
This information is being supplied to you under OSHA Hazard Communication Standard 29 CFR 1910.1200 and is offered in good faith as typical values and not as a product specification. The information contained herein is based on the data available to us and is believed to be true and accurate.
No warranty expressed or implied regarding the accuracy of this data. The hazards connected with the use of the material or the results to be obtained from the use thereof are made. Shanghai Waysmos Fine Chemical Co., Ltd. assumes no responsibility for damage or injury from the use of the product described herein

# APPENDIX F – SAFETY DATA SHEET CHEMORI 5112™

MSDS NUMBER : CR-05112
ISSUED DATE : OCTOBER 17, 2018

## SAFETY DATA SHEET

## 1,1,1,2,2,4,5,5,5-NONAFLUORO-4-(TRIFLUOROMETHYL)-3-PENTANONE

This SDS adheres to the standards and regulatory requirements of the United States and may note meet regulatory requirements in other countries.

### SECTION 1 – IDENTIFICATION OF SUBSTANCE

**PRODUCT IDENTIFIER**

| | |
|---|---|
| Trade Name | : CHEMORI 5112™ |
| Chemical Name | : 1,1,1,2,2,4,5,5,5-nonafluoro-4-(trifluoromethyl)-3-pentanone |
| Synonyms | : CF3CF2C(O)CF(CF3)2, FK-5-1-12, perfluoro(2-methyl-3-pentanone) |
| Chemical formula | : C6F12O |
| CAS number | : 756-13-8 |

**RELEVANT IDENTIFIED USES OF THE SUBSTANCE**

| | |
|---|---|
| Relevant identified uses | : Streaming and flooding fire protection |

**DETAILS OF THE SUPPLIER OF THE SAFETY DATA SHEET**

| | |
|---|---|
| Registered company name | : CHEMORI LLC |
| Address | : 16180 SW 72nd Avenue, Portland, Oregon 97224 |
| Email | : corporate@chemori.com |
| Phone Number | : 1-800-893-9619 (within USA and Canada)<br>1-503-747-7775 (Outside USA and Canada) |
| Emergency Phone Number | : 1-800-424-9300 (within USA and Canada)<br>1-703-527-3887 (outside USA and Canada) |

### SECTION 2 – HAZARD IDENTIFICATION

**CLASSIFICATION OF THE SUBSTANCE**

| Non-hazardous chemical. According to NFPA 704 and HMIS hazard rating schemes. |
|---|

**NFPA 704 HAZARD CLASSIFICATION**

HEALTH = 1
FLAMMABILITY = 0
REACTIVITY = 0
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 materials 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 |
| **REACTIVITY** | = | 1 |
| **PROTECTION** | = | X (***Section 8***) |

Hazardous Material Identification System (HMIS) hazard ratings are designed to inform employees of chemical hazard in the workplace. The provided 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 ratings are to be used with a fully implemented HMIS program.

**NFPA/ HMIS HAZARD INDEX**

0 = MINIMAL HAZARD, 1 = SLIGHT HAZARD, 2 = MODERATE HAZARD, 3 = SERIOUS HAZARD, 4 = SEVERE HAZARD, X = DEPENDING ON THE USE CONDITIONS

**Label elements**

| | |
|---|---|
| **Hazard pictogram(s)** | : Not Applicable |
| **Signal word** | : Not Applicable |

**Hazard statement(s)**

| | |
|---|---|
| **H412** | : Harmful to aquatic life with long lasting effects. |

**Precautionary statement(s) Prevention**

| | |
|---|---|
| **P273** | : Avoid release to the environment. |

**Precautionary statement(s) Response:** Not Applicable

**Precautionary statement(s) Storage:** Not Applicable

**Precautionary statement(s) Disposal**

| | |
|---|---|
| **P501** | : Dispose of contents/ container in accordance with local regulations. |

## SECTION 3 – COMPOSITION / INFORMATION ON INGREDIENTS

**Substances**

| INGREDIENT NAME | CAS NUMBER | % [WEIGHT] |
|---|---|---|
| 1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone | 756-13-8 | >99.9 |

## SECTION 4 – FIRST AID MEASURES

**Description of first aid measures**

| | |
|---|---|
| **Eye Contact** | : Flush eyes with plenty of water immediately. If sign or symptom persists, get medical attention without delay. |
| **Skin Contact** | : Wash affected area with water (and soap if available). If sign or symptom persists, get medical attention in event of irritation. |
| **Inhalation** | : Move the person to get fresh air. If sign or symptom persists, get medical attention. |
| **Ingestion** | : Immediately give the person a glass of water. First aid is not generally required, if in doubIt, get medical attention. Never give anything by mouth to an unconscious person. |

**Most important symptoms and effects, both acute and delayed**

See Section 11. Toxicological information.

**Indication of any immediate medical attention and special treatment needed**

Treat symptomatically.

## SECTION 5 – FIRE AND EXPLOSION HAZARD

**Extinguishing media**

- There is no restriction on the type of extinguisher which may be used.
- Use extinguishing media suitable for surrounding area.

**Special hazards arising from the substance or mixture**

| | |
|---|---|
| **Fire Incompatibility** | : Avoid contamination with oxidizing agents, such as nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may occur. |

**Special protective equipment and precautions for fire-fighters**

| | |
|---|---|
| **Fire Fighting** | • Alert fire Brigade and tell them location and nature of hazard.<br>• Wear breathing apparatus plus protective gloves in the event of a fire.<br>• Prevent, by any means available, spillage from entering drains or water courses.<br>• Use firefighting procedures suitable for surrounding area.<br>• Do not approach containers suspected to be hot.<br>• Cool fire exposed containers with water spray from a protected location.<br>• If safe to do so, remove containers from path of fire.<br>• Equipment should be thoroughly decontaminated after use. |

| | |
|---|---|
| **Fire/ Explosion Hazard** | • Non-combustible.<br>• Not considered to be a significant fire risk.<br>• Heating may cause expansion or decomposition leading to violent rupture of containers.<br>• May emit corrosive, poisonous fumes.<br>• Decomposes on heating and produces acrid and toxic fumes of: carbon dioxide ($CO_2$), hydrogen fluoride and other pyrolysis products typical of burning organic material. |

## SECTION 6 — ACCIDENTAL RELEASE MEASURES

**Personal precautions, protective equipment and emergency procedures**

See section 8

**Environmental precautions**

See section 12

**Methods and material for containment and cleaning up**

| | |
|---|---|
| **Minor Spills** | • Clean up all spills immediately.<br>• Avoid breathing vapors and contact with skin and eyes.<br>• Using personal protective equipment to control personal contact with the substance.<br>• Contain and absorb spill with sand, earth or inert material.<br>• Wipe up.<br>• Place in an appropriate labelled container for waste disposal. |
| **Major Spills** | Moderate hazard.<br>• Clear area of personnel.<br>• Alert Fire Brigade and provide location and nature of hazard.<br>• Wear breathing apparatus and gloves.<br>• Avoid spillage from entering drains or water course by any means available.<br>• Stop leak if safe to do so.<br>• Contain and absorb spill with sand, earth or inert material.<br>• Collect recoverable product into an appropriate labelled container for recycling.<br>• Wash area and avoid runoff from entering drains.<br>• After cleaning up, decontaminate all protective clothing and equipment prior to storing and re-using.<br>• If contamination of drains occurs, advise emergency services. |

## SECTION 7 – HANDLING AND STORAGE

**Precautions for safe handling**

| | |
|---|---|
| Safe handling | • Storage in sealed containers may result in pressure buildup, open carefully.<br>• Always release caps or seals slowly to ensure low dissipation of vapors.<br>• Prevent all personal contacts, including inhalation.<br>• Wear personal protective clothing and equipment when risk of exposure occurs.<br>• Use in a well-ventilated area.<br>• Avoid contact with moisture and incompatible materials.<br>• Do not eat, drink or smoke when handling.<br>• Keep container securely sealed when not in use.<br>• Prevent physical damage to containers.<br>• Always wash hands with soap and water after handling. |
| Other Information | • Store in original containers.<br>• Keep containers securely sealed.<br>• Store in a cool, dry, well-ventilated area.<br>• Store away from incompatible materials and foodstuff containers.<br>• Protect containers again physical damage and check regularly for leaks. |

**Conditions for safe storage, including any incompatibilities**

| | |
|---|---|
| Suitable container | • Store in bulging containers.<br>• Packing as recommended by manufacturer.<br>• All containers should be clearly labelled and free from leaks. |
| Storage incompatibility | • Separate from alcohol and water.<br>• Avoid strong bases.<br>• Avoid direct sunlight and UV light. |

## SECTION 8 – EXPOSURE CONTROLS / PERSONAL PROTECTION

**Control parameters**

EXPOSURE LIMIT:

| Chemical name | Limit type |
|---|---|
| 1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone | TWA: 150 ppm |

TWA: Time-Weighted-Average

**Exposure Controls**

| | |
|---|---|
| Appropriate engineering controls | • Local exhaust ventilation is required to control exposures to below exposure limits.<br>• Provide adequate ventilation in warehouse or closed storage area. |

**Personal Protection**

| | |
|---|---|
| Eye and face protection | • Safety glasses with side shields.<br>• Chemical goggles if wearing contact lenses. |
| Skin protection | • See hand section below. |
| Hands/ feet protection | • Gloves must be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. |
| Body protection | • See other section below. |
| Other protection | • Skin cleansing cream.<br>• Eye wash unit. |
| Respiratory protection | • Type AX filter of sufficient capacity. The wearer must be warned to leave the contaminated area immediately on detecting any odours through the respirator. The odour may indicate that the mask is not functioning properly or not properly fitted. |

## SECTION 9 – PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties:

| | | |
|---|---|---|
| APPEARANCE | : | Colorless, low odor liquid |
| MOLECULAR WEIGHT (G/MOL) | : | 316.04 |
| BOILING POINT | : | 49.2 °C / 120.6 °F |
| FREEZING POINT | : | –108 °C / –162.4 °F |
| VAPOR PRESSURE @ 20 °C/68 °F | : | 0.326 bar |
| VAPOR DENSITY (AIR=1) | : | 11.6 |
| SPECIFIC GRAVITY ($H_20$=1) | : | 1.6 |
| VOC | : | 1600 g/l |
| EVAPORATION RATE (Butyl acetate = 1) | : | >1 |
| SOLUBILITY IN WATER | : | Nil |
| VISCOSITY | : | 0.6 cP at 77 °F (25 °C) |
| pH | : | Not Applicable |
| AUTO-IGNITION TEMPERATURE | : | Not Applicable |
| FLASH POINT | : | Not Applicable |

## SECTION 10 – STABILITY AND REACTIVITY

| | |
|---|---|
| **Reactivity** | • See section 7 |
| **Chemical stability** | • Product is considered stable.<br>• Unstable in the presence of incompatible materials.<br>• Hazardous polymerization will not occur. |
| **Possibility of hazardous reactions** | • See section 7 |
| **Conditions to avoid** | • See section 7 |
| **Incompatible materials** | • See section 7 |
| **Hazardous decomposition products** | • See section 5 |

## SECTION 11 – TOXICOLOGICAL INFORMATION

**Information on Toxicological Effects/ Routes and Symptoms of Exposure**

| | |
|---|---|
| **Inhaled** | • No known health effects |
| **Ingestion** | • No known health effects |
| **Skin contact** | • Not expected to cause significant skin irritation. |
| **Eye** | • Not expected to cause significant eye irritation. |
| **Chronic** | • No applicable information |

**Toxicological Data**

Remark: If a component is disclosed in the other sections but does not appear in a table below, either no data are available for that endpoint or the data are not sufficient for classification.

**(1) Skin Irritation/ Corrosion:**

| Chemical name | Species | Classification |
|---|---|---|
| 1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone | Rabbit | Non-irritant |

**(2) Serious Eye Damage/ Irritation:**

| Chemical name | Species | Classification |
|---|---|---|
| 1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone | Rabbit | Non-irritant |

**(3) Skin Sensitisation:**

| Chemical name | Species | Classification |
|---|---|---|
| 1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone | Guinea pig | Weak sensitiser |

(3) Acute Toxicity:

| Chemical name | Route | Species | Classification |
|---|---|---|---|
| 1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone | Dermal | Sprague-Dawley rat | Low acute toxicity |
| 1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone | Ingestion | Sprague-Dawley rat | Low acute toxicity |
| 1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone | Inhalation-Vapor | Sprague-Dawley rat | Low acute toxicity |

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

## SECTION 12 – ECOLOGICAL INFORMATION

| | |
|---|---|
| Ecotoxicity | • No applicable information |
| Persistence and degradation | • Photolytic half-life is 3 to 5 days. Degradation product from photolytic is trifluoroacetic acid (TFA). |
| Bio-accumulative potential | • No applicable information |
| Others | • Ozone Depletion Potential: 0<br>• Global Warming Potential: 1 for 100-year time horizon |

NOTE: Hydrolysis is not expected to be a significant degradation pathway. Product is highly insoluble in water and volatile, and use as a clean extinguishing agent would not typically result in releases to aquatic environments.

## SECTION 13 – DISPOSAL CONSIDERATIONS

Waste treatment methods

| | |
|---|---|
| Product/ Packaging disposal | • Legislation addressing waste disposal requirements may differ by country, state and/ or territory. Each user must refer to laws operating in their area.<br>• Disposal of waste product in a permitted industrial waste facility. Combustion products could include HF. Facility must be capable of handling halogenated materials.<br>• Do not allow wash water from cleaning or process equipment to enter drains.<br>• It may be necessary to collect all wash water for treatment before disposal.<br>• In all cases disposal to sewer may be subject to local laws and regulations.<br>• Where in doubt, contact the responsible authority.<br>• Recycle where possible.<br>• Consult manufacturer for recycling options or consult local or regional waste management authority for disposal if no suitable treatment or disposal facility can be identified.<br>• Dispose of by: burial in a land-fill specifically licensed to accept chemical and/or pharmaceutical wastes or incineration in a licensed |

apparatus.
- Decontaminate empty containers. Observe all label safeguards until containers are cleaned and destroyed.

## SECTION 14 – TRANSPORT INFORMATION

As the unpressurized agent, CHEMORI 5112, is not a compressed or liquefied gas, non-flammable and low in toxicity. Thus, it is an unregulated material and has no UN designation.

When shipping pressurized as a Fire Extinguishing Unit, the UN number as follows:

**U.S. DOT**

| | | |
|---|---|---|
| PROPER SHIPPING NAME | : | Fire Extinguisher with compressed or liquefied gas |
| HAZARD CLASS | : | 2.2 Non-flammable gas |
| UN NUMBER | : | UN1044 |

**AIR TRANSPORT - ICAO OR IATA**

| | | |
|---|---|---|
| PROPER SHIPPING NAME | : | Fire Extinguisher with compressed or liquefied gas |
| HAZARD CLASS | : | 2.2 Non-flammable gas |
| UN NUMBER | : | UN1044 |

**WATER – IMDG**

| | | |
|---|---|---|
| PROPER SHIPPING NAME | : | Fire Extinguisher with compressed or liquefied gas |
| HAZARD CLASS | : | 2.2 Non-flammable gas |
| UN NUMBER | : | UN1044 |

## SECTION 15 – REGULATORY INFORMATION

Safety, health and environmental regulations/ legislation specific for the substance or mixture

1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone (CAS 756-13-8) is found on the following regulatory lists:

| National Inventory | Status |
|---|---|
| Australia - AICS | All ingredients are on the inventory |
| Canada - DSL | All ingredients are on the inventory |
| Canada - NDSL | Not determined or not on the inventory and are not exempt from listing |
| China - IECSC | All ingredients are on the inventory |
| Europe – EINEC/ ELINCS/ NLP | All ingredients are on the inventory |
| Japan - ENCS | All ingredients are on the inventory |

| | |
|---|---|
| Korea - KECI | All ingredients are on the inventory |
| New Zealand - NZIoC | All ingredients are on the inventory |
| Philippines - PICCS | Not determined or not on the inventory and are not exempt from listing |
| USA - TSCA | All ingredients are on the inventory |

## SECTION 16 – OTHER INFORMATION

**Other Information**

Chemori urges each customer or recipient of this SDS to study it carefully and consult appropriate expertise, as necessary or appropriate, to become aware of and understand the data contained in this SDS, and any hazards associated with the product. The above information is provided in good faith and believed to be accurate, but does not claim to be all inclusive. Since conditions for use of the product are not under the control of the company, it is the buyer's/user's duty to determine the conditions necessary for the safe use of this product. Users should consider these data only as a guide to the appropriate precautionary and emergency handling of the product. Regulatory requirements are subject to change and may differ between various locations. It is the buyer's/user's responsibility to ensure that his activities comply with all federal, state, provincial or local laws. The information presented here is based on data available at the time of shipping, is subject to change without notice as new information is obtained, and may not be valid for such material used in combination with any other material or in any process. However, no warranty of any kind, express or implied, is given.

**Revision Date:** 17/10/2018

**Definitions and Abbreviations:**

- TWA: Time-Weighted-Average;
- AICS: Australia Inventory of Chemical Substances;
- DSL: Domestic Substances List in Canada;
- NDSL: Non-Domestic Substance List in Canada;
- IECSC: Inventory of Existing Chemical Substances Produced or Imported in China;
- EINEC/ ELINCS/ NLP: European Inventory of Existing Commercial Chemical Substances/ European List of Notified Chemical Substances/ No-longer Polymers List;
- ENCS: Existing and New Chemical Substances in Japan;
- KECI: Korea Existing Chemicals Inventory;
- NZIoC: New Zealand's Inventory of Chemicals;
- PICCS: Philippine Inventory of Chemicals and Chemical Substances;
- TSCA: Toxic Substances Control Act Chemical Substance Inventory in USA.

# APPENDIX G – SAFETY DATA SHEET DUKARE 1230

# SAFETY DATA SHEET

According to UN GHS, Annex 4 - Guidance on the Preparation of SDS

**Version** 4 **Issue date** 16-Nov-2016
**Product name** Fire suppression clean agent Dukare 1230 (FK-5-1-12) **Revision date** 3-Dec-2021

## 1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

**Product identifier**

| | |
|---|---|
| Product name | Fire suppression clean agent Dukare 1230 (FK-5-1-12) |
| Chemical name | 1,1,1,2,2,4,5,5,5- Nonafluoro-4-(Trifluoromethyl)-3-Pentanone |
| CAS No | 756-13-8 |
| REACH registration number | 01-2120426966-44-XXXX |

**Other means of identification**

| | |
|---|---|
| Synonym | Dodecafluoro-2-methyl-3-pentanone / Perfluoro(2-methyl-3-pentanone) |

**Recommended use of the chemical and restrictions on use**

| | |
|---|---|
| Recommended use | Extinguishing agents, cleaning agents, solvents, hear transfer/cooling liquid |
| Uses advised against | No information available |

**Details of the supplier of the safety data sheet**

| | |
|---|---|
| Supplier | Sinochem Lantian Trading Co., Ltd. / Sinochem Lantian Fluoro Materials Co., Ltd. |
| Address | Hangzhou / Shangyu, Zhejiang |
| Postal code | 310051 / 312369 |
| Phone | +86-571-87397288 |
| FAX | +86-571-88904247 |
| E-mail | wengyuanda@sinochem.com |
| | |
| EU OR | REACH24H Consulting Group |
| Address | Paramount Court, Corrig Road, Sandyford, Dublin 18, Ireland |
| Postal code | / |
| Phone | +353 1 8899 951 |
| FAX | +353 1 6865 683 |
| E-mail | reach@reach24h.com |

**Emergency telephone number**
+86-571-88844390

## 2. HAZARDS IDENTIFICATION

**Classification of the substance or mixture**
Hazardous to the aquatic environment, long-term (chronic) Category 3

**Label elements**

| | |
|---|---|
| Symbols/Pictograms | None |
| Signal word | None |
| Hazard statements | H412 - Harmful to aquatic life with long lasting effects |
| Precautionary statements | P273 - Avoid release to the environment<br>P501 - Dispose of contents/ container to an approved waste disposal plant |

**Other hazards**
No information available

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

**Description** Substance

| Chemical name | CAS No | Weight-% |
|---|---|---|
| 1,1,1,2,2,4,5,5,5-Nonafluoro-4-(Trifluoromethyl)-3-Pentanone | 756-13-8 | >= 99.90 |

## 4. FIRST AID MEASURES

**Description of first aid measures**

| | |
|---|---|
| General advice | Do not get in eyes, on skin, or on clothing. Do not breathe dust/fume/gas/mist/vapors/spray. In case of accident or unwellness, seek medical advice immediately (show directions for use or safety data sheet if possible). |
| Inhalation | IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Vapors are heavier than air and can cause suffocation by reducing oxygen available for breathing. Administer oxygen if breathing is difficult. Get medical advice/attention if you feel unwell. |
| Skin contact | Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Wash contaminated clothing before reuse. If skin irritation persists, call a physician. |
| Eye contact | IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention. |
| Ingestion | Not an expected route of exposure. If swallowed, do not induce vomiting: seek medical advice immediately and show this container or label. Never give anything by mouth to an unconscious person. |

**Most important symptoms and effects, both acute and delayed**

No information available.

**Indication of any immediate medical attention and special treatment needed**

Treat symptomatically.

## 5. FIRE-FIGHTING MEASURES

**Extinguishing media**

Suitable extinguishing media The substance can be used as extinguishing agent. Wear suitable respiratory equipment to protect from harmful gases caused by thermal decomposition.

Unsuitable extinguishing media No information available.

**Specific hazards arising from the chemical**

Thermal decomposition can lead to release of irritating and toxic gases and vapors, such as carbon monoxide, carbon dioxide, hydrogen fluoride.

**Protective equipment and precautions for firefighters**

Evacuate personnel to safe areas. Move containers from fire area if you can do it without risk. Cool drums with water spray. Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Stay upwind. Ensure adequate ventilation, especially in confined areas.

## 6. ACCIDENTAL RELEASE MEASURES

**Personal precautions, protective equipment and emergency procedures**

Evacuate personnel to safe areas. Remove all sources of ignition. Ensure adequate ventilation, especially in confined areas. Avoid contact with eyes and skin. Do not breathe dust/fume/gas/mist/vapors/spray. Do not eat, drink or smoke when using this product. Wash thoroughly after handling.

**Environmental precautions**

Local authorities should be advised if significant spillages cannot be contained. Prevent entry into waterways, sewers, basements or confined areas.

**Methods and material for containment and cleaning up**
Avoid breathing dust/fume/gas/mist/vapors/spray. Avoid release to the environment.

## 7. HANDLING AND STORAGE

**Precautions for safe handling**
Handle in accordance with good industrial hygiene and safety practice. Do not handle until all safety precautions have been read and understood. Keep away from heat, sparks, flame and other sources of ignition. Ensure adequate ventilation, especially in confined areas. Avoid contact with skin and eyes. Do not breathe dust/fume/gas/mist/vapors/spray. Do not eat, drink or smoke when using this product. Wash thoroughly after handling.

**Conditions for safe storage, including any incompatibilities**
Keep container tightly closed in a dry and well-ventilated place. Keep away from heat, sparks, flame and other sources of ignition. Keep locked up and out of reach of children. Keep away from food, drink and animal feeding stuffs. Store in accordance with local regulations.

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

**Control parameters**
**Exposure limits**
No data applicable

**Appropriate engineering controls**
Ensure adequate ventilation, especially in confined areas. Showers. Eyewash stations. Remove all sources of ignition.

**Individual protection measures, such as personal protective equipment**

| | |
|---|---|
| Respiratory protection | In case of insufficient ventilation, wear suitable respiratory equipment. |
| Hand protection | Wear protective gloves. |
| Eye/face protection | Wear safety glasses with side shields (or goggles). |
| Skin and body protection | Wear suitable protective clothing. |

## 9. PHYSICAL AND CHEMICAL PROPERTIES

**Information on basic physical and chemical properties**

| | |
|---|---|
| **Appearance** | Liquid |
| **Color** | Colorless |
| **Odor** | Faint odor |
| **Odor threshold** | Not determined |
| **pH** | Not determined |
| **Melting point/freezing point** | -108.0 °C |
| **Boiling point / boiling range** | 49.2 °C |
| **Flammability (solid, gas)** | Not flammable |
| **Flammability limit in air** | Not determined |
| **Flash point** | Not determined |
| **Autoignition temperature** | Not determined |
| **Decomposition temperature** | Not determined |
| **Kinematic viscosity** | Not determined |
| **Dynamic viscosity** | Not determined |
| **Solubility(ies)** | Practically insoluble in water |
| **Partition coefficient (LogPow)** | Not determined |
| **Vapor pressure** | 0.3260 bar (20 °C) |
| **Density** | 1.60 g/mL |
| **Relative density** | Not determined |
| **Vapor density** | 11.6 |

| | |
|---|---|
| **Evaporation rate** | Not determined |
| **Explosive properties** | Not an explosive |
| **Oxidizing properties** | Not determined |

**Other information**
No information available

## 10. STABILITY AND REACTIVITY

**Reactivity**
No information available.

**Chemical stability**
Stable under recommended storage conditions.

**Possibility of hazardous reactions**
Hazardous polymerization does not occur.

**Conditions to avoid**
No information available.

**Incompatible materials**
None known based on information supplied.

**Hazardous decomposition products**
Carbon monoxide, carbon dioxide, hydrogen fluoride.

## 11. TOXICOLOGICAL INFORMATION

**Acute toxicity**

| Chemical name | Route | Species | Value |
|---|---|---|---|
| 1,1,1,2,2,4,5,5,5-Nonafluoro-4-(Trifluoromethyl)-3-Pentanone | Oral | Rat | LD50 > 5000 mg/kg |
| 1,1,1,2,2,4,5,5,5-Nonafluoro-4-(Trifluoromethyl)-3-Pentanone | Dermal | Rat | LD50 > 2000 mg/kg |
| 1,1,1,2,2,4,5,5,5-Nonafluoro-4-(Trifluoromethyl)-3-Pentanone | Inhalation | Rat (4 hours) | LC50 > 5000 mg/m$^3$ |

**Skin corrosion/irritation**

| Chemical name | Species | Value |
|---|---|---|
| 1,1,1,2,2,4,5,5,5-Nonafluoro-4-(Trifluoromethyl)-3-Pentanone | Rabbit | Non-irritating to the skin. |

**Serious eye damage/eye irritation**

| Chemical name | Species | Value |
|---|---|---|
| 1,1,1,2,2,4,5,5,5-Nonafluoro-4-(Trifluoromethyl)-3-Pentanone | Rabbit | No eye irritation |

**Sensitization**

| Chemical name | Species | Value |
|---|---|---|
| 1,1,1,2,2,4,5,5,5-Nonafluoro-4-(Trifluoromethyl)-3-Pentanone | Guinea pig | No sensitization responses were observed. |

**Germ cell mutagenicity** (Mammalian Chromosome Aberration Test & Mammalian Cell Gene Mutation Test)

| Chemical name | Route | Value (to somatic cell) |
|---|---|---|
| 1,1,1,2,2,4,5,5,5-Nonafluoro-4-(Trifluoromethyl)-3-Pentanone | In Vitro | Not mutagenic |

**Carcinogenicity**
No information available.

**Reproductive toxicity**
No information available.

**STOT - single exposure**
No information available.

**STOT - repeated exposure** (28-Day (Subacute) Inhalation Toxicity Study)

| Chemical name | Route | Target organ | 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 \| heart \| endocrine system \| hematopoietic system \| muscles \| nervous system \| respiratory system \| vascular system | Rat | NOAEL 3000000 mg/m³ (6h/d, 5d/w) | 28 days |

**Aspiration hazard**
No information available.

## 12. ECOLOGICAL INFORMATION

**Ecotoxicity**

| Chemical name | Algae/aquatic plants EC50 | Fish LC50 | Crustacea EC50 |
|---|---|---|---|
| 1,1,1,2,2,4,5,5,5-Nonafluoro-4-(Trifluoromethyl)-3-Pentanone (CAS: 756-13-8) | 10.6 mg/L 96h Pseudokirchneriella subcapitata | > 1070 mg/L 96h Pimephales promelas | > 1080 mg/L 48h Daphnia magna |

**Persistence and degradability**
Not readily biodegradable.

**Bioaccumulation**
BCF = 1.2 - 4.8

**Mobility**
No information available.

**Other adverse effects**
No information available.

## 13. DISPOSAL CONSIDERATIONS

**Waste treatment methods**

| | |
|---|---|
| Waste from residues/unused products | Disposal should be in accordance with applicable regional, national and local laws and regulations. |
| Contaminated packaging | Disposal should be in accordance with applicable regional, national and local laws and regulations. |
| EU waste code (product as sold) | 07 01 03* Organic halogenated solvents, washing liquids and other mother liquors<br>14 06 02* Other halogenated solvents and solvent mixtures |

## 14. TRANSPORT INFORMATION

| | |
|---|---|
| **UN number** | Not regulated |
| **UN proper shipping name** | Not regulated |
| **Hazard class** | Not regulated |
| **Packing group** | Not regulated |
| **Environmental hazards** | Non-marine pollutant |
| **Special precautions** | No information available |
| **Transport in bulk according to Annex II of MARPOL and the IBC Code** | Not applicable |

## 15. REGULATORY INFORMATION

**International inventories**

| Component | AICS | DSL/NDSL | EINECS/ELINCS | ENCS | IECSC | KECL | PICCS | TSCA |
|---|---|---|---|---|---|---|---|---|
| 1,1,1,2,2,4,5,5,5-Nonafluoro-4-(Trifluoromethyl)-3-Pentanone ( >= 99 ) | X | X | X | X | X | X | - | X |

*"-" Not Listed*
*"X" Listed*

## 16. OTHER INFORMATION

**Revision note**

| | |
|---|---|
| Issue date | 16-Nov-2016 |
| Revision date | 19-Oct-2019 |
| Revision note | Add REACH information |
| Revision date | 07-May-2021 |
| Revision note | Add EU waste code (product as sold) |
| Revision date | 24-Sept-2021 |
| Revision note | Revise "Product name", add "Chemical name" |
| Revision date | 3-Dec-2021 |
| Revision note | Add toxicological information(Germ cell mutagenicity & STOT-repeated exposure) |

**Key or legend to abbreviations and acronyms used in the safety data sheet**

**TWA** - TWA (Time Weighted Average)
**STEL** - STEL (Short Term Exposure Limit)
**Ceiling** - Maximum limit value
**TSCA** - Toxic Substances Control Act Section 8(b) Inventory
**DSL/NDSL** - Canadian Domestic Substances List/Non-Domestic Substances List
**IECSC** - Chinese Inventory of Existing Chemical Substances
**EINECS/ELINCS** - European INventory of Existing Commercial chemical Substances/European LIst of Notified Chemical Substances
**ENCS** - Japanese Existing and New Chemical Substances
**KECL** - Korea Existing Chemicals List
**NZIoC** - New Zealand Inventory of Chemicals
**PICCS** - The Philippine Inventory of Chemicals and Chemical Substances
**AICS** - The Australian Inventory of Chemical Substances

**Disclaimer**

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

-------- End of Safety Data Sheet --------

# APPENDIX H – SAFETY DATA SHEET NOAH® 5112



## SECTION 1: Identification of the substance/mixture and of the company/undertaking

### 1.1 Product identifier

Trade name: Fire Protection Fluid NY5112
Chemical name: 1,1,1,2,2,4,5,5,5-Nonafluoro-4-(Trifluoromethyl)-3-Pentanone

CAS-Number: 756-13-8
EC-number: 436-710-6

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

General use: Streaming and flooding fire protection
For industrial purposes only.

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

Company name: Zhejiang NOAH Fluorochemical Co., Ltd.
Street/POB-No.: Hangzhou Bay Economic Development Zone
Postal Code, city: Zhejiang province
China
Telephone: +86-571-88215295
Telefax: +86-571-85812333
Dept. responsible for information:
Zhejiang NOAH Fluorochemical Co., Ltd.,
Telephone: +86-571-88215295, E-mail: shentuhui@zjnoah.cn

### 1.4 Emergency telephone number

**Zhejiang NOAH Fluorochemical Co., Ltd., Telephone: +86-575-82738216**

## SECTION 2: Hazards identification

### 2.1 Classification of the substance or mixture

**Classification according to EC regulation 1272/2008 (CLP)**
Aquatic Chronic 3; H412 Harmful to aquatic life with long lasting effects.

### 2.2 Label elements

**Labelling (CLP)**

Hazard statements: H412 Harmful to aquatic life with long lasting effects.

Precautionary statements:
P273 Avoid release to the environment.
P501 Dispose of contents/container to hazardous or special waste collection point.

### 2.3 Other hazards

Thermal decomposition: Inhaling hazardous decomposing products can cause serious health damage.
Vapour undergoes indirect photolysis in the troposhere. Degradation products: Hydrogen fluoride, Carbon dioxide, Trifluoroacetic acid.
Atmospheric lifetime: approx. 5 days.

Results of PBT and vPvB assessment:
No data available

## SECTION 3: Composition / information on ingredients

### 3.1 Substances

Chemical characterisation: C6 F12 O
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(Trifluoromethyl)-3-Pentanone, >=99%

CAS-Number: 756-13-8
EC-number: 436-710-6

## SECTION 4: First aid measures

### 4.1 Description of first aid measures

In case of inhalation: Move victim to fresh air; if necessary, provide artificial respiration or oxygen. Put victim at rest and keep warm. In the event of persistent symptoms seek medical treatment.

Following skin contact: Thoroughly wash skin with soap and water. In case of skin irritation, consult a physician.

After eye contact: Immediately flush eyes with plenty of flowing water for 10 to 15 minutes holding eyelids apart. Remove contact lenses, if present and easy to do. Continue rinsing. In case of troubles or persistent symptoms, consult an opthalmologist.

After swallowing: Rinse mouth with water. Seek medical attention.

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

No data available

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

Treat symptomatically.

## SECTION 5: Firefighting measures

### 5.1 Extinguishing media

Suitable extinguishing media:
Use extinguishing material as appropriate for the surrounding area.

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

In case of fire may be liberated: Hydrogen fluoride, carbon monoxide and carbon dioxide.

### 5.3 Advice for firefighters

Special protective equipment for firefighters:
Wear a self-contained breathing apparatus and chemical protective clothing.

Additional information: Hazchem-Code: -
Fire residuals and contaminated extinguishing water must be disposed of in accordance with the regulations of the local authorities. Use water spray jet to knock down vapours. Do not breathe fumes. Do not allow fire water to penetrate into surface or ground water.

## SECTION 6: Accidental release measures

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

Ventilate affected area. Do not breathe vapour/aerosol. Wear appropriate protective equipment. Keep unprotected people away.

### 6.2 Environmental precautions

Do not allow to penetrate into soil, waterbodies or drains.
If necessary notify appropriate authorities.

### 6.3 Methods and material for containment and cleaning up

Absorb with liquid-binding material (e.g. sand, diatomaceous earth, acid- or universal binding agents) and place in closed containers for disposal.
In case of spills of large quantities: Stop leak if safe to do so. Dam spills. Cover spilled material with extinguishing powder or pulverized limestone and collect mechanically. Collect in closed containers for disposal. Cleaning with water/cleaning agent.

### 6.4 Reference to other sections

Refer additionally to section 8 and 13.

## SECTION 7: Handling and storage

### 7.1 Precautions for safe handling

Advices on safe handling: Do not breathe vapour/aerosol. Wear appropriate protective equipment.

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

Requirements for storerooms and containers:
Keep container tightly closed in a cool, well-ventilated place. Protect from heat and direct sunlight. Store in a dry place.

Hints on joint storage: Do not store together with: Strong bases, amines, alcohols.

### 7.3 Specific end use(s)

No information available.

## SECTION 8: Exposure controls/personal protection

### 8.1 Control parameters

Additional information: Manufacturer information: TWA: 150 ppm

### 8.2 Exposure controls

Provide adequate ventilation, and local exhaust as needed.

### Personal protection equipment

#### Occupational exposure controls

Respiratory protection: Use a breathing protection against vapours/aerosol.
The filter class must be suitable for the maximum contaminant concentration (gas/vapour/aerosol/particulates) that may arise when handling the product. If the concentration is exceeded, self-contained breathing apparatus must be used.

Hand protection: Protective gloves according to EN 374. Observe glove manufacturer's instructions concerning penetrability and breakthrough time.

Eye protection: Tightly sealed goggles according to EN 166

Body protection: Wear suitable protective clothing.

General protection and hygiene measures:
Do not breathe vapour/aerosol. Change contaminated clothing. When using do not eat, drink or smoke. Wash hands before breaks and after work. Keep away from food, drink and animal feedingstuffs.

## SECTION 9: Physical and chemical properties

### 9.1 Information on basic physical and chemical properties

| | |
|---|---|
| Appearance: | Form: liquid<br>Colour: colourless, clear |
| Odour: | weak |
| Odour threshold: | No data available |
| pH value: | not applicable |
| Melting point/freezing point: | -108 °C |
| Initial boiling point and boiling range: | 49 °C |
| Flash point/flash point range: | not applicable |
| Evaporation rate: | (Butyl acetate =1) >= 1 |
| Flammability: | No data available |
| Explosion limits: | LEL (Lower Explosion Limit): not applicable<br>UEL (Upper Explosive Limit): not applicable |
| Vapour pressure: | at 20 °C: 328 hPa |
| Vapour density: | (Air =1) 11.6 |
| Density: | at 20 °C: 1.6 g/mL |
| Water solubility: | insoluble |
| Partition coefficient: n-octanol/water: | No data available |
| Auto-ignition temperature: | not applicable |
| Decomposition temperature: | No data available |
| Viscosity, dynamic: | at 25 °C: 0.6 mPa*s |
| Explosive properties: | No data available |
| Oxidizing characteristics: | No data available |

### 9.2 Other information

| | |
|---|---|
| Molecular weight | 316.04 g/mol |
| Additional information: | No data available |

## SECTION 10: Stability and reactivity

### 10.1 Reactivity

refer to 10.3

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No dangerous reactions with proper and specified storage and handling

### 10.4 Conditions to avoid

Protect from heat and direct sunlight.

### 10.5 Incompatible materials

Strong bases, amines, alcohols.

### 10.6 Hazardous decomposition products

Hydrogen fluoride, carbon monoxide and carbon dioxide.

Thermal decomposition: No data available

## SECTION 11: Toxicological information

### 11.1 Information on toxicological effects

Toxicological effects: Acute toxicity (oral): Lack of data.
Acute toxicity (dermal): Lack of data.
Acute toxicity (inhalative): Lack of data.
Skin corrosion/irritation: Lack of data.
Eye damage/irritation: Lack of data.
Sensitisation to the respiratory tract: Lack of data.
Skin sensitisation: Lack of data.
Germ cell mutagenicity/Genotoxicity: Lack of data.
Carcinogenicity: Lack of data.
Reproductive toxicity: Lack of data.
Effects on or via lactation: Lack of data.
Specific target organ toxicity (single exposure): Lack of data.
Specific target organ toxicity (repeated exposure): Lack of data.
Aspiration hazard: Lack of data.

## SECTION 12: Ecological information

### 12.1 Toxicity

Aquatic toxicity: Harmful to aquatic life with long lasting effects.

### 12.2. Persistence and degradability

Further details: Vapour undergoes indirect photolysis in the troposhere. Degradation products: Hydrogen fluoride, Carbon dioxide, Trifluoroacetic acid.
Atmospheric lifetime: 3 - 5 days.

### 12.3 Bioaccumulative potential

Partition coefficient: n-octanol/water:
No data available

### 12.4 Mobility in soil

No data available

### 12.5 Results of PBT and vPvB assessment

No data available

### 12.6 Other adverse effects

General information: Do not allow to enter into ground-water, surface water or drains.

## SECTION 13: Disposal considerations

### 13.1 Waste treatment methods

**Product**

Waste key number: 07 01 03* = Organic halogenated solvents, washing liquids and mother liquors
* = Evidence for disposal must be provided.

Recommendation: Dispose of as special waste in compliance with local and national regulations.

**Contaminated packaging**

Recommendation: Dispose of waste according to applicable legislation. Handle contaminated packages in the same way as the substance itself. Non-contaminated packages may be recycled.

## SECTION 14: Transport information

### 14.1 UN number

ADR/RID, IMDG, IATA-DGR:
not applicable

### 14.2 UN proper shipping name

ADR/RID, IMDG, IATA-DGR:
Not restricted

### 14.3 Transport hazard class(es)

ADR/RID, IMDG, IATA-DGR:
not applicable

### 14.4 Packing group

ADR/RID, IMDG, IATA-DGR:
not applicable

### 14.5 Environmental hazards

Marine pollutant: no

### 14.6 Special precautions for user

No dangerous good in sense of these transport regulations.

### 14.7 Transport in bulk according to Annex II of Marpol and the IBC Code

No data available

## SECTION 15: Regulatory information

### 15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

**National regulations - Great Britain**

Hazchem-Code: -

No data available

**National regulations - EC member states**

Volatile organic compounds (VOC):

100 % by weight = 1600 g/L

### 15.2 Chemical Safety Assessment

No data available

## SECTION 16: Other information

**Further information**

Date of first version: 25/1/2017

**Department issuing data sheet**

Contact person: see section 1: Dept. responsible for information

For abbreviations and acronyms, see: ECHA Guidance on information requirements and chemical safety assessment, chapter R.20 (Table of terms and abbreviations).

The information in this data sheet has been established to our best knowledge and was up-to-date at time of revision. It does not represent a guarantee for the properties of the product described in terms of the legal warranty regulations.

# APPENDIX I – SAFETY DATA SHEET COMPRESSED NITROGEN

# Safety Data Sheet

## Nitrogen

**Allied Gases & Welding Supplies, Inc.**
945 E. Curry Rd.
Tempe, AZ 85281
(480) 894-6000
alliedgases.com

## Section 1: Product and Company Identification

**Allied Gases & Welding Supplies, Inc.**
945 E. Curry Rd.
Tempe, AZ 85281
(480) 894-6000
alliedgases.com

Product Code: Nitrogen
SDS Number: 9010

## Section 2: Hazards Identification

**Warning**

### Hazard Classification:
Gases Under Pressure

### Hazard Statements:
Contains gas under pressure; may explode if heated

### Precautionary Statements

**Storage:**
Protect from sunlight.
Store in well-ventilated place.

## Section 3: Composition/Information on Ingredients

| CAS # |
|---|
| 7727-37-9 |

| Chemical Substance | Chemical Family | Trade Names |
|---|---|---|
| NITROGEN, COMPRESSED GAS | inorganic, gas | DIATOMIC NITROGEN; DINITROGEN; NITROGEN; NITROGEN-14; NITROGEN GAS; UN 1066; N2 |

## Section 4: First Aid Measures

| Skin Contact | Eye Contact | Ingestion | Inhalation | Note to Physicians |
|---|---|---|---|---|
| Wash exposed skin with soap and water. | Flush eyes with plenty of water. | If a large amount is swallowed, get medical attention. | If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention. | For inhalation, consider oxygen. |

## Section 5: Fire Fighting Measures

| Suitable Extinguishing Media | Products of Combustion | Protection of Firefighters |
|---|---|---|
| Non-flammable. Use suitable extinguishing media for surrounding fire. Cylinders may rupture or explode if exposed to heat. | Non-flammable | ▪ Respiratory protection may be needed for frequent or heavy exposure. |

## Section 6: Accidental Release Measures

| Personal Precautions | Environmental Precautions | Methods for Containment |
|---|---|---|
| Keep unnecessary people away, isolate hazard area and deny entry. Stay upwind and keep out of low areas. | No significant effects from contamination expected. | Stop leak if possible without personal risk. |

| Methods for Cleanup | Other Information |
|---|---|
| N/A | N/A |

## Section 7: Handling and Storage

| Handling | Storage |
|---|---|
| Store and handle in accordance with all current regulations and standards. Subject to storage regulations: U.S. OSHA 29 CFR 1910.101. | Keep separated from incompatible substances. |

## Section 8: Exposure Controls/Personal Protection

| Exposure Guidelines |
|---|
| NITROGEN, COMPRESSED GAS: NITROGEN: ACGIH (simple asphyxiant) |

### Engineering Controls

Handle only in fully enclosed systems.

| Eye Protection | Skin Protection | Respiratory Protection |
|---|---|---|
| Eye protection not required, but recommended. | Protective clothing is not required. | Respiratory protection may be needed for frequent or heavy exposure. |

### General Hygiene considerations

- Avoid breathing vapor or mist
- Avoid contact with eyes and skin
- Wash thoroughly after handling and before eating or drinking

## Section 9: Physical and Chemical Properties

| Physical State | Appearance | Color | Change in Appearance | Physical Form | Odor | Taste |
|---|---|---|---|---|---|---|
| Gas | Clear | Colorless | N/A | Gas | Odorless | Tasteless |

| Flash Point | Flammability | Partition Coefficient | Autoignition Temperature | Upper Explosive Limits | Lower Explosive Limits |
|---|---|---|---|---|---|
| Not flammable | Not available | Not available | Nonflammable | Nonflammable | Nonflammable |

| Boiling Point | Freezing Point | Vapor Pressure | Vapor Density | Specific Gravity | Water Solubility | pH | Odor Threshold | Evaporation Rate | Viscosity |
|---|---|---|---|---|---|---|---|---|---|
| -321 F (-196 C) | -346 F (-210 C) | 760 mmHg @ -196 C | 0.967 (Air=1) | Not applicable | 1.6% @ 20 C | Not applicable | Not available | Not applicable | 0.01787 cP @ 27 C |

| Molecular Weight | Molecular Formula | Density | Weight per Gallon | Volatility by Volume | Volatility | Solvent Solubility |
|---|---|---|---|---|---|---|
| 28.0134 | N2 | 1.2506 g/L | Not available | 100% | 1 | Soluble: Liquid ammonia |

## Section 10: Stability and Reactivity

| Stability | Conditions to Avoid | Incompatible Materials |
|---|---|---|
| Stable at normal temperatures and pressure. | Stable at normal temperatures and pressure. | Metals, oxidizing materials |

| Hazardous Decomposition Products | Possibility of Hazardous Reactions |
|---|---|
| Oxides of nitrogen | Will not polymerize. |

## Section 11: Toxicology Information

### Acute Effects

| Oral LD50 | Dermal LD50 | Inhalation |
|---|---|---|
| Not available | Not available | Nausea, vomiting, difficulty breathing, headache, drowsiness, dizziness, tingling sensation, loss of coordination, convulsions, coma |

| Eye Irritation | Skin Irritation | Sensitization |
|---|---|---|
| Contact with rapidly expanding gas may cause burns or frostbite | No information on significant adverse effects | Difficulty breathing |

### Chronic Effects

| Carcinogenicity | Mutagenicity | Reproductive Effects | Developmental Effects |
|---|---|---|---|
| Not hazardous | Not available | Not available | No data |

## Section 12: Ecological Information

### Fate and Transport

| Eco toxicity | Persistence / Degradability | Bioaccumulation / Accumulation | Mobility in Environment |
|---|---|---|---|
| Fish toxicity: Not available<br>Invertibrate toxicity: Not available<br>Algal toxicity: Not available<br>Phyto toxicity: Not available<br>Other toxicity: Not available | Not available | Not available | Not available |

## Section 13: Disposal Considerations

Dispose in accordance with all applicable regulations.

## Section 14: Transportation Information

### U.S. DOT 49 CFR 172.101

| Proper Shipping Name | ID Number | Hazard Class or Division | Packing Group | Labeling Requirements | Passenger Aircraft or Railcar Quantity Limitations | Cargo Aircraft Only Quantity Limitations | Additional Shipping Description |
|---|---|---|---|---|---|---|---|
| Nitrogen, compressed | UN1066 | 2.2 | Not applicable | 2.2 | 75 kg or L | 150 kg | N/A |

### Canadian Transportation of Dangerous Goods

| Shipping Name | UN Number | Class | Packing Group / Risk Group |
|---|---|---|---|
| Nitrogen, compressed | UN1066 | 2.2 | Not applicable |

## Section 15: Regulatory Information

### U.S. Regulations

| CERCLA Sections | SARA 355.30 | SARA 355.40 |
|---|---|---|
| Not regulated. | Not regulated. | Not regulated. |

### SARA 370.21

| Acute | Chronic | Fire | Reactive | Sudden Release |
|---|---|---|---|---|
| Yes | No | No | No | Yes |

### SARA 372.65

Not regulated.

### OSHA Process Safety

Not regulated.

### State Regulations

| CA Proposition 65 |
|---|
| Not regulated. |

### Canadian Regulations

| WHMIS Classification |
|---|
| A |

### National Inventory Status

| US Inventory (TSCA) | TSCA 12b Export Notification | Canada Inventory (DSL/NDSL) |
|---|---|---|
| Listed on inventory. | Not listed. | Listed on inventory. |

## Section 16: Other Information

| NFPA Rating |
|---|
| HEALTH=1 FIRE=0 REACTIVITY=0 |

0 = minimal hazard, 1 = slight hazard, 2 = moderate hazard, 3 = severe hazard, 4 = extreme hazard