FIRETRACE™ International

DESIGN, INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

FOR

PRE-ENGINEERED DRY CHEMICAL ILP AUTOMATIC FIRE SUPPRESSION SYSTEMS

Designed for use in:
Engine Compartments

SPCR 183 (P-Mark) Certified Systems:

941007	10 lb [4.54 kg] Black Widow™ DOT Unit
942007	20 lb [9.07 kg] ABC Dry Chemical DOT Unit
942057	20 lb [9.07 kg] ABC Dry Chemical CE Unit
942227	22 lb [9.98 kg] ABC Dry Chemical DOT Horizontal Unit

R107 Certified Systems:

941012	10 lb [4.54 kg] ABC Dry Chemical DOT Unit
941052	10 lb [4.54 kg] ABC Dry Chemical CE Unit
942012	20 lb [9.07 kg] ABC Dry Chemical DOT Unit
942052	20 lb [9.07 kg] ABC Dry Chemical CE Unit
942222	22 lb [9.98 kg] ABC Dry Chemical DOT Horizontal Unit

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SPCR 183 Certificate Number: SC1263-13
UN ECE Regulation No. 107 Approval Number: 06004

TABLE OF CONTENTS

1 FOREWORD

1.1 General

This manual is written for the fire protection professional that designs, installs, and maintains Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Units. It is intended to communicate details and procedures required for proper design, installation, operation, and maintenance under either SPCR 183 or UN ECE Regulation No. 107.

Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Units are to be designed, installed, inspected, tested, maintained, and recharged by qualified trained personnel in accordance with the following:

- All instructions, limitations, etc. contained in this manual, P/N 800039
- All information contained on the agent cylinder nameplate(s)
- NFPA 17 Standard for Dry Chemical Extinguishing Systems
- Local authority having jurisdiction
- SPCR 183
- UN ECE Regulation No. 107

1.2 Warnings

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

WARNING

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

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

DANGER:

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

WARNING:

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

CAUTION:

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

1.3 Safety Precautions

The following safety precautions should always be followed:

WARNING

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

1. Read and understand this entire manual and any other documents referenced herein.
2. All Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Units are factory equipped with discharge port plugs. The discharge port plugs **MUST** be installed on the cylinder valve at all times and only removed when connected into the discharge piping 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.
4. Ensure the lever on the Firetrace ILP Unit ball valve (installed on the top of the cylinder valve) is in the "OFF" position, and the detection tubing has been removed from the cylinder valve, and the discharge port plugs installed before removing the cylinder from installation and before performing any charging, leak tests, or salvage operations.
5. Follow all of the safety procedures included on the cylinder nameplate and in this manual.
6. Never assume that a cylinder is empty. Treat all cylinders as if they are fully charged.

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

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

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www.firetrace.com

2 GENERAL INFORMATION

2.1 Introduction

The Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Units are certified under SPCR 183 and approved under UN ECE Regulation No. 107. These units are designed for use within bus engine compartments, using ABC Dry Chemical Powder or Black Widow Powder.

The Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Units have been tested to limits established by SP Technical Research Institute of Sweden in compliance with the requirements specified in *SPCR 183: Certification rules regarding Fire suppression systems in engine compartment of buses and coaches* and *UN ECE Regulation No. 107: Uniform provisions concerning the approval of category M_2 or M_3 vehicles with regard to their general construction*, and as detailed in this manual.

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

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

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

2.2 Dry Chemical Extinguishing Agent

Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Units utilize mono ammonium phosphate ($NH_4H_2PO_4$), also known as ABC Powder, or Black Widow™.

The dry chemical powders have been evaluated and approved for use in occupied areas, provided the proper safety precautions have been taken.

The dry chemical powders are capable of being fluidized and free flowing so that they can be discharged through discharge piping and nozzles under the influence of an expellant gas. When discharged, dry chemical will drift through the air and settle on surrounding surfaces.

2.2.1 Cleanliness

Dry chemical powder is slightly acidic and in the presence of moisture can stain or corrode some types of metal surfaces. To minimize possible staining or corrosion, the exposed areas should be cleaned off immediately. Dry chemical powder can be cleaned up by one of the following methods: wiping, vacuuming, or washing the exposed areas. In some cases, the dry chemical powder should be scraped off if the surface was hot at the time of discharge.

2.2.2 Properties

For hazard information, decomposition information, and physical properties of the dry chemical powders used in these systems, please refer to the Safety Data Sheets (SDS) located in Appendix C.

3 SYSTEM DESCRIPTION

3.1 General

The Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Units certified under SPCR 183 are designed for use in engine compartments of buses and coaches. The following systems are certified under SPCR 183:

941007	10 lb [4.54 kg] Black Widow™ DOT Unit
942007	20 lb [9.07 kg] ABC Dry Chemical DOT Unit
942057	20 lb [9.07 kg] ABC Dry Chemical CE Unit
942227	22 lb [9.98 kg] ABC Dry Chemical DOT Horizontal Unit

The SP Method 4912 rating for the 20 lb [9.07 kg] ABC Dry Chemical Suppression Units and the 22 lb [9.98 kg] ABC Dry Chemical Horizontal Suppression Unit is 10 out of 10.
Under SPCR 183 certification, ABC Dry Chemical Powder has been approved in Firetrace Systems for use on:

- High fire loads with and without forced ventilation
- Low fire load with and without forced ventilation
- Class A fire with and without forced ventilation
- Hidden fire with and without forced ventilation
- Hot surface re-ignition protection of 58 seconds

The SP Method 4912 rating for the 10 lb [4.54 kg] Black Widow™ suppression unit is 9 out of 10.
Under SPCR 183 Certification, Black Widow™ Powder has been approved in Firetrace Systems for use on:

- High fire loads with and without forced ventilation
- Low fire loads with and without forced ventilation
- Hidden fire with and without forced ventilation
- Hot surface re-ignition protection of 54 seconds

To achieve the P-Mark certification status, completed documents ENG-40002 and ENG-40003 must be submitted to Firetrace International and approved during the project. (See appendix D)

The Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Units approved under UN ECE Regulation No. 107 are designed for use in engine compartments of buses and coaches. The following systems are certified under UN ECE Regulation No. 107:

941012	10 lb [4.54 kg] ABC Dry Chemical DOT Unit
941052	10 lb [4.54 kg] ABC Dry Chemical CE Unit
942012	20 lb [9.07 kg] ABC Dry Chemical DOT Unit
942052	20 lb [9.07 kg] ABC Dry Chemical CE Unit
942222	22 lb [9.98 kg] ABC Dry Chemical DOT Horizontal Unit

Under UN ECE Regulation No. 107, ABC Powder has been approved in Firetrace Systems for use on:

- High fire loads with and without forced ventilation
- Low fire load with and without forced ventilation
- Hidden fire with and without forced ventilation
- Hot surface re-ignition protection of 117 seconds for 10lb systems and >195 seconds for 20 lb Systems (no re-ignition observed at the end of the test)

Dry Chemical Powder should not be used where the following materials may be present.

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

For hazards beyond the scope described above it is recommended that the designer consult with Firetrace, NFPA 17, and the local authority having jurisdiction as to the suitability on the use of dry chemical powders for a particular hazard, for personnel exposure effects, and for installation requirements.

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

- Cylinder
- Valve assembly
- Mounting Bracket
- Firetrace detection/actuation tubing and fittings (No substitute)
- Discharge nozzles
- Pressure switch (Optional)
- Discharge piping and fittings

Once installed, the Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Unit becomes a self-contained, self-actuating unit that does not require an external source of power or electricity. The unit utilizes a unique UL recognized component linear heat detector known as Firetrace Automatic Fire Detection Tubing. One end of the flexible tubing is attached to the top of the cylinder valve. The tubing is installed throughout the protected enclosure and pressurized with dry nitrogen to maintain the cylinder valve in the closed position. This tubing acts as a continuous linear thermal detector that ruptures upon direct flame impingement or at high temperatures associated with fire conditions. Once the detection tubing is ruptured, the cylinder valve automatically opens, allowing the dry chemical to flow through the discharge piping, distributing the agent through the nozzles into the protected area.

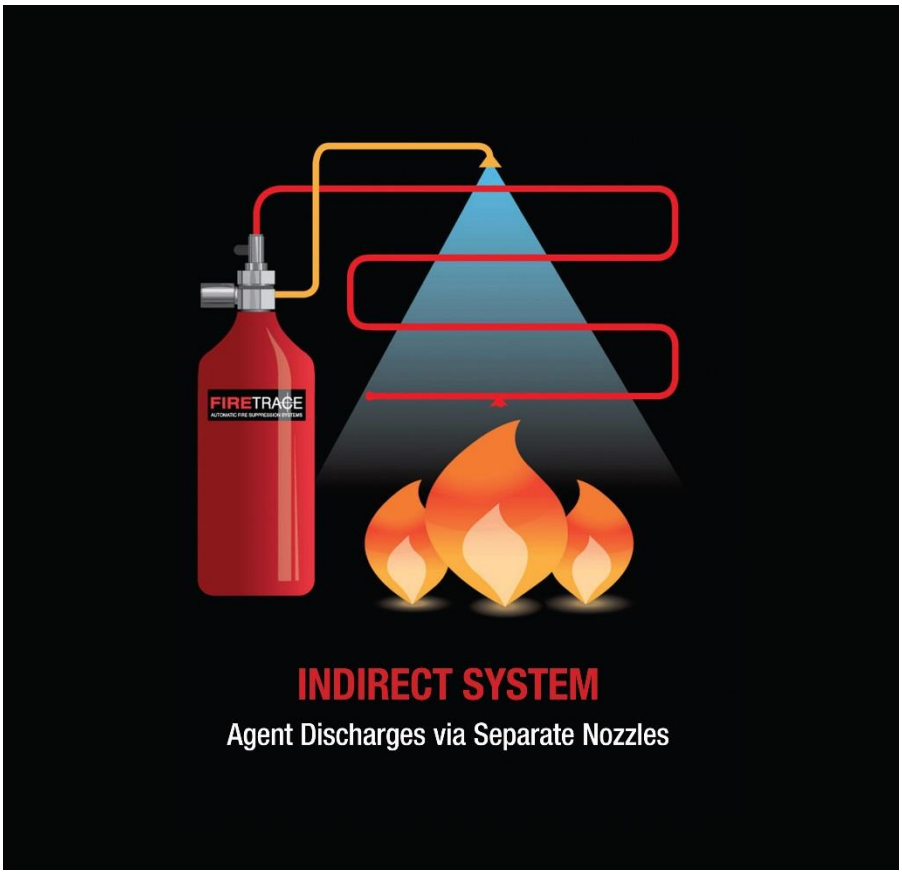


Figure 1: System Overview Diagram

3.2 Component Descriptions

3.2.1 Cylinder

Dry chemical powder is stored in steel cylinders pressurized with nitrogen to 360 psig at 70°F [24.8 bar at 21.1°C]. The unit cylinders are manufactured, tested, and stamped in accordance with DOT-4BA360 or DOT-4BW360, and TC-4BAM25 or TC-4BWM25. Refer to Table 1 and Table 2 for additional details.

Part Number	Orientation	Outside Diameter		Volume		Agent	
		in	cm	in^3	L	lb	kg
941007	Vertical	6.32	16.05	300	4.9	10	4.54
941012	Vertical	6.32	16.05	300	4.9	10	4.54
941052	Vertical	5.91	15.0	305	5.0	10	4.54
942007	Vertical	7.08	17.98	680	11.1	20	9.07
942012	Vertical	7.08	17.98	680	11.1	20	9.07
942052	Vertical	7.28	18.50	687	11.25	20	9.07
942057	Vertical	7.28	18.50	687	11.25	20	9.07
942222	Horizontal	9.00	22.86	1011	16.6	22	9.98
942227	Horizontal	9.00	22.86	1011	16.6	22	9.98

Table 1: Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Unit Specifications

Nominal Size	Cylinder Specification	Cylinder Working Pressure		Cylinder Test Pressure	
		psig	bar	psig	bar
10 lb	DOT-4BA360 TC-4BAM25	360	25	720	50
20 lb	DOT-4BA360 TC-4BAM25	360	25	720	50
22 lb	DOT-4BW360 TC-4BWM25	360	25	720	50
10 lb	PED 2014/68/EU	360	25	667	46
20 lb	PED 2014/68/EU	360	25	667	46

Table 2: Cylinder Specification

3.2.2 Valve Assembly

Each cylinder is equipped with an anodized aluminum valve, 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. Each valve is also equipped with two discharge ports. Each discharge port is provided with a discharge port plug that must be installed in the discharge port whenever a system is not in service. The discharge port plugs are designed to prevent uncontrolled discharge of the system in the event that the valve is accidentally actuated.

WARNING

The discharge port plugs must be installed in the valve discharge ports at all times, except when connected to the discharge piping or when filling. Failure to follow these instructions could result in property damage, personal injury, or death.

3.2.3 Firetrace Detection Tubing

The Firetrace detection tubing is a UL recognized component per UL Standard 521 (see Certificate of Compliance 20140705-S35465). The Firetrace detection tubing performs two functions: heat detection and system activation. One end of tubing is installed to the top of the cylinder. The tubing is then installed throughout the hazard volume and finally pressurized with nitrogen.

The detection tubing is heat sensitive and in a fire situation is designed to rupture at any point along its length upon direct flame impingement or when the temperature reaches above 383 °F [195 °C]. The rupture of the tubing releases the nitrogen pressure causing the unit to actuate. The actuation results in complete discharge of the dry chemical powder through the nozzles.

4 SYSTEM DESIGN AND LIMITATIONS

4.1 General

The Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Unit design limitations were established and tested by Firetrace. The units are certified by SP Technical Research Institute of Sweden who conducted independent evaluations for compliance with SPCR 183 and UN ECE Regulation No. 107.

These units were subjected to numerous performance tests (as specified in SPCR 183 and UN ECE Regulation No. 107), in order to verify their suitability and to establish design limitations for:

- Hazard Volume
- Operating Temperature Range
- Nozzle Placement
- Nozzle Quantity
- Maximum Length/Size of Piping and Number of Fittings

The pre-engineered concept minimizes the amount of engineering required when evaluating a design for a specific application. Provided the discharge piping and nozzles are installed within the limitations 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, agent quantity, detector arrangement, etc., are also met, the system installation can be understood to comply with the design requirements of NFPA 17, therefore no discharge tests should be required.

4.2 Operating Specifications

4.2.1 Temperature Range

Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Units and equipment are designed to be stored and operated at the ambient temperature range of -40 °F to +130 °F [-40.0 °C to +54.4 °C].

4.2.2 Operating Pressure

The normal operating pressure for Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Units is 360 psig at 70°F [24.8 bar at 21.1°C].

Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Units are designed for an operating temperature range of - 40 °F to + 130 °F [-40.0 °C to + 54.4 °C]. Refer to the table below for the cylinder pressure-temperature relationship based on a charging pressure of 360 psig at 70°F [24.8 bar at 21.1 °C].

Cylinder Pressure			
Temperature		Pressure	
°F	°C	psig	bar
-40	-40.0	286	19.7
-30	-34.4	292	20.1
-20	-28.9	299	20.6
-10	-23.3	306	21.1
0	-17.8	312	21.5
10	-12.2	319	22.0
20	-6.7	326	22.5
30	-1.1	333	22.9
40	4.4	340	23.4
50	10.0	346	23.9
60	15.5	353	24.3
70	21.1	360	24.8
80	26.7	367	25.3
90	32.2	374	25.8
100	37.8	380	26.2
110	43.3	387	26.7
120	48.9	394	27.2
130	54.4	401	27.6

Table 3: Cylinder Pressure-Temperature Relationship

4.3 Design Procedure

The following procedures should be used to design a system utilizing a Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Unit.

NOTE: The applicable requirements specified in NFPA 17 should be followed.

a) Conduct a risk assessment of the engine compartment. See Appendix D for risk assessment template.
b) Identify all potential fire risks within the engine compartment. Example risks are stated in the risk assessment, but not limited to the examples provided.
c) Determine the **gross** volume of the engine compartment. Use the guidelines below to determine the volume.
   - Height is measured from the upper boundary ceiling of the engine compartment to the floor of the engine compartment. If there is no floor on the engine compartment, measure the bottom of the chassis beam.
   - Width is measured on the inside of the engine compartment from each side of the bus. If there is a full plate boundary between the engine's compartments, measure to the plate.
   - Length is measured from the front of the engine to the rear of the gearbox.
   - **The gross volume must be used – there is to be no subtraction of volume to account for the engine and it's ancillary components.**
d) Estimate minimum and maximum temperature and the corresponding system pressures.
e) Estimate the maximum airflow within the engine compartment.
f) Establish the size of the unit required to protect the enclosure.
g) Determine the location where the Firetrace Dry Chemical ILP Unit will be installed.
h) Determine the location where the nozzles will be installed.
i) Determine the routing and quantity of discharge piping required. The discharge piping and fitting limitations must not be exceeded. (See Section 4.5)
j) Determine the arrangement and placement of the Firetrace detection tubing. (See Section 4.7)
k) Determine any auxiliary equipment requirements, such as a pressure switch to sound alarms, shut-down ventilation, shut-off electrical power, etc.
l) Create equipment installation drawings of the engine compartment.

4.4 Engine Compartment Size

The Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Units are designed to enable the system to protect an engine compartment ranging from 70 ft³ to 211 ft³ [2 m³ to 6 m³], provided the engine compartment does not exceed the stated limitations.

4.4.1 SPCR 183 Approved Systems

Under SPCR 183, the 20 lb ABC Dry Chemical Unit, the 22 lb ABC Dry Chemical Unit, and the 10 lb Black Widow™ unit are rated to protect an engine compartment with a volume of 141 ft³ [4 m³]. For engine compartments with a volume smaller than 141 ft³ [4 m³], the down-scale factor may be applied to the system. For engine compartments with a volume larger than 141 ft³ [4 m³], the up-scale factor must be applied to the system or tandem cylinders can be used. See Section 4.5 for scaling factor guidelines.

4.4.2 UN ECE Regulation No. 107 Approved Systems

Under UN ECE Regulation No. 107, the 10 lb ABC Dry Chemical Unit, the 20 lb ABC Dry Chemical Unit, and the 22 lb ABC Dry Chemical Unit are rated to protect an engine compartment with a volume of 141 ft³ [4 m³]. The 20 lb ABC dry chemical unit features extended design limitations, or may be used as an up-scaled system per the up-scale factor. For engine compartments with a volume smaller than 141 ft³ [4 m³], the down-scale factor may be applied to the system. For engine compartments with a volume larger than 141 ft³ [4 m³], the up-scale factor must be applied to the system or tandem cylinders can be used. See Section 4.5 for scaling guidelines.

4.5 Scaling Factor Guidelines

The following equations should be used to determine the scaling factor. Once determined, the scaling factor can be used for the number of nozzles, total discharge rate, and minimum mass of suppression agent.

4.5.1 Down-Scaling

The suppression system can be scaled down for engine compartment gross volume in the range of 70 ft³ ≤ 141 ft³ [2 m³ ≤ 4 m³] using the equation below.

$$S_x = 0.15 * x + 0.4$$

Equation 1: Down-scaling factor

Where:
S_x = Scaling factor for an engine compartment [m³]
x = The gross volume of the engine compartment [m³]

4.5.2 Up-Scaling

The suppression system can be scaled up for engine compartment gross volume in the range of 141 ft³ ≤ 211 ft³ [4 m³ ≤ 6 m³] using the equation below.

$$S_x = 0.1 * x + 0.6$$

Equation 2: Up scaling factor

Where:
S_x = Scaling factor for an engine compartment [m³]
x = The gross volume of the engine compartment [m³]

4.5.3 Propellant Gas

The amount of propellant gas shall be as much as the filling ratio of the base line equipment. The filling ratio is determined by the equation below. See the table below for fill ratios for the baseline equipment.

$$r_{fill} = \frac{V_G}{(V_E + V_G)}$$

Equation 3: Fill ratio

r_{fill} = The fill ratio
V_G = Volume of propellant gas
V_E = Volume of extinguishing agent

System P/N	Description	Fill Ratio
941007	10 lb Black Widow™ DOT	0.14
941012	10 lb ABC Dry Chemical DOT	0.14
941052	10 lb ABC Dry Chemical CE	0.14
942007	20 lb ABC Dry Chemical DOT	0.32
942012	20 lb ABC Dry Chemical DOT	0.32
942052	20 lb ABC Dry Chemical CE	0.32
942057	20 lb ABC Dry Chemical CE	0.32

Table 4: Filling Ratios

4.6 Discharge Network

4.6.1 Discharge Nozzle Limitations

4.6.1.1 SPCR 183 Guidelines

Under SPCR 183, the baseline engine compartment system must be designed using 6 dry chemical total flooding nozzles (P/N 500002) to suit the hazard configuration of an engine compartment with a volume of 141 ft³ [4 m³]. If equipment is down-scaled for smaller engine compartments using the down-scaling factor, the number of nozzles shall be rounded up. When equipment is up-scaled for larger engine compartments using the up-scaling factor, the number of nozzles shall be rounded to the nearest whole number. See equations in Section 4. 4 for the appropriate scaling factor.

One nozzle is to be installed at the top of the engine compartment roof facing down in a pendant position. The second nozzle shall be located above the exhaust manifold in the region where oil is most likely to spill. Two nozzles shall be located near the radiator fan. The remaining nozzles shall be strategically placed to protect any remaining fire hazards.

Each cylinder valve is equipped with two discharge ports. Both discharge ports shall be used when installing the discharge piping to the nozzles.

4.6.1.2 UN ECE Regulation No. 107

Under UN ECE Regulation No. 107, the baseline engine compartment must be designed using 4 nozzles, two dry chemical total flooding nozzles (P/N 500002), one cross pattern nozzle (P/N 500017), and one small dry chemical nozzle (P/N 500001), to suit the hazard configuration of an engine compartment with a volume of 141 ft³ [4 m³]. If equipment is down-scaled for smaller engine compartments using the down-scaling factor, the number of nozzles shall be rounded up. When equipment is up-scaled for larger engine compartments using the up-scaling factor, the number of nozzles shall be rounded to the nearest whole number. See equations in Section 4.4 for the appropriate scaling factor.

The two dry chemical total flooding nozzles are to be placed along the top of the engine compartment, with one on each side, so as to provide coverage to the entire main compartment. The cross pattern nozzle is to be located so that it is pointed directly at components known to experience highly elevated temperatures and that may be a fire risk if there is contact with fluid leaks. The small dry chemical nozzle is to be used to provide additional coverage to hazard areas separate from the main engine space.

Each cylinder valve is equipped with two discharge ports. Both discharge ports shall be used when installing the discharge piping to the nozzles.

4.6.2 Discharge Piping and Fitting Specifications

Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Units shall use flexible discharge hoses for the distribution system. Refer to the tables below for discharge piping and fitting specifications.

Material	Size	Minimum Bend Radius	Temperature Rating
High pressure synthetic rubber reinforced with high tensile braided wire.	½ in ID with .28 in wall	3.5 in [88.9 mm]	-40 °F to 212 °F [-40 °C to 100 °C]

Table 5: Discharge Piping Specifications

Note: Refer to NFPA 17 for alternate discharge network options.

Material	Connection Type	Minimum Working Pressure Rating	Manufacturer Working Pressure Rating
Zinc Plated Steel	½ in MNPT and JIC-08	360 psig [24.8 bar]	3000 psig [206.8 bar]

Table 6: Discharge Fitting Specifications

4.6.3 Discharge Piping and Fitting Limitations

To ensure proper distribution through the discharge piping, both discharge ports on the valve must be used. The discharge piping from each discharge port shall not exceed a 10% imbalance.

To provide proper distribution of the dry chemical powder upon splitting the stream, special attention must be given to the method in which an approach is made to a tee after a change in direction. Changes in direction of flow can result in separation of the expellant gas and the dry chemical powder. Refer to the tables below for the discharge piping and fitting limitations.

4.6.3.1 SPCR 183

Nominal Size	Discharge Ports Used	Nozzles Per Discharge Port	Total Nozzles Used	Maximum Length of Discharge Piping Per Discharge Port	
				ft	m
10 lb	2	3	6	16	4.88
20 lb	2	3	6	16	4.88
22 lb	2	3	6	16	4.88

Table 7: Baseline Discharge Piping Limitations for SPCR 183

Nominal Size	Discharge Ports Used	Nozzles Per Discharge Port	Total Nozzles Used	Maximum Elbows Per Discharge Port	Maximum Tees Per Discharge Port
10 lb	2	3	6	3	2
20 lb	2	3	6	3	2
22 lb	2	3	6	3	2

Table 8: Baseline Discharge Fitting Limitations for SPCR 183

4.6.3.2 UN ECE Regulation No. 107

Nominal Size	Discharge Ports Used	Nozzles Per Discharge Port	Total Nozzles Used	Maximum Length of Discharge Piping Per Discharge Port	
				ft	m
10 lb	2	2	4	16	4.88
20 lb	2	2	4	24	7.32
22 lb	2	2	4	24	7.32

Table 9: Baseline Discharge Piping Limitations for R107

Nominal Size	Discharge Ports Used	Nozzles Per Discharge Port	Total Nozzles Used	Maximum Elbows Per Discharge Port	Maximum Tees Per Discharge Port
10 lb	2	2	4	3	1
20 lb	2	2	4	3	1
22 lb	2	2	4	3	1

Table 10: Baseline Discharge Fitting Limitations for R107

4.7 Engine Compartment System Breakdown

The tables below provide a guideline for the system components required for varying engine compartment volumes per the limitations described in Section 4. For each installation, the values and quantities shall be verified using the appropriate scaling factor.

4.7.1.1 SPCR 183 Guidelines

ABC Dry Chemical Powder						
Engine Volume		Agent Amount	Nozzle Quantity	Propellant Ratio	Cylinder Volume*	
ft^3	m^3				in^3	L
70	2	14 lb	5	0.32	476	7.8
106	3	17 lb	6	0.32	578	9.5
141	4	20 lb	6	0.32	680	11.1
177	5	22 lb	7	0.32	748	12.3
211	6	24 lb	8	0.32	815	13.4

* Minimum cylinder volume

Table 11: ABC Dry Chemical Powder System Component Breakdown for SPCR 183

Black Widow™ Dry Chemical Powder				
Engine Volume	Agent	Nozzle	Propellant	Cylinder Volume*

ft³	m³	Amount	Quantity	Ratio	in³	L
70	2	7 lb	5	0.14	210	3.4
106	3	8.5 lb	6	0.14	255	4.2
141	4	10 lb	6	0.14	300	4.9
177	5	11 lb	7	0.14	330	5.4
211	6	12 lb	8	0.14	360	5.9

* Minimum cylinder volume

Table 12: Black Widow™ Dry Chemical Powder Component Breakdown for SPCR 183

4.7.1.2 R107 Guidelines

ABC Dry Chemical Powder						
Engine Volume		Agent Amount	Nozzle Quantity	Propellant Ratio	Cylinder Volume*	
ft³	m³				in³	L
70	2	7 lb	3	0.14	210	3.4
106	3	8.5 lb	4	0.14	255	4.2
141	4	10 lb	4	0.14	300	4.9
177	5	11 lb	5	0.14	330	5.4
211	6	12 lb	5	0.14	360	5.9

* Minimum cylinder volume

Table 13: ABC Dry Chemical Powder Component Breakdown for R107

ABC Dry Chemical Powder						
Engine Volume		Agent Amount	Nozzle Quantity	Propellant Ratio	Cylinder Volume*	
ft³	m³				in³	L
70	2	14 lb	3	0.32	476	7.8
106	3	17 lb	4	0.32	578	9.5
141	4	20 lb	4	0.32	680	11.1
177	5	22 lb	5	0.32	748	12.3
211	6	24 lb	5	0.32	815	13.4

* Minimum cylinder volume

Table 14: ABC Dry Chemical Powder Component Breakdown for R107, Extended Limitations

4.8 Firetrace Detection Tubing

Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Units utilize Firetrace detection tubing as a combination heat detector and unit activation device.

Firetrace detection tubing is heat sensitive and in a fire situation is designed to rupture at any point along the tube upon direct flame impingement or at high temperatures associated with fire conditions. The Firetrace detection tubing can be installed in ambient temperatures of 300 °F [148.9 °C] without bursting. The Firetrace detection tubing will burst in ambient temperatures exceeding 383 °F [195 °C], if there is no direct flame impingement.

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 engine compartment 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. The maximum length of Firetrace detection tubing shall not exceed 120 ft [36.57 m]. Additionally, the maximum height that is allowed between layers is 3.28 ft [1 m], the maximum distance between passes is 21.12 in [53.6 cm], and the maximum distance allowed from any wall to the tubing is 10.56 in [26.8 cm].

5 INSTALLATION INSTRUCTIONS

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

Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Units and equipment must be handled, installed, and serviced only by qualified and trained personnel, in accordance with instructions in this manual and on the cylinder labels, as well as NFPA 17 and any other regulations and codes that may apply.

WARNING

Ensure that the ball valve, located on the top of the cylinder valve, is maintained in the "OFF" position. Failure to follow these instructions will result in actuation and discharge of the cylinder contents. Firetrace ILP Units must be handled, installed, and serviced in accordance with the instructions contained in this manual and on the cylinder nameplate. Failure to follow these instructions could result in property damage, severe injury, or death.

CAUTION

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, the proper PPE, and ensure the discharge port plugs are properly installed before unit installation, servicing, or other general handling.

5.1 Firetrace Dry Chemical ILP Unit

The Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Unit should be located as close as possible to the protected enclosure. In some cases, the unit can be mounted inside the protected enclosure. The unit shall be located in a readily accessible location to allow for ease of inspection, service, and maintenance. The unit shall be located in an environment protected from the weather and where the temperature range is between -40 °F to +130 °F [-40 °C to +54.4 °C].

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

For the horizontal units, the cylinder and bracket must be mounted in the horizontal plane with the pressure gauge facing up to facilitate visual inspection and to ensure proper operation.

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

The figure below shows possible mounting locations within the engine compartment. The unit can be located on top or on the side of the engine compartment, or inside of the engine compartment, provided the discharge network limitations outlined in this manual are not exceeded.

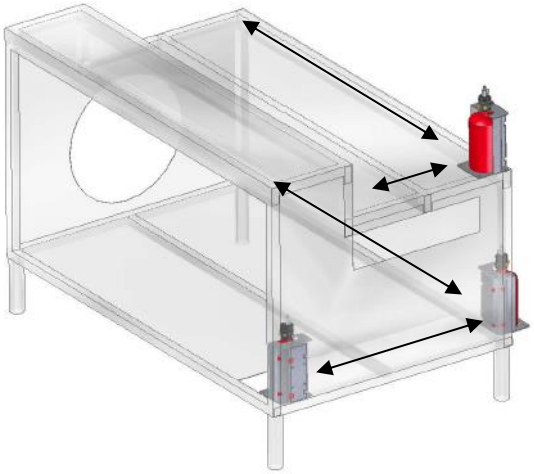


Figure 2: Unit Location Guideline for Engine Compartments

5.2 Discharge Network

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

1. Following the guidelines and limitations outlined in Section 4.6, determine the proper location for the nozzles. Properly secure the nozzles with the appropriate hardware such as the nozzle mounting brackets or similar (P/N 120305 shown below).
2. Determine the routing of the discharge piping and verify that the limitations outlined in Section 4.6 are not exceeded.
3. Remove the discharge port plugs from the valve discharge ports. Install a valve adapter fitting (P/N 850022) into each discharge port.
4. Install the discharge piping and fittings between the discharge ports and nozzles. Secure the discharge piping with the appropriate size pipe clamps, as required. When using the accessory mounting bracket, ensure bulkhead fittings are used to secure discharge hoses and nozzles to the bracket; and that the bracket is securely anchored to the mounting surface using the pre-drilled holes provided.

Figure 3: Accessory Bracket for mounting accessories (P/N 120305)

5.3 Detection Network

5.3.1 Firetrace Detection Tubing

The Firetrace detection tubing should be installed throughout the enclosure, ensuring the limitations outlined in Section 4.8 are not exceeded. The figure located in Appendix B, provides general guidelines for placement of the Firetrace detection tubing. The Firetrace detection tubing shall be placed as close as possible to high risk areas, while ensuring that the ambient temperature does not exceed 300 °F [148.9 °C]. For example, the minimum distance from a turbo charger shall be 18 in [46 cm] to avoid pre-mature tubing activation.

For buses with rear engine compartments, it is recommended that the Firetrace detection tubing is placed on the roof of the engine compartment, refer to the figure below for a Firetrace detection tubing installation example within an engine compartment.

The tubing shall be installed in a way to prevent kinking, bending, or crushing of the tubing. The tubing should be secured by using mounting tabs. The mounting tabs should be placed at 1 ft [0.3 m] intervals. The appropriate grommets shall be used when routing through sharp holes in order to prevent damage to the tubing.

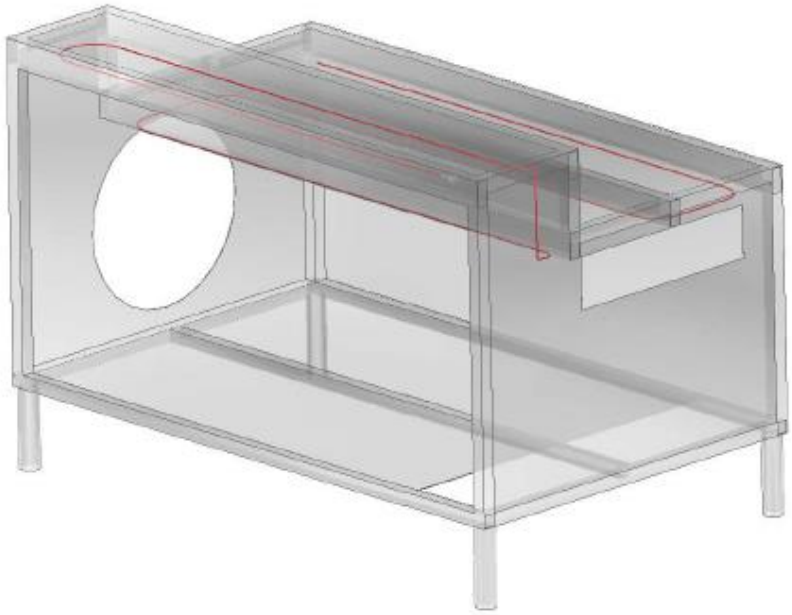


Figure 4: Firetrace Detection Tubing Installation Example

5.3.2 Detection Tubing Slip-On Fittings

All detection tubing slip-on fittings must be secured in the following manner:

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

5.3.3 End of Line Accessories

The end of line adapter is used to install auxiliary accessories to the detection network. One end of the end of line adapter contains a tubing slip-on fitting. The end of line adapter can be installed by following the procedures outlined in Section 5.3.2.

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

5.3.3.1 Pressure Gauge

Verify that the threaded connection of the pressure gauge contains a lubricated O-ring. Thread the pressure gauge hand tight into the end of line adapter. The O-ring should be completely inside and the gauge should indicate the tubing pressure.

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

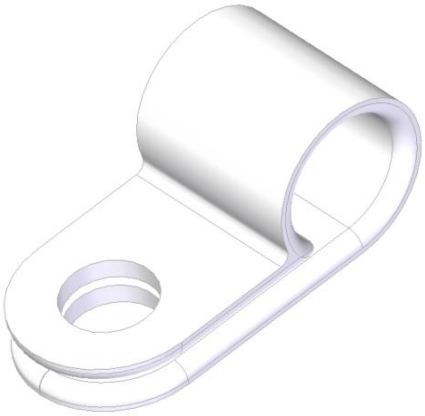
5.3.3.2 Plug

Verify that the threaded connection of the plug contains a lubricated O-ring. Thread the plug hand tight into the end of line adapter. The O-ring should be completely inside.

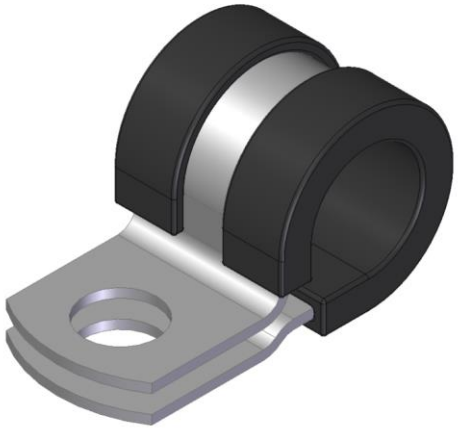
NOTE: The plug must be installed with its included O-ring to ensure a proper seal.

5.3.3.3 FDT mounting options

The FDT can be securely mounted to the enclosure using a variety of fixing methods. The most widely used components are shown below, these can be combined with accessories such as a protective sleeve or rubber grommets to avoid damaging the surface of the FDT.



200171 - Mounting tabs



201133 - Heavy duty mounting clips

820285 - Heavy duty zip tie

5.4 System Activation

The steps below should be followed to ensure proper system activation of the Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Unit:

1. Install the detection tubing, fittings, and accessories, as required, throughout the enclosure in accordance with the procedures outlined in Section 5.3.
2. With the unit ball valve in the closed position, thread the tubing slip-on fitting into the ball valve.
3. Insert one end of the detection tubing to the unit. Ensure the end of line adapter is installed on the opposite end of the detection tubing.
4. Attach the filling adapter into the end of line adapter.
5. Attach a regulated dry nitrogen supply onto the filling adapter. The regulated dry nitrogen supply shall be equipped with a calibrated pressure gauge. It is recommended to have a portable dry nitrogen supply or a Firetrace Nitrogen Fill Kit for on-site use.
6. Pressurize the detection tubing to 360 psig [24.8 bar] at 70 °F [24.8 bar at 21.1 °C].
7. Remove the dry nitrogen supply and filling adapter from the end of line adapter.
8. Thread the pressure gauge into the end of line adapter and verify that the tubing is pressurized to at least 360 psig at 70 °F [24.8 bar at 21.1 °C] (pressure may have to be adjusted for temperature).
9. With the gauge still installed in the end of line adapter, test for leakage:
   a) Apply a soapy water solution to the tubing slip-on fitting connections, end of line adapter connection, and the pressure gauge connection.
   b) Observe for bubble leaks.
   c) After approximately 30 minutes, verify the pressure gauge reading. Any decrease in pressure is an indication of a leak. If the system is determined to contain a leak, refer to Section 5 and verify the installation procedures were properly followed for all fittings and accessories.
10. If the end of line pressure switch is to be installed, remove the pressure gauge from the end of line adapter and install the pressure switch in accordance with the procedures outlined in Section 5. Verify there is no leakage from the pressure switch connection by using the soapy water solution.
11. After confirming that there is no leakage within the detection network, **SLOWLY** rotate the ball valve lever counter clockwise, to the “ON” position.

CAUTION

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

12. Tamperproof the unit by removing the ball valve lever face and securing the lever in the “ON” position with the tamperproof device.
13. If a pressure switch is installed on the unit or on the end of line adapter, ensure the proper electrical connections are made, in accordance with NFPA 70 National Electric Code, NFPA 72 National Fire Alarm and Signaling Code, and any other applicable codes and regulations that may apply.
14. The Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Unit is now fully armed and ready for use.

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, the proper PPE, and ensure the discharge port plugs are properly installed before unit installation, servicing, or other general handling.

6 SERVICE AND MAINTENANCE INSTRUCTIONS

WARNING

Firetrace ILP Units 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 17, and any other codes and regulations that may apply. Before performing maintenance or refilling procedures refer to the material safety data sheets in Appendix C.

6.1 General

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

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

Further to the general maintenance which is performed at the following intervals: monthly, semi-annually and 5-yearly. Spot-checks of installations are recommended to ensure the systems can function between the specified maintenance intervals. This should be performed regularly, at a minimum of one spot-check in the 5-year period.

6.2 Maintenance Schedule and Procedures

6.2.1 Monthly Maintenance

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

1. Verify the Firetrace Dry Chemical ILP Unit is in its proper location.
2. Verify the manual actuators are unobstructed.
3. Verify the tamperproof device is intact.
4. Confirm the maintenance tag or certificate is in its proper location.
5. Verify the Firetrace ILP Unit shows no physical damage or degradation that might prevent operation.
6. Verify the pressure gauge is in the operable range.
7. Inspect the detection tubing for abrasions, distortion, cuts, and dirt accumulation.
8. Verify the nozzle blow off caps (if used) are intact and undamaged.
9. Verify the protected equipment and hazard has not been replaced, modified, or relocated.

6.2.2 Semiannual Maintenance

Semiannual Maintenance is to be performed only by a certified Firetrace distributor. Maintenance should include a repetition of the monthly maintenance as well as verification of the Firetrace Dry Chemical ILP Unit weight. Additionally, the dry chemical powder should be agitated and the installation and design parameters checked against the submitted certification documents, to ensure no changes could affect system performance.

The Firetrace Dry Chemical ILP Unit weight should be verified using the following procedure.

1. Remove the tamperproof device from the ball valve lever.
2. Rotate the ball valve lever clockwise, to the 'OFF' position, to deactivate the system.
3. Depressurize the detection network by removing the pressure gauge found on the end of the line adapter and depressing the Schrader valve until no pressure loss is heard.
4. Remove the Firetrace detection tubing from the tube fitting attached to the top of the cylinder valve.
5. Remove the discharge piping from the discharge outlet ports.
6. Install the discharge port plugs into both discharge ports.
7. Remove the cylinder from the mounting bracket.
8. Weigh the Firetrace Dry Chemical ILP Unit.
   a) Compare the measured weight with the weight specified on the cylinder labels. If the Firetrace Dry Chemical ILP Unit shows a loss in agent quantity of more than 5 percent, the unit shall be refiled or replaced.
9. Verify that the pressure reading on the pressure gauge installed to the Firetrace Dry Chemical ILP Unit is within the operable range.
   a) If the Firetrace Dry Chemical ILP Unit shows a pressure loss (adjusted for temperature) of more than 10 percent, the unit shall be repressurized or replaced.
10. Once the semiannual maintenance is complete, return the system to service by following the procedures outlined in Section 5.

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 any warranty. Please contact Firetrace directly for a list of authorized Firetrace service locations.

6.2.3 Five-Year

The five-year maintenance is to be performed by an authorized Firetrace distributor. Maintenance should include a repetition of the monthly and semiannual maintenance, a complete external visual inspection of the cylinder, per the guidelines detailed in Section 11 of NFPA 17, and evaluation of the Firetrace detection tubing for damage and pliability.

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.

6.3 Firetrace Detection Tubing Maintenance

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

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

After 10 years of continuous use, the Firetrace detection tubing should be replaced in its entirety. However, if all routine maintenance is followed and inspection of the tubing determines the detection 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 detection tubing that have ruptured or have been damaged during a fire must be replaced. Section can be replaced by splice connections.

6.4 Dry Chemical Powder Maintenance

Maintenance of the dry chemical powder is to be performed by an authorized Firetrace distributor. Prior to installation and during every semiannual inspection, the dry chemical powder should be carefully agitated using a rubber mallet. Additionally, at least once every year, the dry chemical powder should be examined for caking. If any concerns are noted, replacement of the dry chemical powder would be recommended.

The following steps should be followed when agitating the dry chemical powder.

1. Remove the tamperproof device from the ball valve lever.
2. Rotate the ball valve lever clockwise, to the 'OFF' position.
3. Depressurize the Firetrace detection tubing.
4. Remove the Firetrace detection tubing from the tube fitting attached to the top of the cylinder valve.
5. Remove the discharge piping from the discharge ports.
6. Install the discharge port plugs into both discharge ports.
7. Remove the cylinder from the mounting bracket.
8. Carefully invert the unit and gently knock on the bottom and sides of the cylinder with a rubber mallet, approximately 5 to 10 times.
9. Once agitation is completed, return the system to service by following the procedures outlined in Section 5.

WARNING

Unit should only be agitated AFTER the ball valve has been closed, the detection tubing depressurized, and the discharge port plugs installed into the discharge port. Agitating without following these steps may cause actuation of the unit, resulting in system discharge.

6.5 Cylinder Maintenance

Cylinders utilized in Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Units that are continuously in service without discharging shall be given a complete external visual inspection every 5 years, or more frequently if required. Follow the visual inspection guidelines detailed in BS EN 1968:2002 and NFPA 17.

Cylinders utilized in Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Units which have discharged shall be subjected to a hydrostatic pressure test, if more than 5 years have passed since the date of the last test. Hydrostatic testing shall be performed only by competent personnel.

Cylinders utilized in Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Units which are damaged or show leakage must be removed from service and either requalified or replaced.

Firetrace Pre-Engineered Dry Chemical ILP Units equipped with DOT cylinders requiring retest must be hydrostatically tested in accordance with DOT CFR Title 49, Section 173.34(e). This periodic retest must be performed by an authorized tester having a current identification number issued by the Associated Administrator for Hazardous Material Safety of DOT, and must include an internal and external examination in accordance with CGA pamphlet C-6, C-6.1, C-6.2, or C-6.3, as applicable. The test procedures are described in CGA pamphlet C-1. Only the water jacket volumetric expansion method or the direct expansion methods are acceptable because volumetric expansion of the container must be measured.

Firetrace Pre-Engineered Dry Chemical ILP Units equipped with CE cylinders requiring retest must be hydrostatically tested in accordance with BS EN 1968:2002. This periodic retest must be performed only by competent personnel, and must include an internal and external examination in accordance with BS EN 1968:2002, as applicable. The test procedures are described in the appendix of BS EN 1968:2002. Only the water jacket volumetric expansion method is acceptable because volumetric expansion of the container must be measured.

7 POST DISCHARGE

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, the proper PPE, and ensure the discharge port plugs are properly installed before unit installation, servicing, or other general handling.

After a discharge of a Firetrace Dry Chemical ILP Automatic Suppression Unit, an authorized Firetrace distributor must be consulted to ensure proper removal, rebuilding, and recharging of the unit.

7.1 Ventilation

Before inspecting the enclosure after a Firetrace Dry Chemical ILP Unit discharge, ventilate the enclosure thoroughly. Dry chemical powder will require clean-up operations after discharge.

7.2 Remove From Service

The following procedure should be followed to remove the unit from service.

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 ports.
3. Install the discharge port plugs into both discharge ports.
4. Remove the cylinder from the mounting bracket.
5. Have the unit rebuilt for service by a qualified Firetrace service location.

7.3 Valve Rebuild

The following procedure should be followed to properly rebuild the valve. In addition to properly following the procedures below, the proper rebuild kit shall be utilized, P/N 300251. The rebuild kit will contain the following items:

P/N	Description
300213	O-Ring, Medium Piston Shaft
300214	O-Ring, Medium Piston Body
300215	O-Ring, Medium Top Cap
300216	O-Ring, Medium Neck

1. Verify that the unit is not pressurized. The pressure gauge on the valve should read 0 psig.
2. Verify the discharge port plugs are installed into the discharge ports.
3. Slowly open the ball valve to release any residual pressure.
4. Remove the valve from the cylinder.
5. Remove the siphon tube from the valve. Discard the O-ring on the bottom of the piston body.
6. Remove the top cap from the valve body. Discard the O-ring contained within the top cap.
7. Remove the piston assembly from inside the valve body. Discard the O-ring located around the top side of the piston and the O-ring located around the bottom of the piston.
8. Thoroughly clean all surfaces on the valve and piston. Verify no dry chemical powder is left on any sealing surfaces or on the small hole in the piston.
9. Lightly lubricate the piston body O-ring and place around the top side of the piston.
10. Lightly lubricate the piston shaft O-ring and place around the bottom side of the piston.
11. Carefully slide the piston assembly back into the valve body.
12. Lightly lubricate the top cap O-ring and insert into the bottom side of the top cap.
13. Thread the top cap back onto the piston body. Tighten the top cap to a torque specification of 70 ft-lb.
14. Lightly lubricate the neck O-ring and carefully install over the bottom threads of the valve body.
15. Thread the siphon tube back into the valve body. Hand tighten the siphon tube until it bottoms out.

7.4 System Recharge

Only the original agent, either ABC Dry Chemical Powder or Dry Chemical Black Widow provided by Firetrace may be used in any Firetrace Pre-Engineered Dry Chemical Self-Contained Automatic Indirect Fire Suppression Unit.

Only commercial grade nitrogen with a dew point of -60 °F [-52.2 °C] may be used in any Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Unit.

The following steps should be followed to properly recharge an empty Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Unit.

1. Fill the cylinder with the appropriate amount of dry chemical. Refer to Table 1 for the correct amounts for each system.
2. Clean the threads of the cylinder with a small brush or dry cloth.
3. Verify the siphon tube is properly threaded into the valve.
4. Thread the valve and siphon tube assembly into the cylinder. Tighten the valve to a torque specification of 60 ft-lb.
5. Ensure the discharge port plugs are installed into the discharge ports.
6. Pressurize the unit to 360 psig at 70 °F [24.8 bar at 21.1 °C].
7. Verify that there is no leakage in the unit. The unit is now ready to be transported to the installation site.

WARRANTY

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

****

LIMITED WARRANTY & PURCHASER'S EXCLUSIVE REMEDY

Purchaser's Limited Warranty

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

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

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

Purchaser's Exclusive Remedy

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

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

Non-Assignability of Warranty

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

Disclaimer of Consequential Damages

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

Use of Non-Firetrace Components

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

SOME FACTORS INFLUENCING ENGINEERING DESIGN AND PRODUCT APPLICATION OF FIRETRACE UNITS

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

1. The Firetrace unit has been designed to provide protection against fire, both existing and imminent, for a limited duration of time when: the unit is fully operational; used in its normal, expected environment; the unit and its component parts are properly installed, maintained, and operated in ***complete*** accordance with written instructions supplied with the unit.

2. The duration of the protection against fires dependent upon a sufficient concentration of agent being maintained in the protected hazard area for a pre-determined period of time. This duration will be shortened by conditions or circumstances which may ventilate, cause the agent concentration dilution within the protected hazard area thereby causing an insufficient concentration of agent as is needed to extinguish or prevent the existence or re-ignition of combustion or fire. All hazard areas have different rate of ventilation, leakage, or agent dilution that, in many cases, may be impossible to predict or determine. Air vents, air conditioning units, gaps and cracks in the enclosure, windows, cable and pipe penetrations, etc., all may effect the agent concentration and the duration of the protection against fire. Also, unforeseen changes in the configuration of a hazard area such as removal of a wall, an explosion or fire external to the protected space, changes in the enclosures configuration, etc. can influence the duration of the fire protection. It is because of these many, and varied, circumstances and conditions that Firetrace makes ***no*** warranty as to the duration of the protection against fire.

3. The effectiveness of an agent, such as Dry Chemical® and/or CO_2, as a fire extinguishant is directly related to the concentration of the agent required to extinguish various substances. Not all substances require the same agent concentration to be extinguished. Therefore, Firetrace can only assume that the customer has properly defined the hazard area(s) being protected.

4. The effectiveness of the Firetrace unit is dependent upon the timely discharge of the agent fire extinguishant in to the protected area. If unforeseen circumstances such as an explosion, failure of the detection system to activate the Firetrace unit, failure to Manually activate the unit, etc. occur, they can prevent the unit discharge from being accomplished in a timely manner, and the fire may become deep seated or out of control and completely destroy the hazard area. Since Firetrace has no control over these circumstances, there are ***no*** warranties as to the effectiveness of extinguishment of the fire other than those specifically stated in this **Limited Warranty**.

5. Even if the Firetrace unit is completely effective in suppressing a fire, failure to remove the ignition source of the fire could result in a re-ignition of the fire. If possible, the source of the fire should immediately be eliminated to prevent re-ignition. Protection against re-ignition only exists when a sufficient concentration of agent remains in the hazard area, as stated above.

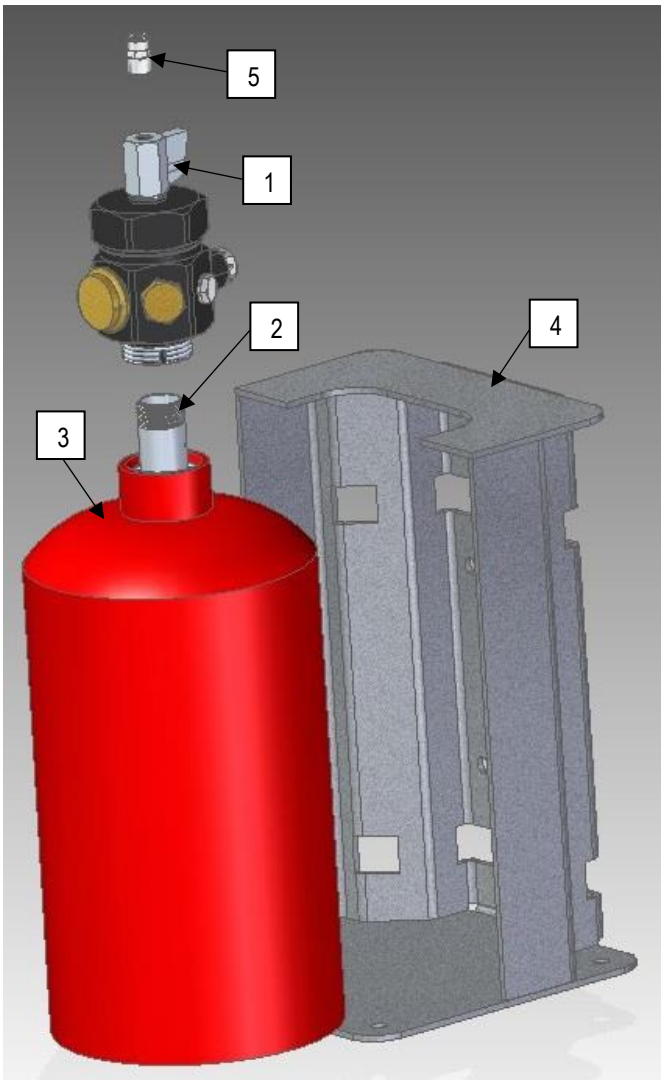
Since the effectiveness of the Firetrace unit depends on when, under what circumstances, it is used, the judgment of operating personnel as to when to activate a Firetrace unit, in an emergency, affects the protection provided by the unit. Because of the widely carrying conditions and circumstances under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

APPENDIX A

System Parts List
Discharge Line Parts List
Detection Line Parts List

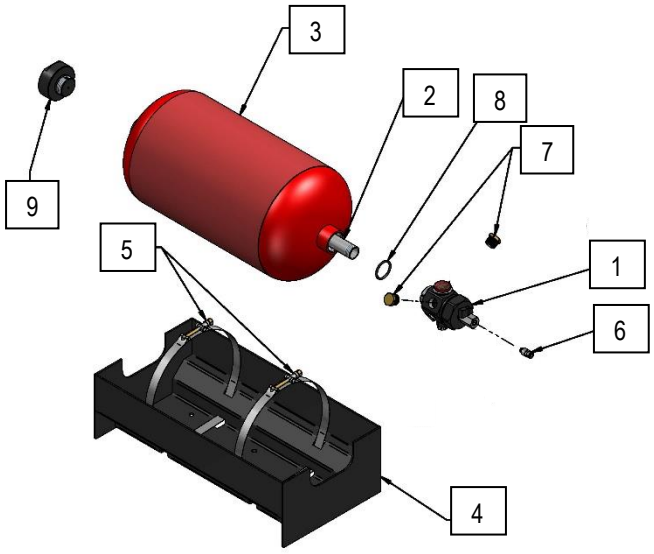
System Parts List – Vertical

ITEM	P/N	DESCRIPTION	SYSTEM
1	300125	2nd Gen Dry Chemical ILP Valve	All Systems
2	600003	Siphon Tube	941007 941012
2	600045	Siphon Tube	942007 942012 942052 942057
2	600046	Siphon Tube	941052
3	100680	DOT Cylinder	942007 942012
3	100700	CE Cylinder	941052
3	100701	CE Cylinder	941052 941057
3	101200	DOT Cylinder	941007 941012
4	111206	Bracket, Large	941052
4	111400	Heavy Duty Bracket – Extra Large, CE	942052 942057
4	111401	Heavy Duty Bracket – Extra Large, DOT	942007 942012
4	111402	Heavy Duty Bracket – Large	941007 941012
5	200179	HP Slip-on Union	All Systems
*	600142	SPCR 183 P-Mark Label	941007 942007 942057
*	620500	R107 Approval Mark Label	941012 941052 942012 942052
*	600143	DOT Dry Chemical Nameplate	941007 941012 942007 942012
*	680143	CE Dry Chemical Nameplate	941052 942052 942057
*	800100	Warranty/Registration Card	All Systems
*Parts not shown			



System Parts List – Horizontal

ITEM	P/N	DESCRIPTION	SYSTEM
1	300125	2nd Gen Dry Chemical ILP Valve	942222 942227
2	600001	Siphon Tube	942222 942227
3	101011	DOT Cylinder	942222 942227
4	111504	Bracket, Horizontal	942222 942227
5	111533	Band Clamp, Horizontal	942222 942227
6	200179	HP Slip-on Union	942222 942227
7	310301	Discharge Port Plugs	942222 942227
8	300216	O-ring, Neck	942222 942227
9	300114	Plug Assembly	942222 942227
*	600142	SPCR 183 P-Mark Label	942227
*	620500	R107 Approval Mark Label	942222
*	600148	DOT Dry Chemical Nameplate	942222 942227
*	800100	Warranty/Registration Card	942222 942227
*Parts not shown			



Discharge Network Parts List

Part Number	Description
201836	Discharge Hose, 1/2 in, 2 ft
201837	Discharge Hose, 1/2 in, 4 ft
201838	Discharge Hose, 1/2 in, 6 ft
201839	Discharge Hose, 1/2 in, 8 ft
201840	Discharge Hose, 1/2 in, 10 ft
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
850043	Fitting, 1/2 in Hose Tee Bulkhead
500001	Nozzle, Small Dry Chemical Nozzle
500002	Nozzle, Dry Chemical Total Flooding
500017	Nozzle, Cross Pattern
520000	Nozzle Kit, SPCR 183
520001	Nozzle Kit, UN ECE R107
510017	Small Nozzle Cap
510018	Medium Nozzle Cap
510019	Medium Blow-Off Cap
120305	Accessory Mounting Brackets

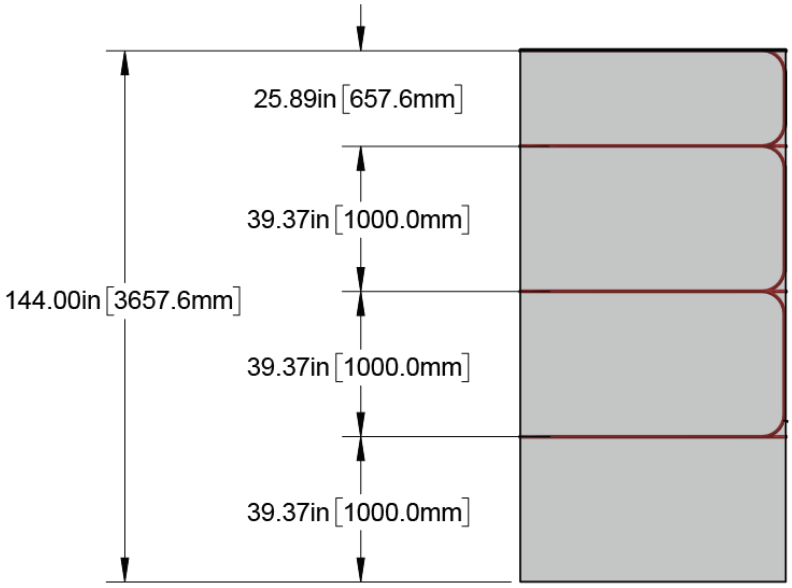
Detection Network Parts List

Part Number	Description
200005	Firetrace Detection Tubing, 4/6 mm, (by the foot)
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
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
200168	End of Line Adapter w/ Tube Union, 4/6 mm
200169	In Line Adapter w/ Tube Tee, 4/6 mm
400365	Pressure Gauge w/ O-Ring, 360 psig

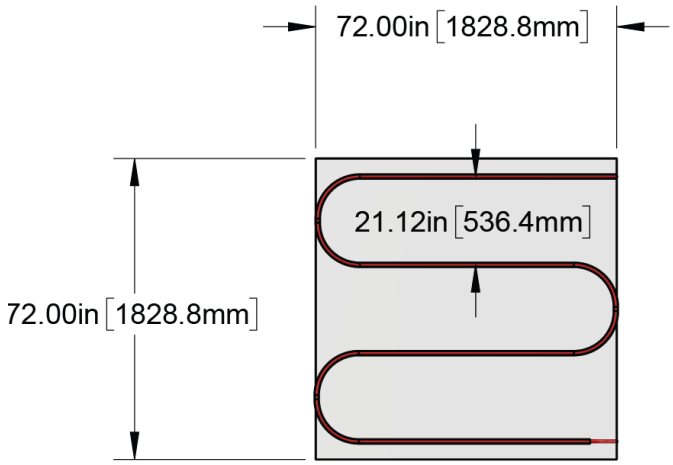
APPENDIX B

Typical Tubing Placement

Typical Tubing Placement



SIDE VIEW



TOP VIEW

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
Minimum distance from wall	10.56 in	26.82 cm
Minimum bend radius	6 in	15.24 cm

APPENDIX C

SAFETY DATA SHEETS

Black Widow

ABC Dry Chemical

Material Safety Data Sheet (MSDS)

Issue Date: December 15, 2008
Replaces MSDS dated June 17, 2004

MSDS #: 08-001

Section 1 – Chemical Product & Company Identification

Product Name: Black Widow ™
Trade Names: None
Synonyms: None
Product Type: Fire Extinguishing Powder
Formulation: Proprietary

Manufacturer
Firetrace Aerospace, LLC
15690 N. 83rd Way, Suite B
Scottsdale, AZ 85260
Tel.: (480) 607-2709

EMERGENCY Phone No.: (800) 662-2927

Section 2 – Hazards Identification / Emergency Overview

Hazard Ratings*

	NPCA/HMIS	NFPA 704
Health:	1	1
Flammability:	0	0
Reactivity:	0	0

Rating Key
0 = minimal
1 = slight
2 = moderate
3 = serious
4 = severe

* See Section 16 for abbreviations used in this MSDS

Potential Health Effects: Inhalation
This product may cause dryness and irritation (via mechanical action) to the mucous membranes lining the respiratory tract.
Potential Health Effects: Skin
This product may cause slight irritation to the skin via mechanical action.
Potential Health Effects: Ingestion
This product may cause severe irritation to the gastrointestinal tract.
Potential Health Effects: Eyes
This product may cause irritation of the eyes via mechanical action.
Chronic Toxicity: Not Determined
Exposure Limits: Although exposure limits have not yet been established for this material, the OSHA limit for respirable particulates of 5 mg/m^3 is recommended.
Aggravation of Pre-Existing Conditions: None Known
Carcinogenic: IARC – No
NTP – No
OSHA – No

Section 3 – Composition / Information on Ingredients

The following ingredients in this material are considered to be hazardous* by the OSHA (Hazard Communication Standard 29 CFR 1910):

			Exposure Limits	
Chemical	CASRN	%	OSHA PEL	ACGIH TLV
Silicon Dioxide (amorphous)	7631-86-9	1.05	80.0 mg/m^3	10.0 mg/m^3
Quartz	1317-95-9	1.05	10.0 mg/m^3	0.05 mg/m^3

*Although iron oxide fumes are also considered to be hazardous by OSHA, the iron oxides in this material are not expected to produce significant amounts of fumes.

Section 4 – First Aid Measures

First Aid: Inhalation
Remove affected person from dusty area to fresh air. If breathing becomes difficult administer oxygen if available and call a physician.
First Aid: Ingestion
If affected person is conscious, administer plenty of water, induce vomiting and call a physician.
First Aid: Skin
Immediately flush affected area with plenty of water for at least 15 minutes. Remove contaminated clothing including shoes. If irritation develops, get medical help. Wash clothing before re-use.
First Aid: Eyes
Immediately flush eyes with copious amounts of water for at least 15 minutes. If irritation develops, get medical help.

Section 5 – Fire Fighting Measures

General Fire Hazards
The material itself is a fire extinguishing agent and will not burn.
Extinguishing Media
Use appropriate methods for the surrounding fire.
Fire-fighting Procedures/Equipment
Wear protective clothing, including helmet and face mask.
Hazardous Combustion Products
None
Unusual Fire/Explosion Hazards
None

Section 6 – Accidental Release Measures

Containment Procedures
Avoid breathing in dust. Stop the flow of material, if this is without risk.
Clean-Up Procedures
Vacuum or sweep up material (avoid generating dusts), place material in appropriately marked container for disposal. Dispose of contents (including the waste container) in full compliance with all applicable federal, state/provincial and local regulations.

Section 7 – Handling & Storage

Handling Procedures
Avoid generating dusts and use this material in presence of adequate ventilation.
Storage Procedures
Store this material in a tightly closed container, away from sources of moisture and at ambient temperatures.

Section 8 – Exposure Controls / Personal Protection

Exposure Controls
Use product in presence of adequate ventilation.
Personal Protection
Nearby eye wash stations and washing facilities are highly recommended. When appropriate, wear NIOSH-approved dust mask, eye protection (safety glasses or goggles) and rubber, cloth or plastic gloves when using this product.

Section 9 – Physical / Chemical Properties

Appearance/State: Off White Powder
Specific Gravity: >1.0
Solubility (Water): insoluble (organics): insoluble
Freezing Point: NA
Vapor Pressure: NA
% Volatiles by Volume: NA
Odor: Ammonia (slight)
pH: ND
Melting Point: ND
Boiling Point: NA
Density: ND
Viscosity: NA

Section 10 – Chemical Stability / Reactivity

Chemical Stability
This material is stable and non-reactive with other materials expected to be encountered in the workplace or the environment.
Chemical Reactivity
No known polymerization or decomposition products.

Section 11 – Toxicological Information

Acute Toxicity
Acute oral LD_{50} of chemically identical product is >5,000 mg/kg. Acute LD_{50} and LC_{50} values have not been determined for this material, it is not expected to be toxic via dermal contact, inhalation or ingestion or be corrosive. It may be irritating to the skin, eyes or mucous membranes (via mechanical action and dehydration)
Chronic Toxicity
This material is not expected to cause chronic toxicity because significant amounts of this powder are not expected to be inhaled into the lungs to cause chronic toxic effects.

Section 12 – Ecological Information

Eco-toxicity
This material is not expected to cause significant adverse effects to the environment.
Components of this product are not biomagnified or bio-concentrated in the environment.

Section 13 – Disposal Considerations

This material may be disposed in a municipal landfill.

Section 14 – Transportation Information

This product is not regulated by the US Department of Transportation

Section 15 – Regulatory Information

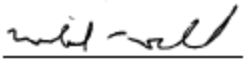
Note: This regulatory information included here should not necessarily be considered all-inclusive. This product is not subject to the reporting requirements of the CERCLA, the SARA, the RCRA, the Clean Air Act and the Clean Water Act (US). This product is not formulated with, nor do the manufacturing or formulation processes utilize any Class I or II Ozone depleting substances. All components of this product are on the TSCA Inventory or are exempt from TSCA inventory requirements.

Section 16 – Other Information

The recommendations and information contained in this MSDS have been compiled from sources believed to represent the most current information available when the MSDS was prepared. However, the manufacturer/distributor of this product does not provide any warranty, guaranty or representation as to the correctness or sufficiency of this information. If this material is to be used in large amounts and/or an unusual manner, the user is obliged to determine what safety measures are appropriate, including the applicable and relevant workplace and environmental regulations pertaining to handling, use and disposal.

Abbreviations used in this MSDS

ACGIH = American Conference of Governmental Industrial Hygienists
CERCLA = Comprehensive Environmental Response Compensation and Liability Act
CFR = Code of Federal Regulations
NA = Not Applicable
ND = Not Determined
IARC = International Agency for Research on Cancer
NA = Not Applicable
ND = Not Determined
NFPA = National Fire Protection Association
NPCA/HMIS = National Paint & Coatings Association's Hazardous Materials Information System
NTP = National Toxicology Program
OSHA = Occupational Safety & Health Administration
PEL = Permissible Exposure Limit
RCRA = Resource Conservation and Recovery Act
SARA = Superfund Amendments Reauthorization Act
TLV = Threshold Limit Value

MSDS Prepared by  M.J. Norvell, Ph.D., DABT

12/15/2008
Date

SAFETY DATA SHEET

Section 1. PRODUCT AND COMPANY IDENTIFICATION

Product Name:	ABC Dry Chemical Fire Extinguishant
Other Identifiers:	Multi-purpose Dry Chemical
Product Code(s):	CH555, F13, F11
Model Code(s) of Extinguishers:	402, IS 18ABC, IS35ABC, IS 45ABC, 13ABC, V25ABC, VH25ABC, V30ABC, VH30ABC, V50ABC, VS50ABC, VS75ABC, V250ABC
Recommended Use:	Fire suppression, not for human or animal drug use.
Manufacturer:	AMEREX CORPORATION
Internet Address:	www.amerex-fire.com
Address:	7595 Gadsden Highway, P.O. Box 81 Trussville, AL 35173-0081
Company Telephone:	(205) 655-3271
E-mail Address:	info@amerex-fire.com
Emergency Contacts:	Chemtrec 1(800) 424-9300 or (703) 527-3887
Revised:	May, 2016

Section 2. HAZARDS IDENTIFICATION

GHS – Classification

Health	Environmental	Physical
Acute Toxicity: Category 5	None	None
Skin Corrosion/Irritation: Category 3	None	None
Skin Sensitization: NO	None	None
Eye: Category 2B	None	Warning
STOT – Category 3	None	Warning
Carcinogen: Category None	None	None

GHS – Label Symbol(s): **Exclamation Mark** 

GHS – Word(s): **Warning**

Other Hazards Not Resulting in Classification: None

GHS – Hazard Phrases

GHS Hazard	GHS Code(s)	Code Phrase(s)
Physical	None	
Health	H303 316 320 335	May be harmful if swallowed Causes mild skin irritation Causes eye irritation May cause respiratory irritation
Environmental	None	
Precautionary:		
General	P101	If medical advice is needed, have product container or label at hand
Prevention	261 264	Avoid breathing dust Wash hands and face thoroughly after handling
Response	P304+340 305+351+313 337+338 312	If inhaled, remove person to fresh air and keep comfortable for breathing. If in eyes, rinse cautiously with water for several minutes. Get immediate medical advice/attention (as appropriate). If eye irritation persists: remove contact lenses, if present and easy to do. Continue rinsing. Call a POISON CENTER/doctor if you feel unwell (as appropriate).
Storage	None	

Section 3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	EC No.	REACH Reg. No.	CAS-No.	Weight%	Classification
Mono-ammonium phosphate	NA	NA	7722-76-1	90-97	NA
Fullers earth magnesium aluminum silicate	NA	Not Available	8031-18-3	>3	NA
Mica- potassium aluminum silicate	NA	Not Available	12001-26-2	1-2	NA
Silicone oil methyl hydrogen polysiloxane	NA	Not Available	63148-57-2	<1	NA
Calcium carbonate	215-279-6	Not Available	1317-65-3	<1	NA
Amorphous silica precipitated synthetic zeolite	262-373-8	Not Available	112926-00-8	<1	NA
Yellow 14 pigment – di-azo dye	228-767-9	Not Available	5468-75-7	<1	NA

Emergency overview: Light yellow, fine solid powder, odorless.

Adverse health effects and symptoms: Mild irritant to the respiratory system, eyes, and skin. Symptoms may include coughing, shortness of breath, and irritation of the lungs, eyes, and skin. Ingestion, although unlikely, may cause cramps, nausea and diarrhea.

Cut-off Levels

Chemical Name	Reproductive Toxicity	Carcinogenicity	Mutagenicity	Other Hazard Classes
Mono-ammonium phosphate	NA	NA	NA	NA
Fullers earth magnesium aluminum silicate	NA	NA	NA	NA
Mica- potassium aluminum silicate	NA	NA	NA	NA
Silicone oil methyl hydrogen polysiloxane	NA	NA	NA	NA
Calcium carbonate	NA	NA	NA	NA
Amorphous silica precipitated synthetic zeolite	NA	NA	NA	NA
Yellow 14 pigment – di-azo dye	NA	NA	NA	NA

Section 4. FIRST AID MEASURES

Eye Exposure:	May cause irritation. Irrigate eyes with water and repeat until pain free. Seek medical attention if irritation develops, or if vision changes occur.
Skin Exposure:	May cause skin irritation. In case of contact, wash with plenty of soap and water. Seek medical attention if irritation persists.
Inhalation:	May cause irritation, along with coughing. If respiratory irritation or distress occurs, remove victim to fresh air. Seek medical attention if irritation persists.
Ingestion:	Overdose symptoms may include numbness or tingling in hands or feet, uneven heart rate, paralysis, feeling faint, chest pain or heavy feeling, pain spreading to the arm or shoulder, nausea, diarrhea, sweating, general ill feeling, or seizure (convulsions). If victim is conscious and alert, give 2-3 glasses of water to drink. If conscious, do not induce vomiting. Seek immediate medical attention. Do not leave victim unattended. To prevent aspiration of swallowed product, lay victim on side with head lower than waist.
Medical conditions possibly aggravated by exposure:	Inhalation of product may aggravate existing chronic respiratory problems such as asthma, emphysema, or bronchitis. Skin contact may aggravate existing skin disease. Chronic overexposure may cause pneumoconiosis (“dusty lung” disease).

Section 5. FIRE-FIGHTING MEASURES

Flammable Properties:	Not flammable

Flash Point:	Not determined
Suitable Extinguishing Media:	Non-combustible. Use extinguishing media suitable for surrounding conditions.
Hazardous Combustion Products:	Carbon oxides
Explosion Data:	
Sensitivity to Mechanical Impact:	Not sensitive
Sensitivity to Static Discharge:	Not sensitive
Unusual fire/explosion hazards:	In a fire, this material may decompose, releasing oxides of carbon, potassium and nitrogen (see Section 10).
Protective Equipment and Precautions for Firefighters:	As in any fire, wear self-contained breathing apparatus pressure-demand. NIOSH (approved or equivalent), and full protective gear.

Section 6. ACCIDENTAL RELEASE MEASURES

Personal Precautions:	Avoid contact with skin, eyes, and clothing.
Personal Protective Equipment:	Minimum - safety glasses, gloves, and a dust respirator.
Emergency Procedure:	NA
Methods for Containment:	Prevent further leakage or spillage if safe to do so.
Methods for Clean Up:	Avoid dust formation. Clean up released material using vacuum or wet sweep and shovel to minimize generation of dust. Bag and transfer to properly labeled containers. Ventilate area and wash spill site after material pickup is complete.
Other:	If product is contaminated, use PPE and containment appropriate to the nature of the most toxic chemical/material in the mixture.

Section 7. HANDLING AND STORAGE

Personal Precautions:	Use appropriate PPE when handling or maintaining equipment, and wash thoroughly after handling (see Section 8).
Conditions for Safe Storage:	Keep product in original container or extinguisher.

Contents may be under pressure – inspect extinguisher consistent with product labeling to ensure container integrity.

Incompatible Products: Do not mix with other extinguishing agents, particularly potassium bicarbonate and sodium bicarbonate. Incompatible with strong oxidizing agents and strong acids. Do not store in high humidity. Do not combine with chlorine compounds.

Section 8. EXPOSURE CONTROL/PERSONAL PROTECTION

Chemical Name	OSHA PEL	ACGIH TLV	DFG MAK *	EU BLV
Mono-ammonium phosphate	PNOC** Total dust, 15 mg/m³ Respirable fraction, 5 mg/m³	PNOC Total dust, 10 mg/m³ Respirable fraction, 3 mg/m³	PNOC Total dust, 4 mg/m³ Respirable fraction, 1.5 mg/m³	NA
Mica	6 mg/m³	3 mg/m³	-------	NA
Fullers earth	PNOC** Total dust, 15 mg/m³ Respirable fraction, 5 mg/m³	PNOC Total dust, 10 mg/m³ Respirable fraction, 3 mg/m³	PNOC Total dust, 4 mg/m³ Respirable fraction, 1.5 mg/m³	
Silicone oil	NR**	NR		
Calcium carbonate	PNOC Total dust, 15 mg/m³ Respirable fraction, 5 mg/m³	PNOC Total dust, 10 mg/m³ Respirable fraction, 3 mg/m³	-------	NA
Amorphous silica	143 mg/m³ 80 mg/m³ or %SiO_2	10 mg/m³	4 mg/m³	NA
Yellow 14 pigment	NR	NR	NR	NA

* German regulatory limits **PNOC = Particulates not otherwise classified (ACGIH) also known as Particulates not otherwise regulated (OSHA) *** NR = Not Regulated. All values are 8 hour time weighted average concentrations.

Engineering Controls:

Showers
Eyewash stations
Ventilation systems

Personal Protective Equipment – PPE Code E:

The need for respiratory protection is not probable during short-term exposure. PPE use during production process must be independently evaluated.




Eye/Face Protection:	Tightly fitting safety goggles
Skin and Body Protection:	Wear protective gloves/coveralls
Respiratory Protection:	If exposure limits are exceeded or irritation is experienced, NIOSH approved respiratory protection should be worn. Use P100 respirators for limited exposure, use air-purifying respirator (APR) with high efficiency particulate air (HEPA) filters for prolonged exposure. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current safety and health requirements. The need for respiratory protection is not likely for short-term use in well ventilated areas.
Hygiene Measures:	Good personal hygiene practice is essential, such as avoiding food, tobacco products, or other hand-to-mouth contact when handling. Wash thoroughly after handling.

Section 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Light yellow powder, finely divided odorless solid
Molecular Weight:	115.03
Odor:	Odorless
Odor Threshold:	No information available
Decomposition Temperature °C:	100 – 120
Freezing Point °C:	No information available
Initial Boiling Point °C:	No information available
Physical State:	Crystalline Powder
pH:	Approximately 4.4 to 4.9
Flash Point °C:	None

Autoignition Temperature °C:	None
Boiling Point/Range °C:	Not Applicable
Melting Point/Range °C:	190 C
Flammability Limits in Air °C:	Upper – Not Flammable; Lower-Not Flammable
Explosive Properties:	None
Oxidizing Properties:	None

Volatile Component (%vol)	Not Applicable
Evaporation Rate:	Not Applicable
MMHG @ 37.8 C :	Not Applicable
Vapor Density:	Not Applicable
Vapor Pressure:	Not Applicable
Specific gravity:	Approximately 1.8 at 25 C
Solubility:	40.4 g/100 ml
Partition Coefficient:	No Information Available
Viscosity:	Not Applicable

Section 9. STABILITY AND REACTIVITY

Stability:	Stable under recommended storage and handling conditions.
Incompatibles:	Strong oxidizing agents; Strong acids; sodium hypochlorite and chlorine compounds. Protect from moisture
Conditions to Avoid:	Storage or handling near incompatibles.
Hazardous Decomposition Products:	Carbon, nitrogen, and potassium oxides. Heat of fire may release carbon monoxide.
Possibility of Hazardous Reactions:	None
Hazardous Polymerization	Does not occur

Section 11. TOXICOLOGICAL INFORMATION

Likely Routes of Exposure:	Inhalation, skin and eye contact.
Symptoms:	
Inhalation:	Irritation, coughing.
Eyes:	Irritation.
Skin:	Irritation.
Acute Toxicity:	Relatively non-toxic.
Chronic Toxicity:	
Short-term Exposure:	None known.
Long-term Exposure:	As with all dusts, pneumoconiosis, or “dusty lung” disease, may result from chronic exposure.

Acute Toxicity Values - Health

Chemical Name	LD50		LC50 (Inhalation)
	Oral	Dermal	
Mono-ammonium phosphate	5750 mg/kg (rat)	>7940 mg/kg (rabbit)	Not available
Mica	None	None	None
Fullers Earth	None	None	None
Silicone oil	None	None	None
Calcium carbonate	6450 mg/kg (rat)	500 mg/24 hr (rabbit)	Not available

Amorphous silica	>5000 mg/kg (rat)	>2000 mg/kg (rabbit)	>2.2 mg/L (rat)
Yellow 14 pigment	>17000 mg/kg (rat)	>3000 mg/kg (rat)	>4448 mg/m³ (rat)

Reproductive Toxicity: This product's ingredients are not known to have reproductive or teratogenic effects.

Target Organs and Effects (TOST): Respiratory system (mild irritant). This product is a mild irritant to epithelial tissue, (eyes, mucous membranes, skin) and may aggravate dermatitis. No information was found indicating the product causes sensitization.

Other Toxicity Categories

Chemical Name	Germ Cell Mutagenicity	Carcino-genicity	Repro-ductive	TOST Single Exp	TOST Repeated Exp	Aspiration
Potassium Bicarbonate	None	None	None	Cat 3	None	None
Fullers Earth	None	None	None	None	None	None
Mica	None	None	None	None	None	None
Silicone oil	None	None	None	None	None	None
Calcium carbonate	None	None	None	None	None	None
Amorphous silica	None	None	None	None	None	None
Yellow 14 pigment	None	None	None	None	None	None

Section 12. ECOLOGICAL INFORMATION

Ecotoxicity: Negative effects unknown. Provides nutrient nitrogen and phosphorus to plant life.

Persistence/Degradability: Degrades rapidly in humid/wet environment.

Bioaccummulation: Extent unknown.

Mobility in soil: Slow evaporation rate; water soluble, may leach to groundwater.

Other Adverse Ecological Effects: No other known effects at this time.

Aquatic Toxicity Values – Environment – None Known

Chemical Name	Acute (LC50)	Chronic (LC50)
Mono-ammonium phosphate	N/A	N/A
Mica	N/A	N/A
Fullers Earth	N/A	N/A
Silicone oil	N/A	N/A
Calcium carbonate	N/A	N/A
Amorphous silica	N/A	N/A
Yellow 14 pigment	N/A	N/A

Section 13. DISPOSAL CONSIDERATIONS

Safe Handling	Use appropriate PPE when handling, and wash thoroughly after handling (see Section 8).
Waste Disposal Considerations	Dispose in accordance with federal, state, and local regulations.
Contaminated Packaging	Dispose in accordance with federal, state, and local regulations.

NOTES:
This product is not a RCRA characteristically hazardous or listed hazardous waste. Dispose of according to state or local laws, which may be more restrictive than federal laws or regulations. Used product may be altered or contaminated, creating different disposal considerations.

Section 14. TRANSPORT INFORMATION

UN Number:	NA
UN Proper Shipping Name:	NA
Transport Hazard Class:	NA
Packing Group:	NA
Marine Pollutant?:	NO
IATA	Not regulated
DOT	Not regulated

NOTES:
This product is not defined as a hazardous material under U.S. Department of Transportation (DOT) 49 CFR 172, or by Transport Canada "Transportation of Dangerous Goods" regulations.
Special Precautions for Shipping:

If shipped in a stored pressure-type fire extinguisher, and pressurized with a non-flammable, non-toxic inert expellant gas, the fire extinguisher is considered a hazardous material by the US Department of Transportation and Transport Canada. The proper shipping name shall be FIRE EXTINGUISHER and the UN designation is UN 1044. The DOT hazard class is Limited Quantity when shipped via highway or rail. Use a Non-Flammable Gas label (class 2.2) when shipping via air.

Section 15. REGULATORY INFORMATION

International Inventory Status: All ingredients are on the following inventories

Country(ies)	Agency	Status
United States of America	TSCA	Yes
Canada	DSL	Yes
Europe	EINECS/ELINCS	Yes

Australia	AICS	Yes
Japan	MITI	Yes
South Korea	KECL	Yes

REACH Title VII Restrictions: No information available

Chemical Name	Dangerous Substances	Organic Solvents	Harmful Substances Whose Names Are to be Indicated on Label	Pollution Release and Transfer Registry (Class II)	Pollution Release and Transfer Registry (Class I)	Poison and Deleterious Substances Control Law
Mono-ammonium Phosphate	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable

Component	ISHA – Harmful Substances Prohibited for Manufacturing, Importing, Transferring, or Supplying	ISHA – Harmful Substances Requiring Permission	Toxic Chemical Classification Listing (TCCL) – Toxic Chemicals	Toxic Release Inventory (TRI) – Group I	Toxic Release Inventory (TRI) – Group II
Mono-ammonium Phosphate 7722-76-1	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Fullers earth magnesium aluminum silicate 8031-18-3 (>4)	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Mica-potassium aluminum silicate 120001-26-2 (>2)	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable

Calcium carbonate 471-34-1	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Amorphous silica 69012-64-2	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Yellow 14 pigment 5468-75-7	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable

European Risk and Safety phrases:

EU Classification:	XN	Irritant
R Phrases:	20	Harmful by inhalation.
	36/37	Irritating to eyes, respiratory system.
S Phrases:	22	Do not breath dust.
	24/25	Avoid contact with skin and eyes.
	26	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

36 Wear suitable protective clothing.

U.S. Federal Regulatory Information:

SARA 313:
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA) - This product does not contain and chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372.
None of the chemicals in this product are under SARA reporting requirements or have SARA threshold planning quantities (TPQs) or CERCLA reportable quantities (RQs), or are regulated under TSCA 8(d).

SARA 311/312 Hazard Categories:

Acute Health Hazard	Yes
Chronic Health Hazard	No
Fire Hazard	No
Sudden Release of Pressure Hazard-*	Yes
Reactive Hazard	No

* - Only applicable if material is in a pressurized extinguisher.

Clean Water/Clean Air Acts:
This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42) or Clean Air Act, Section 112, Hazardous Air Pollutants (HAPs) (see 40 CFR 61) and Section 112 of the Clean Air Act Amendments of 1990.

U.S. State Regulatory Information:

Chemicals in this product are covered under specific State regulations, as denoted below:

Alaska - Designated Toxic and Hazardous Substances: None
California – Permissible Exposure Limits for Chemical Contaminants: None
Florida – Substance List: Mica Dust
Illinois – Toxic Substance List: None
Kansas – Section 302/303 List: None
Massachusetts – Substance List: Mica Dust
Minnesota – List of Hazardous Substances: None
Missouri – Employer Information/Toxic Substance List: None
New Jersey – Right to Know Hazardous Substance List: None
North Dakota – List of Hazardous Chemicals, Reportable Quantities: None
Pennsylvania – Hazardous Substance List: None
Rhode Island – Hazardous Substance List: Mica Dust
Texas – Hazardous Substance List: No
West Virginia – Hazardous Substance List: None
Wisconsin – Toxic and Hazardous Substances: None

California Proposition 65: No component is listed on the California Proposition 65 list.

Other:

Mexico – Grade	No component listed
Canada – WHMIS Hazard Class	No component listed

Section 16. OTHER INFORMATION

This SDS conforms to requirements under U.S., U.K., Canadian, Australian, and EU regulations or standards, and conforms to the proposed 2003 ANSI Z400.1 format.

Issuing Date	17-June-2012
Revision Date	4-May-2016
Revision Notes	None

The information herein is given in good faith but no warranty, expressed or implied, is made.
Updated by William F. Garvin, CIH.

APPENDIX D

Risk Assessment: Bus Engine Compartment Form
Declaration of Installment for P-Marked Systems

The forms in Appendix D shall be used for reference purposes only

Always use official form:

ENG-40003 Fire Risk Assessment:
Bus Engine Compartment to conduct a risk assessment of the vehicle

ENG-40002 Declaration of Installment for P-Marked Systems

FIRETRACE International

Fire Risk Assessment: Bus Engine Compartment

Document Number: ENG-40003-C	Date: 04/19/2023	Page 1 of 8

Section 1: General Information

Check One Box Only: ☐ **R107 System** ☐ **P-Mark System**	
Company:	**Inspector Name:**
Contact Name:	**Company:**
Address 1:	**Phone:**
Address 2:	**Date of Assessment:**
Phone:	**Signature:**
Fire Risk Assessment Project Number:	
Bus Manufacturer and Model:	
Bus VIN or ID number:	
Bus Engine Gross Volume:	
Mass of Suppression Agent needed: (use scaling factor in manual if needed)	
Estimation of Maximum Air Flow:	
Bus Engine Fuel:	
Previous Fire Location (If applicable):	

Previous Fire Suppression System (If applicable):
System Operating Temperature Range:
Approximate minimum temperature the system may be activated and pressure of the system:
Approximate maximum temperature the system may be activated and pressure of the system:
Lowest and Highest Approved System Pressure:
Bus Maintenance Information (List Personal Responsible):

Image of the Bus :

Section 2: Potential Hazards

This form relates to Firetrace USA Testing Procedures for Hazard Identification, Risk Assessment and Control (HIRAC). Using Table 1 seen below to fill out the form by:

1) Providing The Specifics
2) Listing the Hazard
3) Assessing the probability of Potential Risk Factor
4) Listing their preventative controls
5) Assigning individual(s) responsible for controls

Once complete submit along with the formal test procedure for approval.

Table 1: Hazard Identification, Risk Assessment and Control (HIRAC)

Severity	Very Likely Could Happen Any Time	Likely Could Happen Sometime	Unlikely Could Happen But Very Rarely	Very Unlikely Could happen But Probably Never Will
Death or Permanent Disability	High 5	High 4	High 4	Medium 2
Long Term Illness Or Serious Injury	High 5	High 4	Medium 3	Medium 2
Medical Attention Or Short Term Incapacity	High 5	Medium 4	Medium 3	Low 1
First Aid Needed	Medium 4	Medium 4	Low 2	Low 1

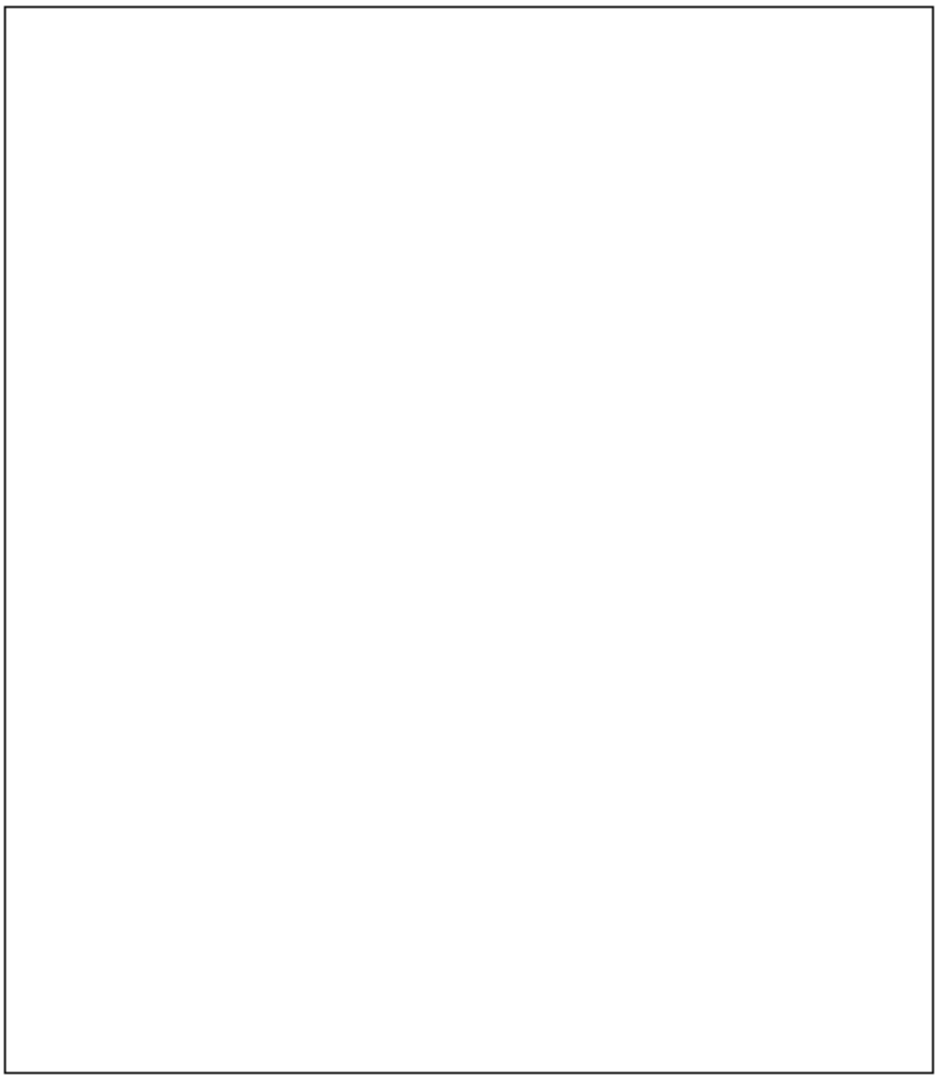
Hazard Description:

HAZARD	RISK ASSESSED BEFORE CONTROL	CONTROL MEASURE(S)	WHO / WHEN	RISK AFTER CONTROL
Manifold Exhaust				
Turbo Charger				

Radiator Airflow				
Pressurized oil and fuel lines				
Auxiliary heaters				
Generators and electrical wiring				

Section 3: Fire Suppression

Proposed Layout and Design of Firetrace Fire Suppression System:



Design Questions	Answers
Are there two nozzles located by the maximum airflow of the radiator fans? The nozzles shall point downwards.	Choose an item.
Is there a nozzle near the exhaust around the area where hydraulic oil may drip?	Choose an item.
Is there a nozzle in a compartmentalize area within the engine compartment? (If applicable)	Choose an item.
Is there a total of 6 nozzles?	Choose an item.
If so, have they been properly distributed along the engine compartment risk areas? (No not include the 2 nozzle by the radiator and the one nozzle in the compartmentalize area as an evenly distributed nozzle)	Choose an item.
Is the discharge piping less than 16ft? (distance from the cylinder to end of the farthest nozzle)	Choose an item.
Has the volume of the engine compartment volume been verified with the amount of suppression chemical needed?	Choose an item.
Was there a need to scale up or down the system?	Choose an item.

If one of these question was answered as "no" please justify your reasoning:

Section 4: Final Submittal

Before any fire suppression installation is done the inspector, owner of the bus, Authority Having Jurisdiction (AHJ), and a Firetrace representative (If inspector is not a Firetrace employee) must sign in this section. By signing here each individual states that they have reviewed this risk assessment and understand the reason for the layout of the equipment.

Inspector Signature: _____ Date: _____

Inspector Name: _____

Owner's Signature: _____ Date: _____

Owner's Name: _____

AHJ's Signature: _____ Date: _____

AHJ's Name: _____ Agency's Name: _____

AHJ's Title: _____

Firetrace Representative's Signature: _____

Firetrace Representative's Name: _____

Firetrace Representative's Title: _____

Date: _____

Note: Spot check inspections intervals will be establish upon completion of installation. Firetrace will be in charge of this upon Declaration of Installment sign off.

FIRETRACE International

Declaration of Installment for P-marked Systems

Document Number: ENG-40002-C	Date: 09/29/2017	Page 1 of 1

ILP Fire Suppression Systems in bus engine compartments
P-marked using SPCR 183 certification rules

Part Number 941007	10 lb ILP Black Widow System
_____ Part Number 942007	20 lb ILP ABC Dry Chemical System
_____ Part Number 942057	20 lb ILP ABC Dry Chemical System (CE)
_____ Part Number 942227	22 lb ILP ABC Dry Chemical System Horizontal

Fire Risk Assessment Project Number:

Installation has been done according to the Firetrace Risk Assessment document stated above. The Fire Risk Assessment shall be attached to this document for convenience.

This equipment is certified by SP Technical Research Institute of Sweden under SPCR 183: Certification rules regarding Fire suppression systems in engine compartments of buses and coaches and NFPA 17 Standard for Dry Chemical Extinguishing Systems, 2013 edition.

User Information:

Bus Location	**VIN Number**
Company	**Contact**
Installation Address	**City**
State/Province	**Zip/Postal Code**
Country:	

Installing Company Information:

Installation Team Members:
Company:
Phone:
Date:

Cylinder Information:

Firetrace Serial Number:	
Cylinder Serial Number:	
Date:	

Installer Signature: _____