



DESIGN, INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

FOR

CLEAN AGENT SELF CONTAINED AUTOMATIC FIRE EXTINGUISHER UNITS

DESIGNED FOR USE WITH:

FK-5-1-12 FIRE PROTECTION AGENT

940205 CYLINDER ASSEMBLY, DOT, ILP, M10X1 GAUGE, FK-5-1-12, 2.5LB

940555 CYLINDER ASSEMBLY, DOT, ILP, M10X1 GAUGE, FK-5-1-12, 5LB

941055 CYLINDER ASSEMBLY, DOT, ILP, M10X1 GAUGE, FK-5-1-12, 10LB

942055 CYLINDER ASSEMBLY, DOT, ILP, M10X1 GAUGE, FK-5-1-12, 20LB

Document: 800027-A (DIOM, ILP, DOT, FK-5-1-12, 195 PSI)



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1 FOREWORD

This manual is written for the fire protection professional that designs, installs, and maintains Firetrace Pre-Engineered ILP (Indirect 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.

Pre-Engineered ILP Automatic Suppression 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, DIOM 800027
- All information contained on the agent cylinder nameplate(s)
- NFPA 2001: Standard on Clean Agent Fire Extinguishing Systems
- FM Approvals (FM 5600)
- UL Listing (UL 2166)
- Local authority having jurisdiction

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 FK-5-1-12 Fire Suppression Systems and equipment. If safety precautions are overlooked or ignored, personal injury or property damage may occur.

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



DANGER:

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



WARNING:

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



CAUTION:

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

1.2 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. The valve discharge outlet safety plug(s) **MUST** be installed on the cylinder valve at all times and only removed when connected to the discharge network or when performing charging, testing, or salvaging operations in accordance with the procedures contained in this manual.
3. Wear safety glasses when working with pressurized cylinders and charging equipment. It is recommended to wear leather gloves to avoid any cryogenic burns if FK-5-1-12 is accidentally discharged on or near the skin.
4. Make sure that the ball valve (attached to the top of the cylinder valve) is closed (lever is in "OFF" position), the detection tubing has been removed from the cylinder valve and the safety caps installed before removing the cylinder from the installation and before performing any charging, leak tests or salvage operations.
5. Follow all the safety procedures included on the cylinder nameplate and in this manual.
6. Never assume that a cylinder is empty. Treat all cylinders as if they are fully charged.

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

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2 INTRODUCTION

The Firetrace Indirect Low Pressure (ILP) FK-5-1-12 Clean Agent Automatic Fire Extinguisher Unit is UL Listed by Underwriters Laboratories Inc, ULC Listed by Underwriters Laboratories of Canada, and approved with FM Approvals. These units are designed for total flooding applications using FK-5-1-12 Clean Agent in accordance NFPA 2001: Standard on Clean Agent Fire Extinguishing Systems.

The Firetrace Self-Contained Automatic Units have been tested to limits established by UL/ULC/FM in compliance with the requirements specified in UL 2166 and FM 5600, and as detailed in this Manual.

Each installed Self-Contained unit is equipped with detection tubing, discharge piping, and nozzles. The Self-Contained concept minimizes the amount of engineering involved in the units design. When the discharge piping and nozzles are installed within the limitations stated in this manual no hydraulic calculations are required to determine pressure drop, agent flow, or discharge time.

The hazard being protected can be any size, shape, or volume provided that the hazard being protected is within the limitations described in this Manual. Each extinguisher unit, when installed, is a self-contained unit, meaning that it is equipped with its own automatic (non-electric) detection system, which when actuated, automatically releases the suppression agent into the hazard area.

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

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

2.1 Fire Suppression Agent

The suppression agent used in Firetrace self-contained automatic indirect fire suppression systems is dodecafluoro-2-methylpentan-3-one and can either be 3M™ Novec™ 1230 or FK-5-1-12 which has been reviewed & tested by Firetrace.

FK-5-1-12, depicted by the chemical formula $\text{CF}_3\text{CF}_2\text{C}(\text{O})\text{CF}(\text{CF}_3)_2$, 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

Please refer to the Material Safety Data sheets located in the appendices for hazard information, decomposition information, and physical properties of FK-5-1-12 agents.

3 SYSTEM DESCRIPTION

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

- 940205 - CYLINDER ASSEMBLY, DOT, ILP, M10X1 GAUGE, FK-5-1-12, 2.5LB
- 940555 - CYLINDER ASSEMBLY, DOT, ILP, M10X1 GAUGE, FK-5-1-12, 5LB
- 941055 - CYLINDER ASSEMBLY, DOT, ILP, M10X1 GAUGE, FK-5-1-12, 10LB
- 942055 - CYLINDER ASSEMBLY, DOT, ILP, M10X1 GAUGE, FK-5-1-12, 20LB

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 – Energized 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 Indirect Low Pressure (ILP) Clean Agent Extinguisher Systems can be used, but are not limited, to protect the following:

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

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 Indirect Low Pressure (ILP) 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)
- Discharge Nozzle(s)
- Discharge Network & Fittings
- Pressure Switch (Optional)

Once installed, the Firetrace Pre-Engineered Automatic Indirect Low Pressure (ILP) Clean Agent Extinguisher System becomes a self-contained, self-actuating unit that does not require an external power source.

The unit utilizes a UL recognized (per UL Standard 521) linear heat detector (see Certificate of Compliance 20140705-S35465) known as Firetrace Detection Tubing (FDT). 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 detection tubing is ruptured, the valve automatically opens, allowing the FK-5-1-12 agent to flow through the discharge piping, distributing the extinguishing agent through the nozzle(s) into the protected volume.

Upon actuation, the pressure switch can be used to indicate discharge, shutdown ventilation, close all openings, shut-off electrical power, etc. as may be required.

3.1 Component Descriptions

See appendices for full parts lists.

3.2 FK-5-1-12 Cylinders (100300, 100600, 101200, 120020)

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 3-1 describes the 2.5, 5, 10 and 20 Lb system assemblies. Each cylinder is equipped with a straight siphon tube and can only be mounted in a vertical (upright) position (±30°).

Cylinder Part No.	Nominal Capacity	Cylinder Diameter		Cylinder Height		Cylinder Volume		Agent Mass	
		In.	Cm	In.	Cm	In3	Cm3	Lb	Kg
100300	2.5 lb	3.0	7.62	17.38	44.15	75	1229	2.5	1.13
100600	5 lb	4.25	10.80	17.49	44.42	145	2376	5	2.27
101200	10 lb	6.32	16.05	17.68	44.91	300	4,916	10	4.54
120020	20 lb	7.08	18.0	20.05	50.90	676	11,077	20	9.07

Table 1 - FK-5-1-12 Cylinder Dimensions

Cylinder Part No.	Nominal Capacity	Volume		Cylinder Specification	Cylinder Service Pressure		Cylinder Test Pressure	
		in ³	cm ³		psig	kPa	psig	kPa
100300	2.5 lb	75	1229	DOT 4B240	240	1,655	480	3,310
100600	5 lb	145	2376	DOT 4B240	240	1,655	480	3,310
101200	10 lb	300	4,916	DOT 4B360	360	2,482	720	4,964
120020	20 lb	676	11,077	UL-299	195	1,344	585	4,033

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

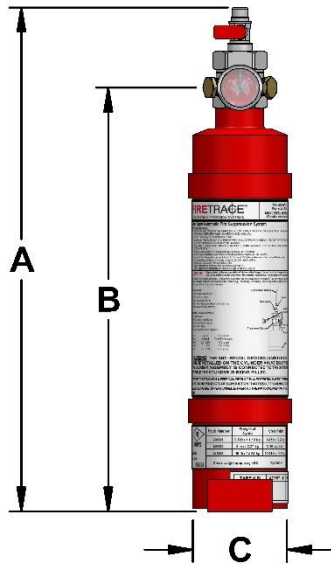


Figure 1 – Unit Assembly

Unit Assembly Part Number	Cylinder Part No.	Agent		Dimension "A"		Dimension "B"		Dimension "C"	
		lb	kg	in	cm	in	cm	in	cm
940205	100300	2.5	1.13	15.7	39.8	13.2	33.5	2.9	7.4
940555	100600	5	2.27	16.7	42.3	13.6	34.6	4.3	10.9
941055	101200	10	4.54	16.9	42.9	13.8	35.1	6.4	16.2
942055	120020	20	9.07	24.6	62.5	21.1	53.6	8.4	21.3

Table 3 – Unit Assembly Dimensions

3.1 Cylinder Mounting Bracket (100003, 100006, 111206, 111020)

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 2 – Cylinder Mounting Bracket Bolt Pattern, Table 4 – 940205 Cylinder Mounting Bracket Dimensions, Table 5 – 940555 Cylinder Mounting Bracket Dimensions, Table 6 – 941055 Cylinder Mounting Bracket Dimensions and Table 7 – 942055 Cylinder Mounting Bracket Dimensions for cylinder mounting bracket dimensions.

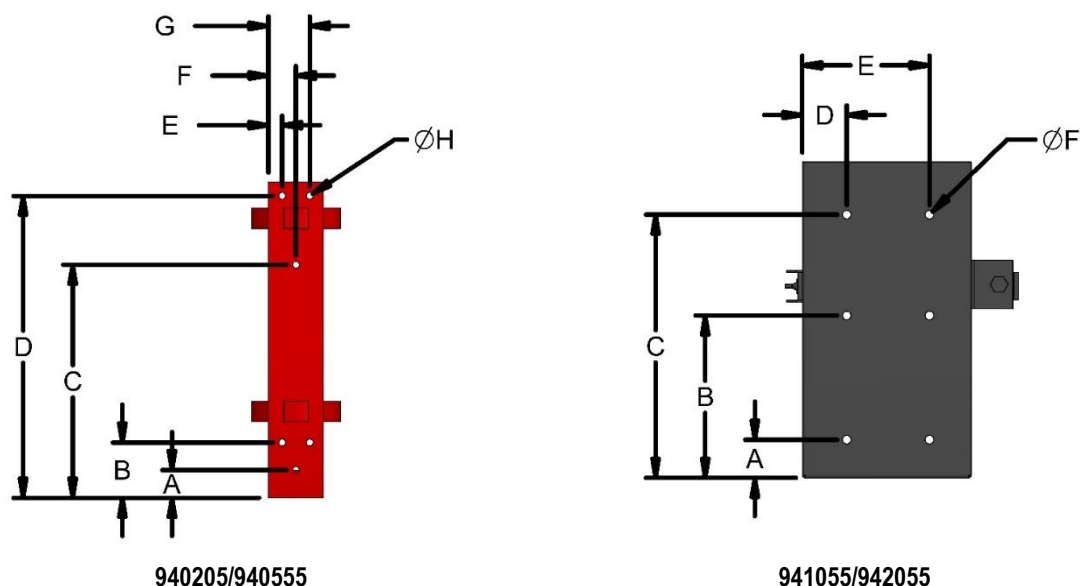


Figure 2 – Cylinder Mounting Bracket Bolt Pattern

Table 4 – 940205 Cylinder Mounting Bracket Dimensions

"A"		"B"		"C"		"D"		"E"		"F"		"G"		"H"	
in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
1.0	2.7	2.0	5.2	9.0	22.9	11.0	28.0	.5	1.3	1.0	2.7	1.5	3.8	1/4	0.6

Table 5 – 940555 Cylinder Mounting Bracket Dimensions

"A"		"B"		"C"		"D"		"E"		"F"		"G"		"H"	
in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
1.0	2.7	2.0	5.2	9.0	22.9	11.0	28.0	.5	1.3	1.0	2.7	1.5	3.8	1/4	0.6

Table 6 – 941055 Cylinder Mounting Bracket Dimensions

"A"		"B"		"C"		"D"		"E"		"F"	
in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
1.4	3.6	5.9	15.0	9.4	23.9	1.4	3.5	4.6	11.7	7/16	1.1

Table 7 – 942055 Cylinder Mounting Bracket Dimensions

"A"		"B"		"C"		"D"		"E"		"F"	
in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
2.3	5.8	7.4	18.8	12.0	30.5	1.5	3.8	6.5	16.5	7/16	1.1

3.2 Cylinder Valves (300112 & 302118)

Each cylinder is equipped with a nickel-plated brass valve. The cylinder valves are backpressure type design. A piston in the valve bore is equipped with a seat seal that keeps the FK-5-1-12 clean agent under pressure within the cylinder. A small hole in the piston allows cylinder pressure to equalize on both sides of the piston. Since the surface area above the piston is greater than the surface area below the piston, the net force seals the piston against the primary valve seal. When the pressure above the piston is relieved by any means, there is only cylinder pressure acting against the piston seal and the piston slides to its fully open position, allowing for agent discharge.

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.

The 940205 unit assembly is equipped with a small ILP valve (300112) containing two 1/4 in NPT discharge ports. The 940555, 941055 and 942055 unit assemblies are equipped with a medium ILP valve (302118) containing two 1/2 in NPT discharge ports.

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

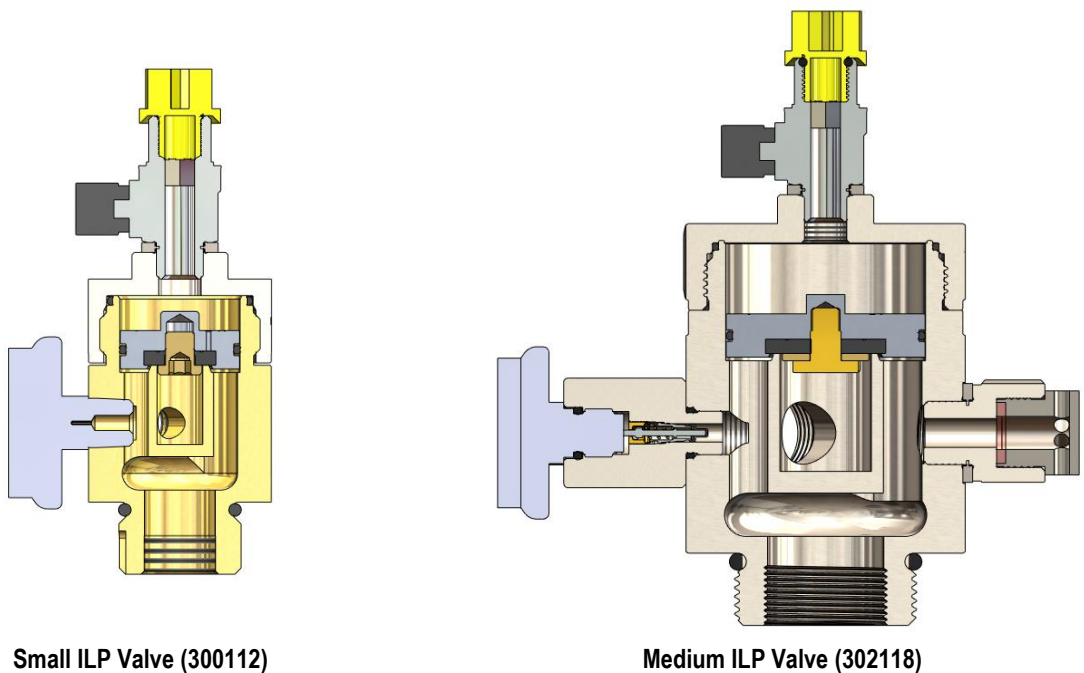
Each valve is also equipped with (2) discharge outlet ports. Each outlet port is provided with a safety plug that must be installed in the discharge outlet whenever a system is not in service. These plugs are safety devices designed to prevent uncontrolled discharge of the system in the event that the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



WARNING

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

NOTE: All Firetrace FK-5-1-12 ILP Units utilize a straight siphon tube. All Firetrace FK-5-1-12 ILP Units are to be installed only in a vertical (valve on top) position.



Small ILP Valve (300112)

Medium ILP Valve (302118)

Figure 3 – Cylinder Valves

3.3 Firetrace Detection Tubing (200005)

The Firetrace Detection Tubing (FDT) is a UL recognized component per UL standard 521 (See Certificate of Compliance 20140705-S35465). 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, 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 383°F (195°C). The rupture of the tube releases the nitrogen pressure causing the cylinder valve to actuate, resulting in complete discharge of the FK-5-1-12 agent through the discharge network and ultimately from the discharge nozzles throughout the protected enclosure.

Table 8 - Firetrace Detection Tubing Properties

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

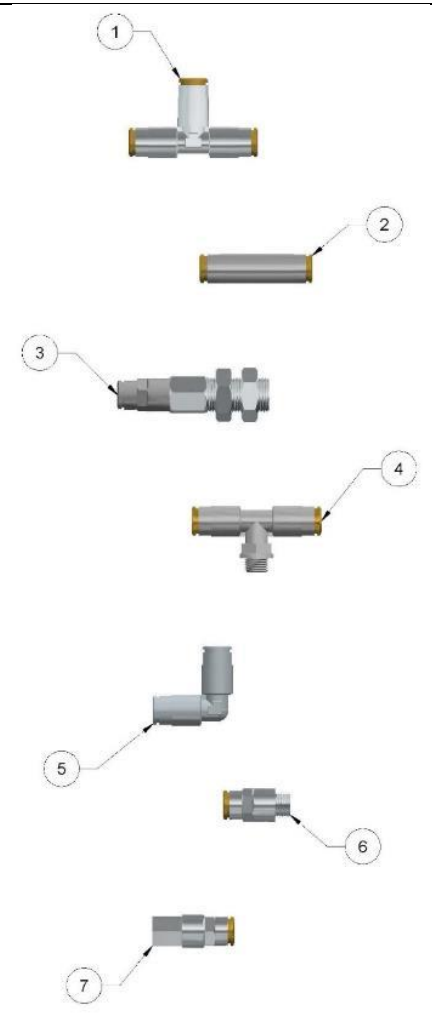
Table 9 – Firetrace Detection Tube Part Numbers

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

3.4 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 Grommet
NP	200153	Plastic Grommet
NP	200172	Mounting Tab
NP	200182	Magnetic Mounting Clips
1	200157	Tube Tee
2	200158	Tube Union
NP	200159	Tube to Threads Elbow
3	200168	Tube to End of Line Adapter
NP	200169	Tube Tee to In Line Adapter
4	200177	Tube Tee to Threads
5	200178	Tube Elbow
6	200179	Tube to Threads Union
7	200203	Tube Plug
NP	310303	End of Line Adapter Plug with O-Ring
NP	201170	Tube to End of Line Adapter Elbow
NP	200185	Tube Fitting End Cap G1/8
NP	200195	End of Line Adapter
NP	200162	Tubing Bulkhead Assembly
NP – PARTS NOT PICTURED		



3.5 Pressure Gauge (400195)

The Firetrace FK-5-1-12 pressure gauge, is used as part of the cylinder valve pressure gauge, manual release 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, manual release and End of Line mounted locations).

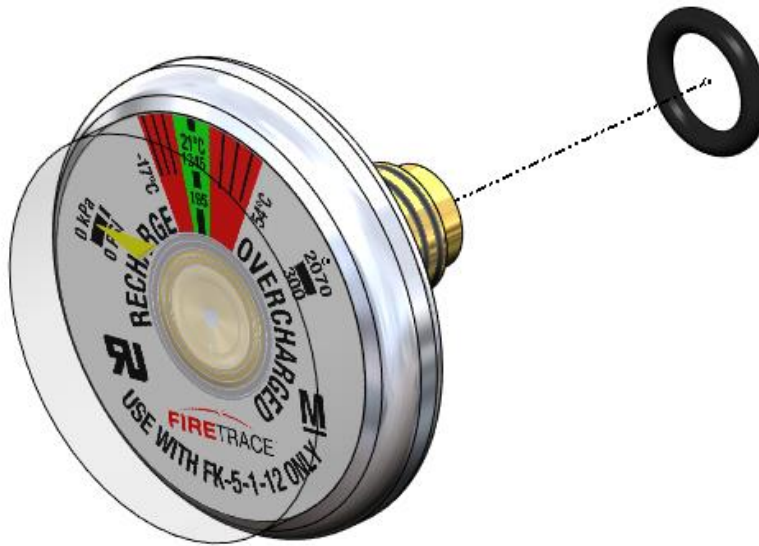


Figure 4 – FK-5-1-12 Pressure Gauge

3.6 Manual Release (600055)

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

The tube fitting on the body of the manual release allows for easy installation onto the system detection line network. The pull tab on the plunger prevents accidental activation of the manual release. The port on the body of the manual release is used to pressurize the tubing and allows for installation of a pressure gauge to monitor system pressure, refer to Figure 5 – Manual Release.

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

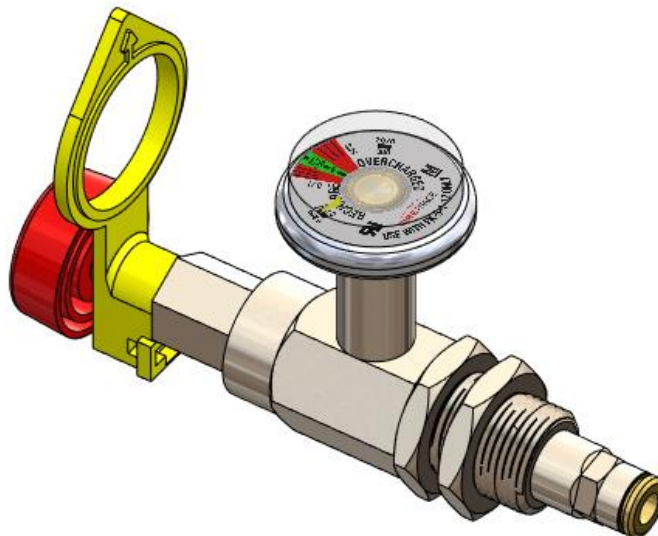


Figure 5 – Manual Release

3.6.1 Manual Release Rebuild Kit (600076)

A rebuild kit is available that contains a replacement burst disc, pull tab and anti-tamper seal along with guidelines of how to reassemble the device.

3.7 Discharge Network

3.7.1 Pipe, Fittings, and Pipe Supports

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

3.7.1.1 Pipe Requirements

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

The 2.5lb assembly, 940205 should only use copper discharge piping.

The 5lb (940555), 10lb (941055) and 20lb (942055) are able to use either copper discharge piping or the Firetrace supplied flexible discharge hoses.

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

3.7.1.2 Pipe Fittings and Pipe Joining

Piping, fittings, and pipe supports shall be in accordance with the latest edition of NFPA 2001 available from National Fire Protection Association. Temperature and pressure ratings of the fittings must not be exceeded. The method of joining all pipe must be in accordance with the latest requirements listed in NFPA 2001.

3.7.1.3 Pipe Supports

Piping shall be securely supported by listed and/or approved hangers. Pipe supports must be installed with allowance for expansion and contraction and must be rated to support the dead weight of the piping and the thrust forces of the FK-5-1-12 discharge.

3.7.2 Flexible Hoses and Fittings

Flexible hoses and flexible hose fittings are available as an optional part for the system discharge network, for the 5lb through 20lb system sizes. Flexible hoses and flexible hose fittings shall be in accordance with the latest edition of NFPA 2001 or the local authority having jurisdiction. Temperature and pressure rating of the flexible hoses and flexible hose fittings shall not be exceeded.

3.7.2.1 Flexible Hoses

The flexible hoses are constructed with synthetic, high tensile textile cord reinforcement. Both ends are fitted with swivel adapters for easy installation. The flexible hoses have a maximum operating pressure of 300 psig [20.7 bar] and a minimum bend radius of 4 in [10.2 cm]. The 940555, 941055 and 942055 unit assemblies use 1/2 in flexible hoses. Refer to Figure 6 – Flexible Hoses, and Table 10 – Flexible Hose Part Numbers for 940555/941055/942055 Unit Assembly for additional information.

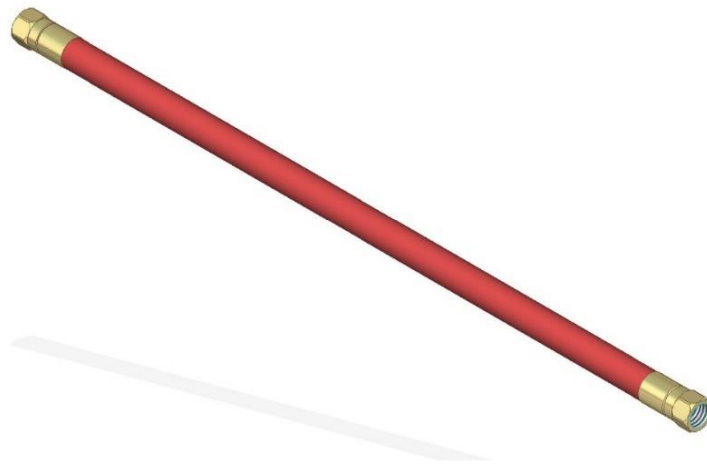


Figure 6 – Flexible Hoses

Table 10 – Flexible Hose Part Numbers for 940555/941055/942055 Unit Assembly

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

3.7.2.2 Flexible Hose Fittings

The flexible hose fittings are constructed of zinc plated steel. The flexible hose fittings allow for easy installation between the Firetrace FK-5-1-12 ILP Units, the flexible hoses, and the system nozzles. The flexible hose fittings have a minimum burst rating of 3000 psig [206.8 bar]. Refer to Table 11 – Flexible Hose Fitting Part Numbers for 940555/941055/942055 Unit Assembly for additional information.



Figure 7 – Flexible Hose Fittings

Table 11 – Flexible Hose Fitting Part Numbers for 940555/941055/942055 Unit Assembly

Flexible Hose Fitting Part Number	Description
820230	Fitting, ½ in Hose to Valve Elbow
850022	Fitting, 1/2 in Hose to Valve Union
850023	Fitting, 1/2 in Hose Union
850024	Fitting, 1/2 in Hose Elbow
850025	Fitting, 1/2 in Hose Tee
850026	Fitting, 1/2 in Hose to Nozzle Union Bulkhead
850027	Fitting, 1/2 in Hose to Nozzle Elbow Bulkhead

3.7.1 Nozzles (500015 500120)

Discharge nozzles are made of nickel-plated brass with female pipe threads. Nozzles are available in two sizes for use with Firetrace ILP FK-5-1-12 Units. The small nozzles contain a G1/4 thread. The medium nozzles contain a 1/2 in NPT thread. The 940205 unit assembly uses the small nozzle, see Figure 8 – Nozzles. The 940205 unit assembly can be designed using 1, 2, or 4 small nozzles. The 940555, 941055 and 942055 unit assemblies use the medium nozzles, Figure 8 – Nozzles. The 940555 941055 and 942055 unit assemblies can be designed using 1 (only 5lb & 10lb systems), 2 or 4 medium nozzles. The coverage for each nozzle must not exceed its maximum length and area of coverage. Refer to Section 4 for nozzle coverage information.

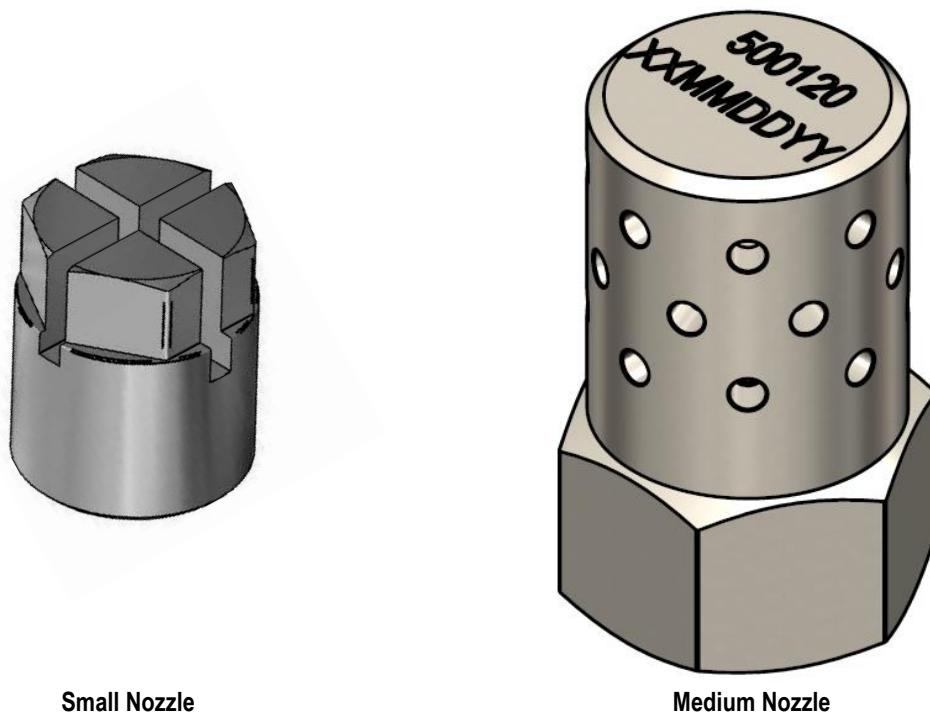


Figure 8 – Nozzles

Table 12 – Nozzle Part Numbers

Nozzle Part Number	Connection Size	Unit Assembly
500015	G1/4 in	940205
500120	1/2 in NPT	940555 / 941055 / 942055

3.8 Pressure Switch (400001)

3.8.1 Valve Mounted Pressure Switch (940205-PS 940555-PS 941055-PS 942055-PS)

The valve mounted pressure switch is an optional part of the unit assembly. It is factory installed into the pressure switch port of the cylinder valve. The valve mounted pressure switch is used to monitor unit pressure, unit actuation, or it can be used to energize or de-energize electrically operated equipment. If the unit to which the pressure switch is attached to loses pressure and reaches a pressure of 135 ± 10 psig [9.3 ± 0.7 bar] or below, the switch contacts will operate. Refer to Figure 9 – Valve Mounted Pressure Switch, Table 13 – Valve Mounted Pressure Switch Part Number, Figure 10 – Pressure Switch Wiring Schematic, and Table 14 – Pressure Switch Properties for additional information.

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

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

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

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

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

CAUTION

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



Figure 9 – Valve Mounted Pressure Switch

Table 13 – Valve Mounted Pressure Switch Part Number

Pressure Switch Part Number	Description
400001	Valve Mounted Pressure Switch

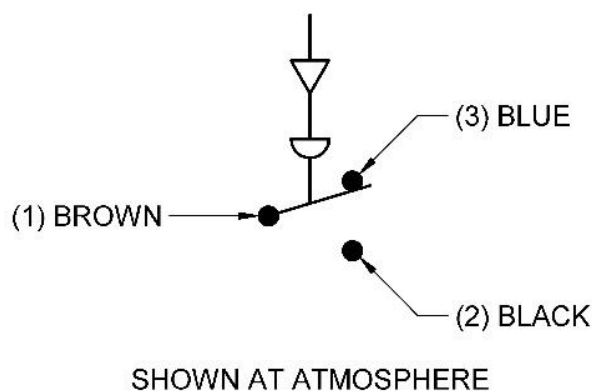


Figure 10 –Pressure Switch Wiring Schematic

Table 14 – Pressure Switch Properties

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

3.8.2 End of Line Pressure Switch (400004)

The end of line pressure switch (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. This is the same pressure switch used as a valve mounted option (400001).

The end of line pressure switch is used to monitor system pressure, system discharge, or it can be used to energize or de-energize electrically operated equipment. If the detection network to which the pressure switch is attached to loses pressure and reaches a pressure of 135 ± 10 psig [9.3 ± 0.7 bar] or below, the switch contacts will operate. Refer to Figure 11 – End of Line Pressure Switch, Table 15 – End of Line Pressure Switch Part Number, Figure 10 –Pressure Switch Wiring Schematic and Table 14 – Pressure Switch Properties.

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

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

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

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

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

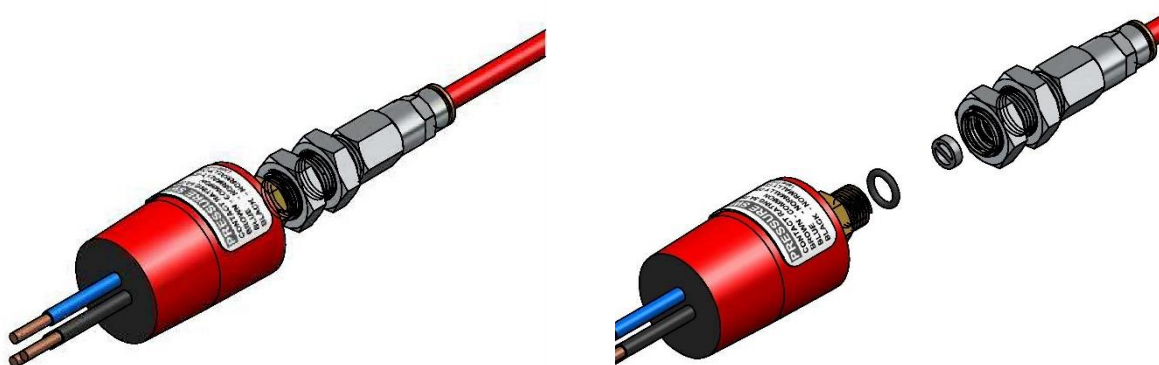


Figure 11 – End of Line Pressure Switch

Table 15 – End of Line Pressure Switch Part Number

Pressure Switch Part Number	Description
400004	End of Line Pressure Switch
400003	End of Line Pressure Switch Washer

3.8.3 Pressure Switch Assembly (400441)

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

The pressure switch assembly is used to monitor system pressure, system discharge, or it can be used to energize or de-energize electrically operated equipment. If the detection network to which the pressure switch is attached to loses pressure and reaches a pressure of 135 ± 10 psig [9.3 ± 0.7 bar] or below, the switch contacts will operate. Refer to Figure 12 – Pressure Switch Assembly, Table 16 –Pressure Switch Assembly Part Number, Figure 10 –Pressure Switch Wiring Schematic, and Table 14 – Pressure Switch Properties.

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 assembly (400441) contains the same pressure switch as the valve mounted option (400001).

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

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

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

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



Figure 12 – Pressure Switch Assembly

Table 16 –Pressure Switch Assembly Part Number

Pressure Switch Part Number	Description
400441	Pressure Switch Assembly

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

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

3.9 Alarm Module – Battery Operated (600096)

The Firetrace supplied alarm module is powered by a 9V cell (supplied), and requires a closed circuit to activate the alarm function. Firetrace recommends using the pressure switch (400001, 400005 or 400441) to supply an open circuit whilst the system is armed and ready for use.

Upon detection of a fire, the pressure switch will change state during discharge to a closed circuit – which will cause the alarm module to sound.



Figure 13 – Alarm Module – Battery Operated

3.10 Electric Solenoid Assembly (200107 400312 400324 600088)

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

The electric solenoid assembly is used to release pressure from the detection tubing, resulting in actuation of the Firetrace FK-5-1-12 ILP Unit. Refer to Figure 14 – Electric Solenoid Assembly, Table 17 – Electric Solenoid Assembly Part Number, Figure 15 – Electric Solenoid Assembly Wiring Schematic, and Table 18 – Electric Solenoid Assembly Properties for additional information.

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

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

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

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

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

NOTE: The solenoid assembly is not part of the FM Approval for Class B fire applications.

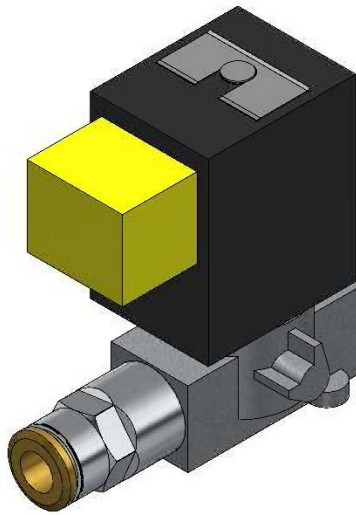


Figure 14 – Electric Solenoid Assembly

Table 17 – Electric Solenoid Assembly Part Number

Electric Solenoid Assembly Part Number	Description
400312	12 VDC Electric Solenoid Assembly
400324	24 VDC Electric Solenoid Assembly
600088	Solenoid Valve Wiring Harness
200107	Solenoid to Ball Valve Adapter

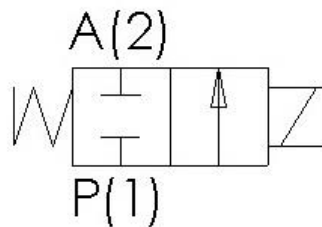


Figure 15 – Electric Solenoid Assembly Wiring Schematic

Table 18 – Electric Solenoid Assembly Properties

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

4 SYSTEM DESIGN AND LIMITATIONS

4.1 General

The Firetrace series of FK-5-1-12 Self-Contained Automatic Indirect Units' design limits were established and tested by Firetrace. The Units are Listed by Underwriters Laboratories Inc, Underwriters' Laboratories of Canada, and Approved by FM Approvals (please note these systems are FM Approved for Class B fire applications only).

These units were subjected to numerous performance and fire tests (as specified in UL 2166 & FM 5600), in order to verify their suitability and to establish design limitations for:

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

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

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

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 FK-5-1-12 Units and equipment are designed to be stored and operated at the ambient temperature range of 0°F to +130°F (-17.8°C to +54.4°C).

4.2.2 System Operating Pressure

The normal operating pressure for the unit is 195 psig at 70°F (13.4 bar at 21°C).

Table 19 - Cylinder Pressure-Temperature Relationship shows the cylinder gauge pressure-temperature relationship based on a charging pressure of 195 psig at 70°F.

Cylinder Pressure			
Temperature		Pressure	
°F	°C	psig	bar
0	-17.8	139	9.6
10	-12.2	147	10.1
20	-6.7	155	10.7
30	-1.1	163	11.2
40	4.4	171	11.8
50	10.0	179	12.3
60	15.5	187	12.9
70	21.1	195	13.4
80	26.7	203	14.0
90	32.2	211	14.5
100	37.8	219	15.1
110	43.3	227	15.7
120	48.9	235	16.2
130	54.4	243	16.8

Table 19 - Cylinder Pressure-Temperature Relationship

4.3 Design Procedure

The following procedures should be used to design a Firetrace FK-5-1-12 Self-Contained Automatic Indirect Fire Suppression Unit. In addition, the applicable requirements specified in Chapter 5 of NFPA 2001 should be followed.

- Conduct a survey and analysis of the hazard to be protected.
- 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.
- Determine the anticipated minimum and maximum ambient temperatures expected within the enclosure to be protected.
- Determine the minimum design concentration required for the hazard.
- Determine the integrity of the enclosure and if any openings must be closed at the time of agent discharge.
- Determine the cylinder size required based on the hazard volume limitations and enclosure size.
Remember, as cautioned in Section 2 of this Manual, only one (1) extinguisher unit can be used to protect one (1) hazard.
- Based on the total quantity of agent being used at the maximum ambient temperature expected within the enclosure, evaluate personnel safety exposure limits.
- Determine the location of the FK-5-1-12 cylinder.
- Determine the location and quantity of nozzles required based on the size and configuration of the enclosure.
- Determine the routing and quantity of discharge network required. The discharge network and fitting limitations must not be exceeded.
- Determine the arrangement and placement of the Firetrace detection tubing (FDT).
- Determine any auxiliary equipment requirements such as a pressure switch(s) to sound alarms, shut-down ventilation, shut-off electrical power, etc.
- 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

4.4.1 Enclosure Size and Nozzle Limitations

The maximum dimensions and area coverage for each size unit are shown in Table 20 - Enclosure Size and Nozzle Limitations. The protected enclosure can be any size, shape, or volume, provided that the dimensions do not exceed the limitations shown in Table 20 - Enclosure Size and Nozzle Limitations.

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

Model	FK-5-1-12 Quantity	Discharge Ports Used (DP)	Nozzles Per DP	Total Number of Nozzles Per Unit	Maximum Area Coverage Per Nozzle	Maximum Protected Height
940205	2.5 lb (1.13 Kg)	1	1	1	5'x5' = 25 ft ² (1.52m x 1.52m = 2.32 m ²)	10 ft (3.05 m)
		2	1	2		
			2	4		
940555	5 lb (2.27 Kg)	1	1	1	6' x 6' = 36 ft ² (1.83m x 1.83m = 3.35 m ²)	10 ft (3.05 m)
		2	1	2		
			2	4		
941055	10 lb (4.54 kg)	1	1	1	6' x 6' = 36 ft ² (1.83m x 1.83m = 3.35 m ²)	10 ft (3.05 m)
		2	1	2		
			2	4		
942055	20 lb (9.08 Kg)	2	1	2	6' x 6' = 36 ft ² (1.83m x 1.83m = 3.35 m ²)	10 ft (3.05 m)
			2	4		

Table 20 - Enclosure Size and Nozzle Limitations



CAUTION

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

4.5 Required Amounts of Agent

4.5.1 Minimum Design Concentrations

The minimum design concentrations to be used with Firetrace FK-5-1-12 units include a minimum safety factor (SF), as specified in NFPA 2001.

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

For Class B hazards, refer to Annex B of NFPA 2001 for the cup burner extinguishment concentration value for the particular Class B fuel(s) to be protected. Choose the fuel with the highest cup burner extinguishment value in the hazard and apply a 30% safety factor (multiply this extinguishment concentration value by 1.3) for the design concentration. The minimum design concentration for the protection of all Class B hazards shall be as per Table 22 – Class B Minimum Design Concentrations. Contact Firetrace for guidance on hazards deviating from these requirements or for fuels not listed.

Minimum design concentrations to be used with Firetrace Pre-Engineered FK-5-1-12 ILP Automatic Suppression Units can be found in Table 21 – Class A Minimum Design Concentrations and Table 22 – Class B Minimum Design Concentrations. For all other Class B fuels not shown in Table 22 – Class B Minimum Design Concentrations, the minimum design concentration can be calculated as follows:

$$MDC = EC * SF * MF$$

where: MDC = minimum design concentration
 EC = minimum extinguishing concentration, determined using the cup burner test method
 SF = safety factor, 1.3
 MF = multiplication factor, 1.032 for Firetrace FK-5-1-12 ILP Units

The maximum volume limitations and minimum temperature specifications MUST be followed in order to maintain the correct safety factor. It is recommended that the designer consult with Firetrace, NFPA 2001, and the local authority having jurisdiction, as to the suitability on the use of FK-5-1-12 for a particular hazard, for personnel exposure effects from the design concentrations, and for installation requirements.

Table 21 – Class A Minimum Design Concentrations

Fuel	Extinguishing Concentration Class A (vol%)	Extinguishing Concentration Class B (vol%)	Multiplication Factor	Minimum Design Concentration (%)
Class A	3.34 – 3.75	4.50 – 4.53	1.032	4.675

Table 22 – Class B Minimum Design Concentrations

Fuel	Extinguishing Concentration Class B* (vol%)	Minimum Safety Factor	Multiplication Factor	Minimum Design Concentration (%)
Acetone	4.3	1.3	1.0317	5.89**
Ethanol	5.5	1.3	1.0317	7.38
n-Heptane	4.5	1.3	1.0317	6.04
Methanol	6.5	1.3	1.0317	8.72
1-Propanol	5.4	1.3	1.0317	7.25
Toluene	3.5	1.3	1.0317	5.89**
*Class B extinguishing concentration values were derived using the cup burner test method				
**Minimum design concentrations cannot be less than 5.89% for any Class B fuel				

Table 23 – Class C Minimum Design Concentrations (3M™ Novec™ 1230, Noah NY5112 & Dukare 1230)

Fuel	Extinguishing Concentration Class A (vol%)	Minimum Safety Factor	Multiplication Factor	Minimum Design Concentration (%)
Class C	3.35	1.35	1.032	4.667

Table 24 – Class C Minimum Design Concentrations (Waysmos FK-5-1-12)

Fuel	Extinguishing Concentration Class A (vol%)	Minimum Safety Factor	Multiplication Factor	Minimum Design Concentration (%)
Class C	3.51	1.35	1.032	4.890

Table 25 – Class C Minimum Design Concentrations (Chemori 5112™)

Fuel	Extinguishing Concentration Class A (vol%)	Minimum Safety Factor	Multiplication Factor	Minimum Design Concentration (%)
Class C	3.75	1.35	1.032	5.225

4.5.2 Actual Concentration

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

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

where: W = agent being used (lb)

V = volume of the protected enclosure (ft³)

s = specific volume of superheated FK-5-1-12 vapor (ft³/lb)

s can be approximated by using the following formula:

$$s = .9856 + .002441 * t$$

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

CAUTION

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

4.6 Maximum Protected Volume Limitations

The maximum volume that can be protected by the Firetrace FK-5-1-12 units is dependent on the design concentration and the minimum ambient design temperature specified for a given hazard.

The following sections can be used for FK-5-1-12 (regardless of agent, and for a standard NFPA defined class of fire as specified).

For more detailed information and an expanded range of temperatures for each system, please refer to the tables in APPENDIX B – PROTECTED VOLUMES BASED ON DESIGN CONCENTRATIONS.

4.6.1 Class A Fires (All FK-5-1-12 agents)

Table 26 – Class A Fire Enclosure Volume Limitations

Design Temperature		Maximum Enclosure Volume (Class A Hazard @4.675vol%) All FK-5-1-12 Agents							
		940205 (2.5 lb)		940555 (5 lb)		941055 (10 lb)		942055 (20 lb)	
°F	°C	ft ³	m ³	ft ³	m ³	ft ³	m ³	ft ³	m ³
0	-17.8	50.2	1.42	100.5	2.85	201.0	5.69	401.9	11.38
70	21.1	59.0	1.67	117.9	3.34	235.8	6.68	471.6	13.35
130	54.4	66.4	1.88	132.8	3.76	265.7	7.52	531.3	15.05

4.6.2 Class B Fires (All FK-5-1-12 agents)

Table 27 – Class B Fire Enclosure Volume Limitations

Design Temperature		Maximum Enclosure Volume (Class B Hazard @6.04vol%) All FK-5-1-12 Agents							
		940205 (2.5 lb)		940555 (5 lb)		941055 (10 lb)		942055 (20 lb)	
°F	°C	ft ³	m ³	ft ³	m ³	ft ³	m ³	ft ³	m ³
0	-17.8	38.3	1.09	76.7	2.17	153.3	4.34	306.6	8.68
70	21.1	45.0	1.27	90.0	2.55	179.9	5.09	359.8	10.19
130	54.4	50.7	1.43	101.3	2.87	202.7	5.74	405.4	11.48

4.6.3 Class C Fires (3M™ Novec™ 1230, Noah NY5112 & Dukare 1230)

Table 28 – Class C Fire Enclosure Volume Limitations (3M™ Novec™ 1230, Noah NY5112 & Dukare 1230)

Design Temperature		Maximum Enclosure Volume (Class C Hazard @4.667vol%) 3M™ Novec™ 1230, Noah NY5112 & Dukare 1230 Only							
		940205 (2.5 lb)		940555 (5 lb)		941055 (10 lb)		942055 (20 lb)	
°F	°C	ft³	m³	ft³	m³	ft³	m³	ft³	m³
0	-17.8	50.3	1.43	100.7	2.85	201.3	5.70	402.7	11.40
70	21.1	59.1	1.67	118.1	3.34	236.2	6.69	472.5	13.38
130	54.4	66.5	1.88	133.1	3.77	266.2	7.54	532.3	15.07

4.6.4 Class C Fires (Waysmos FK-5-1-12)

Table 29 – Class C Fire Enclosure Volume Limitations (Waysmos FK-5-1-12)

Design Temperature		Maximum Enclosure Volume (Class C Hazard @4.890vol%) Waysmos FK-5-1-12 Only							
		940205 (2.5 lb)		940555 (5 lb)		941055 (10 lb)		942055 (20 lb)	
°F	°C	ft³	m³	ft³	m³	ft³	m³	ft³	m³
0	-17.8	47.9	1.36	95.8	2.71	191.7	5.43	383.4	10.86
70	21.1	56.2	1.59	112.5	3.18	224.9	6.37	449.9	12.74
130	54.4	63.4	1.79	126.7	3.59	253.4	7.18	506.8	14.35

4.6.5 Class C Fires (Chemori 5112™)

Table 30 – Class C Fire Enclosure Volume Limitations (Chemori 5112™)

Design Temperature		Maximum Enclosure Volume (Class C Hazard @5.225vol%) Chemori 5112™ Only							
		940205 (2.5 lb)		940555 (5 lb)		941055 (10 lb)		942055 (20 lb)	
°F	°C	ft³	m³	ft³	m³	ft³	m³	ft³	m³
0	-17.8	44.7	1.27	89.4	2.53	178.8	5.06	357.6	10.12
70	21.1	52.4	1.49	104.9	2.97	209.8	5.94	419.5	11.88
130	54.4	59.1	1.67	118.2	3.35	236.3	6.69	472.7	13.38

4.6.6 Altitude Correction Factor (ACF)

The design quantity of agent shall be adjusted to compensate for ambient pressures that vary with elevations greater than 1,000 ft. [300 m] above standard sea level, see Table 31 – Atmospheric Correction Factor for applicable multipliers.

Table 31 – Atmospheric Correction Factor

Altitude		Enclosure Pressure		Mass Correction Factor (MCF)	Volume Correction Factor (VCF)
ft.	km	psia	mm Hg		
-3,000	-0.92	16.25	840	1.11	0.90
-2,000	-0.61	15.71	812	1.07	0.93
-1,000	-0.30	15.23	787	1.04	0.96
0	0.00	14.70	760	1.00	1.00
1,000	0.30	14.18	733	0.96	1.04
2,000	0.61	13.64	705	0.93	1.08
3,000	0.91	13.12	678	0.89	1.12
4,000	1.22	12.58	650	0.86	1.16
5,000	1.52	12.04	622	0.82	1.22
6,000	1.83	11.53	596	0.78	1.28
7,000	2.13	11.03	570	0.75	1.33
8,000	2.45	10.64	550	0.72	1.39
9,000	2.74	10.22	528	0.69	1.45

4.6.6.1 MCF Example

If the calculated agent quantity was 18 lbs (8.17 kg) of FK-5-1-12 and the altitude was 2,000 ft (0.61 km) above sea level – the resulting ACF should be applied from the table as “0.93”, which is 93% of the calculated mass at sea level, using the MCF column:

$$18 \text{ lbs (8.17 kg)} \times 0.93 = 16.74 \text{ lbs (7.60 kg)}$$

The resulting mass of agent required at 2,000 ft (0.61 km) elevation above sea level, would be 16.74 lbs (7.60 kg).

4.6.6.2 VCF Example

If the required protected volume was 90 ft³ (2.55 m³) and the hazard was a class B risk at 70°F (21.1°C) (Table 27 – Class B Fire Enclosure Volume Limitations) a 5 lb FK-5-1-12 system could be specified. However if the altitude was 1,000 ft (0.30 km) **below** sea level, the VCF is stated as “0.96”, we can only use 96% of this protected volume:

$$90 \text{ ft}^3 (2.55 \text{ m}^3) \times 0.96 = 86.4 \text{ ft}^3 (2.45 \text{ m}^3)$$

This means the 940555 system can only protect 86.4 ft³ (2.45 m³) at 70°F, as our volume is 90 ft³ (2.55 m³) we would need to use a larger system.

4.6.7 Ventilation Shut-Down 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.

4.6.8 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.

4.7 Nozzle and Discharge Pipe Requirements

4.7.1 Discharge Nozzle Limitations

Two size nozzles are available for use with the Firetrace ILP FK-5-1-12 Units.

The small nozzle, P/N 500015, is only used with the 2.5 lb (940205) units. The small unit can be designed using 1, 2, or 4 nozzles to suit the hazard configuration.

The medium nozzle, P/N 500120, is only used with the 5 lb (940555), 10 lb (941055) and 20 lb (942055) units. The 5 & 10 lb units can be designed using 1, 2, or 4 nozzles to suit the hazard configuration. The 20 lb (942055) can be designed using 2 or 4 nozzles to suit the hazard configuration.

Each nozzle is to be installed at the top of the hazard enclosure facing down in a pendant position and centered in the area to be protected by that particular nozzle

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

4.7.2 Nozzle Area Coverage

Table 32 – Nozzle Area Coverage Limitations below shows the nozzle area coverage limitations for Firetrace Pre-Engineered FK-5-1-12 ILP Automatic Suppression Units. The maximum enclosure height for nozzle installation is 10 ft [3.05 m]. The minimum enclosure height for nozzle installation is 1.6 ft [0.3 m].

Table 32 – Nozzle Area Coverage Limitations

Model	Discharge Ports Used (DP)	Nozzles Per DP	Total Number of Nozzles Per Unit	Maximum Area Coverage Per Nozzle	Maximum Protected Height
940205	1	1	1	5'x5' = 25 ft ² (1.52m x 1.52m = 2.32 m ²)	10 ft (3.05 m)
	2	1	2		
		2	4		
940555	1	1	1	6' x 6' = 36 ft ² (1.83m x 1.83m = 3.35 m ²)	10 ft (3.05 m)
	2	1	2		
		2	4		
941055	1	1	1	6' x 6' = 36 ft ² (1.83m x 1.83m = 3.35 m ²)	10 ft (3.05 m)
	2	1	2		
		2	4		
942055	2	1	2	6' x 6' = 36 ft ² (1.83m x 1.83m = 3.35 m ²)	10 ft (3.05 m)
		2	4		

4.7.3 Discharge Piping and Fitting Specifications

All Firetrace ILP Units shall use copper tubing or equivalent, or the Firetrace discharge hoses for the FK-5-1-12 distribution system. The following tubing and fittings shall be used. Refer to NFPA 2001, 2015 Edition - Section 4.2 for alternate discharge network options.

Table 33 – Discharge Piping Specifications

Unit Assembly	Material	Outer Diameter	Wall Thickness
940205	soft annealed copper (AS B-280*, for air conditioning and refrigeration service)	5/16 in	.032 in
940555		1/2 in	.032 in
941055		1/2 in	.032 in
942055		1/2 in	.032 in
*The use of AS B-280 soft annealed copper, as specified in this manual, complies with ASME B 31.1 requirements of NFPA 2001.			

Table 34 – Flexible Discharge Hose Specifications

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

Table 35 – Discharge Pipe Fitting Specifications

Material	Connection Type	Minimum Pressure Rating**
Brass	Flareless Bite*	1000 psig
*Use Parker Intru-Lok, Camozzi, or equivalent **Minimum pressure rating for use with Firetrace FK-5-1-12 ILP Units		

4.7.4 Maximum Discharge Piping and Fitting Limitations

Table 36 – Discharge Piping Limitations, the below table shows the discharge piping and pipe fitting limitations for Firetrace Pre-Engineered FK-5-1-12 ILP Automatic Suppression Units.

Table 36 – Discharge Piping Limitations

Unit Assembly	Discharge Ports Used	Nozzles per Discharge Port	Total Nozzles Used	Maximum Length of Discharge Piping per DP	
				ft	m
940205	1	1	1	4	1.22
	2	1	2	8	2.44
	2	2	4	8	2.44
940555	1	1	1	8	2.44
	2	1	2	10	3.05
	2	2	4	10	3.05
941055	1	1	1	8	2.44
	2	1	2	10	3.05
	2	2	4	10	3.05
942055	2	1	2	10	3.05
	2	2	4	10	3.05

4.7.5 Discharge Pipe Bends

Wherever possible, pipe bends should be used in lieu of 90° elbows. It is recommended that a pipe bender be used when forming the 90° bends. Refer to Table 37 –Pipe Bend Radius and Equivalent Length when forming pipe bends, to minimize the chance of flattening the pipe.

Table 37 –Pipe Bend Radius and Equivalent Length

Pipe Outer Diameter (OD)	Minimum Bend Radius* to Pipe Centerline	Equivalent Length** for 90° Bend***
5/16 in	11/16 in	1-1/8 in
1/2 in	1-1/2 in	2-3/8 in
* The minimum bend radii were derived from Parker Industrial Tube Fittings Catalogue 4300, dated March 1991. ** The equivalent length is to be subtracted from the maximum length of piping as stated under Table 36 – Discharge Piping Limitations. ***90° pipe bends are not required to be subtracted from the maximum number of elbows stated under Table 37 –Pipe Bend Radius and Equivalent Length.		

4.8 Firetrace Detection/Actuation Tubing

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 Firetrace detection tubing should not be placed horizontally adjacent to a potential fire source.

Table 38 – Firetrace Detection Tubing Limitations

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

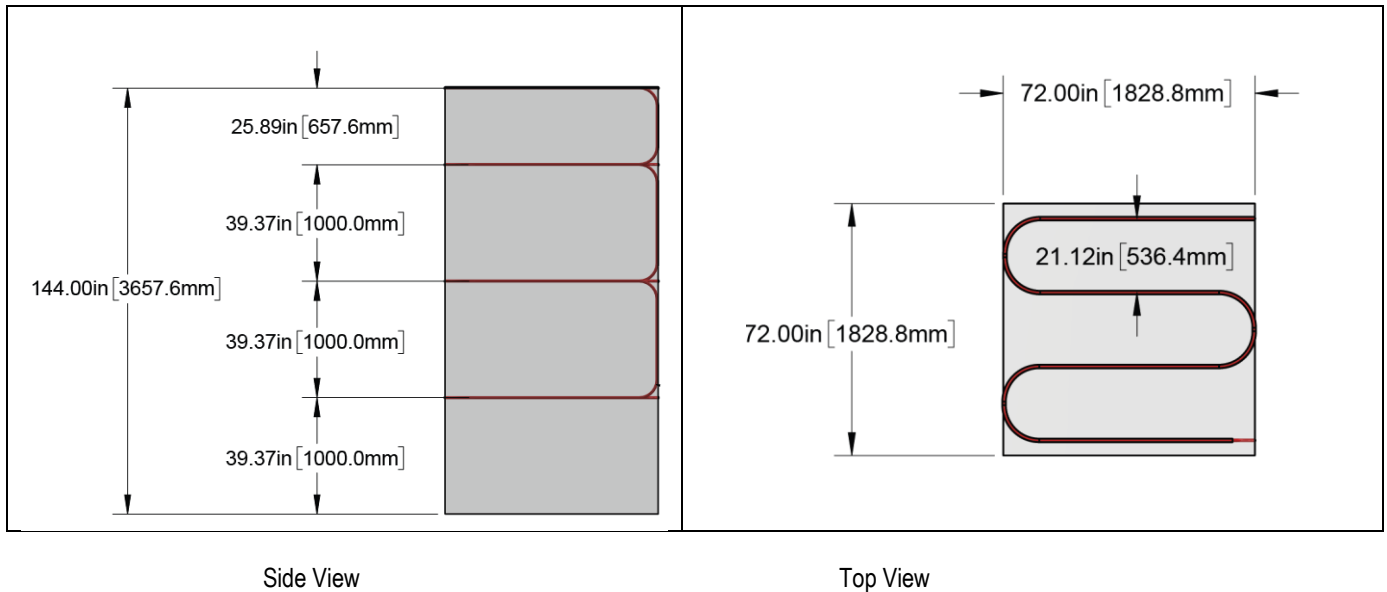


Figure 16 – Tubing Configuration Guideline (Side View and Top View)

5 INSTALLATION INSTRUCTIONS

This section provides installation instructions covering components and limitations described in Section 3 and Section 4 of this Manual.

All components should be installed to facilitate proper inspection, testing, recharging, and any other required service or maintenance as may be necessary. Equipment must not be subjected to severe weather conditions or mechanical, chemical, or other damage which could render the equipment inoperative. The equipment must be installed in accordance with instructions in this Manual and NFPA 2001.



WARNING

FK-5-1-12 cylinder/valve assemblies must be handled, installed, and serviced only by qualified and trained personnel in accordance with the instruction contained in this manual, on the cylinder nameplate, and any other regulations and codes that may apply. Failure to follow these instructions could result in property damage, severe injury, or death.



WARNING

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

5.1 FK-5-1-12 Cylinder/Valve and Bracket Assemblies

The FK-5-1-12 cylinders should be located as close as possible to the protected enclosure. In some cases the cylinder can be mounted inside the protected enclosure. The assemblies shall be located in a readily accessible location to allow for ease of inspection, service, and maintenance. The cylinders shall be located in an environment protected from the weather and where the temperature range is between 0°F to +130°F (-17.8°C to +54.4°C).

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

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



WARNING

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

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

5.2 Discharge Piping and Nozzles

1. Install the nozzle(s) following the guidelines and limitations described in Section 4.6.
2. Determine the routing of the discharge pipe and whether one (1) or two (2) discharge ports will be used following the guidelines and limitations described in Section 4.6. If two (2) discharge ports are used, verify that the pipe length from each discharge port does not exceed a 10% imbalance.
3. Remove one or two safety plugs from the valve discharge ports as required. Attach male connection fittings in discharge port(s) as applicable.
4. Install the discharge pipe and fittings between the cylinder and nozzle(s). Secure the pipe with the appropriate size pipe clamps as required.

5.3 Firetrace Detection Tubing

Location and spacing of the tubing is critical to the response time in the event of a fire. The tubing should be placed above the hazard areas being protected. The Typical Tubing Placement diagram, located in Figure 16, provides general guidelines for placement of the detection tubing along with the maximum spacing and height limitations. Depending on the configuration of specific hazards, the guidelines shown in the Typical Tubing Placement diagram may, or may not, be applicable. The maximum height that is allowed between layers is 3.28 feet (1 m), the maximum distance between passes is 21.12 inches (53.34 cm), and the maximum distance allowed from any wall to the tubing is 10.56 inches (26.82 cm). Refer to the Typical Tubing Placement diagram in Figure 16 for further clarification. Tubing shall not be installed on any galvanic surfaces.



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).

1. Secure the detection tubing using Mounting Tabs at 1.5 ft (0.46 m) 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, to prevent damage to the tubing.
5. When mounting to metal surfaces, rubber P-clips or a small piece of copper/rubber hosing is required to mount to the metal surface.
6. All FDT fittings and joints are to be inspected for leaks with a solution of liquid soap and water.

5.4 Detection Tubing Fittings and Accessories

5.4.1 Firetrace Tubing Cutter (600210)

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

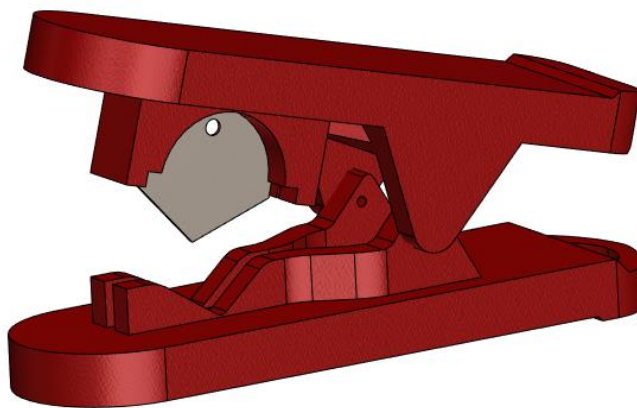


Figure 17 – Firetrace Tubing Cutter 600210

5.4.2 Slip-On Fittings

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

1. Cut the tube end (using a Firetrace Detection Tube (FDT) 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 more comprehensive list of Slip-On Fittings, refer to Appendix A.

5.4.3 End of Line Accessories

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

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

5.4.3.1 Pressure Gauge (P/N 400195):

The 195 psig Pressure Gauge must be installed with its included O-ring. Thread the pressure gauge into the End of Line Adapter so that the gauge indicates the tubing pressure.

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

The Pressure Switch for the EOL Adapter must be installed with its included O-ring and washer. Insert the washer into the EOL Adapter, and then thread the Pressure Switch in until an audible "click" can be heard. The Pressure Switch is now active.

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

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

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

5.4.4 FDT Charging using Nitrogen Charge Kit (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 or a manual release (600055) 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, 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 20 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.

All of 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 5.4.1 or Section 5.4.2.

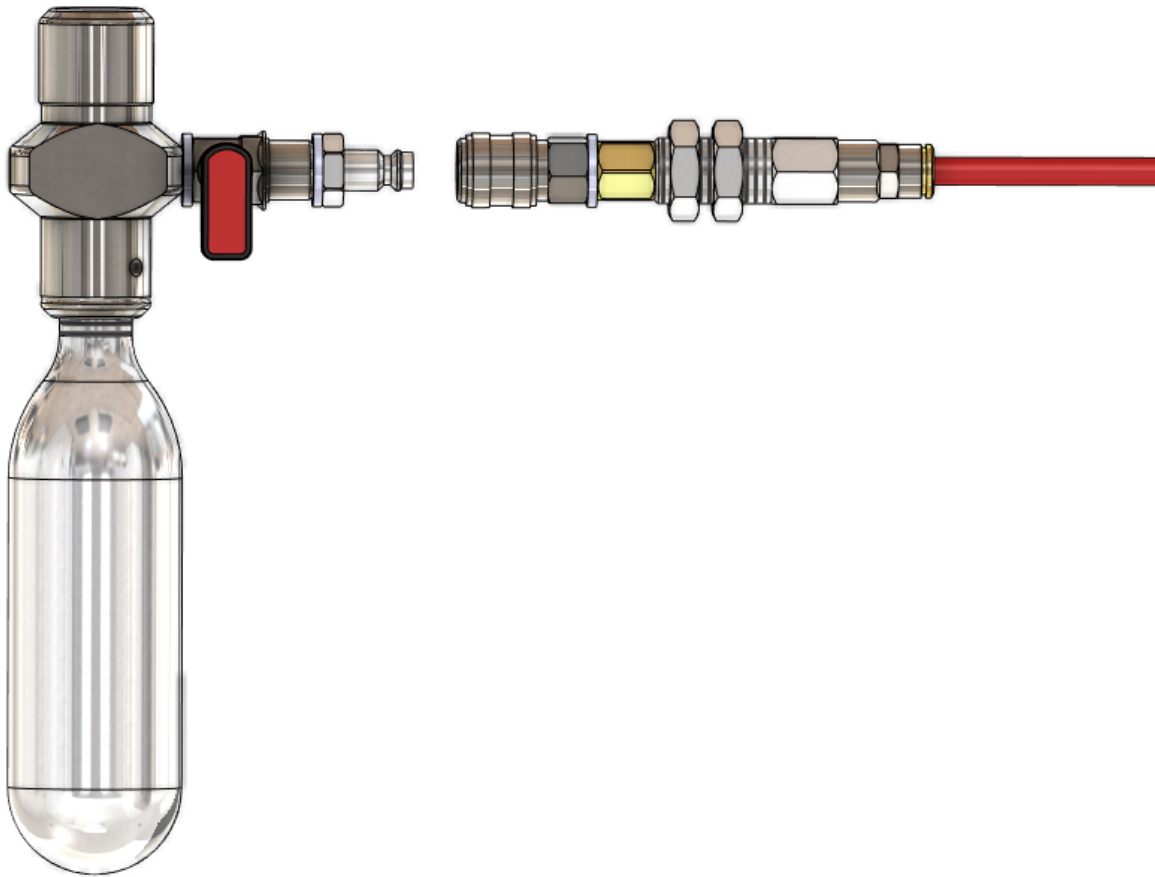


Figure 18 – Firetrace Nitrogen Charge Kit 600213

5.5 System Activation

1. Install the detection tubing, fittings, and accessories according to the procedures specified in Section 5.3 and Section 5.4.
2. With the system ball valve still closed, connect the detection tubing to the system using the appropriate procedure in Section 5.4.1 or Section 5.4.2.
3. Attach the filling adapter (P/N 600023 or 600028) to the End of Line Adapter. Refer to Section 5.4.3.
4. Using a regulated dry nitrogen supply, pressurize the detection tubing through the filling adapter to 195 psig (10.3 bar). It is recommended to have a portable dry nitrogen cylinder or Firetrace Nitrogen Fill Kit for on-site use.
5. Remove the filling adapter and thread the pressure gauge & O-ring (Firetrace P/N 400027) into its place to verify that the tubing is pressurized to at least 195 psig at 70°F (10.3 bar at 21°C) (pressure may have to be adjusted for temperatures higher or lower than 70°F). Refer to Section 5.4.3 for further instructions.
6. With the gauge still attached to the filling adapter, test for leakage:

- Apply soapy water solution to the cylinder valve connection, end of line adapter connection, and the pressure gauge connection. Observe for bubble leaks.
 - Wait 30 minutes, and then observe the pressure gauge. Any decrease in pressure is an indication of a leak.
 - In the event of a leak go back to Section 5.5 and check the installation of all fittings and accessories.
7. If an optional pressure switch is to be installed in the EOL adapter, remove the pressure gauge and install the pressure switch according to the procedures in Section 5.4.3.
- a. Check pressure switch connection for bubble leaks using soapy water solution.
 - b. Ensure proper electrical connections are made to annunciate unit discharge, shut down ventilation, etc., as may be required by the end user or the Local Authority Having Jurisdiction (AHJ). (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.

8. After confirming that there is no leakage within the detector tubing, **SLOWLY** rotate the ball valve lever counter clock wise to the "ON" position.



CAUTION

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

9. Tamper proof the unit by removing the ball valve lever face and securing the lever in the "ON" position with a zip tie. Refer to the Tamper Proof Instruction in Appendix B.
10. The unit is now fully armed and ready for use.

6 SERVICE AND MAINTENANCE INSTRUCTIONS



WARNING

1. 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.
2. 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.

ATTENTION

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

6.1 General

A regular program of systematic maintenance must be established for continuous, proper operation of all FK-5-1-12 units and to avoid violating the warranty. A periodic maintenance schedule must be followed and an inspection log maintained for ready reference. As a minimum, the log must record: (1) inspection interval, (2) inspection procedure performed, (3) maintenance performed, if any, as a result of inspection, and (4) name of inspector performing task.

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

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 Manual Actuators are unobstructed.
3. The Tamper Indicator is intact.
4. The Maintenance Tag or Certificate is in place.
5. The Suppression Unit shows no physical damage or condition that might prevent operation.
 - a. This includes inspecting the detection tubing in the hazard area for abrasion, distortion, cuts, or dirt accumulation.
6. The Pressure Gauge is in the operable range.
7. The Nozzle Blowoff Caps are intact and undamaged.
8. Neither the Protected Equipment nor the Hazard has been replaced, modified, or relocated.
9. If the pressure 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.)

6.2.2 Semiannual 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, then disconnect the detection tubing at the ball valve.
 - Disconnect the discharge network from the cylinder valve discharge ports(s)
 - Immediately install the safety plugs(s) into the valve discharge port(s)
 - Remove the cylinder from the bracket
2. Weigh the cylinder. Compare the measured weight with the weight found on the cylinder nameplate. If the container shows a loss in agent quantity of more than 5 percent or a loss in pressure (adjusted for temperature) of more than 10 percent, the cylinder shall be refilled or replaced.
3. Remove the nozzle(s) and inspect for obstructions. Reinstall the nozzles.
4. Reinstall the cylinder and discharge network, connect and re-pressurize the detection tubing with nitrogen following the applicable procedures outlined in Section 5.

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 7 of NFPA 2001 (2015 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.

6.3 Hydrostatic Testing

Firetrace FK-5-1-12 cylinders are built to DOT-4B specifications and therefore fall under DOT CFR Title 49 & NFPA 2001 regulations for retest and inspection.

All DOT-4B, 4BA and 4BW 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.



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.

7 SYSTEM DISSASSEMBLY, ASSEMBLY, AND CHARGING



WARNING

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



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.

ATTENTION

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

7.1 Depressurizing the Unit

1. Turn the ball valve lever to the "off" position (perpendicular to the valve).
2. Depressurize the detection/actuation tubing by depressing the Schrader valve inside of the End of Line Adapter.
3. Remove the detection/actuation tubing from the top of the ball valve.
4. Remove the discharge piping from the discharge ports.
5. Install discharge plugs into both discharge ports.
6. Slowly, slightly open the cylinder valve mounted ball valve, so only a small amount of nitrogen can be heard leaving the unit.
7. Ensure the unit is depressurized by verifying the pressure gauge reads 0 psig.
8. SLOWLY open the ball valve completely



CAUTION

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

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

7.2 System Recharge

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

1. Fill via the discharge port or 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. Fill system to the correct agent fill level per the system size
4. 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 60 ft-lbs to the cylinder, and that the cylinder valve O-ring is lubricated and in good condition)
5. 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).

6. Open the ball valve and pressurize the cylinder with dry nitrogen.
7. 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.)
8. Open the ball valve and pressurize back up to 195 psig at 70 °F, as will be indicated on the system pressure gauge.
9. Repeat steps 7 thru 8 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.
10. Disconnect the dry nitrogen fill line.
11. Verify the system gross weight by checking it against what is printed on the label.
12. 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
13. The unit is now ready to be transported to the installation site.

8 POST DISCHARGE

8.1 Ventilation

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

FK-5-1-12 does not leave a residue, thus, there are no clean-up operations resulting from Firetrace FK-5-1-12 ILP 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 ILP Unit must be removed and recharged. The Firetrace FK-5-1-12 ILP unit should be removed using the following steps:

1. Remove the Firetrace detection tubing from the tube fitting attached to the top of the cylinder valve.
2. Remove the discharge piping from the discharge outlet ports.
3. Install the discharge outlet port plugs into both discharge outlet ports.
4. Remove the cylinder from the cylinder mounting bracket.
5. Have Firetrace FK-5-1-12 ILP Unit recharged by a qualified Firetrace service location.

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

Appendix A – Parts List

Firetrace FK-5-1-12 ILP Automatic Suppression Unit Assemblies

Table 39 – Firetrace FK-5-1-12 ILP Units

Part Number	Description
940205	Small FK-5-1-12 ILP Suppression Unit (2.5 lb)
940555	Medium FK-5-1-12 ILP Suppression Unit (5 lb)
941055	Large FK-5-1-12 ILP Suppression Unit (10 lb)
942055	Extra Large FK-5-1-12 ILP Suppression Unit (20 lb)

Cylinder Brackets

Table 40 – Cylinder Brackets

Part Number	Description
100003	Cylinder Bracket, DOT, Small (2.5lb-3lb), Generic
100006	Cylinder Bracket, DOT, Medium (5-6lb), Generic
111206	Cylinder Bracket, DOT and CE, Large (10-12lb or 5kg), Generic
111020	Cylinder Bracket, DOT, Extra Large (20-35lb), Generic

Accessory Brackets

Table 41 – Accessory Brackets

Part Number	Description
120305	Accessory Bracket
111022	Bracket Support

Discharge Network

Table 42 – Small ILP Discharge Network Flexible Hoses

Part Number	Description
202816	3/8 in Flexible Hose, 1 ft (Not part of FM Approval)
201816	3/8 in Flexible Hose, 2 ft (Not part of FM Approval)
201817	3/8 in Flexible Hose, 3 ft (Not part of FM Approval)
201818	3/8 in Flexible Hose, 4 ft (Not part of FM Approval)
201819	3/8 in Flexible Hose, 7 ft (Not part of FM Approval)

Table 43 – Medium/Large ILP Discharge Network Flexible Hoses

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

Table 44 – Small ILP Discharge Network Flexible Hose Fittings

Part Number	Description
850016	Fitting, 3/8 in Hose to Valve Union (Not part of FM Approval)
850017	Fitting, 3/8 in Hose Union (Not part of FM Approval)
850018	Fitting, 3/8 in Hose Elbow (Not part of FM Approval)
850019	Fitting, 3/8 in Hose Tee (Not part of FM Approval)
850020	Fitting, 3/8 in Hose to Nozzle Union Bulkhead (Not part of FM Approval)
850021	Fitting, 3/8 in Hose to Nozzle Elbow Bulkhead (Not part of FM Approval)

Table 45 – Medium/Large ILP Discharge Network Flexible Hose Fittings

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

Table 46 – Nozzles

Part Number	Description
500015	Small Clean Agent Nozzle, G1/4
500120	Medium Clean Agent Nozzle, 1/2 NPT
510017	Small Nozzle Cap
510019	Medium Blow-Off Cap

Detection Network

Table 47 – Firetrace Detection Tubing

Part Number	Description
200005	Firetrace Detection Tubing, 4/6 mm, 1 ft
204025	Firetrace Detection Tubing, 4/6 mm, 25
204050	Firetrace Detection Tubing, 4/6 mm, 50 ft
204100	Firetrace Detection Tubing, 4/6 mm, 100 ft
204328	Firetrace Detection Tubing, 4/6 mm, 328 ft
200163	Meal Coil Tubing Protector, 4mm/6mm, 20ft
200300-25	Plastic Tubing Protector, 4mm/6mm, 25ft

Table 48 – Tube Fittings

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

Table 49 – End of Line Accessories

Part Number	Description
200168	End of Line Adapter w/ Tube Union, 4/6 mm
400195	Pressure Gauge w/ O-Ring, 195 psig
310303	End of Line Adapter Plug
400004	End of Line Pressure Switch
600055	Manual Release w/ 195 psig Gauge and Tube Union, 4/6 mm

Miscellaneous

Table 50 – Installation Accessories

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

Table 51 – Auxiliary Accessories

Part Number	Description
400001	Valve Mounted Pressure Switch
400441	Pressure Switch Assembly Box
400312	12 VDC Electric Solenoid Assembly (Not part of FM Approval)
400324	24 VDC Electric Solenoid Assembly (Not part of FM Approval)
400316	120 VAC Electric Solenoid Assembly (Not part of FM Approval)
400327	240 VAC Electric Solenoid Assembly (Not part of FM Approval)
600096	Black Audible Alarm, Battery Operated (requires pressure switch)

Table 52 – Installation Tools

Part Number	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
300246	Tools, ILP Valve Rebuild Kit, Small DOT Valves
300248	Tools, ILP Valve Rebuild Kit, Medium DOT Valves

Table 53 – Valve Accessories

Part Number	Description
201137	Tamperproof Valve Lockout Clip, Disarmed - Red
201132	Tamperproof Valve Locking Clip, Armed - Green
200164	Ball Valve for ILP and DLP Valves
900164	Ball Valve Lever Replacement
200303	Transport Cap, Yellow
310300	Safety Plug for Small (1/4") ILP Valve
310301	Safety Plug for Medium/Large (1/2") ILP Valve
600033	Washer, Bonded Seal, 1/8"

APPENDIX B – PROTECTED VOLUMES BASED ON DESIGN CONCENTRATIONS

Class A Fires (All FK-5-1-12 agents)

Table 54 – Class A Fire Enclosure Volume Limitations for 940205 Unit Assembly

Design Temperature		Maximum Enclosure Volume		Concentration
°F	°C	ft³	m³	%
0	-17.8	50.2	1.42	4.675
10	-12.2	51.5	1.46	
20	-6.7	52.7	1.49	
30	-1.1	54.0	1.53	
40	4.4	55.2	1.56	
50	10.0	56.5	1.60	
60	15.5	57.7	1.63	
70	21.1	59.0	1.67	
80	26.7	60.2	1.70	
90	32.2	61.4	1.74	
100	37.8	62.7	1.78	
110	43.3	63.9	1.81	
120	48.9	65.2	1.85	
130	54.4	66.4	1.88	

Table 55 – Class A Fire Enclosure Volume Limitations for 940555 Unit Assembly

Design Temperature		Maximum Enclosure Volume		Concentration
°F	°C	ft³	m³	%
0	-17.8	100.5	2.85	4.675
10	-12.2	103.0	2.92	
20	-6.7	105.5	2.99	
30	-1.1	107.9	3.06	
40	4.4	110.4	3.13	
50	10.0	112.9	3.20	
60	15.5	115.4	3.27	
70	21.1	117.9	3.34	
80	26.7	120.4	3.41	
90	32.2	122.9	3.48	
100	37.8	125.4	3.55	
110	43.3	127.9	3.62	
120	48.9	130.3	3.69	
130	54.4	132.8	3.76	

Table 56 – Class A Fire Enclosure Volume Limitations for 941055 Unit Assembly

Design Temperature		Maximum Enclosure Volume		Concentration
°F	°C	ft³	m³	%
0	-17.8	201.0	5.69	4.675
10	-12.2	205.9	5.83	
20	-6.7	210.9	5.97	
30	-1.1	215.9	6.11	
40	4.4	220.9	6.25	
50	10.0	225.9	6.40	
60	15.5	230.8	6.54	
70	21.1	235.8	6.68	
80	26.7	240.8	6.82	
90	32.2	245.8	6.96	
100	37.8	250.7	7.10	
110	43.3	255.7	7.24	
120	48.9	260.7	7.38	
130	54.4	265.7	7.52	

Table 57 – Class A Fire Enclosure Volume Limitations for 942055 Unit Assembly

Design Temperature		Maximum Enclosure Volume		Concentration
°F	°C	ft³	m³	%
0	-17.8	401.9	11.38	4.675
10	-12.2	411.9	11.66	
20	-6.7	421.8	11.95	
30	-1.1	431.8	12.23	
40	4.4	441.8	12.51	
50	10.0	451.7	12.79	
60	15.5	461.7	13.07	
70	21.1	471.6	13.35	
80	26.7	481.6	13.64	
90	32.2	491.5	13.92	
100	37.8	501.5	14.20	
110	43.3	511.4	14.48	
120	48.9	521.4	14.76	
130	54.4	531.3	15.05	

Class B Fires (All FK-5-1-12 agents)

Table 58 – Class B Fire Enclosure Volume Limitations for 940205 Unit Assembly

Design Temperature		Maximum Enclosure Volume		Concentration
°F	°C	ft³	m³	%
0	-17.8	38.3	1.09	6.04
10	-12.2	39.3	1.11	
20	-6.7	40.2	1.14	
30	-1.1	41.2	1.17	
40	4.4	42.1	1.19	
50	10.0	43.1	1.22	
60	15.5	44.0	1.25	
70	21.1	45.0	1.27	
80	26.7	45.9	1.30	
90	32.2	46.9	1.33	
100	37.8	47.8	1.35	
110	43.3	48.8	1.38	
120	48.9	49.7	1.41	
130	54.4	50.7	1.43	

Table 59 – Class B Fire Enclosure Volume Limitations for 940555 Unit Assembly

Design Temperature		Maximum Enclosure Volume		Concentration
°F	°C	ft³	m³	%
0	-17.8	76.7	2.17	6.04
10	-12.2	78.6	2.22	
20	-6.7	80.5	2.28	
30	-1.1	82.4	2.33	
40	4.4	84.3	2.39	
50	10.0	86.2	2.44	
60	15.5	88.1	2.49	
70	21.1	90.0	2.55	
80	26.7	91.9	2.60	
90	32.2	93.7	2.65	
100	37.8	95.6	2.71	
110	43.3	97.5	2.76	
120	48.9	99.4	2.82	
130	54.4	101.3	2.87	

Table 60 – Class B Fire Enclosure Volume Limitations for 941055 Unit Assembly

Design Temperature		Maximum Enclosure Volume		Concentration
°F	°C	ft³	m³	%
0	-17.8	153.3	4.34	6.04
10	-12.2	157.1	4.45	
20	-6.7	160.9	4.56	
30	-1.1	164.7	4.66	
40	4.4	168.5	4.77	
50	10.0	172.3	4.88	
60	15.5	176.1	4.99	
70	21.1	179.9	5.09	
80	26.7	183.7	5.20	
90	32.2	187.5	5.31	
100	37.8	191.3	5.42	
110	43.3	195.1	5.52	
120	48.9	198.9	5.63	
130	54.4	202.7	5.74	

Table 61 – Class B Fire Enclosure Volume Limitations for 942055 Unit Assembly

Design Temperature		Maximum Enclosure Volume		Concentration
°F	°C	ft³	m³	%
0	-17.8	306.6	8.68	6.04
10	-12.2	314.2	8.90	
20	-6.7	321.8	9.11	
30	-1.1	329.4	9.33	
40	4.4	337.0	9.54	
50	10.0	344.6	9.76	
60	15.5	352.2	9.97	
70	21.1	359.8	10.19	
80	26.7	367.4	10.40	
90	32.2	375.0	10.62	
100	37.8	382.6	10.83	
110	43.3	390.2	11.05	
120	48.9	397.8	11.26	
130	54.4	405.4	11.48	

Class C Fires (3M™ Novec™ 1230, Noah NY5112 & Dukare 1230)

Table 62 – Class C Fire Enclosure Volume Limitations for 940205 Unit Assembly

Design Temperature		Maximum Enclosure Volume		Concentration
°F	°C	ft³	m³	%
0	-17.8	50.3	1.43	4.667
10	-12.2	51.6	1.46	
20	-6.7	52.8	1.50	
30	-1.1	54.1	1.53	
40	4.4	55.3	1.57	
50	10.0	56.6	1.60	
60	15.5	57.8	1.64	
70	21.1	59.1	1.67	
80	26.7	60.3	1.71	
90	32.2	61.6	1.74	
100	37.8	62.8	1.78	
110	43.3	64.0	1.81	
120	48.9	65.3	1.85	
130	54.4	66.5	1.88	

Table 63 – Class C Fire Enclosure Volume Limitations for 940555 Unit Assembly

Design Temperature		Maximum Enclosure Volume		Concentration
°F	°C	ft³	m³	%
0	-17.8	100.7	2.85	4.667
10	-12.2	103.2	2.92	
20	-6.7	105.7	2.99	
30	-1.1	108.1	3.06	
40	4.4	110.6	3.13	
50	10.0	113.1	3.20	
60	15.5	115.6	3.27	
70	21.1	118.1	3.34	
80	26.7	120.6	3.42	
90	32.2	123.1	3.49	
100	37.8	125.6	3.56	
110	43.3	128.1	3.63	
120	48.9	130.6	3.70	
130	54.4	133.1	3.77	

Table 64 – Class C Fire Enclosure Volume Limitations for 941055 Unit Assembly

Design Temperature		Maximum Enclosure Volume		Concentration
°F	°C	ft ³	m ³	%
0	-17.8	201.3	5.70	4.667
10	-12.2	206.3	5.84	
20	-6.7	211.3	5.98	
30	-1.1	216.3	6.12	
40	4.4	221.3	6.27	
50	10.0	226.3	6.41	
60	15.5	231.2	6.55	
70	21.1	236.2	6.69	
80	26.7	241.2	6.83	
90	32.2	246.2	6.97	
100	37.8	251.2	7.11	
110	43.3	256.2	7.25	
120	48.9	261.2	7.40	
130	54.4	266.2	7.54	

Table 65 – Class C Fire Enclosure Volume Limitations for 942055 Unit Assembly

Design Temperature		Maximum Enclosure Volume		Concentration
°F	°C	ft ³	m ³	%
0	-17.8	402.7	11.40	4.667
10	-12.2	412.6	11.68	
20	-6.7	422.6	11.97	
30	-1.1	432.6	12.25	
40	4.4	442.5	12.53	
50	10.0	452.5	12.81	
60	15.5	462.5	13.10	
70	21.1	472.5	13.38	
80	26.7	482.4	13.66	
90	32.2	492.4	13.94	
100	37.8	502.4	14.23	
110	43.3	512.4	14.51	
120	48.9	522.3	14.79	
130	54.4	532.3	15.07	

Class C Fires (Waysmos FK-5-1-12)

Table 66 – Class C Fire Enclosure Volume Limitations for 940205 Unit Assembly

Design Temperature		Maximum Enclosure Volume		Concentration
°F	°C	ft ³	m ³	%
0	-17.8	47.9	1.36	4.890
10	-12.2	49.1	1.39	
20	-6.7	50.3	1.42	
30	-1.1	51.5	1.46	
40	4.4	52.7	1.49	
50	10.0	53.9	1.53	
60	15.5	55.0	1.56	
70	21.1	56.2	1.59	
80	26.7	57.4	1.63	
90	32.2	58.6	1.66	
100	37.8	59.8	1.69	
110	43.3	61.0	1.73	
120	48.9	62.2	1.76	
130	54.4	63.4	1.79	

Table 67 – Class C Fire Enclosure Volume Limitations for 940555 Unit Assembly

Design Temperature		Maximum Enclosure Volume		Concentration
°F	°C	ft ³	m ³	%
0	-17.8	95.8	2.71	4.890
10	-12.2	98.2	2.78	
20	-6.7	100.6	2.85	
30	-1.1	103.0	2.92	
40	4.4	105.3	2.98	
50	10.0	107.7	3.05	
60	15.5	110.1	3.12	
70	21.1	112.5	3.18	
80	26.7	114.8	3.25	
90	32.2	117.2	3.32	
100	37.8	119.6	3.39	
110	43.3	122.0	3.45	
120	48.9	124.3	3.52	
130	54.4	126.7	3.59	

Table 68 – Class C Fire Enclosure Volume Limitations for 941055 Unit Assembly

Design Temperature		Maximum Enclosure Volume		Concentration
°F	°C	ft³	m³	%
0	-17.8	191.7	5.43	4.890
10	-12.2	196.4	5.56	
20	-6.7	201.2	5.70	
30	-1.1	205.9	5.83	
40	4.4	210.7	5.97	
50	10.0	215.4	6.10	
60	15.5	220.2	6.23	
70	21.1	224.9	6.37	
80	26.7	229.7	6.50	
90	32.2	234.4	6.64	
100	37.8	239.2	6.77	
110	43.3	243.9	6.91	
120	48.9	248.7	7.04	
130	54.4	253.4	7.18	

Table 69 – Class C Fire Enclosure Volume Limitations for 942055 Unit Assembly

Design Temperature		Maximum Enclosure Volume		Concentration
°F	°C	ft³	m³	%
0	-17.8	383.4	10.86	4.890
10	-12.2	392.9	11.13	
20	-6.7	402.4	11.39	
30	-1.1	411.9	11.66	
40	4.4	421.4	11.93	
50	10.0	430.9	12.20	
60	15.5	440.4	12.47	
70	21.1	449.9	12.74	
80	26.7	459.4	13.01	
90	32.2	468.9	13.28	
100	37.8	478.4	13.55	
110	43.3	487.8	13.81	
120	48.9	497.3	14.08	
130	54.4	506.8	14.35	

Class C Fires (Chemori 5112™)

Table 70 – Class C Fire Enclosure Volume Limitations for 940205 Unit Assembly

Design Temperature		Maximum Enclosure Volume		Concentration
°F	°C	ft³	m³	%
0	-17.8	44.7	1.27	5.225
10	-12.2	45.8	1.30	
20	-6.7	46.9	1.33	
30	-1.1	48.0	1.36	
40	4.4	49.1	1.39	
50	10.0	50.2	1.42	
60	15.5	51.3	1.45	
70	21.1	52.4	1.49	
80	26.7	53.5	1.52	
90	32.2	54.7	1.55	
100	37.8	55.8	1.58	
110	43.3	56.9	1.61	
120	48.9	58.0	1.64	
130	54.4	59.1	1.67	

Table 71 – Class C Fire Enclosure Volume Limitations for 940555 Unit Assembly

Design Temperature		Maximum Enclosure Volume		Concentration
°F	°C	ft³	m³	%
0	-17.8	89.4	2.53	5.225
10	-12.2	91.6	2.59	
20	-6.7	93.8	2.66	
30	-1.1	96.0	2.72	
40	4.4	98.2	2.78	
50	10.0	100.5	2.84	
60	15.5	102.7	2.91	
70	21.1	104.9	2.97	
80	26.7	107.1	3.03	
90	32.2	109.3	3.10	
100	37.8	111.5	3.16	
110	43.3	113.7	3.22	
120	48.9	116.0	3.28	
130	54.4	118.2	3.35	

Table 72 – Class C Fire Enclosure Volume Limitations for 941055 Unit Assembly

Design Temperature		Maximum Enclosure Volume		Concentration
°F	°C	ft³	m³	%
0	-17.8	178.8	5.06	5.225
10	-12.2	183.2	5.19	
20	-6.7	187.6	5.31	
30	-1.1	192.1	5.44	
40	4.4	196.5	5.56	
50	10.0	200.9	5.69	
60	15.5	205.3	5.81	
70	21.1	209.8	5.94	
80	26.7	214.2	6.07	
90	32.2	218.6	6.19	
100	37.8	223.1	6.32	
110	43.3	227.5	6.44	
120	48.9	231.9	6.57	
130	54.4	236.3	6.69	

Table 73 – Class C Fire Enclosure Volume Limitations for 942055 Unit Assembly

Design Temperature		Maximum Enclosure Volume		Concentration
°F	°C	ft³	m³	%
0	-17.8	357.6	10.12	5.225
10	-12.2	366.4	10.38	
20	-6.7	375.3	10.63	
30	-1.1	384.1	10.88	
40	4.4	393.0	11.13	
50	10.0	401.8	11.38	
60	15.5	410.7	11.63	
70	21.1	419.5	11.88	
80	26.7	428.4	12.13	
90	32.2	437.2	12.38	
100	37.8	446.1	12.63	
110	43.3	455.0	12.88	
120	48.9	463.8	13.13	
130	54.4	472.7	13.38	

APPENDIX C – COMMISSIONING DOCUMENT CHECKLIST



Firetrace Installation, Testing, & Commissioning Report ENG-40011 - 05/17/21

All information and specifications herein subject to change without notice.

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

System Details			
Agent: ☐ Novec 1230 ☐ FM-200		System Size: lbs kg	
Valve Serial Numbers (of installed systems):			

Installation Check		System Check	
Cylinder Pressure Gauge	☐	System installed per respective DIOM 800023 (FM-200) & 800035 (Novec1230)	☐
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

3M™ Novec™ 1230 Fire Protection Fluid 04/20/22



Safety Data Sheet

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Document Group:	16-3425-2	Version Number:	31.00
Issue Date:	04/20/22	Supersedes 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
Carbon monoxide
Carbon dioxide
Toxic Vapor/Gas

Condition
During Combustion
During Combustion
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 °C

Boiling Point

49 °C [@ 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 °C]

Vapor Density

11.6 [Ref Std:AIR=1]

Density

1.6 g/ml

Specific Gravity

1.6 [@ 68 °F] [Ref Std:WATER=1]

Solubility in Water

Nil

Solubility- non-water

No Data Available

Partition coefficient: n-octanol/ water

No Data Available

Autoignition temperature

Not Applicable

Decomposition temperature

No Data Available

Viscosity

0.6 centipoise [@ 25 °C]

Molecular weight

No Data Available

Volatile Organic Compounds

1600 g/l [Test Method:calculated SCAQMD rule 443.1]

Percent volatile

100 %

VOC Less H2O & Exempt Solvents

1600 g/l [Test Method:calculated SCAQMD rule 443.1]

SECTION 10: Stability and reactivity

10.1. Reactivity

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

10.2. Chemical stability

Stable.

10.3. Possibility of hazardous reactions

Hazardous polymerization will not occur.

10.4. Conditions to avoid

Light

10.5. Incompatible materials

Strong bases

Amines

Alcohols

10.6. Hazardous decomposition products**Substance**

Hydrogen Fluoride

Condition

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	prematuring & 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	prematuring & 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).

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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. P273: Avoid release to the environment. 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

Revision date: May.7,2021 Version 4.1

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Safety Data Sheet

Inhalation	Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. 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. Get medical attention if frostbitten by liquid or if irritation persists
Eyes	Immediately flush with large amounts of water for at least 15 minutes 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 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 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 See SECTION 8 for information on personal protection equipment See SECTION 13 for information on disposal

Section 7 – Handling and Storage

Safety Data Sheet

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 (H₂O=1)	1.6 g/cm ³
Solubility(ies)	Not available
Partition coefficient: n-octanol/water	log Kow = 2.11

Revision date: May.7,2021 Version 4.1

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Safety Data Sheet

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 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.

Safety Data Sheet

Section 14—Transport Information

ITEM	LAND ☐ EU: ADR/RID ☐ US: DOT	SEA IMDG	AIR 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 not meet regulatory requirements in other countries.

SECTION 1 – IDENTIFICATION OF SUBSTANCE

PRODUCT IDENTIFIER

Trade Name : 

Chemical Name	: 1,1,1,2,2,4,5,5,5-nonafluoro-4-(trifluoromethyl)-3-pentanone
Synonyms	: CF ₃ CF ₂ C(O)CF(CF ₃) ₂ , FK-5-1-12, perfluoro(2-methyl-3-pentanone)
Chemical formula	: C ₆ F ₁₂ O
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) 1-503-747-7775 (Outside USA and Canada)
Emergency Phone Number	: 1-800-424-9300 (within USA and Canada) 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 doubt, 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. • Wear breathing apparatus plus protective gloves in the event of a fire. • Prevent, by any means available, spillage from entering drains or water courses. • Use firefighting procedures suitable for surrounding area. • Do not approach containers suspected to be hot. • Cool fire exposed containers with water spray from a protected location. • If safe to do so, remove containers from path of fire. • Equipment should be thoroughly decontaminated after use.
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Fire/ Explosion Hazard	• Non-combustible. • Not considered to be a significant fire risk. • Heating may cause expansion or decomposition leading to violent rupture of containers. • May emit corrosive, poisonous fumes. • Decomposes on heating and produces acrid and toxic fumes of: carbon dioxide (CO₂), hydrogen fluoride and other pyrolysis products typical of burning organic material.
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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. • Avoid breathing vapors and contact with skin and eyes. • Using personal protective equipment to control personal contact with the substance. • Contain and absorb spill with sand, earth or inert material. • Wipe up. • Place in an appropriate labelled container for waste disposal.
Major Spills	Moderate hazard. • Clear area of personnel. • Alert Fire Brigade and provide location and nature of hazard. • Wear breathing apparatus and gloves. • Avoid spillage from entering drains or water course by any means available. • Stop leak if safe to do so. • Contain and absorb spill with sand, earth or inert material. • Collect recoverable product into an appropriate labelled container for recycling. • Wash area and avoid runoff from entering drains. • After cleaning up, decontaminate all protective clothing and equipment prior to storing and re-using. • If contamination of drains occurs, advise emergency services.

SECTION 7 – HANDLING AND STORAGE

Precautions for safe handling

- | | |
|---------------|--|
| Safe handling | <ul style="list-style-type: none">• Storage in sealed containers may result in pressure buildup, open carefully.• Always release caps or seals slowly to ensure low dissipation of vapors.• Prevent all personal contacts, including inhalation.• Wear personal protective clothing and equipment when risk of exposure occurs.• Use in a well-ventilated area.• Avoid contact with moisture and incompatible materials.• Do not eat, drink or smoke when handling.• Keep container securely sealed when not in use.• Prevent physical damage to containers.• Always wash hands with soap and water after handling. |
|---------------|--|

- | | |
|-------------------|---|
| Other Information | <ul style="list-style-type: none">• Store in original containers.• Keep containers securely sealed.• Store in a cool, dry, well-ventilated area.• Store away from incompatible materials and foodstuff containers.• Protect containers against physical damage and check regularly for leaks. |
|-------------------|---|

Conditions for safe storage, including any incompatibilities

- | | |
|-------------------------|---|
| Suitable container | <ul style="list-style-type: none">• Store in bulging containers.• Packing as recommended by manufacturer.• All containers should be clearly labelled and free from leaks. |
| Storage incompatibility | <ul style="list-style-type: none">• Separate from alcohol and water.• Avoid strong bases.• 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. - Provide adequate ventilation in warehouse or closed storage area.
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Personal Protection

Eye and face protection	- Safety glasses with side shields. - 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. - 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 ₂ O=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. • Unstable in the presence of incompatible materials. • 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 - 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. - Disposal of waste product in a permitted industrial waste facility. Combustion products could include HF. Facility must be capable of handling halogenated materials. - Do not allow wash water from cleaning or process equipment to enter drains. - It may be necessary to collect all wash water for treatment before disposal. - In all cases disposal to sewer may be subject to local laws and regulations. - Where in doubt, contact the responsible authority. - Recycle where possible. - 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. - Dispose of by: burial in a land-fill specifically licensed to accept chemical and/or pharmaceutical wastes or incineration in a licensed
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- 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

Product name Fire suppression clean agent Dukare 1230 (FK-5-1-12)

Issue date 16-Nov-2016

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- Nonfluoro-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, heat 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
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.
Eyeface 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
Explosive properties
Oxidizing properties

Not determined
Not an explosive
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/m ³ (8h/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

Contaminated packaging

EU waste code (product as sold)

Disposal should be in accordance with applicable regional, national and local laws and regulations.

Disposal should be in accordance with applicable regional, national and local laws and regulations.

07 01 03* Organic halogenated solvents, washing liquids and other mother liquors

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 NY5112



SAFETY DATA SHEET

according to Regulation (EC) No. 1907/2006 (REACH)
and Regulation (EU) No 2015/830

Revision date: 25/1/2017
Version: 1
Language: en-GB,JE
Date of print: 9/2/2017

Fire Protection Fluid NY5112

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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.



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2.3 Other hazards

Thermal decomposition: Inhaling hazardous decomposing products can cause serious health damage.

Vapour undergoes indirect photolysis in the troposphere. 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 ophthalmologist.

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.



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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

Advice 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.



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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
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
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



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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.



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12.2. Persistence and degradability

Further details: Vapour undergoes indirect photolysis in the troposphere. 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



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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.