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APPLICATION OF WATER MIST FIRE SUPPRESSION FOR AMMUNITION LOADING MACHINES

1. THE INDUSTRY

The ammunition loading industry worldwide manufacturers between 10,000,000,000 and 15,000,000,000 (ten and fifteen BILLION) bullets per year. This requires the use of more than 45,000,000 (forty-five MILLION) kilograms of smokeless powder.

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2. PRODUCTION

A typical loading / production facility has multiple ammunition loading machines and operators working in close proximity. Numerous variations of automatic loading machines exist including pistol loaders, rifle loaders, high speed loaders, etc. The machines have hoppers with bulk powder and cartridges.

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3. THE RISK!

Ammunition loading machines utilize various mechanical and electrical components to measure and load smokeless powder into cartridges at mass production speeds. Smokeless powder is an energetic material classified as a 1.3 propellant that can burn vigorously, deflagrate, or detonate depending on configuration and conditions. World-wide ammunition loader fire reporting is incomplete and likely underreported but is estimated in the thousands per year.

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4. YOUR PRESENTERS

SARADUKE
Technical Services Inc

www.saraduketechnicalservices.com

Glen Saraduke, FPE, PE, CFEI oversees Saraduke Technical Services, Inc. – a fire safety consulting firm based in the United States. Glen sits on the NFPA 495 Explosive Materials and NFPA 1 Fire Code committees

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XDSFIRE

www.xdsfire.com

Chris van der Stokker, EMI, SET, CRO, IEEE oversees XDS FIRE, INC. – a fire protection R&D, design, and installation firm focusing on special hazards fire protection systems.

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5. ANALYSIS OF RISK

Initial analysis performed for various machine manufacturers and ammunition production facilities indicated that fire code required ceiling mounted automatic fire sprinklers take too long to react to loading machine fires, increasing the risk of a detonation event. Saraduke Technical Services and XDS FIRE performed a market analysis to determine existing options for local application fire suppression.

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6. SOLUTION?

Market analysis determined that no listed local application fire suppression systems existed that were focused on ammunition loading machines. Utilizing existing R&D and testing facility capabilities of Saraduke Technical Services and XDS FIRE, a determination was made to perform full scale fire suppression tests utilizing various chemical and water-based agents. Preliminary testing showed excellent flame extinguishment using INTERMEDIATE PRESSURE WATER MIST.

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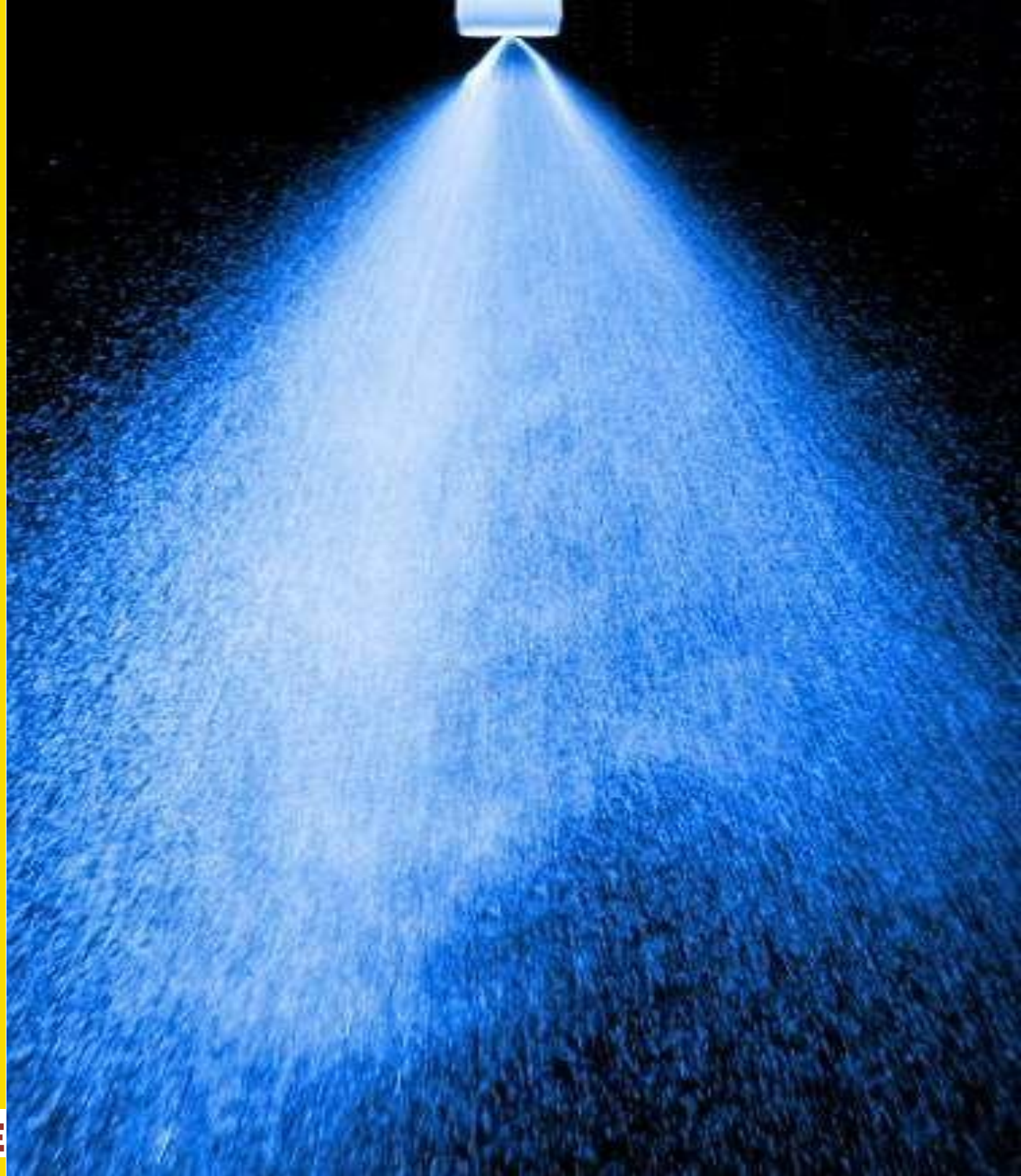

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7. TESTING RESULTS

Optimal results came from intermediate pressure water mist due to:

- **HEAT ABSORPTION**
- **FIRE PLUME ENTRAINMENT**
- **MINIMAL POWDER DISTURBANCE**
- **FAST KNOCKDOWN**

- **(switch speakers)**

Overview

The hazard is an automated ammunition loading machine manufactured by Mark L Loader and designated as "Frame 1162-FR-01." This model is for pistol ammunition and includes various storage hoppers for brass, bullets, and black powder. The machine also includes several moving pistons and rotating components lubricated by gear oil and grease. The machine includes various electrical controls and an electric motor as well as an onboard electrical control cabinet with up to 120VAC and 12VDC. The primary fire hazard includes the presence of black powder, grease, and presence of electricity. The proposed water mist fire system's primary focus is to snuff a black powder fire which may present in the brass case filling section, but the system also has a nozzle aimed at the rotating electric motor and aimed at the various equipment located underneath the loading area. The water mist system is comprised of a pressurized storage cylinder containing 1L of water pressurized to 360 psig. The cylinder has a brass valve with a manual primary control valve which is in the open position under normal condition. The outlet of the valve is connected via a stainless steel flexible hose to a 1/4" brass manifold containing a 1/4 turn primary control valve and three 1/4" outlet tees. The tees are connected to brass 1/4" aspirating nozzles mounted onto the machine with steel brackets. Upon activation of the 1/4 turn primary valve, the pressurized water immediately begins flowing through the stainless steel flexible hoses to the aspirating nozzles which spray misted water onto the areas of concern.

System Parameters

Cylinder	DOT-3AL 1800, Aluminum, 2L Capacity (Filled with 1L), w/ 8-3/8" Bias Cut Dip Tube, On 4" Black Powder Coated Mild Steel Bracket
Valve	Brass, CGA (Currently 320, Future Version to be CGA 33, 34, or 35) w/ Manual Wheel Valve (Open in Normal Condition)
Extinguishing Agent	Water (may be standard tap or similar) / N2 Mixture
Accelerant	N2 (Industrial Standard Grade)
Manifold	Brass, 1/4", Includes (1) 1/4 Turn Brass Primary Actuation Valve and (3) Outlet Tees
Nozzles	Brass, 1/4", 0.21W Flow Chamber, XDS FIRE INC

Test Equipment and Setup

The test setup includes a retired 1162-FR-01 Frame with all hoppers and operational equipment. The water mist system components have been installed in a manner as suggested for final assembly. The water mist system components have been designed and machined with the ability to install the fire system onto existing active ammunition loaders. The testing inclues three Test Sets. Test Set #1 focused on system configuration and connections. Test Set #2 focused on evaluating the quality of mist produced, nozzle aiming, and extinguishing agent run-out time. Test Set #3 focused on fire extinguishment through live fire testing.

Test Results

Date	Test Set	Test #	H2O Quantity (Liters)	Pressure (PSIG)	Cylinder Wt. - Empty (#)	Cylinder Wt. - Full (#)	Discharge Time (S)	Result	Notes
10/24/2024	1	1.1	2	360	5.3	9.7	1	:(	Overfilled, not enough accelerant
10/24/2024	1	1.5	1.5	360	5.3	6.4	16	:|	Overfilled, not enough accelerant, nitrogen only, no water. Added bias cut dip tube to cylinder. Nozzle 3 different than 1 and 2, need to manufacture matching 0.21W nozzle.
10/24/2024	1	1.7	0.75	360	5.3	7.5	22	:)	Slight mismatch on water versus N2, dip tube worked well. Need to recalculate water versus N2.
11/15/2024	2	2.3	1	360	5.3	7.5	29.5	:) :)	Changed inside 3to 0.21W - 5850 water to N2 ratio. Near perfect discharge time, water and N2 run out time matched on valve and in cylinder and N2 towels for ~1 second after water finished.
11/25/2024	3								
11/25/2024	3								

Test Results and Analysis

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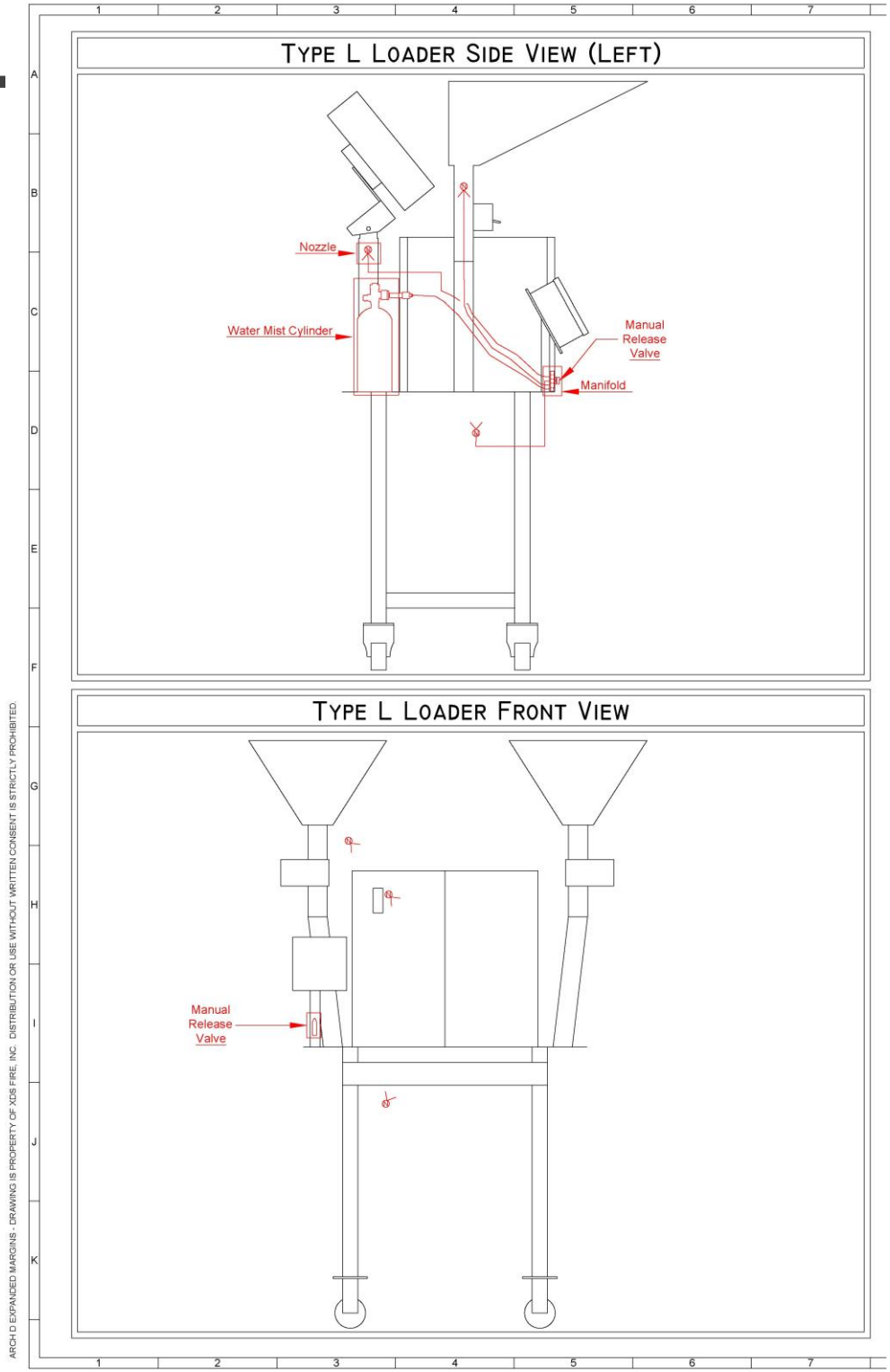

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8. THE SYSTEM

The patent pending ammunition loading machine water mist fire suppression system needed to meet the following requirements:

- **SELF-CONTAINED**
- **REDUCE DETONATION RISK**
- **MACHINE MOUNTABLE**
- **NO INTERFERENCE**
- **DURABLE**
- **EASY RECHARGE**

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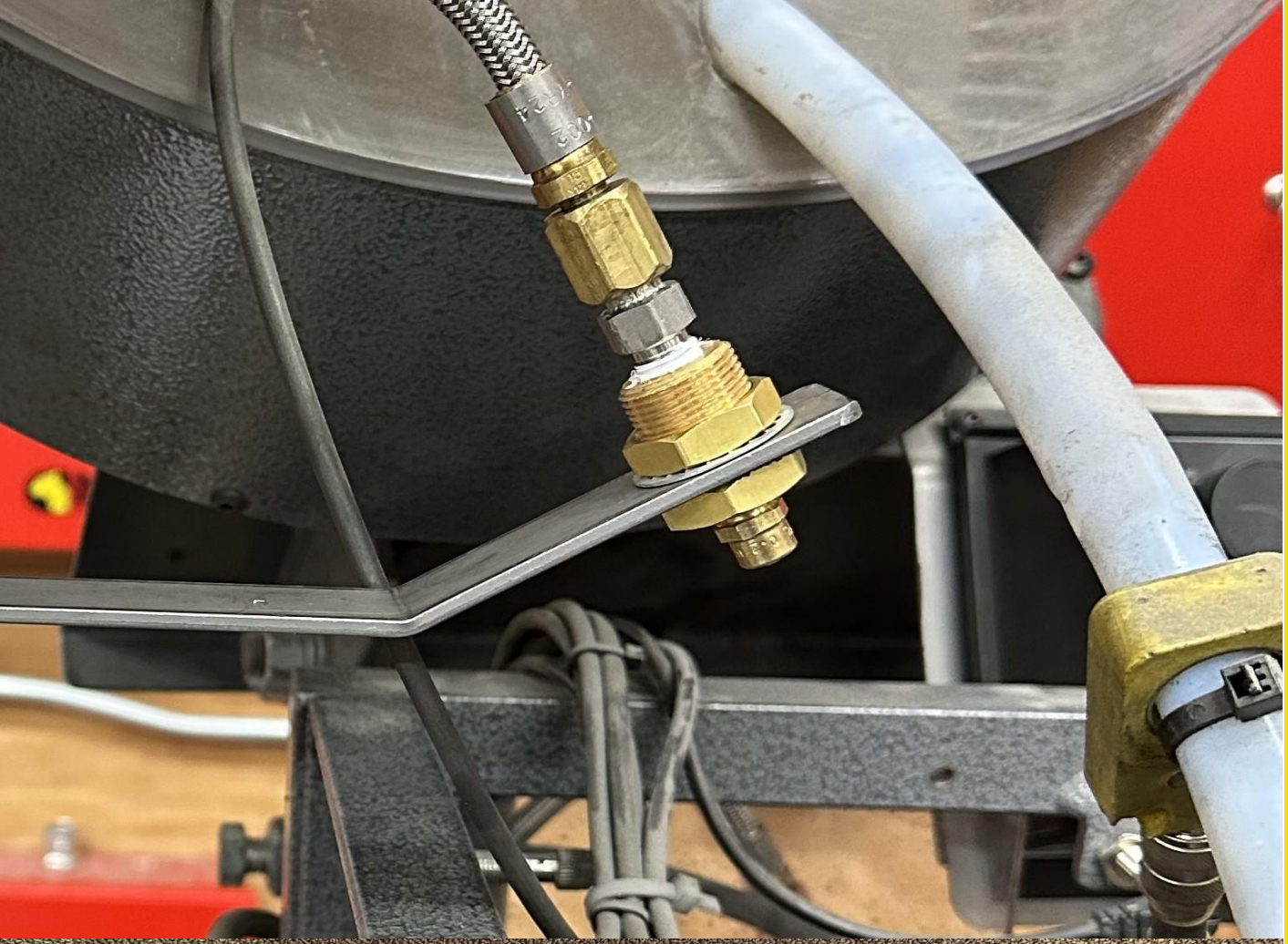
9. COMPONENTS (CYLINDER)

- PRESSURIZED
- 30 SECOND SUPPLY



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10. COMPONENTS (NOZZLES)

NOZZLES

- **CUSTOM DESIGN**
- **PURPOSE BUILT BRACKET**

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11. COMPONENTS (MANUAL RELEASE)

- V1 = Manual Only
- V2 = Manual + Automatic
- Purpose Built Bracket
- Conveniently Mounted

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12.1 ACTION!

(DOORS = OPEN)

- **Water Usage: ~1 Liter**
- **Effective on Single Base Powder**
- **Effective on Double Base Powder**
- **Discharge Time: ~30 Seconds**
- **Full Extinguishment: <15 Seconds**

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12.2 ACTION!

(DOORS = CLOSED)

- V1 = Manual Only
- V2 = Manual + Automatic
- Purpose Built Bracket
- Conveniently Mounted

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THANK YOU!

BEDANKT!

DANKE!

MERCI!

GRACIAS!

GRAZIE!

KIITOS!

TAKK!

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