HEAVY VEHICLE FIRE SUPPRESSION SYSTEM

FSI FOAMGUARD OPERATORS MANUAL V5.2



Fire & Safety Industries Pty Ltd
Global Fire Solutions
www.fireandsafety.com.au

THINK WORK HOME SAFE

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ABBREVIATIONS

2C	2-Core Fire Harness
4C	4-Core Fire Harness
AS	Australian Standards
BSP	British Standard Pipe
CPS	Cylinder Pressure and Solenoid Enclosure
EHP	Extreme High Pressure
EOL	End of Line
F3	Fluorine Free Foam
IL	In Line
JIC	Joint Industry Council
LI	Lithium
LHD	Linear Heat Detector
LOP	Loss of Pressure
MSM	Mechanical Sensor Module
PME	Pressure Monitoring Enclosure
PRV	Pressure Relief Valve
PTFE	Poly-Tetra-Fluoro-Ethylene Tape
ROP	Rise of Pressure
RTC	Real Time Clock
SME	System Monitoring Enclosure

SYMBOLS

CO_2	Carbon Dioxide
˚C	Degrees Celsius
ID	Internal Diameter
LGTH	Length
OD	Outside Diameter
N_2	Nitrogen Gas

UNITS

g	Gram
kPa	Kilopascal
L	Litre
m	Metre
mm	Millimetres
Nm	Newton metres
Ω	Ohms
psi	Pounds per square inch
V (DC)	Volts (Direct Current)

1.0 INTRODUCTION

This manual provides operational guidance for the use of FSI's Foam-Guard Fire Suppression Systems, including Rise of Pressure (ROP), Loss of Pressure (LOP), and Electric Actuation configurations. It also details the individual components that comprise the FSI Foam-Guard system.

2.0 DISCLAIMER

Fire & Safety Industries Pty Ltd disclaims any liability for use of data contained within this manual by any other party. This manual is an uncontrolled document when printed. FSI reserves the right to modify this manual at any time without prior notice.

All FSI personnel, FSI accredited distributors or other competent personnel shall ensure that always appropriate site safety procedures are adhered to when maintaining Foam-Guard systems.

Any modifications to the Pre-Engineered Foam-Guard System that occurs after commissioning shall first be approved by Fire & Safety Industries Pty Ltd.

In addition, it is important for owners, operators, hirers, and suppliers to provide details of all fire incidents to the vehicle manufacturer and the fire protection system manufacturer.

The technical data contained within this manual is to be used as a guide only. FSI Foam-Guard systems are to be designed, installed, commissioned, and modified by trained and competent FSI personnel or FSI accredited distributors only.

Foam-Guard systems are to be maintained by suitably trained and qualified FSI personnel, FSI accredited distributors or other formally qualified and competent personnel who are maintaining vehicle fire suppression systems on a full-time basis.

3.0 WARRANTY STATEMENT

Fire and Safety Industries Pty Ltd warrants that products manufactured and/or supplied by them are free from faults and defects. This warranty is limited to the replacement and/or repair of FSI products that have been damaged as a consequence of the defect despite proper treatment.

Products that have been sold by description or sample shall be accepted by the buyer even though alterations in design or construction have been introduced by FSI between the date of the contract and the delivery of the product.

Unless otherwise agreed to in writing the warranty period shall be twelve (12) months from date of delivery of the product to the original purchaser/client.

Freight charges for parts replaced / returned will be incurred by the customer. Products shall be returned to Fire and Safety Industries postage/freight prepaid. Fire and Safety Industries Pty Ltd does not accept responsibility for expenses relating to freight, packaging, dis-assembly, expenses for a technician or charges of a similar nature.

Claims under this warranty will be considered only if made in writing immediately as the claim arises. Repair and/or replacement shall not extend or renew the warranty.

Warranty will not be accepted unless accompanied by a warranty return document, available from Fire and Safety Industries Pty Ltd. Without limiting the generality of these terms this warranty shall not apply to products sold in the following cases:

1. When products sold are repaired or altered by any third party without FSI's consent.

2. When parts not manufactured by FSI are used in replacement or repair.

3. When products are not used with proper care or not used for the purpose for which they were sold and in accordance with any specified instructions for use.

4. If changes occur to the condition / performance of the product due to the incorrect storage / mounting or as a result of climatic or other external influences.

5. Faulty construction with the product due to the use of unsuitable materials if such method of construction / use of materials has been specified by the buyer.

6. Claims for repairs to FSI LOP (loss of pressure operation) systems unless it can be proved beyond doubt that faulty materials and or workmanship was responsible for the drop in pressure.

7. Where the products have not been installed or maintained by qualified FSI personnel or their approved service agents and distributors.

4.0 INTRODUCTION

Heavy mining equipment operates in high-risk environments where fire hazards are prevalent. These fires pose serious threats to personnel safety, can cause extensive damage to capital equipment, and result in costly production downtime.

The use of a pre-engineered fire suppression system is strongly recommended under the following conditions:

INACCESSIBLE HAZARDS

Fixed suppression nozzles can be strategically installed in areas where handheld extinguishers are impractical or cannot reach. FSI Foam-Guard systems are ideal for applications where fire hazards are obstructed or inaccessible to personnel.

RAPID RESPONSE REQUIREMENT

FSI Foam-Guard systems are designed for immediate actuation, removing the potential for human error or delay. These systems are recommended when a fire is likely to engulf the entire hazard area rapidly and immediate suppression is critical.

LIMITED PERSONNEL AND TRAINING

FSI Foam-Guard systems are particularly effective in environments where onsite personnel are limited or lack formal firefighting training. The systems operate automatically to provide reliable fire protection without manual intervention.

DEFINED FIRE RISK ZONES

Foam-Guard systems are suitable for equipment where fire hazards are well-defined and confined to specific locations, such as engine bays, hydraulic compartments, and electrical enclosures.

FSI offers Fluorine-Free Foam (F3) solutions, engineered to meet the diverse fire protection needs across heavy industry. Typical application areas are outlined in Table 1.

Table 1
FSI Foam-Guard Typical System Applications

SURFACE MINING EQUIPMENT	UNDERGROUND MINING EQUIPMENT
Dozers	Loaders
Graders	Service Units
Excavators	Haul Trucks
Haul Trucks	Wheel Loaders
Wheeled Loaders	Refuelling Stations

FORESTRY EQUIPMENT	CONSTRUCTION EQUIPMENT
Loggers	Bulldozers
Skidders	Graders
Graders	Shovels
Trucks	Wheel Loaders
Excavators	Generator Sets
Bulldozers	Scrapers

INDUSTRIAL	ROAD TRANSPORT
Fuel Stores	Prime Movers
Transformers	Service Trucks
Machines	Water Carts
Generator Rooms	Concrete Pumpers
Forklift Trucks	Powered Trailers

5.0 SYSTEM OVERVIEW

FSI Foam-Guard Fire Suppression Systems are available in four configuration types: Rise of Pressure (ROP), Loss of Pressure (LOP), Electric Actuation, and ROP/Electric Actuation.
Regardless of configuration type, there are four main sub-systems that go into creating the fire suppression system:

The component parts required are as follows:

FOAM STORAGE CYLINDER containing Foam-Guard Fluorine Free Foam (F3) concentrate, Drinkable/Potable water and compressed with dry nitrogen.

MONITORING SYSTEM comprising of V5 Fire Alarm Module located in the operator's cab which provides audible and visual signals of both fire system status, activation, system faults and engine shutdown integration.

ACTUATION AND DETECTION SYSTEM comprising either a Foam-Guard Mechanical Sensor Module (MSM), Foam-Guard LOP Tubing, Foam-Guard Linear Heat Detector (LHD), or Foam-Guard Thermal Probes to automatically initiate activation. Activation may also be initiated manually via pneumatic or electrically operated manual actuators.

DISCHARGE NETWORK includes discharge hoses, ring-main hoses and discharge nozzles to distribute the foam solution throughout the risk area.

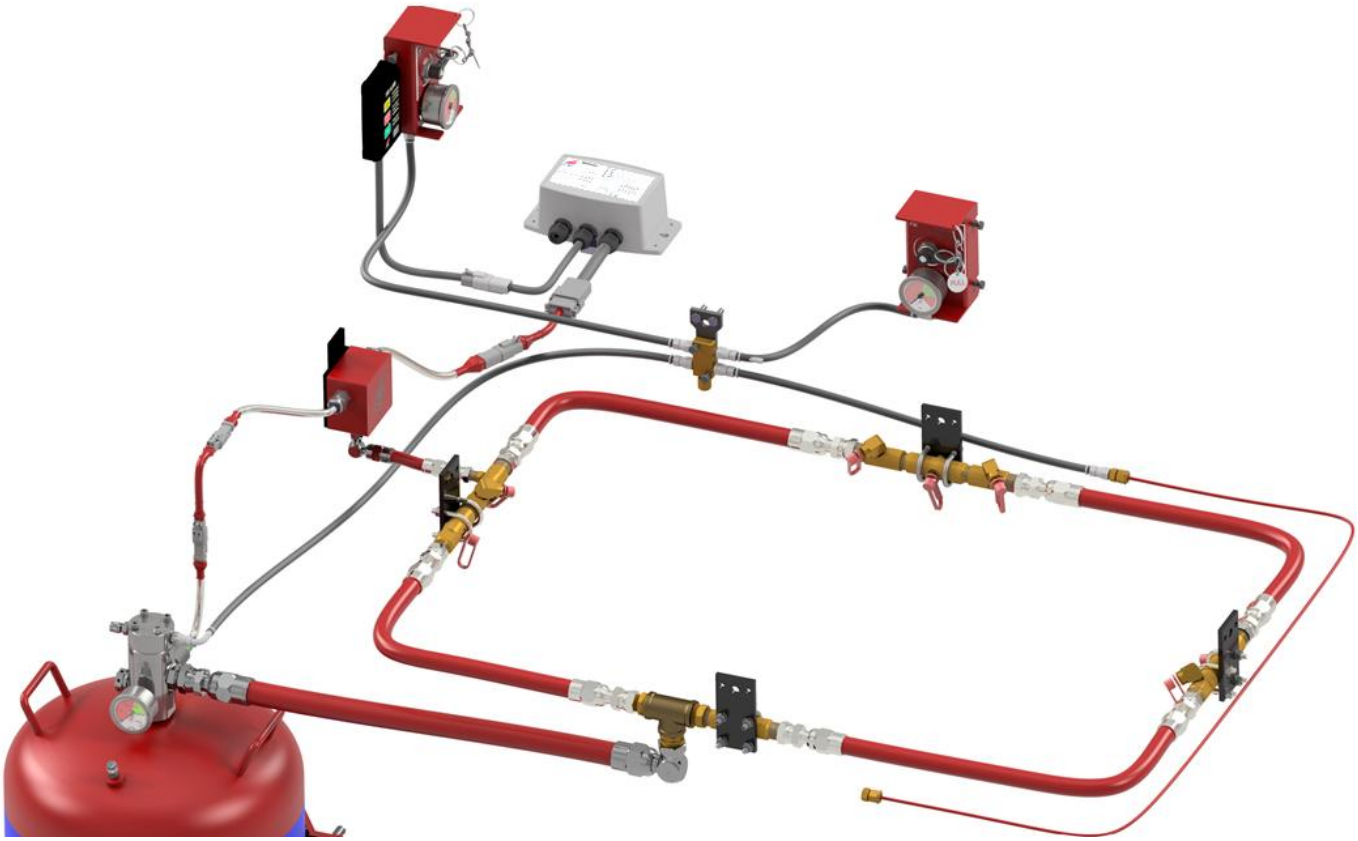


Figure 1
System Overview

5.1 RISE OF PRESSURE SYSTEM (ROP)

FSI ROP Foam-Guard Fire Suppression Systems operate via an increase in actuation line pressure. This system is manually activated by an operator striking the ROP manual actuator or automatically by an increase in temperature within the risk area, activating the Mechanical Sensing Module (MSM). This activates the ROP discharge valve located on the cylinder.
Foam solution is then distributed via discharge hosing and nozzle assemblies to cover the risk area. Pressure switches are also activated to initiate an audible and visual alarm via the V5 Display Module indicating a system discharge.



Figure 2
ROP System Layout

5.2 LOSS OF PRESSURE SYSTEM (LOP)

FSI LOP Foam-Guard Fire Suppression Systems operate via a loss of actuation line pressure. This is manually activated by an operator turning the LOP manual actuator lever, or automatically by an increase in temperature within the risk area, rupturing the LOP detection tube. This activates the LOP discharge valve located on the cylinder.
Foam solution is then distributed via discharge hosing and nozzle assemblies to cover the risk area. Pressure switches are also activated to initiate an audible and visual alarm via the V5 Display Module indicating a system discharge.



Figure 3
LOP System Layout

5.3 ELECTRIC ACTUATION

FSI Electric Foam-Guard Fire Suppression Systems operate via an electrical signal. This is manually activated by an operator using the manual actuator switch, or automatically by an increase in temperature within the risk area activating the (LHD) Linear Heat Detector and/or Thermal Probes. This activates the solenoid on the discharge valve located on the cylinder.
Foam solution is then distributed via discharge hosing and nozzle assemblies to cover the risk area. Pressure switches are also activated to initiate an audible and visual alarm via the V5 Display Module indicating a system discharge.

CAUTION
Before carrying out any maintenance on an electric actuation system, the control module SHALL BE ISOLATED to prevent an accidental discharge. Disconnecting the main power supply WILL NOT reset the system. Isolating the electric system will disable all input and outputs



Figure 4
Electric Actuation System Layout

5.4 ROP ELECTRIC ACTUATION

FSI ROP Electric Foam-Guard Fire Suppression Systems operate via an increase in actuation line pressure. This is manually activated by an operator striking the ROP manual actuator, or automatically by an increase in temperature within the risk area activating the (LHD) Linear Heat Detector and/or Thermal Probes. This activates the solenoid on the ROP discharge valve located on the cylinder.
Foam solution is then distributed via discharge hosing and nozzle assemblies to cover the risk area. Pressure switches are also activated to initiate an audible and visual alarm via the V5 Display Module indicating a system discharge.

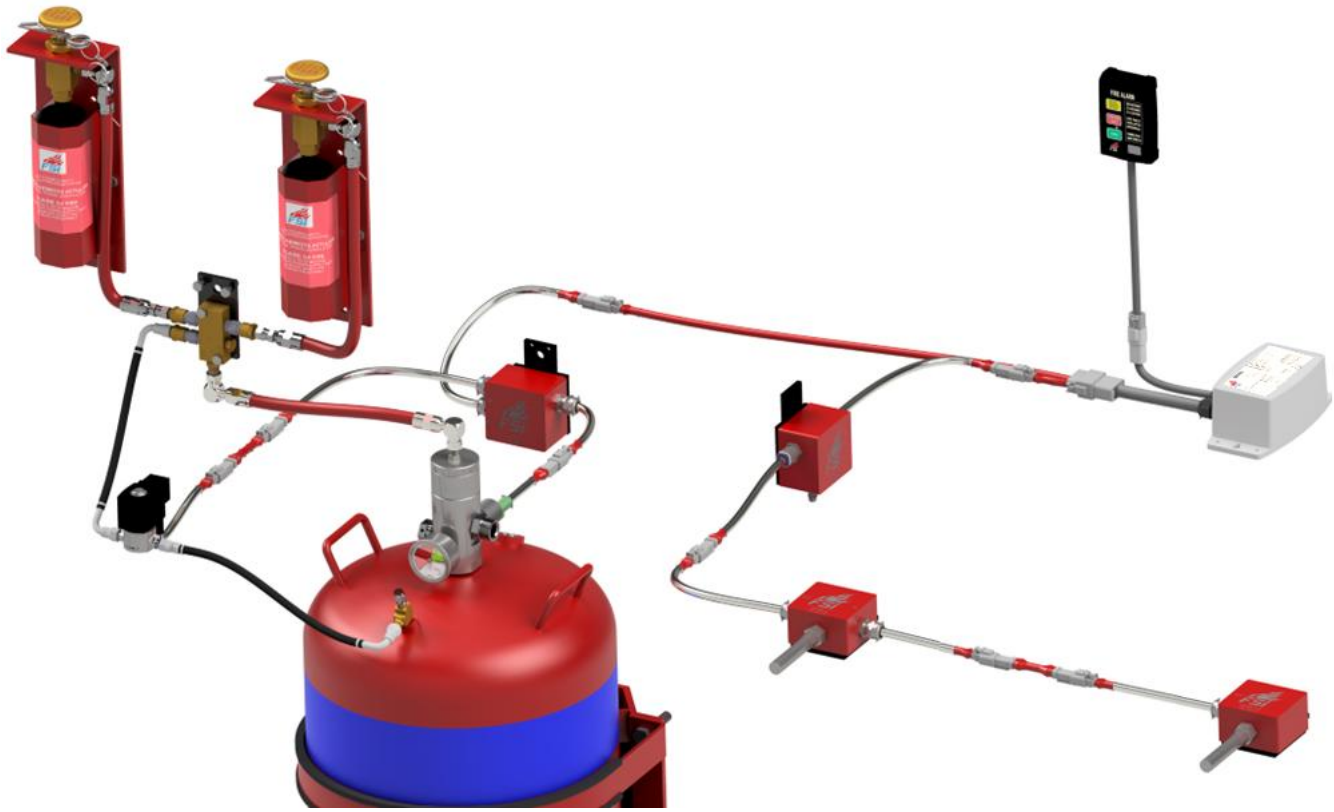


Figure 5
ROP Electric Actuation System Layout

6.0 PRESTART INSPECTIONS

Regular inspections of FSI Foam-Guard systems are necessary to maintain system performance and reliability. A pre-start inspection is required at the commencement of any shift. During the pre-start inspection, check ALL components and locations listed in Table 1 for obvious signs of system component damage. Damaged components are to be repaired or replaced by qualified and competent personnel only.

Table 2
Daily Inspection Requirements

SYSTEM COMPONENT	LOCATION
System Pressure	Cylinder Discharge Valve(s)
Manual Actuator	Vehicle (various location)
Pull-pins	Manual Actuators
Securities	Manual Actuators
Fire Alarm Module	Operator Cabin

7.0 MAINTENANCE SCHEDULE

The maintenance schedule in Table 2 shall be used when maintaining FSI Foam-Guard Fire Suppression Systems. It is recommended to consider all government and environmental regulations when conducting maintenance.

Highly corrosive and extreme environments are commonplace in mining activities. This can adversely affect the integrity of the systems and its components. It is important the integrity of the system components are thoroughly inspected.

Table 3
Maintenance Schedule

Service Level	Service Type	Service Frequency	Tolerances +/-
1	6 Monthly	6 Months	1 Month
2	1 Yearly	1 Yearly	2 Months
2	2 Yearly	2 Yearly	2 Months
4	Cylinder Pressure Test	5 Yearly	3 Months

CAUTION

The scheduled frequencies of inspection, testing, and maintenance are based on a single work shift under moderate operating conditions.
Failure to conduct these maintenance tasks could result in an inoperative fire protection system, increasing the risk of personal injury and potential machine loss.

CRITICAL DEFECTS

A defect that renders a system inoperative.
Shall be rectified as soon as practicable and confirmed in writing within 24 hr.

Equipment shall not be operated until the critical defects are rectified unless alternative risk reduction measures are implemented for the safety of personnel.

An "out-of-service" tag should be used to indicate that the system is temporarily impaired. Tags should be attached to the affected equipment for the duration of the impairment.

NON-CRITICAL DEFECTS

A system impairment or faulty component not likely to critically affect the operation of the system.
Shall be rectified as soon as practicable and reported.

NON-CONFORMANCE

Should be rectified prior to the next yearly condition report.
Missing or incorrect features that do not affect the system operation but are required to facilitate ongoing routine service.

NOTE
In adverse conditions or continuous operation, consideration should be given to increasing the frequency of the maintenance schedule. For example, the 6-monthly may need to be conducted at a 3-monthly frequency or 1 yearly may need to be conducted at a 6-monthly frequency. The tolerance schedule does not require additional routine service activities to be carried out (e.g., 6-monthly routines carried out at 5 or 7 monthly intervals). These tolerances are designed to allow for occasional scheduling conflicts.

NOTE
An “Out of Service” tag shall be located at the machine isolation point and fire system activation locations when servicing or maintenance procedures are likely to impair the effective operation of the fire suppression system.

8.0 GENERAL SAFETY INFORMATION - OPERATOR TRAINING

8.1 OPERATOR TRAINING

All operators, supervisors, and maintenance personnel must receive appropriate training to ensure they are prepared to respond effectively in the event of a fire. Training should include, but is not limited to, the following areas:

- Understanding the fire hazards specific to the make and model of the vehicle or equipment.
- Familiarisation with the fire protection system installed on the vehicle, including its coverage limits and actuation methods.
- Proper use of portable fire extinguishers, including extinguisher types, ratings, and limitations.
- Emergency response actions to be taken in the event of a fire, in line with site emergency procedures.
- Correct operation of system actuators, including remote manual actuators (ROP/LOP) and electric actuation devices.
- Training must be conducted by qualified personnel and should be refreshed regularly or when new equipment or systems are introduced.

8.3 IN THE EVENT OF A FIRE

In the event of a fire, the FSI Foam-Guard system will actuate automatically via the Foam-Guard Mechanical Sensor Module (MSM), Foam-Guard LOP Tubing, Foam-Guard Linear Heat Detector (LHD), or Foam-Guard Thermal Probes, depending on system type. Warning alarms will be emitted from the fire alarm panel (if fitted) upon automatic system discharge.

The FSI Foam-Guard system can also be operated manually. In the event of a fire, park the vehicle in a safe location, shutdown the engine and activate the system via the manual actuator. Warning alarms, both visible and audible, will be emitted from the fire alarm panel (if fitted) upon manual system discharge.

The engine shutdown function (optional) may engage after a pre-set time of 0 - 30 seconds (regardless of actuation method).

CAUTION

Even after the FSI Foam-Guard fire suppression system has discharged, residual hot spots may remain in the protected area. These can present a risk of reignition, particularly in the presence of flammable fluids or materials.
The operator should remain at a safe distance with a portable fire extinguisher readily available until the risk of reignition has fully subsided.

8.4 AFTER SYSTEM DISCHARGE

Immediately following system discharge, it is not recommended to start the vehicle until the fire incident is investigated and the reason for system discharge has been identified by a suitably trained technician. The FSI Foam-Guard fire suppression system shall be inspected and recharged before releasing back into operation, in accordance with the FSI maintenance manual.

9.0 OPERATOR CONTROLS

9.1 ROP MANUAL CO2 ACTUATOR OPERATION

The FSI Foam-Guard ROP Manual Actuation System is designed to allow for manual discharge of the fire suppression system using a striker-type actuator.

- The ROP Actuator Assembly contains a high-pressure CO_2 cartridge that provides gas pressure to the actuation circuit.
- A striker knob and pin mechanism pierces the CO_2 cartridge when struck, initiating system discharge.
- A pull-pin is fitted to all ROP actuator assemblies to prevent unintentional actuation.
- A securitie device secures the pull-pin in place. If the securitie is missing, inspect the cylinder pressure immediately to confirm the system has not been discharged.

ACTUATOR LOCATION

Manual actuation points are positioned based on fire risk assessment and are commonly located:

- Within the operator cabin
- Along egress paths and emergency exits
- Near service points

EMERGENCY FIRE SUPPRESSION ACTIVATION – STEP-BY-STEP

1. Bring the vehicle to a stop in a safe location and commence emergency procedures.
2. Locate the Remote Manual Actuator (ROP) as identified during operator induction or the fire risk assessment.
3. Remove the pull-pin from the actuator. This action will cause the securitie to break away.
4. Firmly strike the striker knob to pierce the CO_2 cartridge and discharge the fire suppression system.
5. Exit the vehicle safely and move to a designated assembly or safe area.
6. Stand at a safe distance with a portable fire extinguisher, remaining vigilant for signs of reignition.
7. Contact a qualified technician to inspect, recharge, and recommission the fire suppression system before the vehicle is returned to service.

NOTE
Emergency procedure may vary depending on site and location.

NOTE
Firmly strike the striker knob as below



Figure 6
ROP Manual Actuator

9.2 LOP MANUAL ACTUATOR OPERATION

The FSI Foam-Guard LOP Manual Actuation System uses a ball valve-type actuator to manually discharge the system.

- The actuator is equipped with a pressure gauge that displays the actuation circuit pressure. The operational pressure range is indicated in green on the gauge:
- A pull-pin is provided to secure the actuator handle and prevent unintentional activation.
- A securitie device retains the pull-pin. If the securitie is missing, check system pressure immediately to verify the system hasn't discharged.

ACTUATOR LOCATION

Manual actuation points are positioned based on fire risk assessment and are commonly located:

- Within the operator cabin
- Along egress paths and emergency exits
- Near service points

EMERGENCY FIRE SUPPRESSION ACTIVATION – STEP-BY-STEP

1. Bring the vehicle to a stop in a safe location and commence emergency procedures.
2. Locate the LOP Manual Actuator as identified during operator training and the fire risk assessment.
3. Remove the pull-pin. The securitie will break away upon removal.
4. Rotate the handle anticlockwise to actuate the system and discharge the foam solution.
5. Exit the vehicle safely and proceed to a designated assembly area.
6. Remain at a safe distance with a portable fire extinguisher to monitor for any reignition.
7. Engage a qualified technician to inspect, recharge, and recommission the fire suppression system prior to returning the vehicle to service.

NOTE
Emergency procedure may vary depending on site and location.

NOTE
Rotate handle anticlockwise to manually actuate/discharge the system as below



Figure 7
LOP Manual Actuator Handle

9.3 ELECTRIC MANUAL ACTUATOR OPERATION

The FSI Foam-Guard Electric Actuation System is designed to allow manual discharge of the fire suppression system via an electrically triggered toggle switch.

The electric actuator includes the following safety features:

- A pull-pin to secure the switch and prevent unintentional actuation.
- A securitie device, which holds the pull-pin in place. If this is missing, check the system to ensure it has not been activated.
- A red safety cover that shields the toggle switch from accidental contact.

ACTUATOR LOCATIONS

Manual actuation points are positioned based on fire risk assessment and are commonly located

- Within the operator cabin
- Along egress paths and emergency exits
- Near service points

EMERGENCY FIRE SUPPRESSION ACTIVATION – STEP-BY-STEP

1. Bring the vehicle to a stop in a safe location and commence emergency procedures.
2. Locate the Electric Actuator as identified in site-specific training and the fire risk assessment.
3. Remove the pull-pin. The securitie will break away upon removal.
4. Flip up the red safety cover to access the toggle switch.
5. Activate the toggle switch by switching it to the ON position to discharge the fire suppression system.
6. Exit the vehicle safely and proceed to a designated safe area.
7. Remain nearby with a portable fire extinguisher to monitor for potential reignition.
8. Notify a qualified technician to inspect and recommission the fire suppression system before returning the vehicle to operation.

NOTE
Emergency procedure may vary depending on site and location.

NOTE
When the pull pin is removed, the red safety cover can be lifted up, and the switch underneath can be switched to the on position



Figure 8
Electric Manual Actuator Switch

9.4 FIRE ALARM PANEL

The Foam-Guard system uses visual and audible indications to constantly monitor system pressure, system discharge, ambient engine bay temperatures, system faults and the supply voltage. These indications can be identified in the display window. The display panel has easy to read sealed touch buttons. The touch buttons are backlit by LED light bars and can be dimmed for night-time operation. A system test also can be controlled via the display panel.

FSI V5 Alarm Modules with Firmware version 17 have been updated with an acknowledgement mode. This feature allows non-critical system faults to be acknowledged and temporarily silenced until they can be rectified. Firmware versions are displayed in the window upon initial power-up or resetting of the display module.

When the system is in operational condition, NORMAL and MAIN POWER ON are illuminated green. If activated, the FIRE ALARM illuminates red, and the engine shutdown timer counts down in the display window. This timer varies depending on configuration parameters. Once the shutdown counter reaches "00," it will be displayed for 2 minutes, during which time the system cannot be isolated until the display window is blank.

It is possible to press the Shutdown Extend button to extend the shutdown delay in order to move the vehicle to safe location. Each time the Shutdown Extend button is pressed the timer is reset to delay the shutdown a further 3 x 10 seconds. At the end of the shutdown delay the vehicle shutdown signal is activated, the red ENG SHUTDOWN goes steady (stops flashing) and the Shutdown Extend Switch and System Test Switch become inoperable. The red FIRE ALARM and CYL DISCHARGE will continue to flash accompanied by pulsed tone.

System Normal; Two green indications are normally illuminated when the system is in operational condition: NORMAL and MAIN POWER ON.

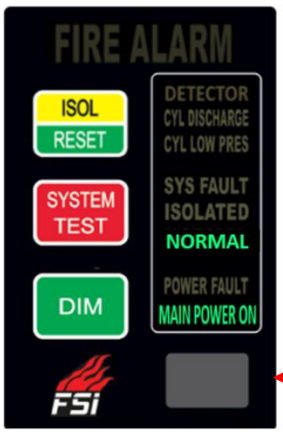


Figure 9
Indicator Display Panel

Display Window



Figure 10
Shutdown Display Panel

NOTE
All Alarm, Shutdown and Fault conditions are latched on and cannot be operator reset. Notify a qualified FSI service technician to inspect, diagnose, and rectify any issue before returning the system to service Disconnecting any power supply WILL NOT reset the latching switch which controls the electric actuation solenoid valve (where fitted).

10.0 PRE START INSPECTION

10.1 SYSTEM PRESSURE

CAUTION
DO NOT remove any parts from the cylinder prior to fully depressurising the cylinder. Failure to comply with these instructions may result in personal injury.

The FSI Foam-Guard fire suppression system uses a pressurised cylinder assembly comprising of a cylinder pressure vessel, a cylinder discharge valve, and a pressure gauge. The pressure gauge displays the current cylinder charge pressure. Variations within the green zone are considered normal due to environmental conditions. The system is deemed operational only when the gauge reading is within the designated green sector.

NORMAL OPERATING PRESSURE

- For F3 systems, the operating pressure ranges between 1400 kPa and 1800 kPa.
- This range is indicated by the GREEN sector on the pressure gauge.
- Fluctuations within the green zone are acceptable and expected due to changes in ambient temperature and elevation (refer to Table 4).

INSPECTION PROCEDURE

1. Visually inspect the cylinder pressure gauge before each shift.
2. Confirm that the gauge needle is within the GREEN sector.
3. If the gauge is below the green zone, the system may not function correctly and must be inspected by qualified and competent personnel.
4. A low-pressure condition may indicate a leak, failed component, or temperature-related pressure drop.
5. Immediately notify a qualified FSI service technician to inspect, diagnose, and rectify any issue before returning the system to service.

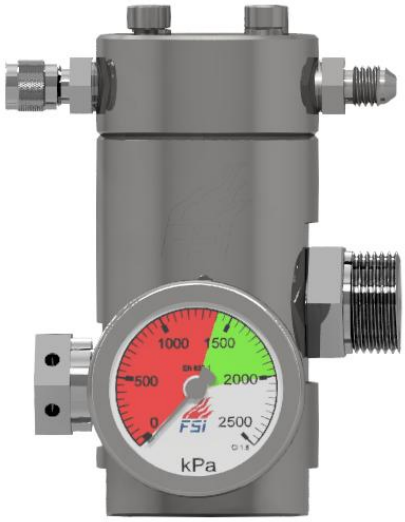


Figure 11
Cylinder Pressure Gauge

CAUTION
Varying ambient air temperatures will not cause the fire suppression system to go into low pressure alarm, if charged correctly. When the pressure gauge reads outside of the green sector the system is required to be inspected by a qualified service technician Refer to Table 4 for Pressure vs Temperature variation.

Table 4

Charge Pressure Vs Temperature

TEMPERATURE (°C)	CHARGE PRESSURE (KPA)
1	1527
5	1549
10	1577
15	1605
20	1633
25	1661
30	1689
35	1716
40	1744
45	1772
50	1800
55	1829
60	1857

10.2 ROP MANUAL CO2 ACTUATOR

1. Locate all Manual Actuators, including those positioned in:

    - The operator cabin
    - Access stairs, Paths of egress
    - Emergency stop (E-Stop) locations
    - Service platforms or arms

    The cabin-mounted actuator must be within the operator's normal field of view and reach for immediate accessibility in an emergency.

2. Inspect each Manual Actuator for any visible signs of damage, corrosion, loose components or tampering.

3. Ensure no obstructions are present that may restrict access to or operation of the actuators.

4. Confirm both the pull-pin and securitie are correctly fitted on all Manual Actuators to prevent accidental actuation.

5. If the pull-pin or securitie is missing, immediately check the system pressure to verify whether the system has discharged.

6. Immediately notify a qualified FSI service technician to inspect, diagnose, and rectify any issue before returning the system to service.



Figure 12
ROP Manual Actuator and CO_2 Cartridge

WARNING
The CO_2 cartridge is a sealed pressure vessel. Avoid heavy impacts; this may rupture the CO_2 cartridge and cause personal injury and/or damage to equipment.

10.3 LOP MANUAL ACTUATOR

1. Locate all Manual Actuators, including those positioned in:

    - The operator cabin
    - Access stairs, Paths of egress
    - Emergency stop (E-Stop) locations
    - Service platforms or arms

    The cabin-mounted actuator must be located within the operator's normal field of view and reach for immediate access during an emergency.

2. Inspect each Manual Actuator for visible signs of damage, corrosion, loose components or tampering.

3. Ensure no obstructions are present that may restrict access to or operation of the actuators.

4. Confirm both the pull-pin and securitie are correctly fitted on all Manual Actuators to prevent accidental actuation.

5. If the pull-pin or securitie is missing, check the system pressure immediately to determine whether the fire suppression system has been actuated.

6. Compare all actuator pressure gauges to ensure:

    - All readings are consistent across actuators.
    - Each gauge is indicating within the GREEN sector, confirming the system is pressurised and ready for operation.

7. Immediately notify a qualified FSI service technician to inspect, diagnose, and rectify any issue before returning the system to service.



Figure 13
LOP Manual Actuator

WARNING
Low ambient air temperatures will not cause the system to enter a low-pressure alarm condition, provided the fire suppression system has been charged correctly. If the pressure gauge reading falls outside the GREEN sector, regardless of ambient conditions, the system must be inspected by a qualified service technician before the equipment is returned to service.

10.4 ELECTRIC MANUAL ACTUATOR

1. Locate all Manual Actuators, including those positioned in:

    - The operator cabin
    - Access stairs, Paths of egress
    - Emergency stop (E-Stop) locations
    - Service platforms or arms Operator cabin

    The cabin-mounted actuator must be located within the operator's normal field of view and reach for immediate access during an emergency

2. Inspect each Manual Actuator for visible signs of damage, corrosion, loose components or tampering

3. Ensure no obstructions are present that may restrict access to or operation of the actuators.

4. Confirm both the pull-pin and securitie are correctly fitted on all Manual Actuators to prevent accidental actuation.

5. If the pull-pin or securitie is missing, check the system pressure immediately to determine whether the fire suppression system has been actuated.

6. If the display panel indicates a fault, the fire suppression system may not be operational. The system must be inspected immediately by a qualified and competent FSI service technician



Figure 14
Electric Manual Actuator

NOTE
If a faulty circuit is detected from the electric actuator, it will initiate a shutdown sequence on systems fitted with a Shutdown Module.

10.5 V5 - FIRE ALARM DISPLAY

1. Locate the Display Panel

2. Inspect the display panel for any active fault codes or warning indicators.
   If the display panel indicates a fault, the fire suppression system may not be operational. The system must be inspected immediately by a qualified and competent FSI service technician

3. Confirm that the Display Panel is positioned within the operator's normal field of view and reach for ease of monitoring during operation.

4. Verify that the Display Panel is securely mounted and appears to be in operational condition, free from damage, loose fittings, or water ingress.

5. Test the functionality of the Display Panel by pressing the System Test button.

6. Check that all visual indicators and audible alarms activate correctly during the test sequence.

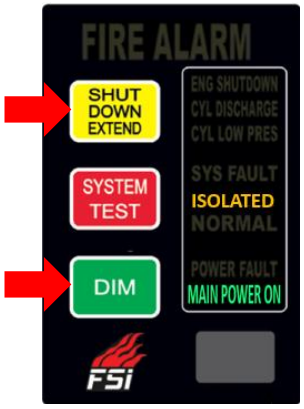


Figure 15
Display Panel

11.0 V5 SHUTDOWN MODULE

11.1.1 V16 - SYSTEM ISOLATION/ RESET PROCEDURE

Isolation Mode is used to disable the detection and actuation circuits of the fire suppression system, preventing accidental discharges during maintenance or testing. When isolated mode is activated, the ISOLATED indicator will illuminate, to indicate the system is isolated.

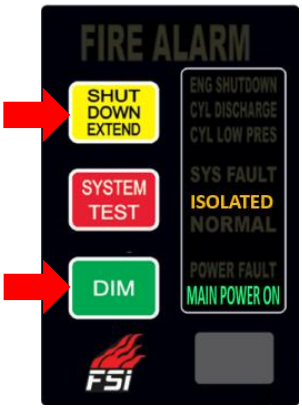


- **ISOLATION**
  1. Press and hold SHUTDOWN EXTEND and DIM buttons for 7 seconds.
  2. ISOLATED will illuminate.

- **RESET**
  1. Press and hold SHUTDOWN EXTEND and DIM buttons for 7 seconds.
  2. This will reset any non-latched faults or alarms and illuminate NORMAL.

11.1.2 V17 - ACKNOWLEDGMENT MODE PROCEDURE

Acknowledgment Mode allows operators to acknowledge non-critical faults without affecting the systems operation. When a fault is detected on the Discharge/Low-Pressure circuits or a battery fault, activating this mode mutes the audible tone for 12 minutes. During this period, the circuit indicator remains illuminated while the SYS FAULT light flashes once per second. If the fault persists after 12 minutes, the system resumes beeping every 2 minutes. All shutdown inputs remain active, ensuring the system will discharge as required. Entering or exiting Acknowledgment Mode also resets any latched faults or alarms, and the mode cannot be activated if no faults are present. If no faults are detected when the 12-minute period expires, the system resets automatically.

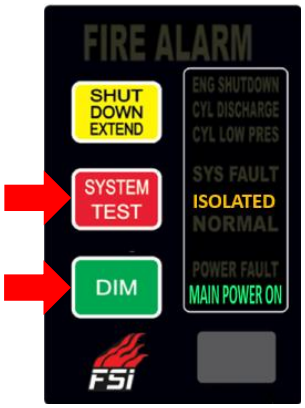


- **ENTER ACKNOWLEDGMENT MODE**
  1. Press and hold SHUTDOWN EXTEND and DIM buttons for 7 seconds.
  2. This will mute any non-critical system faults 12 minutes.

- **EXIT ACKNOWLEDGMENT MODE**
  1. Press and hold SHUTDOWN EXTEND and DIM buttons for 7 seconds.
  2. This will reset any non-latched faults or alarms and illuminate NORMAL.

11.1.3 V17- ISOLATION MODE PROCEDURE

Isolation Mode is used to disable the detection and actuation circuits of the fire suppression system, preventing accidental discharges during maintenance or testing. When Isolation Mode is activated, the ISOLATED indicator will illuminate, and the system will beep once every two minutes to indicate the system is isolated. If the system is operating on the back-up battery, the beep will not occur. Programming access and Bluetooth connectivity are restricted to Isolated Mode.

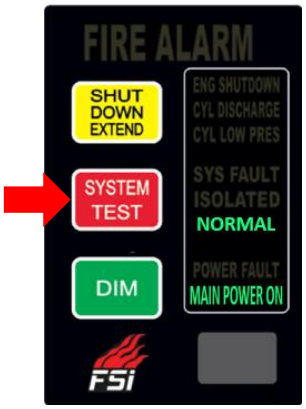


- **ENTER ISOLATION MODE**
  1. Press and hold **SYSTEM TEST** and **DIM** buttons for 10 seconds, 1 beep to confirm and ISOLATED Flashes rapidly
  2. Enter the sequence of 6 keys (beeping after each press)
     1) **SYSTEM TEST** (RED)
     2) **SHUT DOWN EXTEND** (YELLOW)
     3) **SHUT DOWN EXTEND** (YELLOW)
     4) **SHUT DOWN EXTEND** (YELLOW)
     5) **DIM** (GREEN)
     6) **SHUT DOWN EXTEND** (YELLOW)

     If the sequence is entered wrong or taken longer than 30 sec, it will exit and return to normal mode, where the procedure can be repeated.

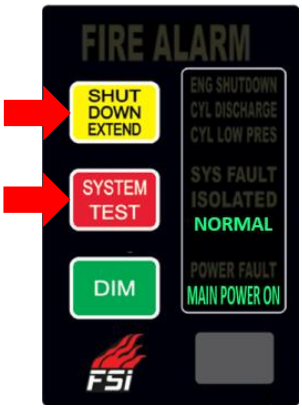
- **EXIT ISOLATION MODE**
  1. Press and hold **SHUTDOWN EXTEND** and **DIM** buttons for 7 seconds.
  2. This will reset any non-latched faults or alarms and illuminate NORMAL.

11.1.4 SYSTEM TEST



- Under normal operational conditions momentarily pressing the **SYSTEM TEST** button will cycle the Module through a system check
- Upon completion, provided no faults are detected, the display will return to the normal and main power on condition when 12/24VDC mains power is supplied.
- In the Alarm or Fault modes pressing the **SYSTEM TEST** button will cycle through all latched faults and/or alarms in the display window.

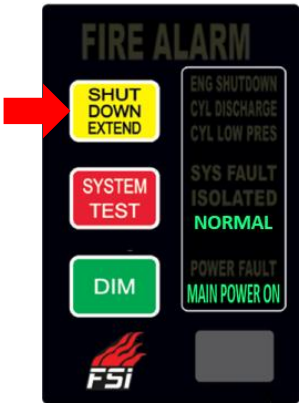
11.1.5 SHUTDOWN TEST



- Ensure that vehicle engine is on and running normally.
- Press and hold **SYSTEM TEST** and **SHUTDOWN EXTEND** buttons for 7 seconds, this will start the shutdown timer. This will in turn test the engine shutdown output function which should shut down the engine after the pre-set time delay.
- A System reset procedures is required to reset Module back to normal.

NOTE
Ensure to comply with all OEM and/or site requirements for functional testing of equipment.

11.1.6 SHUTDOWN EXTEND



- It is possible to press the **SHUTDOWN EXTEND** button to extend the shutdown delay to get the vehicle to safe location.
- Each time the **SHUTDOWN EXTEND** button is pressed the timer is reset to delay the shutdown a further 10 seconds.
- Maximum number of three 10 second shutdown delays.
- At the end of the shutdown delay the vehicle shutdown signal is activated.

SYSTEM NORMAL



NORMAL and **MAIN POWER** ON indications are illuminated when the system is in operational condition.

FIRE ALARM



If a Thermal Probe/LHD operates due to a rise in temperature the **NORMAL** will go out, **FIRE ALARM** and **ENG SHUTDOWN** will flash red, at this time the engine shutdown timer will initiate accompanied by the pre-programmed count down in the display window.

SYSTEM FAULT



If a system fault is detected on a circuit the **NORMAL** will go out and the **SYS FAULT** will illuminate.

Pressing **SYSTEM TEST** will display a fault code in the display window.

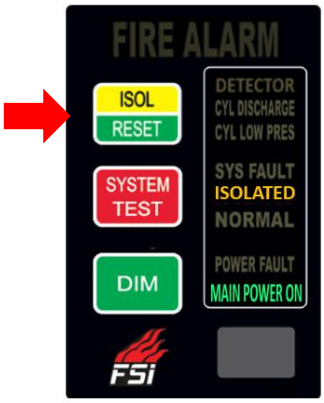
SYSTEM POWER FAILURE (BACK UP BATTERY)



If the main power supply is lost when the backup battery is enabled **NORMAL** will illuminate every 1 min to indicate the loss of main power. All fault and alarm conditions will still be detected.

11.2.0 V5 INDICATOR MODULE

11.2.1 V16 - SYSTEM ISOLATION/ RESET PROCEDURE

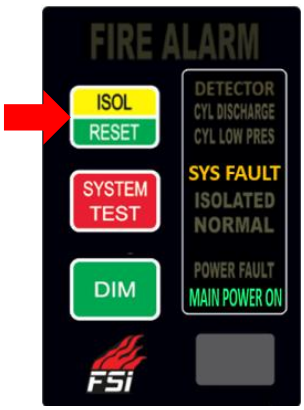


- **ISOLATION**
  To isolate the Indicator Module, press and hold the ISOL/RESET for 7 seconds. This will illuminate the Amber ISOLATED display and allow maintenance to be carried out, all three (3) detector circuits are isolated.

- **RESET**
  To reset the Indicator Module, press and hold the ISOL/RESET for 7 seconds. This will illuminate the NORMAL on the display.

11.2.2 V17 - ACKNOWLEDGMENT MODE PROCEDURE

Acknowledgment Mode allows operators to acknowledge non-critical faults without affecting the systems operation. When a non-critical fault is detected on the Discharge/Low-Pressure circuits or back-up battery, activating this mode mutes the audible tone for 12 minutes. During this period, the circuit indicator remains illuminated while the SYS FAULT light flashes once per second. If the fault persists after 12 minutes, the system resumes beeping every 2 minutes. All inputs remain active, ensuring the system will discharge as required. Entering or exiting Acknowledgment Mode also resets any latched faults or alarms, and the mode cannot be activated if no faults are present. If no faults are detected when the 12-minute period expires, the system resets automatically.

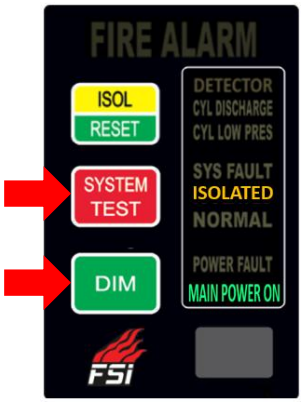


- **ENTER ACKNOWLEDGMENT MODE**
  1. Press and hold ISOL/RESET button for 7 seconds.
  2. This will mute any non-critical system faults 12 minutes

- **EXIT ACKNOWLEDGMENT MODE**
  1. Press and hold ISOL/RESET buttons for 7 seconds.
  2. This will reset any non-latched faults or alarms and illuminate NORMAL

11.2.3 V17 -ISOLATION MODE PROCEDURE

Isolation Mode is used to disable the detection and actuation circuits of the fire suppression system, preventing accidental discharges during maintenance or testing. When Isolation Mode is activated, the ISOLATED indicator will illuminate, and the system will beep once every two minutes to indicate that the system is isolated. If the system is operating on the back-up battery, the beep will not occur. Programming access and Bluetooth connectivity are restricted to Isolation Mode.

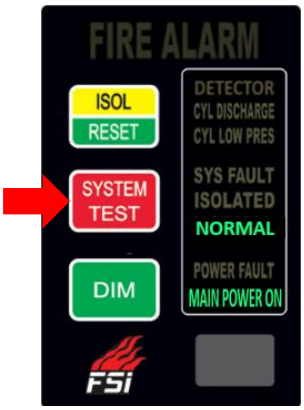


- **ENTER ISOLATION MODE**
  1. Press and hold SYSTEM TEST and DIM buttons for 10 seconds, 1 beep to confirm and ISOLATED Flashes rapidly
  2. Enter the below sequence (beeping after each press)
     1. SYSTEM TEST (RED)
     2. ISOL/RESET (YELLOW/GREEN)
     3. ISOL/RESET (YELLOW/GREEN)
     4. ISOL/RESET (YELLOW/GREEN)
     5. DIM (GREEN)
     6. SHUT DOWN EXTEND (YELLOW)

     If the sequence is entered incorrectly or takes longer than 30 seconds, the process will exit, and the procedure can be repeated.

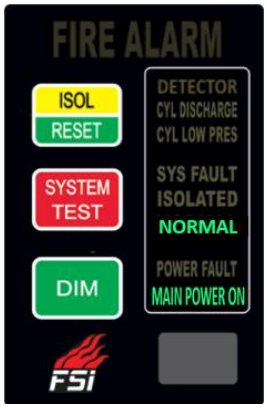
- **EXIT ISOLATION MODE**
  1. Press and hold ISOL/RESET buttons for 7 seconds.
  2. This will reset any non-latched faults or alarms and illuminate NORMAL

11.2.4 SYSTEM TEST



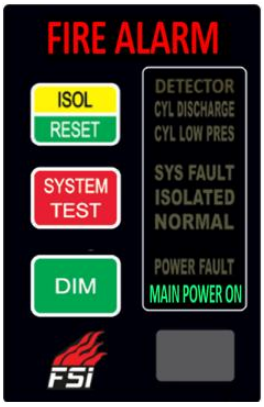
- Under normal operational conditions momentarily pressing the SYSTEM TEST button will cycle the Module through a system check.
- Upon completion, provided no faults are detected, the display will return to the normal and main power on condition when 12/24VDC mains power is supplied.
- In the Alarm or Isolated mode pressing the SYSTEM TEST button will cycle through all latched faults and/or alarms on the display window.

SYSTEM NORMAL



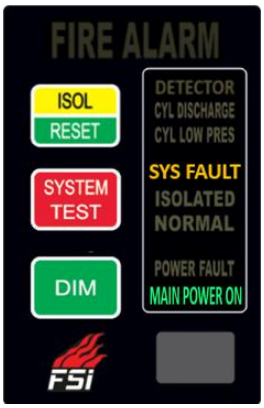
NORMAL and **MAIN POWER ON**, indications are illuminated when the system is in operational condition.

ALARM



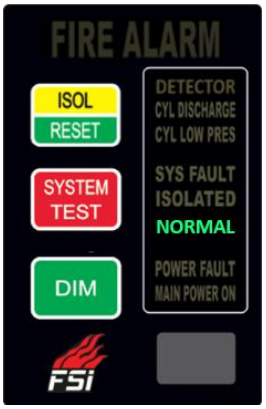
If an alarm is activated due to a thermal probe, cylinder low pressure or system discharge the **NORMAL** will go out and the alarm circuit that has activated will illuminate. Pressing **SYSTEM TEST** will display a fault code in the display window.

SYSTEM FAULT



If a system fault is detected on a circuit the **NORMAL** will go out and the **SYS FAULT** will illuminate.
Pressing **SYSTEM TEST** will display a fault code in the display window.

SYSTEM POWER FAILURE (BACK UP BATTERY)



If the main power supply is lost when the backup battery is enabled **NORMAL** will illuminate every 1 min to indicate the loss of main power. All fault and alarm conditions will still be detected.

12.0 ALARM AND FAULT CODES

When the FSI Foam-Guard V5 Control Module is in an alarm or fault condition the applicable codes will be displayed in the display window, this is accessed by pressing the SYSTEM TEST button.

- An alarm condition will override any pre-existing fault conditions.
- All alarms and fault conditions are latching until reset.
- Resetting the Module is done by entering and then exiting the isolated mode.

12.1 ALARM CODES

A0	Detector Circuit Alarm
A1	Discharge Switch Alarm
A2	Low Pressure Switch Alarm
A3	Remote Trigger Alarm – Aux Digital In
AA	Electric Manual Actuation Circuit Alarm
00	Solenoid is energised (2 Mins)

12.2 FAULT CODES

F0	Detector Circuit Fault
F1	Discharge Pressure Switch Circuit Fault
F2	Low Pressure Switch Circuit Fault
F3	Solenoid Circuit Fault (Set when Driven)
F4	Display Cable Fault
F5	Internal Supply Fault
F6	Backup Battery Fault
F7	Battery Charge Fault
F8	RTC Battery Fault
F9	General System Fault
FA	Manual Actuation Circuit Fault
F4 + F9	Incorrect Configuration of Display Module

WARNING
All alarm and fault conditions are latching and cannot be operator reset.

ALARM		CAUSE
A0	Detector Circuit Alarm	• Detection circuit has activated • Faulty probes/LHD. • Faulty plugs/wiring.
A1	Discharge Switch Alarm	• System has been discharged. • Faulty pressure switch. • Faulty plugs/wiring.
A2	Low Pressure Switch Alarm	• System is low pressure. • Faulty pressure switch. • Faulty plugs/wiring.
A3	Remote Trigger Alarm – Aux Digital In	• System has been activated. • Faulty plugs/wiring.
AA	Electric Manual Actuation Circuit Alarm	• System has been actuated. • Faulty electric actuator. • Faulty plugs/wiring.

FAULTS		CAUSE
F0	Detector Circuit Fault.	• Faulty probes/LHD. • Faulty plugs/wiring. • System configuration.
F1	Discharge Pressure. Switch Circuit Fault.	• Faulty pressure switch. • Faulty plugs/wiring.
F2	Low Pressure Switch. Circuit Fault.	• Faulty pressure switch. • Faulty plugs/wiring. • System configuration.
F3	Solenoid Circuit Fault. (Set when driven)	• Faulty solenoid. • Faulty plugs/wiring. • System configuration.
F4	Display Fault	• Faulty Display cable. • Faulty plugs.
F5	Internal Supply Fault.	• Incorrect voltage supply
F6	Backup Battery Fault.	• Battery is low voltage. • Battery not connected, battery is faulty, or a board fault exists. • System configuration.
F7	Battery Charge Fault.	• Ambient Temp below 0˚C or above 47˚C. • Battery not connected. • Battery is faulty. • CPU fault exists.
F8	RTC Battery Fault.	• Battery fault. • RTC Voltage below 1.8 volts.
F9+F4	Incorrect Configuration	• nA selected for a shutdown Module.
FA	Manual Actuation Circuit Fault	• Faulty Electric actuator. • Faulty plugs/wiring. • System configuration.
U	Unconfigured (Isolated Mode)	• System not configuration.
U	Display will not program (No display illumination)	• CPU frozen.
	Display Module will not deisolate	• All configurations not programmed.

13.0 EXTINGUISHERS

The FSI Foam-Guard fire suppression system is engineered to protect specific hazards and fire risk areas identified during the initial fire risk assessment. It is not designed to extinguish fires in all areas of the equipment. Protection is limited to the system's coverage as defined and agreed upon by all stakeholders during the assessment and system design process.

The presence of a fixed FSI fire suppression system does not eliminate the requirement for portable fire extinguishers or other supplementary firefighting equipment.

LIMITATIONS OF SYSTEM COVERAGE

Fires may still occur in areas outside the designed protection zone, such as:

- Fuel or oil spill areas
- Locations affected by hot work (e.g., welding or cutting)
- Compartments not covered by fixed nozzles or foam solution

PORTABLE FIRE EXTINGUISHERS – SELECTION AND REQUIREMENTS

The fire risk assessment determines the type, quantity, rating, and placement of extinguishers and other firefighting equipment, in accordance with site-specific requirements and applicable standards.

Key factors influencing the selection of extinguishers include:

- Type of fire risk (e.g., Class A, B, C, E fires) – determines the extinguishing type (e.g., foam, dry powder, CO_2).
- Size and weight of the extinguisher – affects the user's ability to carry and operate it safely and effectively.
- Vehicle or equipment occupancy – influences the number and accessible locations of extinguishers required.

Notes