SOLID AEROSOL GENERATOR FIRE SUPPRESSION SYSTEMS
TECHNICAL MANUAL M2SAGTM01
DATE ISSUED JANUARY 2017
Fire Suppression Systems have basically not changed in concept for many decades, however Muster® now utilises modern technology to produce a 24/7 fully monitored fire suppression system.

JSG introduces advanced system innovations in product & system design in the Muster® Fire Suppression System range. It combines the latest technologies with a simple design and quick connect components. The in-built accuracy of the Muster® Fire Suppression System is controlled using intelligent monitoring features that ensure the discharge performance meets the initial design criteria, effectively suppressing fires in the most punishing environments where many machines operate.

A number of key innovations in the Muster® System provide this intelligent performance and precise 24/7 monitoring. These include the Muster® Design Program, independently powered Muster® Alarm Panel and more recently introduced Muster® Integration Module for Solid Aerosol Generators. These innovations combine to deliver one of the lowest risk fire suppression systems on the market for the widest range of applications.

Whatever the demand; the new Muster® Fire Suppression System will operate as designed and to its full potential, suppressing the flames while protecting your assets and personnel.

A full range of Safety Data Sheets are available www.musterfire.com
A high level of testing gives people the confidence in Muster®

- Operation test of manual actuators and manual pull stations
- Mounting device test
- Salt spray corrosion test
- Ageing test
- Temperature cycling test
- 30-Day elevated temperature test
- Calibration test
- Vibration test
- Blow off test
- Shock test
- Light and water test
- Exposure to extinguishing agent test
- Air oven aging test
- Burst strength test

Muster® Solid Aerosol Generator products are Activfire listed for compliance.
FORWARD

THE MUSTER® SOLID AEROSOL GENERATOR FIRE SUPPRESSION SYSTEMS RANGE CONSISTS OF M2SAG AND M2SAG-M MODELS.

This manual is intended for use with Muster® M2SAG & M2SAG-M Fire Suppression Systems otherwise known as Solid Aerosol Generator (SAG or SAG-M) Systems. The system is designed as a total flooding, pre-engineered system for normally unoccupied areas on mobile or fixed plant equipment and to meet the requirements of the Codes of Practice for the Safety of Small Commercial Motor or Sailing Vessels of up to 24 metres Load Line length, The Code of Practice for the Safety of Small Work boats and Pilot Boats, The Code of Practice for Police Boats and The Fishing Vessels (Safety Provisions) Rules 1975 for Craft or Vessels less than 24.4 metres Registered Length.

Muster® M2SAG & M2SAG-M Systems for total flooding applications shall comply with the requirements of the following Standards where applicable:

- AS/NZS 4487:2013  Australia/New Zealand Standard Muster® Fire Suppressing Systems
- AS5062-2016  Fire Protection for Mobile & Transportable Equipment
- NFPA 2010  Standard for Fixed Aerosol Fire Suppressing Systems
- CEN/TC 191  Fixed firefighting systems – Condensed aerosol suppressing systems – Part 1: Requirements and test methods for components (WI00191148)
- CEN/TC 191  Fixed firefighting systems – Condensed aerosol suppressing systems – Part 2: Design, Installation and Maintenance (WI00191149)

Those who design, operate, own and maintain these systems should read the entire manual. Specific sections would be of particular interest depending on one’s responsibility. If there should be any questions regarding this manual, please contact our representatives from a JSG office, or contact the nearest Muster® M2SAG & M2SAG-M Authorised Distributor.

Where required, persons who install and commission Muster® M2SAG & M2SAG-M systems must be trained and certified by JSG Industrial Systems. Marine System Design Approval Certificates must be completed and sent to a JSG office for endorsement prior to supply and installation of a Muster® M2SAG & M2SAG-M Fire Suppression System where applicable to MARINE vessels.

Approved companies may also be required to supply details to the Marine Approval Authority prior to each installation and provide a Commissioning Certificate upon completion of the installation in the specified risk areas.

The Muster® M2SAG & M2SAG-M Fire Suppression System requires minimal maintenance, mainly supervision of electrical circuitry, however the system should be inspected at regular intervals to provide maximum assurance that your fire suppression system will operate effectively and safely. Inspection and maintenance should be conducted in accordance with the inspection and maintenance schedule included in this manual.

This manual is limited for use with Muster® M2SAG & M2SAG-M Fire Suppression Systems and within the requirements and limitations detailed within this manual. These units may also be combined with other Muster® Fire Suppression System components & suppressing agents to provide the best suited fire protection for any piece of equipment.
M2SAG & M2SAG-M FIRE SUPPRESSION SYSTEM

SECTION 1 — GENERAL
The following definitions apply to this document:

**Actuating mechanism:** Automatic or manual activation leading to the physical discharge of the suppressing agent.

**Aerosol:** An suppressing agent consisting of finely divided solid particles and gaseous matter, these being combustion products of solid aerosol-forming composition.

**Aerosol generator:** Same as MusterII M2SAG & M2SAG-M units.

**Aggressive environment:** Where environmental variables such as temperature and/or vibration undergo cycling at or close to the extreme limits of the MusterII M2SAG & M2SAG-M units. Corrosive atmosphere may also be a factor.

**Appropriate authority:** A Minister of the Crown, a government department, or other public authority having power to issue regulations, order or other instructions having the force of law in respect of any subject covered by a British Marine Standard, Australian Standard or, in the case where none of these apply, the owner or the owner’s agent.

**Approved and approval:** Approved by, or the approval of, the appropriate & relevant authority.

**Automatic:** Performing a function without the necessity of human intervention.

**Automatic/Manual Switch:** A device that can be operated before a person enters a space protected by MusterII fire suppression system to prevent automatic release of fire suppressing aerosol. Normal detection sequence is unaffected.

**Class A fires (Australian Classification):** Fire involving solid materials, usually of organic nature but also rubber or plastic. Can be further categorised into surface burning fires and deep-seated fires. Deep-seated fires smoulder and may combust slowly beneath the surface of the hazard.

**Class B fires (Australian Classification):** Fires involving flammable liquids or liquefiable solids.

**Class C fires (Australian Classification):** Fires involving flammable gases.

**Class E fires (Australian Classification):** Fires involving electrically energised equipment.

**Combustion reaction:** A reaction resulting from the ignition of a solid aerosol-forming composition, which produces fire suppressing aerosol.

**Control device:** A device to control the sequence of events leading to the release of the suppressing agent.

**Coolant:** A heat absorbing medium.

**Design concentration (g/m³):** The mass of MusterII aerosol per m³ of enclosure volume required to suppress a specific type of fire, including a safety factor.

**Design Factor (g/m³):** The mass of MusterII aerosol-forming composition per m³ of enclosure volume required to achieve the design concentration.

**Design quantity:** The mass of MusterII aerosol-forming composition necessary to suppress a fire in a particular risk, including a safety factor.

**Suppressing agent:** Aerosol produced from MusterII M2SAG & M2SAG-M units.

**Generator:** Same as MusterII M2SAG & M2SAG-M units.

**G.W.P:** Global Warning Potential.

**Holding time:** The period during which the suppressing agent is required to maintain a minimum effective concentration.

**Hot Work:** Grinding, welding, thermal or oxygen cutting or heating and other related heat-producing or spark-producing operations.
**Inerting:** The prevention of ignition of a flammable or explosive atmosphere by establishing a suitable concentration of suppressing agent.

**Location drawing:** A plan of the risk clearly indicating the as-installed location of all Muster® M2SAG & M2SAG-M units, controls and maintenance isolate switch.

**Manual:** Requiring human intervention to accomplish a function.

**Monitoring:** The supervision of the operating integrity of an electrical control feature of a system.

**Normally occupied area:** An area where, under normal circumstances, humans are present.

**Normally unoccupied area:** An area that is not occupied by humans under normal circumstances but may be entered occasionally for brief periods.

**Unoccupiable area:** An area that is not occupied by humans under any circumstances.

**O.D.P:** Ozone Depleting Potential.

**Operating device:** Any component involved between actuation and release.

**Primary release:** Release of suppressing agent initiated by detection system or manual operation under normal conditions.

**Muster® generator:** A device capable of generating the Muster® aerosol suppressing agent when activated either electrically or thermally. Consists of an electrical and/or thermal activation device, solid aerosol forming element and coolant element enclosed within a corrosion-resistant casing incorporating an end-plate nozzle.

**Release:** The action leading to the physical discharge or emission of the suppressing agent into the enclosure.

**Shall:** Indicates that a statement is mandatory.

**Should:** Indicates a recommendation.

**Smouldering:** Slow combustion of material without visible light and generally evidenced by smoke and an increase in temperature.

**Solid aerosol-forming composition:** A mixture of combustible component, potassium salt based oxidant and technical admixtures producing fire-suppressing aerosol upon ignition.

**System isolate switch:** See Automatic/Manual switch.

**Thermal activation device:** A device, which automatically activates at a rated temperature or when exposed to a naked flame and is arranged to activate the solid aerosol forming element.

**Total flooding system:** A fixed fire suppression system, which distributes the suppressing medium throughout the protected enclosure.
MUSTER® SOLID AEROSOL GENERATOR: PRODUCT DESCRIPTION

THE MUSTER® SOLID AEROSOL GENERATOR FIRE SUPPRESSION SYSTEMS RANGE CONSISTS OF M2SAG AND M2SAG-M MODELS.

Muster® M2SAG & M2SAG-M canisters are a self-generating Aerosol Fire Suppressing device intended to be used in conjunction with other Muster® monitoring & activation components.

The principle of suppressing action employed by Muster® M2SAG & M2SAG-M units is unique - a special solid chemical, when electrically or thermally activated, produces combustion products - micron sized dry chemical particles and gases. Dry chemical particles - mainly potassium carbonates, and gases - mainly carbon dioxide, nitrogen and water vapour, mix together into uniform aerosol, which represents an actual suppressing medium.

Before being released into a protected area, the aerosol propels itself through a solid chemical element, which decomposes absorbing heat, thus ensuring a low temperature discharge and uniform distribution of the aerosol within the area.

As aerosol is self-generated it requires no pressure cylinders and does not need to be stored. The aerosol generating chemical reaction in itself provides a sufficient propellant force to ensure rapid discharge and efficient distribution of the aerosol. No piping is required.

The solid aerosol-generating element, together with the solid chemical element and activation components are contained in a small non-pressurised canister available in single end plate delivery nozzle. The canisters are called Muster® M2SAG & M2SAG-M generators and vary in size depending on the mass of solid aerosol-generating element contained in the generator.

Muster® M2SAG & M2SAG-M canisters are very compact and normally placed inside the protected enclosure.

Operation of the Solid Aerosol Generator is either electronic automatic, electronic manual or thermal automatic. When an electric current/impulse is applied to the electric activation device, the solid aerosol-generating element undergoes a chemical reaction of combustion to produce an aerosol suppressing agent. The aerosol propels itself through the chemical element and out of the delivery nozzle into the protected area.

Muster® Aerosol is a whitish gas-like medium that is close in density to air. Small particle size ensures three-dimensional distribution qualities and long suspension times. The aerosol is non-conductive and non-corrosive. As Muster® Aerosol stays in suspension for extended periods, it can be removed from the protected area by any airflow. Solid fraction of the aerosol that has settled can easily be brushed, blown or washed away.

The Musterm® M2SAG & M2SAG-M Series units are designed to be installed separately or in conjunction with other Muster® Fire Suppression Systems & components, as an individual system or as stand-alone devices. When configured for electrical activation, the combined Muster® Alarm Panel & Muster® Solid Aerosol Generator Integration Module are capable of activating one or several generators simultaneously. When used in conjunction with other Muster® components, reference & instruction from the relevant Muster® Technical Manual must be observed.

The supplied equipment of a Muster® M2SAG & M2SAG-M Series canisters include mounting brackets & all necessary fasteners to connect & attach the Solid Aerosol Generator. A weather & vibration resistant electrical connector with a plug & cabling is available with all Muster® M2SAG & M2SAG-M devices.

The Muster® M2SAG-M Series canisters can be used in a wide variety of applications.

**The Muster® SAG units are suited only to fixed building & low vibration plant applications.
**The Muster® SAG-M units are suited for BOTH fixed and mobile equipment applications, being more robust in design to withstand harsher operating environments. They are suitable for use in mining, military, machinery, marine or tropical environments, as evidenced by results of its testing for resistance to vibration, salt-spray corrosion & moisture ingress.

**It should be noted that accidental & deliberate releases of Muster® Aerosol does not contribute to global atmospheric warming or ozone depletion.
Muster™ Aerosol is an exceptional fire suppressant. Its suppressing action is achieved primarily by interfering chemically with the fire reaction or otherwise known as the “Chain Reaction” element of the fire tetrahedron. Two chemical mechanisms can be underlined:

1. **Removal of fire propagation radicals** - “chain carriers” OH, H and O from the fire zone:

   The main component of Muster™ Aerosol - potassium carbonates which are formed in the gas phase. In the flame zone they dissociate producing potassium radicals. Potassium radicals are very active and react with so called “chain carriers” which are active radicals responsible for supporting of a fire combustion reaction - removing them from the flame zone causes disruption to the fire reaction. The chemical action of potassium radicals in Muster™ Aerosol is similar to that of bromine radicals in Halons.

2. **Recombination of fire propagation radicals** - “chain carriers” OH, H and O on aerosol particles surface:

   Gaseous potassium carbonates condense to a liquid and then a solid form producing a large number of micron sized particles. Being so small, the particles produce a large surface area, where recombination of “chain carriers” takes place.

The Muster™ Aerosol suppressing action is achieved by lowering fire temperature to a temperature below which the fire reaction cannot continue (thermal cooling). Several physical mechanisms can be underlined:

1. **Heat absorption** (endothermic) phase changes.

2. **Heat absorption** (endothermic) decomposition reaction.

3. **Dilution of the fire combustion zone by the aerosol cloud** (additional fuel molecules cannot participate in the combustion process); physical hindrance to flame propagation (aerosol particles slow down velocity of a flame front propagation).

   The extremely high surface area of the micron-size aerosol particles increase the likelihood of radical recombination and heat absorbing reactions, thus ensuring rapid extinguishment with a small amount of agent.

**Muster™ Aerosol is one of the lowest suppressing concentration known among commercially available agents** - flammable liquids (class B fires) are extinguished at the design factor of 100 g/m³ compared to 330 g/m³ for Halon 1301. Due to the high rate of aerosol discharge ensures a tremendous knockdown effect.

**Micron sized aerosol particles exhibit gas-like three-dimensional qualities** that allow the agent to rapidly distribute throughout enclosure and reach the most concealed and shielded locations. Homogeneous distribution is achieved in a matter of seconds, while long holding times all help to prevent fire re-ignition.

Muster™ Aerosol is suitable for the protection of a variety of potential fire hazards, including those involving flammable liquids, combustible solids, oils and energised electrical equipment.

Like all total-flooding agents, **Muster™ Aerosol is most effective when used in an enclosed risk area.**
MUSTER® SOLID AEROSOL GENERATOR: APPLICATIONS

Muster® may be used as a total flooding fire suppressant for unoccupiable and normally unoccupied areas to fight fires of classes A, B, C and E.

For class C fires consideration should be given to the use of vapour detection, explosion venting or explosion suppression systems where an explosion potential may exist, owing to the possible presence of gaseous, volatile or atomised fuels either before or following a fire. It may be dangerous, under certain conditions to extinguish a burning jet of flammable gases without first shutting off its supply.

The design factor required to suppress normal fires involving flammable gases and liquids at atmospheric pressure shall apply if it can be shown that a potentially explosive atmosphere cannot exist in the enclosure either before or as a result of the fire.

The minimum design factor for Classes C and E fire hazards shall be determined by test as part of a listing program.

An unoccupied area is an area that is not occupied by humans under any conditions.

A normally unoccupied area is an area that is not occupied by humans under normal circumstances but may be entered occasionally for brief periods.

Total Flooding Applications

Muster® Solid Aerosol Generators may be used where the hazard is within an enclosure that will permit the establishment of the required concentration and the maintenance of that concentration for the required period, for M2SAG & M2SAG-M, for:

- Transport: engine compartments.
- Marine: enclosed flammable liquid storage, storage tanks & processing areas.
- Industrial: enclosures such as rooms, garages, control rooms, engine rooms, vaults.
- Equipment: enclosed machines, data processing equipment, and mining equipment.
- Electrical: enclosed electrical hazards such as power stations, transformers, control cubicles, electrical cabinets, switchboards, circuit breakers & rotating equipment.

Non Enclosed and Local Applications

Where a fire hazard requires a local application, due to the protected area being an open space or one with high leakage rates, special application and engineering of the Muster® Solid Aerosol Generator product will be required. In these instances the Technical Department for Muster® Systems should be contacted.

Limitations of Use:

General Limitations

Muster® Solid Aerosol Generator systems are not suitable for fires involving the following:

- Certain chemicals or mixtures of chemicals such as cellulose nitrate and gunpowder, which are capable of rapid oxidation in the absence of air.
- Reactive metals such as sodium, potassium, magnesium, titanium, zirconium, uranium, and plutonium.
- Metal hydrides or metal amides.
- Chemicals capable of undergoing auto-thermal decomposition such as certain organic peroxides and hydrazine.
- Pyrophoric materials such as white phosphorous or metal-organic compounds.
- Oxidising agents such as nitric oxides and fluorine.

Limitations on Temperature of Discharge
- Temperature at the specified minimum clearance from the nozzle shall not exceed 75°C for locations where people may be present;
- Temperature at the specified minimum clearance from the nozzle shall not exceed 200°C for locations containing combustible materials.
- Temperature at the specified minimum clearance from the nozzle shall not exceed 400°C for locations containing non-combustible materials.

For other limitations please refer to Section 4.

Non Enclosed and Local Applications
Where a fire hazard requires a local application, due to the protected area being an open space or one with high leakage rates, special application and engineering of the Muster® product will be required. In these instances the local main JSG office should be contacted.

As part of the design process consideration MUST also be given to the following circumstances:

1. In the event of fire due to electrical hazards, power to the electrical machinery/equipment must be cut-off prior or simultaneously to operation of the fire protection system for effective suppression of fire.

2. An unoccupied area is an area that is not occupied by humans under any conditions.

3. A normally unoccupied area is an area that is not occupied by humans under normal circumstances but may be entered occasionally for brief periods. These application must utilise suitable warning label devices as a result of thorough risk assessment.

4. For class C fires consideration should be given to the use of vapour detection, explosion venting or explosion suppression systems where an explosion potential may exist, owing to the possible presence of gaseous, volatile or atomised fuels either before or following a fire. It may be dangerous, under certain conditions to extinguish a burning jet of flammable gases without first shutting off its supply.

The design factor required to suppress normal fires involving flammable gases and liquids at atmospheric pressure shall apply if it can be shown that a potentially explosive atmosphere cannot exist in the enclosure either before or as a result of the fire.

The minimum design factor for Classes C and E fire hazards shall be determined by test as part of a listing program.
M2SAG & M2SAG-M FIRE SUPPRESSION SYSTEM

SECTION 2 – SOLID AEROSOL GENERATOR PRODUCTS
The Muster® Fire Suppression System comes complete with M2SAG & M2SAG-M generators of a specified size/s, an electrical connector, mounting brackets, bracket supports, bolts and nuts. Accessories & add-on products are available to complement the system & make it easier to assemble the complete system.

Muster® M2SAG & M2SAG-M generators are mostly of Stainless Steel construction & finish while larger M2SAG units are mild steel construction with powder coat finish. Generator’s mounting brackets are manufactured from mild steel and powder coated red. The M2SAG-Z3, M2SAG-Z6, M2SAG-1 / M2SAG-M-1, M2SAG-2 / M2SAG-M-2 and M2SAG-5 / M2SAG-M-5 generators are supplied with bracket sets for normal use, while the larger M2SAG-M-10 generators are supplied with two brackets.

Generators M2SAG-10, M2SAG-20, M2SAG-30 & M2SAG-50 come without brackets as they have mounting clamps welded to their casings.
MUSTERII SOLID AEROSOL GENERATOR: PERFORMANCE CHARACTERISTICS

Muster® Solid Aerosol Generators come in a range of small, non-pressurised canisters available in single end plate delivery nozzle. The devices are called Muster® M2SAG & Muster® M2SAG-M canisters and vary in size depending on the mass of solid aerosol-generating chemical contained in the canister. The Muster® M2SAG-M Series have been specially developed for Mobile industries (Marine, Mining, Military and Machinery) and feature extended application temperature range (up to 85°C), resistance to high humidity and vibration levels and “heavy-duty” execution. Technical parameters of the current range of M2SAG & M2SAG-M generators are as follows:

Muster® Range for M2SAG Series

<table>
<thead>
<tr>
<th>Parameter</th>
<th>M2SAG-Z3</th>
<th>M2SAG-Z6</th>
<th>M2SAG-1</th>
<th>M2SAG-2</th>
<th>M2SAG-5</th>
<th>M2SAG-10</th>
<th>M2SAG-20</th>
<th>M2SAG-30</th>
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<tr>
<td>Mass of generator, grams</td>
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<td>650</td>
<td>940</td>
<td>1700</td>
<td>3100</td>
<td>9000</td>
<td>11500</td>
<td>23500</td>
<td>27500</td>
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<tr>
<td>Mass of aerosol-forming element, grams</td>
<td>30</td>
<td>60</td>
<td>100</td>
<td>200</td>
<td>500</td>
<td>1000</td>
<td>2000</td>
<td>3000</td>
<td>5000</td>
</tr>
<tr>
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<td>0.6</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>10</td>
<td>20</td>
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<tr>
<td>Outlet direction</td>
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<td>End</td>
<td>End</td>
<td>End</td>
<td>End</td>
<td>End</td>
<td>End</td>
<td>End</td>
<td>End</td>
</tr>
<tr>
<td>Length of generator, B (mm)</td>
<td>101</td>
<td>121</td>
<td>122</td>
<td>200</td>
<td>215</td>
<td>200</td>
<td>254</td>
<td>342</td>
<td>415</td>
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<tr>
<td>Diameter of generator, A (mm)</td>
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<td>51</td>
<td>64</td>
<td>76.2</td>
<td>89</td>
<td>220</td>
<td>220</td>
<td>310</td>
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<td>Discharge time, sec (Based on design factor of 100 g/m³)</td>
<td>&lt;20.0</td>
<td>&lt;25.0</td>
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<td>Minimum Nozzle Clearance mm</td>
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<td>400</td>
<td>700</td>
<td>700</td>
<td>1000</td>
<td>1500</td>
<td>1700</td>
<td>2000</td>
</tr>
<tr>
<td>Temperature range</td>
<td>-50°C to +85°C</td>
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<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Muster® Range for M2SAG-M Series

Muster® M2SAG-M series have been specially developed for Mobile industries (Marine, Mining, Military and Machinery) and feature extended application temperature range (up to 85°C), resistance to high humidity and vibration levels and “heavy-duty” execution. Technical parameters of the current range of M2SAG-M generators are as follows:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>M2SAG-M-1</th>
<th>M2SAG-M-2</th>
<th>M2SAG-M-5</th>
<th>M2SAG-M-10</th>
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<td>Mass of generator, grams</td>
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<td>1200</td>
<td>4700</td>
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<tr>
<td>Mass of aerosol-forming element, grams</td>
<td>100</td>
<td>200</td>
<td>500</td>
<td>1000</td>
</tr>
<tr>
<td>Max protected volume m³</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>10</td>
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<tr>
<td>Outlet direction</td>
<td>End</td>
<td>End</td>
<td>End</td>
<td>End</td>
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<td>Length of generator, B (mm)</td>
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<td>250</td>
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<td>Diameter of generator, A (mm)</td>
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<td>75</td>
<td>113</td>
<td>113</td>
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<td>Discharge time, sec (Based on design factor of 100 g/m³)</td>
<td>&lt;15.0</td>
<td>&lt;15.0</td>
<td>&lt;15.0</td>
<td>&lt;20.0</td>
</tr>
<tr>
<td>Minimum Nozzle Clearance mm</td>
<td>400</td>
<td>700</td>
<td>700</td>
<td>1000</td>
</tr>
<tr>
<td>Temperature range</td>
<td>-50°C to +85°C</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MUSTER™ SOLID AEROSOL GENERATOR: CHEMICAL IDENTITY

The secret to Muster™ Aerosol’s power is in two unique formulations contained in the canister - the solid aerosol-generating element and the solid chemical element.

The solid aerosol-generating element is a thermoplastic mixture consisting of an oxidiser, a combustible binder and technological additives. The oxidiser is a solid potassium nitrate (KNO₃(s)), the combustible binder is an organic polymer (CₙHₘNₚOₜ(s)) and technological additives include the activator of the oxidiser’s decomposition, chemical and mechanical stabilisers and some other ingredients.

When ignited the solid-generating chemical undergoes a combustion reaction, which can schematically be represented as follows:

$$\text{KNO}_3(s) + \text{C}_n\text{H}_m\text{N}_p\text{O}_q(s) = \text{KHCO}_3(s) + \text{K}_2\text{CO}_3(s) + \text{CO}_2(g) + \text{N}_2(g) + \text{H}_2\text{O}(g)$$

Combustion products consist of potassium carbonates (KHCO₃, K₂CO₃), carbon dioxide gas (CO₂(g)), nitrogen gas (N₂(g)) and water vapour (H₂O(g)) and represent the actual suppressing agent.

As the reaction temperatures are high, potassium carbonates are formed in the gas phase, but as the vapour cools, the potassium carbonates condense to a liquid and then a solid. As solid potassium carbonates are produced by condensation, the particle size is very small - approximately from 1 to 10 microns. Micron sized solid particles mix with the gaseous carbon dioxide, nitrogen and water into a uniform homogeneous gas-like phase - an aerosol.

Thus, Muster™ Aerosol is a suspension of the micron sized solid particles, mainly potassium carbonates, in the gas mix of carbon dioxide, nitrogen and water vapour.

Being a combustion product of the aerosol-generating chemical, Muster™ aerosol is hot upon formation. Although, Muster™ Aerosol is most effective in terms of the actual fire extinguishment when in it’s hottest state, the negative impacts of very high temperatures are obvious.

That is where a second unique formulation - the natural coolant - comes into action.

When the hot Muster™ Aerosol passes through the cooling element, the coolant decomposes absorbing heat.

Muster™ M2SAG & M2SAG-M contain a cooling element of a special composition highly impregnated with endothermic ingredients - substances that decompose at 200-300°C without melting generating gases and absorbing approximately 400 Cal of heat per one kilogram of their mass.

Application of the Muster™ M2SAG & M2SAG-M cooling element provides uniform distribution of the aerosol within the area, which certainly contributes to the reliability and safety of the extinguishment. Moreover, additional amounts of inert gases are formed due to a thermal decomposition of the coolant, which contribute to the effectiveness of the extinguishment.
MUSTER II SOLID AEROSOL GENERATOR: TECHNICAL CHARACTERISTICS

Chemical Composition of Solid Aerosol-Generating Chemical

Chemical Composition of Aerosol

Minimum System Design Factor

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class B and surface class A fires:</td>
<td>100 g/m³</td>
</tr>
<tr>
<td>Dense cable fires:</td>
<td>100 g/m³</td>
</tr>
<tr>
<td>Min Particle Size:</td>
<td>1 micron</td>
</tr>
<tr>
<td>Min/Max Suspension of Aerosol:</td>
<td>30 / 60 min</td>
</tr>
<tr>
<td>ODP:</td>
<td>0</td>
</tr>
<tr>
<td>GWP:</td>
<td>0</td>
</tr>
<tr>
<td>Obscuration:</td>
<td>high</td>
</tr>
<tr>
<td>Toxicity:</td>
<td>low</td>
</tr>
<tr>
<td>Temperature range of application:</td>
<td>from -50°C to + 65°C (M2SAG)</td>
</tr>
<tr>
<td>Humidity range of application:</td>
<td>0-98 %, non-condensing</td>
</tr>
<tr>
<td>Electric ignition:</td>
<td>Nominal resistance 0.6 – 5.0 Ohms</td>
</tr>
<tr>
<td></td>
<td>Activation current 400 milliamps</td>
</tr>
<tr>
<td></td>
<td>Maximum test current &lt; 50 milliamps / 5 min</td>
</tr>
<tr>
<td></td>
<td>Supervisory current less than 5 milliamps</td>
</tr>
<tr>
<td></td>
<td>Actuation time 2 milliseconds</td>
</tr>
<tr>
<td>Dangerous Goods Classification</td>
<td>4.1 class, category C</td>
</tr>
<tr>
<td>Service Life</td>
<td>7 - 10 years</td>
</tr>
</tbody>
</table>
The Muster® generators have been designed to operate in a wide range of temperature and humidity conditions.

Operating temperature range for M2SAG generators is from -50°C to + 65°C.

Operating temperature range for M2SAG-M generators is from -50°C to + 85°C.

Operating humidity range is up to 98 % humidity.

The following Muster® SAG accessories are optional and designed to complete Muster® SAG System Supply for specific installations, where other components besides those supplied by the Muster® range may be required:

- T-start device - Designed for an automatic thermal detection of fire and subsequent automatic operation of Muster® generators. T-start does not require any external power supply;
- Directional Nozzles - Designed to constrict and direct the original aerosol flow in a specified application;
- Fire Rated Cable - Shall be used in Muster® electrical wiring to prevent shorting of circuitry in an event of fire as well as accidental discharge due to an induction or electromagnetic interference;
- Muster® Signs - Designed for normally unoccupied areas.

The following signs are available:

- Label displayed at the entrance to the enclosure;
- Instruction Label displayed inside the enclosure;
- System Isolate Switch Label;
- Instruction Label displayed at manual release point.

For more information on Warning and Instruction signs, please refer to page 38.
**MUSTER® ALARM PANEL**

When used with M2SAG & M2SAG-M units the Muster® Alarm Panel must be configured for use with MusterWire only via the Muster® SAG Integration Module (M2SAGIM01). The M2AP01 Alarm Panel is an advanced control system for the monitoring, control and activation of Muster® fire systems. Used in conjunction with the various Muster® transducers, actuators, integration devices and detectors providing a flexible and complete solution to fire protection.

*Note: When used with M2SAG & M2SAG-M units the LOP/LHD switch must be in the LHD position.*

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2APK01</td>
<td>Alarm kit</td>
<td>Alarm Panel kit consists of; Alarm Panel (with 1m cable and external data port), battery pack, 10m of 2 core silicone cable, Electronic and LOP actuation tags, 2mm stainless steel bracket with bolts, 10 cable splices, 4 heat shrinks and installation manual</td>
</tr>
<tr>
<td>M2AP01</td>
<td>Alarm only</td>
<td>Includes Alarm Panel and battery only</td>
</tr>
<tr>
<td>M2BP01</td>
<td>Battery pack</td>
<td>Long life non-recharging Lithium Manganese Dioxide</td>
</tr>
<tr>
<td>M2AP01</td>
<td>Fuse pack</td>
<td>2 Amp x 10 unit</td>
</tr>
</tbody>
</table>

- Ingress Protection: IP66
- Battery: 15 V 1.5Ah Lithium Manganese Dioxide with internal fuse
- Battery Life: Min. 2 years + 6 months warning
- Operating Temperature: -40°C to + 70°C
- Dimensions: Ø97mm depth 57mm (housing only)
- Cable: 1.1m 10 core x 0.75mm
- Buzzer: 98dB @ 1m in free air
- Outputs: 3 x relay contacts @ 30 V 1 Amp max.
- Detection Input: Max. 50m LHD wire with 4.7k EOL resistor
- Activation Output: 12 V 1 Amp
- Fuse: 5 internal fuses – LittleFuse Nano2A
- Response Time: Max. 1 sec
- Circuit Integrity: Pulse every 1 sec

**WARNING**

- Do not alter or modify any part of this equipment.
- Do not attempt to repair or disassemble the equipment while the system is pressurised.
- Always use recommended protective clothing and equipment.
- Check equipment regularly and replace worn or damaged parts immediately.
- Always check equipment for proper operation before each use, making sure safety devices are in place and operating properly.
Muster® Alarm Panel: Set Up

Two banks of five DIP switches each are used to set up the operating parameters of the Alarm Panel.

**Relay Contacts**

DIP switches 1, 2 and 3 control the contact types of the SHUTDOWN (1), ALARM (2) and FAULT (3) relay outputs. The options are contacts normally open (N/O) and contacts normally closed (N/C). The factory setting is N/O as this is the most common application. However it is recommended where possible to use the N/C setting as this allows immediate indication of breaks (open circuits) in the external wiring to these circuits. The switch position is irrelevant if the associated relay is not used.

These circuits must be connected to function & run any external components via a relay to prevent excessive power draw from the Alarm Panel itself & also to protect its internal circuitry.

**LOP/LHD (MusterWire)**

Dip switch 4 (LOP/LHD) controls the type of fire detection system being installed. For M2SAG & M2SAG-M systems the “LHD” position MUST be selected.

**Isolated/Active**

Dip switch 5 (ACTIVE/ISOLATED) is used to ISOLATE the Alarm Panel. With ISOLATED selected mode the Alarm Panel releases any relay outputs and will not go into FIRE mode or discharge the system. When changing from ISOLATED to ACTIVE mode any fire that is detected within the first 4 seconds will be treated as a fault and not a fire. Furthermore, in ISOLATED mode the pressure, fault and fire indicator lights on the Alarm Panel will reflect the status of those circuits thus allowing a technician to safely fault-find without any risk of the system being discharged. This setting is disabled for LOP systems.
Shutdown Delay

Dip switches 1, 2 and 3 are used to select the SHUTDOWN delay between detection of a fire and the activation of the Shutdown Circuit. The times indicated on the individual switches are added together giving a total of 8 possible settings from 0 to 36 seconds in 6 second steps.

*In order to accommodate a request for a 20 second option the 42 second setting has been internally programmed to 20 seconds.*

<table>
<thead>
<tr>
<th>SWITCH 1</th>
<th>SWITCH 2</th>
<th>SWITCH 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 secs</td>
<td>Right</td>
<td>Left</td>
</tr>
<tr>
<td>12 secs</td>
<td>Left</td>
<td>Right</td>
</tr>
<tr>
<td>18 secs</td>
<td>Right</td>
<td>Right</td>
</tr>
<tr>
<td>20 secs</td>
<td>Right</td>
<td>Right</td>
</tr>
<tr>
<td>24 secs</td>
<td>Left</td>
<td>Left</td>
</tr>
<tr>
<td>30 secs</td>
<td>Right</td>
<td>Left</td>
</tr>
<tr>
<td>36 secs</td>
<td>Left</td>
<td>Right</td>
</tr>
</tbody>
</table>

System Functions

Switched F1 & F2 offer extended function for the Alarm Panel. The available switch positions in various combination will cause the Alarm Panel to behave in a specific manner

Dip switch 4 (F1) must be ON to enable individual function of any pressurised system, Dip switch 5 OFF.

Dip switch 5 (F2) must be ON to enable individual function of the SAG/SAG-M system, Dip switch 4 OFF.

Dip switch 4 & 5 ON to enable function for combined SAG/SAG-M & pressurised system.

Dip switch 4 & 5 OFF cause panel to function as ALARM only on detection.
Muster® Alarm Panel: Tamper Evident Seal

There are two seal kits supplied with each Alarm Panel, an LOP blanking seal and a FIRE tamper seal.

The FIRE tamper must ONLY be used for M2SAG & M2SAG-M systems to ensure the system can be manually activated via the Alarm Panel.

Note: The LOP blanking seal shall NOT be used with M2SAG & M2SAG-M systems.

In MusterWire LHD installations the FIRE tamper seal is used to discourage tampering with the manual activation button. Place the metal toggle over the FIRE button and secure with the FIRE tamper seal. Any attempt to remove the seal causes it to de-laminate as evidence that it has been tampered with. In high traffic areas insert toggle facing downwards to avoid it being accidentally dislodged.

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2AT01</td>
<td>Actuation tag, MusterWire</td>
<td>LHD configuration</td>
</tr>
</tbody>
</table>

Face Panel Removed

Face Panel and Main Circuit Board Removed

Tamper Evident Seal Location

MusterWire Tag

LOP Tag
(Discard for SAG Systems)
Muster® Alarm Panel: Wiring

Wiring of the Muster fire detection system and associated peripherals is simple with a maximum of five circuits, each requiring only a single pair of wires. Wires from the Alarm Panel are pre-paired, colour coded and marked. Only the pressure transducer / integration module circuit is polarised, the remaining four circuits having no polarity. Wiring for all circuits is done with the two core silicone cable provided and joints are made with the two way splice kits supplied. The splice kits are IP67 rated, however it is important that exposed splices are protected with the red glue-lined heat shrink supplied.

**WARNING**

- Care must be taken when using the heat shrink over the MusterWire LHD as excessive heat could activate the wire. Apply heat only to the heat shrink and not directly to the wire and only use a suitable heat gun. Do not use a lighter or flame.
- Use of proper safety wear and tools is highly recommended to help prevent injury to self and damage to the equipment.

SAG Integration Module: (Used individually or combined with Pressure Transducer Circuit).

This circuit connects the Alarm Panel to the M2SAGIM01 Integration Module to both M2SAG & M2SAG-M devices and to the M2VA31 electronic cylinder valve assemblies for MusterWire LHD systems. In MusterWire LHD installations this circuit performs multiple functions from for monitoring pressure where used in combination with a pressurised cylinder of other suppressing agent and activating the release solenoid as well as the integrity of M2SAG & M2SAG-M units. This circuit is polarity sensitive. Use the two core silicone cable with blue and brown cores as provided to assist in maintaining the correct polarity when wiring. Note that should this circuit be wired reverse polarity no damage will be done and the Alarm Panel will indicate a SYSTEM FAULT LED indicator.

**BROWN = (+) VE Positive**

**BLUE = (-) VE Negative**

MusterWire Detector and Manual LHD Activation Circuit:

This circuit connects the Alarm Panel to the MusterWire LHD (Linear Heat Detector wire) and to any manual actuation stations required. All devices must be wired in series, with a resistor plug M2RP01 used to terminate the very end of the line. If the resistor plug M2RP01 termination is not present or if the circuit is broken at any point (open circuit) the Alarm Panel will indicate a SYSTEM FAULT via the LED indicator. The MusterWire LHD and the Manual Remote Actuators can be wired in any order and any number of Manual Remote Actuators can be used though a maximum of 50m of actuation and detection cabling is permitted.

**WHITE & GREEN No polarity**
Alarm and Fault Relay Circuits:

*Note: For MARINE & NORMALLY UNOCCUPIED applications of M2SAG & M2SAG-M systems these output circuits must be used to power external warning devices. Both circuits are optional for applications other than MARINE.*

These circuits connect to isolated, voltage-free relay contacts inside the Alarm Panel. The relays can be set to Normally Open or Normally Closed (see SETUP). These circuits are available for connection to external warning devices such as strobe lights, sounders & evacuation devices to provide signalling to nearby equipment or personnel in event of a required area evacuation, fire activation or a system fault. These circuits must be limited to a maximum of 1 amp and power for these functions must be supplied from another source on the machine via a suitable relay. The Alarm Relay (Purple and Grey wires) is used to signal the system is activated (Fire). The Fault Relay (Black and Yellow wires) is used to signal the system is in fault or evacuation of the area is required.

---

**Shutdown Relay Circuit:**

This circuit connects to voltage free relay terminals inside the Alarm Panel. This relay is energised after the required delay following detection of a fire & subsequent system activation and can be used in conjunction with a suitable contactor to shut down the machine or vehicle. This circuit can be set to Normally Open or Normally Closed (see SETUP).

---

**Fuses**

There are five fuses located on the mezzanine board in the base of the Alarm Panel. These fuses are all rated 2 Amps and serve to protect the Alarm Panel from incorrect wiring or overloading of the relay circuits. It is advisable to test all circuits connected to the relays after installation to ensure they are correctly wired and do not exceed the ratings of the contacts or fuses. The relay circuits are not monitored for faults.

- **F1 (ALARM):** ALARM RELAY FUSE
- **F2 (FAULT):** FAULT RELAY FUSE
- **F3 (BATTERY):** BATTERY PROTECTION FUSE
- **F4 (VALVE):** PRESSURE TRANSUDER & ACTIVATION CIRCUIT FUSE
- **F5 (SHUTDOWN):** SHUTDOWN RELAY FUSE (ALL FUSES 2 AMP FAST BLOW)

---

**Fuse Pack of 10 – M2FP01**
Muster® Alarm Panel: Functions

Battery
This Alarm Panel operates independently of any external power supply and uses an advanced non-rechargeable lithium battery pack to drive all functions including energizing the release solenoids. The pack has built-in circuitry that allows it to accurately keep track of its charge state and will notify the Alarm Panel that it needs replacement once 60% of its capacity has been used up. This ensures that it will always have enough capacity to handle activation even if the battery is not replaced for 6 months after notification. The Alarm Panel regularly tests the battery under a full simulated load to ensure that any premature cell failures are picked up. If both the REPLACE BATTERY indicator and the OK indicator are lit the battery MUST be replaced at the next convenient opportunity. If only the REPLACE BATTERY indicator is lit the battery is critical and MUST be replaced immediately.

Battery Life
The battery life is very much dependent on the conditions the Alarm Panel operates in. STANDBY MODE places the least load on the battery and FIRE MODE places the highest load. Battery capacity is significantly reduced in subzero temperatures. In most applications the battery should last for at least two years and in ideal conditions over 4 years. It is important to note that the battery life is dramatically reduced if fault or fire scenarios are not attended and cleared within 24hrs. If left unattended the battery can be run completely flat inside the nominated 2 year life expectancy. When the Alarm Panel gives the first battery indication signal, it will effectively support the fire system operation for a further 6 months before it MUST be replaced.

The battery incorporates a built in fuse for safety purposes. This fuse is rated at 3 Amps which is far above the requirements of the Alarm Panel so will never fuse in normal use. Care should be taken when handling the battery not to short out any of the terminals. If this fuse is blown it cannot be changed and the battery pack must be replaced.

Observe the INSTALL BY date printed on the battery as indicated below.

* Dispose of used batteries in an environmentally responsible manner or preferably return to your dealer for correct disposal.

Safety Data Sheets are available at www.musterfire.com or can be supplied by JSG on request.
Data Port
The Alarm Panel incorporates a data port on the back to accommodate extended functions. Used in conjunction with the M2DM01 Diagnostic Module the following features are available:

- **RESET PANEL** – Resets the Alarm panel from a FIRE condition without requiring the Alarm Panel to be opened.
- **ISOLATE PANEL** – Allows the system to be isolated without requiring the Alarm Panel to be opened.
- **DATA LOGGING** – This function allows a history of all events with time stamps to be downloaded.
- **FIRMWARE UPDATE** – Allows the firmware of the Alarm Panel to be updated and for special programs to be loaded to handle non-standard applications.
- **DIAGNOSTICS** – The Diagnostic Module allows advanced details on system faults and diagnosis along with detailed information on battery status, system pressure etc.
- An extension cable M2DEC01 is available for those installations where access to the back of the panel is restricted.

Operation
The Alarm Panel operates in a number of possible states depending on the conditions and settings:

- **ISOLATED MODE** – System is isolated (only available on MusterWire LHD installations)
- **STANDBY MODE** – System is functioning correctly
- **FAULT MODE** – A fault has been detected
- **FIRE MODE** – A FIRE has been detected
**Turn-On Delay**
When the face of the Alarm Panel is secured the panel will remain off for 60 seconds to allow the operator time to fully secure all the screws ensuring a reliable electrical connection. Once secured, the remaining delay can be skipped by pressing the TEST button.

**LED Indicators**
For the majority of the time the Alarm Panel is in a low power state and will only blink the appropriate indicator briefly every 3 seconds. This is essential to keep the battery life to a maximum. On detection of a fire however the appropriate LED’s will flash brightly for maximum effect.

**DIM Function**
The SHUTDOWN DELAY button serves an additional non-conflicting function of dimming the led indicators should they prove to be a nuisance in low light conditions – this dim mode is automatically exited after two hours or on request by re-pressing the button.

**Audible Buzzer**
The built in buzzer gives a brief pip every 15 seconds if there are any system faults and a loud alarm in event of a fire. At most stages the buzzer can be toggled on and off with the MUTE button. Note that the MUTE function is disabled if there is no fault or alarm and automatically resets itself on any new event. This ensures that no event can go unnoticed.

**Isolated Mode**
This mode is selected using the DIP switch located inside the lid of the Alarm Panel and is generally used to isolate the system during maintenance.

When a MusterWire LHD installation is isolated the Alarm Panel will not discharge the system on detection of a fire, nor will it activate the Alarm, Fault or Shutdown relays. It will however continuously monitor all circuits for faults or fire and the appropriate indicator will light (non-latching) enabling a technician to do fault-finding.

When exiting this mode the Alarm Panel will treat any fire detected within the first 4 seconds as a fault to avoid unintentional discharge.

**TEST FUNCTION:** Press and hold this button for 5 seconds to enter a latched relay test mode, the button can be released at this point. In this mode the three relays will be energised in the following sequence with each successive press of the test button: FAULT relay – ALARM (fire) relay – SHUTDOWN relay – FAULT relay and so on. When a relay is activated the appropriate LED (FAULT, FIRE or SHUTDOWN) will blink continuously. To exit this relay test mode press and hold the TEST button for 2 seconds. The relay test mode will automatically exit if the TEST button is not pressed for 60 seconds. This mode is useful to test the integrity of the wiring of an installation.

**Standby Mode (OK MODE)**
The OK LED indicates that all systems are functioning correctly and monitoring for fire conditions. In normal state this LED blinks once every 3 seconds.

**TEST FUNCTION:** Briefly pressing the TEST button will activate (test) the buzzer and all LEDs.
**Fire Mode**

The Alarm Panel behaves differently depending on the type of installation.

**MUTE FUNCTION:** In FIRE MODE once the Alarm Panel has completed the SHUTDOWN sequence the MUTE function can be enabled to allow the alarm to be silenced.

**Fault Mode**

The Alarm Panel is able to detect a number of faults conditions. Most fault conditions are latched and can only be cleared by pressing the TEST button. This ensures that intermittent faults do not go unnoticed. Once a fault is latched the appropriate indicator will blink and the audible alarm will give a short pip every 15 seconds and the OK indicator will be off. Should the fault clear by itself (for example an intermittent open circuit) the OK led will indicate that the Alarm Panel is now functioning correctly but the appropriate orange indicator will remain lit until cleared by pressing the TEST button. Detailed information relating to any fault is provided with use of the Muster² Diagnostic module.

**Replace Battery**

Indicates the battery is due for replacement. Note that if the OK indicator remains lit the battery still has enough charge for the Alarm Panel to function correctly but should be replaced at the first opportunity. If the OK indicator is off then the battery is critical and the Alarm Panel can no longer function correctly, the battery must be replaced immediately.

**Over/Under Pressure**

Indicates that the pressure in the system is either below 9 bar or above 16 bar. (Only applicable where other Muster² suppressant agents are in combination with M2SAG & M2SAG-M units)

**System Fault**

Indicates there is an electrical fault. On the pressure transducer circuit the Alarm Panel will detect a short or open circuit as well as incorrectly wired or faulty pressure transducers. In MusterWire LHD installations the Alarm Panel will also detect if there is a fault with the release solenoid.

When used with the Muster² Solid Aerosol Generator Integration Module, it will be detect missing or used Solid Aerosol Generators.

On the detection circuit the Alarm Panel will detect an open circuit and a missing or faulty resistor plug M2RP01. Detailed information relating to any fault is provided with use of the Muster² Diagnostic module.

**TEST FUNCTION:** Briefly pressing the TEST button will activate (test) the buzzer and all LEDs. All latched faults will be cleared and all circuits will be tested — any faults still detected will be latched and indicated. Use this button to clear any faults after they have been corrected.
Fire Mode: MusterWire LHD & SAG/SAG-M Installations

With MusterWire installations the Alarm Panel will detect a fire if any of the following conditions are met:

- Automatic activation of the MusterWire Linear Heat Detection as a result of excessive heat.
- Manual activation of a remote actuator attached to the detector circuit.
- Manual activation of the FIRE button on the Alarm Panel itself.

Once activated the Alarm Panel goes through a strict sequence of events as follows:

1. The Solid Aerosol Generator is activated immediately and remains activated for a period of 6 seconds. This triggers the release of the Muster® agent which will continue to discharge without further action from the Alarm Panel. The DISCHARGED LED will flash during the 4 seconds that the solenoid is activated.
2. The ALARM relay contacts are activated.
3. The buzzer and FIRE indicator goes into a ½ second on – ½ second off cycle.
4. a. If the SHUTDOWN delay is set to 0 seconds the SHUTDOWN relay will activate immediately, otherwise the SHUTDOWN delay timer starts to count down from its set value (see SETUP).
   b. 5 seconds before actual SHUTDOWN the buzzer and FIRE indicator change to a ¼ second on – ¼ second off cycle to indicate the impending shutdown. At any stage during the SHUTDOWN delay the operator can press the DELAY SHUTDOWN button to extend the delay by a further 6 seconds. This can be done a maximum of twice. After the SHUTDOWN delay is over the SHUTDOWN relay is energized and if this circuit is used the machine will shut down permanently. The buzzer and FIRE indicator will revert to a ½ second on – ½ second off cycle.
   c. At any stage the SHUTDOWN delay period can be extended by pressing the DELAY SHUTDOWN button to allow safe parking of a machine. Pushing this button will extend the SHUTDOWN by the preset delay period. Use of this feature is only available twice during any discharge sequence.
   d. 5 seconds after shutdown the delay button can be held down and the machine can be started and relocated. Once the button is released the machine will shutdown instantly. Repairs should be completed first before the use of this function.
5. After the 6 second activation of the release solenoid the Alarm Panel will continue to monitor the pressure in the system and the DISCHARGED led will only be lit once the pressure drops below 3 bar.

Exiting Fire Mode and Releasing the SHUTDOWN Relay

After a fire event the Alarm Panel remains in FIRE mode and the SHUTDOWN relay remains energized. The TEST button serves no purpose. To exit FIRE mode the following procedure must be followed:

- Reset any activated remote actuation stations and replace any activated lengths of MusterWire.
- Using a Hex Key, remove (for a minimum of 5 seconds) and then re-install the Alarm Panel face. Press the TEST button to skip the rest of the panel turn-on delay. This will reset the Alarm Panel and release the Shutdown relay.
**MUSTER® SOLID AEROSOL GENERATOR: INTEGRATION MODULE (M2SAGIM01)**

The Solid Aerosol Generator Integration Module (M2SAGIM01) provides connection, monitoring & activation of the M2SAG & M2SAG-M units through the Muster® Alarm Panel. The integration module allows for up to 4 individual circuits of M2SAG & M2SAG-M units to be connected, each circuit capable of supporting 2 units to give a total of up to 8 units available if required.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ingress Protection</td>
<td>IP65 - (Unused cable glands to be sealed with plugs provided)</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-20°C to +60°C</td>
</tr>
<tr>
<td>Dimensions</td>
<td>L115mm x W105mm x H35mm (including cable glands)</td>
</tr>
<tr>
<td>Outputs</td>
<td>4 channels. Current limited to 1A, –12VDC 100msec/channel</td>
</tr>
<tr>
<td>Max unit per Channel</td>
<td>2</td>
</tr>
<tr>
<td>Cable Glands</td>
<td>PG7 cable diameter max 6mm</td>
</tr>
<tr>
<td>Alarm S ware Version</td>
<td>0.0.6 or later</td>
</tr>
</tbody>
</table>

The SAG Integration Module is required to be connected to the Alarm Panel via the blue & brown pair of wires to be functional. When installed in combination with other Muster® Suppressing agents it is installed in-line of the same circuit allowing communication & monitoring through to the M2VA31 Cylinder valve. Refer Muster® AFFF Technical Manual M2TM01.

For systems configured for M2SAG or M2SAG-M only the Alarm Panel must have Switch F2 in the ON position.

For systems configured for combined M2SAG-M and other Muster® agents the alarm Panel must have both Switch F1 & F2 in the ON position.

The M2SAGIM01 comes in a kit with sufficient components available to connect up to 4 circuits including blanking plugs & resistors where less than 4 circuits are required.
NOTES:
- Maximum of two aerosol generators per channel in series.
- Seal unused glands with blanking plugs provided.
- Terminate unused channels with 100Ω 1W resistor.
- Aerosol generators are not polarity sensitive.
- M2AP01 alarm panel dip switch F2 must be on to enable the M2SAGIM01.
- M2AP01 alarm panel must be updated to software V0.0.6 or later.

EXAMPLE: CHANNEL 1 DRIVING 2 AEROSOL GENERATORS IN SERIES
EXAMPLE: CHANNEL 2 DRIVING SINGLE AEROSOL GENERATOR

MAX 2 GENERATORS PER CHANNEL WIRED IN SERIES

EXAMPLE: CHANNEL 3 & 4 UNUSED WITH RESISTORS INSERTED

TO CYLINDER PRESSURE SENSOR M2TA31 (IF REQUIRED)

CYLINDER VALVE ASSEMBLY (ONLY APPLICABLE IN COMBINED SYSTEMS)

AUXILIARY CIRCUIT (PRESSURE SENSOR CIRCUIT) FROM M2AP01 ALARM PANEL

SPECIFICATIONS
- ONLY COMPATIBLE WITH M2AP01 Muster® alarm panel.
- Outputs: 4 Channels. Current limited to 1 A, ~12VDC 100 msec/ channel
- Protection: IP65 (seal unused cable glands with plugs supplied)
- Dimensions: L115mm x W105mm x H35mm (including cable glands)
- Operating Temp.: -20°C to +60°C
- Cable Glands: PG7 cable diameter max 6mm
Wiring for Shutdown Interval

Suggested Shutdown Wiring Using a Normally Closed Relay

Set the panels SHUTDOWN RELAY DIP switch to NORMALLY OPEN (N/O) when driving a NORMALLY CLOSED external relay.

Suggested Shutdown Wiring Using a Normally Open Relay

Set the panels SHUTDOWN RELAY DIP switch to NORMALLY CLOSED (N/C) when driving a NORMALLY OPEN external relay.
MUSTER™ REMOTE ACTUATOR (M2RA31)

The Muster™ Remote Actuator is an advanced activation feature of the Muster™ Fire Suppression Systems. When used in conjunction with the various Muster™ transducers, control systems and detectors, it provides a flexible and complete solution to fire protection.

Manual actuation is a process that puts the power into the hands of the operator. It is important for the operator to know where the manual activation panel is and how to use it. Muster™ uses a small box with a single motion activator, in accordance to AS 5062-2016 regulations. The fast actuation gives the operator and machine the best chance of a fast response and the best chances for protection.

### General Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP Rating</td>
<td>IP66</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40°C to +80°C</td>
</tr>
<tr>
<td>Dimensions</td>
<td>105mm (l) x 120mm (w) x 90mm (d)</td>
</tr>
<tr>
<td>Weight</td>
<td>1.6kg (LHD)</td>
</tr>
<tr>
<td>Housing Material</td>
<td>304 stainless steel</td>
</tr>
<tr>
<td>Main Activation Operation</td>
<td>Turn handle</td>
</tr>
<tr>
<td>Switch</td>
<td>Momentary push button (LHD)</td>
</tr>
<tr>
<td>Voltage</td>
<td>28 VDC (LHD)</td>
</tr>
<tr>
<td>Current</td>
<td>1 Amp (LHD)</td>
</tr>
<tr>
<td>On Resistance</td>
<td>&lt; 50 Ω (LHD)</td>
</tr>
<tr>
<td>Switch Cycles</td>
<td>60 000 (LHD)</td>
</tr>
<tr>
<td>Security Tag</td>
<td>Nylon 7lb breaking strain</td>
</tr>
</tbody>
</table>

### Parts

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2RA31</td>
<td>Remote Actuator Electronic</td>
<td>Includes 10m twin core cable</td>
</tr>
<tr>
<td>M2ST01</td>
<td>Security tie used with actuators</td>
<td>Used with actuators</td>
</tr>
<tr>
<td>M2L31</td>
<td>Replacement label</td>
<td>UV stabilised, suits both remote actuators</td>
</tr>
</tbody>
</table>

Electronic – M2RA31

For use with MusterWire systems

Remote Actuator Label

Security Tie
Remote Actuator Operation

The Remote Actuator is used to manually activate the system discharge via an electronic signal to the Alarm Panel.

The LHD Remote Actuator (M2RA31) is activated by turning the handle in the direction of the arrow indicated to the final stop/position. This action will depress an internal momentary switch causing the circuit to be closed. The closed circuit will provide continuity to the Alarm Panel indicating a remote activation status.

The Remote Actuator (M2RA31) works in conjunction with the Solid Aerosol Generator Integration Module (M2SAGIM01) & where other Muster suppressant agent systems are configured via the Electronic Cylinder Valve (M2VA31). The signal received at the Alarm Panel (M2AP01) from the Remote Actuator (M2RA31) will trigger the alarm status and energise the initiator in one or multiple M2SAG & M2SAG-M canisters.

Functioning Principal

The M2RA31 Remote Actuator working principal is to push a momentary switch closed inside the main chamber and provide continuity to the Alarm Panel indicating actuation. Actuation takes place by turning the actuation handle in the direction of the arrow. This in turn will position the grub screw inside the main block and push the switch in a linear direction to close it. The 2nd illustration shows the shaft position at full lock against the grub screw and the switch fully closed. See the yellow arrow as illustrated. When the handle is returned to its normal "de-activated” position the switch will automatically reset for further use.
**Automatic Sensing Components**

It is important to understand the high risk or heat sources that exist in the environment. Analyse where the heat source eg. Turbo and exhaust manifold are and predict where the flame will travel. Heat always rises; intensity increases near exiting vents that are above the heat source. Place the detection equipment anywhere between the heat source and the vent for more rapid automatic detection. In open conditions place the detector directly above the heat source.

**MusterWire**

MusterWire is used in the electronic system and actuates at 180°C. MusterWire has a high performance fluoro polymer jacket which gives it superior protection from abrasion, chemical permeation, weather and direct sunlight. The internal design of the wire is simple but effective; two strands of conductive wire are separated by a heat sensitive polymer. When the wiring is exposed to temperatures above 180°C the polymer melts, the conductive wires arc and send a signal to the Alarm Panel (M2AP01) which in turn activates the system. When installing MusterWire it must be placed at least 450mm clear of the turbo to prevent unwanted activation during normal machine operation.

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2FW01</td>
<td>MusterWire kit 10m</td>
<td>Includes end of line resistor 2 cable splices, heat shrink and 10m of MusterWire</td>
</tr>
<tr>
<td>M2FW02</td>
<td>MusterWire kit 20m</td>
<td>Includes end of line resistor 2 cable splices, heat shrink and 20m of MusterWire</td>
</tr>
</tbody>
</table>

**End of Line Resistor Plugs**

The MusterWire End of Line Resister Plug must be used with the MusterWire detection system. Its purpose is to seal the end of the MusterWire and is required to be placed at the end of the electronic actuation circuit.

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2RP01</td>
<td>Resister plug</td>
<td>End of line resistor used with MusterWire silicone cable</td>
</tr>
</tbody>
</table>

**Silicone Cable Kits**

The MusterII electronic signals travel through the flexible Silicone cable. This cable will carry the signal in the electronic system, allowing the MusterWire to only be used in the high risk areas. MusterII installations have been made simple by having various kits available for connecting the actuation circuits.

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2SC101</td>
<td>Silicone cable 2 core 10m</td>
<td>Includes joiner plugs and 200mm heat shrink</td>
</tr>
<tr>
<td>M2SC102</td>
<td>Silicone cable 2 core 20m</td>
<td>Includes joiner plugs and 200mm heat shrink</td>
</tr>
</tbody>
</table>

*Note: A 10m length of silicone cable is already supplied in the Panel kit and electronic actuator kit. If you need extra these MusterII Silicone cable kits comes in 10m and 20m, complete with MusterSplice connectors and heat shrink.*
MusterSplice Connectors

The MusterSplice has been designed to cope with -40°C to +85°C in continuous conditions and are IP67 rated. MusterSplice connectors are UV stabilised and will fit within a 16mm diameter hole or tube. The only application tool needed for installation is a pair of standard pliers and a heat gun.

Before placing wires into the connector ensure the heat shrink is slid onto one side of the connection to be made.

MusterWire – Remove 17mm of protective outer sheath. The inner conductors do not need to be stripped before crimping, separate wires and insert into the connector until the pair of wires seat on the centre of the connector. Press down the tabs with pliers until the tab sits flush with the connector body.

Silicon Cable – Remove 14mm of the silicon outer sheath. The inner conductors do not need to be stripped before crimping, separate wires and insert into the connector until the pair of wires seat on the centre of the connector. Press down the tabs with pliers until the tab sits flush with the connector body.

Slide the heat shrink over the connector body and gently apply heat. The heat shrink material will plasticise and form to the connector body and silicon cable and/or MusterWire. Extra care must be taken when applying heat so as not to activate the MusterWire.

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2CP01</td>
<td>Connector kit</td>
<td>Includes connector plugs and 200mm heat shrink</td>
</tr>
<tr>
<td>M2G01</td>
<td>Grommet red silicone 2mm</td>
<td>Holds MusterWire use with M2PC02, P clamps</td>
</tr>
<tr>
<td>M2G02</td>
<td>Grommet red silicone 5mm</td>
<td>Holds MusterWire use with M2PC02, P clamps</td>
</tr>
<tr>
<td>M2DP01-2</td>
<td>Deutsch Plug 2-Pin set</td>
<td>includes all pins, wedges &amp; casings to complete the set</td>
</tr>
</tbody>
</table>
**Muster™ Labels**

A range of labels for M2SAG / M2SAG-M and actuators are readily available. It is important to inspect the tags and labels ensuring all are clearly identifiable during system inspection.

- UV stabilised
- Peel off numbers for shutdown time frame
- Part numbers printed on labels for easy reordering

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2L09</td>
<td>'In the Event of a Fire' – small</td>
<td>Used in the cab to notify the operator the correct procedure in case of a fire</td>
</tr>
<tr>
<td>M2L10</td>
<td>'Warning' – small</td>
<td>Engine shutdown label has tear off of numbers. These number are used on the label to signify the shutdown time setting. This label would be used in the cabin of the vehicle</td>
</tr>
<tr>
<td>M2L11</td>
<td>'Warning' – large</td>
<td>Used internally to notify of the installation of a fire suppression system</td>
</tr>
<tr>
<td>M2L12</td>
<td>Remote actuator location arrow</td>
<td>This label is used to highlight to the operator and others where the Remote Actuator is located. This label is to be used externally and is UV stabilised and reflective</td>
</tr>
</tbody>
</table>

---

**Remote Actuator Location Arrow Label – M2L12**

---

**PART NO.**

**DESCRIPTION**

**M2SAGLEA01** Evacuate Area on Sound

**M2SAGLMRP01** Ensure Area is Evacuated

**M2SAGLSI01** System is Isolated

**M2SAGLCA01** Check that the Area is Clear

**COMMENTS**

Label to be displayed inside enclosure

Label to be displayed at the manual release point

Label to be displayed at isolation point location

Label to be displayed at entrance of enclosure

---

'In the Event of a Fire' Label – M2L09

Small 'Warning' Label – M2L10

(Peel off numbers included with the shut down times)

Large 'Warning' Label – M2L11

Remote Actuator Location Arrow Label – M2L12

---

**M2SAGLEA01**

**M2SAGLMRP01**

**M2SAGLSI01**

**M2SAGLCA01**

---

**IN THE EVENT OF A FIRE ACTIVATE FIRE SUPPRESSION SYSTEM SAFELY STOP MACHINE APPLY PARK BRAKE SHUT DOWN POWER INITIATE EMERGENCY PROCEDURE**

**WARNING**

THE ENGINE WILL SHUT DOWN AUTOMATICALLY ___ SECONDS AFTER THE FIRE SYSTEM HAS BEEN ACTIVATED

**WARNING**

THE EQUIPMENT IS FITTED WITH A FIRE SUPPRESSION SYSTEM WHICH MAY DISCHARGE AUTOMATICALLY

**WARNING**

EVACUATE AREA ON SOUND OF ALARM AFTER AEROSOL DISCHARGE DO NOT ENTER

**WARNING**

SURE AREA IS EVACUATED BEFORE RELEASE OF SOLID AEROSOL

**WARNING**

CHECK THAT THE AREA IS CLEAR OF PERSONNEL BEFORE RE-ACTIVATING THE SYSTEM
MUSTERII DIAGNOSTIC MODULE

The Muster® System is compatible with a specially designed Diagnostic Module. The Diagnostic Module is used to communicate important system status information in an easy to read format & a transfer device for event history logs to be read on a laptop or PC.

Product Features
- Compatible with Muster® fire Alarm Panels
- Compact
- Upgradable via USB
- Rechargeable via USB
- +/- 15 hours use per charge
- Monochrome graphic display
- Backlight
- Full Alarm Panel diagnostics
- Allows Alarm Panel software upgrades

Handling
Avoid pulling on the cable.

Protect from sharp objects and tools, especially during storage.

Note: Pull collar to release plug, do not pull on cable

Operation

POWER

Turn the unit on and off with the power button. When turned on the unit displays a home screen for three seconds. This can be skipped by pressing the ENTER button.

The unit will automatically turn itself off if it is inactive for 5 minutes

NAVIGATION

The various menus and options are selected using the four navigation buttons.

The UP and DOWN buttons will navigate through a menu or a sub menu and where applicable are used to select from lists of options or settings.

The BACK and ENTER buttons are used to navigate between menus and sub-menus or to accept a menu selection.

ICONS

Along the bottom of the screen are four context sensitive icons that indicate which navigation options are available.

- This flashing icon indicates a system fault or a parameter that is out of spec.
- This locked padlock indicates that the Alarm Panel is isolated and safe.
- This unlocked padlock indicates that the Alarm Panel is not isolated.

Charging

The module is charged via the USB port. The LCD display is not backlit during charging but will indicate when the battery is charging and when it is fully charged.

A full charge can take up to 3 hours. To extend the life of the battery recharge at least every 3 months.
Main Menu

The main menu lets you navigate between 8 different screens. Each screen has it’s own title. A brief description on each screen follows:

“Pressure” screen indicates the pressure of the system and warns if the pressure is too low or too high.

“The software of this module can be upgraded via the USB port as updates become available. Consult JSG Industrial Systems for details.

“Clear Fire” screen allows you to reset the Alarm Panel after a fire without opening it. Press ENTER to unlock the TEST button on the Alarm Panel. Then press the TEST button on the Alarm Panel to clear the fire condition.

“Panel Info” screen displays the serial number along with the hardware version and the software version of the Alarm Panel.

“Update” screen allows you to update the software inside the Alarm Panel. The module can store three different files so it is possible to carry both the latest standard version as well as two special applications.

To update the Alarm Panel press ENTER, then scroll to the version you want to upgrade to and then press ENTER.

Press ENTER again to confirm your choice or press BACK to abort. Once the update starts you can abort any time before it ends by pressing the BACK or ENTER buttons.

“Battery” screen indicates the remaining capacity of the Alarm Panel’s battery and warns if it is too low. This screen indicates the exact percentage of battery capacity remaining and flash the warning signal when attention is required.

“Sys. Faults” displays a list of system faults (if any). If there is only one fault press ENTER to get detailed information. If there is more than one fault press ENTER to allow you to select an individual fault and then press ENTER again to get detailed information. Press BACK to return to the previous menu.

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“Isolate” screen allows you to put the Alarm Panel into isolated mode without opening it. Press ENTER to toggle between isolated and active mode.

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Press ENTER again to confirm your choice or press BACK to abort. Once the update starts you can abort any time before it ends by pressing the BACK or ENTER buttons.

“Sys. Faults” displays a list of system faults (if any). If there is only one fault press ENTER to get detailed information. If there is more than one fault press ENTER to allow you to select an individual fault and then press ENTER again to get detailed information. Press BACK to return to the previous menu.

“Setup” screen allows you to view the setup parameters (dip switch settings) of the Alarm Panel.

“Battery” screen indicates the remaining capacity of the Alarm Panel’s battery and warns if it is too low. This screen indicates the exact percentage of battery capacity remaining and flash the warning signal when attention is required.

Note: If the Alarm Panel detects that the battery voltage is too low it can report a critical fault even if the capacity is above 40% – replace the battery.

Note: This option is not available for all setups.

The software of this module can be upgraded via the USB port as updates become available. Consult JSG Industrial Systems for details.
M2SAG & M2SAG-M FIRE SUPPRESSION SYSTEM

SECTION 3 – RISK ASSESSMENT PROCEDURE
RISK ASSESSMENT PROCEDURE

Risk management has become far more sophisticated in recent times as companies face the challenge of managing vast investments in capital equipment, as well as their human resources. Fire events, although low in probability, are often offset by catastrophic outcomes. As such, the JSG approach is to partner with clients to investigate the “Big Picture” concept of fire prevention and suppression, and by utilising a comprehensive risk assessment procedure, following a process whereby clients can, in real terms, reduce the risk of loss.

The recommended approach is for the client to appoint a committee involving persons ranging from OEM’s, Fire system experts, maintenance fitters, equipment owner and hirers and operators. This committee should bring to the table all the expertise and experience that allows it to identify hazards and risks, the committee rates these risks on a predetermined scale and then agrees on suitable control measures to achieve the required level of protection. The committee is responsible for identifying all hazards and risks related to each piece of equipment and then rating each risk based on probability against consequence. This is termed the Weighted Risk Assessment Criteria (WRAC).

These preventative measures take the lead in the process to achieve the age old philosophy: Prevention is better than cure. Fire risk assessments and audits are carried out to identify any areas which need to be addressed in order to create a safer work environment and comply with necessary fire legislations. The risk assessment process assesses all fire related risks and produces a full, comprehensive and itemised report which will include any remedial work to existing equipment. While prevention of many identified causes can be effected under a good management program, they cannot be entirely eliminated. It is at this point, if the risk is still considered unacceptable, the Muster® Fire Suppression System provides effective fire control to achieve the final risk reduction outcome.
Risk & Design

The Muster\textsuperscript{II} Fire Suppression System is an engineered system which requires the designer to carry out calculations to select suppressant volume and quantity, pipe sizes and nozzles. The program software process uses a step by step guide to calculate and check material selections for compliance. The designer can then quickly and easily produce a comprehensive system design together with a detailed bill of materials and system costing. The Muster\textsuperscript{II} Design Program also includes a Risk Matrix to aid the Muster\textsuperscript{II} accredited designer. The risk assessment process is a compulsory process which is necessary to comply with AS 5062-2016 and also the Muster\textsuperscript{II} design rules. Failure to complete this process will result in a non-compliant fire suppression system being installed. The Muster\textsuperscript{II} design program enables the designer to print a selection of documents including copies of the fire system design, the risk assessment, technical specifications and the commissioning and maintenance documentation required to comply with AS 5062-2016. These documents are to be handed over to the customer at the time of system completion. The risk process is detailed in the flow charts below and should involve all parties involved with the risk assessment process.

The following charts from AS 5062-2016 should be followed when assessing risk before any installation of a fire suppression system. Please note a risk assessment must be carried out for a Muster\textsuperscript{II} system installation for it to comply with AS 5062-2016.

Once all risks have been identified and quantified we look for ways to reduce the risks down to an acceptable level using the “Hierarchy of control”. This process includes control measures such as elimination of the risk by re-design, machine Safeguards, Administrative Controls, Installation of Fire Protection Equipment as well as Site and Public fire Facilities.

AS 5062-2016 states that a risk assessment must be always take place before any installation is carried out, however in many instances a customer might initially only require a quotation. The design program can be used for this purpose without a risk assessment being carried but this should be noted on the program. An experienced designer will likely predict an accurate specification with little or no modifications required later, however carrying out the risk assessment process will often reveals factors not known to the designer in the early stages.

From the risk flow chart it can be seen that risk management follows a logical process allowing the assessment committee to make decisions on whether risks are acceptable or not. The charts shown above are reproduced from AS 5062-2016. These charts show this process in the form of a flow chart. The processes in the flow chart must be followed until the risk is reduced to an acceptable level.

Fire Risk Assessment is a formal process to identify associated fire risks and documents the control measures to reduce the risk to an acceptable level.
Assessing The Risk

A mandatory process required for compliance to the AS 5062-2016 is to carry out a detailed risk assessment prior to the design and installation of any fire suppression system. To comply with this standard the risk assessment process must be carried out by relevant parties as prescribed by AS 5062-2016 before installation is commenced.

In order to carry out the risk assessment the first step is to understand exactly what risks exist and to list the location of those risks. A fire suppression system can then be designed; supplied and installed that will eliminate or reduce all risks to an acceptable level.

A fire risk assessment is an organised and methodical look at a piece of equipment. The process requires assessment of the operational tasks in which the equipment is used. Assess the likelihood of a fire occurring and the likely consequences of the fire if it does occur. We then record the highest priority based on the Risk Matrix below. For instance, if an engine fire is judged to be almost certain to occur in the life of a machine and the likely outcome of such a fire to be catastrophic; in other words; lead to death or complete loss of the machine, then this would be given this a risk score of 30, which is the highest level of risk.

There is no standard answer for the level of each risk; it is simply a best estimate after considering the circumstances. It will be found that those carrying out the risk assessment will have differing opinions of the level of risk. This is why it is important for all parties to be involved in the assessment process. The final assessment should include, selected personnel from the following: The owner, the operator, maintenance personnel, the manufacturer’s representative, the supplier, hirer, insurer and specialist fire consultant, the workshop supervisor etc.

<table>
<thead>
<tr>
<th>LIKELIHOOD</th>
<th>CONSEQUENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOUBLETFUL</td>
<td>INSIGNIFICANT NO INJURIES AND NO DAMAGE</td>
</tr>
<tr>
<td>OCCUR IN EXCEPTIONAL CIRCUMSTANCES</td>
<td>1</td>
</tr>
<tr>
<td>SLIGHT</td>
<td>2</td>
</tr>
<tr>
<td>COULD OCCUR SOME TIME</td>
<td>3</td>
</tr>
<tr>
<td>POSSIBLE</td>
<td>4</td>
</tr>
<tr>
<td>MIGHT OCCUR</td>
<td>5</td>
</tr>
<tr>
<td>EXPECTED</td>
<td>VERY LOW</td>
</tr>
<tr>
<td>WILL PROBABLY OCCUR</td>
<td></td>
</tr>
<tr>
<td>DEFINITE</td>
<td></td>
</tr>
<tr>
<td>ALMOST CERTAIN TO OCCUR</td>
<td></td>
</tr>
</tbody>
</table>

Risk Matrix

You will note from the above chart that scores between 10 and 30 are regarded as high risks which must be tackled as a priority. In the case of mobile equipment the identified risks must be tackled before the machine is put to work. The object of the exercise is to reduce the identified risks down to an acceptable level of 7 or less, this would put them into the very low to moderate range.
The assessment process is a simple system that breaks down the risk into two key components, the likelihood of an event happening and the possible consequences. When the combined score of these two factors is substantial we have an unacceptable risk. Conversely, if the consequences of an event is negligible then the possibility of the event will not likely matter as the outcome will be acceptable. The Muster® Risk Matrix shown on the previous page lists the risk score for each risk, the group would then consider all the risks discovered throughout this process and recommend ways to reduce them to an acceptable level.

Definitions of Likelihood

- **DEFINITE** – Likely to occur often during the life of an individual item or system, or very often in the operation of a large number of similar pieces of equipment.
- **EXPECTED** – Likely to occur several times in the life of an individual item or system, or often in the operation of a large number of similar pieces of equipment.
- **POSSIBLE** – Likely to occur sometimes in the life of an individual item or system, or will occur several times in the life of a large number of similar pieces of equipment.
- **SLIGHT** – Unlikely, but possible to occur sometime in the life of an individual item or system, or can reasonably be expected to occur in the life of a large number of similar pieces of equipment.
- **DOUBTFUL** – So unlikely to occur in the life of an individual item or system that it may be assumed not to be experienced, or it may be possible, but unlikely to occur in the life of a large number of similar pieces of equipment.

Definitions of Consequence

- **CATASTROPHIC** – Death, loss of system or plant, release to environment, such that significant public interest or regulatory intervention occurs or reasonably could occur.
- **MAJOR** – Severe injury, major system damage or other event which causes some loss of production, unplanned localised damage to environment, or could have resulted in catastrophic consequences under different circumstances.
- **MODERATE** – Modest injury and or system damage.
- **MINOR** – Slight injury, slight system damage, or confined and non-damaging environmental exposure.
- **INSIGNIFICANT** – No injuries or damage occurring will result.

Documentation of Risk Assessment Process

The risk assessment process is documented using the Muster® Design Program, this will become part of the fire system design record.

*Note: The design records, commissioning documents and the risk assessment records must be presented to the customer at time of equipment handover and also kept on file by the installation company.*
M2SAG & M2SAG-M FIRE SUPPRESSION SYSTEM

SECTION 4 – SYSTEM DESIGN: FIXED & MOBILE MACHINERY
SYSTEM DESIGN: FIXED & MOBILE MACHINERY

General

The Muster® II system of aerosol generators distributed within the risk area eliminates the complications associated with traditional gaseous agent systems. Muster® II aerosol generating units do not require pressurised cylinders of liquefied gas, traditional pipe and nozzle networks, or engineered hydraulic calculations to determine nozzle orifices.

Following completion of a Formal Risk Assessment, the Installer only needs to determine the size and number of Muster® II generators required as well as their location within the enclosure. The use of the Muster® Design Program will assist completion of a Formal Risk Assessment & then calculate the size and number of M2SAG or M2SAG-M canisters required to suit the installation.

The below information explains the process used to perform applicable calculations when using M2SAG & M2SAG-M devices. This information along with the Risk Assessment Documentation must then be presented to the Authority Having Jurisdiction &/or Customer to accept & sign-off prior to installation. These documents form part of the complete Muster® Document package.

Design Methodology

The outline for the design of a Muster® Marine fire suppression system generally involves the following at a minimum:

1. Identify all possible hazards within the protected enclosure. Please refer to Section 1 for the list of fire hazards/fuel types that are unsuitable for use with Muster® M2SAG & M2SAG-M units. For fire hazards/fuel types not covered in Section 1, please refer the query to an Authorised Muster® representative.
2. Identify possible points of agent loss within the protected enclosure ie Ventilation points.
3. Determine volume of the protected enclosure. Identify if the required coverage extends to the ceiling void and/or raised floor and determine the protected volume for these.
4. Calculate the quantity of agent required for the hazard and fuel type within the enclosure. Factors such as non-closable openings, forced ventilation, low altitude, low temperature and other conditions may affect the quantity of agent required.
5. Select the model and quantity of generators required to achieve the minimum design quantity.

Design Factor

Muster® design calculations refer not to the design concentration of the actual suppressing agent, aerosol, but to the design factor, which is the mass of solid aerosol-generating element per unit of enclosure volume required to extinguish a specific type of fire, including a safety factor.

- Muster® design factor is expressed in g/m³.
- Muster® minimum design factor for Class B fires, involving flammable liquids such as petrol, diesel, hydraulic oil and automotive distillate is 100 g/m³.
- Muster® minimum design factor for Class A surface fires, involving non-smouldering combustible solids such as wood, textile and ordinary plastic is 100 g/m³.
- Muster® minimum design factor for Class A non-surface fires, involving dense cables is 200 g/m³.
- Muster® design factor of 100 g/m³ has been accepted for marine applications in machinery spaces.

Advice from JSG or authorised Muster® Technical Representative should be sought for any fire/fuel type not covered by the above minimum design factors.

IMPORTANT

- Care should be taken to prevent any possibility of personnel exposure to the high initial concentrations of Muster® Aerosol.
Enclosure Volume

Please note that enclosure volume for MARINE applications refers to the gross volume of the machinery space.

If a compressed air vessel is fitted in the machinery space, the gross volume must always be included for the free air volume of the air vessel. The free air volume is the volume of air at atmospheric pressure (1 Bar). It is calculated by using the following formula:

\[ \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \]

The \( T_1 \) and \( T_2 \) cancel out and \( P_2 \) is always 1Bar absolute for this calculation.

The formula can now be re-arranged and reduced as:

\[ V_2 = \frac{P_1 V_1}{P_2} \]

Where

- \( V_2 \) = volume of free air in m\(^3\) at 1 Bar;
- \( P_1 \) = absolute pressure which is the gauge pressure on the compressed air vessel at 20°C plus 1 Bar;
- \( V_1 \) = volume of compressed air in the vessel at \( P_1 \)

M2SAG & M2SAG-M example: If the compressed air vessel stores 2 m\(^3\) of air at 8 Bar gauge at 20°C, what is the volume of free air?

\[ V_2 = \frac{P_1 V_1}{P_2} \]

\[ P_1 = 8 + 1 = 9 \text{ Bar}; \quad V_1 = 2 \text{ m}^3; \quad \text{therefore} \quad V_1 = 9 \times 2 = 18 \text{ m}^3 \text{ of free air}. \]

In determining the machinery space gross volume, the Naval architect responsible for the vessel’s design should be consulted. However, if this information is not available, refer to the relevant Maritime Authority, which gives a guide in determining gross volume and quantity of suppressing agent.

Design Quantity

For normal total flooding applications based on a static volume enclosure with all openings sealed and all ventilation systems shut down prior to Muster\(^\text{II}\) discharge, the total flooding quantity is determined as follows:

\[ \text{Total Flooding Quantity (g)} = \text{Design Factor (g/m}^3\text{)} \times \text{Enclosure Volume (m}^3\text{)}. \]

Total Flooding Quantity refers to the total mass of solid aerosol-forming composition required to suppress fire in a given volume, including safety factor.

Number of M2SAG & M2SAG-M Generators

For normal total flooding applications based on a static volume enclosure with all openings sealed and all ventilation systems shut down prior to Muster\(^\text{II}\) discharge, the number of M2SAG & M2SAG-M generators is determined as follows:

\[ \text{Number of M2SAG & M2SAG-M} = \frac{\text{The mass of the solid aerosol-forming Composition in one M2SAG & M2SAG-M generator}}{\text{The mass of the solid aerosol-forming Composition in one M2SAG & M2SAG-M generator}} \]

The above calculation refers to the same size of M2SAG & M2SAG-M generators only. However, different sizes of M2SAG & M2SAG-M generators may be selected, in which case the total mass of aerosol-forming composition shall be not less than the Total Flooding Quantity.

The type of M2SAG & M2SAG-M generator selected is typically based on several considerations as follows:

1. Height of Protected Enclosure: M2SAG & M2SAG-M generators chosen must be appropriate for the height of the protected enclosure. Please refer to Section 2.10 for the height limitation list.
2. Minimum Clearance: minimum clearance is an essential criteria to ensure that the possibility of damage due to heat of the discharge is minimised. Please refer to Section 2.
3. Distribution of Aerosol: Although Muster® aerosol has the three-dimensional distribution of a gas, the even and rapid attainment of the minimum suppressing concentration throughout the protected enclosure would obviously be desirable. E.g. In applications such as the protection of cable ducts and trenches, which are typically long and narrow, it would be appropriate to select several smaller units and spread them out evenly along the protected volume although one large unit may fulfil the agent quantity requirement.

4. Mounting Locations: Certain protected enclosures may have very specific permissible mounting locations. This may influence the quantity and orientation of the units selected.

5. Cost Factors: The price/m³ of the different M2SAG & M2SAG-M units may differ. The best cost option without sacrificing technical requirements are the elements of good design.

### Muster® Range for M2SAG Series

<table>
<thead>
<tr>
<th>Parameter</th>
<th>M2SAG-Z3</th>
<th>M2SAG-Z6</th>
<th>M2SAG-1</th>
<th>M2SAG-2</th>
<th>M2SAG-5</th>
<th>M2SAG-10</th>
<th>M2SAG-20</th>
<th>M2SAG-30</th>
<th>M2SAG-50</th>
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</thead>
<tbody>
<tr>
<td>Mass of generator, grams</td>
<td>360</td>
<td>650</td>
<td>940</td>
<td>1700</td>
<td>3100</td>
<td>9000</td>
<td>11500</td>
<td>23500</td>
<td>27500</td>
</tr>
<tr>
<td>Mass of aerosol-forming element, grams</td>
<td>30</td>
<td>60</td>
<td>100</td>
<td>200</td>
<td>500</td>
<td>1000</td>
<td>2000</td>
<td>3000</td>
<td>5000</td>
</tr>
<tr>
<td>Max protected volume m³</td>
<td>0.3</td>
<td>0.6</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>Outlet direction</td>
<td>End</td>
<td>End</td>
<td>End</td>
<td>End</td>
<td>End</td>
<td>End</td>
<td>End</td>
<td>End</td>
<td>End</td>
</tr>
<tr>
<td>Length of generator, B (mm)</td>
<td>101</td>
<td>121</td>
<td>122</td>
<td>200</td>
<td>215</td>
<td>200</td>
<td>254</td>
<td>342</td>
<td>415</td>
</tr>
<tr>
<td>Diameter of generator, A (mm)</td>
<td>38</td>
<td>51</td>
<td>64</td>
<td>76.2</td>
<td>89</td>
<td>220</td>
<td>220</td>
<td>310</td>
<td>310</td>
</tr>
<tr>
<td>Discharge time, sec (Based on design factor of 100 g/m³)</td>
<td>&lt;20.0</td>
<td>&lt;25.0</td>
<td>&lt;30.0</td>
<td>&lt;30.0</td>
<td>&lt;30.0</td>
<td>&lt;30.0</td>
<td>&lt;30.0</td>
<td>&lt;35.0</td>
<td>&lt;35.0</td>
</tr>
<tr>
<td>Minimum Nozzle Clearance mm</td>
<td>300</td>
<td>300</td>
<td>400</td>
<td>700</td>
<td>700</td>
<td>1000</td>
<td>1500</td>
<td>1700</td>
<td>2000</td>
</tr>
<tr>
<td>Temperature range</td>
<td>-50°C to +65°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Muster® Range for M2SAG-M Series

<table>
<thead>
<tr>
<th>Parameter</th>
<th>M2SAG-M-1</th>
<th>M2SAG-M-2</th>
<th>M2SAG-M-5</th>
<th>M2SAG-M-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass of generator, grams</td>
<td>800</td>
<td>1200</td>
<td>4700</td>
<td>7500</td>
</tr>
<tr>
<td>Mass of aerosol-forming element, grams</td>
<td>100</td>
<td>200</td>
<td>500</td>
<td>1000</td>
</tr>
<tr>
<td>Max protected volume m³</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Outlet direction</td>
<td>End</td>
<td>End</td>
<td>End</td>
<td>End</td>
</tr>
<tr>
<td>Length of generator, B (mm)</td>
<td>132</td>
<td>188</td>
<td>250</td>
<td>433</td>
</tr>
<tr>
<td>Diameter of generator, A (mm)</td>
<td>75</td>
<td>75</td>
<td>113</td>
<td>113</td>
</tr>
<tr>
<td>Discharge time, sec (Based on design factor of 100 g/m³)</td>
<td>&lt;15.0</td>
<td>&lt;15.0</td>
<td>&lt;15.0</td>
<td>&lt;20.0</td>
</tr>
<tr>
<td>Minimum Nozzle Clearance mm</td>
<td>400</td>
<td>700</td>
<td>700</td>
<td>1000</td>
</tr>
<tr>
<td>Temperature range</td>
<td>-50°C to +85°C</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Minimum Holding Time

Upon Muster\textsuperscript{II} discharge a minimum holding time of 3 minutes should be allowed for fires involving flammable liquids (class B fires) and non-smouldering combustible solids (class A surface fires).

For fires involving electrical cables and smouldering solids the minimum holding time should be extended to 10 minutes.

Design Limitations

Height Limitations

The Muster\textsuperscript{II} suppressing agent, being a hot aerosol, has a tendency to rise upward on its release due to buoyancy forces. As such, the aspect of spatial distribution needs to be addressed.

This requires that a height limitation for the protected enclosure be set for each individual Muster\textsuperscript{II} generators.
Venting Requirements

Special venting requirements refer to large Muster® M2SAG units only and are as follows:

<table>
<thead>
<tr>
<th>Model No.</th>
<th>Minimum venting area, cm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2SAG-20</td>
<td>70</td>
</tr>
<tr>
<td>M2SAG-30</td>
<td>100</td>
</tr>
<tr>
<td>M2SAG-50</td>
<td>150</td>
</tr>
</tbody>
</table>

Minimum venting area must be observed for the larger M2SAG units only & include existing natural gaps, ventilation outlets and etc. Where additional pressure relief venting is required the installed vents should be of an appropriate type, such as closeable flaps, and suitably located to ensure maximum possible containment of Muster® aerosol within the enclosure during and after discharge.

Minimum Clearances

Due to a potential hazard of high temperatures (100-150°C) of Muster® aerosol at the end-plate nozzle, the minimum clearances from the discharge nozzle for each type of M2SAG & M2SAG-M generator should be observed during installation. The below minimum clearances refer to the locations where people may be present and where therefore temperature at the minimum clearance should not exceed 75°C.

<table>
<thead>
<tr>
<th></th>
<th>M2SAG-Z3</th>
<th>300 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M2SAG-Z6</td>
<td>300 mm</td>
</tr>
<tr>
<td></td>
<td>M2SAG-1</td>
<td>400 mm</td>
</tr>
<tr>
<td></td>
<td>M2SAG-2</td>
<td>700 mm</td>
</tr>
<tr>
<td></td>
<td>M2SAG-5</td>
<td>700 mm</td>
</tr>
<tr>
<td></td>
<td>M2SAG-10</td>
<td>1000 mm</td>
</tr>
<tr>
<td></td>
<td>M2SAG-20</td>
<td>1500mm</td>
</tr>
<tr>
<td></td>
<td>M2SAG-30</td>
<td>1700mm</td>
</tr>
<tr>
<td></td>
<td>M2SAG-50</td>
<td>2000mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>M2SAG-M-1</th>
<th>400mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M2SAG-M-2</td>
<td>700mm</td>
</tr>
<tr>
<td></td>
<td>M2SAG-M-5</td>
<td>700mm</td>
</tr>
<tr>
<td></td>
<td>M2SAG-M-10</td>
<td>1000mm</td>
</tr>
</tbody>
</table>

Muster® M2SAG & M2SAG-M Discharge

Muster® aerosol suppresses the fire chemically by reacting with the flame chain carriers and thereby interfering with the process of combustion. (Please refer to Section 1 for a full treatise on the process of flame suppressant). As Muster® does not rely on halogen compounds to react with the flame, it does not produce corrosive halogen-acid by-products when in contact with flame.

In order to minimise damage due to the fire, however, the system should be designed to attain its design concentration within the shortest time possible upon actuation of the aerosol generators. An important factor to achieving a rapid and even distribution of the suppressing agent depends upon the placement/distribution of the Muster® generators within the protected enclosure.
M2SAG & M2SAG-M FIRE SUPPRESSION SYSTEM

SECTION 5 – TRAINING & CERTIFICATION

FOR AUTHORISED DISTRIBUTORS
Muster Agents; Trained and Accredited for Installation and Servicing

All system design and installation is carried out by trained and qualified personnel. Every system design begins with a thorough risk assessment of the equipment to be protected, ensuring that all fuel and ignition sources are identified and assessed for protection. The end result of which is a more effective management of fire risks. It is a requirement of JSG Industrial Systems for our System Houses (distributors) personnel before they design, install or service the fire systems that they are trained and must pass competency tests to verify this capability to deliver the correct design, installation and service. Refresher training is required to retain accreditation at 2 yearly intervals.

Muster Agents have access to:

- Training
- Fully monitored system design
- Technical support
- Risk assessments
- Service log templates

The Muster® accreditation process and fire suppression system’s holistic approach, gives the customer confidence; in their contractors, asset management and security.

Ensure Muster® Systems are installed and serviced by companies displaying this shield.
The following screens show the sequence for website access to distributor login, program download, license request, and the process of periodically renewing your Muster™ Design Program license. If you have any problems – please email licensing@musterfire.com.

1. Go to www.musterfire.com and click on the login button in the top right corner.
2. Fill in each of the required fields marked with an asterisk (*), if possible fill in other fields as well. Hit the SUBMIT button when complete. This will forward an email to the MusterIT team who will respond with an email detailing your USER NAME and PASSWORD.
3. After receiving back your USER NAME and PASSWORD email, hit the CLICK HERE TO LOGIN button. This will open a window to enter your USER NAME and PASSWORD. Hit the LOGIN button.

4. In this next screen select the DESIGN PROGRAM tab which then gives you a number of files that can be downloaded. Please check your operating system at this time to ensure you have the Microsoft.net framework on your PC or laptop before attempting to download the Design Program, if you don’t have it download this file first. Once download is complete you can then download the Design Program. Follow the prompts to select where you would like to store the program on your computer.
5. Install the Muster® Setup.EXE file on your PC or Laptop. Complete the form as shown below (all fields are required) and hit the GET LICENSE button. The program will then close.
Receiving Your Licence File

6. Your licence will be sent to you at the email address you specified during the installation process. It will include a unique file to be saved in a suitable location on your PC or Laptop.

7. Open the Design Program again and hit the BROWSE button. Select your license file and type in your license code.

Note: The splash screen will always show the number of remaining days in your current license.
When the number of days you have remaining on your licence reaches 21 days, the RENEW LICENCE function will be available. Hit the RENEW LICENSE button to send a renewal request to the Muster™ IT team who will return a new license file.

Note: It is recommended each Design Program licensee downloads the USER GUIDE to reference when using the program.
M2SAG & M2SAG-M FIRE SUPPRESSION SYSTEM

SECTION 6 – SYSTEM OPERATION
SYSTEM OPERATION

Operation of Muster® M2SAG & M2SAG-M generator is either electrical automatic, electrical manual or thermal automatic. Please note that normally marine fire suppression systems are operated manually only. Please refer to your local Marine Authority for other operation options you may have available for a specified vessel where applicable for MARINE installations.

Electrical Manual Operation

Electrical manual operation is performed electrically by operating a manual release point located outside the protected enclosure.

This is achieved either via the FIRE button on the Muster® Alarm Panel or Remote Manual Actuator.

System Isolate Switch

The discharge of Muster® generators in the electrical manual operation mode shall be capable of being prevented by means of a system isolation switch that shall be manually operated when personnel are present in the protected area or the adjacent area which could be rendered hazardous by the discharge of suppressing agent. This is located inside the Muster® Alarm Panel – see page 18.

The system isolate switch shall be situated outside the protected area or adjacent to the main exit from the area and protected from accidental operation.

While the system isolate switch is active and the discharge of the system is inhibited, the fire detection and alarm systems shall continue to function and the system shall return to full automatic control when the switch is reactivated.

The operation of the system isolate switch will electrically isolate and earth each conductor of the wiring to the suppressing agent discharge device and initiate a yellow or amber visual indicator on the Muster® Alarm Panel face. The purpose of this requirement is to provide a level of protection equivalent to a gas lock-off valve.

Manual Actuation Points

The Manual Actuation points must be fitted at locations accessible to any personnel & be protected from inadvertent operation. Upon activation of any Manual Actuation point an audible & visual alarm will be raised via the Muster® Alarm Panel.

For MARINE, the Manual Actuation points must be fitted within an enclosure box. This enclosure box shall have a tamper switch fitted to the door, which raises an audible and visual evacuation alarm in the protected machinery space when the enclosure door is opened.
Operating Devices

Operating devices such as ancillary equipment, including shutdown equipment, dampers and door closures, required for successful system performance shall be considered integral parts of the system. All ancillaries shall incorporate manual reset facilities when used & do not form part of this supply. These items, where required, are available through alternate supply channels.

Detection, Alarm and Control Systems, Indicating Equipment, Warning Devices

Automatic fire detection, alarm and control systems for Muster® as well as indicating equipment and warning devices shall comply with the standard requirements established for a specified risk.

Fire Alarm

The fire alarm is raised by a Fire Detection System and does not form part of this supply.

NOTE: Some Marine Authorities may not require a separate fire alarm from the audible and visual evacuation alarms provided in the machinery space. Other authorities may have different requirements, so each installing company should check with their local authorities.

Operation in Fire Situation

For General or Non-Occupiable space:

1. Actuate the Muster® generators by operating the manual release system.
2. If equipment is mobile, safely park & exit. Equipment Shutdown will automatically engage after the pre-determined period.
3. Report the incident.

For MARINE or Occupiable Space Applications:

1. Open the manual release point enclosure.
2. The evacuation alarm will operate.
3. Ensure all personnel have evacuated from the protected space.
4. Shut down any ancillary machinery in the risk.
5. Shut down the engine. This action may not be necessary if the air intake is taken from outside the protected space and the exhaust terminal is outside of the protected space.
6. Close all vents and doors.
7. Actuate the Muster® generators by operating the manual release system.
8. After activating period, the aerosol will be generated and discharged within 3 to 10 seconds, depending on the size of M2SAG & M2SAG-M generator. The holding time for the design concentration shall be a minimum of 3 minutes.
Post-fire Procedure

After the fire:

1. Ensure first aid portable fire extinguishers are at hand.

2. Ventilate the area / space by operating ventilation system or opening doors and vents to disperse the agent and fire combustion products. Avoid exposure to the fire by-products and suppressing agent mixture.

   **NOTE:** Wearing a respirator or other available means of protection may be required should it be necessary to enter the area before it is fully ventilated.

3. Enter the area / space when it is clear of agent and fire by-products, to inspect and ensure that the fire is fully extinguished and there is no danger of re-flash from hot spots or damaged equipment.

4. Inspect the area, machinery and equipment for any damage. Investigate the cause of the fire and repair if possible.

5. Should any residue be left, blow, brush or, if appropriate, wash it away.

   **NOTE:** Any residue that is allowed to absorb moisture may become electrically conductive.

6. Start up the engine and check that all is correct.

7. Start-up ancillary equipment and machinery and check that all is correct.


Contact your Muster® Distributor for a replacement of M2SAG & M2SAG-M generators.
M2SAG & M2SAG-M FIRE SUPPRESSION SYSTEM

SECTION 7 – SYSTEM INSTALLATION
SYSTEM INSTALLATION

Prior to Installation

Integrity and Resistance of the Electric Actuation Circuit

It is important that prior to the installation of M2SAG & M2SAG-M generators the integrity and resistance of the electric circuit for each M2SAG & M2SAG-M generator be checked with the use of a digital multi-meter. The maximum test current shall not exceed 50 milliamps for a period of 5 minutes. The monitoring current shall not exceed 1 milliamp.

Resistance of the electric activation circuit shall be within 0.6-5.0 Ohms.

It is also important to check earth fault of every M2SAG & M2SAG-M generator. Earth fault resistance must not be less than 0.1 MOhm.

Note: Failure to verify resistance may cause system to not operate as intended or false activate.

Spacing and Location

Once the size and number of Muster® M2SAG & M2SAG-M generators have been determined, they should be securely mounted on to a bulk head or similar location, observing the following:

Even Distribution

Generators should be evenly distributed within the risk area, to achieve an unhindered distribution of the agent discharge.

Orientation of Aerosol Discharge

Aerosol discharge should not be orientated across any route of exit.

Generators should be so oriented to reduce any potential thermal damage caused by hot generators and suppressing agent discharge. There should be no flammable or highly combustible materials or equipment within a specified minimum clearance from the generator’s nozzle.

If there are any un-closable openings that cannot be avoided such as exits, doors and apertures, aerosol discharge should be directed across the likely fire zone and towards those openings, but not away from them.

Clear Obstructions

While Muster® aerosol is an extremely penetrating suppressing agent, severe obstruction of the aerosol discharge pattern should be avoided. Several small generators may be preferable to one large generator, should design limitations for smaller units allow such a replacement. If it is not possible, the distance from the nozzle to the obstacle shall be not less than the specified minimum clearance.

In case of multiple obstacles the design factor shall be increased, such increase to be determined by preliminary tests conducted in the areas and spaces concerned.

Environment

Temperature range of application for M2SAG & M2SAG-M generators is from -50°C to + 65°C.

Temperature range of application for M2SAG & M2SAG-M-M generators is from -50°C to + 85°C.

Humidity range of application is up to 98% humidity, non-condensing.

Note: Generators are not generally suited to direct exposure of severe weather conditions or mechanical, chemical or other damage. Where excessive climatic or mechanical exposures are expected, suitable protection or enclosures shall be provided.
Mounting Methods

Muster® generators could be mounted in any orientation without affecting its aerosol-forming capability. It is important to bear in mind that the resultant aerosol being warm would tend to rise at the onset. Muster® M2SAG & M2SAG-M has been tested successfully in both the horizontal & vertical positions as depicted in the below diagrams.
Electric Wiring

Up to eight Muster® generators may be connected on a single discharge circuit with one power source for all applications except for MARINE applications. Should more than eight generators be required for one enclosure, two circuits will be required with each interconnected with the other to enable simultaneous activation.

When used in MARINE applications the maximum Muster® generators permitted is 4 unless junction housing, suitably rated & acceptable to the relevant Authority, are used to make additional connections.

Cable

Cables should be fire-resistant. Conductors should be of copper, each having a cross-sectional area of not less than 1mm², or if stranded, not less than 0.5mm² should be used.

The cable shall be screened and the care taken when the cable runs through a high frequency energy zone, such as a two-way radio, a sonar, etc so as to not cause false activation. Should the cabling run alongside electric magnetic fields of high intensity, such as high voltage transformers in power substations or cable tunnels, the cables shall be enclosed into a steel conduit. Cable screen and steel conduit shall be grounded in accordance with standard requirements.

Should there be any possibility of the mechanical damage, the cables shall be enclosed into a plastic or metal conduit. All cabling shall be secured in a manner acceptable to the relevant Authority.

Power source

In normal applications power is supplied via the internal battery of the Muster® Alarm Panel.

Power Sources – MARINE Applications

A standard power source that provides at least 2 Amp current and 6 to 24 Volts voltage shall be used. The power source shall have a backup power supply of the same voltage. Where the backup power is shared with other devices, sufficient capacity for a minimum of 24 hour’s standby condition, 1-hour alarm condition and thereafter, sufficient capacity remaining to discharge the generators shall be provided for.
2RMDT Connector Assembly and Wiring for Muster® M2SAG & M2SAG-M Connector (When not Pre-cabled)

Part No. M2SAGMSP01

Note: Only pins 1 & 2 are utilised for connection. Wires to be soldered to connectors.
M2SAG & M2SAG-M FIRE SUPPRESSION SYSTEM

SECTION 8 – SYSTEM MARKINGS
SYSTEM MARKINGS

Muster® Product Label Integrity and Resistance of the Electric Actuation Circuit

Each Muster® M2SAG & M2SAG-M generators is complete with its product label stating vital information regarding the product. The general format is as follows:
**Muster II Warning & Instruction Signs**

The following Warning and Instruction Signs shall be firmly attached to specified locations by the installer on completion of Muster II installation in normally unoccupied areas, where people may enter the enclosure for brief periods:

**a) Label to be Displayed at Entrance to Enclosure**

![Label to be Displayed at Entrance to Enclosure]

**b) Label to be displayed Inside Enclosure**

![Label to be displayed Inside Enclosure]

**c) Label to be Displayed at Isolation Point Location**

![Label to be Displayed at Isolation Point Location]

**d) Label to be Displayed at Manual Release Point**

![Label to be Displayed at Manual Release Point]
M2SAG & M2SAG-M FIRE SUPPRESSION SYSTEM

SECTION 9 – SYSTEM COMMISSIONING
SYSTEM COMMISSIONING

The completed Muster installation shall be commissioned in accordance with commissioning checklist, reference section 12 page 87.

On completion and acceptance of the commissioning procedure, the installation contractor shall issue a signed copy of the commissioning report.

Note: Commissioning should be carried out by trained and authorised personnel only.

Commissioning

1. Install electrical wiring;

2. Install and connect such devices as audible and visual alarm devices, manual release points or automatic activation fire panel, heat or flame detectors, timer, etc;

3. Connect miniature filament lamps with 12-24 Volts voltage and current up to 50mA in place of M2SAG & M2SAG-M generators;

4. Ensure the manual release point or the automatic activation fire panel has been protected from the accidental discharge. Placing of a sign “Do not operate. Device is under service” is recommended.

5. Activate the system. All devices shall operate and all lamps shall glow. Should the system fail to operate properly, disconnect the power supply, check connections between devices, reconnect the power supply and repeat.

6. Reset the system. All lamps shall be switched off;

7. Disconnect all of the lamps and connect the M2SAG & M2SAG-M generators in its place. Install M2SAG & M2SAG-M generators in accordance with installation recommendations.

8. Remove the sign on the manual release point or the automatic activation fire panel.


Note: Commissioning Form will be contained within the complete Muster Design Documentation package or is available on the www.musterfire.com website via the distributor login section.

WARNING

Prior to connecting M2SAG & M2SAG-M generators ensure the wires leading to the generators are not carrying voltage. Alarm Panel connection of M2SAG & M2SAG-M generator systems should always be the last function in electrical wiring procedure.
M2SAG & M2SAG-M FIRE SUPPRESSION SYSTEM

SECTION 10 – SAFETY MEASURES
SAFETY MEASURES

Personnel Safety

The uses of Muster® automatic total flooding systems are limited to unoccupiable and normally unoccupied areas only. In any proposed use of Muster® where there is a possibility that people may enter the protected enclosure or be close to the protected risk, the following safety aspects shall apply:

- A thermal automatic operation shall not be used.
- A system isolate switch shall be installed at the entrance to the protected area to prevent actuation during abnormal periods of occupation such as maintenance and repair.
- A location drawing should be attached to or next to any manual actuation points.
- Exit routes should be kept clear at all times with emergency lighting and adequate direction signs being installed to minimise travel distances.
- Consideration should be given to canister location in the event of spurious activation. Unless absolutely unavoidable, canisters should not be placed at head height or in close proximity to egress doors nor emergency exits.
- Outward-swinging doors shall be self-latching and incorporate a self-closing mechanism to prevent possibility of doors opening inadvertently due to increase of pressure within the protected enclosure during discharge. Doors should be able to be opened from the inside including when locked from the outside.
- Continuous visual and audible alarms installed at entrances and designated exits should operate until the protected area has been made safe.
- Warning and instruction signs shall be installed in accordance with Section 9.
- Pre-discharge alarms shall operate immediately upon detection of the fire.
- A time delay shall be incorporated within the manual release point and shall commence upon Muster® system operation.
- Means for ventilation after discharge should be available; forced draft ventilation will often be necessary. Care should be taken to completely dissipate hazardous atmospheres and not just to be moved to other locations.
- Written instructions appropriate to the risk, instructions and drills shall be given to all personnel within or in the vicinity of protected area, including maintenance or construction personnel who may be brought into the area, to ensure their correct actions when the system operates.
- A hold off switch should be provided within any protected area if there is a risk of personnel taking longer to egress than any pre-discharge alarm may allow. This may apply to persons who are involved in maintenance or are unfamiliar or untrained in the company fire procedures.

![WARNING]

**Potential hazards**
The discharge of Muster® in fire suppressing concentrations represents potential hazards to personnel in protected area. The hazards include the following:

- High obscuration caused by the aerosol during and after discharge.
- Potential toxicity due to some by-products of the aerosol-generating combustion reaction.
- Thermal hazard due to an elevated temperature at the end plate nozzle.

See Section 4 - Design Limitations for minimum clearances.

Please refer to Section 1 for the detailed information on the above hazards.
Re-entry

Following the use of Muster<sup>II</sup>, personnel should not enter the protected area until it has been thoroughly ventilated. The minimum holding times should be observed prior to ventilation of the protected area (please refer to page 50 for minimum holding times). Unless stated otherwise the minimum holding time permitted before re-entry is 3 minutes.

Avoid exposure to the fire by-products and suppressing agent mixture.

The wearing of suitable Respirator & other available means of protection may be required should it be necessary to enter the area before it is fully ventilated.

Clean-up

Following a system discharge the aerosol particles that have settled should be vacuumed, using HEPA filter fitted equipment, brushed or, if appropriate, washed away.

Protective gloves and goggles should be worn. A suitable Respirator may be required.

![WARNING]

- Be aware, that any residue that is allowed to build up in large quantities and to absorb moisture may become electrically conductive.
- When replacing Muster<sup>II</sup> generators, be aware that immediately after discharge the canisters outer surface may exceed 200°C. Therefore, protective gloves should be worn before handling generators until at least 15 minutes after discharge.

Hot Work

As naked flame or prolonged exposure to temperatures above 300°C may cause activation of the generators, **hot work must not be carried out within the vicinity of any generator.** If hot works are absolutely necessary the Muster<sup>II</sup> generators should be removed to a safe area prior to any work being carried out.

Storage and Transportation

Storage and transportation shall be in accordance with Class 4.1 Dangerous Goods Classification.
MUSTER® SOLID AEROSOL GENERATOR: SAFETY DATA

Visibility: Muster® Aerosol is intended to be used in unoccupied and normally unoccupied areas. For occupied areas proper instruction for human evacuation shall be incorporated into the design, principally due to the high obscuration caused by the aerosol during and after discharge.

Oxygen Levels: Muster® Aerosol chemically attacks the fire, breaking the flame chain reaction. It does not suppress fires by oxygen depletion. After discharge, oxygen levels will remain at or about normal.

Toxicity: Inadvertent exposure to Muster® Aerosol should always be avoided. Toxicological information refers to an inadvertent exposure to the aerosol in the event of accidental discharge in a non-fire situation.

The main ingredients of the Muster® Aerosol are solid potassium carbonates, nitrogen gas, carbon dioxide gas and water vapour. At normal suppressing concentrations these products present little health hazard to personnel. However, small amounts of potentially hazardous by-products of the aerosol-generating combustion reaction, such as carbon monoxide and nitrogen oxides will be produced. Their actual concentrations depend on Muster® Aerosol design factor used and type of enclosure under protection. Their toxicological characteristics depend upon the actual concentrations achieved and duration of exposure.

**WARNING**

- Exposure to a Muster® Aerosol design factor of 100 g/m³, which is typical for class B fires in total flooding applications, for up to 15 minutes, is normally considered to represent a minor risk to personnel and may cause only moderate local irritation of the upper respiratory tract and to the eyes.

Post Fire Exposure: Safety requirements dictate, that unnecessary exposure to post-fire atmospheres should be avoided. CAUTION! Venting of the post-fire atmosphere should be to an open-air area, where possible, to prevent the inadvertent exposure of personnel to any combustion products of the fire and aerosol-generating reaction.

Thermal Hazard: There is a potential hazard of high temperatures (+150°C) of Muster® Aerosol at the end-plate nozzle, but within the minimum clearance (Refer chart page 51) from the discharge nozzle as specified for every type of M2SAG/M2SAG-M generator for locations where humans may be present, the temperature does not exceed 75°C. Those distances should be observed during installation. For further information please see page 51.

**WARNING**

- Immediately after discharge the generators can be hot, therefore, protective gloves should be worn before handling generators up to 15 minutes after discharge.

Hot Work: As naked flame or prolonged exposure to temperatures above 300°C may cause activation of the generators, hot work MUST NOT be carried out within the vicinity of any generator. If so they shall be removed prior to any hot work being carried out.

Re-entry: Following the use of Muster® Aerosol, personnel should not enter the protected area until it has been thoroughly ventilated. Exposure to the fire by-products and suppressing agent should be avoided. Wearing a respirator or other available means of protection must be worn should it be necessary to enter the area before it is fully ventilated.

Clean-up: Following a system discharge the aerosol particles that have settled should be vacuumed, blown, brushed or, if appropriate, washed away. Protective gloves and goggles must be worn. A respirator or mask must be worn.

**Large amounts of residue that is allowed to absorb moisture may become electrically conductive over a period of time.**
**Dangerous Goods Classification**: Muster® Solid Aerosol Generator is a Class 4.1 article in accordance with the United Nations Dangerous Goods Classification Code.

**CoSHH Statement**: A by-product of Muster® aerosol-generating combustion reaction are fine potassium carbonate particles, small enough to be respirated by persons not wearing RPE. There are no known toxicological long term effects of these soluble micron sized particles, and physiological effects of deep lung penetration are usually a concern for insoluble sub-micron particles as they can interfere with pulmonary functions.

However, there are clear European guidelines controlling the exposure of persons to fine particles, irrespective of their nature. Further information is available in BS EN 481:1993 & BS EN 451:1993, and in CoSHH supportive documents EH40/98 & EH44 and MDHS 14/2.

**Noise**: The sound output & frequency at the time of activation and during discharge is similar to that produced by other suppressing agents. Consequently, no specific precautions need to be taken. Environmental Impact: Muster® Aerosol does not affect earth’s ozone layer, since it does not contain chlorine or bromine in its molecular structure.

Ozone Depleting Potential (ODP) is a calculated ozone depletion per unit mass of material released relative to a standard, normally CFC-11 (CCl3F).

Ozone Depleting Potential (ODP) of Muster® Aerosol is zero.

Contribution of Muster® Aerosol to global warming is negligible, since the only component that could contribute to global warming - carbon dioxide - is present in minor quantities at normal suppressing concentrations.

Global Warming Potential (GWP) is a calculated change in warming resulting from the emission of a unit mass of a chemical relative to that of a reference. In the past CFC-11 was often used as a reference; carbon dioxide is now typically used.

The GWP depends on three variables:

1. The integrated infrared radiation absorption spectrum band strength.
2. The location of the infrared bands; and
3. The atmospheric lifetime.

Global Warming Potential (GWP) of Muster® Aerosol relatively to carbon dioxide is zero.
SYSTEM MAINTENANCE & SERVICE LIFE

The user of the installation should ensure that the system is in good working order at all times. The user should carry out monthly inspections of the fire suppression equipment. This should include looking out for obstruction of the discharge nozzle, extension/alteration of the protected enclosure, openings left unclosed that were not catered for during design, and that the position and orientation of the Muster® generators remain in the designed position.

The installation should be inspected at least once a year by an authorised Muster® M2SAG & M2SAG-M agent. The inspection plan should include all components of the system and parts of the area / space necessary for the effective operation of the system.

The M2SAG & M2SAG-M manufacture date should be checked on once a year by an authorised inspector and shall not exceed its service life within the next 12 months from the inspection. The owner shall be notified by the inspector if the expiry date occurs within the next 12 months from the inspection.

A system maintenance log should be kept and status of every maintenance visit is recorded. Please refer to the Maintenance Checklist on page 83 for a typical maintenance record.

Periodic check-up is required for electrical circuitry of Muster® system. The following steps shall be undertaken:

If the control system is designed to transmit alarm signals to a remote manned centre or bridge, always ensure that the link is disabled, or in the event that disabling the link is not an option, it would be essential to notify the centre before undertaking the test. Occupants of the area or space should also be notified that the system test might result in the sounders being activated.

1. Isolate the system via the isolation switch inside the Alarm Panel.
2. Disconnect the wiring at EVERY single M2SAG & M2SAG-M generator. It is extremely important to ensure that there are no generators inadvertently left connected.
3. Connect miniature filament lamps with 12-24 Volts voltage and current up to 50 mA in place of M2SAG & M2SAG-M generators.
4. De-isolate the Alarm Panel.
5. Activate the system. All devices shall operate and all lamps shall glow. Should the system fail to operate properly, disconnect the power supply, check connections between devices, reconnect the power supply and repeat.
6. Reset the system. All lamps shall be switched off.
7. Disconnect all of the lamps and connect the M2SAG & M2SAG-M generators in its place. Install M2SAG & M2SAG-M generators in accordance with installation recommendations.
8. Remove the sign on the manual release point or the automatic activation fire panel.

WARNING

Prior to the start of ANY maintenance work, always ensure that the first step before wiring all Muster® generator loops, the system has been electrically isolated. Failure to do so may result in unwanted spurious discharge which may result in injury.

1. Isolate the system via the isolation switch inside the Alarm Panel.
2. Disconnect the wiring at EVERY single M2SAG & M2SAG-M generator. It is extremely important to ensure that there are no generators inadvertently left connected.
3. Connect miniature filament lamps with 12-24 Volts voltage and current up to 50 mA in place of M2SAG & M2SAG-M generators.
4. De-isolate the Alarm Panel.
5. Activate the system. All devices shall operate and all lamps shall glow. Should the system fail to operate properly, disconnect the power supply, check connections between devices, reconnect the power supply and repeat.
6. Reset the system. All lamps shall be switched off.

WARNING

Prior to connecting M2SAG & M2SAG-M generators, ensure the wires leading to the generators are not carrying voltage. Connection of M2SAG & M2SAG-M generators should always be the last function in electrical wiring procedure.
Definitions of shelf and service life

Shelf (warehouse) life: a period from the date of manufacture to the date of installation – “dispatch from warehouse before” date – used by Muster® Distributors only;

Service (installation) life: a period from the date of installation to expiry date;

Expiry date: a date after which the Muster® generators shall be replaced

System Service Life

System service life in total flooding applications under normal conditions is 10 years. System service life in local applications or under conditions of aggressive environment is 7 years.

<table>
<thead>
<tr>
<th>ENVIRONMENT</th>
<th>GENERAL SERIES</th>
<th>M SERIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conditions</td>
<td>Total flooding applications under normal conditions</td>
<td>Local applications or aggressive environments</td>
</tr>
<tr>
<td>Temperature range</td>
<td>From -50°C to +65°C</td>
<td>From -50°C to +85°C</td>
</tr>
<tr>
<td>Humidity range</td>
<td>0 – 90 %</td>
<td>Above 90%</td>
</tr>
<tr>
<td>Environments which subject the system to continuous or intense vibrations</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Exterior situations exposed to the sun, ultraviolet radiation, wind, rain, or salt spray</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Corrosive atmospheres</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Abnormally dusty or moisture-laden atmospheres</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>M2SAG &amp; M2SAG-M examples of applications</td>
<td>General Industrial</td>
<td>Marine - Automotive</td>
</tr>
<tr>
<td></td>
<td>Power Industry</td>
<td>Aviation - Mining</td>
</tr>
<tr>
<td></td>
<td>Electrical</td>
<td>Gas &amp; Oil - Defence</td>
</tr>
</tbody>
</table>

Period Service Inspection

To ensure the Muster® M2SAG & M2SAG-M unit’s integrity is kept to the highest level & conform to applicable standards they required to be periodically inspected.
**Daily Inspections**

An operator should visually inspect the system &/or individual units have not been damaged or obstructed with no warning signals displayed on the Alarm Panel. The below Checklist should be followed:

---

### Daily Service Procedure - Prestart Inspection

The following service documents are a minimum outline of service requirements for the MUSTER II Fire Suppression System. The current MUSTER II Service Manual must be referred to at all times during these procedures for technical data & safety procedures.

In the Australian Standards for fire systems it is stated that a daily inspection is to be conducted. JSG recommends that this is completed so the risk of damage & defects can be lowered. The below schedule outlines inspection process. If any defects or damage sighted during this inspection should be reported.

<table>
<thead>
<tr>
<th>DATE</th>
<th>PERSON</th>
<th>PROCEDURE</th>
<th>ACTIONS TAKEN</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1. CYLINDER, CANISTER &amp; BRACKET</td>
<td>A) Check cylinder w/ or without canisters, brackets &amp; valves for damage</td>
<td>Please record procedures A through G below and comment on issues identified &amp; action taken to rectify.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>B) Check system pressure for AFFF, DCP or WM systems are within acceptable range</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C) Check actuators are undamaged, secure &amp; accessible</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D) Check security ties and date tags are in place</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. MANUAL ACTUATORS</td>
<td>E) Visual inspection for damage and security of hoses and/or cables</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>F) All indicators are normal, including battery</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. HOSES AND/OR CABLES</td>
<td>G) Panel &amp; devices are secure, undamaged &amp; accessible</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. ALARM PANEL AND WARNING DEVICES</td>
<td>H) Check system is clean, unobstructed &amp; damage free</td>
<td></td>
</tr>
</tbody>
</table>

---

2. **MANUAL ACTUATORS**

- **C) Check actuator/s are undamaged, secure & accessible.**
- **D) Check security tie and date tags are in place.**

3. **HOSES AND/OR CABLES**

- **E) Visual inspection for damage and security of hoses and/or cables.**

4. **ALARM PANEL AND WARNING DEVICES**

- **F) All indicators are normal, including battery.**
- **G) Panel & devices are secure, undamaged & accessible.**
Monthly & 6 Monthly Service Inspections

An operator or equipment maintenance person should conduct a reasonably thorough inspection of the M2SAG & M2SAG-M devices by visual inspection to ensure correct system functionality. For MARINE installation this shall be done on a monthly basis:

**THE FOLLOWING SERVICE DOCUMENTS ARE A MINIMUM OUTLINE OF SERVICE REQUIREMENTS FOR THE MUSTER FIRE SUPPRESSION SYSTEM. WHERE SAG & SAG-M UNITS ARE USED IN MARINE APPLICATIONS SERVICE INTERVAL MUST BE COMPLETED ON A MONTHLY BASIS, FOR ALL OTHER APPLICATIONS REVERT TO 6 MONTHLY INTERVALS.**

In the Australian Standards for Fire Systems it is stated that a daily inspection is to be conducted. JSG recommends that this is completed so the risk of damage & defects can be lowered. The below schedule outlines inspection process & any defects or damage sighted during this inspection should be reported.

**B) Go Through Panel Test Procedures by pressing the Test Button on F7D;B<79; (Refer to Manual)**

**A) Check Cylinder & Valve or Canister/for Damage.**

**B) Record Serial Number(s) of Cylinder(s) or Canister(s).**

**C) Record Current Test Dates of Cylinder(s) or Canister(s). Each shall not expire within 6 months. Exchange if required for testing or replacement.**

**D) Check Cylinder(s) only - check pressure is within acceptable range.**

**E) Check mounting bracket & mounts are undamaged & secure.**

**F) Battery Power**

**Operate Remote Actuator - All Test Lights Must Glow (Observe Delay to Activate for Marine Applications).**

**Reconnect all components.**

**3. Alarm Panel**

**A) Panel is Undamaged, Secure and Accessible.**

**B) Go Through Panel Test Procedures by pressing the Test Button on Panel, Press A/B/C (Refer to Manual).**

**Power Supply Indication ok - Green LED.**

**System Fault Indication - Amber LED.**

**Fire Indication - Red LED.**

**Equipment Shutdown Indication - Amber LED.**

**Mute - Green LED.**

**Warning Devices & Audible Buzzers.**

**A) Check A/B/C Connections to Cylinder(s) As Applicable.**

**B) Functional Test Electrical System - Remove A/B/C Connections to Canister(s) As Applicable.**

**Operate Remote Actuator - All Test Lights Must Glow (Observe Delay to Activate for Marine Applications).**

**Reconnect all Components.**

**4. Hosing &/or Wiring & Detection Devices for Actuation Network**

**A) Visual Inspection of All Wiring and Connectors from Alarm Panel to Valve &/or Canister(s), Manifold, Warning Block and Actuators. Check All is Secure with no Rubbing or Damage.**

**B) Visual Inspection of Detection Devices. Check Positioning & Security With no Rubbing or Damage.**

<table>
<thead>
<tr>
<th>MDW</th>
<th>Procedure</th>
<th>Pass/Fail</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cylinder/Canister Bracket</td>
<td>A) Check Cylinder/Valve or Canister/for Damage.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B) Record Serial Number(s) of Cylinder(s)/or Canister(s).</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>C) Record Current Test Dates of Cylinder(s)/or Canister(s). Each shall not expire within 6 months. Exchange if required for testing or replacement.</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>D) Check Cylinder(s) only - check pressure is within acceptable range.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E) Check mounting bracket &amp; mounts are undamaged &amp; secure.</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>B) Security Tie and Date Tag In Place.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C) Actuator and Arrow Labels Is in Good Condition.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B) Go Through Panel Test Procedures by Pressing the Test Button on Panel, Press A/B/C (Refer to Manual).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power Supply Indication ok - Green LED.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>System Fault Indication - Amber LED.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fire Indication - Red LED.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equipment Shutdown Indication - Amber LED.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mute - Green LED.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Warning Devices &amp; Audible Buzzers.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A) Check A/B/C Connections to Cylinder(s) As Applicable.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B) Functional Test Electrical System - Remove A/B/C Connections to Canister(s) As Applicable.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Operate Remote Actuator - All Test Lights Must Glow (Observe Delay to Activate for Marine Applications).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reconnect all Components.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Hosing &amp;/or Wiring &amp; Detection Devices for Actuation Network</td>
<td>A) Visual Inspection of All Wiring and Connectors from Alarm Panel to Valve &amp;/or Canister(s), Manifold, Warning Block and Actuators. Check All is Secure with no Rubbing or Damage.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Monthly & 6 Monthly Service Inspections (Continued)

### 5. DISTRIBUTION NETWORK

- **A)** Check all nozzle aiming points and positions. Check all nozzles are in place and tight.
- **B)** Check nozzles & caps are in place. Repair or replace blocked or damaged nozzles & caps. Ensure clear passage for all hosed or piped systems.
- **C)** For all hosed or piped systems - check that all 1/2" hose and pipework is tight & secure with no rubbing or damage.

### 6. LABEL & DATE TAG

- **A)** In case of fire label in place and in good condition.
- **B)** Equipment shutdown label in place and in good condition.
- **C)** Cylinders &/or canisters' labelling in place and in good condition.
- **D)** Remote actuator labels are in place and in good condition.
- **E)** Date tags fitted to cylinders &/or canisters, remote actuators and alarm panel - stamped level 1.

### NOTES

- **CHECK ALL HOSED OR PIPED SYSTEMS - CHECK THAT ALL 1/2" HOSE AND PIPEWORK IS TIGHT & SECURE WITH NO RUBBING OR DAMAGE.**

---

**MUSTER® FIRE SUPPRESSION SYSTEM**

**MONTHLY OR 260HR & 6 MONTHLY OR 2000HR SERVICE PROCEDURE**

The following service documents are a minimum outline of service requirements for the Muster® Fire Suppression System. Where SAG & SAG-M units are used in marine applications, service interval must be completed on a monthly basis. For all other applications revert to 6-MONTHLY service intervals.

**INSPECTED BY:**  
**SIGNATURE:**  
**DATE:**

**ACCEPTED BY:**  
**SIGNATURE:**  
**DATE:**

**POSITION:**  
**COMPANY:**
Annual or 12 Monthly Service Inspections (For AFFF & WM combined systems)

Equipment maintenance personnel shall conduct a highly in-depth inspection of a system if combined with the SAG or SAG-M devices through full functional testing to ensure correct system operation:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PROCEDURE</th>
<th>PASS/FAIL</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. CYLINDER OR CANISTER &amp; BRACKET</td>
<td>A) CHECK CYLINDER &amp; VALVE OR CANISTER FOR DAMAGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B) RECORD SERIAL NUMBER/S OF CYLINDER/S OR CANISTER/S.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C) RECORD CURRENT TEST DATE/S OF CYLINDER/S OR CANISTER/S.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>D) FOR CYLINDER/S ONLY - CHECK PRESSURE IS WITHIN ACCEPTABLE RANGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E) CHECK MOUNTING BRACKET &amp; MOUNTS ARE UNDAMAGED &amp; SECURE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. REMOTE ACTUATOR</td>
<td>A) CHECK ACTUATOR/S ARE UNDAMAGED, SECURE AND ACCESSIBLE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B) SECURITY TIE AND DATE TAG IN PLACE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C) ACTUATOR AND ARROW LABEL/S IN IN GOOD CONDITION.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. ALARM PANEL</td>
<td>A) PANEL IS UNDAMAGED, SECURE AND ACCESSIBLE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B) GO THROUGH PANEL TEST PROCEDURES BY PRESSING THE TEST BUTTON ON PANEL FACE (REFER TO MANUAL)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>POWER SUPPLY INDICATION - GREEN LED</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SYSTEM FAULT INDICATION - AMBER LED</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FIRE INDICATION - RED LED</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EQUIPMENT SHUTDOWN INDICATION - AMBER LED</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NOTE - GREEN LED</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>WARNING DEVICES &amp; AUDIBLE BUZZER</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>BATTERY POWER</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C) FUNCTIONAL TEST ELECTRICAL SYSTEM - REMOVE SOLENOID &amp; CONNECTIONS TO CANISTERS (AS APPLICABLE)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OPERATE REMOTE ACTUATOR - ALL TEST LIGHTS MUST GLOW DELAYED TO ACTIVATE FOR MARINE APPLICATIONS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. HOSE &amp;/OR WIRING &amp; DETECTION DEVICES FOR ACTUATION NETWORK</td>
<td>A) VISUAL INSPECTION OF ALL HOSES AND CONNECTIONS FROM ALARM PANEL TO VALVE OR CANISTERS, I-MODULE, MANIFOLD BLOCK AND ACTUATORS. CHECK ALL IS SECURE WITH NO RUBBING OR DAMAGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B) VISUAL INSPECTION OF DETECTION DEVICES. CHECK POSITIONING &amp; SECURITY WITH NO RUBBING OR DAMAGE.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

IN THE AUSTRALIAN STANDARDS FOR FIRE SYSTEMS IT IS STATED THAT A DAILY INSPECTION IS TO BE CONDUCTED. JSG RECOMMENDS THAT THIS IS COMPLETED SO THE RISK OF DAMAGE OR DEFECTS CAN BE LOWERED. THE BELOW SCHEDULE OUTLINES INSPECTION PROCESS. ANY DEFECTS OR DAMAGE SIGHTED DURING THIS INSPECTION SHOULD BE REPORTED.

IN THE AUSTRALIAN STANDARDS FOR FIRE SYSTEMS IT IS STATED THAT A DAILY INSPECTION IS TO BE CONDUCTED. JSG RECOMMENDS THAT THIS IS COMPLETED SO THE RISK OF DAMAGE OR DEFECTS CAN BE LOWERED. THE BELOW SCHEDULE OUTLINES INSPECTION PROCESS. ANY DEFECTS OR DAMAGE SIGHTED DURING THIS INSPECTION SHOULD BE REPORTED.
## 5. Distribution Network

A) Check all nozzle aiming points and positions. Check all nozzles are in place and tight.

B) Check nozzles & caps are in place. Repair or replace blocked or damaged nozzles & caps. Ensure clear passage for all hosed or piped system.

C) For all hosed or piped systems - check that all 1/2" hose and pipe work is tight & secure with no rubbing or damage.

## 6. Label & Date Tag

A) In case of fire label in place and in good condition.

B) Equipment shutdown label in place and in good condition.

C) Cylinder's & canister's labelling in place and in good condition.

D) Remote actuator label is in place and in good condition.

E) Date tags fitted to cylinders & canisters. Remove actuators and alarm panel - stamped level 1.

## 7. Discharge Test

For AFFF & WM System

A) Once all is completed a discharge test must be performed for AFFF & WM systems. Operate one of the manual actuation points to cause discharge of liquid agent and record the discharge time.

B) Check alarm panel functions. Record shutdown time. Must correspond with label time delay arrived.

C) Check all nozzles have provided adequate coverage to risk area. Adjust if necessary.

D) After discharge is complete flush the discharge/delivery lines and refit all nozzle caps.

E) Refill any test lights for sag & SAG-M systems, reconnect cable & reset system.

F) Internally inspect cylinder for defects.

G) Refill cylinders to correct fluid volume & ratio using listed agent as stated on cylinder label.

H) Charge the cylinders to the correct pressure & check there are no nitrogen leaks.

I) Remove any test lights for Sag & Sag-M systems, reconnect cable & reset system.

###.DISCHARGE TIME IN SECONDS:

###.SHUTDOWN TIME IN SECONDS:
M2SAG & M2SAG-M FIRE SUPPRESSION SYSTEM

SECTION 12 – DESIGN APPROVAL

& COMMISSIONING DOCUMENTATION
DESIGN APPROVAL & COMMISSIONING DOCUMENTATION

Prior to commencing an installation the Authority Having Jurisdiction &/or customer will have been presented documentation pertaining to the fire risk areas defined during the Risk Assessment process & a design proposal of system layout to effectively protect those risk areas. The Authority having Jurisdiction &/or customer MUST sign off on these documents prior to the installation. These documents form part of the MusterII Fire Suppression System Documentation package.

After installation, the MusterII system shall be commissioned in accordance with this Commissioning Checklist. On completion and acceptance of the commissioning, the installation contractor shall issue a Commissioning Report. The person responsible for commissioning any system is to observe the below checklist points to be recorded on the Commissioning Report & Acceptance Form.

Once the system is commissioned, the Authority Having Jurisdiction &/or customer will be presented with a thorough & completed documentation package related to the new installation.

The Package will include:

- An overview of the protected equipment.
- Risk Assessment Identification & Risk Reduction measures with Weighted Risk Scores.
- System Design Features & Layout.
- Full Bill of Materials for the installed system.
- Detailed Commissioning Report & Acceptance Form.
- Detailed Service Requirements & Checklist.

This package meets the minimum compliance requirements for AS5062-2016, most Marine Survey.
**This report is used for AFFF, DCP or WM SYSTEMS when configured with Solid Aerosol Generator system M2SAG / M2SAG-M.**

## COMMISSIONING CHECK LIST

<table>
<thead>
<tr>
<th>Name of Installer:</th>
<th>Muster Certification No.:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation Company:</td>
<td>Commissioning Date:</td>
</tr>
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</table>

### CLIENT DETAILS

<table>
<thead>
<tr>
<th>Customer:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address:</td>
</tr>
<tr>
<td>Machine Make:</td>
</tr>
<tr>
<td>Model No.:</td>
</tr>
<tr>
<td>Serial No.:</td>
</tr>
<tr>
<td>Commissioning Location:</td>
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</table>

### SERIAL NUMBERS

<table>
<thead>
<tr>
<th>Alarm Panel:</th>
<th>Cylinder 1</th>
<th>Cylinder 2</th>
<th>Cylinder 3</th>
<th>Cylinder 4</th>
<th>Cylinder 5</th>
<th>Cylinder 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valve:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D.O.M:</td>
<td>/</td>
<td>/</td>
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<td>/</td>
<td>/</td>
</tr>
<tr>
<td>Valve Type:</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>LHD</td>
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<td></td>
<td></td>
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<tr>
<td>LOP</td>
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<table>
<thead>
<tr>
<th>Remote Actuator</th>
<th>Unit 1:</th>
<th>Unit 2:</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOP Transducer Assembly:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit 3:</td>
<td>Unit 4:</td>
<td></td>
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</tbody>
</table>
**This report is for use with Solid Aerosol Generator system M2SAG / M2SAG-M only.**

<table>
<thead>
<tr>
<th><strong>SAG &amp; SAG-M COMMISSIONING FORM</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of Installer:</td>
</tr>
<tr>
<td>Muster Certification No:</td>
</tr>
<tr>
<td>Installation Company:</td>
</tr>
<tr>
<td>Commissioning Date:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>SAG &amp; SAG-M COMMISSIONING FORM</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer:</td>
</tr>
<tr>
<td>Address:</td>
</tr>
</tbody>
</table>

| Machine Make:                     |
| Model No.:                        |
| Machine Serial/VIN:               |
| Commissioning Location:           |

<table>
<thead>
<tr>
<th><strong>SYSTEM COMPONENT SERIAL NUMBERS &amp; DETAILS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer:</td>
</tr>
<tr>
<td>Canister 1</td>
</tr>
<tr>
<td>Canister:</td>
</tr>
<tr>
<td>D.O.M.:</td>
</tr>
<tr>
<td>Type: SAG &amp; SAG-M</td>
</tr>
<tr>
<td>Direction: Single - Other</td>
</tr>
<tr>
<td>Size: Location:</td>
</tr>
<tr>
<td>Canister 2</td>
</tr>
<tr>
<td>Canister:</td>
</tr>
<tr>
<td>D.O.M.:</td>
</tr>
<tr>
<td>Type: SAG &amp; SAG-M</td>
</tr>
<tr>
<td>Direction: Single - Bi</td>
</tr>
<tr>
<td>Size: Location:</td>
</tr>
<tr>
<td>Canister 3</td>
</tr>
<tr>
<td>Canister:</td>
</tr>
<tr>
<td>D.O.M.:</td>
</tr>
<tr>
<td>Type: SAG &amp; SAG-M</td>
</tr>
<tr>
<td>Direction: Single - Bi</td>
</tr>
<tr>
<td>Size: Location:</td>
</tr>
<tr>
<td>Canister 4</td>
</tr>
<tr>
<td>Canister:</td>
</tr>
<tr>
<td>D.O.M.:</td>
</tr>
<tr>
<td>Type: SAG &amp; SAG-M</td>
</tr>
<tr>
<td>Direction: Single - Bi</td>
</tr>
<tr>
<td>Size: Location:</td>
</tr>
<tr>
<td>Canister 5</td>
</tr>
<tr>
<td>Canister:</td>
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<tr>
<td>D.O.M.:</td>
</tr>
<tr>
<td>Type: SAG &amp; SAG-M</td>
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<tr>
<td>Direction: Single - Bi</td>
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<td>Size: Location:</td>
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</table>
## COMMISSIONING CHECKLIST

### SYSTEM CONFIGURATION

<table>
<thead>
<tr>
<th>Single/Primary Agent</th>
<th>Secondary Agent</th>
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<tbody>
<tr>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Actuation Method</th>
<th>System Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ LHD</td>
<td>□ Alarm &amp; Discharge</td>
</tr>
<tr>
<td>□ LOP</td>
<td>□ Alarm Only</td>
</tr>
<tr>
<td></td>
<td>□ Discharge Only</td>
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</tbody>
</table>

### CYLINDERS/CONTAINERS - AFFF, DCP, WM

<table>
<thead>
<tr>
<th>Location</th>
<th>Quantity</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>15L</td>
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<tr>
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<td>66L</td>
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<tr>
<td></td>
<td></td>
<td>110L</td>
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<table>
<thead>
<tr>
<th>Fill Volume</th>
<th>Installation orientation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>□ Vertical □ 45° □ Other</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Checklist</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Bracket/Straps – Tight &amp; Secure</td>
</tr>
<tr>
<td>□ Cylinder Label Applied</td>
</tr>
<tr>
<td>□ Vibration Eliminators Fitted</td>
</tr>
</tbody>
</table>

| Charge pressure within Range |
| Cylinder checked for leaks |
| Valve checked for leaks |

| Maintenance tag fitted to cylinder |
| Vibration eliminators fitted |

### REMOTE ACTUATORS

<table>
<thead>
<tr>
<th>Quantity Installed</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Locations Installed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
</tr>
<tr>
<td>3.</td>
</tr>
<tr>
<td>4.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Checklist</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ LOP circuit leak tested &amp; secure</td>
</tr>
<tr>
<td>□ Actuator leak tested &amp; secure</td>
</tr>
<tr>
<td>□ Security tie fitted</td>
</tr>
</tbody>
</table>

### HEAT DETECTION LOCATIONS

<table>
<thead>
<tr>
<th>Quantity Locations</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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</table>

<table>
<thead>
<tr>
<th>Location Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
</tr>
<tr>
<td>3.</td>
</tr>
<tr>
<td>4.</td>
</tr>
<tr>
<td>5.</td>
</tr>
<tr>
<td>6.</td>
</tr>
</tbody>
</table>
## ALARM PANEL & SAG/SAG-M WARNING DEVICES

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Engine Shutdown Set:</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAG or SAG-M Fitted:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warning Devices Fitted:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activation Delay Setting:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Checklist:
- All Functions as Designed
- Cabling Secure
- Equipment Shutdown Functioned
- Warning Devices Operated
- Connectors Sealed

### ACTIVATION TEST

<table>
<thead>
<tr>
<th>Actuation Point:</th>
<th>Test Lights Fitted:</th>
<th>AFFF &amp; WM Only</th>
<th>Designed Run Time:</th>
<th>Actual Run Time:</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAG &amp; SAG-M Only</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Checklist:
- Equipment Shutdown Tested
- All Caps Released
- All Test Lights Illuminated (As Applicable) After Activation Delay
- Run Time within 10% of Design Time
- All Risk Areas Received Uniform Agent Coverage
- Warning Devices Activated Immediately

## SIGNS & WARNING LABELS

### Checklist:
- In the event of fire label
- Equipment Shutdown Label
- External Warning Label
- Remote Actuator Label/s
- Evacuation Delay Label

## RISKS BEING PROTECTED

### Checklist:
- Engine 1
- Turbo
- Gear Box
- Cabin
- Hydraulic Pump(s)
- Engine 2
- Alternator
- Transmission
- Brakes
- Walkway

### Other risk areas:
## NOZZLE SCHEDULE

<table>
<thead>
<tr>
<th>Nozzle No.</th>
<th>Nozzle Type</th>
<th>Location Aiming Point</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60°</td>
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</tbody>
</table>
## SYSTEM ACCEPTANCE

This system has been installed in accordance with manufacturer’s design documentation and AS 5062-2016

<table>
<thead>
<tr>
<th>System installed by:</th>
<th>Name</th>
<th>Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>System accepted by:</td>
<td>Name</td>
<td>Signature</td>
</tr>
<tr>
<td></td>
<td>Company</td>
<td>Position</td>
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