HEAVY VEHICLE FIRE SUPPRESSION SYSTEM

FSI FOAM-GUARD MAINTENANCE MANUAL - V5.3

Fire & Safety Industries Pty Ltd

Global Fire Solutions

www.fireandsafety.com.au

THINK WORK HOME SAFE

TABLE OF CONTENTS

TABLES

FIGURES

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 FSI Foam-Guard Maintenance Manual - V5.3 (AS5062-2016) provides inspection, testing, and maintenance procedures for FSI Foam-Guard Rise of Pressure (ROP), Loss of Pressure (LOP), and Electric Actuation fire suppression systems. It is intended for use by qualified personnel responsible for maintaining FSI Foam-Guard Fire Suppression Systems.

Regular maintenance of the FSI Foam-Guard Fire Suppression System is essential to ensure ongoing reliability and performance throughout the systems service life. To support this, a defined maintenance schedule is provided to verify that all required inspection and servicing tasks are completed.

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 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.

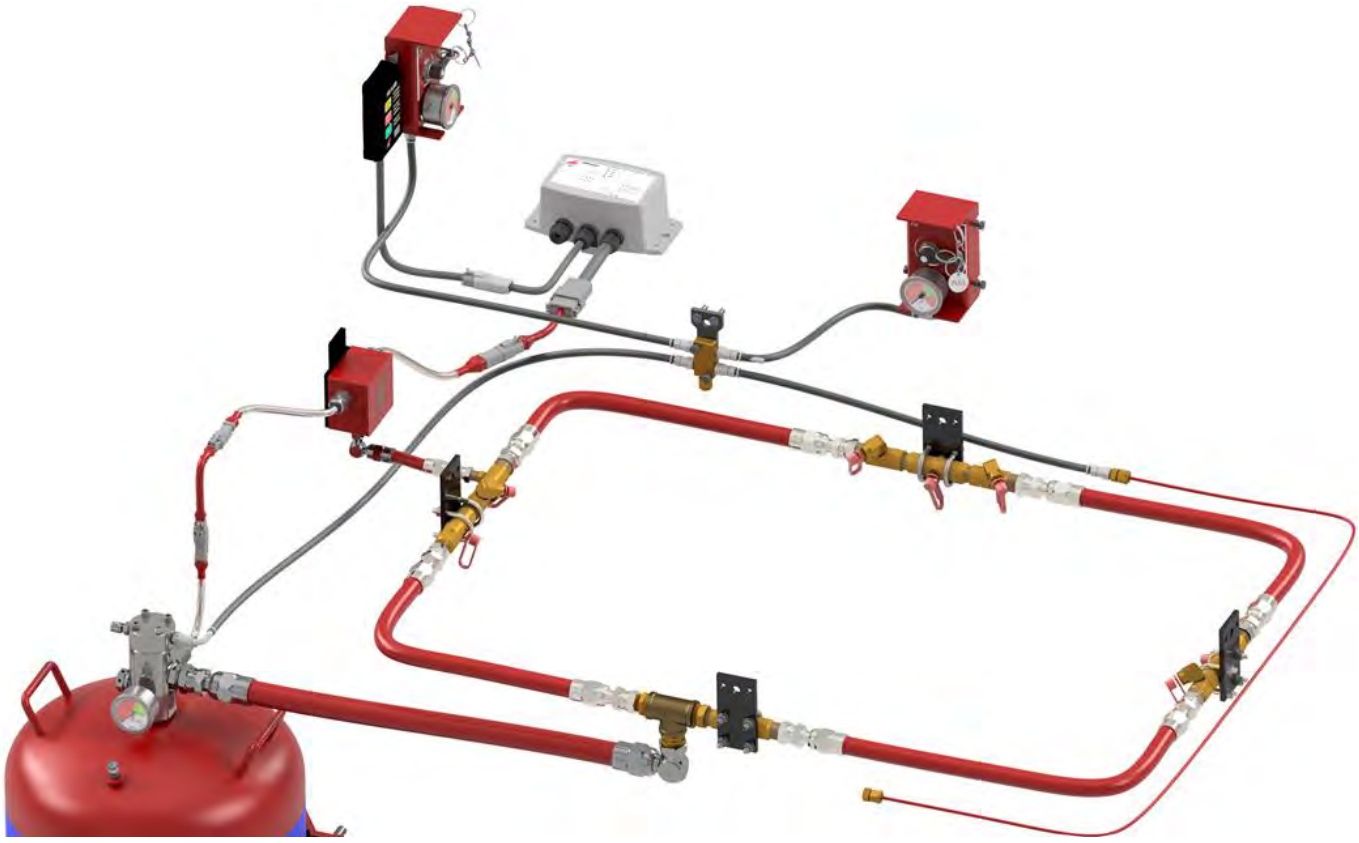


Figure 1
System Overview

3.1 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

3.2 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

3.3 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

3.4 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.

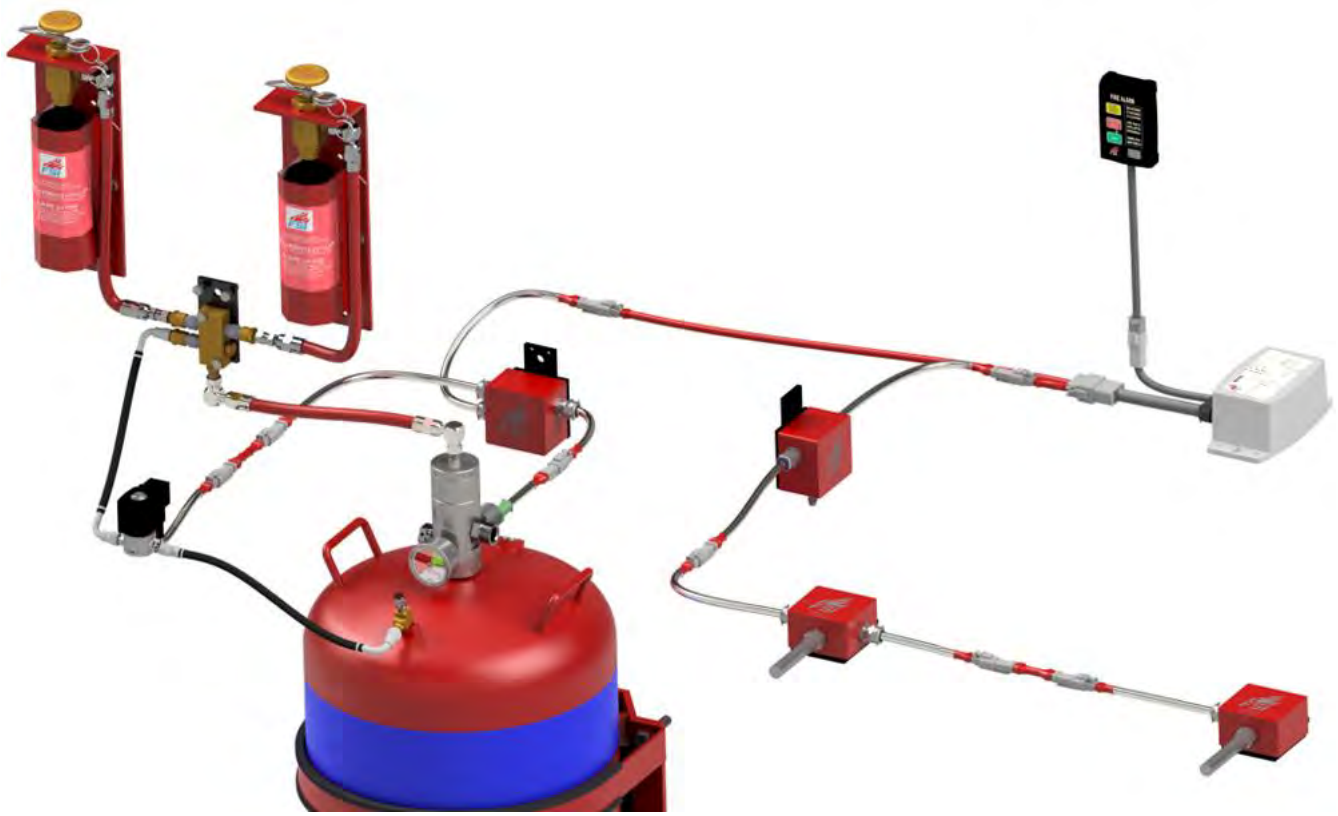


Figure 5
ROP Electric Actuation System Layout

4.0 PRESTART INSPECTIONS

Regular inspections of FSI Foam-Guard system 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 1
Daily Inspection Requirements

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

5.0 MAINTENANCE SCHEDULE

The maintenance schedule in Table 2 shall be used when maintaining FSI Foam-Guard Fire Suppression System. 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 system and its components. It is important the integrity of the systems components are thoroughly inspected.

Table 2
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

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

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.

6.0 MAINTENANCE SERVICE CHECKLIST

6.1 6-MONTHLY SERVICE

1. Check system pressure is in operational range and gauges are visible.
2. Check the discharge valve for condition and security.
3. Check cylinder for condition and security.
4. Check cylinder bracket for condition and security.
5. Check manual actuators for condition and security.
    a. Check ROP cartridges for correct weight, date, and condition.
    b. Check LOP pressure gauges are in operational range and gauges are visible.
    c. Check electric actuator and circuitry.
6. Ensure safety pins can be easily removed and replace all securities.
7. Check nozzles and caps are clean and unobstructed.
8. Check nozzles are correctly aligned and secure.
9. Check the condition of the discharge hoses for security and obstructions.
10. Check the condition of the actuation hoses for security and leaks.
11. Check audible and visual alarms are operational on the Display Module.
12. Check for correct program configuration to ensure all monitoring circuits are operational.
13. Check pressure switches, cables, connectors, and enclosures for condition and security.
14. Check all detection circuits for condition, security, and correct location.
    a. Probe condition, security, and correct location.
    b. MSM, condition, security, and correct location.
    c. LOP condition, security, and correct location.
    d. LHD and Solenoid condition, security, and correct location.
15. Ensure the condition of all system labels are legible and up to date.

6.2 1-YEARLY SERVICE

1. Complete all 6 monthly service requirements.
2. Full system discharge test via manual actuator.
3. Clear passage test all discharge hoses and refit nozzle caps.
4. Clear passage and leak test all actuation circuits.
5. Test operation of all actuators.
    a. ROP Cartridges weighed/replaced. Replace striker pin if used.
    b. LOP actuator reset (lever, pull pin, refit relief port cap).
    c. Solenoid clear passage and leak tested.
    d. Test the operation of each electric actuator.
6. Replace all securities.
7. Refilled and recharged system to the correct pressure.
8. Yearly survey of fire system.

6.3 2-YEARLY SERVICE

1. Complete all the 6 monthly and 1 yearly service requirements.
2. Replace detection devices and mounting hardware.
    a. ROP Mechanical Sensor Modules (MSM).
    b. LOP Detection Tubing.
    c. LHD Linear Heat Detector.
3. Replace and lubricate all discharge valve O-rings.
4. Replace and lubricate all discharge valve shuttle assemblies.
5. Replace and lubricate all ROP striker pins.
6. Replace all nozzle silicone caps.
7. Replace all LOP manual actuator pressure relief port caps.
8. Replace backup battery (Electric Actuation).
9. Test operation of thermal probes (if fitted).

6.4 5-YEARLY SERVICE - CYLINDER PRESSURE TESTING

1. Complete all 1 Yearly or 2 Yearly service requirements.
2. Replace cylinder(s).
3. Replace all cylinder band rubbers and bracket band rubbers.
4. Replace thermal probes (if fitted).
5. Replace electric solenoid (Electric Actuation).
6. Affix all required cylinder labels.
7. Replace burst disc/ pressure relief valve (PRV)
8. Replace Control module RTC battery.

7.0 6-MONTHLY SERVICE PROCEDURE

7.1 SYSTEM PRESSURE

The cylinder pressure gauge is located on the Cylinder Discharge Valve.

System operating pressure is between 1400kPa & 2000kPa and is represented by the GREEN sector on the pressure gauge.

A variation within the green sector is normal when there are variations in ambient temperatures as per Table 5.

If the system is below its operational pressure the relevant inspections shall be made to determine the cause of the low-pressure condition by qualified and competent personnel.

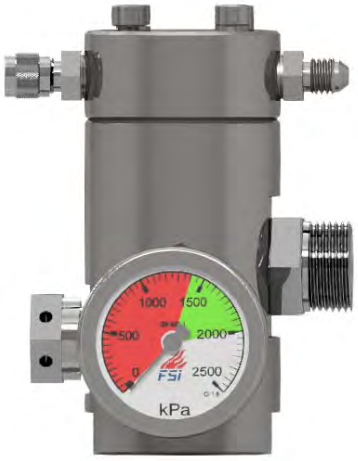


Figure 6
Cylinder Pressure Gauge

1. The FSI Foam-Guard fire suppression system should be isolated prior to commencing any inspection or maintenance to prevent an uncontrolled discharge as per the ROP and LOP ISOLATION PROCEDURE.

2. Inspect system pressure via the pressure gauge located on the cylinder discharge valve. Compare the pressure to the ambient temperature as per Table 5

3. If the system is low in pressure, it shall be checked for leaks and rectified. The system shall then be recharged to the correct operating 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. Depress Schrader valve cores to ensure the cylinder is fully depressurised.

NOTE

The reason why the system discharged shall be identified and repaired prior to recharging.

7.2 CYLINDER DISCHARGE VALVE

The Cylinder Discharge Valve is manufactured from a solid piece of nickel-plated brass which houses the Burst Disc/Pressure Relief Valve (PRV), Cylinder Low-Pressure Switch, Pressure Gauge, Charging Port and Shuttle assembly. The Syphon Tube is threaded into the base of the Cylinder Discharge Valve.

The Cylinder Discharge Valve has two variations, Rise of Pressure and Loss of Pressure. An electric solenoid can be connected to either valve to allow for electric actuation.

If required, the cylinder discharge valve can be reconditioned/repaired.

Figure 7
LOP Cylinder
Discharge Valve

Figure 8
ROP Cylinder
Discharge Valve

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. Depress Schrader valve cores to ensure the cylinder is fully depressurised.

7.3 CYLINDERS

FSI Cylinders are constructed of Stainless Steel and powder coated red. A blue band is fitted to the cylinder to identify FSI Foam-Guard Fluorine Free Foam (F3). Cylinders are available in various configurations and sizes. 16L, 23L, 45L, 65L, 106L for vertical configuration and 23L, 65L, 106L for horizontal configurations.
Vertical cylinders shall be mounted no greater than 30° off vertical and horizontal cylinder shall be mounted horizontally

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. Depress Schrader valve cores to ensure the cylinder is fully depressurised.

1. Visually inspect cylinders for physical damage and ensure cylinders will not exceed the 5-year period for hydrostatic pressure testing prior to next scheduled service.
2. Inspect all surfaces of the cylinder for abrasion and damage.
3. If damage is identified, compare the area with the limits given in 15.0 AS2337.1-2004 CYLINDER INSPECTION.
4. Ensure cylinder labels are affixed and legible. Replace labels if damaged, missing, or illegible.

CAUTION
If the cylinder exceeds the limits as stated in as 2337.1 the cylinder shall be condemned.

Figure 9
Cylinder Assembly

7.4 CYLINDERS BRACKETS

The FSI Cylinder Bracket is constructed of steel and are powder coated Blue or Red. They are available in various configurations and sizes; vertical, horizontal, Slimline, and extra heavy duty. The Cylinder is secured to the Bracket using steel Cylinder Bands and protected with rubber moulded Band Rubbers.

Ensure the cylinder bracket is free from damage and is securely mounted to the equipment with M12 bolts, washers, spring washers and nuts **(A).**

Ensure the cylinder is secured in the bracket and there is no damage to the cylinder bands or rubbers.

If cylinder bands/rubbers are loose, remove bands and check condition of cylinder and rubbers, replace if damaged. Refit bands and rubbers correctly ensuring the cylinder is firmly secure **(B).**

Check and retention bracket mounting bolts **(A)** & **(B)** as per Table 6.

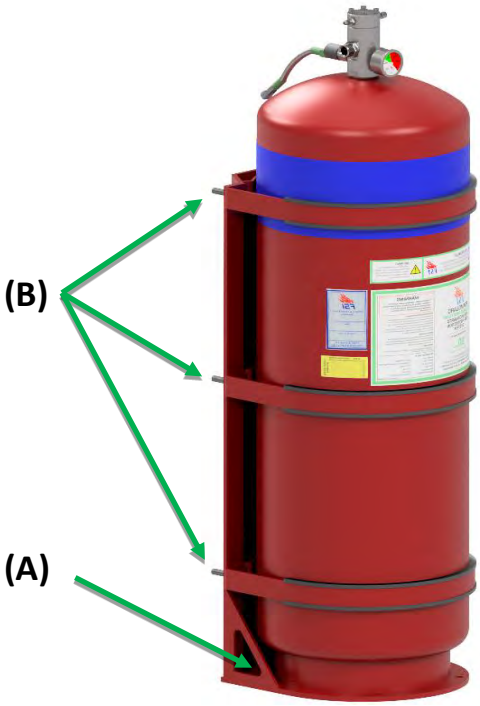


Figure 10
Cylinder Bracket Assembly

7.5 MANUAL ACTUATORS

CAUTION
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.

ROP MANUAL ACTUATOR

The FSI Foam-Guard ROP system uses a striker pin-type actuator for manual system activation. The ROP actuator assembly contains a high-pressure CO_2 cartridge that, when pierced, releases gas to pressurise the actuation circuit.

A strike knob and striker pin are used to puncture the CO_2 cartridge, initiating system actuation. To prevent accidental discharge, a pull-pin secures the striker pin in place during normal operation. A security tie is used to retain the pull-pin and provide visual indication of tampering or prior activation.

Figure 11
ROP Manual Actuator and CO_2 Cartridge

1. Identify all Manual Actuator locations i.e., operator cabin, access stairs, egress paths, E-Stops, service arms etc.
2. Inspect all manual actuators for visible signs of damage. Replace damaged components as required.
3. Remove all actuator cartridges and weigh using digital scales (accurate to 1.0g)
4. If the disc is punctured, damaged or older than 5 years, condemn and replace the cartridge.
5. Remove and reinsert all safety pins to ensure they are free from damage.
6. Inspect the condition of the striker pin and knob. Ensure the pin is sharp.
7. Ensure the striker knob is retained with LOCTITE 263.
8. Secure the cartridge into the actuator body and ensure O-ring is lubricated with Molykote 111.
9. Install a new securitie.
10. Apply LOCTITE 263 to the cartridge thread when operating in harsh conditions.
11. Ensure the actuator label and AS5062 maintenance tags are affixed and legible. Replace label if damaged or illegible. Label should be located on the manual actuator shroud and marked according to date of service.

NOTE
The cab manual actuator should be within the operator's normal field of view and reach.

NOTE
The measured weight shall be within +/- five (5) grams of the charged weight printed onto the cartridge. If the measured weight is outside these limits or cannot be determined, the cartridge shall be condemned and replaced.

LOP MANUAL ACTUATOR

FSI Foam-Guard LOP systems utilise a ball valve-type manual actuator for manual system activation.

The actuator includes a pressure gauge that displays the pressure within the actuation circuit. Normal operating pressure is indicated by the green sector on the gauge.

A pull-pin is used in all LOP Manual Actuator assemblies to secure the actuator lever, preventing accidental discharge. A security tie is also installed to retain the pull-pin and indicate any unauthorised tampering or prior activation.

Figure 12
LOP Manual Actuator F3

1. Identify all Manual Actuator locations i.e., operator cabin, access stairs, egress paths, E-Stops, service arms etc.
2. Inspect all manual actuators for visible signs of damage. Replace damaged components as required.
3. Check the pressure gauge is liquid filled, and the rubber grommet is in place.
4. Compare all manual actuator pressure gauges to confirm they are all indicating the same pressure in the green sector.
5. Remove and reinsert all safety pins to ensure they are free from damage.
6. Install a new securitie.
7. Ensure an actuator label and AS5062 maintenance tag is attached and legible. Replace if damaged or illegible.

NOTE
The cab manual actuator should be within the operator's normal field of view and reach

NOTE
A fluctuation within the green sector is normal when there is variations in ambient temperatures as per Table 5. If the pressure gauge reads outside of the green sector, the system may need to be inspected by a qualified and competent service technician.

ELECTRIC MANUAL ACTUATOR

FSI V5 Foam-Guard fire suppression systems can utilise electric actuators to actuate the system.

A red cover protects the switch from accidental actuation. When the pull pin is removed, the red safety cover can be flipped up, and the switch underneath can be switched to the on position actuating the fire suppression system.

A safety pull-pin and securitie is used to secure the lever and prevent an accidental discharge.

The EOL Electric Actuator contains a 10kΩ (+/- 10%) resistor to monitor the circuit. A number of additional Inline Electric Actuators can be installed depending on the size of the risk area.

The electric actuator in the off position has open contacts, upon activation the contacts within the electric actuator will close. The FSI V5 Control module will detect this condition and initiate the electric solenoid.

Figure 13
Electric Manual Actuator

1. Identify all Manual Actuator locations i.e., operator cabin, access stairs, egress paths, E-Stops, service arms etc.
2. Check Display Module for fault codes.
3. Test Electric Actuator
   2 Pin EOL Actuator Check for the correct resistance across terminal pins 1 + 2 when in the off position.
   4 Pin Inline Actuator Check for continuity across terminal pins 1 + 4 and 2 + 3 when in the off position.
4. Inspect all manual actuators are free from damage, replace damaged components as required.
5. Remove and reinsert all safety pins to ensure they are free from damage.
6. Install a new securitie.
7. Ensure the Fire Harness is secured using P-clamps at the required spacing.
8. Ensure an actuator location label and AS5062 maintenance tag is attached and legible. Replace if damaged or illegible.

NOTE
An Open Circuit (OC) or Closed Circuit (CC) detected from an Electric actuator will cause a shutdown sequence (Shutdown Module only)

NOTE
The cab manual actuator should be within the operator's normal field of view and reach. FSI electric actuators are factory sealed and are not field serviceable.

7.6 DISCHARGE AND ACTUATION HOSES

FSI Foam-Guard fire suppression systems utilise flexible hoses for discharge and actuation due to their resistance to vibration and corrosion. To ensure longevity and performance, hoses must be regularly inspected and protected against potential damage. Spiral guards should be used to prevent abrasion when hoses are exposed to hard surfaces or UV light, P-clamps are used to segregate (MDG15) hoses to prevent rubbing. Fire sleeve should be applied in high-temperature areas for thermal protection. Regular maintenance, proper routing, and adherence to industry standards ensure the hoses remain effective and compliant with AS5062 guidelines.

1. Inspect ALL discharge and actuation hosing for visible signs of damage and/or heat deterioration.
2. Ensure all discharge and actuation hose fittings are correctly fitted and secured.
3. Ensure all discharge and actuation hose lengths are correctly segregated (MDG15) from other hose assemblies and/or wiring.
4. Ensure discharge and actuation hose lengths are not routed close to or touching machine/vehicle fuel, hydraulic hoses, or wiring harnesses.
5. Ensure all discharge and actuation hose lengths are secured by P-clamps at the required spacing as per Table 4.
6. Ensure protective spiral wrap has been fitted where required to prevent rubbing.
7. Ensure protective spiral wrap has been fitted to hose in areas exposed to high UV.
8. Ensure protective fire sleeve is fitted to hose near high heat areas.

Figure 14
Internally mounted hosing.

Figure 15
Externally mounted hosing and spiral wrap.

Figure 16
Hosing protected with fire sleeve.

NOTE
Cable ties should only be used in conjunction with swivel cable tie mounts and only used where P-clamps cannot be utilised.

7.7 NOZZLE ASSEMBLES

FSI nozzle assemblies shall be inspected for signs of physical damage, particularly in aggressive environments and high-vibration areas, any damaged nozzles should be replaced to maintain system effectiveness. Ensure FSI silicon nozzle caps are properly in place to prevent contamination.

1. Inspect the silicone nozzle caps, refitting any that are dislodged, and replace any that are missing or damaged.
2. Ensure each nozzle is correctly aligned and directed toward the hazard it is protecting.
3. Ensure the spray outlet of each nozzle is unobstructed, with no obstruction between the nozzle and the hazard.
4. Confirm all nozzle assemblies are securely fastened, and all hose assemblies are properly connected to the nozzle assembly.
5. Ensure the nozzle is secured into the nozzle tube with LOCTITE 569.

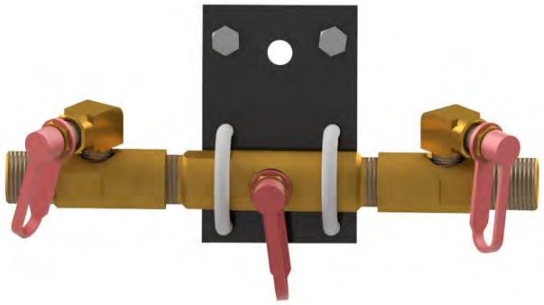


Figure 17
Nozzle Assembly/Silicone Nozzle Caps

7.8 MECHANICAL SENSOR MODULE (MSM)

FSI ROP Foam-Guard fire suppression systems utilise a Mechanical Sensor Module (MSM) to automatically discharge the ROP fire suppression system. It is manufactured from stainless steel tube and available in two lengths 1.0 meter and 1.5 meter. It incorporates a pyrotechnic wick which, at approximately 220˚C converts to a gas generating pressure to actuate the discharge valves.

1. Ensure the MSM location and coverage has not changed from the original installation.
2. Inspect the visual indicator at the base of the MSM to determine if the MSM has been actuated.

   GREEN indicates the MSM is charged.
   BLACK indicates the MSM has been actuated.

Figure 18
Charged MSM

3. Ensure the MSM is securely mounted using a minimum of three (3) mounting points, 100mm from each end and the centre of MSM.
4. Ensure the MSM is free from damage i.e., dents, cuts, kinks, corrosion etc.
5. Replace the MSM if damaged or actuated.
6. Inspect the 1/4” Actuation Hose. Ensure it is firmly secured to the MSM.

Figure 19
Actuated MSM

NOTE
The MSM’s have a combined shelf and service life of no longer than 5 years from the date stamped on the base of the MSM.

7.9 LOP DETECTION TUBING

FSI LOP Foam-Guard fire suppression systems utilise LOP detection tube to automatically discharge the fire suppression system. The FSI Foam-Guard fire suppression system LOP detection tube is manufactured from a specially modified Polymer; the melting point is approximately 180˚C.

1. Ensure the LOP detection tubing location and coverage has not changed from the original installation.
2. Inspect all LOP detection tubing.
3. Check the compression fittings for security, condition, and leaks.
4. Ensure the LOP tubing is securely mounted at required spacing using the correct sheathed P- Clamps.
5. Check for nitrogen leaks as per LOP - LEAK TESTING ACTUATION CIRCUIT procedure.

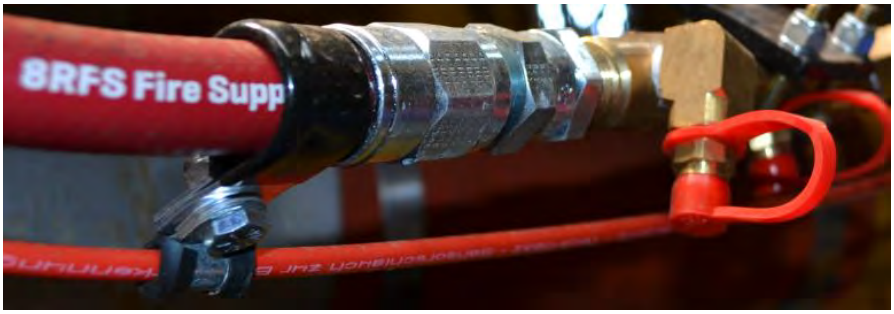


Figure 20
LOP Detection Tubing

NOTE
Before any maintenance is carried out on the LOP detection tube the fire suppression system shall be depressurised to prevent an uncontrolled discharge.

7.10 V5 - FIRE ALARM MODULE

The FSI V5 Fire Alarm Module is designed and tested to comply with the requirements of AS 5062 and is available in both Indicator and Shutdown versions, fully configurable via the display module.

The FSI V5 Display Module utilises visual and audible alarms to monitor system pressure, system discharge, ambient engine bay temperatures, solenoid activation, electric actuation, system faults, and supply voltages. These can be identified on the display window via a code.

FSI V5 Fire 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.

V5 Control Modules are supplied with individual serial numbers located on the module. The serial number format is: 24A001 – indicating the manufacture year (2024), fortnight (A-Z, 26 per year), and unit number produced in that fortnight.

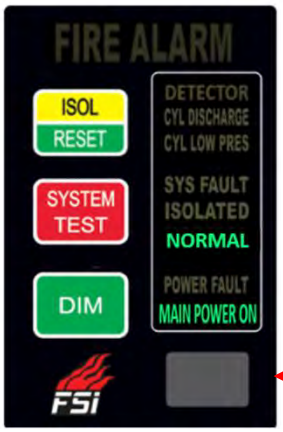


Figure 21
V5 - Indicator Display Module

Figure 22
V5 - Shutdown Display Module

Display Window

FSI V5 DISPLAY

- The FSI V5 display module is connected to the control module using a 3.6m 4 core loom which is monitored for disconnection, this can initiate the engine shutdown output where configured.
- FSI V5 Modules may run a maximum of two Display Modules. Dual display systems require two additional communication cables and a “Y” adaptor.
- Touch buttons are backlit by LED light bars and can be dimmed for night-time operation.
- A range of tests and isolations can be controlled via the Display Module.

FSI V5 MODULE

- The FSI V5 Module comes with pre-configured 4pin, 8pin and 12 pin DT plug connections for mains power, pressure switches, thermal probes, display module, electric actuation, solenoid valve and remote telemetry.
- The FSI V5 Control module will operate using either 12VDC or 24VDC.
- The control module incorporates a RTC (real time clock) to save programming configurations when 12VDC or 24VDC is disconnected.

FSI V5 ELECTRIC ACTUATION CONTROL MODULE

- FSI V5 Electric Actuation Control Modules are supplied with an internal rechargeable battery (FSI 16003) and requires >12.5 VDC for approximately 2 hours to correctly charge the internal Lithium-Ion backup battery when first installed. This will provide enough power to control all required functions in accordance with AS 5062.
- When 12/24VDC main power supply is deenergised and backup battery (FSI 16003) is enabled, this will initiate the pre-set vehicle shutdown timer. Once the shutdown sequence is complete it will illuminate NORMAL every 1 minute to indicate the loss of main power supply. All fault and alarm conditions will still be detected in accordance with AS 5062.
- FSI V5 Electric Actuation system operates via an electrical signal, manually activated by the operator using the FSI Electric Manual Actuator, or automatically by Foam-Guard Linear Detection (LHD) and/or FSI Thermal Probes. Once the V5 control module receive an input signal it then energises the 12 VDC 1/8", 0-2.5MPa electric solenoid with (11.2 VDC) for 2 minutes at this time the V5 display window will illuminate "00", this allows time for the system to completely depressurise the actuation circuit.
- The FSI V5 Control module monitors the solenoid circuit (when enabled) with a 1v reference voltage. If there is an Open Circuit (OC) or Closed Circuit (CC) detected, the V5 control module will output a shutdown signal (Shutdown Module only).

SHUTDOWN RELAY CONFIGURATION

- The engine shutdown timer can be programmable from 0 to 30 seconds in 5 second increments, a maximum of 3 x 10 second shutdown delays extensions are available, before the shutdown relay is de-energised.
- As represented on the wiring schematic, the relay is in the de-energised state.
- The Shutdown Relay should be configured as follows:
  - For ignition or E-Stop circuits that are N.O. in the run condition use Pins 5 (N.C.) and 6 (COM)
  - For ignition or E-stop circuits that are N.C. in the run condition use Pins 6 (COM) and 7 (N.O.)
- When 12/24VDC power is supplied to the Control Module the internal relay becomes energised, Pin 5 (N.C.) will switch open and Pin 7 (N.O.) will switch closed.
- The FSI V5 control module internal shutdown relay is rated to 10 amps. It is also recommending an external 10amp fuse is installed to the shutdown circuit. If machine ignition or E-stop circuits have increased current draw above 10 amps in normal operational conditions, an external 25-30 amp 12 or 24V relay (depending on machine supply voltage) is used. Under these circumstances the FSI V5 controller should supply an earth signal through the appropriately selected V5 shutdown relay terminals to the external relay.

AUX DIGITAL IN

- For automated or remote telemetry control machinery, the Aux Digital-In Circuit should be used to activate the fire system remotely, in conjunction with an electric solenoid and battery backup (FSI 16003).
- This can be achieved using a 12/24VDC connected to pins 5 & 6 of the 12-pin plug (Aux Digital In) and configuring as required.

ELECTRICAL DATA

- The V5 Control Module requires a 10-28 VDC 3A Fused power supply on its own dedicated circuit free from electrical interference from other electrical components.

Power Requirement	10-28 VDC 3A Fused
Back up Battery Charging Temperature Range	0°c to 50°c
Internal Shutdown Control Relay	10 Amp Max
Internal Aux Control Relay	5 Amp Max
External Aux Digital In (Remote Activation)	External 12/24VDC Input
Solenoid	G1/8" 2-way NC 0-2.5MPa 12VDC 50Hz
Backup Battery Service Life	2 Yearly from installation
Backup Battery Specification	7.2V (Nominal) 2.5Ah 18Wh Lithium
Real Time Clock (RTC) Battery	BR2032 3V
Real Time Clock (RTC) Battery Service Life	5 Yearly from installation
IP Rating	Module – IP66, Display - IP65

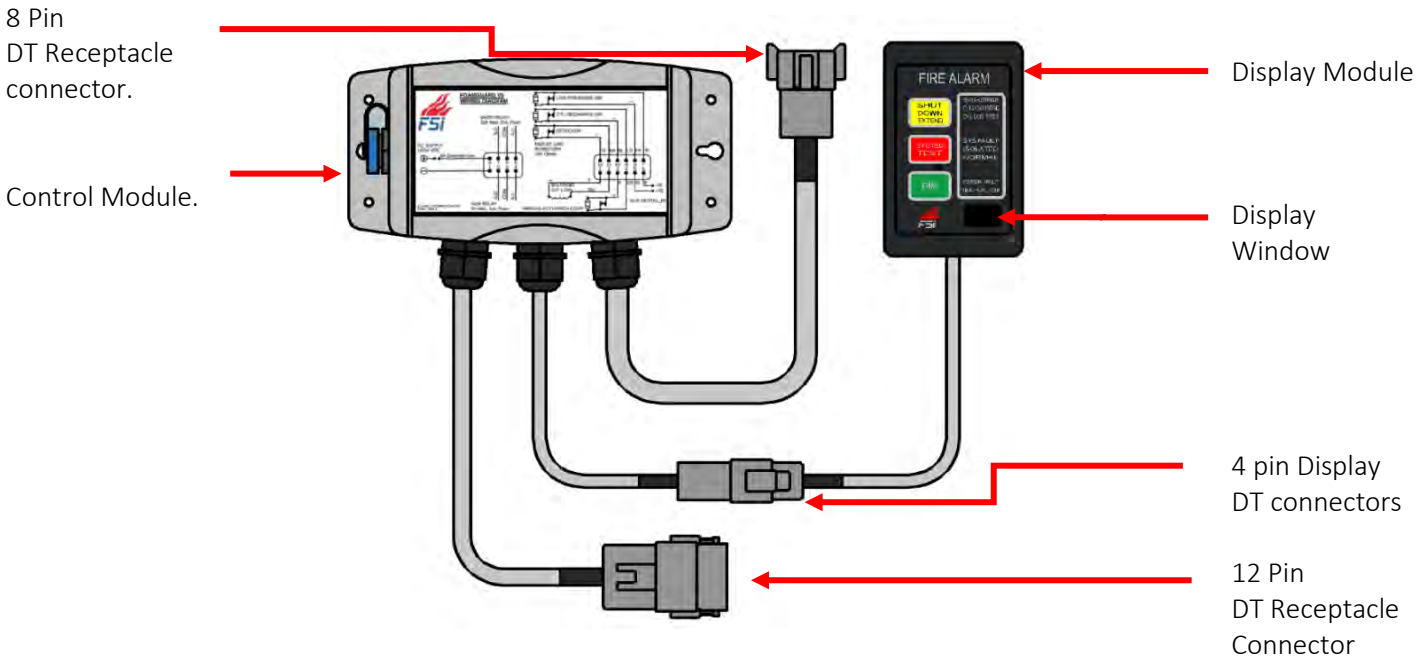


Figure 23
V5 FSI Control and Display Modules

7.11 DISPLAY MODULE

1. Ensure the Display Module is within the operator's normal field of view and reach.
2. Ensure the Display Module is well secured and in operational condition.
3. Ensure all cabling and plugs are connected and secured with P-clamps.
4. Test the operation of the Display Module by pressing the System Test button.
5. Ensure the module is configured correctly for the required circuits.
6. Test the shutdown output and operation of the Module if fitted.

Figure 24
V5 FSI Display Module

7.12 FIRE ALARM CONTROL MODULE

1. Ensure the Control Module is well secured and in operational condition.
2. Disconnect DT plug, inspect terminals for corrosion and security to wiring.
3. Ensure rubber seal and wedge is present on the DT plug and apply dielectric grease to the seal.
4. Check circuitry for correct readings and configurations.
5. Ensure all cabling and plugs are connected and well secured with P-clamps.

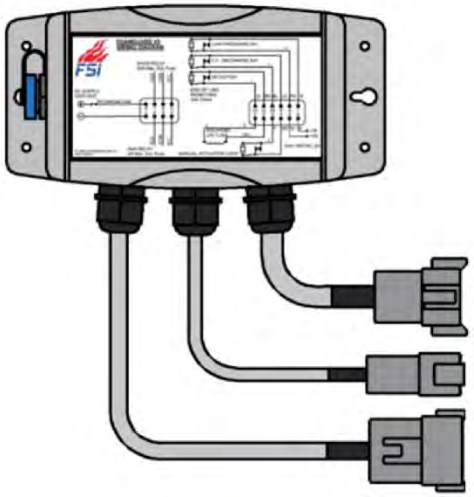


Figure 25
V5 Control Module

7.13 CYLINDER LOW PRESSURE SWITCHES

SINGLE CYLINDER SYSTEM

FSI Foam-Guard fire suppression systems utilise a low-pressure switch located in each discharge valve.
On a single cylinder system, a normally open two pin pressure switch containing a 10kΩ resistor is used to monitor for an open circuit condition. Below 1400kPa (F3) contacts within the pressure switch will close and the control module will detect this condition which will initiate a low-pressure alarm.

MULTI CYLINDER SYSTEM

FSI Foam-Guard fire suppression systems with two or more cylinders utilise a 4-pin change over pressure for each additional cylinder.
Below 1400kPa (F3) the 4-pin pressure switch internal contacts will change over and close, the control module will detect this condition and will initiate a low-pressure alarm.

Multiple low-pressure switches are terminated together within a SME (System Monitoring Enclosure)

1. Inspect the pressure switch for secure installation and any visible signs of damage.
2. Check all fire harness lengths for security, visible damage, or deterioration.
3. Disconnect the DT plug and inspect the terminals for corrosion and secure wiring connections.
4. Ensure the rubber seal and wedge is present on the DT plug and apply dielectric grease to the seal.
5. Verify correct circuitry readings and configurations.
6. Ensure the fire harness and fly leads are secured with a P-clamp, positioned 50mm on either side of the DT plug, with the receptacle facing downward or horizontally.

2 PIN PRESSURE SWITCH

Check for the correct resistance across terminal pins 1 + 2 on the pressure switch when the system is charged.

4 PIN PRESSURE SWITCH

Check for continuity across terminal pins 1 + 4 and 2 + 3 when the system is charged.

CAUTION
Do Not remove the heat shrink and back probe the DT connector. This can damage the seal, leading to potential damage and electrical faults. Always use the correct diagnostic tools and follow the recommended procedures for testing and troubleshooting.

Figure 26
4 Pin Low Pressure Switch

7.14 SYSTEM MONITORING ENCLOSURE (SME)

FSI Foam-Guard multicylinder fire suppression systems utilise 2 and 3-cylinder System Monitoring Enclosures (SME's) to connect cylinder pressure switches.
Twin cylinder systems utilise a single 2-cylinder SME and 3-cylinder systems utilise a single 3-cylinder SME. Where the FSI fire suppression system has 4 or more cylinders the cylinders should be grouped into banks of 2. The end of line bank will use a 2-cylinder SME, and the following inline banks will use 3-cylinder SME's. The SMEs can then be joined and run back to either a Cylinder Pressure and Solenoid Enclosure (CPS) in the case of electric operated systems or directly back to the FSI V5 control module if the system is pneumatic.

1. Inspect the SME for secure installation and any visible signs of damage.
2. Check all fire harness lengths for security, visible damage, or deterioration.
3. Disconnect the DT plug and inspect the terminals for corrosion and secure wiring connections.
4. Ensure the rubber seal and wedge is present on the DT plug and apply dielectric grease to the seal.
5. Verify correct circuitry readings and configurations.
6. Ensure the fire harness and fly leads are secured with a P-clamp, positioned 50mm on either side of the DT plug, with the receptacle facing downward or horizontally.

2 PIN DT RECEPTACLE

Check for the correct resistance across terminal pins 1 + 2 from the DT Receptacle output when the system is charged.

CAUTION
Do Not remove the heat shrink and back probe the DT connector. This can damage the seal, leading to potential damage and electrical faults. Always use the correct diagnostic tools and follow the recommended procedures for testing and troubleshooting.

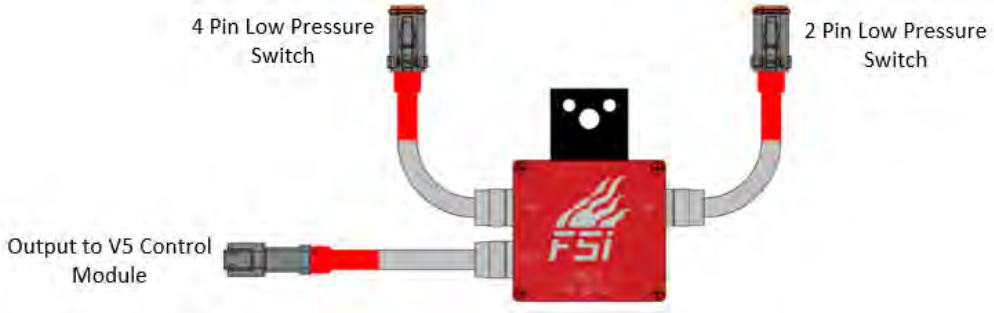


Figure 27
SME 2 Cylinder

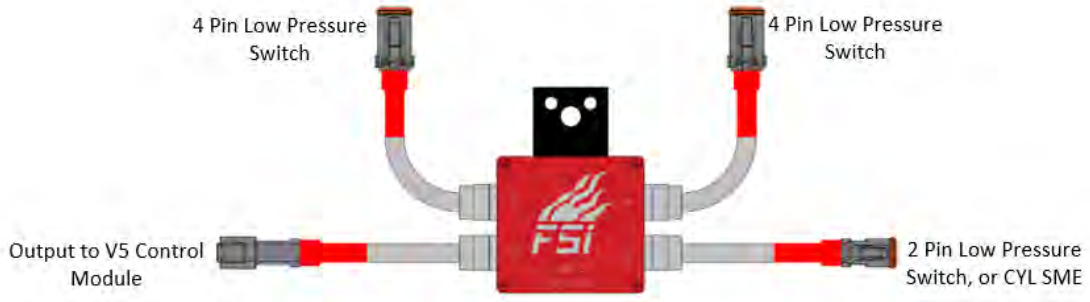


Figure 28
SME 3 Cylinder

7.15 PRESSURE MONITORING ENCLOSURE (PME)

FSI Foam-Guard fire suppression systems utilise a discharge pressure switch located in the Pressure Monitoring Enclosure (PME) to detect system discharge on ROP, LOP and Electric Actuation systems.
The discharge pressure switch contains a 10kΩ resistor to monitor the circuit. The discharge pressure switch is normally open (OC). When the system is discharging, and the pressure applied to the discharge pressure switch exceeds 50kPa the contacts will close. The FSI V5 control module will detect this condition and initiate a system discharge alarm.

The PME also includes wiring connections to the Thermal Probe, LHD circuit or cylinder low pressure switch.

1. Inspect the PME for secure installation and any visible signs of damage.
2. Check all fire harness lengths for security, visible damage, or deterioration.
3. Disconnect the DT plug and inspect the terminals for corrosion and secure wiring connections.
4. Ensure the rubber seal and wedge is present on the DT plug and apply dielectric grease to the seal.
5. Verify correct circuitry readings and configurations.
6. Ensure the fire harness and fly leads are secured with a P-clamp, positioned 50mm on either side of the DT plug, with the receptacle facing downward or horizontally.
7. Ensure 1/4” hose assembly from the discharge circuit to the PME is securely attached and routed correctly.

DISCHARGE PRESSURE SWITCH

Check for the correct resistance across terminal pins 1 + 3 of the 4 Pin Receptacle.

LOW PRESSURE OR PROBE CIRCUIT

Check for the correct resistance across terminal pins 2 + 4 of the 4 Pin Receptacle when the system is in normal conditions.

CAUTION
Do Not remove the heat shrink and back probe the DT connector. This can damage the seal, leading to potential damage and electrical faults. Always use the correct diagnostic tools and follow the recommended procedures for testing and troubleshooting.

Figure 29
Pressure Monitoring Enclosure (PME)

7.16 CYLINDER PRESSURE AND SOLENOID ENCLOSURE (CPS)

FSI Foam-Guard fire suppression systems utilise a Cylinder Pressure and Solenoid Enclosure (CPS) to terminate solenoid and low-pressure switch connections on electric actuation systems. Inspect CPS for security and visible signs of damage.

1. Inspect the CPS for secure installation and any visible signs of damage.
2. Check all fire harness lengths for security, visible damage, or deterioration.
3. Disconnect the DT plug and inspect the terminals for corrosion and secure wiring connections.
4. Ensure the rubber seal and wedge is present on the DT plug and apply dielectric grease to the seal.
5. Verify correct circuitry readings and configurations.
6. Ensure the fire harness and fly leads are secured with a P-clamp, positioned 50mm on either side of the DT plug, with the receptacle facing downward or horizontally.

SOLENOID CIRCUIT

Check for the correct resistance across terminals pins 1 + 3 of the 4 Pin Receptacle.

LOW PRESSURE SWITCH CIRCUIT

Check for resistance across terminal pins 2 + 4 of the 4 Pin Receptacle.

CAUTION
Do Not remove the heat shrink and back probe the DT connector. This can damage the seal, leading to potential damage and electrical faults. Always use the correct diagnostic tools and follow the recommended procedures for testing and troubleshooting.

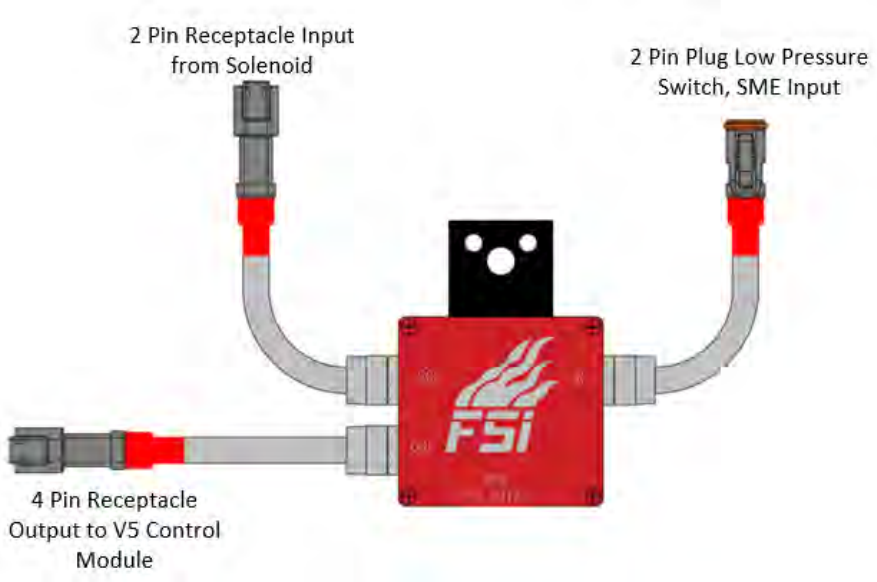


Figure 30
Cylinder pressure and solenoid Enclosure (CPS)

7.17 SYSTEM MONITORING ENCLOSURE/CYLINDER PRESSURE & SOLENOID ENCLOSURE (SME/CPS)

FSI Foam-Guard fire suppression systems (as an option) can combine the System Monitoring Enclosure (SME) and Cylinder Pressure and Solenoid Enclosure (CPS) on electric actuation system. This incorporates two enclosures into one

1. Inspect the SME/CPS for secure installation and any visible signs of damage.
2. Check all fire harness lengths for security, visible damage, or deterioration.
3. Disconnect the DT plug and inspect the terminals for corrosion and secure wiring connections.
4. Ensure the rubber seal and wedge is present on the DT plug and apply dielectric grease to the seal.
5. Verify correct circuitry readings and configurations.
6. Ensure the fire harness and fly leads are secured with a P-clamp, positioned 50mm on either side of the DT plug, with the receptacle facing downward or horizontally.

SOLENOID CIRCUIT

Check for the correct resistance across terminals pins 1 + 3 of the 4 Pin Receptacle.

LOW PRESSURE SWITCH CIRCUIT

Check for resistance across terminal pins 2 + 4 of the 4 Pin Receptacle.

CAUTION
Do Not remove the heat shrink and back probe the DT connector. This can damage the seal, leading to potential damage and electrical faults. Always use the correct diagnostic tools and follow the recommended procedures for testing and troubleshooting.

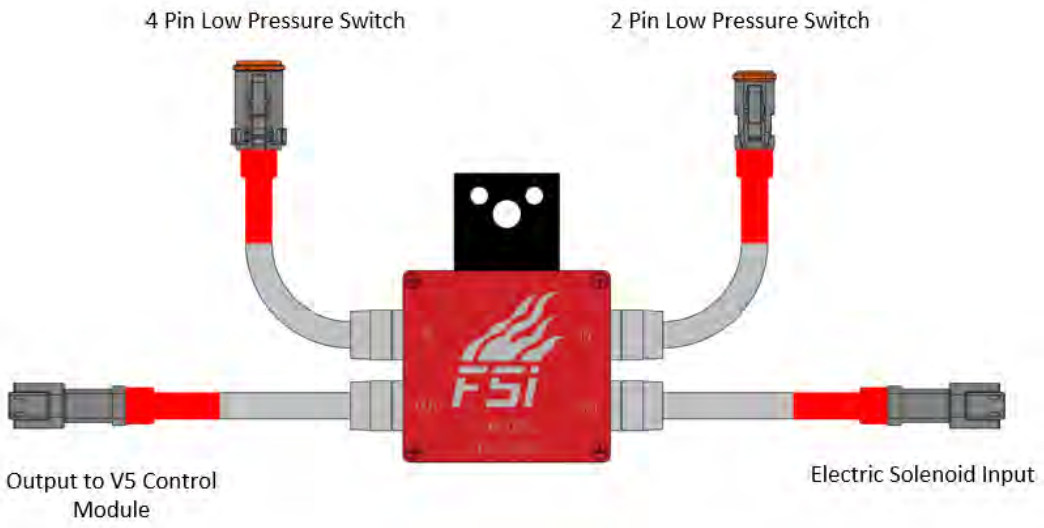


Figure 31
System Monitoring Enclosure/Cylinder Pressure & Solenoid Enclosure (SME/CPS)

7.18 THERMAL PROBES

FSI Foam-Guard fire suppression systems can utilise thermal probes to monitor ambient temperature or actuate the system on an electric actuation system.

The EOL Thermal Probe contains a 10kΩ (+/- 10%) resistor to monitor the circuit. A number of additional Inline Thermal Probes can be installed depending on the size of the risk area.

Below 163°C the Thermal Probe contacts are open, above 163°C the contacts within the Thermal Probe will close. The Control Module will detect this condition, initiate an alarm, energise the solenoid (if fitted) and output a shutdown signal (Shutdown Module only).

If there is an Open Circuit (OC) or Closed Circuit (CC) detected from a Thermal Probe. The FSI V5 control module will output a shutdown signal (Shutdown Module only).

1. Inspect the thermal probe for secure installation and any visible signs of damage.
2. Check all fire harness lengths for security, visible damage, or deterioration.
3. Disconnect the DT plug and inspect the terminals for corrosion and secure wiring connections.
4. Ensure the rubber seal and wedge is present on the DT plug and apply dielectric grease to the seal.
5. Verify correct circuitry readings and configurations.
6. Ensure the fire harness and fly leads are secured with a P-clamp, positioned 50mm on either side of the DT plug, with the receptacle facing downward or horizontally.

CAUTION
Do Not remove the heat shrink and back probe the DT connector. This can damage the seal, leading to potential damage and electrical faults. Always use the correct diagnostic tools and follow the recommended procedures for testing and troubleshooting.

Figure 32
Thermal Probe (IL)

7.19 LHD LINEAR HEAT DETECTOR

FSI Foam-Guard fire suppression systems can utilise Linear Heat Detector (LHD) to actuate the system on an electric actuation system. The length of the LHD depends on the size of the risk area.

The LHD is monitored by a 10kΩ (+/- 10%) resistor. At approximately 180˚C the LHD outer sheath melts causing the contacts to close circuit (CC). The FSI V5 Control Module will then energise an electric solenoid for 2 min. This allows pressure to vent to atmosphere via a silicone cap (LOP) or controls cylinder pressure into the actuation circuit via check valves (ROP).

If there is an Open Circuit (OC) or Closed Circuit (CC) detected, the FSI V5 control module will output a shutdown signal (Shutdown Module only).

1. Ensure the LHD wiring location and coverage has not changed from the original installation.
2. Inspect all LHD wiring for rubbing or wear.
3. Ensure the LHD wiring is securely mounted at the required spacing using LHD grommets and P-clamps.
4. Remove enclosure covers to inspect electrical connections for continuity and corrosion.

Figure 33
Linier Heat Detector (LHD)

7.20 ELECTRIC SOLENOID

FSI Foam-Guard Electric fire suppression systems utilise a solenoid, backup battery, Linear Heat Detector (LHD) and/or Thermal Probes to electrically actuate and discharge the system.

Once the FSI V5 Control module receives an input from a detection or actuation circuit it will energise the electric solenoid with 11.5 volts for 2 min. This allows pressure to vent to atmosphere via a silicone cap (LOP) or controls cylinder pressure into the actuation circuit via check valves (ROP). The FSI V5 Control module also initiates a system discharge alarm and outputs a shutdown signal (Shutdown Module only).

The FSI V5 Control module monitors the solenoid circuit (when enabled) with a 1.5v reference voltage. If there is an Open Circuit (OC) or Closed Circuit (CC) detected, the V5 control module will output a shutdown signal (Shutdown Module only).

1. Inspect solenoid for security and visible signs of damage. Replace the complete assembly if damaged.
2. Disconnect DT plug, inspect terminals for corrosion and security to wiring.
3. Ensure rubber seal and wedge is present on the DT plug and apply dielectric grease to the seal.
4. Verify correct circuitry readings and configurations.
5. Ensure the solenoid is in an operational condition with a reading of 10Ω (+/- 10%) across terminals 1 and 2.
6. Ensure discharge cap is in place on the solenoid release port (LOP) and there are no leaks.
7. Ensure the Fire Harness and fly leads are secured using a P-clamp 50mm either side of the DT plug.

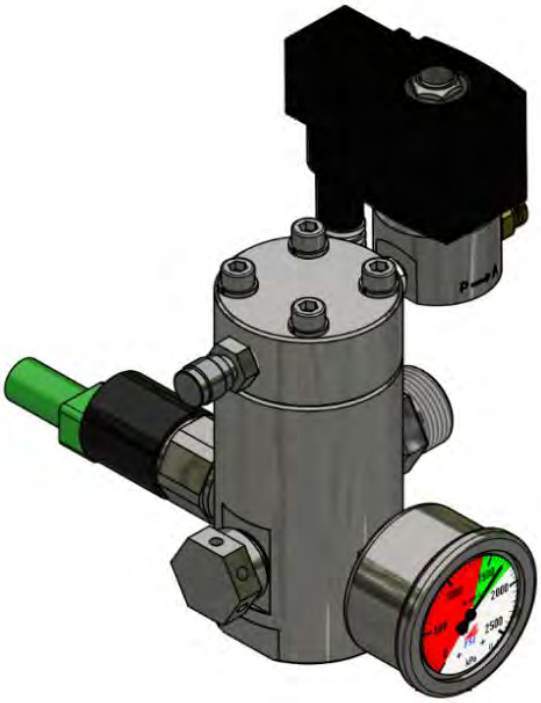


Figure 34
Electric Solenoid

7.21 DT PLUG CONNECTORS

FSI Foam-Guard fire suppression systems utilise DT Plug Connectors with heat shrink adaptors to prevent the ingress of contaminants and support the Fire Harness. DT plugs are used as disconnection points and connections to low pressure switches, Thermal Probes, PME, SME, CPS, Electric Actuators and V5 control module. These are to be used sparingly to maintain the integrity of the circuits.

1. Disconnect the DT plug and inspect the terminals for corrosion and secure wiring connections.
2. Ensure the rubber seal and wedge is present on the DT plug and apply dielectric grease to the seal.
3. Verify correct circuitry readings and configurations.
4. Ensure the fire harness and fly leads are secured with a P-clamp, positioned 50mm on either side of the DT plug, with the receptacle facing downward or horizontally.

CAUTION
Do Not remove the heat shrink and back probe the DT connector. This can damage the seal, leading to potential damage and electrical faults. Always use the correct diagnostic tools and follow the recommended procedures for testing and troubleshooting.

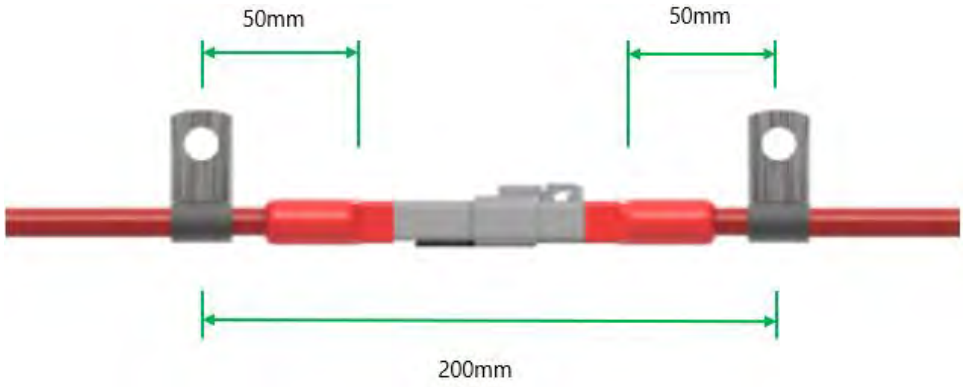


Figure 35
DT Plug

7.22 FIRE HARNESS

FSI Foam-Guard fire suppression systems utilise 2-core and 4-core Fire Harness. Fire Harness provides thermal protection within the risk area and is used to provide electrical connection between low pressure switches, Thermal Probes, PME, SME, CPS, and control module.

1. Inspect all Fire Harness lengths to ensure they are secure and free from visible damage or deterioration. Replace any harness found to be damaged
2. Ensure the Fire Harness is secured using a P-clamps at the required spacing as per table 4.

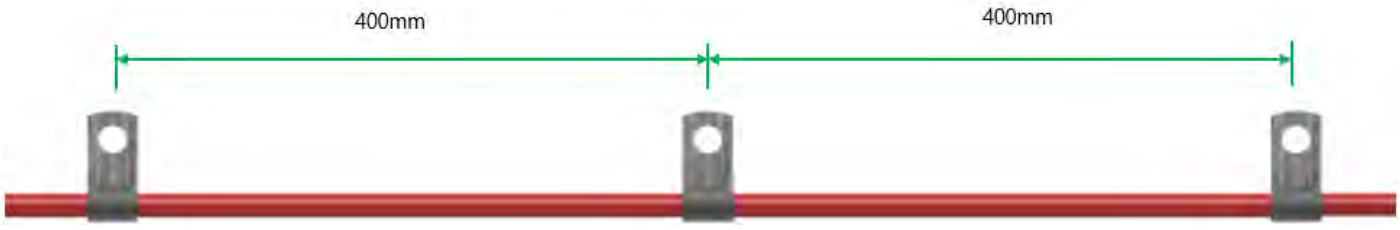


Figure 36
Fire Harness

7.23 SYSTEM LABELS

FSI Foam-Guard fire suppression systems utilise a range of information labels, warning labels and tamper seals to inform operator and maintenance personnel on important system information and operational requirements.
It is critical all labels are correctly located, orientated and legible.

1. Inspect all in cabin system labels, cylinder labels and manual actuator labels for damage or wear.
2. If any label is illegible, has deteriorated or is obstructed, it shall be replaced.
3. Ensure all labels are installed neatly and in the correct configuration.

Figure 37
Cylinder Labels

Figure 38
Cab Information and Warning Labels

Figure 39
Manual Actuator Labels

7.24 SERVICE MAINTENANCE RECORD LABEL

AS 5062 Maintenance record labels/tags should be located on each of the manual actuators and on each cylinder. These labels/tags indicate the level of service.

0 = Installation/System Commissioning
1 = 3 or 6 Monthly
2 = 1 Yearly or 2 Yearly
4 = Pressure Test – 5 Yearly
5 = Recharge After Discharge

Figure 40
Service maintenance record label/tag

8.0 1 YEARLY SERVICE PROCEDURE

8.1 FULL SYSTEM DISCHARGE

1. Carry out all 6 monthly service procedures.
2. Discharge system using a manual actuator.
3. Check all nozzle caps have blown off and all nozzles are discharging solution on to the risk areas.
4. Record the effective discharge time in seconds from the most hydraulically disadvantaged nozzle
5. Clear passage test the discharge hoses as per DISCHARGE HOSES – CLEAR PASSAGE TEST procedure.
6. Clear passage test the actuation circuits,
   A. **ROP** - Clear passage test the actuation hoses as per ACTUATION HOSES – ROP SYSTEM CLEAR PASSAGE TEST procedure.
   B. **LOP** - Clear passage test the actuation hoses as per ACTUATION HOSES – LOP SYSTEM CLEAR PASSAGE TEST procedure.
   C. **ELECTRIC** - Clear passage test the electric solenoid as per ELECTRIC SOLENOID – CLEAR PASSAGE TEST procedure.
7. Refill and recharge the fire suppression system as per FILLING WITH SOLUTION procedure.
8. Refit all nozzle caps and ensure all hoses are correctly fitted.
9. Reset Display Module to the normal operational condition.

CAUTION
Discharge of FSI Foam-Guard Fluorine Free Foam (F3) solution must strictly adhere to government and site regulations. Obtain permission before conducting any discharge test.

CAUTION
If nozzle caps do not dislodge correctly or coverage is inadequate, nozzles or discharge hose assemblies may be blocked. In this case, conduct INADEQUATE DISCHARGE - FLUSHING REQUIREMENT procedure. Once the flushing procedure is complete the system will need to be recharged and discharged again to confirm accurate discharge time and coverage (these subsequent discharge tests shall be done using Drinkable/Potable water).

NOTE
Systems fitted with electric actuation shall be discharged via the electric circuitry to ensure the discharge solenoid and circuitry operate correctly.

8.2 YEARLY SURVEY

The yearly survey together with the inspection, testing and preventive maintenance demonstrates the fire suppression system is functional and capable of performing to a standard no less than originally designed.
The design survey shall be undertaken to determine whether.

NOZZLE OBSTRUCTION

Check for adequate clear space at nozzles for obstructions likely to impede discharge.

NOZZLE ORIENTATION

Check that nozzles are pointing at pre-determined fire risks.

NOZZLE LOCATION AND COVERAGE

Check for the introduction of fixtures and bulkheads shielding nozzle discharge and the presence of unprotected hazard areas particularly where a source of fuel and heat may have been introduced.

OPERATIONAL CONDITIONS EXISTS

Check that the detector response and extinguishing agent discharge or retention will not be adversely affected by such things as enclosure openings, ventilation airflows or high temperature protected areas.

ENVIRONMENTAL CONDITIONS

Check the fire system and its components are suitable for the environmental conditions in which the machine is operating. For example, that components are suitable for underground mining ensuring road gradient and slopes are within cylinder orientation limits.

INITIAL INSTALL

Check the system will perform as it is intended to at the time of commissioning or recommissioning: neither the fire protection system nor the equipment being protected has changed from the system documentation. For example, obstructions to nozzles or fire protection.

MAINTENANCE

Ensure that the scheduled maintenance has been carried out as per the maintenance manual.

MODIFICATION

The design survey shall include a check against the baseline data, including the approved design for alterations, changes in use, operating environment or other factors that could adversely affect the performance of the fire protection system.

9.0 2 - YEARLY SERVICE PROCEDURE

9.1 REPLACE MECHANICAL SENSOR MODULES (MSM)

1. Locate all Mechanical Sensor Modules (MSM).
2. Confirm MSM location(s) are correctly protecting the risk areas.
3. Replace all MSM, s and MSM's support kits/nuts and bolts.
4. Ensure the MSM is securely mounted using the correct MSM support kit.
5. Inspect the 1/4" Actuation Hose. Ensure that it is firmly secured to the MSM.

NOTE
A pipe bending tool is required to bend the MSM to its original orientation as installed. There is to be a minimum of three (3) mounting points per MSM (1.0m or 1.5m).

CAUTION
Refer to the SDS when disposing of MSM's. The Mechanical Sensor Modules (MSM) core is highly flammable and cannot be extinguished by water as it does not require oxygen to burn.

CAUTION
MSM's shall be destroyed by competent FSI personnel. DO NOT dispose of Mechanical Sensor Modules (MSM) tubing in rubbish bins or with commercial waste.

9.2 REPLACE LOP DETECTION TUBING

1. Locate all LOP detection tubing.
2. Confirm LOP detection tubing location(s) are protecting the risk areas.
3. Replace all LOP detection tubing and compression fittings.
4. Replace all sheathed P-clamps, nuts, and bolts at required spacing as per Table 4.
5. Inspect the actuation hose to ensure it is correctly secured to the LOP detection tubing.
6. Carry out LOP - LEAK TESTING ACTUATION CIRCUIT procedure.

9.3 REPLACE LINEAR HEAT DETECTOR (LHD)

1. Locate all Linear Heat Detector (LHD).
2. Confirm LHD Detection location(s) are protecting the risk areas.
3. Replace LHD and LHD grommets/P-clamps.
4. Inspect all connection points, junction boxes and metal enclosures. Ensure they are adequately secured, all wiring connections are secure, and metal cable glands tight.
5. Carry out continuity test of the detection circuit.

9.4 REPLACE BACKUP BATTERY

1. To prevent uncontrolled discharges, the fire suppression system shall be isolated and depressurised prior to commencing any maintenance.
2. Disassemble the control module to gain access to the backup battery. Disconnect plug connections and remove the 4 retaining screws.
3. Replace back up battery.
4. Reassemble control module.
5. Reset Display Module and confirm configuration.

Figure 41
Back Up Battery

CAUTION
Ensure care is taken with all electrical connections when disconnecting and reconnecting the battery.

NOTE
A backup battery requires a main power supply >12.5V for approximately 2 hours to charge correctly.

9.5 REPLACE DISCHARGE VALVE O-RINGS AND SHUTTLE - ROP

CAUTION

DO NOT remove any parts from the cylinder prior to fully depressurising. Failure to comply with this warning may result in personal injury. Depress Schrader valve cores to ensure the cylinder is fully depressurised.

1. Remove discharge valve / syphon tube assembly from the cylinder.
2. Dismantle the valve assembly in a clean environment.

3. Remove syphon tube assembly from the discharge valve and discard O-ring.

4. Remove pneumatic actuator cap and spring from cylinder discharge valve.

5. Remove actuator piston from pneumatic actuator cap and discard O-ring.

6. Loosen the 4 x 6mm cap screws evenly and remove end cap.

7. Remove O-ring from end cap and discard.

8. Remove shuttle assembly from the valve body and discard shuttle assembly.

9. Using a clean cloth thoroughly clean the valve bore of any contaminants and check to ensure there is no damage, scoring or corrosion of the components.
10. Inspect the relief vent port on the side of the valve body end cap. Ensuring it is not obstructed, and pressure can vent adequately
11. Apply Molykote 111 to new O-rings, ensuring Molykote 111 does not obstruct the shuttle ports.
    a. 1 x replacement shuttle (top and bottom O-ring).
    b. 1 x actuation piston O-ring.
    c. 1 x syphon tube O-ring.
    d. 1 x valve body end cap O-ring.

CAUTION

- Only approved Molykote 111 shall be used to lubricate the valve and O-rings.
- Excessive amounts of Molykote 111 may prevent the system from operating correctly.

11. Ensure the equalising pintle within the shuttle moves freely and is unobstructed.
12. Install new shuttle assembly into valve, ensuring it seats easily and moves freely within the valve bore.
13. Ensure the shuttle assembly is sitting flush with the top of discharge valve body prior to assembly.
14. Reassemble discharge valve in reverse order as above.
15. **Cap screws shall be Torqued to 14Nm as per TORQUING DISCHARGE VALVE TOP CAP procedure.**
16. Secure discharge valve to the syphon tube assembly with LOCTITE 263.
17. Ensure to thoroughly leak test the cylinder valve using Big Blu after the system has been recharged.

9.6 REPLACE DISCHARGE VALVE O-RINGS AND SHUTTLE - LOP

CAUTION

DO NOT remove any parts from the cylinder prior to fully depressurising the cylinder. Failure to comply with this warning may result in personal injury. Depress Schrader valve cores to ensure the cylinder is fully depressurised.

1. Remove discharge valve/syphon tube assembly from the cylinder.
2. Dismantle the valve assembly in a clean environment.
3. Remove syphon tube assembly from the discharge valve and discard O-ring.

4. Loosen the 4 x 6mm cap screws. Remove end cap.

5. Remove end cap from valve body and discard O-ring.

6. Remove shuttle assembly from the valve body and discard shuttle assembly.

7. Using a clean cloth thoroughly clean the valve bore of any contaminants and check to ensure there is no damage, scoring or corrosion of the components.
8. Apply Molykote 111 to new O-ring, ensuring Molykote 111 does not obstruct the shuttle ports.
9. 1 x replacement shuttle (top and bottom O-ring).
10. 1 x syphon tube O-ring.
11. 1 x valve body end cap O-ring.

CAUTION

- Only approved Molykote 111 shall be used to lubricate the valve and O-rings.
- Excessive amounts of Molykote 111 may prevent the system from operating correctly

12. Ensure the equalising pintle within the shuttle moves freely and is unobstructed.
13. Install new shuttle assembly into valve, ensuring it seats easily and moves freely within the valve bore.
14. Ensure the shuttle assembly is sitting flush with the top of discharge valve body prior to assembly.
15. Reassemble discharge valve in reverse order as above.
16. **Cap screws shall be Torqued to 14Nm as per TORQUING DISCHARGE VALVE TOP CAP procedure.**
17. Secure discharge valve to the syphon tube assembly with LOCTITE 263.
18. Ensure to thoroughly leak test the cylinder valve using Big Blu after the system has been recharged.

9.7 TORQUING DISCHARGE VALVE TOP CAP

FSI ROP and LOP valves have a sealing O-ring between the top cap and body of the discharge valve. It shall be torqued down to ensure adequate sealing.

1. Ensure the O-ring and grove is free from contaminants and the O-ring is lubricated with Molykote 111.
2. Install the O-ring and top cap to the valve body.
3. Finger tighten the 4 x Allen head bolts.
4. **Cap screws shall be Torqued to 14Nm in a crisscross type pattern.**
5. A leak test of the valve shall be completed once the system is charged.

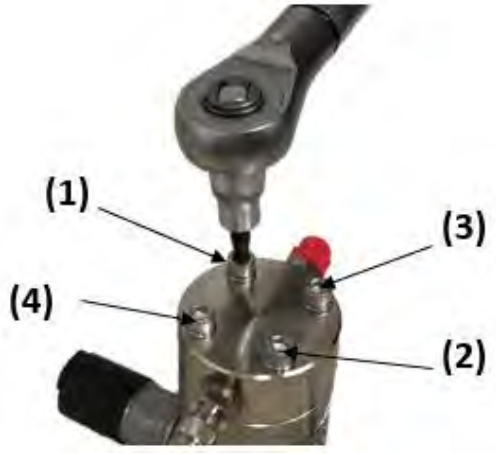


Figure 42
Valve Top Cap Torquing

9.8 REPLACE STRIKER PIN – ROP MANUAL ACTUATORS

CAUTION

The CO_2 cartridge is a pressure vessel. Care shall be taken when handling to avoid damage, as this could cause personal injury.

1. Locate ALL manual CO_2 actuators.

2. Remove CO_2 cartridge from actuator body. CO_2 cartridge shall be removed from actuator body to gain access to striker pin.

3. Remove striker knob from striker pin.

4. Remove striker pin from actuator body.

5. Replace striker pin complete with O-ring.

6. Apply Molykote 111 lubricant to new striker pin O-ring.

7. Re-insert the striker pin into the manual actuator body.

8. Use LOCTITE 263 to secure the striker knob to the striker pin.

CAUTION

Only approved Molykote 111 shall be used to lubricate the striker pin and O-rings.

9.9 REPLACE SILICONE NOZZLE CAPS

1. Locate all nozzles assemblies.
2. Remove old silicone nozzle caps and discard.
3. Ensure nozzle orifice is clean and unobstructed.
4. Replace with new FSI silicone nozzle caps.
5. Ensure that nozzle caps are orientated so that they will not obstruct the discharge of foam solution.

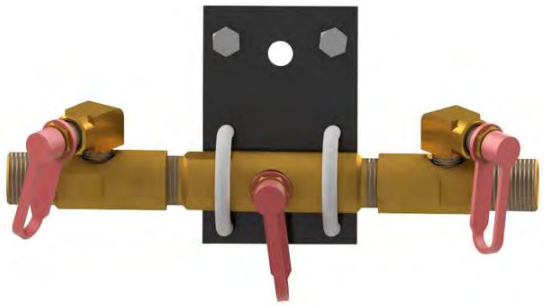


Figure 43
Silicone Nozzle Caps

9.10 REPLACE LOP ACTUATOR PRESSURE RELIEF PORT CAP

1. Locate all LOP manual actuators.
2. Loosen retaining bolts and remove actuator body.
3. Remove old silicone pressure relief port caps and discard.
4. Ensure relief port orifice is clean and unobstructed.
5. Replace with new silicone pressure relief port caps.

Figure 44
LOP Actuator Relief Port Cap

9.11 TEMPERATURE TESTING THERMAL PROBES

1. Isolate the fire system as required to prevent a uncontrolled discharge.
2. Use a heat gun (maximum 250 ˚C) applied to the Thermal Probe Stem until the probe activates, typically 20-60 seconds. This can be measured with a multimeter.
3. Remove heat source and observe Thermal Probe reset.
4. If a change is not observed in the specified time remove and replace Thermal Probe assembly. (Second test may be required).
5. Repeat process for all additional Thermal Probe assemblies.

CAUTION
Do not apply a naked flame to the Thermal Probe. Temperatures exceeding 1300 ˚C could result in damage to the Thermal Probe internal components.

10.0 5 YEARLY SERVICE PROCEDURE - CYLINDER PRESSURE TESTING

10.1 CYLINDER PRESSURE TESTING

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. Depress Schrader valve cores to ensure the cylinder is fully depressurised.

1. All FSI cylinders require hydrostatic testing at a licenced and approved test facility at no greater than 5 yearly intervals. During normal servicing procedures, cylinders shall be replaced with new or refurbished cylinders. Cylinders can only be replaced/exchanged with cylinders of the same capacity.
2. Ensure that cylinder serial numbers and new hydrostatic test required dates are recorded on all service reports so that the service records database can be updated and maintained.
3. Neatly orientate and affix all required cylinder labels and tags.

10.2 BURST DISC/PRESSURE RELIEF VALVE (PRV) REPLACEMENT

CAUTION

DO NOT remove any parts from the cylinder prior to fully depressurising the cylinder. Failure to comply with this warning may result in personal injury. Depress Schrader valve cores to ensure the cylinder is fully depressurised.

1. Ensure the cylinder is completely depressurised.
2. Remove the old burst disc/PRV assembly.
3. Clean threads and apply LOCTITE 577 sealant to the threads.
4. Ensure that excessive 577 LOCTITE is not applied that can cause the orifice to become obstructed.
5. Torque assembly to 48Nm (35 ft. lb.)
6. Conduct a leak test to ensure the treads are sealed.

Figure 45
Burst Disc

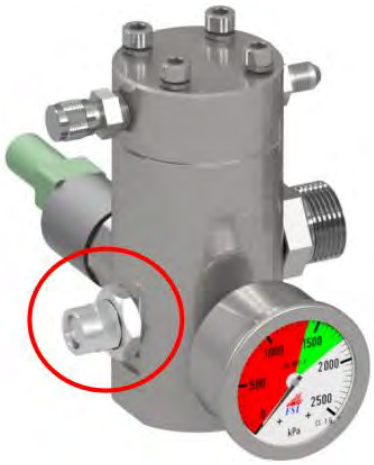


Figure 46
Pressure Relief Valve

10.3 CYLINDER BAND RUBBERS - REPLACEMENT

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. Depress Schrader valve cores to ensure the cylinder is fully depressurised.

1. Locate all cylinder bracket assemblies.
2. Ensure the cylinder is completely depressurised and empty of foam solution.
3. Remove band bolts and cylinders bands from cylinder brackets.
4. Remove front and rear band rubbers and discard.
5. If required fit an exchange cylinder ensuring it is clean, in operational condition and all required labels have been affixed.
6. Install new band, bracket rubbers, and reassemble using new M12 bolt kit.

Figure 47
Band and Bracket Rubbers

10.4 THERMAL PROBES AND SOLENOID REPACEMENT

THERMAL PROBES

1. Locate all Thermal Probes.
2. Confirm Thermal Probes are protecting the risk areas.
3. Replace all Thermal Probes and connections.
4. Carry out continuity test of the electric actuation circuit.

ELECTRIC SOLENOID

1. Locate electric solenoid.
2. Replace electric solenoid and connectors.
3. Carry out continuity test of the actuation circuit.
4. Carry out a clear passage test and check operation of electric solenoid as per ELECTRIC SOLENOID – CLEAR PASSAGE TEST procedure.

10.5 RTC BATTERY

1. Locate the FSI V5 control module.
2. Disassemble the control module to gain access to the RTC battery.
3. Remove and replace the RTC battery (FSI 16032).
4. Reassemble control module.
5. Conduct system configuration as per procedure.

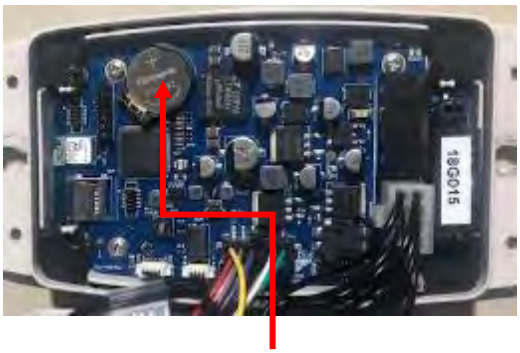


Figure 48
RTC Battery

CAUTION
Ensure when removing the RTC battery care is taken not to damage the RTC battery retaining clips

11.0 V5 FIRE ALARM MODULE

FSI V5 Fire Alarm Modules are configurable via the Display Module and will require configuring upon installation. When a new module initially receives a 12/24V connection. The ISOLATED and MAIN POWER ON LED's will illuminate. This indicates an unconfigured state. Once the module is configured it will retain this information until the RTC battery is removed.

11.1 V5 CONFIGURATION PARAMETERS

PNEUMATIC SYSTEM (LOP/ROP) – NO SECONDARY DETECTION (NO PROBES INSTALLED)			
CIRCUIT NAME	DISPLAY	ASSETCONNECT	DESCRIPTION
SOLENOID	S 0	Pneumatic Actuation	Solenoid Disabled/Not installed.
BACKUP BATTERY	b 0	Disabled	Backup Battery Disabled/Not Installed.
DISPLAY SYSTEM	d 1	1 Display	1 or 2 Display Connected.
SHUTDOWN COUNTER	0 -30 NA	0-10-15-20-25-30 NA – Indicate Only	Varies by site, Default 10sec. NA – Indicator Panel Installed.
MONITORING CIRCUIT	P 3	P3	Low pressure switch installed. Discharge switch installed.

PNEUMATIC SYSTEM (LOP/ROP) – SECONDARY DETECTION (PROBES INSTALLED)			
CIRCUIT NAME	DISPLAY	ASSETCONNECT	DESCRIPTION
SOLENOID	S 0	Pneumatic Actuation	Solenoid Disabled/Not installed.
BACKUP BATTERY	B 0	Disabled	Backup Battery Disabled/Not Installed.
DISPLAY SYSTEM	D 1	1 Display	1 or 2 Display Connected.
SHUTDOWN COUNTER	0 -30 NA	0-10-15-20-25-30 NA – Indicate Only	Varies by site, Default 10sec. NA – Indicator Panel Installed.
MONITORING CIRCUIT	P 4	P4	Low pressure switch installed. Discharge switch installed. Probes/LHD installed.

LOP or ROP PNEUMATIC ACTUATORS & ELECTRIC DETECTION (PROBES AND/OR LHD)			
CIRCUIT NAME	DISPLAY	ASSETCONNECT	DESCRIPTION
SOLENOID	S 1	Electric Actuation	Solenoid Enabled/Solenoid Installed.
BACKUP BATTERY	b 1	Enabled	Backup Battery Enabled/Battery Installed.
DISPLAY SYSTEM	d 1	1 Display	1 or 2 Display Connected.
SHUTDOWN COUNTER	0 -30 NA	0-10-15-20-25-30 NA – Indicate Only	Varies by site, Default 10sec. NA – Indicator Panel Installed.
MONITORING CIRCUIT	P 4	P4	Low pressure switch installed. Discharge switch installed. Probes/LHD installed.

ELECTRIC ACTUATORS & LOP/ROP PNEUMATIC DETECTION			
CIRCUIT NAME	DISPLAY	ASSETCONNECT	DESCRIPTION
SOLENOID	S 1	Electric Actuation	Solenoid Enabled/Solenoid Installed.
BACKUP BATTERY	b 1	Enabled	Backup Battery Enabled/Battery Installed.
DISPLAY SYSTEM	d 1	1 Display	1 or 2 Display Connected.
SHUTDOWN COUNTER	0 -30 NA	0-10-15-20-25-30 NA – Indicate Only	Varies by site, Default 10sec. NA – Indicator Panel Installed.
MONITORING CIRCUIT	P5	P5	Low pressure switch installed. Discharge switch installed. Electric actuators installed.

FULL ELECTRIC			
CIRCUIT NAME	DISPLAY	ASSETCONNECT	DESCRIPTION
SOLENOID	S 1	Electric Actuation	Solenoid Enabled/Solenoid Installed.
BACKUP BATTERY	b 1	Enabled	Backup Battery Enabled/Battery installed.
DISPLAY SYSTEM	d 1	1 Display	1 or 2 Display Connected.
SHUTDOWN COUNTER	0 -30 NA	0-10-15-20-25-30 NA – Indicate Only	Varies by site, Default 10sec. NA – Indicator Panel Installed.
MONITORING CIRCUIT	P 6	P6	Low pressure switch installed. Discharge switch installed. Probes/LHD installed. Electric actuators installed.

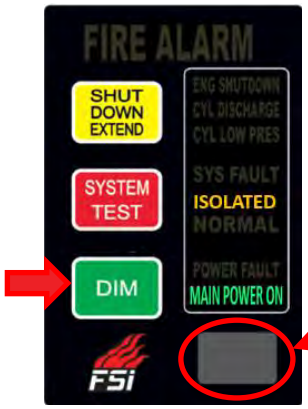
11.2 V5 SHUTDOWN MODULE

11.2.1 V5 SHUTDOWN MODULE - SYSTEM CONFIGURATIONS

- FSI V5 Fire Modules require programming upon installation or removal of the RTC battery.
- All configuration parameters shall be set correctly for the FSI V5 module to enter the Normal operation.
- Configuration parameters are accessed from the ISOLATED mode only.
- Unconfigured parameters are identified by a "-" symbol in the display window when in that parameter menu.
- Parameters are saved automatically after 7 seconds of standby.
- The Display Module will beep twice and return to the isolated mode where more parameters may be accessed.
- If all programming is not completed the display will not de isolate.

STEP 1 DISPLAY SYSTEM

To configure a Display Module, select either **d1** for one display module or **d2** for two display modules, depending on how many displays are installed.



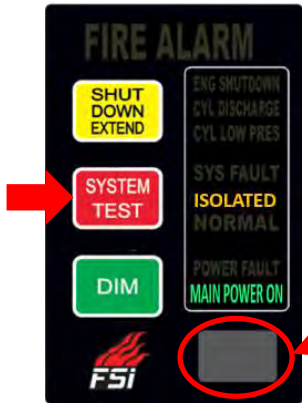
1. Press and hold **DIM** button for 7 seconds from within isolated mode.
2. Press **DIM** to cycle between the listed settings.

- Parameters are saved automatically after 7 seconds of standby.
- The Display Module will beep twice and return to the isolated mode.

d-	Display Unconfigured
d1	1 X Display Module Configured
d2	2 X Display Module Configured

STEP 2 BATTERY INSTALLED - ELECTRIC ACTUATION

For electric systems or systems with a solenoid installed, set the installed backup battery to **b1** (enabled). If it is a pneumatically actuated system, disable the backup battery by setting it to **b0** (disabled)



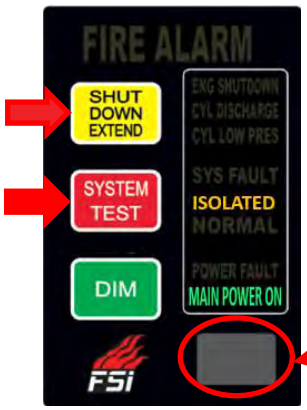
1. Press and hold **SYSTEM TEST** button for 7 seconds from within isolated mode.
2. Press **SYSTEM TEST** to cycle between the listed settings.

- Parameters are saved automatically after 7 seconds of standby.
- The Display Module will beep twice and return to the isolated mode.

b-	Backup Battery Unconfigured
b0	Backup Battery Disabled
b1	Backup Battery Enabled/Installed

STEP 3 SOLENOID – ELECTRONIC ACTUATION

For systems with a solenoid installed, set the solenoid to **S1** (enabled). If a solenoid is not installed, set it to **S0** (disabled).



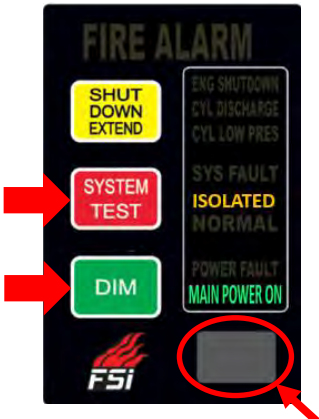
1. Press and hold **SHUTDOWN EXTEND** and **SYSTEM TEST** buttons for 7 seconds from within isolated mode.
2. Press **SHUTDOWN EXTEND** to cycle between the listed settings.

- Parameters are saved automatically after 7 seconds of standby.
- The Display Module will beep twice and return to the isolated mode.

S-	Solenoid Unconfigured
S0	Solenoid Disabled
S1	Solenoid Enabled/Installed

STEP 4 MONITORING CIRCUIT SETTINGS

Refer to the chart below to select and enable the correct **P** channel **1 – 6** based on the detection or actuation method installed:



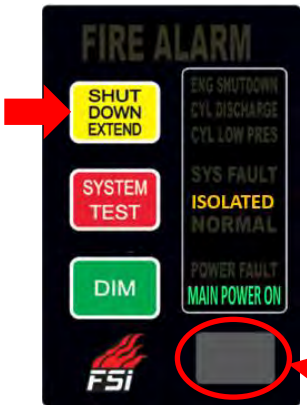
1. Press and hold **SYSTEM TEST** and **DIM** buttons for 7 seconds from within isolated mode.
2. Press **SYSTEM TEST** to cycle between the listed settings.

- Parameters are saved automatically after 7 seconds of standby.
- The Display Module will beep twice and return to the isolated mode.

	Detector (LHD/Thermal Probes)	Cylinder Low Pressure Switch	Discharge Pressure Switch	Manual Electric Actuation
P-	Unconfigured	Unconfigured	Unconfigured	Unconfigured
P1	Disabled	Disabled	Enabled	Disabled
P2	Enabled	Disabled	Enabled	Disabled
P3	Disabled	Enabled	Enabled	Disabled
P4	Enabled	Enabled	Enabled	Disabled
P5	Disabled	Enabled	Enabled	Enabled
P6	Enabled	Enabled	Enabled	Enabled

STEP 5 SHUTDOWN COUNTER SETTING

Refer to the chart below to select the shutdown time, which can be set between 0 and 30 seconds. The shutdown time will vary depending on the risk assessment. Ensure the shutdown display module is not set to "NA."



1. Press and hold **SHUTDOWN EXTEND** button for 7 seconds from within isolated mode.
2. Press **SHUTDOWN EXTEND** to cycle between the listed settings.

- Parameters are saved automatically after 7 seconds of standby.
- The Display Module will beep twice and return to the isolated mode.

--	Unconfigured
0	Immediate Shutdown
10	10 second delay
15	15 second delay
20	20 second delay
25	25 second delay
30	30 second delay
nA	Set when an indicator Module is installed

NOTE

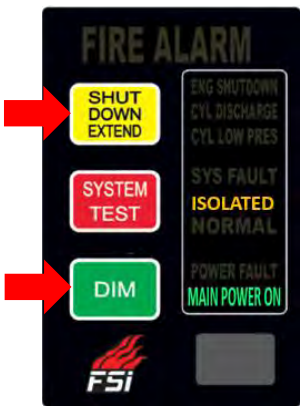
If a shutdown Display Module is programmed to “nA” fault codes F4 and F9 will register in the display window when reset to the Normal operational mode.

NOTE

Reset the module to its normal mode. If the module does not return to normal, verify all configuration have been complete.

11.2.2 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 Isolation Mode is activated, the ISOLATED indicator will illuminate, to indicate the system is isolated.

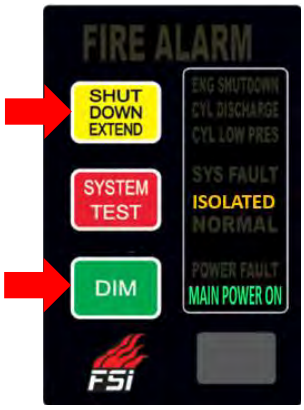


- **ISOLATION**
  1. Press and hold **SHUTDOWN EXTEND** and **DIM** buttons for 7 seconds.
  2. ISOLATED will illuminate.

- **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

11.2.3 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.

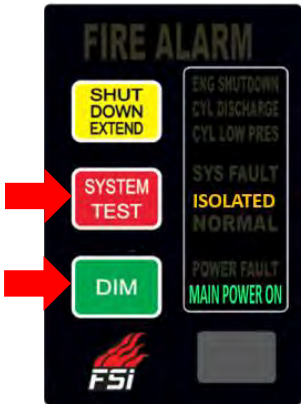


- **ENTER ACKNOWLEDGMENT MODE**
  1. Press and hold **SHUTDOWN EXTEND** and **DIM** buttons for 7 seconds.
  2. This will mute any non-critical system faults for 12 minutes

- **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

11.2.4 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 Isolated Mode.

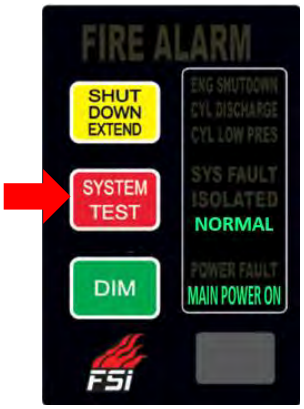


- **ENTER ISOLATION MODE**
  1. Press and hold **SYSTEM TEST** and **DIM** buttons for 10 seconds, 1 beep to confirm and ISOLATED Flashes rapidly
  2. Enter the sequence of 6 keys (beeping after each press)
     1) **SYSTEM TEST** (RED)
     2) **SHUT DOWN EXTEND** (YELLOW)
     3) **SHUT DOWN EXTEND**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

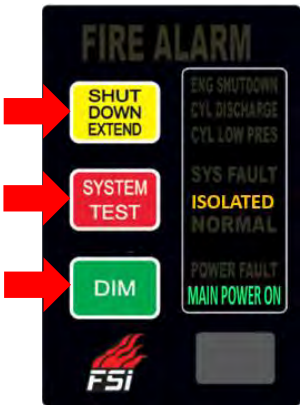
11.2.5 SYSTEM TEST



- 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.

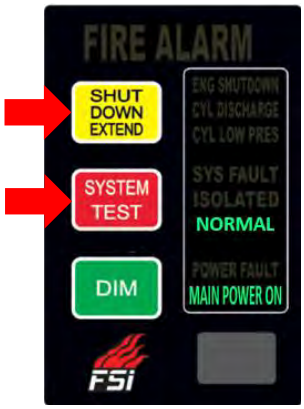
11.2.6 SLEEP MODE (Back up Battery Only)

Sleep mode electronically disconnects the internal backup battery, conserving battery life when the machine's batteries are isolated for extended periods. This prevents unnecessary power consumption from the V5 module while the main power supply is disconnected. Once vehicle power (12/24V) is restored, the internal backup battery automatically reconnects, allowing the system to resume normal operation without manual intervention.



1. Disconnect the main power supply to the V5 Module.
2. Place the module into isolate
3. Press and hold SHUTDOWN **EXTEND, SYSTEM TEST** and **DIM** buttons for 30 seconds until the 5 second countdown has timed out
4. Once the countdown completes, the system will electronically disconnect the internal back-up battery, putting the unit into sleep mode

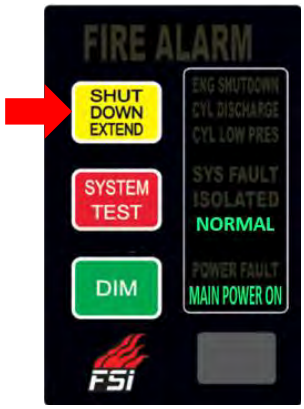
11.2.7 SHUTDOWN TEST



- Ensure that vehicle engine is on and running normally.
- Press and hold the **SYSTEM TEST** and **SHUTDOWN EXTEND** buttons simultaneously 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 isolation and reset procedure is required to reset Module back to its normal mode.

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

11.2.8 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.

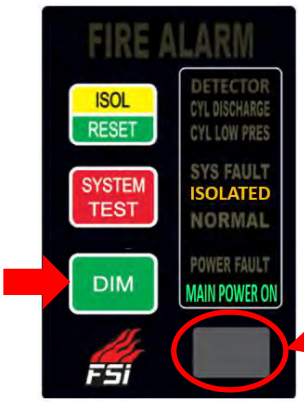
11.3 V5 INDICATOR MODULE

11.3.1 V5 INDICATOR MODULE - SYSTEM CONFIGURATIONS

- FSI V5 Fire Modules require programming upon installation or removal of the RTC battery.
- All configuration parameters shall be set correctly for the FSI V5 module to enter the Normal operation.
- Configuration parameters are accessed from the ISOLATED mode only.
- Unconfigured parameters are identified by a "-" symbol in the display window when in that parameter menu.
- Parameters are saved automatically after 7 seconds of standby.
- The Display Module will beep twice and return to the isolated mode where more parameters may be accessed.
- If all programming is not completed the display will not de isolate.

STEP 1 DISPLAY SYSTEM

To configure a Display Module, select either **d1** for one display module or **d2** for two display modules, depending on how many displays are installed.



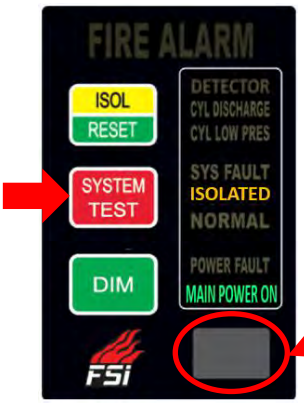
1. Press and hold **DIM** button for 7 seconds from within isolated mode.
2. Press **DIM** to cycle between the listed settings.

- Parameters are saved automatically after 7 seconds of standby.
- The Display Module will beep twice and return to the isolated mode.

d-	Display Unconfigured
d1	1 x Display Module Configured
d2	2 x Display Module Configured

STEP 2 BATTERY INSTALLED - ELECTRIC ACTUATION

For electric systems or systems with a solenoid installed, set the installed backup battery to **b1** (enabled). If it is a pneumatically actuated system, disable the backup battery by setting it to **b0** (disabled)



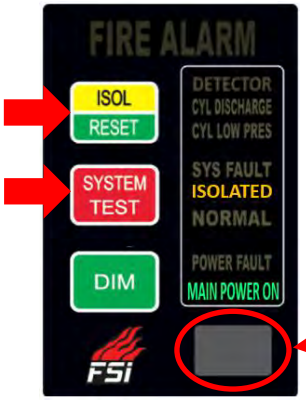
1. Press and hold **SYSTEM TEST** button for 7 seconds from within isolated mode.
2. Press **SYSTEM TEST** to cycle between the listed settings.

- Parameters are saved automatically after 7 seconds of standby.
- The Display Module will beep twice and return to the isolated mode.

b-	Backup Battery Unconfigured
b0	Backup Battery Disabled
b1	Backup Battery Enabled/Installed

STEP 3 SOLENOID – ELECTRONIC ACTUATION

For systems with a solenoid installed, set the solenoid to **S1** (enabled). If a solenoid is not installed, set it to **S0** (disabled).



1. Press and hold **ISOL/RESET** and **SYSTEM TEST** buttons for 7 seconds from within isolated mode.
2. Press **ISOL/RESET** to cycle between the listed settings.

- Parameters are saved automatically after 7 seconds of standby.
- The Display Module will beep twice and return to the isolated mode.

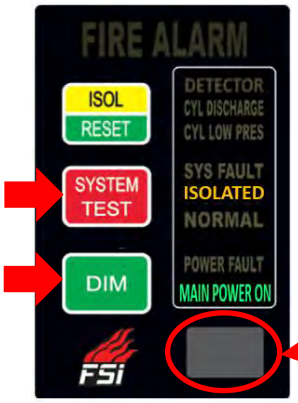
S-	Solenoid Unconfigured
S0	Solenoid Disabled
S1	Solenoid Enabled/Installed

NOTE

If set to S1, the control module will expect a solenoid to be connected and will fault and perform vehicle shutdown if not installed.

STEP 4 MONITORING CIRCUIT SETTINGS

Refer to the chart below to select and enable the correct **P** channel **1 – 6** based on the detection or actuation method installed



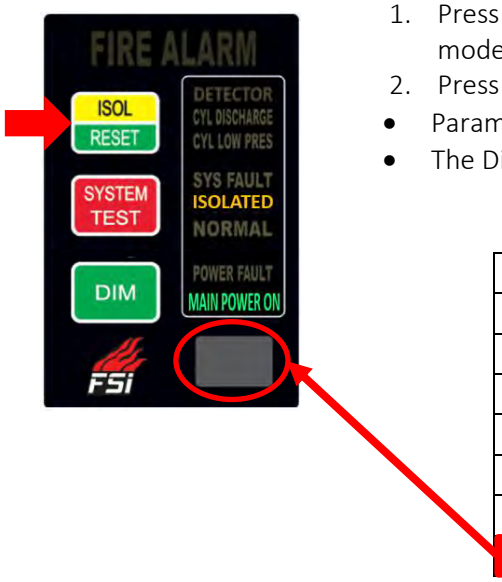
1. Press and hold **SYSTEM TEST** and **DIM** buttons for 7 seconds from within isolated mode.
2. Press **SYSTEM TEST** to cycle between the listed settings.

- Parameters are saved automatically after 7 seconds of standby.
- The Display Module will beep twice and return to the isolated mode.

	Detector (LHD/Thermal Probes)	Cylinder Low Pressure Switch	Discharge Pressure Switch	Manual Electric Actuation
P-	Unconfigured	Unconfigured	Unconfigured	Unconfigured
P1	Disabled	Disabled	Enabled	Disabled
P2	Enabled	Disabled	Enabled	Disabled
P3	Disabled	Enabled	Enabled	Disabled
P4	Enabled	Enabled	Enabled	Disabled
P5	Disabled	Enabled	Enabled	Enabled
P6	Enabled	Enabled	Enabled	Enabled

STEP 5 SHUTDOWN COUNTER SETTING

For indicator display modules set the shutdown counter to NA only.



1. Press and hold **ISOL/RESET** buttons for 14 seconds from within isolated mode.
2. Press **ISOL/RESET** to cycle between the user adjustable settings.

- Parameters are saved automatically after 7 seconds of standby.
- The Display Module will beep twice and return to the isolated mode.

--	Unconfigured
0	Immediate Shutdown
10	10 second delay
15	15 second delay
20	20 second delay
25	25 second delay
30	30 second delay
nA	Set when an indicator Module is installed

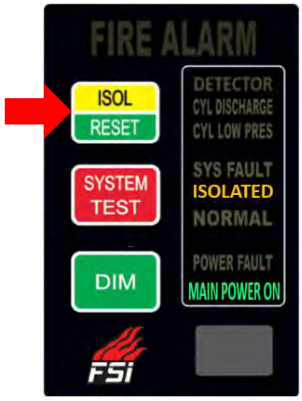
NOTE

Reset the module to its normal mode. If the module does not return to normal, verify all configuration have been complete.

NOTE

If a shutdown time is selected when programming an indicator module fault codes F4 and F9 will register in the display window when the display is reset to the Normal operational mode.

11.3.2 V16 - SYSTEM ISOLATION/ RESET PROCEDURE

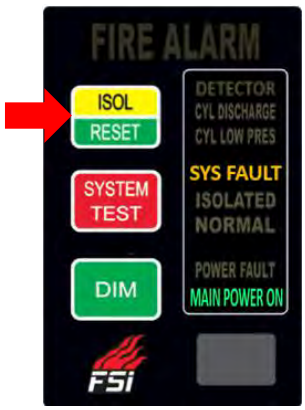


- **ISOLATION**
  To isolate the Indicator Module, press and hold the **ISOL/RESET** for 7 seconds. This will illuminate the Amber ISOLATED display and allow maintenance to be carried out, all three (3) detector circuits are isolated.

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

11.3.3 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.

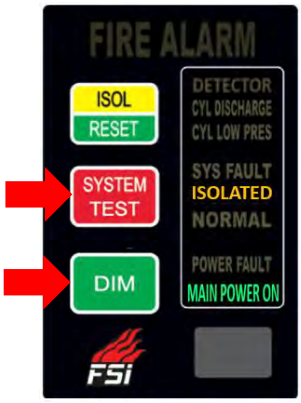


- **ENTER ACKNOWLEDGMENT MODE**
  1. Press and hold **ISOL/RESET** button for 7 seconds.
  2. This will mute any non-critical system faults for 12 minutes

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

11.3.4 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 Isolated 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 Isolated Mode.

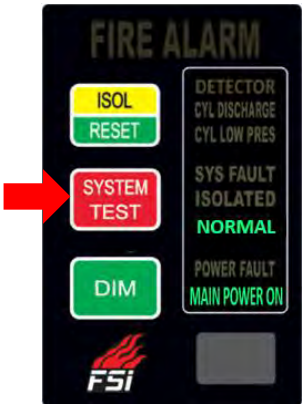


- **ENTER ISOLATION MODE**
  1. Press and hold **SYSTEM TEST** and **DIM** buttons for 10 seconds, 1 beep to confirm and ISOLATED Flashes rapidly
  2. Enter the below sequence (beeping after each press)
     1. SYSTEM TEST (RED)
     2. ISOL/RESET (YELLOW/GREEN)
     3. ISOL/RESET (YELLOW/GREEN)
   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

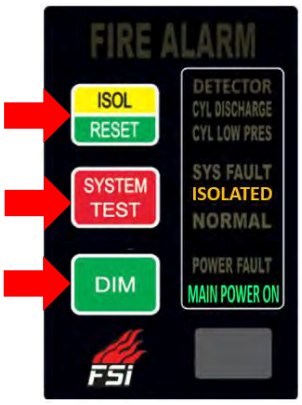
11.3.5 SYSTEM TEST



- Under normal operational conditions momentarily depressing 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 modes, pressing the **SYSTEM TEST** button will cycle through all latched faults and/or alarms on the display window.

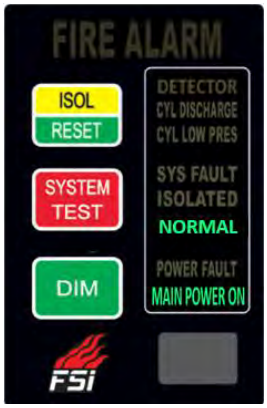
11.3.6 SLEEP MODE (Back up Battery Only)

Sleep mode electronically disconnects the internal backup battery, conserving battery life when the machine's batteries are isolated for extended periods. This prevents unnecessary power consumption from the V5 module while the main power supply is disconnected. Once vehicle power (12/24V) is restored, the internal backup battery automatically reconnects, allowing the system to resume normal operation without manual intervention.



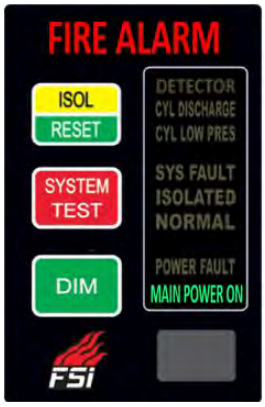
1. Disconnect the main power supply to the V5 Module.
2. Place the module into isolate
3. Press and hold **ISOL/RESET, SYSTEM TEST** and **DIM** buttons for 30 seconds until the 5 second countdown has timed out
4. Once the countdown completes, the system will electronically disconnect the internal back-up battery, putting the unit into sleep mode

SYSTEM NORMAL



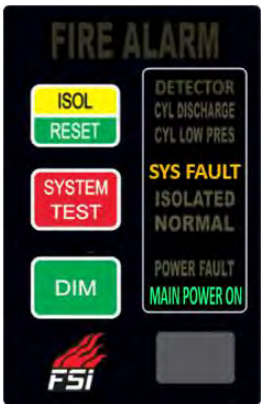
NORMAL and **MAIN POWER ON**, indications are illuminated when the system is in operational condition.

ALARM



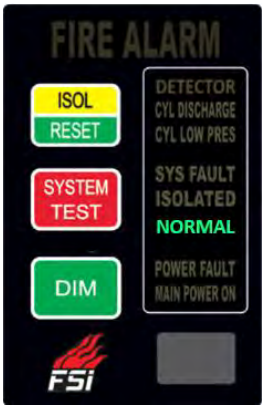
If an alarm is activated due to a thermal probe, cylinder low pressure or system discharge the **NORMAL** will go out and the alarm circuit that has activated will illuminate. Pressing **SYSTEM TEST** will display a fault code in the display window.

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

12.3 DIAGNOSTIC TABLE - ALARMS

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

12.4 DIAGNOSTIC TABLE - FAULTS

FAULTS		CAUSE	REPAIR
F0	Detector Circuit Fault.	• Faulty probes/LHD. • Faulty plugs/wiring. • System configuration.	• Check probes/LHD. • Check plugs/wiring. • Check system configuration. • Reset Module.
F1	Discharge Pressure. Switch Circuit Fault.	• Faulty pressure switch. • Faulty plugs/wiring.	• Check pressure switch. • Check plugs/wiring. • Reset Module
F2	Low Pressure Switch. Circuit Fault.	• Faulty pressure switch. • Faulty plugs/wiring. • System configuration.	• Check pressure switch. • Check plugs/wiring. • Check system configuration. • Reset Module.
F3	Solenoid Circuit Fault. (Set when driven)	• Faulty solenoid. • Faulty plugs/wiring. • System configuration.	• Check Solenoid. • Check plugs/wiring. • Check system configuration. • Reset Module.

F4	Display Fault	• Faulty Display cable. • Faulty plugs.	• Reset Module. • Replace display cable/plugs.
F5	Internal Supply Fault.	• Incorrect voltage supply	• Reset Module. • Return to FSI.
F6	Backup Battery Fault.	• Battery is low voltage. • Battery not connected, battery is faulty, or a board fault exists. • System configuration.	• Allow battery to charge with voltage >12.5 volts for 2 hours. • Check system configuration. • Reset Module. • Return to FSI.
F7	Battery Charge Fault.	• Ambient Temp below 0˚C or above 47˚C. • Battery not connected. • Battery is faulty. • CPU fault exists.	• Check system configuration. • Check Ambient Temp • Reset Module. • Return to FSI.
F8	RTC Battery Fault.	• Battery fault. • RTC Voltage below 1.8 volts.	• Replace RTC battery. • Reset Module.
F9+F4	Incorrect Configuration	• nA selected for a shutdown Module.	• Carry out correct shutdown timer configuration procedure.
FA	Manual Actuation Circuit Fault	• Faulty Electric actuator. • Faulty plugs/wiring. • System configuration.	• Check Electric actuator. • Check plugs/wiring. • Check system configuration. • Reset Module.
U	Unconfigured (Isolated Mode)	• System not configuration.	• Carry out configuration procedure.
U	Display will not program (No display illumination)	• CPU frozen.	• Cycle main power supply • Remove RTC battery to hard reset. • Reprogram all configurations.
	Display Module will not deisolate	• All configurations not programmed.	• Check system configuration. • Reset Module.

13.0 MAINTENANCE PROCEDURES

13.1 FILLING WITH SOLUTION

NOTE
Refer to the Foam-Guard F3 foam SDS. Clean Drinkable/Potable water shall be used when testing or refilling.

1. Select the correct sized FSI Fill Tube for the cylinder being refilled.
2. Screw the correct FSI Fill Tube onto the cylinder neck ensuring it is seated and firmly hand tight.
3. Fill with Drinkable/Potable water using a hose or container until water is sitting at the top of the fill tube.
4. Remove FSI Fill Tube.
5. Accurately measure out the correct amount of F3 concentrate as stated on the cylinder label or manual.
6. Using a funnel pour slowly into the cylinder.
7. Ensure the O-ring at the top of the syphon tube is in operational condition and there is Molykote 111 on the bevelled lip of the cylinder neck.
8. Carefully reinstall the valve and hand tighten only.
9. Carry out same procedure for multiple cylinders.

CAUTION
Horizontal cylinders shall be level when filling with solution to ensure the correct volume is achieved.

Table 3
Solution Capacities

CYLINDER CAPACITY (L)	SOLUTION CAPACITY (L)	DRINKABLE/POTABLE WATER (L)	F3 (L)
16	12	11	1
23	17	15.5	1.5
45	30	28	2
65	50	46	4
106	90	84	6

13.2 DISCHARGE HOSES – CLEAR PASSAGE TEST

1. Remove discharge hose **(A)** from the cylinder valve.
2. Plug remaining discharge hoses on multi cylinder configurations.
3. Connect (FSI 51010) FSI Line Flushing Adaptor **(B)** to compressed air or nitrogen and then connect to the discharge hose.
4. Clear passage test the discharge hoses including the foam line to PME, of all residual solution. On larger systems separate sections may need to be clear passage tested individually.
5. Refit all silicone nozzle caps.

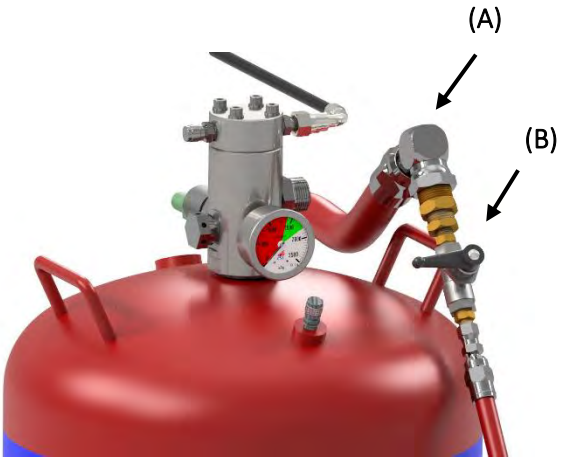


Figure 49
Line Flushing Adaptor

13.3 INADEQUATE DISCHARGE - FLUSHING REQUIREMENT

1. Disconnect the discharge hose(s) from the cylinder discharge valve(s).
2. Connect a Drinkable/Potable water supply to the discharge hose end(s) using the FSI line flushing adaptor and suitable fittings.
3. Clear passage test all of the discharge system including the foam line to PME until Drinkable/Potable water is observed from each nozzle, in a uniform spray pattern, and is discharging from the foam line. Any nozzle assembly failing to provide a uniform spray pattern may need to be replaced. This may also include blocked or damaged hose assemblies.
4. Disconnect the Drinkable/Potable water supply from the discharge hoses.
5. Carry out DISCHARGE HOSES – CLEAR PASSAGE TEST procedure.

CAUTION
INADEQUATE DISCHARGE - FLUSHING REQUIREMENT procedure may also be required when the system is in an extremely aggressive environment.

13.4 ACTUATION HOSES – ROP SYSTEM CLEAR PASSAGE TEST

CAUTION
Inadvertent discharge of the system may occur if the actuation hoses are not flushed as per the procedure. Nitrogen shall be used to conduct this procedure

1. To prevent accidental discharge, connect a (FSI 51004) FSI Cylinder Isolation cap to the discharge outlet
2. Disconnect the ROP actuation hoses from the cylinder discharge valves. **(A)**
3. Disconnect the ROP actuation hoses from ALL actuation points, manual actuators, and Mechanical Sensor Module (MSM) **(B).**
4. Connect (FSI 51005) FSI Actuation Line Tester to an actuation hose and clear passage test the hose assembly ensuring adequate pressure is venting from the actuation hoses at the cylinder valves.
5. Ensure No pressure is venting from any other actuation hose assembly. This can indicate a check valve is damaged.
6. Repeat step 3 and 4 for all individual actuation hose assemblies.
7. Connect (FSI 51010) FSI Line Flushing Adaptor to the actuation hose located at the cylinder discharge valve.
8. With all actuators and MSM's disconnected, pressurise the actuation hose from each cylinder discharge valve. This will test the operation and orientation of the check valves situated in the manifold. Ensure the actuation line maintains pressure and is not venting from the actuators or MSM hose assemblies.
9. Reinstall all actuation hoses.

56rtdfcvcx
To avoid personal injury, ensure all disconnected actuation hose assemblies are adequately secured with suitable P-clamps or cable ties for this procedure.

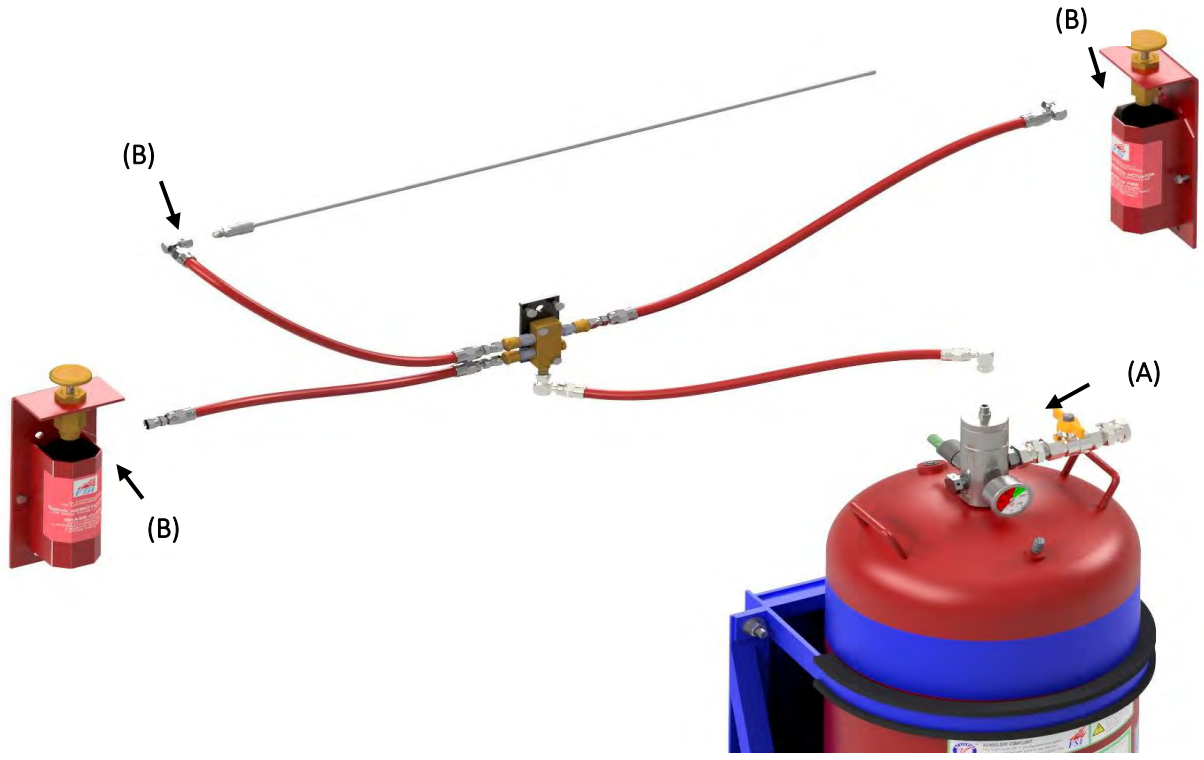
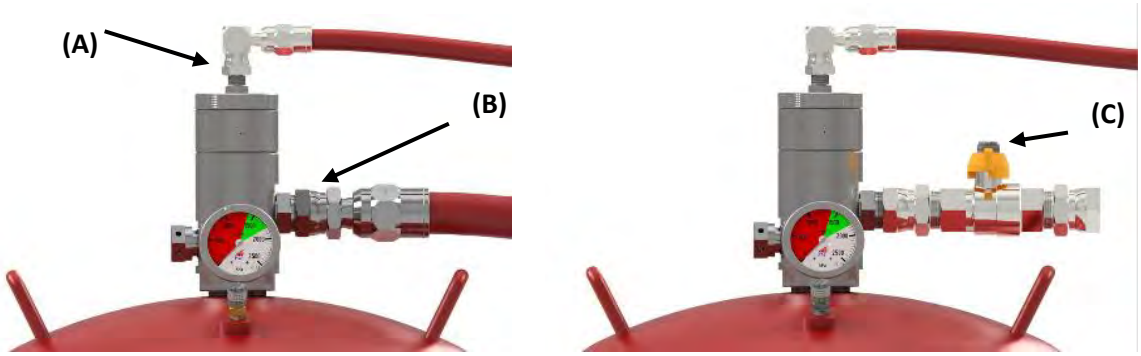


Figure 50
ROP System Clear Passage

13.5 ROP – ISOLATION PROCEDURE

NOTE
This procedure is also applicable to FSI ROP Electric systems.



1. Locate all FSI fire suppression cylinders.
2. Disconnect the actuation hose **(A)** and discharge hose **(B)** from each cylinder valve and cover hose inlet to prevent the ingress of contaminants.
3. Unplug DT plug(s) from all pressure switches.
4. Connect (FSI 51004) FSI Discharge Isolation cap **(C)** to the ROP discharge valve outlet.
5. Remove cap from the lower Schrader valve located in the cylinder crown.
6. Slowly vent the nitrogen until the cylinder is completely depressurised and the cylinder gauge is reading 0kPa prior to removing any part of the cylinder valve assembly.
7. Carry out all required work as required.

13.6 ROP - MANUAL ACTUATION RECHARGE PROCEDURE

1. Locate and identify which manual actuator has been used to actuate the system, inspect the safety pin and securitie.
2. Inspect for visible signs of damage. Replace if necessary.
3. Retract striker pin / knob to its fully extended position.
4. Re-locate safety pin into striker pin.
5. Attach securitie in place.
6. Remove CO_2 cartridge. Inspect burst disc (cartridge burst disc shall be punctured prior to disposal)
7. Replace striker pin and cartridge if burst disc has been punctured. Ensure O-ring is present.
8. Clear passage test the discharge hoses as per DISCHARGE HOSES – CLEAR PASSAGE TEST procedure.
9. Clear passage test the actuation hoses as per ACTUATION HOSES – ROP SYSTEM CLEAR PASSAGE TEST procedure.
10. Recharge the ROP system as per ROP - CHARGING PROCEDURE.

WARNING
Inadvertent discharge may be attributed to NOT flushing out the actuation lines. Following system actuation via a CO_2 manual actuator, residual CO_2 will be present within the actuation line. If all actuation hoses are NOT flushed out prior to reconnection, it is possible that the system may inadvertently actuate.

13.7 ROP - AUTOMATIC ACTUATION RECHARGE PROCEDURE

1. Locate and identify how the MSMs have been actuated. Inspect the visual indicator at the base of the MSM.
2. Replace MSM as required.
3. Dispose of the damaged MSM as per SDS.
4. Clear passage test the discharge hoses as per DISCHARGE HOSES – CLEAR PASSAGE TEST procedure.
5. Clear passage test the actuation hoses as per ACTUATION HOSES – ROP SYSTEM CLEAR PASSAGE TEST. procedure.
6. Recharge the ROP system as per ROP - CHARGING PROCEDURE.

NOTE - ELECTRIC ACTUATION SYSTEMS
Before carrying out any maintenance on an electric actuation system the Module SHALL BE ISOLATED to prevent an accidental discharge. Disconnecting the main power supply WILL NOT reset the system.

13.8 ROP/ELECTRIC - ACTUATION RECHARGE PROCEDURE

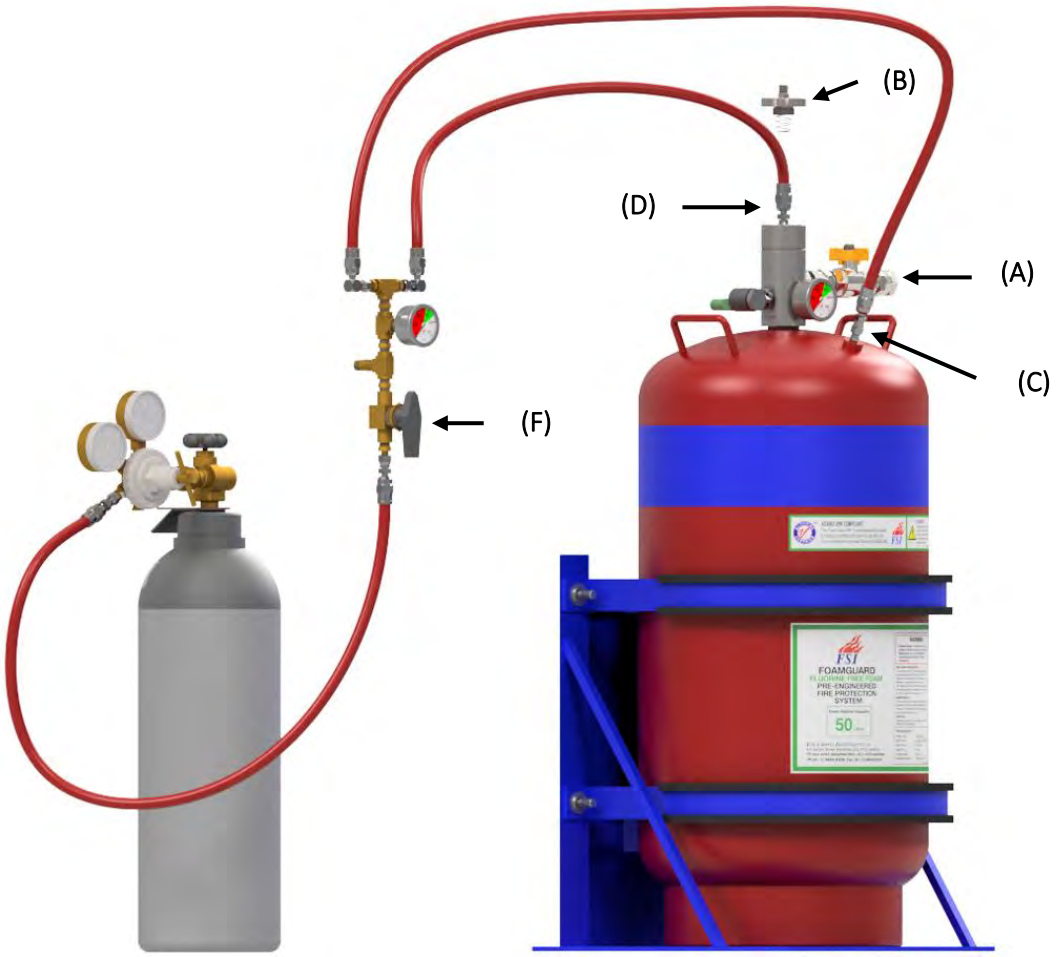
1. Locate and identify what caused the LHD wire or Thermal Probes to actuate the system.
2. Replace damaged LHD wire, Thermal Probes or fire harness as required.
3. Clear passage test the discharge hoses as per DISCHARGE HOSES – CLEAR PASSAGE TEST procedure.
4. Clear passage test the electric solenoid as per ELECTRIC SOLENOID – CLEAR PASSAGE TEST procedure.
5. Recharge the ROP system as per ROP - CHARGING PROCEDURE.

13.9 ROP - CHARGING PROCEDURE

1. To prevent accidental discharge, connect (FSI 51004) FSI Cylinder Isolation cap **(A)** to the discharge outlet
2. Remove the 1/4" BSP actuation line from the top of the discharge valve assembly.
3. Unscrew the actuation cap **(B)** and spring from the discharge valve assembly.
4. Remove the Schrader valve cap from the lower Schrader valve **(C)** on the cylinder crown.
5. Connect (FSI 50001) FSI Charge Rig to a Nitrogen Regulator and set the Nitrogen Regulator to a pressure of 2200kPa.

CAUTION
EHP nitrogen regulators **shall NOT** be used.

6. Connect hoses from (FSI 50001) FSI Charge Rig to the Schrader valves on the discharge valve **(D)** and cylinder crown **(C).**
7. Open charge rig ball valve **(F)** by turning 90 degrees. Monitor cylinder gauge until cylinder pressure reaches the correct pressure for the ambient temperature as per table 5.
8. Allow a minimum of **10 minutes** for cylinder pressure to stabilise. Depending on ambient temperature this time may vary.



9. Disconnect (FSI 50001) FSI Charge Rig hoses from the upper Schrader valve **(D)** and lower Schrader valve **(C).**
10. Re-fit a Schrader valve cap to the lower Schrader valve **(C)** only**.**

CAUTION
A Schrader valve cap **shall NOT** be fitted to the Upper Schrader valve on a ROP system.

11. Check valve and cylinder assembly for leaks using leak detection fluid. If a leak is present system shall be depressurised and the leak rectified.
12. Re-fit the actuation spring into the discharge valve end cap and re-fit the actuation cap **(B)** onto the discharge valve assembly.
13. Disconnect (FSI 51004) FSI cylinder isolation cap **(A)** from the discharge outlet and reconnect discharge and actuation hoses.
14. Reset fire alarm Display Module to its normal operation condition.

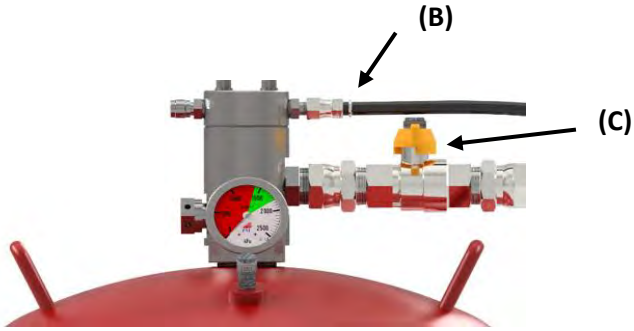
NOTE
The control Module SHALL BE ISOLATED prior to recharging the fire suppression cylinders. Disconnecting any power supply WILL NOT reset the electric actuation solenoid valve. For multi cylinder ROP systems each cylinder is charged individually.

CAUTION - ELECTRIC ACTUATION SYSTEMS
Ensure the control module is configured, isolated and the back-up battery is adequately charged prior to conducting the cylinder recharge procedure.

13.10 LOP - ISOLATION PROCEDURE

NOTE
These procedures are also applicable to FSI Electric systems.

1. Locate all FSI fire suppression cylinders.
2. Disconnect the discharge hose **(A)** from the discharge nipple on each discharge valve.
3. Unplug DT plugs from pressure switch.
4. Connect (FSI 51004) FSI Cylinder Isolation Caps **(C)** to the LOP discharge valve outlet.
5. Remove cap from the lower Schrader valve located in the cylinder crown.
6. Slowly vent the nitrogen until the cylinder is completely depressurised and the cylinder gauge is reading 0kPa prior to removing any part of the cylinder valve assembly.
6. The actuation hose **(B)** can be removed, and maintenance carried out as required.



13.11 LOP - RECONNECTION PROCEDURE

1. Reinstall actuation hose **(B)** and reseal threads with Nylog Blue.
2. Charge the FSI Foam-Guard Fire Suppression System (LOP).
3. Gently vent residual pressure from the (FSI 51004) FSI discharge isolation cap **(C).**
4. Remove all (FSI 51004) FSI discharge isolation caps.
5. Resecure discharge hoses **(A).**
6. Reconnect DT plug(s) to all pressure switches.
7. Reset fire alarm Display Module.

13.12 LOP - MANUAL ACTUATION RECHARGE PROCEDURE

NOTE

When disconnecting any part of the actuation circuit each 7/16 JIC fitting shall be sealed on the tread with a small amount of Nylog Blue to ensure operational integrity of the system.

1. Locate and identify which manual actuator has been used to actuate the system, inspect the safety pin and securitie.
2. Inspect for visible signs of damage.
3. Clear passage test the discharge hoses as per DISCHARGE HOSES – CLEAR PASSAGE TEST procedure.
4. Clear passage test the actuation hoses as per ACTUATION HOSES – LOP SYSTEM CLEAR PASSAGE TEST procedure.
5. Leak test actuation circuit as per LOP - LEAK TESTING ACTUATION CIRCUIT procedure.
6. Recharge the LOP system as per LOP - CHARGING PROCEDURE.

13.13 LOP - AUTOMATIC ACTUATION RECHARGE PROCEDURE

1. Locate and identify how the LOP detection tube has actuated the system; an actuation circuit leak test may be required to determine the location of the leak.
2. Replace the LOP detection tubing or actuation hose as required.
3. Clear passage test the discharge hoses as per DISCHARGE HOSES – CLEAR PASSAGE TEST procedure.
4. Clear passage test the actuation hoses as per ACTUATION HOSES – LOP SYSTEM CLEAR PASSAGE TEST procedure.
5. Leak test actuation circuit as per LOP - LEAK TESTING ACTUATION CIRCUIT procedure.
6. Recharge the LOP system as per LOP - CHARGING PROCEDURE.

13.14 ELECTRIC - MANUAL ACTUATION RECHARGE PROCEDURE

1. Locate and identify which manual actuator has been used to actuate the system, inspect the safety pin and securitie.
2. Inspect for visible signs of damage to the actuator and fire harness, replace if necessary.
3. Clear passage test the discharge hoses as per DISCHARGE HOSES – CLEAR PASSAGE TEST procedure.
4. Clear passage test the electric solenoid as per ELECTRIC SOLENOID – CLEAR PASSAGE TEST procedure.
5. Recharge the system as per LOP - CHARGING PROCEDURE.

NOTE - ELECTRIC ACTUATION SYSTEMS

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.

13.15 ELECTRIC - AUTOMATIC ACTUATION RECHARGE PROCEDURE

1. Locate and identify what caused the LHD wire or Thermal Probes to actuate the system.
2. Replace damaged LHD wire, Thermal Probes or fire harness as required.
3. Clear passage test the discharge hoses as per DISCHARGE HOSES – CLEAR PASSAGE TEST procedure
4. Clear passage test the electric solenoid as per ELECTRIC SOLENOID – CLEAR PASSAGE TEST procedure.
5. Recharge the system as per LOP - CHARGING PROCEDURE.

NOTE - ELECTRIC ACTUATION SYSTEMS
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.

13.16 ACTUATION HOSES – LOP SYSTEM CLEAR PASSAGE TEST

CAUTION
Do not remove the actuation line from the actuator to conduct a clear passage test, as this does not test for obstruction within the actuator.

1. The FSI system shall be isolated and depressurised to prevent an uncontrolled discharge.
2. Disconnect the actuation hose **(A)** at the cylinder discharge valve.
3. Connect (FSI 51005) FSI Actuation Line Tester **(B)** to the nitrogen supply.
4. Conduct the clear passage test with Nitrogen on the actuation circuits by opening each LOP Manual Actuator one at a time, to ensure contaminants are removed from the internals of the hose, and there are no restrictions.
5. Remove actuator cover and reinstall the relief port silicone cap.
6. Remove the EOL LOP cap and conduct a clear passage test of the LOP detection circuits.
7. After the system has been inspected carry out an actuation line leak.

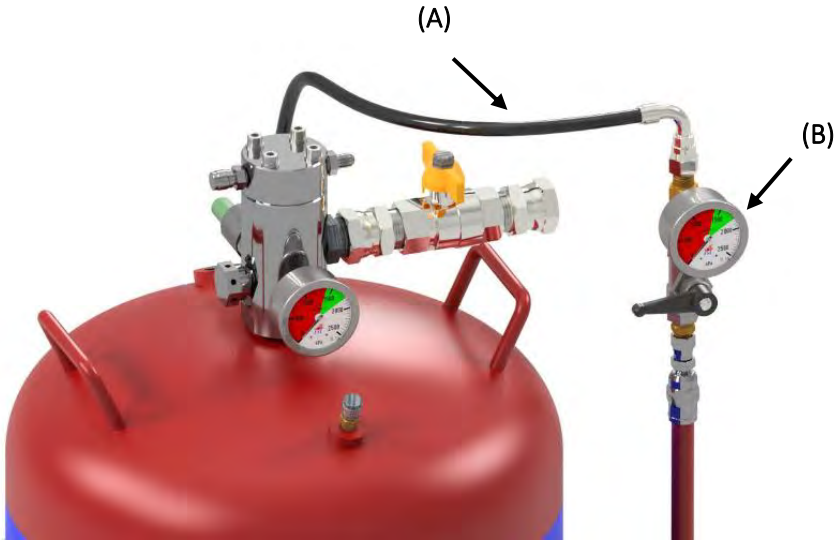


Figure 51
LOP Clear Passage Test

13.17 ELECTRIC SOLENOID – CLEAR PASSAGE TEST

CAUTION
Ensure the fire suppression system is isolated and depressurised to prevent accidental discharge.

1. The FSI system shall be isolated, depressurised and empty of solution to prevent an uncontrolled discharge.
2. Connect (FSI 51005) FSI Actuation Line Tester **(A)** to the nitrogen supply.
3. Actuate the electric actuator to energise the solenoid and conduct a clear passage test of the solenoid and hose assembly to ensure contaminants are removed from the internals of the hose and solenoid.
4. Reinstall the relief port silicone cap (LOP)
5. Isolate the system and reconnect components.

Figure 52
Solenoid Clear Passage Test

13.18 LOP - SEALING FITTINGS

1. Remove and clean off all Nylog Blue from the JIC thread and check inside the JIC fitting for blockages.
2. Ensure the JIC fitting surface is clean before applying the Nylog Blue.
3. Apply Nylog Blue to the JIC sealing surface and the threads of the male JIC fitting.
4. Reinstall the actuation circuit hose.

CAUTION
Ensure that excessive Nylog Blue is not applied which can cause the orifice to become obstructed.

Figure 53
Applying Nylog

13.19 LOP - LEAK TESTING ACTUATION CIRCUIT

1. Ensure the cylinder has been isolated/depressurised.
2. Remove the LOP actuation hose from the top of the discharge valve **(A).**
3. Connect (FSI 51005) FSI actuation line Test Rig **(B).**
4. Set the pressure to **2000kPa for a minimum of 30 minutes** and monitor for a pressure drop.
5. Using Leak Detector Fluid spray all connection fittings and hose assemblies.
6. If there is a pressure drop or a leak is found, safely depressurise the actuation circuit. Remove the leaking fitting or hose assembly, replace, and reseal with Nylog Blue.
7. Repeat step 4 - 5 and retest the actuation circuit to confirm the repair is correct and there are no further leak points in the system.

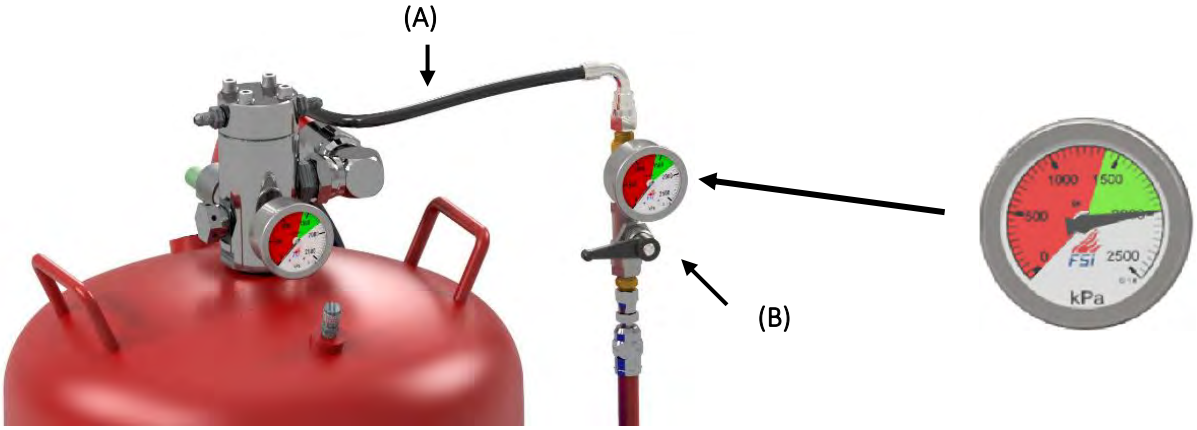


Figure 54
FSI Actuation Line Test Rig set to 2000kPa

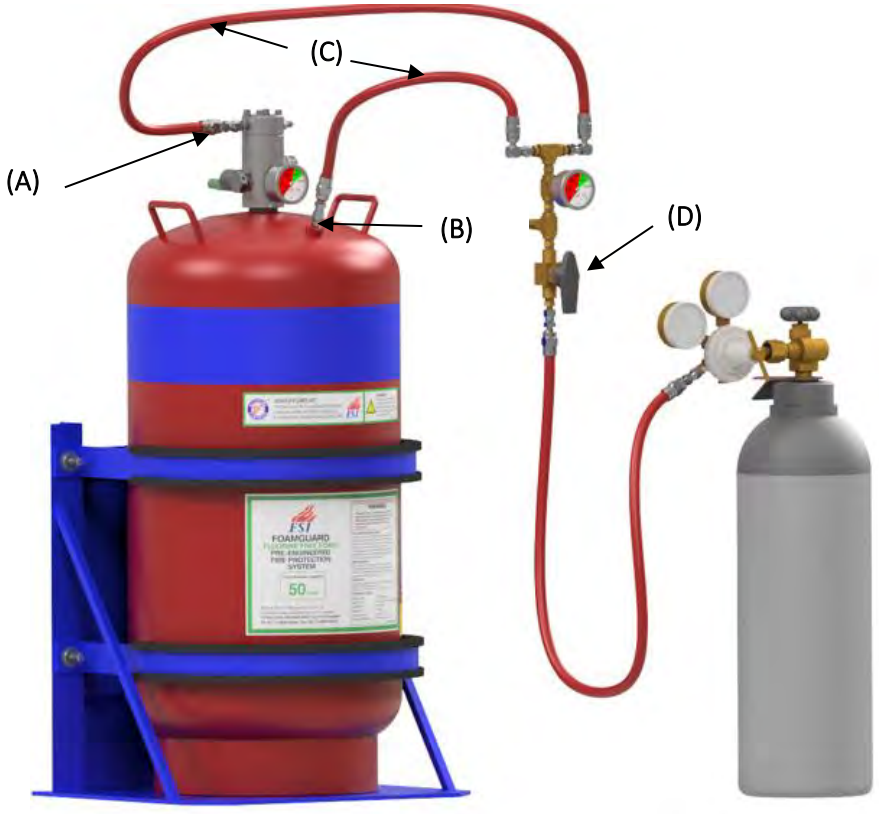
13.20 LOP - CHARGING PROCEDURE - SINGLE CYLINDER

CAUTION
Before refilling and charging a LOP system it is highly recommended to carry out a full actuation leak test to prevent accidental discharges due to loose connections.

1. Ensure the actuation hose is fitted and sealed with Nylog Blue to the top of the valve.
2. To prevent accidental discharge, connect (FSI 51004) FSI cylinder isolation cap to the discharge outlet on the LOP discharge valve.
3. Remove the Schrader valve cap from the upper Schrader valve **(A)** and lower Schrader valve **(B)**
4. Connect the (FSI 50001) FSI Charge Rig to the nitrogen regulator and set the nitrogen regulator to a pressure of 2200kPa.

CAUTION
EHP nitrogen regulators **shall not** be used.

5. Connect (FSI 50001) FSI Charge Rig hoses **(C)** to the upper Schrader valve **(A)** and lower Schrader valve **(B).**
6. Open charge rig ball valve **(D)** by turning 90 degrees. Monitor cylinder gauge until cylinder pressure reaches the correct pressure for the ambient temperature as per table 5.
7. Allow a minimum of **10 minutes** for cylinder pressure to stabilise. Depending on ambient temperature this time may vary.



8. Disconnect both (FSI 50001) FSI Charge Rig hoses **(C)** from the upper Schrader valve **(A)** and lower Schrader valve **(B).**
9. Check all connections at valve assembly for leaks using leak detection fluid. If a leak is present system shall be depressurised and the leak rectified.
10. Re-fit Schrader valve caps to the Schrader valves.
11. Disconnect (FSI 51004) FSI cylinder isolation cap from the discharge valve outlet and reconnect discharge hoses.
12. Reset fire alarm Display Module to its normal operation condition.

NOTE -ELECTRIC ACTUATION
The control Module SHALL BE ISOLATED prior to recharging the fire suppression cylinders. Disconnecting any power supply WILL NOT reset the electric actuation solenoid valve.

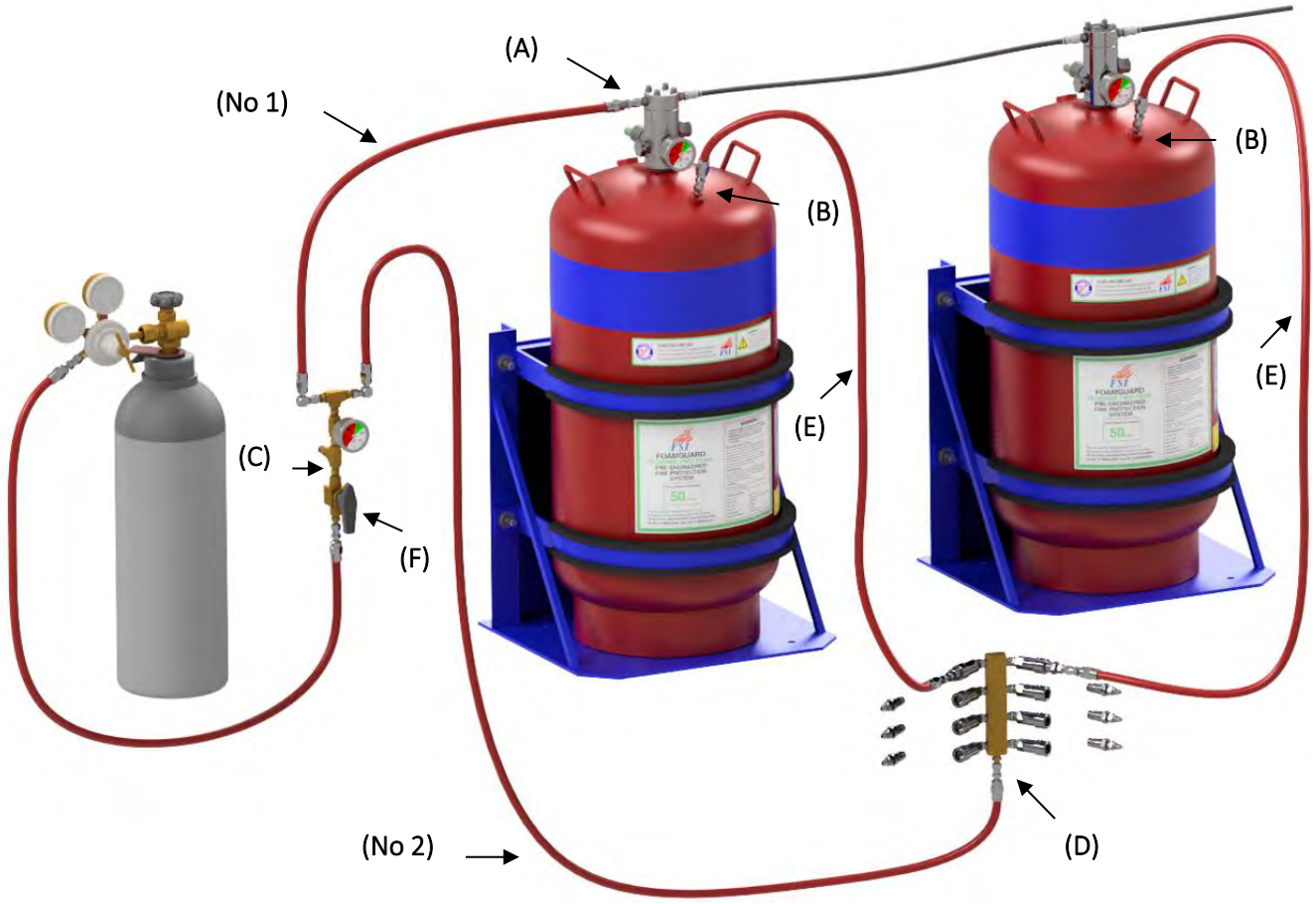
CAUTION - ELECTRIC ACTUATION SYSTEMS
Ensure the control module is configured, isolated and the back-up battery is adequately charged prior to conducting the cylinder recharge procedure.

13.21 LOP - CHARGING PROCEDURE - MULTI CYLINDER

1. Ensure the actuation hoses are fitted and sealed with Nylog Blue to the top of the valves.
2. To prevent accidental discharge, connect (FSI 51004) FSI cylinder isolation caps to the LOP discharge valves.
3. Remove the Schrader valve cap from the upper Schrader valve **(A)** and lower Schrader valves **(B).**
4. Connect (FSI 50001) FSI Charge Rig **(C)** to (FSI 50001/B) FSI Multi Cylinder Charge Adaptor **(D)** and nitrogen regulator and set the nitrogen regulator to a pressure of 2200kPa.

CAUTION
EHP nitrogen regulators **shall not** be used.

5. Connect hose **(No 1)** from the (FSI 50001) FSI Charge Rig to the upper Schrader Valve **(A)**.
6. Connect hose **(No 2)** from the (FSI 50001) FSI Charge Rig to (FSI 50001/B) FSI Multi Cylinder Charge Adaptor **(D).**
7. Connect FSI Multi Cylinder Charge Adaptor hoses **(E)** connect to the lower Schrader valve **(B)** on each lower cylinder Schrader valve.
8. Open charge rig ball valve **(F)** by turning 90 degrees. Monitor cylinder gauge until cylinder pressure reaches the correct pressure for the ambient temperature as per table 5.
9. Allow a minimum of **10 minutes** for cylinder pressure to stabilise. Depending on ambient temperature this time may vary.



10. Disconnect (FSI 50001) FSI Charge Rig and (FSI 50001/B) FSI Multi Cylinder Charge Adaptor hoses.
11. Check all connections at valve assembly for leaks using leak detection fluid.
12. Re-fit Schrader valve caps to the Schrader valves.
13. Disconnect the (FSI 51004) FSI cylinder isolation caps from the discharge outlet and reconnect discharge hoses.
14. Reset fire alarm Display Module to its normal operation condition.

NOTE- ELECTRIC ACTUATION
The control Module SHALL BE ISOLATED prior to recharging the fire suppression cylinders. Disconnecting any power supply WILL NOT reset the electric actuation solenoid valve.

CAUTION - ELECTRIC ACTUATION SYSTEMS
Ensure the control module is configured, isolated and the back-up battery is adequately charged prior to conducting the cylinder recharge procedure.

Table 4

Maximum Unsupported Hose and Wiring Lengths

HOSE DIA ID (INCH)	MAX UNSUPPORTED HOSE/WIRING (mm)
19mm - (3/4'')	750
12.5mm - (1/2'')	500
6.3mm - (1/4'')	400
Fire Harness	400
LOP Tube	400
LHD Wire	400
DT Plug from Enclosure	200
DT plug Disconnection Point	50

Table 5

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

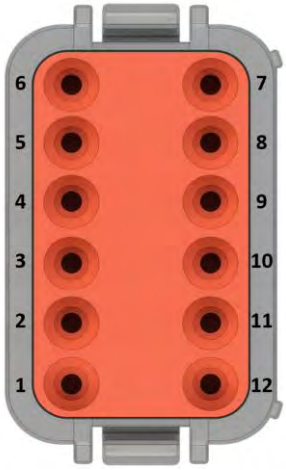
Table 6

Recommended Torque Setting

THREAD	RECOMMENDED TORQUE	SEALANTS
1/8" BSP or 1/8" NPT	10 to 15 Nm	577
1/4" BSP	10 to 15 Nm	577
1/2" BSP	25 to 30 Nm	Thread Tape
3/4" BSP	45 to 50 Nm	Thread Tape
1/4" BSP Hose End	7 to 9 Nm	N/A
1/2" BSP Hose End	40 to 50 Nm	N/A
3/4" BSP Hose End	50 to 55 Nm	N/A
7/16" JIC	10 to 15 Nm	Nylog Blue
1/4" Bolt	17 to 23 Nm	N/A
M6 Bolt	17 to 23 Nm	N/A
M10 Bolt	75 to 85 Mn	N/A
M12 Bolt	160 to 170 Nm	N/A
M12 High Tensile	142 to 152 Nm	N/A

14.0 WIRING DIAGRAMS

14.1 12 PIN DT PLUG

6	AUX Digital in (-)		CYL Low Pressure Switch (-) (WHITE)	7
5	AUX Digital in (+)		CYL Low Pressure Switch (+) (RED)	8
4	Electric Actuator (-) (YELLOW/GREEN)		Discharge Pressure Switch (-) (BLACK)	9
3	Electric Actuator (+) (BROWN)		Discharge Pressure Switch (+) (BLUE)	10
2	Solenoid (-) (BLACK)		LHD/Thermal Probes (-) (WHITE)	11
1	Solenoid (+) (BLUE)		LHD/Thermal Probes (+) (RED)	12

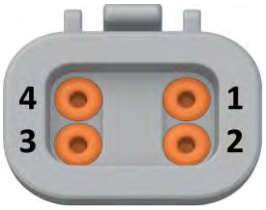
14.2 8 PIN DT PLUG

4	AUX Relay – N.C		Shutdown Relay – N.C	5
3	AUX Relay – COM		Shutdown Relay – COM	6
2	AUX Relay – N. O		Shutdown Relay – N. O	7
1	DC Negative		DC Supply 12/24 VDC	8

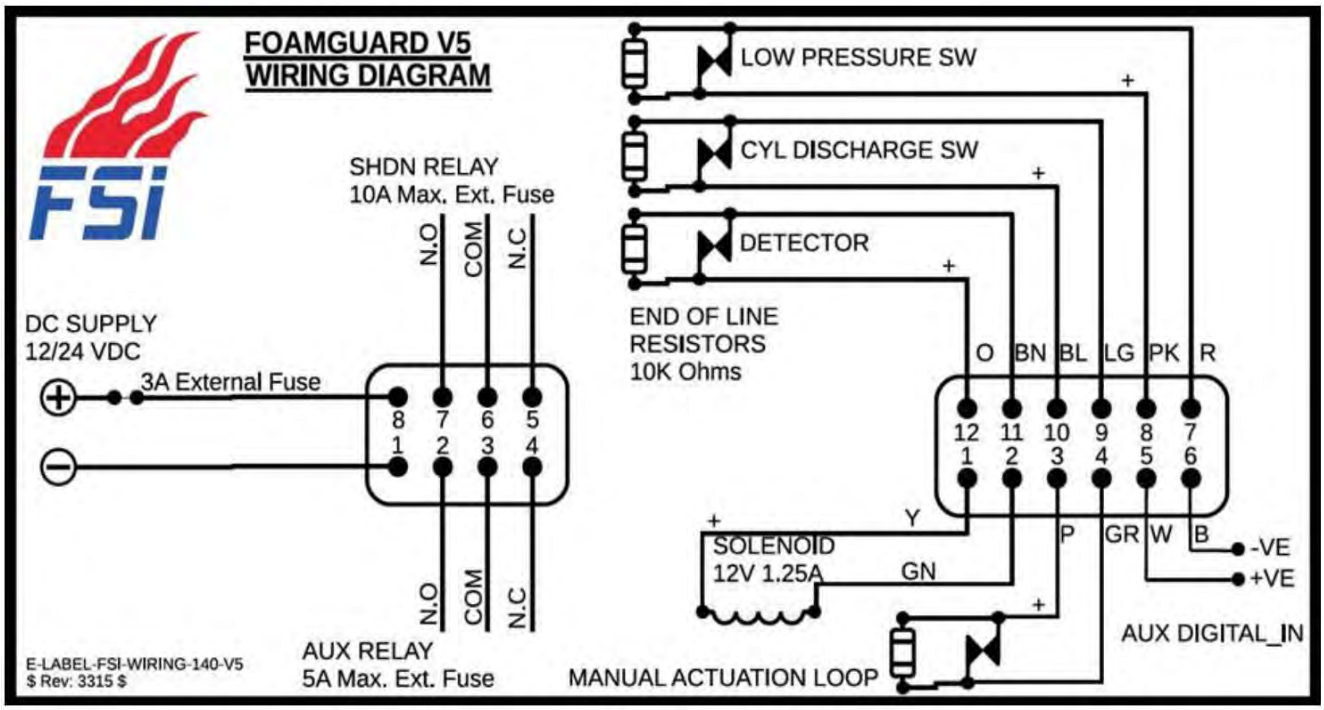
14.3 2 PIN DT PLUG AND RECEPTACLE

1	RED		WHITE	2

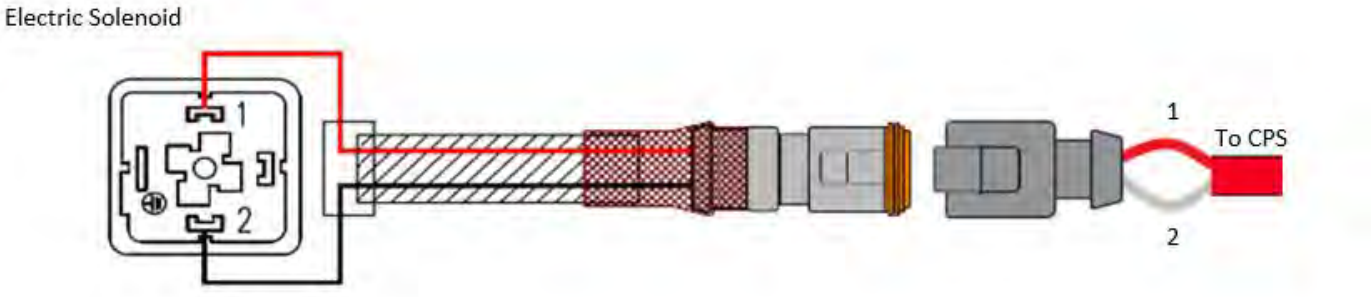
14.4 4 PIN DT PLUG AND RECEPTACLE

4	WHITE		BLACK	1
3	BLUE		RED	2

14.5 FSI V5 WIRING DIAGRAM

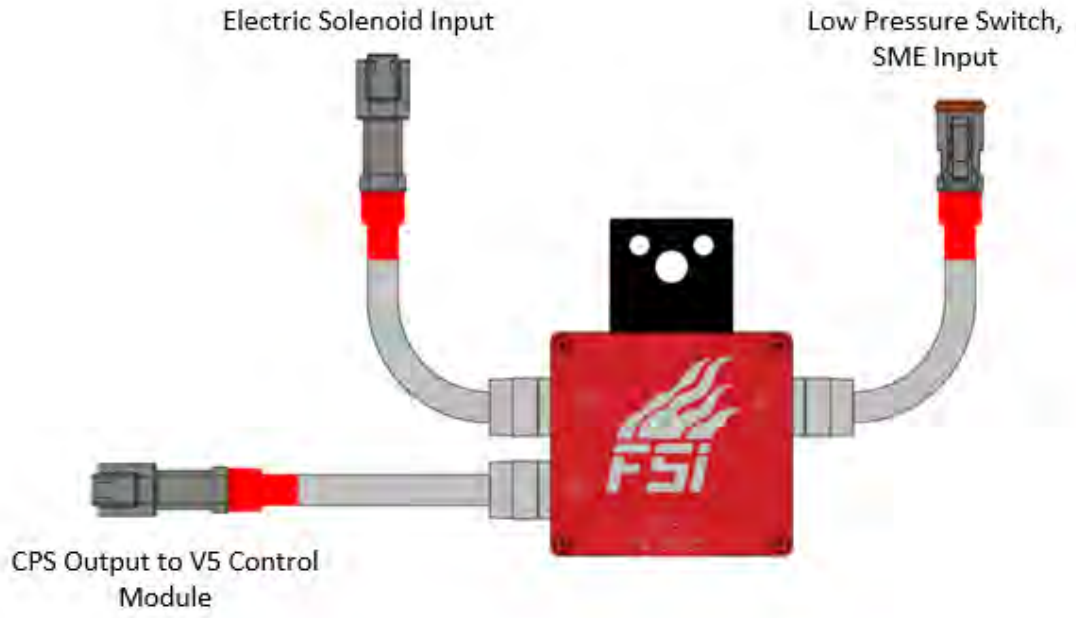


14.6 SOLENOID HIRSCHMANN PLUG

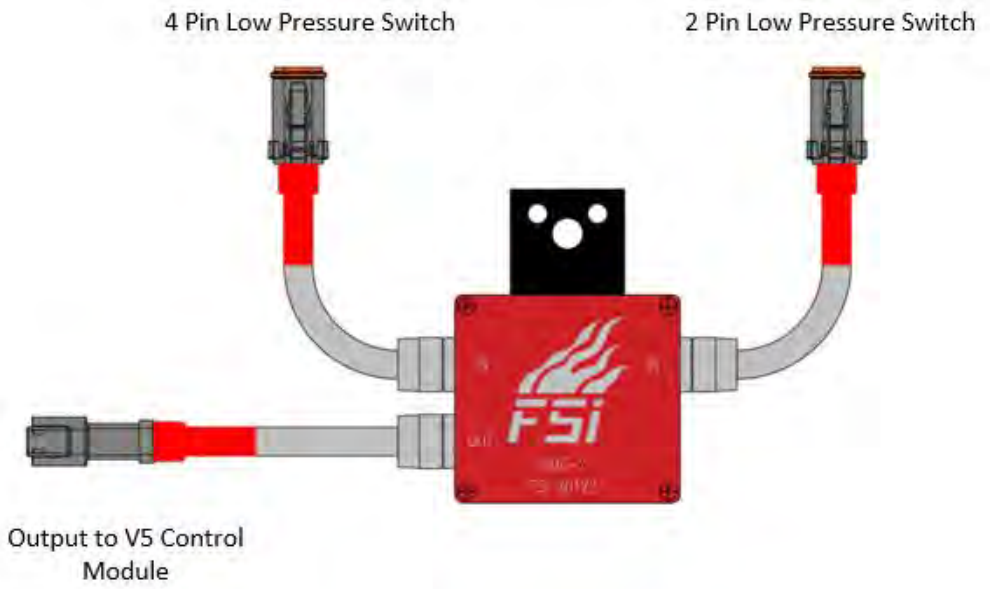


14.7 PME

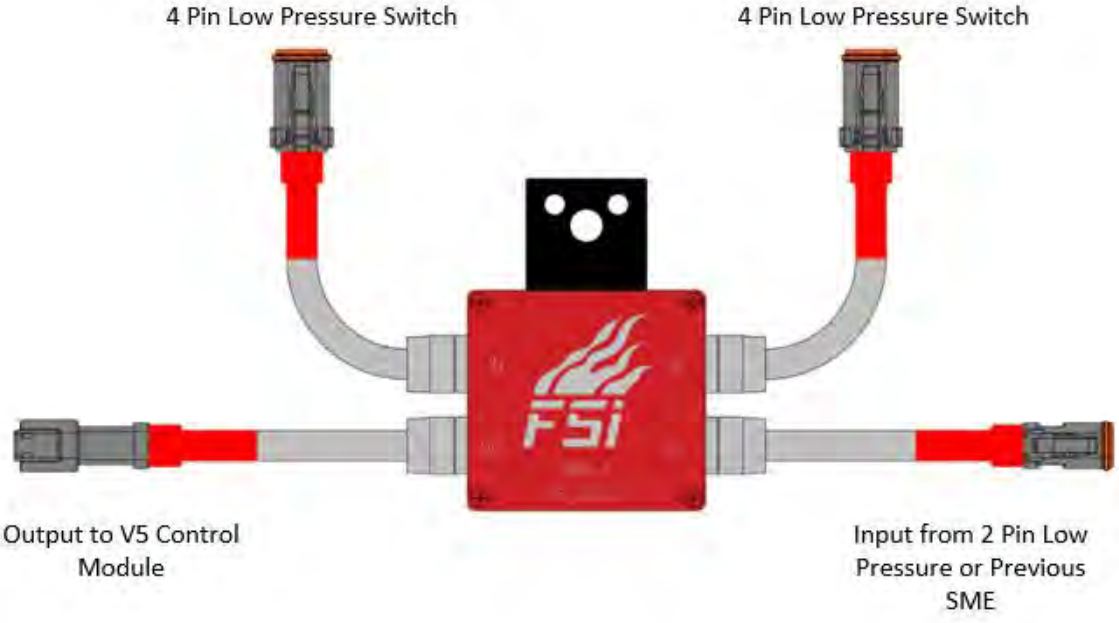
14.8 CPS



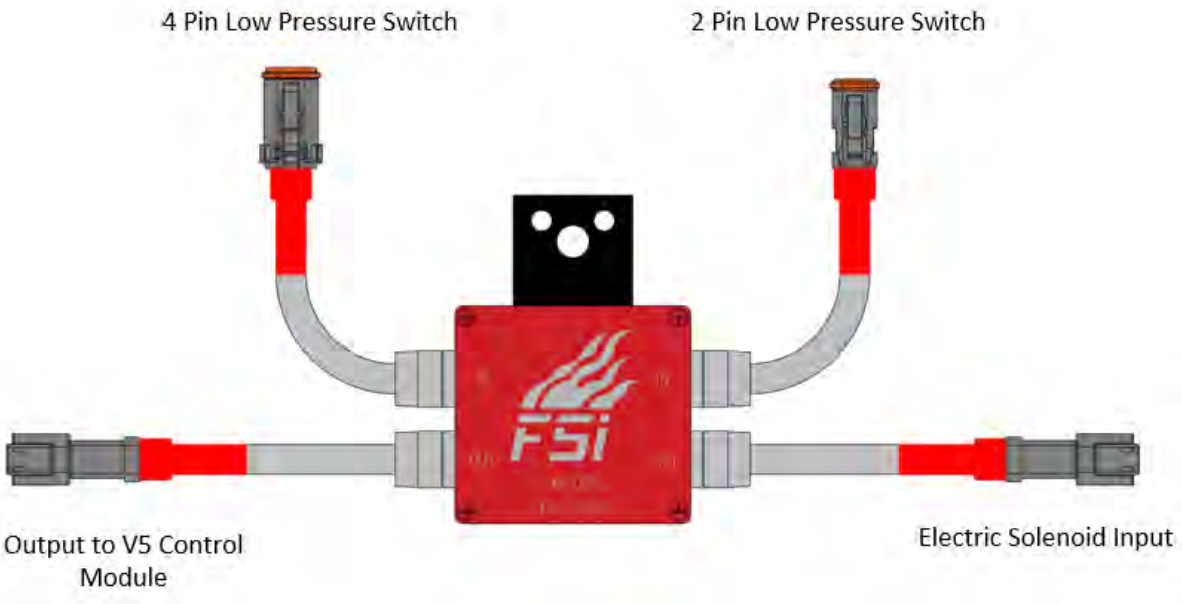
14.9 2 CYLINDER SME



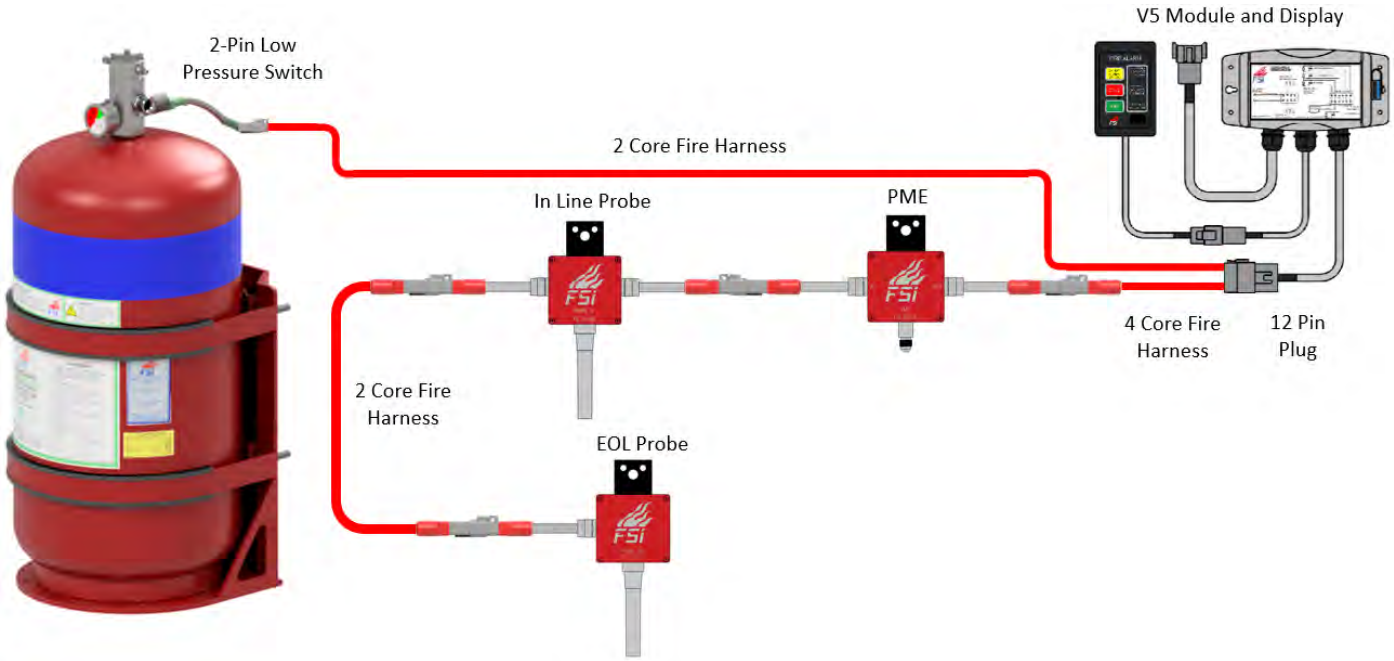
14.10 3 CYLINDER SME



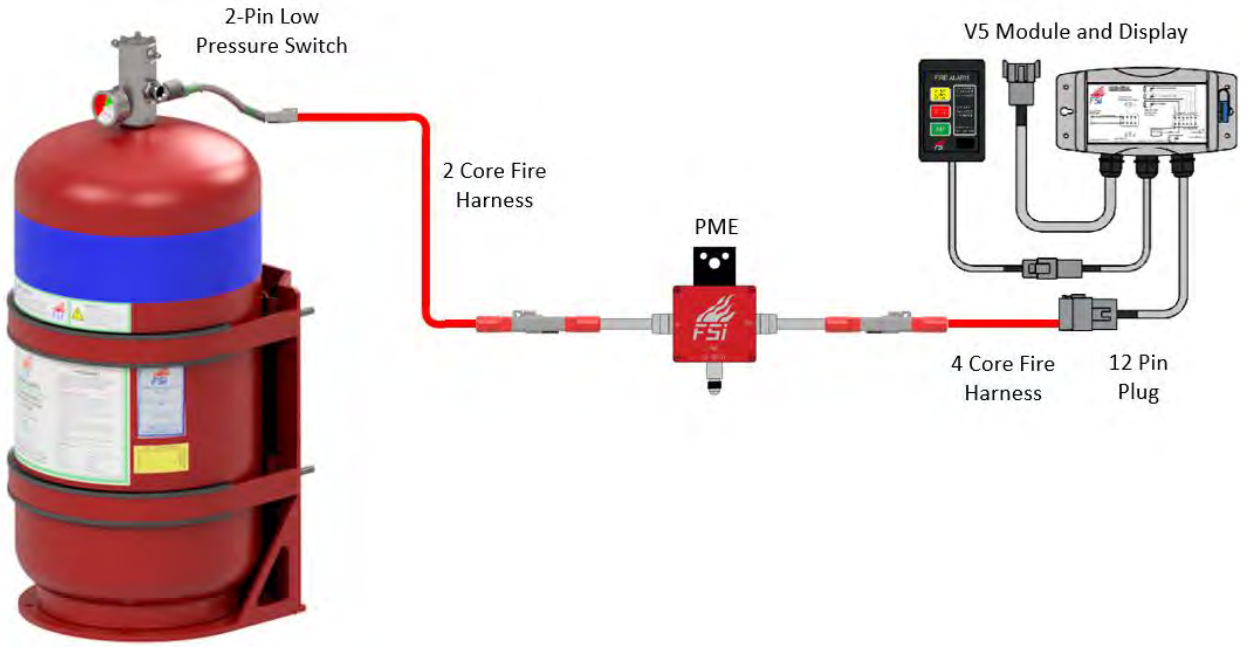
14.11 CPS/SME


4 Pin Low Pressure Switch
2 Pin Low Pressure Switch
FSI
Output to V5 Control Module
Electric Solenoid Input

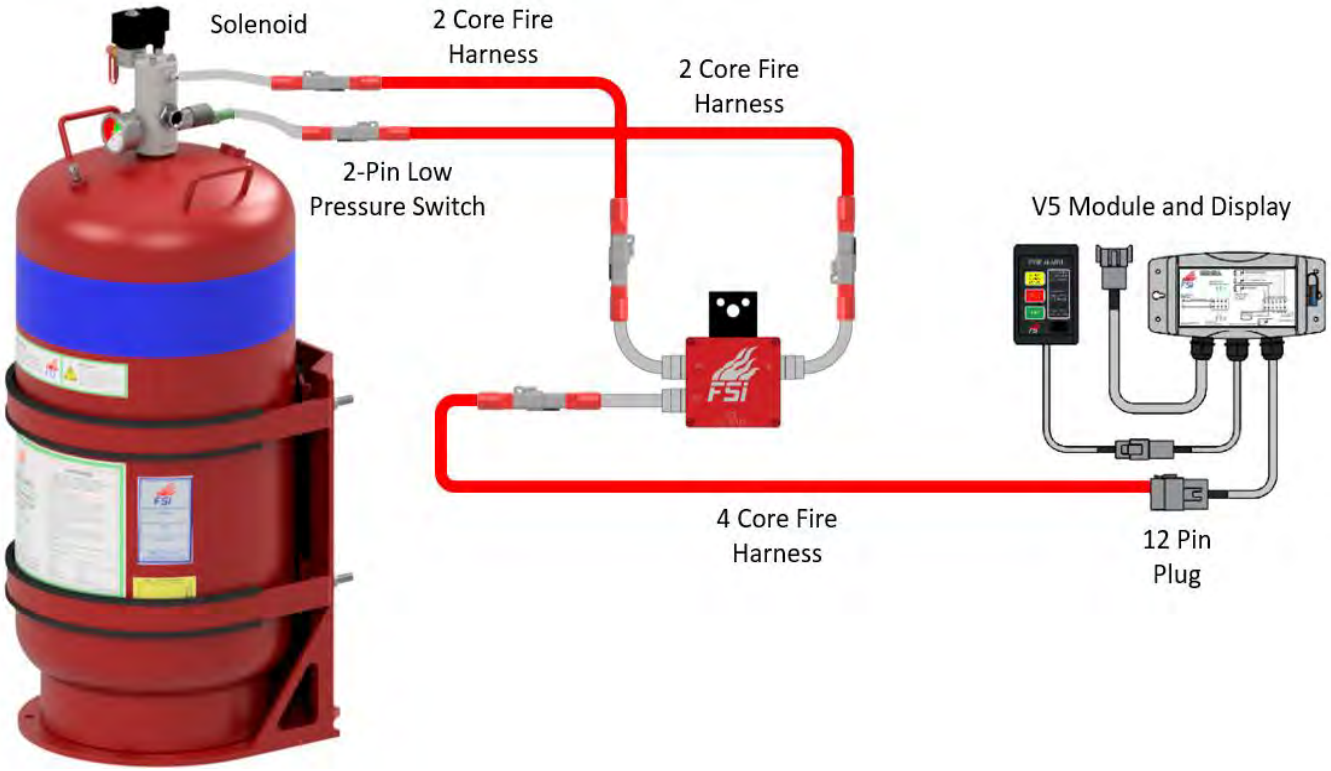
14.12 SECONDARY DETECTION AND LOW PRESSURE SWITCH WIRING



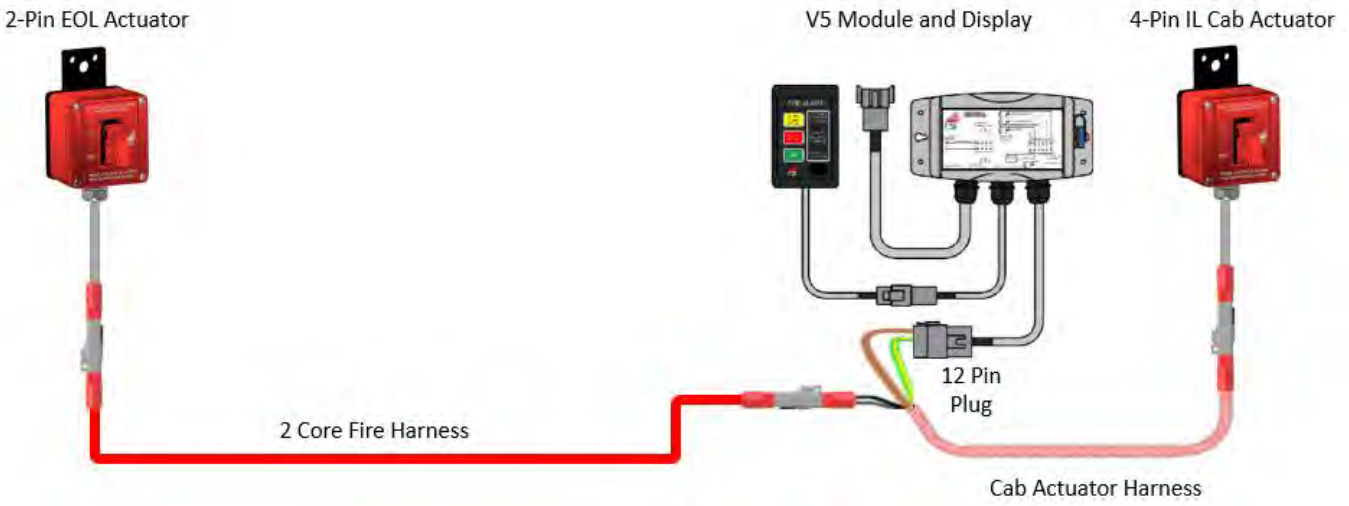
14.13 LOW PRESSURE SWITCH WIRING



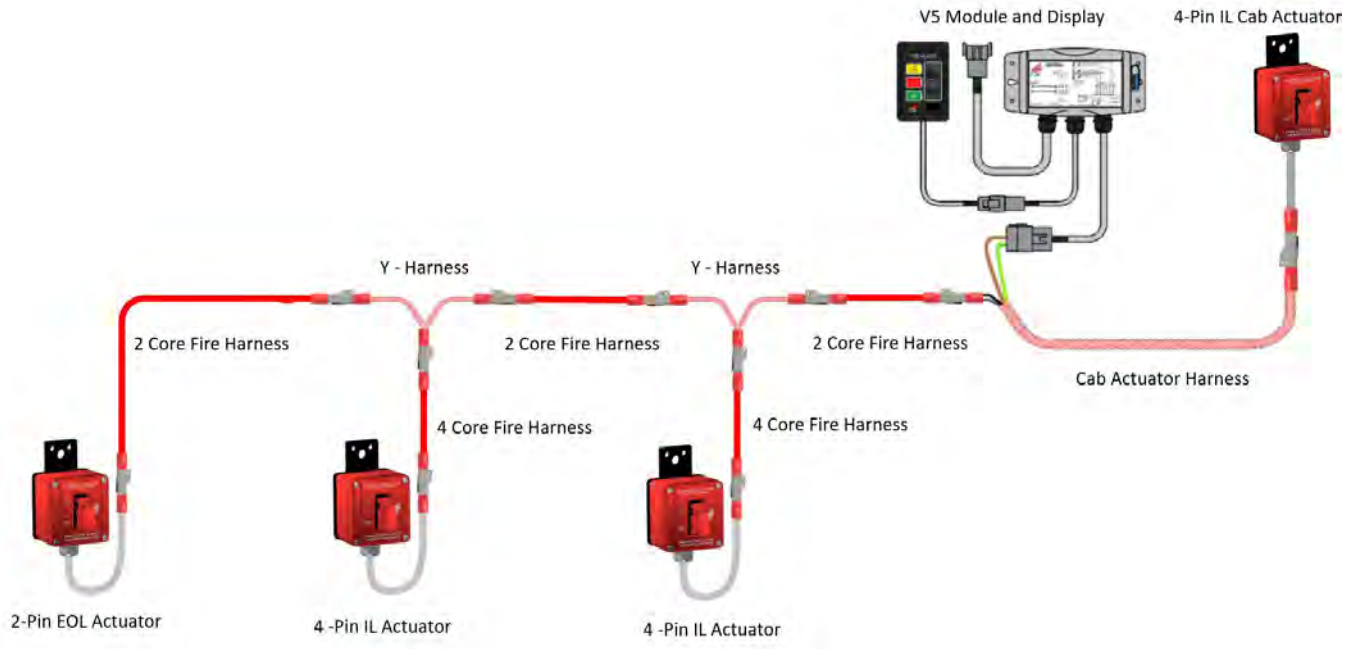
14.14 CPS AND SOLENOID



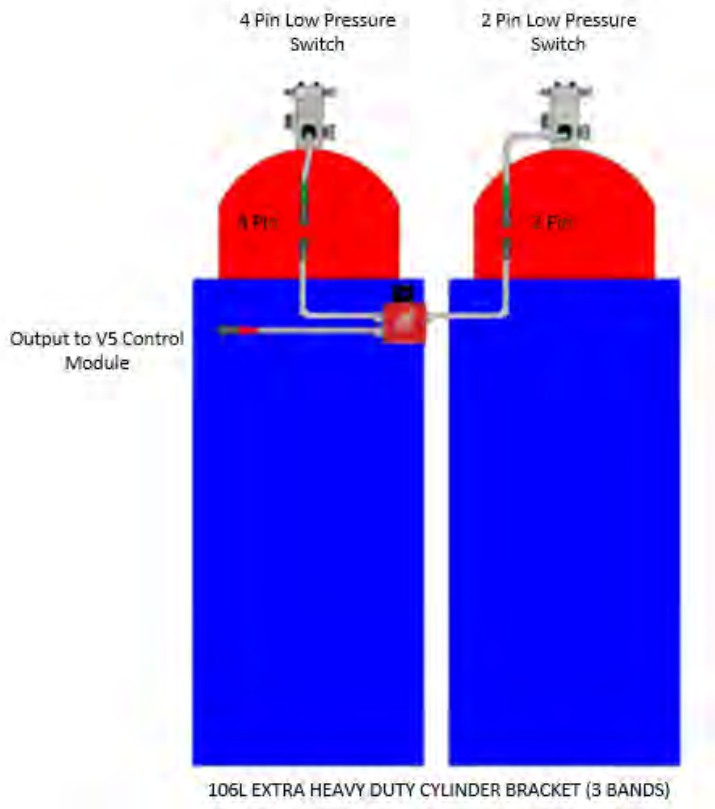
14.15 2 ELECTRIC ACTUATORS CONFIGURATION



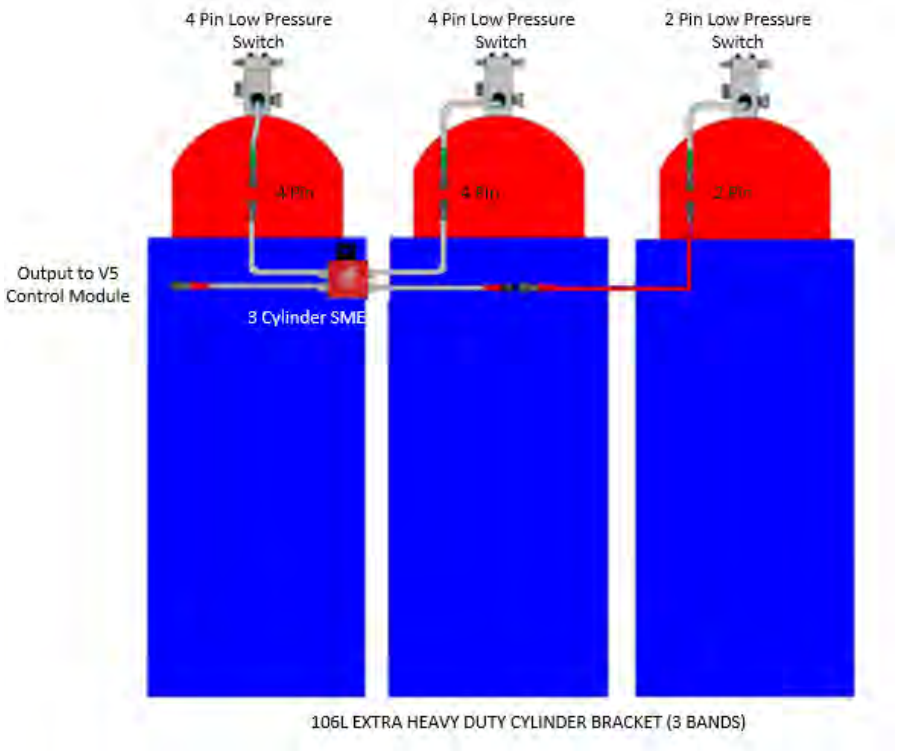
14.16 3 OR MORE ELECTRIC ACTUATORS CONFIGURATION



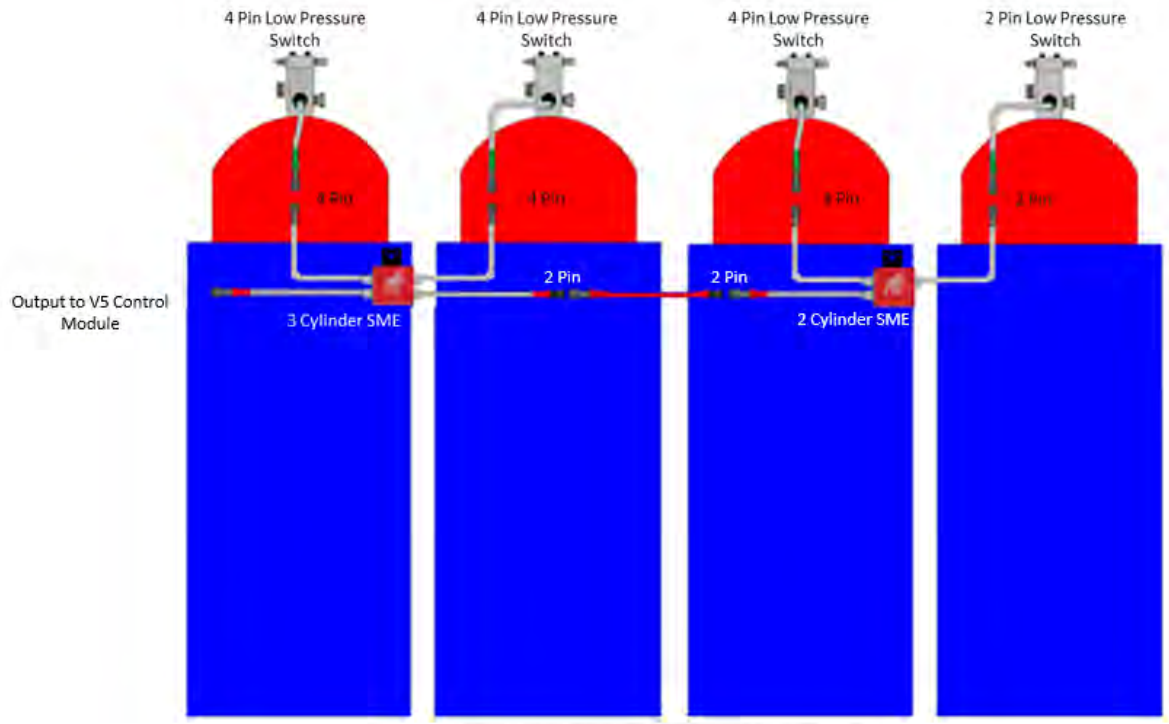
14.17 2 CYLINDER



14.18 3 CYLINDER

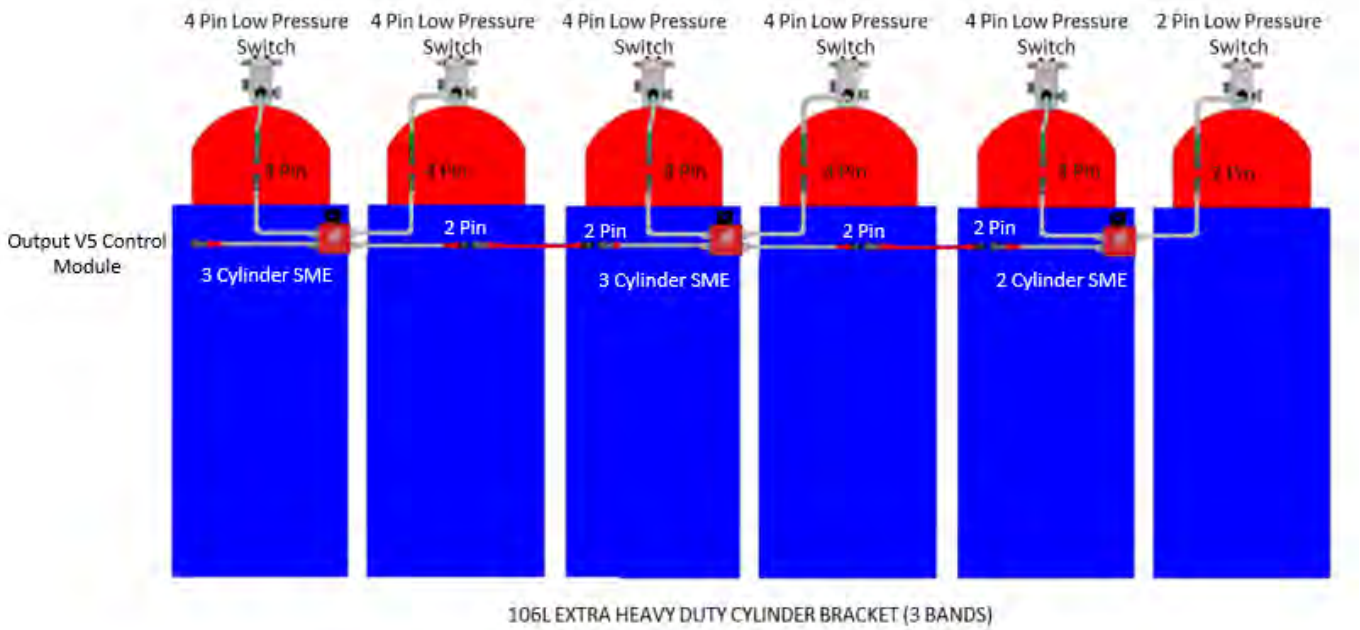


14.19 4 CYLINDER



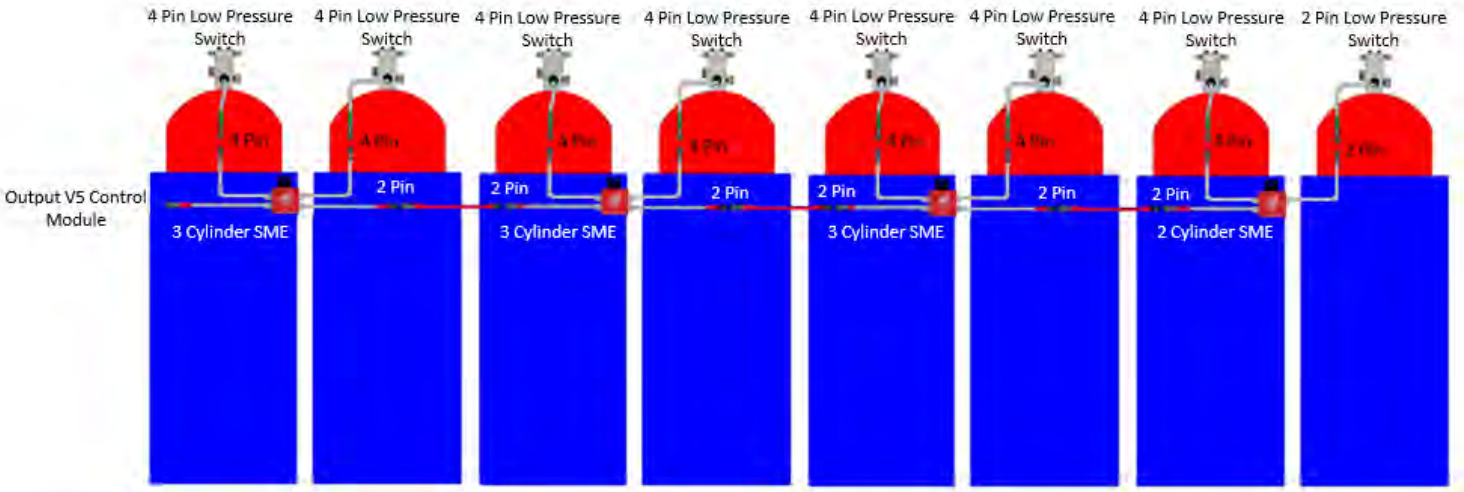
106L EXTRA HEAVY DUTY CYLINDER BRACKET (3 BANDS)

14.20 6 CYLINDER



106L EXTRA HEAVY DUTY CYLINDER BRACKET (3 BANDS)

14.21 8 CYLINDER



106L EXTRA HEAVY DUTY CYLINDER BRACKET (3 BANDS)

15.0 AS 2337.1-2004 CYLINDER INSPECTION

15.4 GENERAL

Where there is doubt concerning the type and/or severity of a defect found on an external or internal visual inspection, refer to Clause 6.5. Only when all doubts are eliminated shall the cylinder be further processed.

A cylinder which fails a visual inspection shall be rejected. If the defect which caused the rejection cannot be repaired, the cylinder shall be condemned and treated as per Section 9.

1.2 EXTERNAL EXAMINATION

6.2.1 Preparation for examination

All rust, scale, and foreign matter and, where necessary, the protective paint, plating, or other coating, shall be removed to permit proper examination of the cylinder surface.

If a plastic or similar coating has been applied and the coating prevents a proper inspection, then the coating shall be stripped by any suitable safe method. If the coating has been removed by the application of heat, in no case shall the temperature of the cylinder exceed the design maximum for the cylinder parent material.

6.2.2 External inspection procedure

The external surface of the cylinder shall be inspected for each of the defects defined in Table 6.1 and shall be assessed according to the limits specified therein.

Particular attention shall be paid to the cylinder base, and where applicable, to the junction of the cylinder with a foot-ring, to detect corrosion.

A comparison with the original wall thickness is used to establish the limit of a number of defects. Where this information is not available, it may be obtained either from the documentation, or by measurement of the actual thickness at an undamaged and uncorroded area adjacent to the defect.

In addition, the cylinder stampings shall be examined to confirm that it complies with AS 2030.1 and has not been stamped as having failed as indicated in Clause 9.3.

Cylinders which fail the external inspection shall be treated in accordance with Section 9.

NOTE: Prior to the publication of this Standard, a condemned cylinder was stamped with the gas test station number between numerals representing the month and the year.

6.2.3 Heat damaged aluminium and stainless-steel cylinders

Aluminium and stainless-steel cylinders shall be put aside for further testing if the cylinder surface, coating, label or attachments show any evidence of overheating, including smoke damage, smudging, discolouration, even if it is localised.

Further testing shall include a hydrostatic stretch test, and may include hardness testing and internal inspection for discolouration.

Any cylinder which fails these test conditions shall be rejected.

NOTE: Test stations are advised to contact the cylinder manufacturer if heat damage is suspected

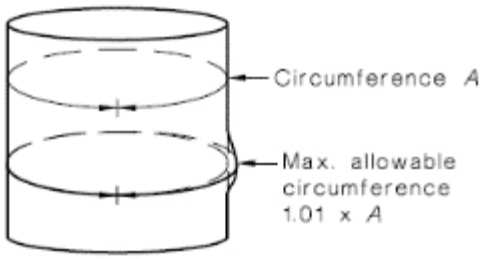
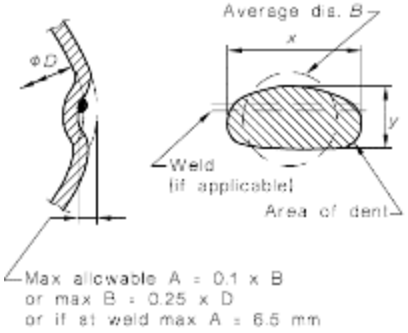
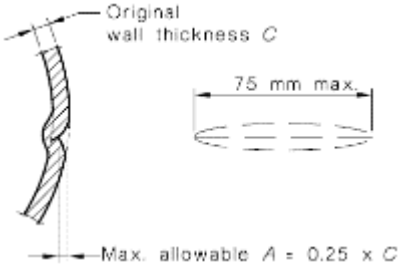
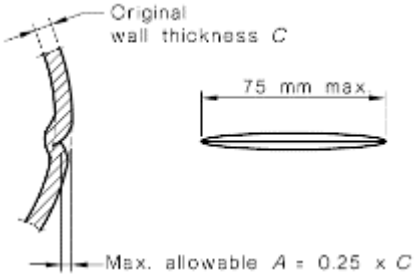
TABLE 6.1 DEFECTS—DEFINITIONS, ILLUSTRATIONS AND TREATMENT		
Name	**Definitions and illustrations (with limits)**	**Limits and treatment**
Bulge	A swelling of the cylinder or vessel wall.  	Condemn where measured circumference varies by more than 1% between any two similar sections of the cylinder
Dent	A blunt impression where the surface material has not been penetrated.  	(a) Condemn where— (b) the depth of dent exceeds 10% of the average dent diameter. (c) the average diameter of dent exceeds 25% of the cylinder diameter; or (d) the dent impinges on a weld, and it exceeds 6.5 mm in depth. Average dent diameter B is taken to be. $\frac{x + y}{2}$
Dig	A sharp impression where the surface material has not been penetrated.  	Condemn where length of dig exceeds 75 mm, or the depth of the dig exceeds 25% of the original wall thickness (see Note 3).
Cut (gouge)	A sharp impression where the surface material has been penetrated.  	Condemn where the length of cut exceeds 75 mm, or the depth of the cut exceeds 25% of the original wall thickness (see Note 3).

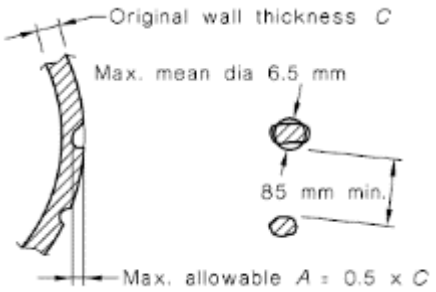
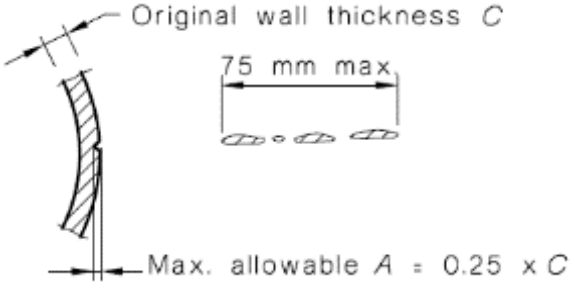
TABLE 6.1 (continued)		
Name	Definitions and illustrations (with limits)	Limits and treatment
Pit	Local corrosion which does not exceed 6.5 mm mean diameter and is not nearer than 85 mm to any other local corrosion  	Condemn where depth of the pit is greater than 50% of original wall thickness (see Note 3). Where the distance between adjacent pits is less than 85 mm, treat as general corrosion.
Line corrosion or linear wear or abrasion	Corrosion in a line and not wider than 6.5 mm at the surface.  NOTE: Line corrosion occurs most commonly at a junction with an attachment such as a foot-ring.	Condemn where the length exceeds 75 mm, or the depth exceeds 25% of the original wall thickness (see Note 3).
General corrosion	Any corrosion more extensive than pit or line corrosion.	Condemn where mass check in accordance with Section 8 is failed, or where depth of corrosion exceeds 25% of the original wall thickness (see Note 3).
Cracks	A crack or rift in the metal.	Condemn (see Appendix H)
Gas leakage	Any gas leakage through the cylinder, or at the valve due to damaged or worn cylinder neck threads. NOTE: Areas around the base of the cylinder are particularly susceptible to gas leakage	Condemn where any leak is detected. Where leakage is suspected, the cylinder shall be pressured to working pressure and either submerged in a water bath or bathed with soapy water and observed to determine whether or not leakage occurs. Cylinders which have leakage due to damage to threaded openings may be repaired, provided that this is permitted by AS 2030.1 and the cylinder specifications. Otherwise, such cylinders shall be condemned.

TABLE 6.1 (continued)		
Name	Definitions and illustrations (with limits)	Limits and treatment
Burns	localised heat-affected region of the cylinder wall. NOTE: Burns may result from contact with an electric arc or an oxygen-acetylene flame	Where surface damage is evident, either the cylinder shall be condemned or the affected surface ground smooth and any remaining cuts and pits treated in accordance with 'cut (gouge)' and 'pit'. Where the limits are not exceeded, the cylinder shall then be re-heat treated in accordance with Clause 9.4, and then hydraulically pressure tested in accordance with Section 7. For cylinders with heat affected regions but no evidence of surface damage, treat as fire damaged as specified in 'Fire damage' below. (See Note 2.)
Fire and heat damage	Any damage resulting from a fire or excessive or unusual application of heat.	Condemn where — (a) warping or distortion is evident. (b) bulging exceeds limits specified for a bulge; or (c) there is evidence of damage from excessive heat. See Notes 1 and 2 below. Where a steel cylinder has not suffered damage to the extent specified in (a), (b), or (c) above, but has burned areas exceeding 6000 mm2, it shall either be re-heat treated and tested where appropriate, in accordance with the original manufacturing specification, and hydraulically. pressure tested in accordance with Section 7 or shall be condemned. Where the burned areas of a steel cylinder do not exceed 6000 mm2, the cylinders may be returned to service (see Notes 1 and 2).

NOTES TO TABLE 6.1:

1. A steel cylinder with only the protective coating of paint smudged, discoloured, or bruised, and were the
2. underlying metal surface is intact, and heat has not transferred to the inside, is not considered to be fire damaged.
3. Aluminium cylinders refer to Clause 6.2.3.
4. The original wall thickness may be obtained by measurement of an undamaged and uncorroded area from
5. a similar section of the cylinder.
6. Measurement criteria are the same for both internal and external surfaces.

6.3 INTERNAL EXAMINATION

6.3.1 Internal cleaning

Any internal liner or coating that could obstruct adequate internal visual inspection shall be removed. The cylinder shall be rejected if the lining cannot be removed.

NOTE: Chemical passivation coatings should not be considered as linings.

Where the internal surface is affected by rust, scale, corrosion or oil or any other surface contamination, it shall be cleaned by one or more of the following methods:

(a) Careful blasting with a suitable medium, rotary wire brushing, or rumbling.
(b) For steel cylinders only, burn-out treatment in a furnace at not more than 300°C, for not more than 1 h,
(c) after which all free rust and scale shall be removed by one of the methods specified in Items (a) to (c).

16.0 RECOMMENDED TOOLING

HAND TOOLS

- Spanner Set – Metric & Imperial/Ratchet
- Shifter
- 1/4 - 3/8 - 1/2 Socket set Metric/Imperial
- Pliers - Side cutters
- Pliers - needle nose
- Pliers - combination
- Pliers - multi grips
- Pliers - Vice grips
- Deutsch pliers
- Wire stripers
- Industrial scissors (Black Panthers)
- Allen Key set - Metric- Imperial
- Torx Bit set
- Screwdriver Set & Jewellers screwdrivers.
- 1/4, 3/8, 1/2 drive torque wrench
- 5mm Allen socket – 1/4 drive (Valve)
- 1 '' socket - 3/8 drive (Burst Disc)
- Digital Multi meter
- Metal cable tie gun
- Stillsons large
- Pipe bender (MSM)
- Schrader Valve Tool
- Seal Pick Set
- Tape Measure - 8M
- Stanley Knife
- File Set
- Steel Ruler
- LED Torch
- Stick Magnet
- Ball Pin Hammer
- Centre punch
- LOP/Tube cutters.
- T-handle Tap
- Drill bit set

BATTERY TOOLS

- Battery Grinder - 18V
- Battery Rattle Gun - 18V
- Battery Drill - 18V
- Milwaukee Heat Gun – 18V
- Battery Charger, 3 x batteries - 18V

DRILL BIT SIZES

- 3mm Pilot Bit
- 5mm
- 8.5mm
- 10mm
- 11.5mm
- 13mm

HOLE SAWS

- 16mm
- 22mm
- 26mm
- Step Drill Bit

TAPS

- M12
- M10
- M6

FSI TOOLS

- FSI DT Plug Breakout kit.
- FSI Multi LOP Cylinder Charge Rig
- FSI Line Flushing Adaptor Kit
- FSI Actuation Line Test Rig
- FSI Charge Rig
- FSI Fill tube set.
- FSI Isolation Caps
- Nitrogen Regulator 4000kpa
- Burgaflex Crimpers

SPECIAL TOOLS

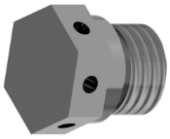
- Digital scales (ROP Cartridge)
- Handheld scales (Extinguishers)
- Caulking/Silicon Gun
- Watering can/Measuring Jug
- Funnel
- Number Pliers (Extinguishers)
- Marker/texter
- Tool Bag
- Dustpan & Brush

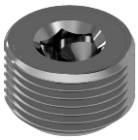
CONSUMABLES

- Leak Detector Liquid - Big Blue
- LOCTITE 577 High Pressure Sealant
- LOCTITE 263 + 569
- Molykote 111
- Dielectric grease
- Nylog Blue
- Rags/Cloths
- Cleaning Solution
- Cutting Compound
- WD-40
- 2mm Cutting Disc
- Metal cable ties (Heat Sleave)

17.0 PARTS LISTING

CYLINDER DISCHARGE VALVE / COMPONENTS

FSI 90300EOL		F3 LOP DISCHARGE VALVE ASSY MK VI - EOL GREEN
FSI 90300I/L		F3 LOP DISCHARGE VALVE ASSY MK VI - I/L GREEN
FSI 90300-REV		F3 LOP DISCHARGE VALVE - REV THREADS, EOL TOP,4 PIN SWITCH
FSI 90300EOL-PRV		LOP DISCHARGE VALVE F3 - EOL C/W PRESSURE RELIEF VALVE
FSI 90300I/L-PRV		LOP DISCHARGE VALVE F3 - I/L C/W PRESSURE RELIEF VALVE
FSI 10300EOL		ROP DISCHARGE VALVE F3 - EOL GREEN
FSI 10300I/L		ROP DISCHARGE VALVE F3 - I/L GREEN
FSI 13002		F3 CYLINDER GAUGE 1400kPa
FSI 60000		BURST DISC ASSEMBLY
FSI 60000PRV		PRESSURE RELIEF VALVE ASSY
FSI 60012		VALVE OUTLET NIPPLE
FSI 60050		SHUTTLE ASSEMBLY MK VI
FSI 60009		SCHRADER VALVE WITH CAP 1/8" BSP

FSI 60010		SCHRADER VALVE WITH CAP 1/4" BSP
FSI 70036NP		NICKLE PLATED 1/4"BSP – 7/16" JIC NIPPLE
FSI 60051		ROP ACTUATOR PISTON (NEW STYLE - Post 2016)
FSI 10118		O RING KIT
FSI 60016		PORT PLUG
FSI 50002		SYPHON TUBE O RING

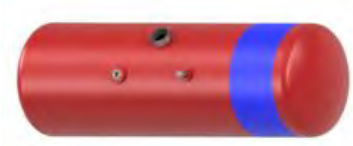
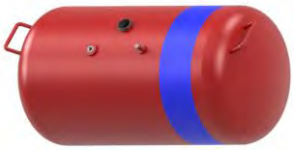
SYPHON TUBES

PART NO.	IMAGE	DESCRIPTION	Overall length (including fittings)	Cut Hose Length
FSI 60015		16L SYPHON TUBE	520mm	450mm
FSI 60018		23L SYPHON TUBE	710mm	635mm
FSI 60019		45L SYPHON TUBE	550mm	475mm
FSI 60020		65L SYPHON TUBE	740mm	665mm
FSI 60021		106L SYPHON TUBE	1150mm	1075mm
FSI 60022		23L SYPHON TUBE HORIZONTAL CYLINDER	240mm	170mm
FSI 60023		106L/65L SYPHON TUBE HORIZONTAL CYLINDER	384mm	314mm

CYLINDERS

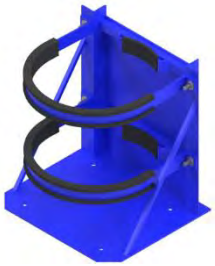
FSI 10000A		16L CYLINDER 527mm(H)x216mm(D)
FSI 10001A		23L CYLINDER 727mm(H)x216mm(D)

FSI 10002A		45L CYLINDER 577mm(H)x360mm(D)
FSI 10003A		65L CYLINDER 777mm(H)x360mm(D)
FSI 10004A		106L CYLINDER 1192mm(H)x360mm(D)

FSI 10001H	FSI 10003H	FSI 10004H
		
23 LITRE HORIZONTAL CYLINDER	65 LITRE HORIZONTAL CYLINDER	106 LITRE HORIZONTAL CYLINDER

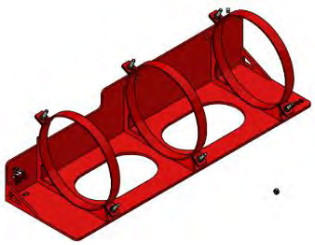
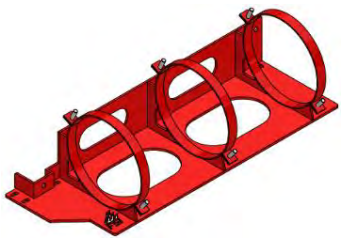
CYLINDER BRACKETS

FSI 10019	BRACKET BAND FOR 45L, 65L & 106L
FSI 10102	BAND RUBBERS 2 OF (1 SHORT, 1 LONG) (1 SET PER BAND)

FSI 10021	FSI 10018	FSI 10020	FSI 10020HD	FSI 10020XHD
				

FSI 10018SLB	FSI 10020SLB
	
BRACKET CYLINDER SLIMLINE 45L& 65L	BRACKET CYLINDER SLIMLINE 106L

FSI 10019SLB	BAND FOR SLIMLINE 45L, 65L & 106L

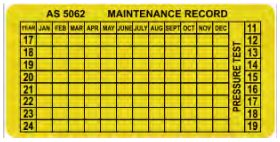
FSI 10021H	FSI 10018HB	FSI 10020HB-D65	FSI 10020HB-T45
			
BRACKET CYL HORIZONTAL 23L INC BAND	BRACKET CYL HORIZONTAL 65L INC BAND	BRACKET HORIZONTAL CYL 106L – EPIROC D65	BRACKET HORIZONTAL CYL 106L - EPIROC T45

SYSTEM IDENTIFICATION LABELS

PART NO. F3	DESCRIPTION
FSI 13001/12	16L CYLINDER LABEL
FSI 13001/17	23L CYLINDER LABEL
FSI 13001/17H	23L CYLINDER LABEL (HORIZONTAL CYLINDER)
FSI 13001/30	45L CYLINDER LABEL
FSI 13001/50	65L CYLINDER LABEL
FSI 13001/90	106L CYLINDER LABEL

				
12L/16L Cylinder Label	17L/23L Cylinder Label	30L/45L Cylinder Label	50l/65L Cylinder Label	90L/106L Cylinder Label

SIGNAGE AND LABELS

SMALL FSI 10133 LARGE FSI 10134		MANUAL ACTUATOR LOCATION SIGN SMALL / LARGE
FSI 10139		IN CASE OF FIRE LABEL
FSI 10140		YELLOW WARNING LABEL
FSI 10147		SHUTDOWN DELAY LABEL AS5062-2016
FSI 10143		AS5062 MAINTENANCE RECORD LABEL

FSI 40001		SERVICE & MAINTENANCE LABEL
FSI 10146		AS5062-2016 COMPLIANT LABEL (F3)
FSI 10146H		AS5062-2016 COMPLIANT LABEL 23LT HORIZONTAL CYLINDER
FSI 10120L		ROP DASH ACTUATOR LABEL
FSI 10007		ROP MANUAL ACTUATOR LABEL

CYLINDER ULTRAMARINE BLUE BANDS

FSI 60038	SUIT 16L & 23LT CYLINDERS
FSI 60039	SUIT 45L & 65LT CYLINDERS
FSI 60040	SUIT 106L CYLINDER

DISCHARGE HOSES

FSI 70005		19mm - (3/4'') DISCHARGE HOSE
FSI 70014		12.5mm - (1/2'') DISCHARGE HOSE

ACTUATION HOSES

FSI 70029		6.3mm - (1/4'') ACTUATION HOSE – ROP
FSI 90040		LOP ACTUATION HOSE

HOSE PROTECTION

FSI 10129		16mm - (1/4'') SPIRAL GUARD to suit 6.3mm hose
FSI 10130		20mm - (1/2'') SPIRAL GUARD to suit 12.5mm hose
FSI 10131		32mm - (3/4'') SPIRAL GUARD to suit 19mm Hose
FSI 90045		12mm - SPIRAL GUARD to suit LOP Actuation Hose

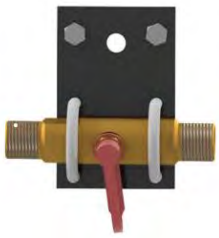
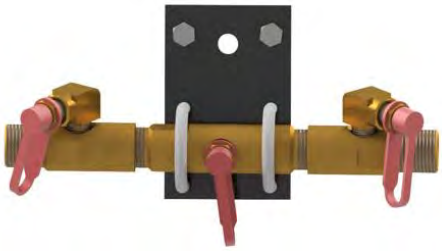
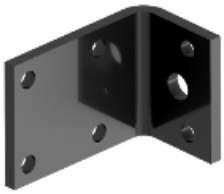
FIRE SLEEVE

FSI 10132B		¼'' FIRE SLEEVE to suit 6.3mm hose
FSI 10132		1/2'' FIRE SLEEVE to suit 12.5mm hose
FSI 10132A		3/4'' FIRE SLEEVE to suit 19mm hose

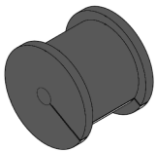
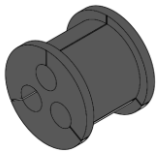
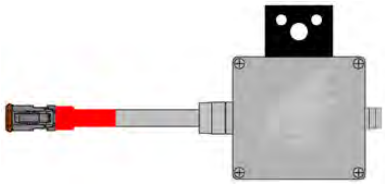
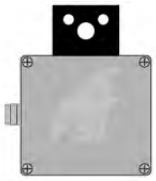
P-CLAMPS

FSI 70004		8mm P-CLAMP suits Fire Harness
FSI 70033		12mm – (1/4'') P-CLAMP to suit 6.3mm hose
FSI 70017		20mm – (1/2'') P-CLAMP to suit 12.5mm Hose
FSI 70008		26mm – (3/4'') P-CLAMP to suit 19mm Hose.
FSI 90033		6mm SHEATHED P-CLAMP

NOZZLES ASSEMBLIES / COMPONENTS

FSI 80001		SINGLE NOZZLE ASSEMBLY
FSI 80002		DOUBLE NOZZLE ASSEMBLY
FSI 80003		TRIPLE NOZZLE ASSEMBLY
FSI 60029		NOZZLE BARE
FSI 60029SP		NOZZLE BARE (PACK 10)
FSI 60033		SILICONE NOZZLE CAP
FSI 60033SP		SILICONE NOZZLE CAP (PACK 10)
FSI 30009		90 BENT NOZZLE PLATE

DETECTION

FSI 10009		1.0m MECHANICAL SENSOR MODULE
FSI 10010		1.5m MECHANICAL SENSOR MODULE
FSI 10024KIT		MSM SUPPORT PACK ASSY
FSI 91000		LOP DETECTION TUBE
FSI 91021		LOP TUBE INLINE CONNECTOR
FSI 91022		LOP TUBE END OF LINE CONNECTOR
FSI 91024		LOP CLEAR PASSAGE CONNECTOR
FSI 21000		LHD WIRE
FSI 21007		GROMMET SILICONE 1 HOLE C/W CLAMP
FSI 21013		GROMMET SILICONE 3 HOLE C/W CLAMP
FSI 21008		LHD INLINE ENCLOSURE
FSI 21009		LHD EOL ENCLOSURE

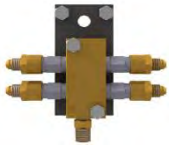
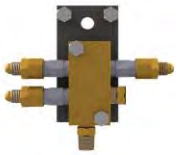
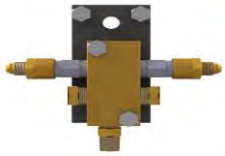
MANUAL ACTUATOR ASSEMBLIES / COMPONENTS

FSI 93000		LOP REMOTE ACTUATOR ASSEMBLY (F3)
FSI 93002		LOP MANUAL ACTUATOR PRESSURE GAUGE (F3)
FSI 90112		SAFETY PIN ASSEMBLY LOP
FSI 91008		LOP ACTUATOR FASCIA
FSI 91007		LOP ACTUATOR LABEL (TRAFFOLYTE)
FSI 90009		LOP ACTUATOR MOUNTING ANGLE
FSI 90006		MODULE DISPLAY MODULE MOUNT LOP

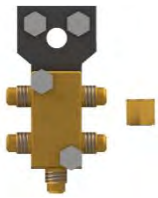
FSI 10005I		ROP MANUAL ACTUATOR ASSEMBLY (NO CARTRIDGE)
FSI 10006		CO2 CARTRIDGE
FSI 10101		ACTUATOR CARTRIDGE O RING
FSI 10120		ROP DASH ACTUATOR
FSI 10110		ACTUATOR STRIKE PIN ASSEMBLY
FSI 10112		SAFETY PIN ASSEMBLY
FSI 10107E		ACTUATOR KNOB
XSTIE		SECURITIE
FSI 10035		MODULE DISPLAY MODULE MOUNT ROP

FSI 21312		0-2.5MPa 12V ROP Electric Solenoid
FSI 21412		0-2.5MPa 12V LOP Electric Solenoid
FSI 21106		V5 SOLENOID WIRING HARNESS
FSI 21100		ELECTRIC ACTUATOR EOL (Includes mounting plate)
FSI 21101		ELECTRIC ACTUATOR I/L (Includes mounting plate)
FSI 21102		ELECTRIC ACTUATOR I/L CAB (NO PLATE)
FSI 21103		ELECTRIC ACTUATOR & DISPLAY MOUNTING PLATE
FSI 21107		ELECTRIC I/L ACTUATOR CAB HARNESS
FSI 21108		ELECTRIC I/L ACTUATOR Y-HARNESS

ACTUATION MANIFOLD – ROP

FSI 10030A		ROP 4 WAY ACTUATION MANIFOLD C/W CHECK VALVES
FSI 10030B		ROP 3 WAY ACTUATION MANIFOLD C/W CHECK VALVES
FSI 10030D		ROP 2 WAY ACTUATION MANIFOLD C/W CHECK VALVES
FSI 10030C		ROP 2 WAY ACTUATION MANIFOLD - NO CHECK VALVES
FSI 10022		CHECK VALVE 1/4''

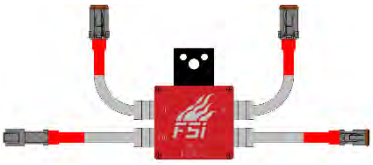
ACTUATION MANIFOLD – LOP

FSI 90032		LOP ACTUATION MANIFOLD – 5 WAY
FSI 90034		LOP ACTUATION MANIFOLD – 3 WAY
FSI 70061		7/16 JIC TEE F/M/M

ENCLOSURES - PME

FSI 20124		PRESSURE MONITORING ENCLOSURE (PME)

ENCLOSURES - SME

FSI 20122		SYSTEM MONITORING ENCLOSURE 2 CYL
FSI 20123		SYSTEM MONITORING ENCLOSURE 3 CYL
FSI 20125		CYLINDER PRESSURE & SOLENOID ENCLOSURE (CPS)
FSI 20126		SME/CPS ENCLOSURE

THERMAL PROBES

FSI 20120		INLINE PROBE
FSI 20121		END OF LINE PROBE

PRESSURE SWITCHES

FSI 23000		1400KPa 2 PIN LOW PRESSURE SWITCH F3
FSI 23001		1400KPa 4 PIN LOW PRESSURE SWITCH F3

FIRE ALARM MODULES

FSI 16017		**FSI V5 Shutdown Module Assembly** • Display & Control Module • 4m cable & connectors
FSI 16018		**FSI V5 Shutdown Module Assembly Battery Backup** • Display & Control Module • 4m cable & connectors • Internal backup battery module
FSI 16014		**FSI V5 Indicator Module Assembly** • Display & Control Module • 4m cable & connectors
FSI 16012		SHUTDOWN DISPLAY MODULE V5
FSI 16015		INDICATOR DISPLAY MODULE V5
FSI 16016		DISPLAY CABLE V4 / V5
FSI 16003		BATTERY PACK V4/V5
FSI 16032		RTC BATTERY
FSI 16033		SD CARD
FSI 59005		AssetCONNECT App ACCESS

FITTINGS

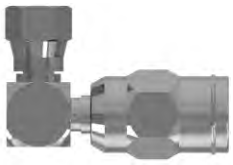
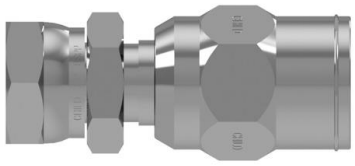
FSI 70007		3/4'' BSP BULKHEAD FITTING
FSI 70009		3/4'' TEE
FSI 70010		3/4'' M&F ELBOW
FSI 70011		3/4'' x 1/2'' NIPPLE
FSI 70012		3/4'' NIPPLE
FSI 70013		3/4'' x 1/2'' BUSH
FSI 70013A		3/4'' (F) x 1/2'' (M) ADAPTOR
FSI 70016		1/2'' BSP BULKHEAD FITTING

FSI 70018		1/2'' x 1/4'' BUSH
FSI 70019		1/2'' NIPPLE
FSI 70020		1/2'' TEE
FSI 70021		1/2'' M&F ELBOW
FSI 70026C		1/2'' BSP BLANKING CAP
FSI 70032		7/16" JIC BULKHEAD FITTING
FSI 70034		1/4'' NPT (F) - 7/16" JIC (M) SOCKET
FSI 70036		1/4'' BSP (M) - 7/16" JIC (M) NIPPLE
FSI 70037L		1/4'' M&F ELBOW LONG
FSI 70039		1/4'' BSP TEE

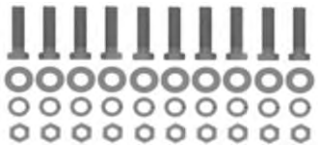
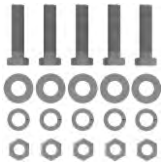
FSI 70040		1/4'' BSP PLUG
FSI 70041		1/4'' BSP BULKHEAD FITTING
FSI 70042		1/4'' BSP NIPPLE
FSI 70044		1/4'' BSP (M) – 1/8" BSP (M) NIPPLE
FSI 70045		1/4'' BSP (M) – 1/8" NPT (F) BUSH
FSI 70054		1/8" BSP (M) – 7/16" JIC (M) NIPPLE
FSI 70055		1/8" NPT (F) – 7/16" JIC (M) SOCKET
FSI 70057MRT		1/8" x 1/8" MALE RUN TEE
FSI 70060		7/16" JIC CAP

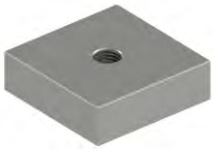
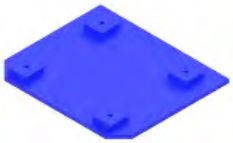
FSI 70028PPSINLET		MODULE PRESSURE SWITCH INLET
FSI 70028STDINLET		3/4'' INLET ASSEMBLY
FSI 86000		3/4'' TWIN CYLINDER MANIFOLD
FSI 70070		3/4" MODULE PRESSURE SWITCH INLET
FSI 70048		PTFE TAPE

HOSE FITTINGS

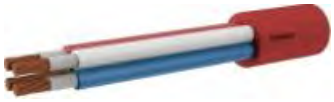
FSI 70030-90		7/16” JIC 90 DEG HOSE END to suit 6.3mm hose
FSI 70031		7/16” JIC HOSE END to suit 6.3mm hose
FSI 10121		1/4’’ BSP HOSE END to suit 6.3mm hose
FSI 70015		1/2’’ BSP HOSE END to suit 12.5mm Hose
FSI 70006		3/4’’ BSP HOSE END to suit 19mm Hose
FSI 10122-90		1/4’’ BSP 90 DEG HOSE END to suit 6.3mm hose
FSI 70015-90		1/2’’ BSP 90 DEG HOSE END to suit 12.5mm Hose
FSI 70006-90		3/4’’ BSP 90 DEG HOSE END to suit 19mm Hose
FSI 90052		LOP ACTUATION HOSE FITTING 316SS 90 DEG
FSI90051		LOP ACTUATION HOSE FITTING 316SS ST
FSI 90044		LOP ACTUATION HOSE METAL CLIP PK 10

FASTENERS

FSI 01258M		BOLT KIT M10 (PACK 4)
FSI 01259M		BOLT KIT M12 (PACK 4)
FSI 01260M		BOLT KIT M6 (PACK 10)
FSI 01260MFSP		M6 FLAT WASHER PACK (20)
FSI 01259MSLB		BOLT KIT M12 (5)
FSI 01259MCAP		M12x25 SOCKET CAP SCREW KIT
FSI 01259MHDCAP		M12x35 SOCKET CAP SCREW KIT
FSI 01259MCAPSLB		M12 x 25 SOCKET CAP SCREW BOLT KIT (5)
FSI 70090		MAGNETIC MOUNT
FSI 01258MRPK		M10 ROD – STEP OUT ADAPTOR (PACK OF 10)

FSI BKTBLOCK		CYLINDER MOUNTING BLOCKS
FSI INT-DECK		CYLINDER DECK PLATE
FSI INT-DECKSLB		SLIMLINE BRACKET MOUNTING PLATE

ELECTRICAL

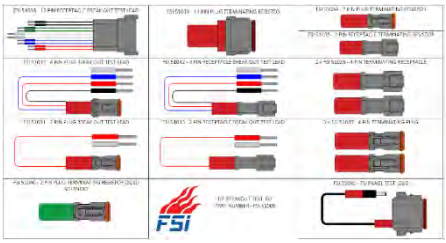
FSI 20016		DT CONNECTOR KIT – 2 PIN
FSI 20017		DT CONNECTOR KIT – 4 PIN
FSI 20140		FLY LEAD ADAPTOR 2 PIN F/F
FSI 20141		FLY LEAD ADAPTOR 2 PIN M/M
FSI 01282		2 CORE FIRE HARNESS
FSI 01284		4 CORE FIRE HARNESS
FSI 20020		PLASTIC GLAND 16mm
FSI 70049		CABLE TIE LARGE NYLON
FSI 70049S		CABLE TIE SMALL NYLON
FSI 10049		SWIVEL CABLE TIE MOUNT

FOAM

FSI 13000		20 LITRE DRUM F3

TOOLING AND CONSUMABLES

FSI 50000		NITROGEN REGULATOR
FSI 50001		CHARGING KIT 2 x 1.0m 1 x 8.0m
FSI 50001/A		LOP MULTI CYLINDER CHARGE RIG 2 x 1.5m 2 x 2.0m 2 x 2.5m
FSI 50001/B		MULTI-CYLINDER CHARGING ADAPTOR KIT (8 CYL'S) 2 x 1.5m 2 x 2.0m 2 x 2.5m 2 x 3.0m

FSI 51010		LINE FLUSHING ADAPTOR
FSI 51005		ACTUATION LINE TEST RIG
FSI 51008		1/2" ISOLATION CAP VALVE
FSI 51004		3/4" ISOLATION CAP VALVE
FSI 51007		SCHRADER VALVE RELIEF TOOL
FSI 51030		DEUTSCH PLUG BREAKOUT TEST KIT
FSI 90046		NYLOG BLUE – Thread Sealant
FSI 90047		Crimping Tool (Actuation hose Clips)

FSI 50022		LIQUID LEAK DETECTOR
FSI 50023		LOCTITE 577 HIGH PRESSURE SEALANT
FSI 50020		MOLYKOTE 111
FSI 50021		DOW CORNING No.4
FSI 20038		BIZGEL EXPRESS SEALING GEL 280ml CARTRIDGE
FSI 50018		LOCTITE 263 THREAD LOCKER
FSI 50019		LOCTITE 569 THREAD SEALANT

CYLINDER FILL TUBES

FSI 50155 (15.5) & FSI 50170 (17)	23L CYLINDER FILL TUBES
FSI 50280 (28) & FSI 50300 (30)	45L CYLINDER FILL TUBES
FSI 50460 (46) & FSI 50500 (50)	65L CYLINDER FILL TUBES
FSI 50840 (84) & FSI 50900 (90)	106L CYLINDER FILL TUBES
FSI 50900SET	CYLINDER FILL TUBE SET

FSI 50155H	CYLINDER FILL TUBE - 15.5L HORIZONTAL CYLINDER
FSI 50170H	CYLINDER FILL TUBE - 17L HORIZONTAL CYLINDER
FSI 50460H	CYLINDER FILL TUBE - 46L HORIZONTAL CYLINDER
FSI 50500H	CYLINDER FILL TUBE - 50L HORIZONTAL CYLINDER
FSI 50840H	CYLINDER FILL TUBE - 84L HORIZONTAL CYLINDER
FSI 50900H	CYLINDER FILL TUBE - 90L HORIZONTAL CYLINDER
FSI 50900SETH	CYLINDER FILL TUBE SET (HORIZONTAL)