



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

LHD Systems (Non-Certified):

961012	10 lb [4.54 kg] ABC Dry Chemical LHD DOT Unit
962012	20 lb [9.07 kg] ABC Dry Chemical LHD DOT Unit
962222	22 lb [9.98 kg] ABC Dry Chemical LHD DOT Horizontal Unit

Firetrace International

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1 FOREWORD

1.1 General

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

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 800106
- All information contained on the agent cylinder nameplate(s)
- NFPA 17 Standard for Dry Chemical Extinguishing Systems
- Local authority having jurisdiction
- SPCR 183 (FDT Systems)
- UN ECE Regulation No. 107 (FDT Systems)

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.



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.

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.

1.3 Safety Precautions

The following safety precautions should always be followed:

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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The following website should be visited for frequent technical announcements:

www.firetrace.com

2 GENERAL INFORMATION

2.1 Introduction (P-Mark & R107 FDT Systems)

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 M₂ or M₃ 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 Introduction (Non-Certified LHD Systems)

The Firetrace Pre-Engineered ILP Automatic Suppression Units with Dry Chemical Powder are units designed for total flooding applications in accordance with NFPA 17: Standard for Dry Chemical Extinguishing Systems.

Each installed unit is equipped with linear heat detection cable, 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. 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.

2.3 Dry Chemical Extinguishing Agent

Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Units utilize mono ammonium phosphate ($\text{NH}_4\text{H}_2\text{PO}_4$), 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.

2.3.1 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.

2.3.2 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 (P-Mark & R107 FDT Systems)

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.

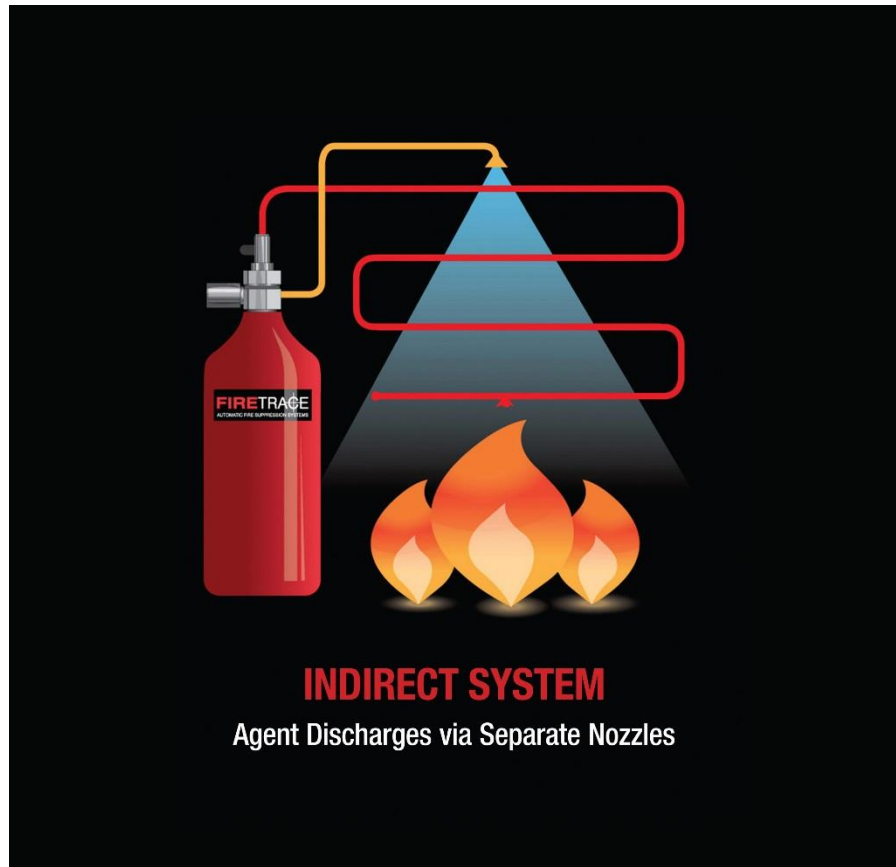


Figure 1: System Overview Diagram

3.2 General (Non-Certified LHD Systems)

Firetrace Pre-Engineered ILP Automatic Suppression Units are intended to be designed and installed to protect hazards within the limitations as stated in this manual ONLY. The authority having jurisdiction should follow the information specified by this manual, NFPA 17: Standard for Dry Chemical Fire Extinguishing Systems, and any other applicable standards.

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 LHD Dry Chemical ILP Automatic Suppression Units consists of the following major components:

- Cylinder
- Valve assembly (releasing solenoid included)
- Mounting bracket
- Linear heat detection cable (LHD) (No substitute)
- Discharge nozzles
- Valve mounted pressure switch (Optional)
- NANO controller and accessories
- Discharge piping and fittings

The unit utilizes a UL recognized component (per UL standard 521) Linear Heat Detector (See Certificate of Compliance) known as Linear Heat Detection Cable. This cable is comprised of a pair of twisted low resistance, tri-metallic conductors, sheathed in advanced temperature sensitive polymers. When the cable reaches the required temperature the two twisted cores will fuse together and signal the NANO controller. Once the NANO controller is signaled, it opens the solenoid valve, allowing the Dry Chemical Powder to flow through the discharge piping, distributing the extinguishing agent through the nozzle(s) into the protected enclosure.

3.3 Component Descriptions

3.3.1 Cylinder

Dry chemical powder is stored in steel cylinders pressurized with nitrogen to 360 psig at 70°F [24.8bar 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
961012	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
962012	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
962222	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

3.3.2 Valve Assembly (P-Mark & R107 FDT Systems)

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.



Figure 2 - FDT Valve Assembly

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.

3.3.3 Valve Assembly (Non-Certified LHD Systems)

Each cylinder is equipped with an anodized aluminum valve, a pressure gauge to monitor cylinder pressure, and a solenoid valve that interfaces with the NANO controller. The solenoid valve must be disconnected from power 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.



Figure 3 - LHD Valve Assembly

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.

3.3.4 Firetrace Detection Tubing (P-Mark & R107 FDT Systems)

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.

3.3.5 Linear Heat Detection Cable (Non-Certified LHD Systems)

The Linear Heat Detection Cable (LHD) is a UL recognized component per UL standard 521. It is installed throughout the hazard volume with one end connected to the releasing panel and one end terminated with the end of line device.

Linear Heat Detection Cable uses fixed temperature detection technology to provide an easy method for sensing changes in temperature levels. At 445°F (230°C), the temperature sensitive polymer melts and triggers the NANO controller to open the valve mounted solenoid and release the agent from the system through the connected discharge network.

3.3.6 NANO Controller (Non-Certified LHD Systems)

Firetrace LHD systems have been tested to be compatible with the NANO controller. The NANO is a compact and robust stand-alone fire detection and extinguishant release panel designed to protect various applications like electrical cabinets, CNC machines or engine compartments. As well as other small areas or equipment in which the user should be able to detect and extinguish a fire rapidly and effectively. This is done by pressing two buttons (the yellow external release buttons) or using fire sensor inputs. The NANO continuously senses its inputs and, in the event of a fire, gives the signal to release a Firetrace suppression system. The NANO is a combined fire detection and extinguishing release system. It has two fire detection zones, any, or all of which can contribute to the extinguishant release decision. The NANO is a versatile fire alarm extinguishing release system, please consult the user manual that is included with the controller and Appendix D of this manual.

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 (P-Mark & R107 FDT Systems)

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 Temperature Range (Non-Certified LHD Systems)

Firetrace Pre-Engineered Dry Chemical ILP Automatic Suppression Units and equipment are designed to be stored at the ambient temperature range of -40 °F to +130 °F [-40.0 °C to +54.4 °C]. The units have an operating temperature of -13°F to +130°F [-25.0°C to +54.4°C].

Note: The operating temperature of Firetrace LHD Systems is limited by the NANO controller only.

4.2.3 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 (P-Mark & R107 FDT Systems)

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 E 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 Design Procedure (Non-Certified LHD Systems)

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

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

- a) 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 its ancillary components.**
- b) Estimate minimum and maximum temperature and the corresponding system pressures.
- c) Estimate the maximum airflow within the engine compartment.
- d) Establish the size of the unit required to protect the enclosure.
- e) Determine the location where the Firetrace LHD Dry Chemical ILP Unit will be installed.
- f) Determine the location where the NANO controller will be installed.
- g) Determine the location where the nozzles will be installed.
- h) Determine the routing and quantity of discharge piping required. The discharge piping and fitting limitations must not be exceeded. (See Section 4.5)
- i) Determine the arrangement and placement of the linear heat detection cable. (See Section 4.6)
- j) Determine any auxiliary equipment requirements, such as a pressure switch to sound alarms, shut-down ventilation, shut-off electrical power, etc.
- k) Create equipment installation drawings of the engine compartment.

4.5 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.

4.5.1 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.

4.5.2 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.

4.6 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.

4.6.1 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]

4.6.2 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]

4.6.3 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

4.7 Discharge Network

4.7.1 Discharge Nozzle Limitations

4.7.1.1 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.

4.7.1.2 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.

4.7.2 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

4.7.3 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.

4.7.3.1 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

4.7.3.2 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

4.8 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.

4.8.1.1 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 Amount	Nozzle Quantity	Propellant Ratio	Cylinder Volume*	
ft ³	m ³				in ³	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

4.8.1.2 R107 Guidelines

ABC Dry Chemical Powder						
Engine Volume		Agent Amount	Nozzle Quantity	Propellant Ratio	Cylinder Volume*	
ft ³	m ³				in ³	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*	
ft ³	m ³				in ³	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

4.9 Firetrace Detection Tubing (P-Mark & R107 FDT Systems)

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].

4.10 Linear Heat Detection Cable (Non-Certified LHD Systems)

Firetrace Pre-Engineered LHD Dry Chemical ILP Automatic Suppression Units utilize linear heat detection cable as a heat detector and activation signaling device.

Linear heat detection cable is heat sensitive and in a fire situation is designed to melt the inner insulation of the twisted wires to allow the metal cores to come in contact with each other. The LHD cable can be installed in ambient temperatures up to 338 °F [170 °C] without activating. The LHD cable will activate in ambient temperatures exceeding 424 °F [218 °C], if there is no direct flame impingement.

Location of the LHD cable is critical to the response time in the event of a fire. The LHD cable should be installed throughout the engine compartment and routed in close proximity to all potential fire sources. The LHD cable should not be placed horizontally adjacent to a potential fire source. The maximum length of LHD cable shall not exceed 164 ft [50 m]. Additionally, there should be a minimum distance of 1" [20 mm] between the LHD cable and any mounting surfaces in the engine compartment.

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 FDT systems and -13 °F to +130 °F [-25.0°C to 54.4°C] for LHD systems.

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.

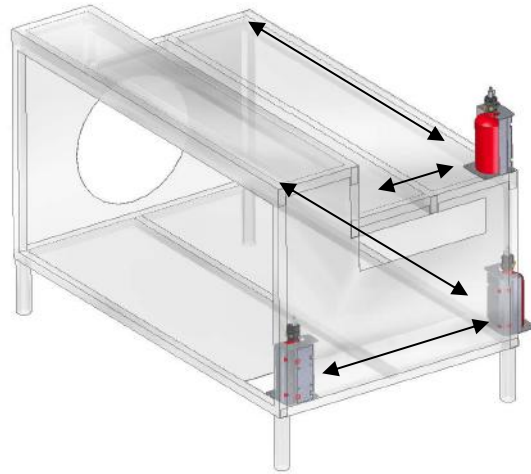


Figure 4: Unit Location Guideline for Engine Compartments

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

5.3 Detection Network (P-Mark & R107 FDT Systems)

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.

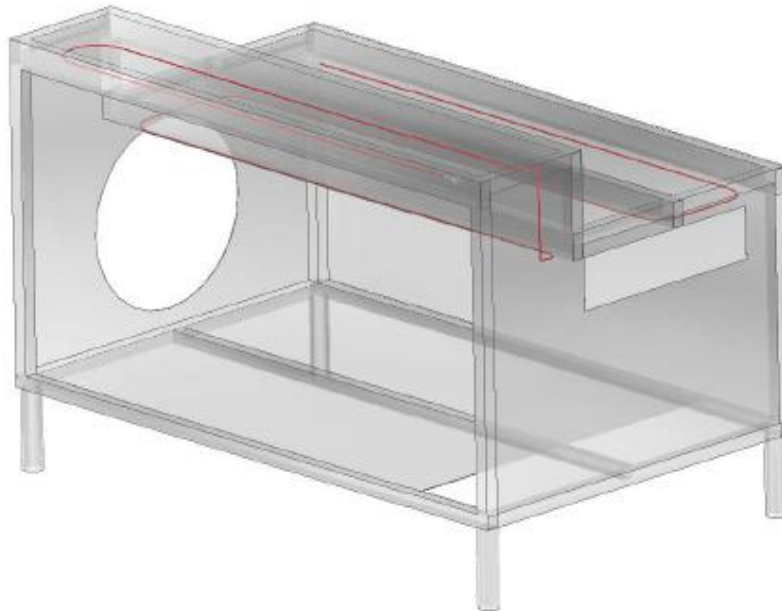


Figure 6: Firetrace Detection Tubing Installation Example

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.

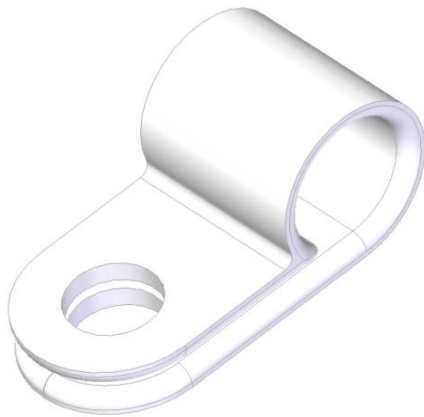
5.3.3.2 Plug

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.

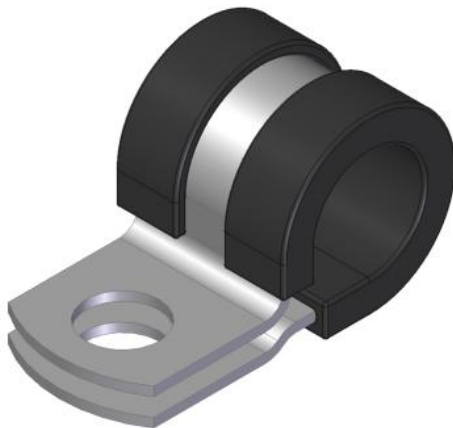
NOTE: The plug must be installed with its included O-ring to ensure a proper seal.

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 Detection Network (Non-Certified LHD Systems)

5.4.1 Linear Heat Detection Cable

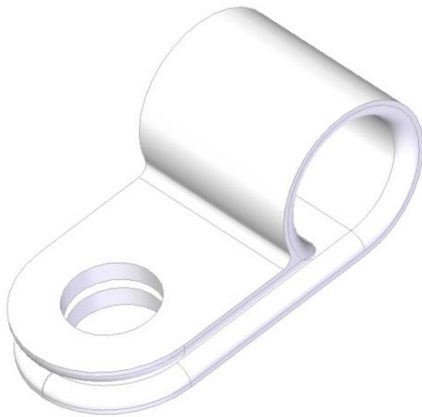
Linear heat detection cable is heat sensitive and in a fire situation is designed to melt the inner insulation of the twisted wires to allow the metal cores to come in contact with each other. The LHD cable can be installed in ambient temperatures up to 338 °F [170 °C] without activating. The LHD cable will activate in ambient temperatures exceeding 424 °F [218 °C], if there is no direct flame impingement. The steps below should be followed to ensure proper installation of the detection network.

1. Use Firetrace supplied p-clips and spacers to securely mount the detection cable. Ensure there is a minimum 1 in [25.4mm] gap from the mounting surface. The p-clip mounting tabs should be placed at 1.5ft [0.46m] intervals. The length of the LHD cable run shall not exceed 164ft [50m].
2. Install end of line termination box (552011) with included 10kΩ resistor at the end of the detection circuit. Failure to install the 10kΩ resistor will result in faults with the NANO controller.

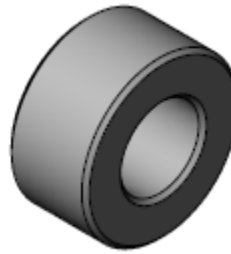
NOTE: Do not kink, bend, or crush LHD cable. Damage to the cable can result in accidental discharge of the Firetrace ABC Dry Chemical Powder ILP Unit.

5.4.1.1 LHD 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.



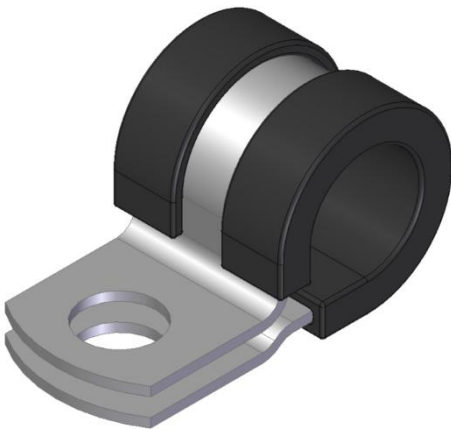
200171 – Mounting tabs



101298 – 1/2" spacer



820285 - Heavy duty zip tie



201133 – Heavy duty mounting clips

5.4.2 NANO Controller

The NANO controller enclosure has an IP 65 rating and ambient temperature range of -13 °F – 131 °F [-25 °C – 55 °C] however, it is intended to be installed inside of a vehicle cabin where an operator has access to it. Mount the controller in a location where it is clearly visible and the manual release and hold buttons are accessible. The controller requires an input voltage of 12/24VDC ± 30% and will output 24VDC to the solenoid when a fire is detected. Use wire between 16 – 18AWG for any connections between the NANO and other components. Refer to Appendix D for more detailed information about the NANO controller.

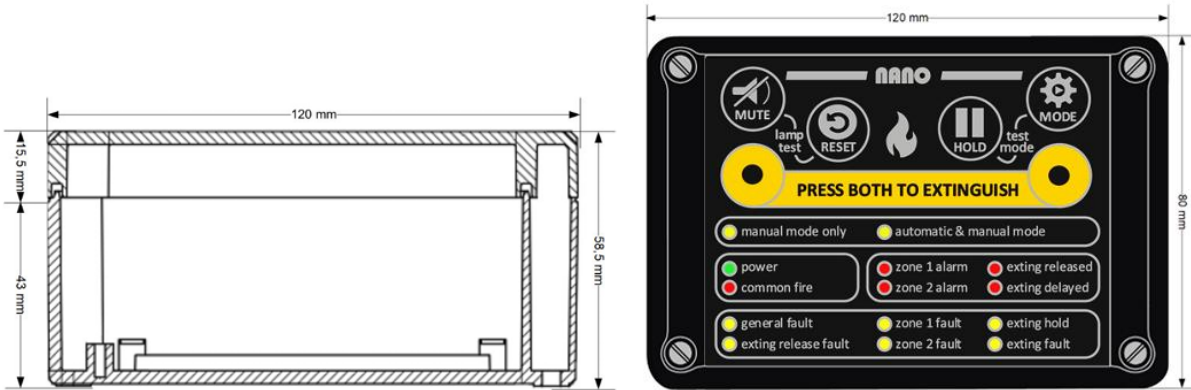


Figure 7: NANO Mounting Dimensions

Follow the wiring diagram in Figure 11 to connect all necessary components to the NANO controller. Ensure the correct resistors are used, the diode on the solenoid circuit is correctly oriented, and that all connections are secure before re-attaching the front panel of the controller. When wiring to a Firetrace provided solenoid, ensure the diode is connected as shown in Figure 36, failure to follow this setup may result in faults when the device is powered. Wago connectors are the recommended form of wire connection, but the environment of each installation should be considered before choosing connectors to ensure all requirements are met. Please refer to the NANO user manual that is included with the controller and Appendix D of this manual for more detailed information, a guide for the DIP switch settings, and information on the required resistances for each circuit.

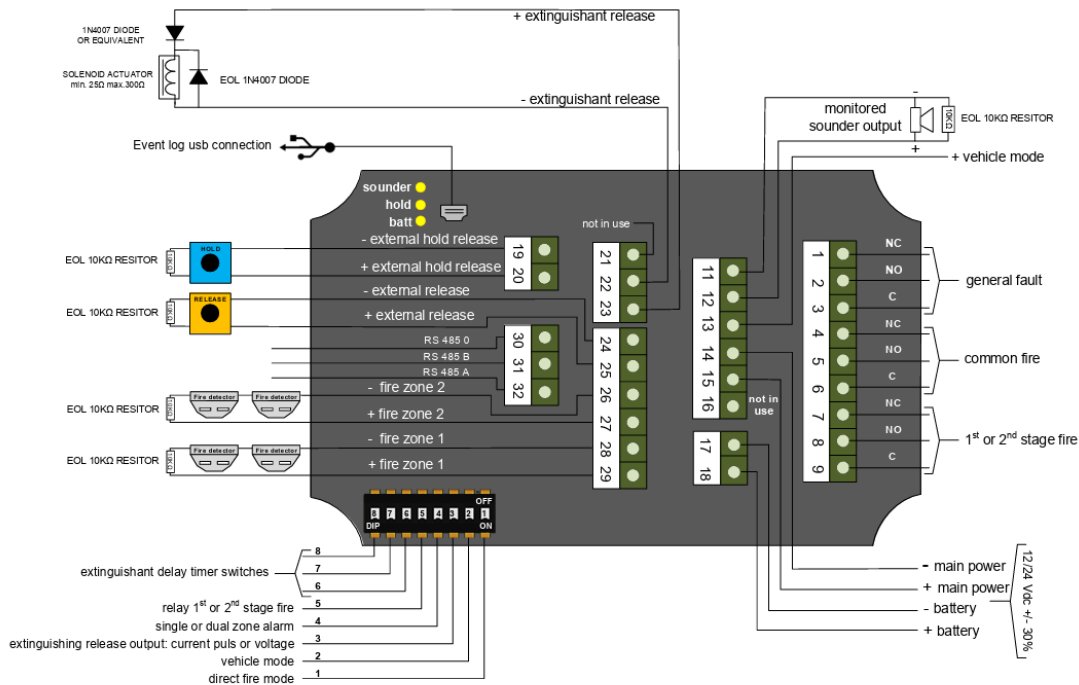


Figure 8: Solenoid Wiring Diagram

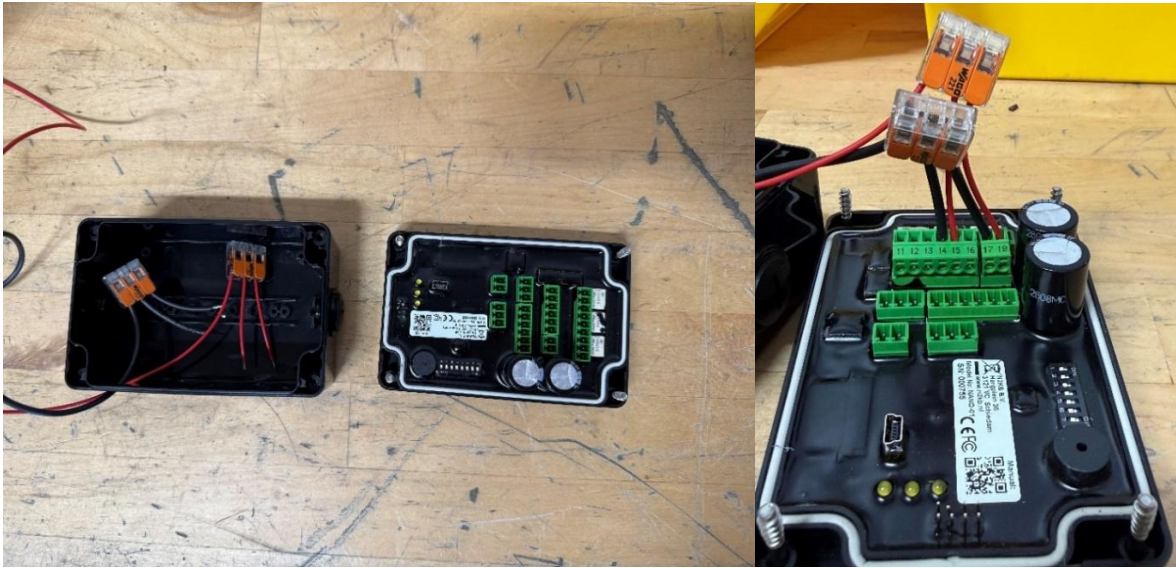


Figure 9: Wiring Main and Backup Power from Singular Source

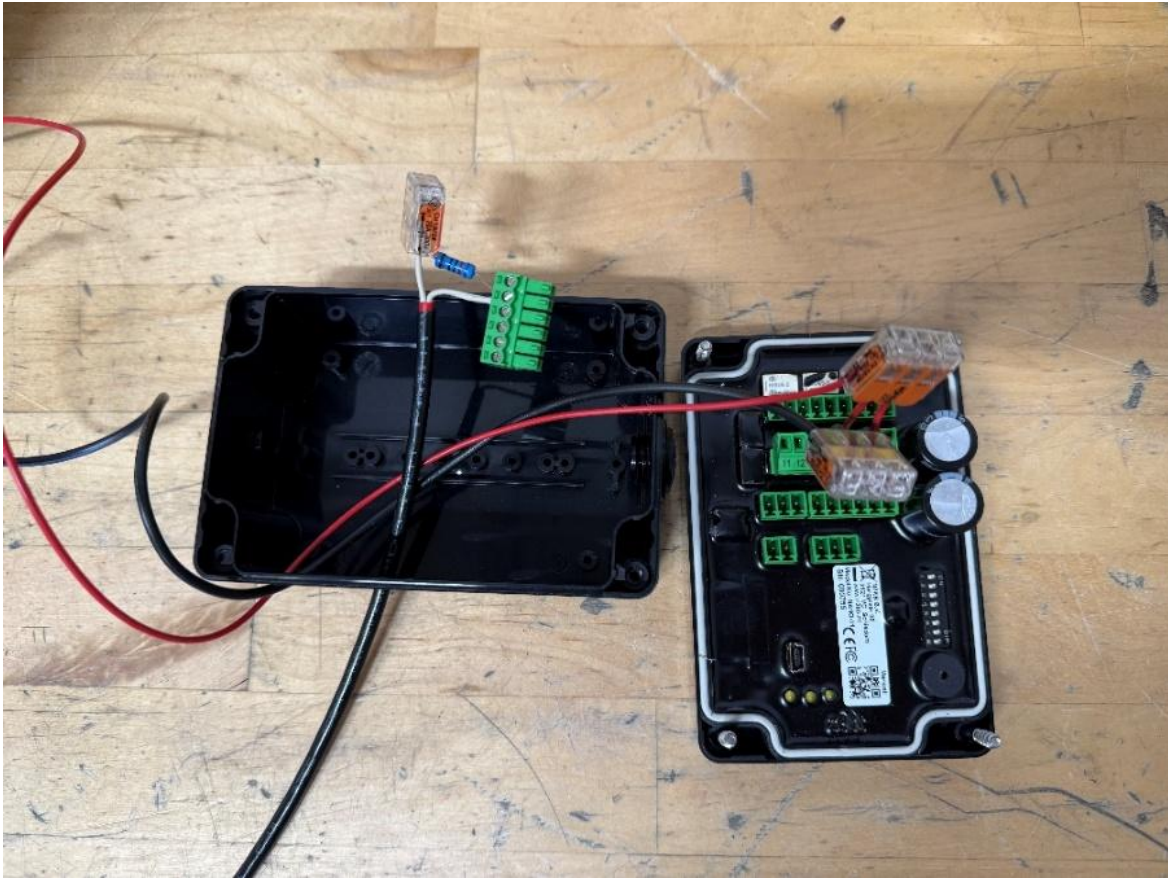


Figure 10: Linear Heat Detection Cable with In-line 120Ω Resistor

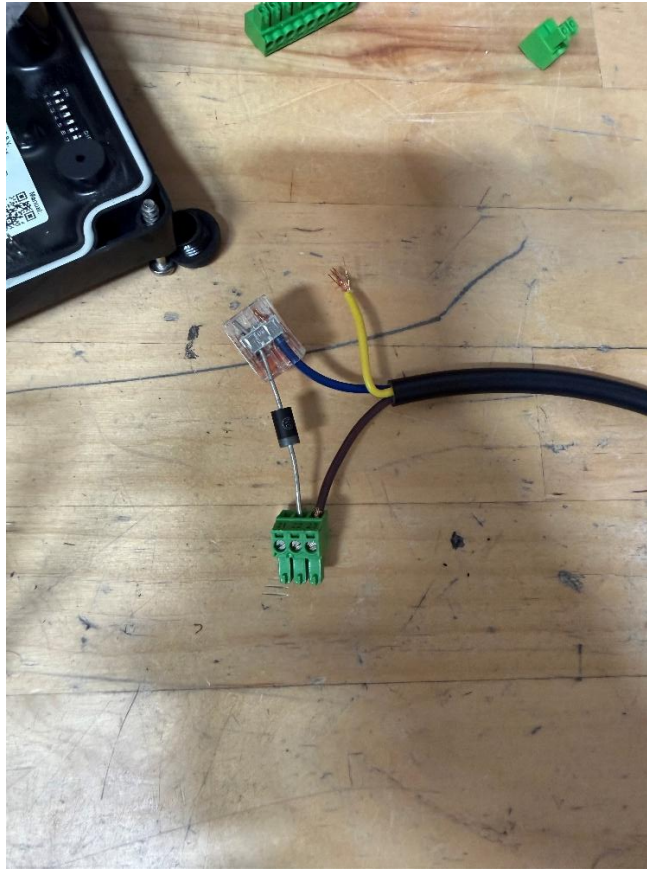


Figure 11: Solenoid Connection with Included Diode

Note: Brown wire from solenoid connector connects to terminal 23, the silver stripe from the diode must be facing terminal 22 and connected to it, and the blue wire from the solenoid connector is connected to the opposite end of the diode . In some cases, the blue and brown wire need to be swapped. The controller will flash “EXTING FAULT” if the connection needs to be changed.



Figure 12: Linear Heat Detection End of Line Termination Box with 10kΩ Resistor

5.5 System Activation (P-Mark & R107 FDT Systems)

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.

5.6 System Activation (Non-Certified LHD Systems)

WARNING

Ensure the solenoid connector, located on the top of the cylinder valve, is disconnected from the solenoid and that no power is being delivered to the solenoid.

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

1. Install the LHD cable throughout the enclosure. Ensure all necessary fittings and accessories are installed in accordance with the procedures specified in Section 4.
2. Make all necessary connections to the NANO controller following guidance in the NANO user manual and Appendix D.
3. With the power supplied to the NANO controller turned off and the solenoid connector disconnected, wire the solenoid to the proper terminals as described in the NANO user manual and Appendix D.
4. Install the end of line termination box to the end of the LHD cable with an included 10kΩ resistor.
5. Turn on the power source, plug in the solenoid connector, and monitor the NANO controller front panel for any fault or alarm signals.
6. If faults are shown on the NANO controller, examine circuits for loose connections and ensure the proper resistors and diode are correctly wired in until no faults remain.
7. Enter test mode on the NANO controller by pressing the hold and mode buttons simultaneously for one second to disable the solenoid releasing circuit and test the functionality of the system components. The “exting fault” LED will be flashing yellow when the controller is in test mode.
8. Leave test mode by pressing the hold and mode buttons simultaneously for one second. The “exting fault” LED will switch off when the controller is out of test mode.
9. If a pressure switch is installed on the system, 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.
10. The Firetrace Pre-Engineered ABC Dry Chemical Powder ILP Automatic Suppression Unit is now ready for use.

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

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 (FDT Systems Only).
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 Semi-Annual Maintenance (P-Mark & R107 FDT Systems)

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 refilled 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 Semi-Annual Maintenance (Non-Certified LHD Systems)

The semi-annual maintenance is to be performed by an authorized Firetrace distributor. Maintenance should include a repetition of the monthly maintenance as well as verification of the Firetrace ABC Dry Chemical Powder ILP Unit weight. Additionally, the ABC Dry Chemical Powder should be agitated. The Firetrace ABC Dry Chemical Powder ILP unit weight should be verified using the following steps:

1. Turn off main and backup power sources.
2. Disconnect the solenoid connector from the solenoid valve.
3. Remove the discharge piping from the discharge outlet ports.
4. Install the discharge outlet port plugs into both discharge outlet ports. Discharge outlet port plugs are 1/2in NPT male fittings.
5. Remove the cylinder from the cylinder mounting bracket.
6. Weigh the Firetrace ABC Dry Chemical Powder ILP Unit.
 - a) Compare the measured weight with the weight specified on the cylinder labels. If the Firetrace ABC Dry Chemical Powder ILP Unit shows a loss in agent quantity of more than 5 percent, the unit shall be refilled or replaced.
7. Carefully invert the unit assembly and gently knock on the bottom and sides of the cylinder with a rubber mallet approximately 5 to 10 times.
8. Verify pressure reading on the pressure gauge installed to the Firetrace ABC Dry Chemical Powder ILP Unit.
 - a) If the Firetrace ABC Dry Chemical Powder ILP Unit shows a pressure loss (adjusted for temperature) of more than 10 percent, the unit shall be refilled or replaced.
9. Reinstall the Firetrace ABC Dry Chemical Powder ILP Unit, see Section 4 and Section 5 for instructions.

NOTE: This system consists of components tested within limitations contained in this manual. The designer of this system must be consulted prior to any planned changes to either the system or the area being protected. An authorized Firetrace distributor must be consulted after the system has discharged.



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.

6.2.4 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 NFPA 17, and evaluation of the Firetrace detection tubing or linear heat detection cable 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 (P-Mark & R107 FDT Systems)

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 Dry Chemical Powder Maintenance (Non-Certified LHD Systems)

Maintenance of the Purple Dry Chemical Powder is to be performed by an authorized Firetrace distributor. Prior to installation and during every semi-annual inspection the ABC Dry Chemical Powder should be agitated using a rubber mallet. Additionally, at least once every 6 years the ABC Dry Chemical Powder should be examined for caking. If any concerns are noted, replacement of the ABC Dry Chemical Powder is recommended. The following steps should be followed when agitating the ABC Dry Chemical Powder:

1. Turn off main and backup power sources.
2. Disconnect the solenoid connector from the solenoid valve.
3. Remove the discharge piping from the discharge outlet ports.
4. Install the discharge outlet port plugs into both discharge outlet ports.
5. Remove the cylinder from the cylinder mounting bracket.
6. Carefully invert the unit assembly and gently knock on the bottom and sides of the cylinder with a rubber mallet approximately 5 to 10 times.
7. Reinstall the system.



WARNING

Unit should only be agitated AFTER the solenoid connector has been unplugged, the power disconnected, and the discharge port plugs installed into the discharge ports. Agitating without following these steps may cause actuation of the unit, resulting in system discharge.

6.6 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



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 (P-Mark & R107 FDT Systems)

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 Remove From Service (Non-Certified LHD Systems)

An authorized Firetrace distributor must be consulted after a system has discharged. The Firetrace ABC Powder ILP Unit must be removed and recharged. The Firetrace ABC Dry Chemical Powder ILP unit should be removed using the following steps:

1. Disconnect the solenoid plug attached to the solenoid valve on top of the cylinder valve.
2. Remove the discharge piping from the discharge outlet ports.
3. Install the discharge outlet port plugs into both discharge outlet ports.
4. Remove the cylinder from the cylinder mounting bracket.
5. Have Firetrace ABC Dry Chemical Powder ILP Unit recharged by a qualified Firetrace service location.

7.4 System Recharge (P-Mark & R107 Systems)

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.

7.5 System Recharge (Non-Certified LHD Systems)

Only the original agent 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 steps below should be followed to ensure proper recharge of an empty Firetrace ABC Dry Chemical Powder ILP Unit:

1. Fill the cylinder with the appropriate amount of agent. Refer to **Error! Reference source not found.**, for correct agent amount.
2. Clean the threads of the cylinder with a small brush or dry cloth.
3. Thread the siphon tube into the bottom of the valve.
4. Insert bottom end of siphon tube into the cylinder, and thread the valve into the cylinder.
5. With the discharge port plugs in place and solenoid plug disconnected, use the solenoid valve attached to the top of the valve to pressurize the Firetrace ABC Dry Chemical Powder ILP Unit to 360psig at 70°F [24.8bar at 21.1°C].
6. Shake the system thoroughly to ensure the nitrogen is absorbed by the ABC Dry Chemical Powder.
7. Leak test the Firetrace ABC Powder ILP Unit. If a leak detector is unavailable, a 48-hour holding period should be used to evaluate whether there is a leak.
8. The Firetrace ABC Dry Chemical Powder ILP 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 FITNESS FOR A PARTICULAR PURPOSE, BEYOND THOSE EXPRESSLY PROVIDED FOR IN THIS LIMITED WARRANTY.** These warranties shall be void where defects occur due to improper maintenance, installation, service, alterations and/or modifications subsequent to installation, not expressly authorized in writing by Firetrace or due to intentional or negligent acts of the original purchaser or third parties.

Non-Assignability of Warranty

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

Disclaimer of Consequential Damages

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

Use of Non-Firetrace Components

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

SOME FACTORS INFLUENCING ENGINEERING DESIGN AND PRODUCT APPLICATION OF FIRETRACE UNITS

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

1. The Firetrace unit has been designed to provide protection against fire, both existing and imminent, for a limited duration of time when: the unit is fully operational; used in its normal, expected environment; the unit and its component parts are properly installed, maintained, and operated in **complete** accordance with written instructions supplied with the unit.
2. The duration of the protection against fires dependent upon a sufficient concentration of agent being maintained in the protected hazard area for a pre-determined period of time. This duration will be shortened by conditions or circumstances which may ventilate, cause the agent concentration dilution within the protected hazard area thereby causing an insufficient concentration of agent as is needed to extinguish or prevent the existence or re-ignition of combustion or fire. All hazard areas have different rate of ventilation, leakage, or agent dilution that, in many cases, may be impossible to predict or determine. Air vents, air conditioning units, gaps and cracks in the enclosure, windows, cable and pipe penetrations, etc., all may effect the agent concentration and the duration of the protection against fire. Also, unforeseen changes in the configuration of a hazard area such as removal of a wall, an explosion or fire external to the protected space, changes in the enclosures configuration, etc. can influence the duration of the fire protection. It is because of these many, and varied, circumstances and conditions that Firetrace makes **no** warranty as to the duration of the protection against fire.
3. The effectiveness of an agent, such as Dry Chemical® and/or CO₂, 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 varying 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**

Firetrace ABC Dry Chemical Powder ILP Automatic Suppression Unit Assemblies

Part Number	Description
941007	Black Widow™ Dry Chemical Powder ILP FDT Suppression Unit (10lb)
942007	ABC Dry Chemical Powder ILP FDT Suppression Unit DOT (20lb)
942057	ABC Dry Chemical Powder ILP FDT Suppression Unit CE (22lb)
942227	ABC Dry Chemical Powder ILP FDT Horizontal Suppression Unit DOT (22lb)
941012	ABC Dry Chemical Powder ILP FDT Suppression Unit DOT (10lb)
941052	ABC Dry Chemical Powder ILP FDT Suppression Unit CE (10lb)
942012	ABC Dry Chemical Powder ILP FDT Suppression Unit DOT (20lb)
942052	ABC Dry Chemical Powder ILP FDT Suppression Unit (22lb)
942222	ABC Dry Chemical Powder ILP FDT Horizontal Suppression Unit DOT (22lb)
961012	ABC Dry Chemical Powder ILP LHD Suppression Unit DOT (10lb)
962012	ABC Dry Chemical Powder ILP LHD Suppression Unit DOT (20lb)
962222	ABC Dry Chemical Powder ILP LHD Horizontal Suppression Unit DOT (22lb)

Heavy Duty Bracket Assemblies

Part Number	Description
111403	Medium Heavy Duty Bracket w/ Clamps
111402	Large Heavy Duty Bracket w/ Clamps
111502	Extra Large Heavy Duty Bracket w/ Clamps

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 (P-Mark & R107 FDT Systems)

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

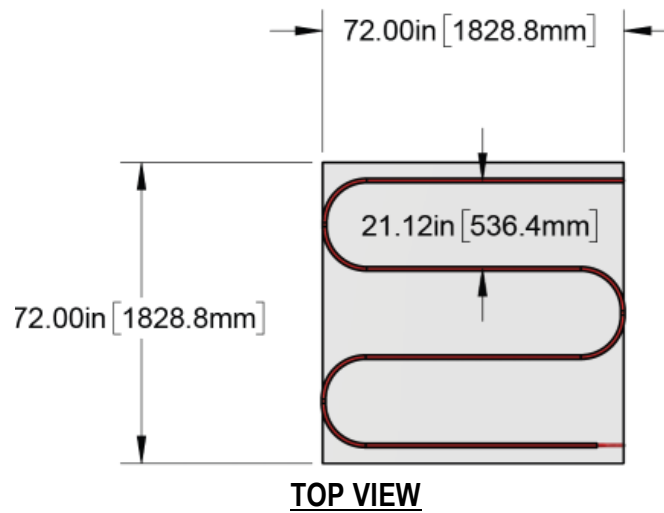
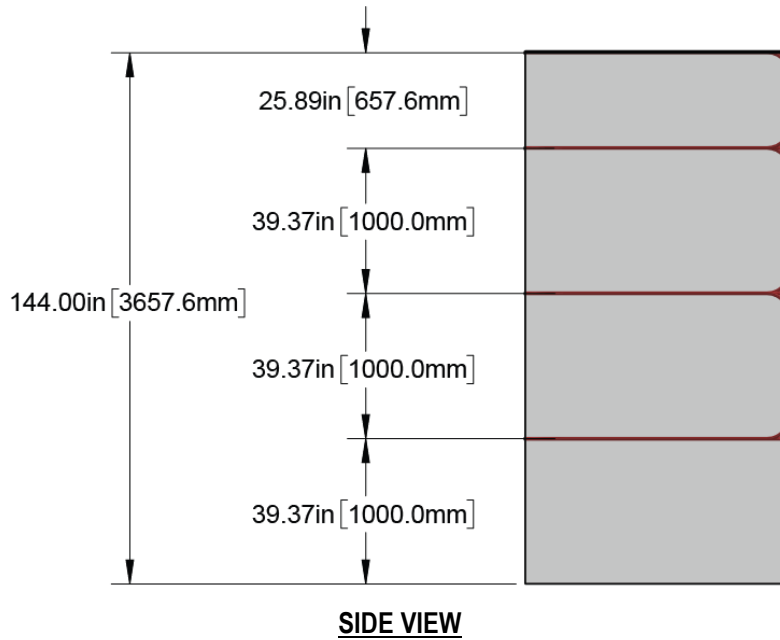
Detection Network Parts List (Non-Certified LHD Systems)

Part Number	Description
221499	Linear Heat Detection, VHT, Stainless Steel Braid, 230°C, 100m (328ft)
221496	Linear Heat Detection, VHT, Stainless Steel Braid, 230°C, 30m (98.4ft)
204050	Linear Heat Detection, VHT, Stainless Steel Braid, 230°C, 20m (65.6ft)
204100	Linear Heat Detection, VHT, Stainless Steel Braid, 230°C, 10m (32.8ft)
552011	LHD Cable Termination Box IP65

APPENDIX B

Typical Tubing Placement

Typical Tubing Placement



Description	Limitation	
	Maximum length	120 ft
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

SDS - Black Widow

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

<u>Hazard Ratings*</u>	<u>NPCA/HMIS</u>	<u>NFPA 704</u>	<u>Rating Key</u>
Health:	1	1	0 = minimal
Flammability:	0	0	1 = slight
Reactivity:	0	0	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/m³ 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):

Chemical	CASRN	%	Exposure Limits	
			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

Odor: Ammonia (slight)

Specific Gravity: >1.0

pH: ND

Solubility (Water): insoluble (organics): insoluble

Melting Point: ND

Freezing Point: NA

Boiling Point: NA

Vapor Pressure: NA

Density: ND

% Volatiles by Volume: NA

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 LD₅₀ of chemically identical product is >5,000 mg/kg. Acute LD₅₀ and LC₅₀ 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

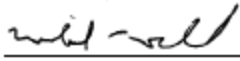
Note: This regulatory information included here should not necessarily be considered all-inclusive. This product is not subject to the reporting requirements of the CERCLA, the SARA, the RCRA, the Clean Air Act and the Clean Water Act (US). This product is not formulated with, nor do the manufacturing 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

SDS - ABC Dry Chemical



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: April 17, 2024; Revision C

Section 2. HAZARDS IDENTIFICATION

GHS – Classification

Hazard Class	Category	Signal Word
Aerosols	Category 3	Warning
Acute Toxicity	Category 5	Warning
Skin Corrosion/Irritation	Category 2	Warning
Serious eye damage/eye irritation	Category 2A	Warning
Acute Toxicity, Inhalation	Category 5	Warning

GHS – Label Symbol(s):



If Pressurized: Gas Under Pressure



GHS – Words(s):

Warning

Other Hazards Not Resulting in Classification: Mica may contain small quantities of quartz (crystalline silica). Prolonged exposure to respirable crystalline silica dust at concentrations exceeding the occupational exposure limits may increase the risk of developing a disabling lung disease known as silicosis. IARC found limited evidence for pulmonary carcinogenicity of crystalline silica in humans. In the case of normal use of this product, exposure to silica should be nil. The attapulgite clay used in this product has a fiber length of less than 5 µm; therefore, the clay is not considered to be carcinogenic in animals or humans.

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GHS – Hazard Phrases

GHS Hazard	GHS Code(s)	Code Phrase(s)
Physical	H229	*Pressurized container, may burst if heated.
Health	H303 315 319 335	May be harmful if swallowed. Causes skin irritation. Causes serious eye irritation. May cause respiratory irritation.
Environmental	None	
Precautionary:		
General	P101	If medical advice is needed, have product container or label at hand
Prevention	P210 251 261 264 271 280	*Keep away from heat, hot surface, sparks, open flames, and other ignition sources. No smoking. *Do not pierce or burn, even after use. Avoid breathing dust. Wash hands and face thoroughly after handling. Use only outdoors or in a well-ventilated area. Wear protective gloves/protective clothing/eye protection/face protection.
Response	P319 321 340 362 301+317 302+352 304+317 305+351+338 332+317 362+364	Get medical help if you feel unwell. Specific treatment (see Section 4. First Aid Measures). Remove person to fresh air and keep comfortable for breathing. Take off contaminated clothing. IF SWALLOWED: Get medical help. IF ON SKIN: wash with plenty of water IF INHALED: Get medical help. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do – continue rinsing. If skin irritation occurs: Get medical help. Take off contaminated clothing and wash it before reuse.
Storage	403+233 405 410+403	Store in a well-ventilated place. Keep container tightly closed. Store locked up. *Protect from sunlight. Store in well-ventilated place.
Disposal	P501	Dispose of contents through a licensed disposal company. Contaminated container should be disposed as unused product.

*- Fire extinguishers are designed to be used to extinguish fires.

Section 3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	EC No.	REACH Reg. No.	CAS-No.	Weight %	Classification
Mono-ammonium phosphate	231-764-5	01-2119488166-29	7722-76-1	80-98	NA
Attapulgit clay	601-805-5	Not Available	12174-11-7	3-16	NA
Mica-potassium aluminum silicate	310-127-6	Not Available	12001-26-2	1-2	NA
Silicone oil methyl hydrogen polysiloxane	613-152-3	Not Available	63148-57-2	<1	NA
Calcium carbonate	207-439-9	Not Available	471-34-1	<1	NA
Amorphous silica precipitated synthetic zeolite	231-545-4	01-2119379499-16-0036	7631-86-9	<1	NA
Yellow 14 pigment – di-azo dye	226-789-3	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. Irritant to 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.

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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
<u>Explosion Data:</u>	
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.

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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 Procedures:	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 for extinguisher rust periodically 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 CONTROLS/PERSONAL PROTECTION

Chemical Name	OSHA PEL	ACGIH TLV	DFG MAK *	EU BLV
Mono-ammonium phosphate	PNOC** Total dust, 15 mg/m ³ Respirable fraction, 5 mg/m ³	PNOC Total dust, 10 mg/m ³ Respirable fraction, 3 mg/m ³	PNOC Total dust, 4 mg/m ³ Respirable fraction, 1.5 mg/m ³	NA
Mica	6 mg/m ³	3 mg/m ³	-----	NA
Attapulgite clay	PNOC** Total dust, 15 mg/m ³ Respirable fraction, 5 mg/m ³	PNOC Total dust, 10 mg/m ³ Respirable fraction, 3 mg/m ³	PNOC Total dust, 4 mg/m ³ Respirable fraction, 1.5 mg/m ³	
Silicone oil	NR**	NR		
Calcium carbonate	PNOC Total dust, 15 mg/m ³ Respirable fraction, 5 mg/m ³	PNOC Total dust, 10 mg/m ³ Respirable fraction, 3 mg/m ³	-----	NA
Amorphous silica	20mppcf $\frac{80 \text{ mg/m}^3}{\text{or } \% \text{ SiO}_2}$	10 mg/m ³	4 mg/m ³	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. During production, the manufacturer should use judgement concerning the need for PPE.



Eye/Face Protection:
Skin and Body Protection:
Respiratory Protection:

Wear tightly fitting safety goggles.
Wear protective gloves/coveralls.
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 local regulations. The need for respiratory protection is not likely for short-term use in well-ventilated areas.

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Hygiene Measures:

Good personal hygiene practices 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:	NH ₄ H ₂ PO ₄ : 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:	No information available
Melting Point/Range °C:	NH ₄ H ₂ PO ₄ : 190
Flammability/Explosion Limits in Air °C:	Upper – None; Lower-None
Explosive Properties:	None
Oxidizing Properties:	None
Volatile Component (%vol)	Not applicable
Evaporation Rate:	No information available
Vapor Density:	No information available
Vapor Pressure:	NH ₄ H ₂ PO ₄ : 1.41 mm/Hg
Specific gravity at 25°C:	NH ₄ H ₂ PO ₄ : 1.80
Solubility:	40.4 g/100 ml
Partition Coefficient:	NH ₄ H ₂ PO ₄ Est: -4.11
Viscosity:	No information available
NOTE: NH ₄ H ₂ PO ₄ – Monoammonium Phosphate	

Section 10. 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
Attapulgite clay	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	Carcinogenicity	Reproductive	TOST Single Exp	TOST Repeated Exp	Aspiration
Mono-ammonium phosphate	None	None	None	Cat 3	None	None
Attapulgite clay	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.
Probability of rapid biodegradation:	NH ₄ H ₂ PO ₄ Est: 0.693 (Rapid); (NH ₄) ₂ SO ₄ : Est: 0.684 (Rapid)
Anaerobic biodegradation probability:	NH ₄ H ₂ PO ₄ Est: 0.398 (Slow); (NH ₄) ₂ SO ₄ : Est: 0.398 (Slow)
Bioaccumulation potential:	Low.
Bioconcentration factor:	NH ₄ H ₂ PO ₄ : 3.16 L/kg (wet weight) (Low BCF)
Bioaccumulation factor:	NH ₄ H ₂ PO ₄ : 63.04 L/kg (wet weight)
Mobility in soil:	Slow evaporation rate; water soluble, may leach to groundwater.
Log Koc:	NH ₄ H ₂ PO ₄ Est: -1.25
Log Koa:	NH ₄ H ₂ PO ₄ Est: 16.72
Log Kaw:	NH ₄ H ₂ PO ₄ Est: -20.86
NOTE: NH ₄ H ₂ PO ₄ – Mono-ammonium Phosphate	

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

Aquatic Toxicity Values – Environment – Research

Chemical Name	Acute (LC50)	Chronic (LC50)
Mono-ammonium phosphate	N/A	N/A
Mica	N/A	N/A
Attapulgite clay	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

Aquatic Toxicity Values – Environment – Estimates

Chemical Name	Acute (LC50)	EC50
Mono-ammonium phosphate	2.91e+07 mg/L Fish 96 hr; 9.4e+06 mg/l Daphnid 48 hr;	6.70e+05 mg/L Gr. Algae 96 hr
Mica	N/A	N/A
Attapulgite clay	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

See current applicable transport regulation (Dot - Ground, IATA - Air, IMDG - Maritime) prior to shipping.

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:

The transportation information above covers the ABC 555 dry chemical extinguisher agent as shipped in bulk containers and not when contained in fire extinguishers or fire extinguisher systems. 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/division is LIMITED QUANTITY when pressurized to less than 241 psig and when shipped via highway or rail. UN Class 2.2. Non-Flammable Gas, when shipping via air. Packing Group – N/A

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 XVII 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
Monoammonium 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
Monoammonium Phosphate 7722-76-1	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Attapulgite clay 12174-11-7 (>3)	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
36/37/38
S Phrases: 22
24/25
26
36

Harmful by inhalation.
Irritating to eyes, respiratory system and skin.
Do not breath dust.
Avoid contact with skin and eyes
In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
Wear suitable protective clothing.

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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 any 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.

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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	17-April-2024; Revision C
Revision Notes	None

The information herein is given in good faith but no warranty, expressed or implied, is made. This document is controlled by Amerex Compliance Department.

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Appendix D – NANO DIOM

Design Installation Operation Manual



NANO FIRE DETECTION AND EXTINGUISHING CONTROL SYSTEM



www.N2KB.nl | February 2025 | Version 2.3

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1 DOCUMENT REVISION DETAILS

Ver.	Modification Detail	Author	Date
01	1 st publishing document	CvT	01 / 08 / 2022
02	Textual addition chapter 20 (environment & power)	CvT	01 / 09 / 2022
03	Textual addition chapter 22 (specifications extended)	CvT	01 / 03 / 2023
04	Improvement diagram 16	CvT	14 / 04 / 2023
05	Textual addition chapter 3	CvT	01 / 07 / 2023
2.0	Sounder & beacon type expanded, improve diagram 16/17/19/30	CvT	01 / 07 / 2024
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2.2	Add test mode	CvT	01 / 10 / 2024
2.3	Hold function improved	CvT	01 / 02 / 2025

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02	1 st release Kiwa/Dare EMC test	CvT	01 / 08 / 2022
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2.1	Add Modbus register	CvT	01 / 08 / 2024
2.2	Add test mode	CvT	01 / 10 / 2024
2.3	Hold function improved	CvT	01 / 02 / 2025



3 IMPORTANT NOTES

This manual should be thoroughly read and understood before installation and/or commissioning of the system is undertaken. The NANO system is not to be regarded as properly used when it is used without regard to any relevant information or advice relating to its use that has been made available by the supplier. The NANO system and the associated connections must be installed, commissioned, and maintained by a skilled, knowledgeable, and competent person or organization that is qualified to perform this work and is familiar with the objective of the equipment and the associated technical terminology. This equipment is not guaranteed unless the complete installation is installed and commissioned in accordance with the laid down local, national and/or international standards.

The NANO/MAR has successfully passed CE and FCC, EMC testing according to EN 50130, EN 61000, EN 55016, 47 CFR15-ICES-003, ANSI 63.4, IEC60945-pt11 and a DNV marine type approval according to the DNV Class Guideline 0339-2021, certificate TAA000037H. For that the NANO has endured extensive environmental tests such as vibration, dry & damp heat, and cold tests in accordance with the requirements of the DNV-CG 0339 standard. Where applicable to the NANO, it also meets the requirements of the FSS CODE, the International Maritime Code for Fire Safety Systems.

4 WARRANTY

N2KB B.V. represents the NANO system and is free from material defects in materials and workmanship. Our warranty does not cover a NANO system which is damaged, misused, and/or used contrary to the supplied operating manuals or which has been repaired or altered by others. The liability of N2KB B.V. is at all times limited to repair or, at N2KB BV's discretion, replacement of the NANO system. N2KB B.V. shall not under any circumstances be liable for any indirect, special, or consequential damages such as, but not limited to, damage or loss of property or equipment, cost of de-installation or reinstallation, cost of transport or storage, loss of profits or revenue, cost of capital, cost of purchased or replacement goods, or any claims by customers of the original purchaser or third parties or any other similar loss or damage, whether incurred directly or indirectly. Remedies set forth herein to the original purchaser and all others shall not exceed the price of the NANO system supplied. This warranty is exclusive and expressly in lieu of all other warranties, whether expressed or implied, including, without limitation, any warranties of merchantability or fitness for a particular purpose. The warranty may be void if the equipment is damaged by ESD.

5 INTRODUCTION

The NANO is a very compact and robust stand-alone fire detection-extinguishant release panel designed to protect various applications like electrical cabinets, CNC machines or engine rooms in vessels, yachts. Further all kind of vehicles and other small areas or equipment in which the user should be able to detect and extinguish a fire rapidly and effective. This is done by pressing two buttons, external release button or using fire sensor inputs. The NANO continuously senses its inputs and, in the event of a fire, gives the correct output to enable a product specific fire extinguishing.

In a marine application, it is NOT common for a fire suppression system intended for an engine room to be released by automatic fire detector. By default, the NANO is set to only manual release, but can also be changed to automatic & manual release via push buttons on the front. The NANO is a combined fire detection and extinguishing release system. It has two fire detection zones, any, or all of which can contribute to the extinguishant release decision. The NANO is a versatile fire alarm extinguishing release system with a high-performance level.



6 ENCLOSURE & INSTALLATION

The NANO control panel should be mounted on a dry, flat surface, at eye height in a horizontal position so that the enclosure cannot be deformed. The NANO should be installed in an accessible area. Take into consideration environmental factors such as high temperatures. The enclosure is provided with 7 predrilled holes for cable glands: 2 x M16 and 5 x M12. To ensure IP rating the cables must be brought in using the appropriate cable glands. Dimensions enclosure 120 x 80 x 58,5 mm w x h x d



7 MAINTENANCE & CLEANING

There are no user-replaceable parts in the NANO. Take Electrostatic Discharge (ESD) precautions when opening the NANO. Always wear a properly grounded anti-static wrist strap. Avoid direct contact with any of the components or connectors connected to the printed circuit board. Never let the electronics come in contact with clothing. The ground strap cannot dissipate static charges from fabrics. Failure to follow accepted ESD handling practices could cause damage to the NANO.

Before starting the cleaning process, bring the system out of operation to prevent an unwanted fire extinguishing system release. The NANO fire detection-/ extinguishing release panel has an IP rating of 65. The IP rating system uses a 2-digit system to define its protection rating for all products. The first digit represents protection against solids and the second against liquids. The six stands for totally dust tight, with full protection against dust and other particulate. The five stands for protection against low-pressure jets (6.3 mm) of directed water from any angle (limited ingress permitted with no harmful effects). This IP rate concerns the housing and is only and exclusively applying if the correct mounting method is used, and the correct glands are fitted and assembled. It is important to note that improper cleaning of the NANO front can damage this panel inhibit their ability to sense fire and activate the fire extinguishers. To remove dust and contaminants, use nonalcoholic products which has been designed for that purpose.

DON'T USE HIGH PRESSURE WASHERS OR STEAM CLEANERS

It will certainly damage the front foil with the control buttons and indication LEDs.



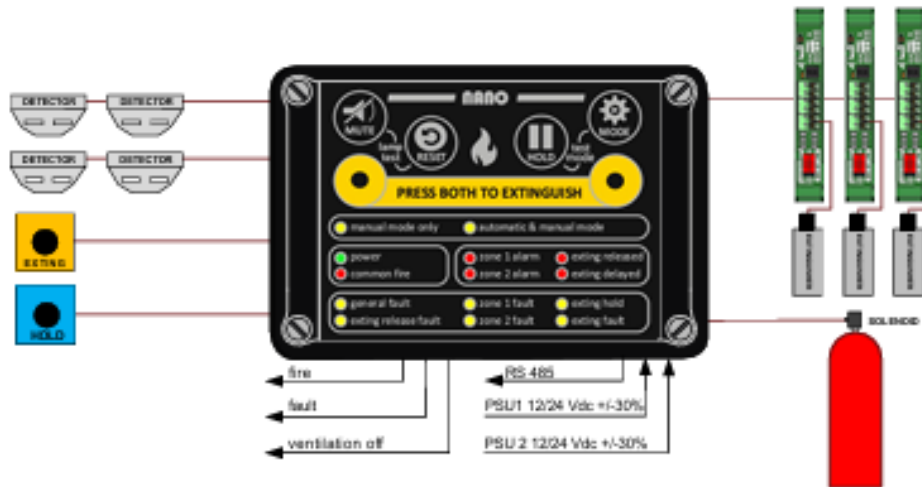
8 THE NANO

The NANO is not only developed for land based installations, but can also be applied in marine applications. It has a DNV-CG Type Approval in accordance with the 0339 CG standard. NANO system consists of two components. The basis is formed by the NANO control panel which is placed on the bridge or in its vicinity. Then there is an extinguisher terminal board (ETB). This ETB must be placed in a proper enclosure outside, but in the immediate vicinity of the to protected engine room. ETB/L is suitable for an extinguisher igniting actuator with a maximum resistance of $<2\Omega$. The ETB/H is suitable for an extinguisher igniting actuator with a maximum resistance of $>2\Omega$. From the ETB a cable led to the aerosol extinguisher installed in the volume to be protected. The cable connection between the NANO control panel and the fire extinguisher ETB connection board is continuously scanned for faults. The cable from the extinguishers terminal board (ETB) to the extinguisher's igniter is also



monitored for fault or malfunction. In a marine application, it is NOT common that a fire suppression system intended for an engine room protection is released by an automatic fire detector. However, the NANO has two fire alarm zones suitable for connecting marine approved fire detectors such as the Apollo Orbis Marine series fire detectors. The NANO system

can be set up so that fire alarms from these fire detectors, signaled on the NANO panel, are considered as informative only. Then they will not have any effect on the extinguishing system, nor activate the extinguishing system. BY default, the NANO is set to only manual release, but can be changed to automatic & manual mode. Then they will have effect on the extinguishing system and be able to activate the extinguishing system.



9 KEY PROPERTIES

- Able to set to manual, single stage or double stage detection, alarm, and extinguishing
- Outputs for fire, fault, ventilation off and visual & acoustic alarm device
- A full monitored output for the aerosol fire extinguishing generators
- Two full monitored fire alarm input groups (zones) for linear heat and / or int detectors
- Two full monitored alarm input groups for external extinguishing release and hold function
- Double extinguisher release buttons to prevent unwanted releases
- Extinguishers hold release button to postpone releases
- Extinguisher release delay to prevent unwanted releases
- Extinguishing delay which can be set between 0 and 35 seconds
- Additional option to override the release extinguishing delay after manual release
- Additional functionality regarding separated external hold-off functions
- Additional functionality regarding separated external release extinguishing functions
- Historic event log memory readable from a mini-USB port
- Modbus RS485 communication port
- The NANO works on input voltage 8 to 28 Volt DC
- The NANO has an IP 65 waterproof enclosure, with cable glands
- ESD and EMC protected, and CE and FCC marked.
- DNV-CG type approval; according the 0339 DNV-CG standard

10 FEATURES NANO

10.1 ACOUSTIC ALARM

The NANO has an internal attention signal and a monitored output for an external sounder/beacon. Malfunctions are standard signaled with a continuous tone signal, alarms with a pulsating tone signal. Deviating tone signaling takes place with extinguishing activation and operation of the hold (extinguishing delay) function. The voltage of the monitored output to drive an additional sounder/beacon is controlled by the NANO and is independent of the main power supply voltage.

10.2 EXTINGUISHANT RELEASE OUTPUT

The NANO is equipped with two activation techniques for the activation of fire extinguishing systems. The selection can be made using DIP switch 3. By default, the NANO is programmed for the activation of electrical igniters intended for aerosol fire extinguisher generators, with DIP switch 3 in the OFF position. The activation of aerosol fire extinguisher units is actuated by means of a current pulse of 1.3A for 50ms.

When DIP switch 3 is place into the ON position, then the NANO is suitable for activating a fire extinguishing system that makes use of a solenoid as actuator of the fire suppression system. The activation voltage is then 24V DC with a maximum of 1A.

IMPORTANT

For the default current pulse activation method (DP3 OFF) the NANO supply voltage, meant for electrically activatable aerosol fire extinguisher units, is 12V to 24Vc +/-30%. For the voltage-controlled activation (DP3 ON), the NANO supply voltage, meant for an extinguishing system that uses a solenoid actuator, is 24VDC.



10.3 HISTORIC EVENT LOG

The NANO has an historic event log memory of 10,000 events readable from a USB port. Connect an USB cable between the Mini-B USB port and your computer. The device will act as an USB stick. Your operating system will create a new disk station. The files on the disk station are text files with logged event. The event log system is only meant for viewing, monitoring, and analyzing. The events are recorded without time and date but in order of event. Each time the NANO reboots, a new file is created with a new batch number in the name. Pressed control buttons, detailed alarm and fault indications, and relay switching events are logged in the text files.



10.4 COMMUNICATION PORT

The NANO has a Modbus network connection. Modbus enables communication among devices connected to the same network. A Modbus network consists of one master and a number of slaves units, each with a unique address. For more information, see the MODBUS user manual.

10.5 DIRECT RELEASE

When the timer settings are set to a delay (between 10 – 35 seconds), the direct extinguish release DIP switch 1 gives the choice to override the delay in case of a fire event. If a fire alarm is detected, by the automatic fire detectors of the NANO and the count-down timer is started, you can override the timer. By pressing the dual release extinguishing buttons on the front of the panel or the external release extinguishing button, the extinguishing releasing process starts without delay immediately. This function can be selected via DIP switch 1.

10.6 VEHICLE MODE (NORMALLY NOT IN USE IN MARINE APPLICATIONS)

If the extinguishing system is intended for the protection of a vehicle engine bay, then a programmed extinguishing delay must be disabled, when the vehicle is parked, and the driver leaves the vehicle. A fire extinguisher delay is then of no use and should be overridden. As soon as the ignition switch is used again, even for a very short moment, the system returns to the programmed state. In vehicle mode, a single or dual (depending on the DIP switch) fire alarm immediately release the extinguishers without delay. In normal operation, the vehicle power the NANO at terminals 15 + and 14 -, which means that the engine is switched on. In vehicle mode, the + on connection point 15 must be extend with a + on connection point 13. If the vehicle is parked and the driver removes the car key from the ignition lock, then this should remove the voltage at point 13 and thus eliminate any delay. When the vehicle function (DP2) is enabled, the green power LED flashes at a different frequency than when switching to secondary voltage. When the vehicle mode is not in use and there is no external back-up battery/power supply available, connect battery inputs 17 and 18 in parallel on respectively the power terminals 14 and 15 to avoid a battery failure signal. This function can be selected via DIP switch 2.

Please note that the vehicle mode does not work in the only manual mode (12.5)

10.7 GENERAL FAULT RELAY

The fault relay is normally energized and will de-energize upon any fault condition including total loss of power. This secures a complete fail-safe condition of the NANO panel in case of a fault condition.



10.8 VFC FIRE RELAY IN SINGLE OR DUAL MODE

A single or dual FIRE indication can trigger the VFC relay. In the single mode the VFC relay will be activated when one of the fire zones have a fire alarm condition. In the dual mode this relay shall be activated after both fire zones have a fire alarm condition. This function can be selected with DP 5.

10.9 SINGLE OR DUAL ZONE

Usually, the extinguishing system is activated in the so-called two group-dependent status (avoiding coincidence). Two fire conditions must be met before an extinguishing activation will be initiated. In some cases, a single mode status can be handy. In dual (standard) mode the extinguisher(s) shall be released after both detection zones will have a fire alarm condition and cause an internal pulsing alarm sound. The fire relay and extinguisher are activated according to the DIP switch settings. In single mode the extinguisher(s) will be released when one detection zone is in fire alarm condition and cause an internal pulsing alarm sound. The fire relay and extinguisher are activated according to the DIP switch settings. This function can be selected via DIP switch 4.

10.10 EXTINGUISHANT RELEASE DELAY

Extinguishing delay is only useful in normally occupied spaces. For the delay timer settings, there are 3 Dip Switches 6,7 and 8, which can be set in steps of 5 seconds the delay time between 0 and 35 seconds. The countdown timer is used to wait a certain amount of time before extinguisher/s are activated.

11 INPUTS

The NANO is equipped with two detection zones and two external button inputs (Extinguishing Release & Hold). These inputs are continuously scanned for alarm or fault detection. All inputs are monitored and require a 10 k Ω end of line resistor, even if the input is not used. The button inputs must have a trigger resistor between 470 and 1000 Ω .

11.1 DETECTION ZONES

The NANO is equipped with two fire detection zone inputs. The loop inputs are continuously scanned for fire or fault detection. The loops are set to the following values:

- RESISTANCE of less than 100 Ω : FAULT
- RESISTANCE of more than 100 Ω and less than 1,5 k Ω : FIRE
- RESISTANCE of more than 1,5 k Ω and less than 8 k Ω : FAULT
- RESISTANCE of more than 8 k Ω and less than 12 k Ω : NORMAL
- RESISTANCE of more than 12 k Ω : FAULT

When a low resistance (less than 450 Ω) linear heat cable is used, a 470 Ω resistor must be installed in series at the begin of the loop on one of the wires. Otherwise, the wires of the linear heat cable which will give a fault instead of a fire alarm. Contrary to the linear heat cable, when using a Fenwal or equal thermal heat detector, a resistor of 470 Ω must be placed in series with the alarm contact, an end of line resistor 10 k Ω in parallel over the alarm contact and 470 Ω resistor. The maximum number of detectors in one zone is 4. The voltage of all monitored detection inputs is controlled by the NANO and is independent of the main power supply voltage. The NANO alarm zones 1 and 2 operate in the quiescent state with a voltage of 15 VDC. Each input zone needs an EOL resistor of 10 k Ω , even if the fire zone is not used.



11.2 EXTERNAL RELEASE INPUT

The NANO has a separate input for an external extinguishing release button. The external extinguishing release button has the same function as the dual extinguishing release buttons on the front of the panel. By pressing the external extinguishing release button, the fire extinguisher(s) will be released. Depending on the Dip switch (time) settings it is possible to delay the release. The delay time can be set from 0 to 35 seconds in steps of 5 seconds. These loop inputs are continuously scanned for alarm or fault conditions.

11.3 EXTERNAL HOLD INPUT

The NANO has a separate input for an external hold button. The external hold button has the same function as the internal hold button. When an alarm is active and this button is pressed, the extinguisher release is delayed. When the button is released, the system will wait the configured delay time. Release of the Hold input shall re-start the countdown release timer from maximum.

12 OUTPUTS

The NANO is equipped with 5 outputs, two monitored and three potential free. The monitored outputs are continuously scanned for open and short circuit fault conditions. The potential free outputs have a contact load of 30 VDC /1A. The monitored outputs are for the extinguishing output (extinguishing release) and for the electronic sounder/beacon output.

12.1 VOLT FREE CONTACT RELAY OUTPUTS

Contact load relays 30 VDC 1A.

- **1 relay output general fire alarm.** The general fire relay will energize upon activation of a fire condition on any of the fire zones or by pressing of the in or external extinguishing release buttons.
- **1 relay output general fault message.** The general fault relay signals the presence of a fault in the NANO. In the event of a complete power failure, the general fault relay will be activated.
- **1 relay output at 1st or 2nd fire alarm.** VFC relay output is programmable for 1st or 2nd fire alarm and intended, among other things, for switching off ventilation and/or air conditioning of the area to be protected.

12.2 MONITORED EXTINGUISHING OUTPUT

THE NANO is equipped with a fire extinguisher output monitored for short circuit and wire breakage. In combination with the ETB (Extinguishers Terminal Board), the NANO's extinguishing output is protected against reverse polarity and equipped with surge protection. Without the use of an ETB, this extinguishing activation output is NOT protected against surge and reverse polarity. If the ETB is not used then an end of line diode is required (1N5400, 1N4007, RL201, SF21). Read chapter 18/33.

12.3 MONITORED SOUNDER OUTPUT

This output, intended for the optical and/or acoustical alarm device, is monitored for short circuit and wire break by placing a 10 K Ω end-of-line monitoring resistor of the alarm device such as on the VTB-32EM or YL 40 sounder/beacon see schedules sheet at 26 and 27. At some sounders the end of line resistor is not necessary, because the resistance of the sounder input is sufficient enough to monitor on short circuit and/or wire break.



13 CONTROL BUTTONS

The NANO has a clear and orderly front panel with which the system status of the NANO can be determined rapidly. The figure shows the controls and indications with text. The NANO fascia consists of a special foil with embedded the control buttons and LED indicators.



13.1 MUTE

The buzzer can be silenced at any time by pressing the Mute button. To silence the external sounder, press the button twice. It is not permitted to disable the external sounder in the extinguishant release state. In the event of a 2nd alarm, the sounder and buzzer are activated again.

13.2 RESET

After the cause of the alarm has been determined the NANO can be reset by pressing the Reset button. Manual Call Points, if triggered, must first be reset locally. Fault indications are self resetting type and vanished automatically when the fault condition is removed.

13.3 LAMP TEST

All indicators and buzzer can be tested at any time by pressing the Mute and Reset simultaneously.

13.4 HOLD EXTINGUISHING RELEASE

By pressing the hold button at the panel or external hold button, as long this button is pressed, the extinguishing release sequence will be halted and cause the yellow hold activated indicator flash, and the buzzer sound pulsating. When the control panel is in the second stage alarm condition and the hold function is activated, the extinguishing release sequence will be halted, the second stage sound shall change to first stage sound. Release the Hold button shall re-start the countdown release timer from maximum.

13.5 AUTOMATIC & MANUAL RELEASE OR MANUAL ONLY MODE

The mode of the system can be toggled between Manual Only and Automatic & Manual by operating the MODE push button on the NANO. When the system is in Manual Only mode, the extinguishant cannot be released by the operation of automatic detectors. In that mode the automatic fire detectors are only informative. To switch the system from manual only tot automatic & manual press the MODE push button for 3 seconds. To return the system to manual mode only, press the MODE push button again for 3 seconds.



13.6 EXTINGUISHING RELEASE

When a fire emerges, press simultaneous both front extinguishing release push buttons, this will trigger an alarm and the fire extinguishers will be released, depending on the DIP switch (time) settings.

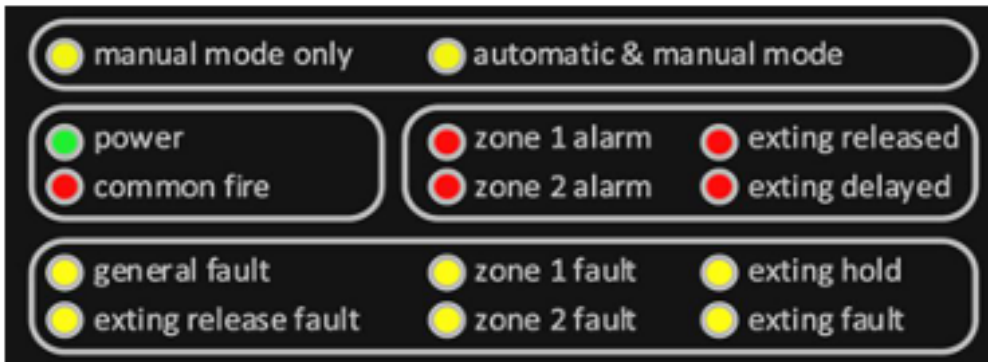


13.7 TEST MODE

Fire alarm systems must be tested regularly to ensure they function correctly. For an extinguishing system based on aerosol technology, our ETB has a provision to disable the extinguishers during testing and maintenance operations. However, an ETB is not applicable to a solenoid-controlled system. But the need to be able to switch it off is still necessary, of course. For this purpose, the NANO has a TEST MODE function. This test mode function allows you to test the alarm and fault circuits WITHOUT ACTIVATING the extinguisher's output. Activating the test mode function is signaled. Press both the mode and hold buttons simultaneously for 1 second to enable the test mode. This activates the GENERAL FAULT relay, and the yellow "Exting fault" LED lights up continuously when the test mode is enabled. This yellow LED indicator flashes when a critical fault is detected (open or short circuit) in the extinguishing output line. Press both the mode and hold buttons again for 1 second to return the system to normal status. The yellow test mode indicator switches off.

14 LED INDICATORS

The front of the NANO has 1 common fire, 3 internal fault, and 13 individual LED indicators on the front divided in three sections to indicate general functions, fire alarm and the extinguishing status. Under normal state, control panel will have only the green, Power LED lite and either the Manual Only or Automatic and Manual LED lite. The yellow fault LEDs automatically turn off when the cause of the fault is recovered.



14.1 MANUAL RELEASE ONLY

When the yellow "manual mode only" LED lit, the extinguishing agent is not released by automatic fire detectors, but only by manual operation.



14.2 AUTOMATIC & MANUAL RELEASE

When the yellow LED "automatic and manual mode" is on, the extinguishing agent is released by the automatic fire detectors and/or manual operation.

14.3 POWER PSU 1 & 2

PSU 1 = mains and PSU 2 = backup. Under normal conditions the NANO control panel will have only the green, power on LED lit and either the manual only or automatic & manual LED lit. Failure of the mains power or disconnection of the backup power will cause a fault. The power LED lite differently, indicating an abnormality in the power supply to the NANO. When starting the NANO after a power failure or an extinguishers release, the green power LED flashes for maximal 1 minute until the system is ready and this LED lit continuously.

If the mains power supply is NOT present, the secondary power supply takes it over, the power LED flashes 1 x per second, the yellow general fault LED lit, the common fault relay will be deactivated.

If the standby power supply is NOT present, the power LED flashes 2 x per second followed by a pause of 1 second, then repeating, the general fault and internal battery fault LED lit, the common fault relay is deactivated.

If a standby power source is not available, then the connection points 17/18 must be connected to respectively point 14/15 to avoid an fault message.

When the vehicle function (DP2) is enabled, the green power LED flashes at 1 x per second when vehicle is parked and switch to the secondary vehicle voltage.

14.4 COMMON FIRE

In the event of a fire alarm from either the fire alarm detectors or the operation of the extinguishant release pushbuttons, the red general fire LED lit.

14.5 FIRE ZONE ALARM

Upon receipt a fire alarm condition caused by the activation of a fire detector, the red alarm indicator of the relevant fire alarm zone will flash. The common fire indicator will always accompany this, and the internal buzzer sounds pulsating.

14.6 EXTINGUISHING RELEASED

The red extinguishing release indicator lights continuously when the extinguishers are activated. This red extinguishing release indicator lights up after ending of the configured extinguishing delay time, or when the two extinguishing release buttons on the front are pressed or the external release button is activated. A tone sounds when the extinguishing has released.

14.7 EXTINGUISHING DELAY

The red extinguishing delay indicator indicates that the extinguishing release delay is active. This indicator flash when the delay time is running. This indicator will light continuously when pressing the hold button. When the hold button is released, the indicator shall flash again and re-start the countdown release timer from maximum. This indicator turns off when the delay time has elapsed, and the extinguishing release has taken place.



14.8 GENERAL FAULT

General fault indicator lights and specific fault indicators flash. This yellow fault indicator will light continuously at any fault condition.

14.9 FIRE ZONE FAULT

When the NANO has detected an error in one of the critical fire detection paths of the system, the specific yellow zone fault indicator flash and the general fault indicator lights up. The internal buzzer sounds pulsating.

14.10 EXTINGUISHING RELEASE HOLD

The yellow hold indicator flash and a different tone sounds as long the hold button on the panel front, or the external hold button is pressed. This yellow hold indicator is turns off when the hold button is released.

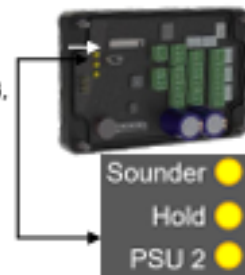
14.11 EXTINGUISHING RELEASE FAULT

This yellow indicator lights up continuously when the system is in test mode. In the event of a critical fault in the extinguishing output, the yellow exting release LED will flash. This yellow light goes out when the cause of the fault has been resolved.

14.12 INTERNAL FAULT INDICATORS

There are three extra yellow fault indicators on the internal electronic PCB, meant for second priority fault messages and these indicators will flash.

- LED 1 signals a fault in the monitored sounder/beacon line
- LED 2 signals a fault in the external extinguishing release hold input
- LED 3 signals a fault in the emergency power source PSU 2



15 DIP SWITCHES

15.1 SETTINGS

Standard setting ex factory, all dipswitches in OFF position.

- Automatic fire detector as the initiators of an extinguishing action is the standard, no override the delay timer.
- The vehicle mode is disabled
- Activation of electrical igniters for aerosol fire extinguishers
- Dual zone alarm for automatic extinguishing release.
- VFC relay activate at 2nd fire alarm
- Extinguishant release delay 0 seconds



Recommended setting for marine application with manual release only:

- Front NANO manual release ONLY, fire detectors are not in use (DP1 OFF)
- The vehicle mode is disabled is not in use (DP 2 OFF)
- Activation of electrical igniters for aerosol fire extinguishers (DP 3 OFF)
- Dual zone alarm is not in use (DP 4 OFF)
- VFC relay activate at 1st (DP 5 ON)
- Extinguishant release 20 seconds (DP 6 ON - DP 7 OFF - DP 8 OFF)



15.2 DIRECT RELEASE (DP1)

If a fire alarm is detected, by the automatic fire detectors the countdown timer is started, you can override the timer when press the manual release.
DS 1 OFF = extinguishing delayed also in manual operation if a delay has been programmed.

DS 1 ON = extinguishing without delay in manual operation.



15.3 VEHICLE MODE (DP2)

If the extinguishing system is intended to protect the engine compartment of a vehicle, a programmed extinguishing delay must be disabled when the vehicle is parked, and the driver leaves the vehicle.

DS 2 OFF = system behaves as programmed with delay.

DS 2 ON = delayed extinguishing is disabled when parked.

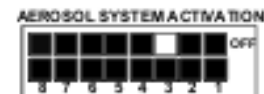


15.4 EXTINGUISHING RELEASE OUTPUT (DP3)

The N2KB NANO is equipped with two activation techniques for the activation of fire extinguishing systems. Standard (DP3OFF) the NANO is programmed for the activation of electrical igniters intended for aerosol fire extinguisher units. When DIP switch 3 is set to the ON position, the NANO is suitable for activating an extinguishing system using a solenoid

DS 3 OFF = system is suitable for electrical igniters intended for aerosol fire extinguishers 1,3A/50ms

DS 3 ON = system is suitable for solenoid activation 24V DC 1 A



WARNING

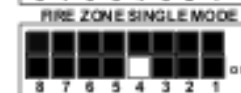
When the DP3 is in the ON position (solenoid only) DO NOT USE it in combination with an ETB.
This may cause irreparably damage to the ETB and the NANO control panel.

15.5 SINGLE OR DUAL FIRE ALARM (DP4)

Normally we work in dual fire zone mode. In some cases, a single mode state can be useful. In dual mode, the extinguisher(s) are released after an alarm condition is detected in both fire zones. In single mode, the extinguisher(s) are released when one fire zone is in alarm.

DS 4 OFF = automatic extinguishment activation with 2 fire zones in alarm.

DS 4 ON = automatic extinguishing activation with 1 fire zone in alarm.

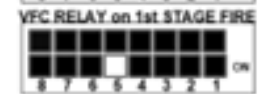


15.6 VFC RELAY (DP5)

Here one has a choice to have the relay active at the first fire alarm or after the second fire alarm.

DS 5 OFF = VFC relay active with 2nd fire alarm.

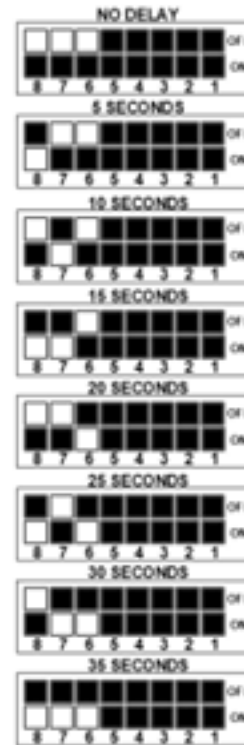
DS 5 ON = VFC relay active with 1st fire alarm.



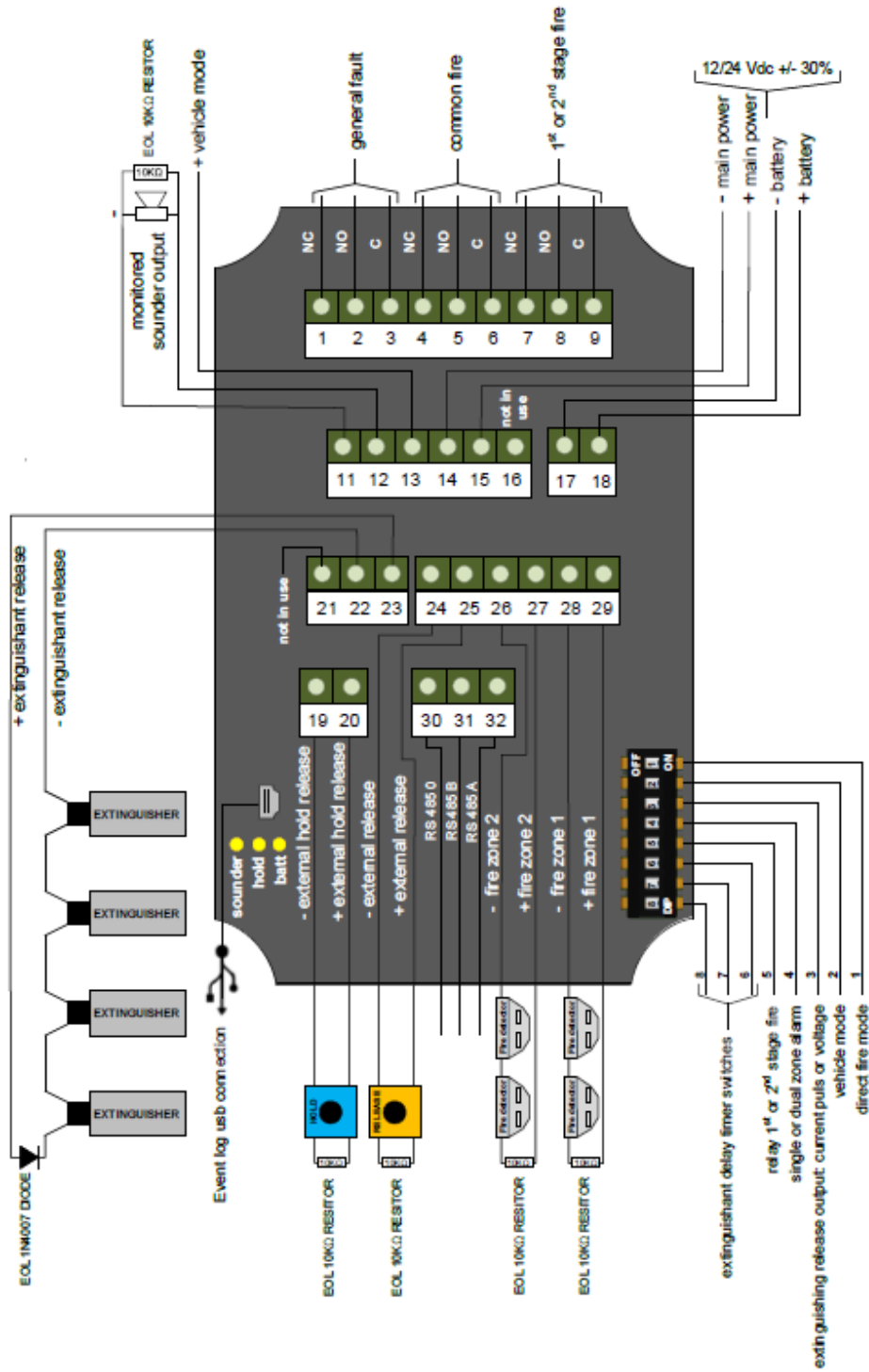
15.7 EXTINGUISHING DELAY TIMER (DP6-7-8)

Extinguishing delay is only useful in normally occupied spaces. For the delay timer settings, there are 3 DIP switches, which can be set between 0 and 35 seconds, with steps of 5 seconds. The count-down timer is used to wait a certain amount of time before extinguisher is activated. This timer can be set with the use of the timer DIP switches 6,7 and 8.

- DS 6 OFF |
- DS 7 OFF | - is no delay
- DS 8 OFF |
- DS 6 OFF |
- DS 7 OFF | - is 5 seconds delay
- DS 8 ON |
- DS 6 OFF |
- DS 7 ON | - is 10 seconds delay
- DS 8 OFF |
- DS 6 OFF |
- DS 7 ON | - is 15 seconds delay
- DS 8 ON |
- DS 6 ON |
- DS 7 OFF | - is 20 seconds delay
- DS 8 OFF |
- DS 6 ON |
- DS 7 OFF | - is 25 seconds delay
- DS 8 ON |
- DS 6 ON |
- DS 7 ON | - is 30 seconds' delay
- DS 8 OFF |
- DS 6 ON |
- DS 7 ON | - is 35 seconds delay
- DS 8 ON |



16 WIRING DIAGRAM NANO CONNECTED TO IGNITER ACTUATORS



18 THE ETB

The ETB is specially developed for connecting aerosol extinguishers. This terminal connection board is equipped with built-in security electronics, which ensures that all igniters of the extinguishing units are activated. Together with an end line switch, this option turns the NANO system into a complete and reliable fire detection and extinguishing system.

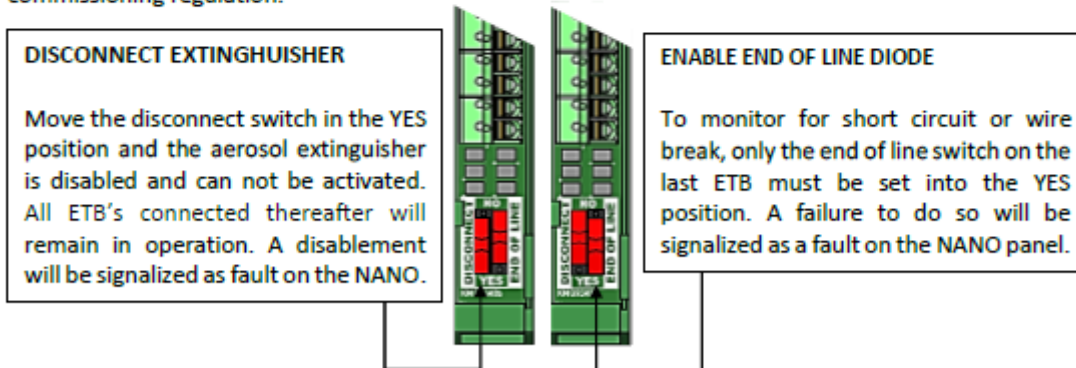
The most important characteristics of the ETB are:

- simple push-in connection technology
- minimum core diameter 0.5 mm² (AWG 20)
- maximum core diameter 1.5 mm² (AWG 16)
- a bridging protection ensures that the ignition current flows through ALL electrical activators for at least 50 ms, also when one of the igniters is malfunctioning or behaving differently than others (eg. Ignite sooner and going in high impedance before other igniters have been ignited)
- the ETB is equipped with a switch that activates the end-line monitoring diode on the last extinguishing generator
- a second switch is intended to disconnect the electrical activator from the extinguishing line for the purpose of testing the extinguishing line without activating the extinguishing generators
- there is a red test LED that shows that an activation current is actually being initiated during the installation test
- the ETB is equipped with reverse polarity protection, thereby avoiding connection errors
- the ETB is equipped with surge protection, which reduces the risk of activation of a fire generator near a lightning strike
- mounting method: DIN rail 35 mm

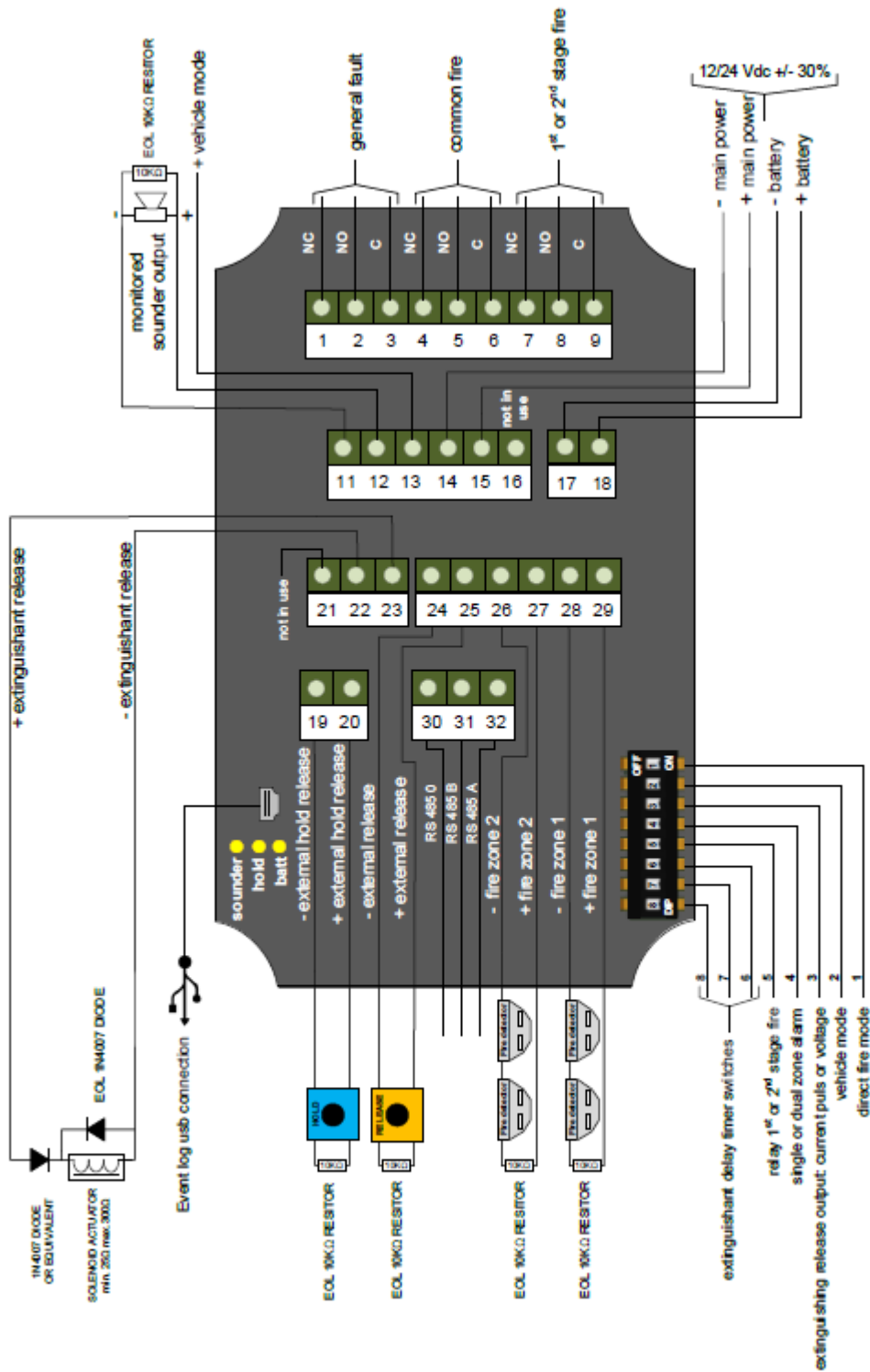


18.1 USING THE TWO SWITCHES ON THE ETB

Incorrect placement of the end line switch makes it possible to disable a part of the extinguisher's activation circuit. Therefore, a visual inspection is an essential part of the commissioning and maintenance engineers' work. This visual inspection must be a standard provision in the commissioning regulation.



19 WIRING DIAGRAM OF THE NANO USING A SOLENOID ACTIVATOR



20 NANO WIRING DIAGRAM SOLENOID ACTIVATION SYSTEM

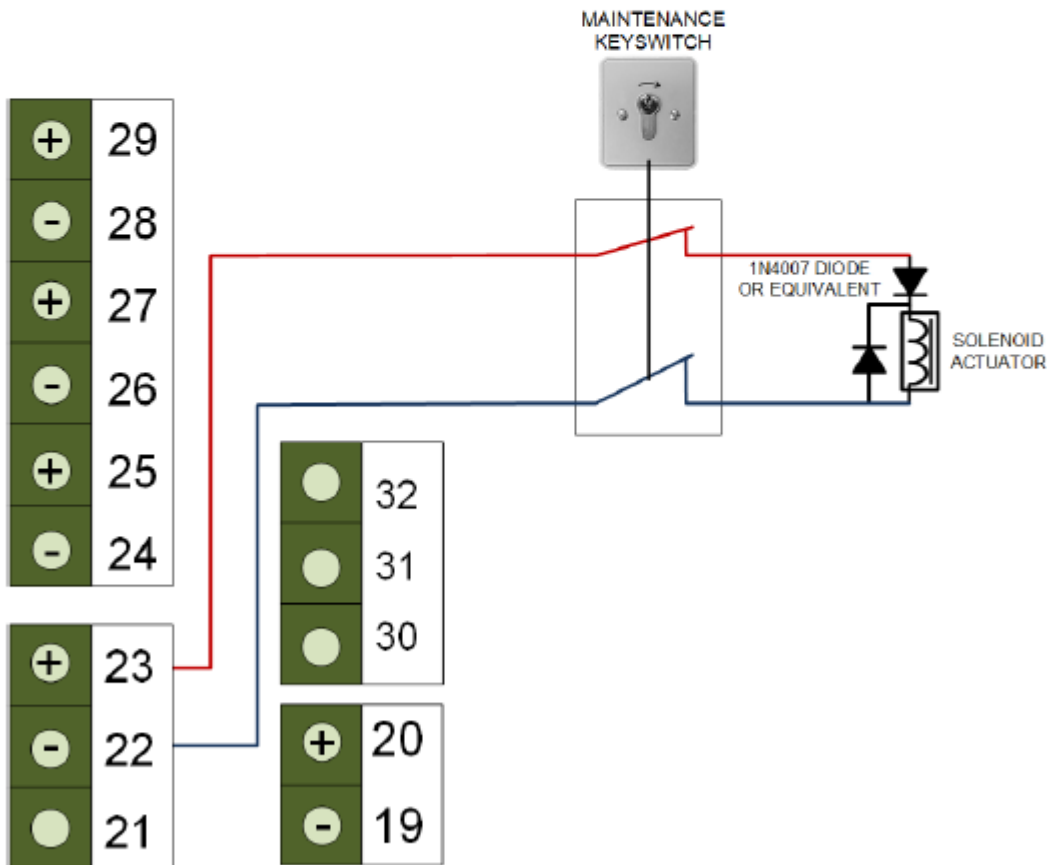
In addition to a fire extinguishing output for electric igniters meant for aerosol fire extinguishing generators, the NANO also has an extinguishing output suitable for a solenoid-controlled fire extinguishing system.

The extinguishant output is capable to supply up to 1 Amp for the maximum duration to a solenoid. Solenoids must have a resistance of 25 to 200 ohms 18/28V DC, to ensure that the maximum current rating of the extinguishant output is not exceeded. The maximum cable impedance is 1.5Ω-5.0Ω depending on the coil impedance.

Calculate the voltage drop across the cable to ensure that sufficient voltage remains at the end of the control cable for the activation of the solenoid activator.

The solenoid should be fitted with two diodes. One diode for the end of line monitoring. The other is a flyback diode. A fly back diode is a diode connected across the coil used to eliminate flyback, which is the sudden voltage spike seen across an inductive load when its supply current is suddenly reduced or interrupted. It is used in circuits with a possible inductive load. **IMPORTANT**

Despite the presence of a button on the NANO front for manual extinguishing activation only, we do recommend a service/maintenance key switch in the extinguishing output line to perform test and maintenance work without activating the extinguishing system.



21 WIRING & CABLE SPECIFICATIONS:

- There is NO need for shielded cable
- Use a pair twisted cable, this strength the protection against electrical or magnetic field.
- Minimal solid copper core diameter, extinguisher line cable <50 meters length 1,0 mm² (AWG 18)
- Minimal solid copper core diameter, extinguisher line cable >50 meters length 1,5 mm² (AWG 16)
- Minimal solid copper core diameter, fire detection cables 0,5mm² (AWG 20)
- Maximum solid copper core diameter other cables 1,0mm² (AWG 18)
- Maximum conductor loop resistance, 1,5mm² cable is 24 Ω/km.
- Maximum cable length of the fire zone cables is 50 meters.
- Maximum cable length of the cable from NANO to ETB is 30 meters.
- The total cable length of all extinguishers together is max 100 meters in total.

22 TECHNICAL SPECIFICATION

Environment

Ambient Temperature Range	-25 to +55 degrees Celsius
Dust and water rating	IP65
Compass safe distance	minimum 50 mm

Power related specification

Input voltage main and emergency battery	12/24 VDC +/-30%
Maximum power usage	1 Watt quiescent 5 Watt in alarm
Maximum contact rate relays	30 VDC/1A
Voltage fire zone	15 Vdc
Limited alarm current fire detectors	60 mA
Sounder / beacon voltage main powered mode	12 – 22 VDC
Sounder / beacon alarm maximum current	150 mA

Connector and cable specification

Conductor cross section solid (Cross Sectional Area mm ²)	0.5 mm ² ... 1.5 mm ²
Conductor cross section flexible (Cross Sectional Area mm ²)	0.5 mm ² ... 1.5 mm ²
Conductor cross section AWG	20 ... 16
Stripping length	8 mm

Aerosol extinguisher output specification

Max extinguisher count ETB/L (Igniter ≤ 2ohm)	8 connected on ETB max 100-meter cable
Max extinguisher count ETB/H (Igniter ≥ 2ohm)	6 connected on ETB/H max 100-meter cable
Max extinguishers count without ETB	6 connected without ETB max 100-meter cable
Extinguisher release current	1,3A
Extinguisher release pulse length	35 ms

Solenoid extinguisher output specification

End of line component	2 x back - EMF diodes 1N4004 or equal
Maximum number solenoids	1
Maximum coil resistance	25 to 200 ohms
Maximum current	1 A
Voltage	24Vdc
Extinguisher release pulse length	20 seconds



Detection zone, hold and extinguishing release inputs

Normal state	> 8 k Ω < 12 k Ω
Alarm load	< 100 Ω > 1.2 k Ω
Zone fault threshold 1	< 100 Ω
Zone fault threshold 2	> 1.2 k Ω < 8 k Ω
Zone fault threshold 3	> 12 k Ω
Alarm resistant	470 Ω
End of line resistant	10 k Ω

23 DEVICES SUPPORTED AND INVOLVED BY THE NANO APPROVAL

23.1 DETECTION DEVICE SUPPORT

The detector types below have been evaluated on the NANO and are approved for such		
Part no	Type	Brand
ORB-OP-42001-MAR ¹	smoke detector	Apollo
ORB-OH-43001-MAR ¹	smoke/heat detector	Apollo
ORB-HT-41002-MAR ¹	heat 61°C detector	Apollo
ORB-HT-41004-MAR ¹	heat 73°C detector	Apollo
ORB-HT-41006-MAR ¹	heat 90°C detector	Apollo
ORB-MB-00001-MAR	standard detector base	Apollo

23.2 SOUNDER/BEACON DEVICE SUPPORT

Part no	Type	Brand
YL40/DL/C/25/WN/WR	sounder beacon	Clifford Snell
VTB-32EM-DB-RB/RL (VTB ²)	Sounder beacon	Cranford

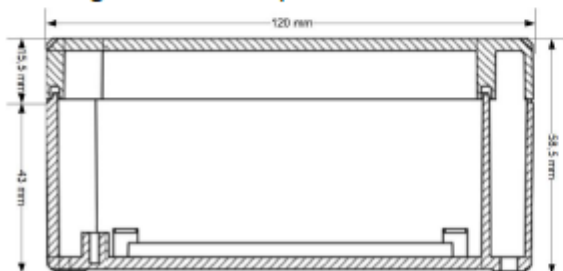
Note: 1 Device input voltage 8 – 22 VDC

Note: 2 Device input voltage 18 – 22 VDC

Always check the specification of the devices of your preference before installing them on the NANO control panel.

24 ENCLOSURE SPECIFICATIONS

- outside enclosure : 120 x 80 x 58,5 mm w x h x d
- protection class : IP 65
- color of enclosure : black RAL 9005
- enclosure material : ABS suitable for outdoor use
- cable gland holes : 7 predrilled holes

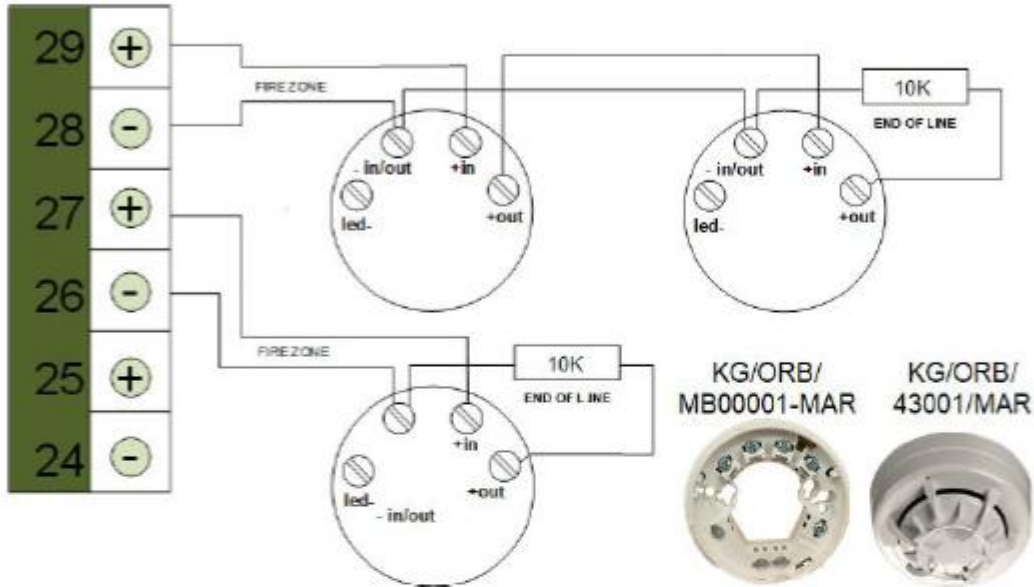


25 NANO FIRE DETECTOR AND WIRING OPTIONS

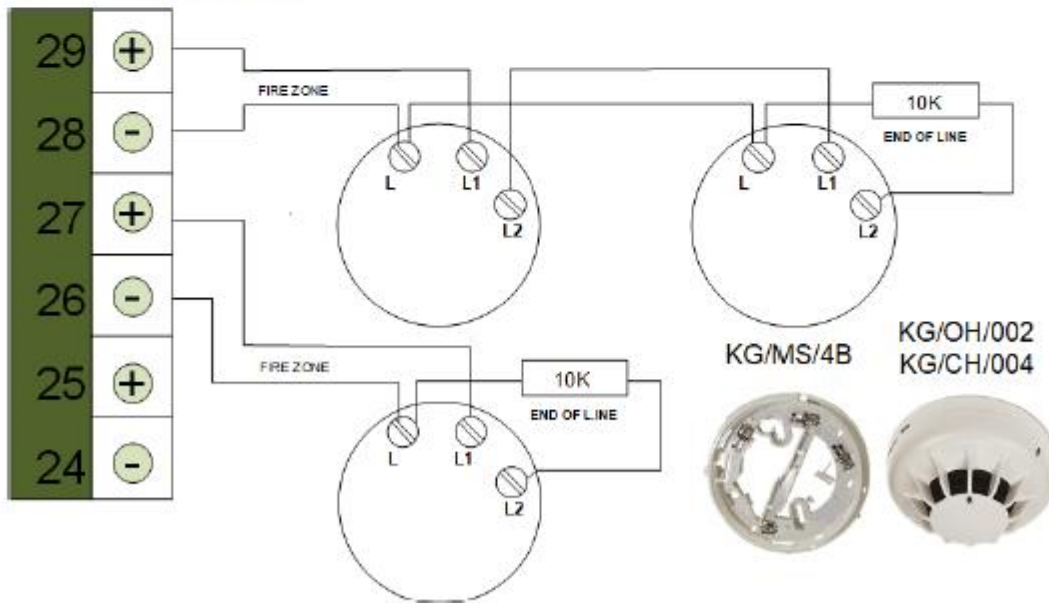
There are three options for connecting fire detectors to the NANO.

- Conventional Apollo Orbis Marine and Fireclass fire detectors
- Heat detectors
- Linear cable heat detection

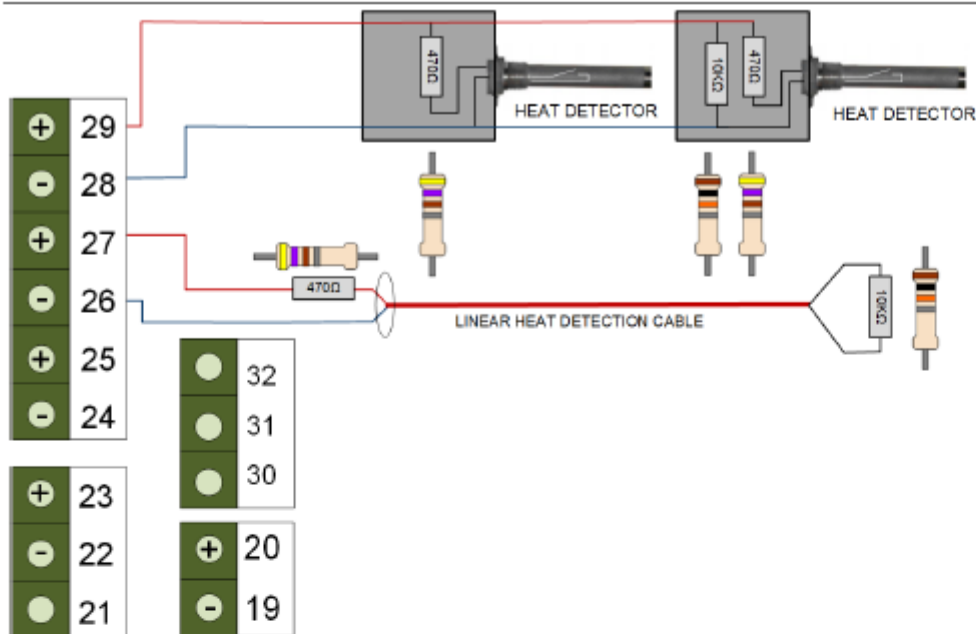
25.1 APOLLO DETECTOR



25.2 FIRECLASS DETECTOR

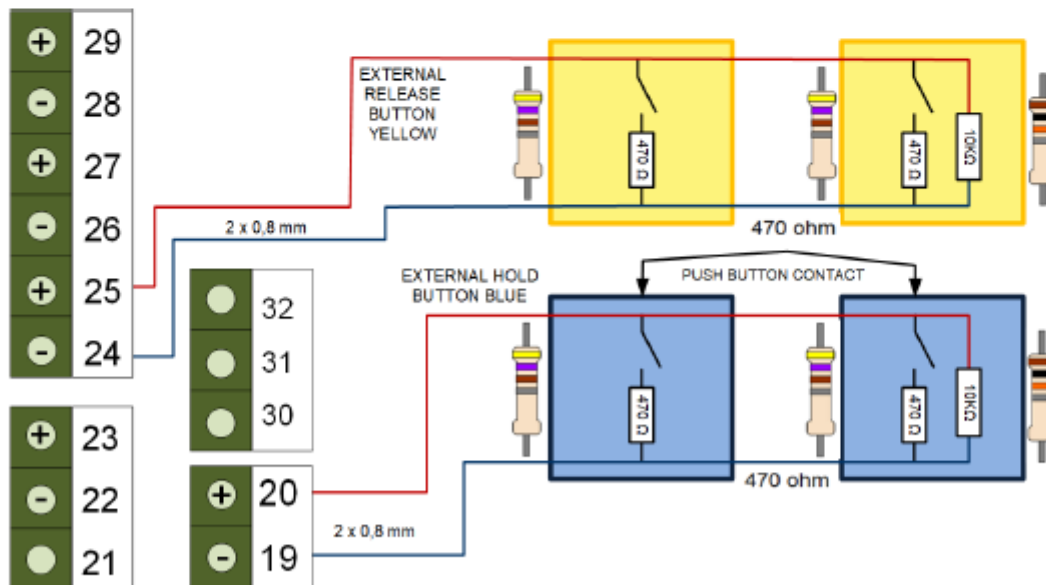


26 NANO LINEAR CABLE HEAT DETECTION



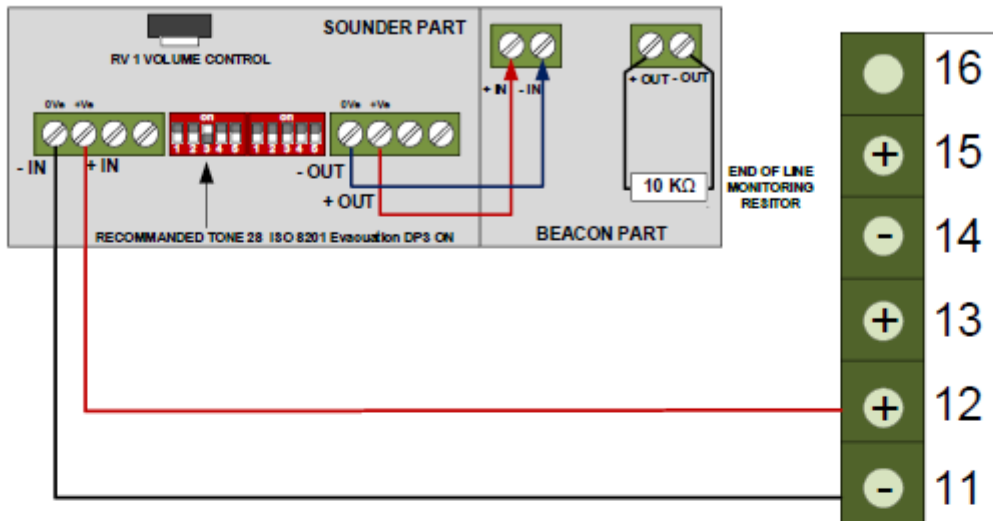
27 NANO EXTERNAL EXTINGUISHERS RELEASE & HOLD WIRING OPTIONS

The NANO has a separate input for external extinguishing release and external hold-off button.



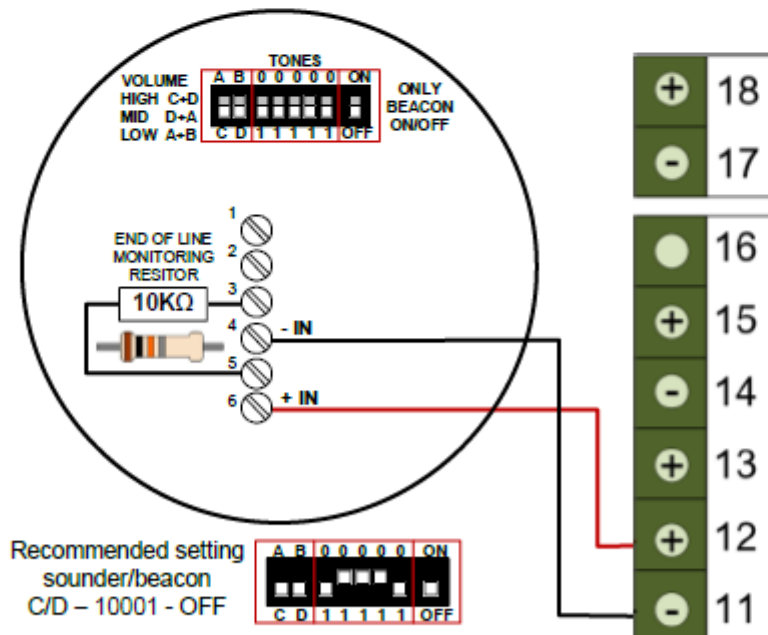
28 YL 40 WIRING OPTION SOUNDER & BEACON

By a single sounder beacon follow the connection diagram below. The recommended setting gives the best and deviating alarm signal compared to the usual evacuation alarm signal on vessels.



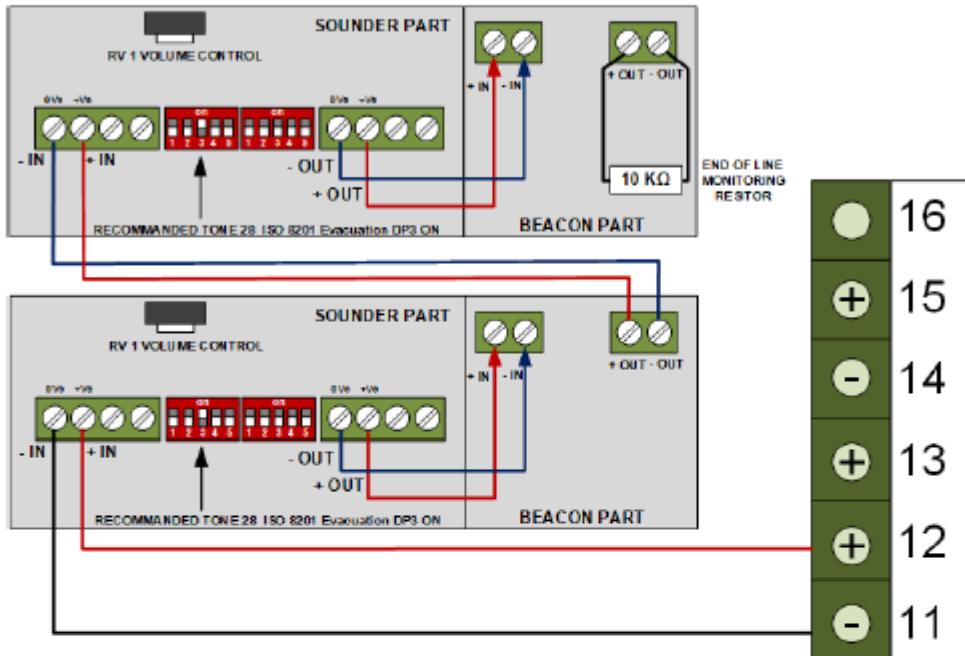
29 VTB-EM WIRING OPTION SOUNDER & BEACON

By a single sounder beacon follow the connection diagram below. The recommended setting gives the best and deviating alarm signal compared to the usual evacuation alarm signal on vessels.

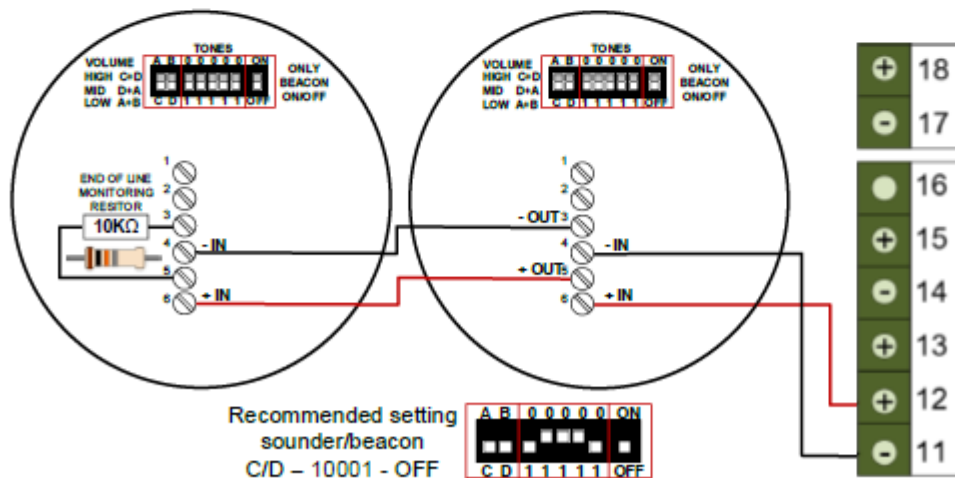


30 YL 40 WIRING OPTION EXTENDED SOUNDER & BEACONS

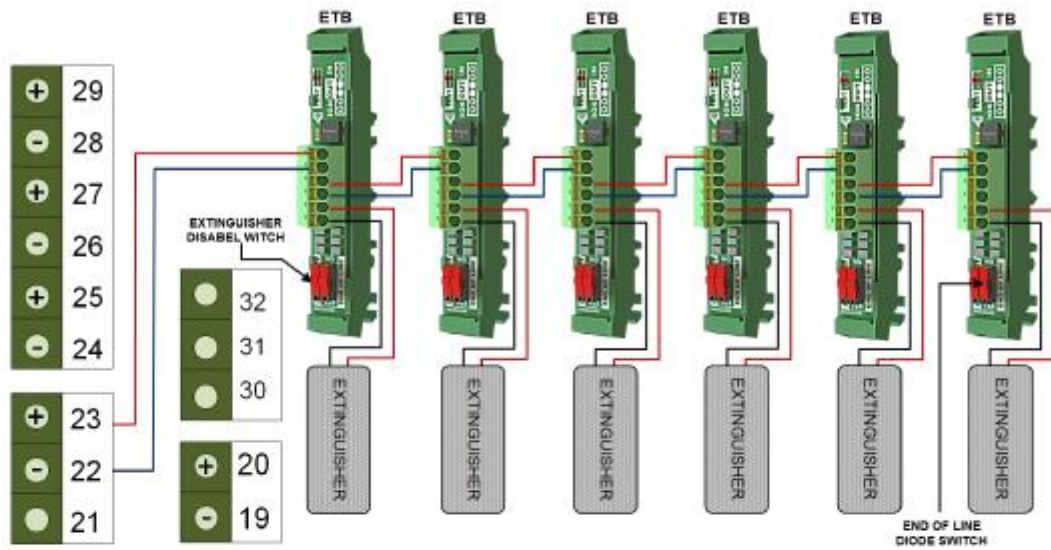
In some cases, the installation of a second signaling device is necessary. Usually this is caused by the lack of visibility of the optical alarm beacon in the protected area. In a noisy environ, the optical alarm signal is the leading warning element. By more than a single sounder beacon follow the connection diagram below. The recommended setting gives the best and deviating alarm signal compared to the usual evacuation alarm signal on vessels. At some sounders the end of line resistor is not necessary, because the resistance of the sounder input is sufficient to monitor on short circuit and/or wire break.



31 VTB-EM WIRING OPTION EXTENDED SOUNDER & BEACONS

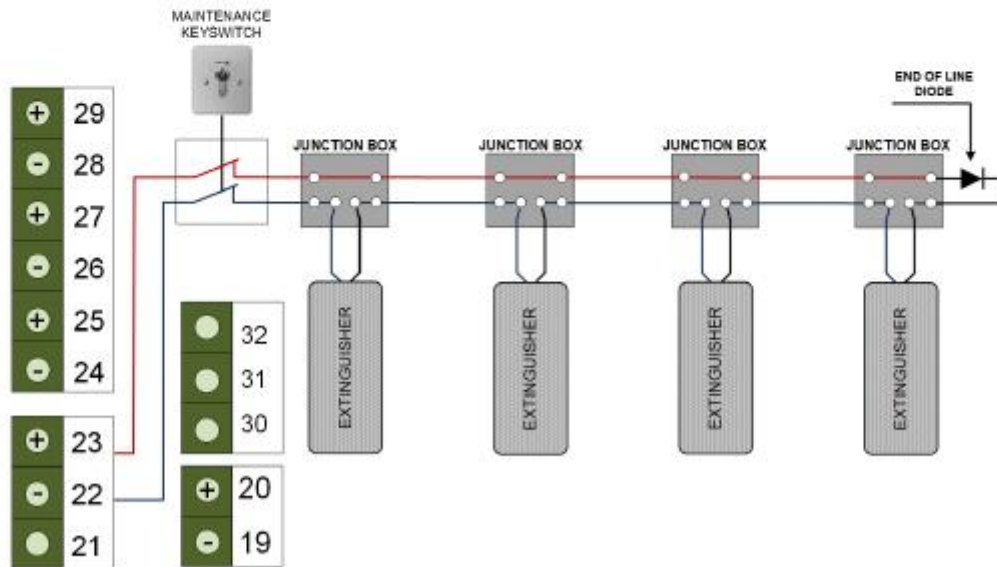


32 NANO WITH ETB CONNECTION



33 NANO WITHOUT ETB CONNECTION

A connection as shown below with a junction box is technically possible. However, it is not covered by the manufacturer's warranty. The manufacturer only guarantees the proper functioning of the NANO in combination with an ETB. Only an ETB has a bridge protection against a possible early blockage, which always ensures that the activation current flows through all igniters.



APPENDIX E

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

The forms in Appendix E 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

		
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: <input type="checkbox"/> R107 System <input type="checkbox"/> 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):	



Fire Risk Assessment: Bus Engine Compartment

Document Number: ENG-40003-C

Date: 04/19/2023

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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):

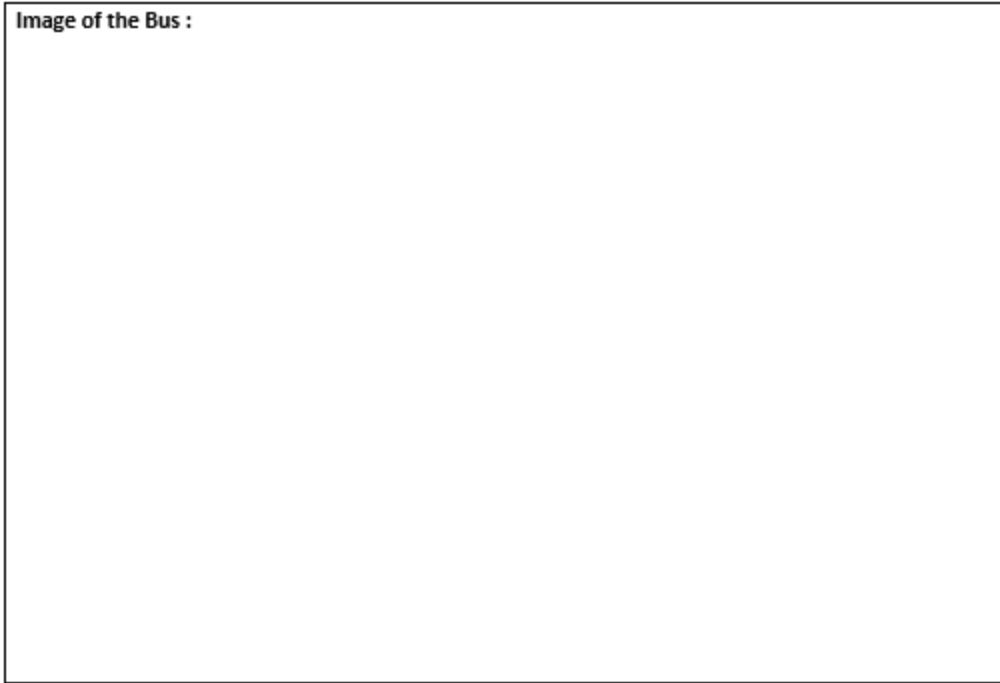
Fire Risk Assessment: Bus Engine Compartment

Document Number: ENG-40003-C

Date: 04/19/2023

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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)

Fire Risk Assessment: Bus Engine Compartment

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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				



Fire Risk Assessment: Bus Engine Compartment

Document Number: ENG-40003-C

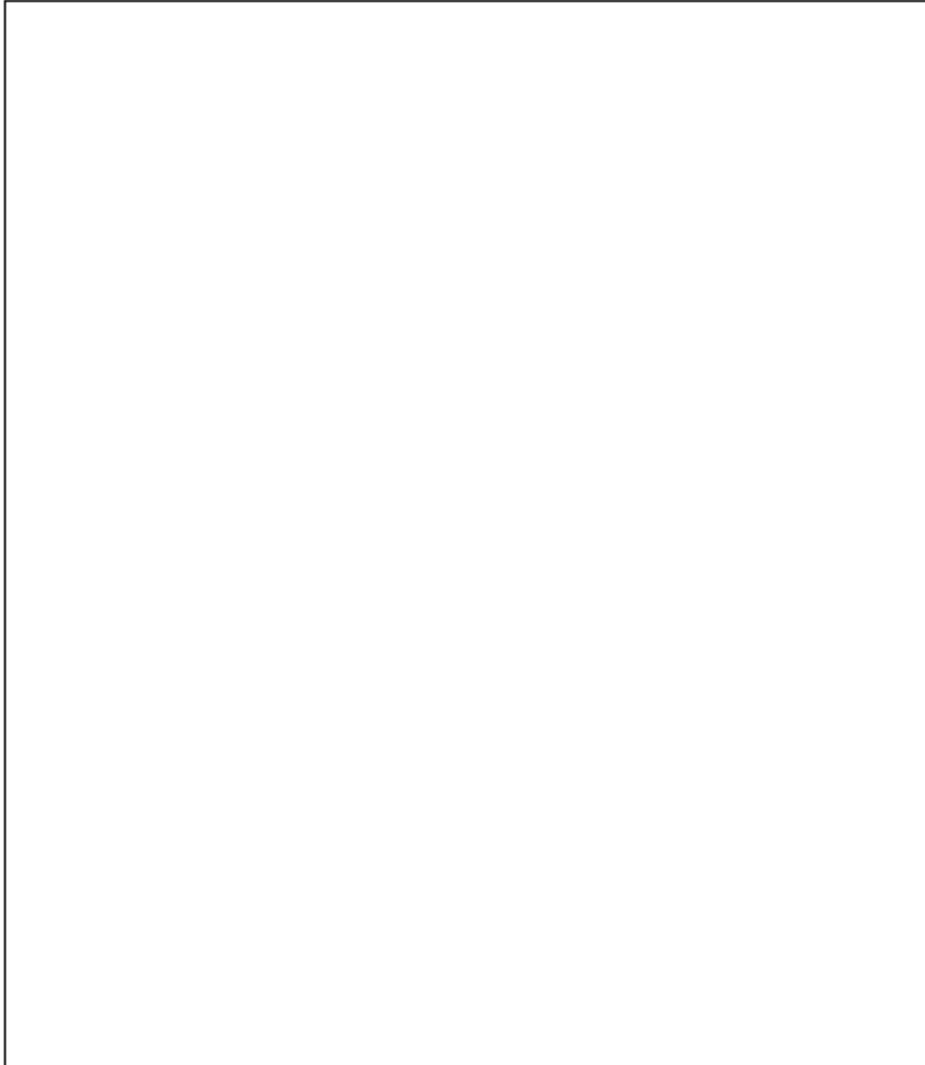
Date: 04/19/2023

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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:



Fire Risk Assessment: Bus Engine Compartment

Document Number: ENG-40003-C

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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 compartmentalized 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? (Do not include the 2 nozzle by the radiator and the one nozzle in the compartmentalized 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 questions was answered as "no" please justify your reasoning:



Fire Risk Assessment: Bus Engine Compartment

Document Number: ENG-40003-C

Date: 04/19/2023

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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.

		
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: _____