Chubb

PEFS F3N
Vehicle Fire Suppression System

VEHICLE FIRE SUPPRESSION SYSTEM

Design, Installation and Commissioning Manual

PART No. 61450
Version 1.0, OCT 2020

PREFACE

Document History

Version	Summary of Change
1.0	Original

This manual is an uncontrolled document. Chubb Fire & Security Pty Ltd ("Chubb") reserves the right to alter this manual at any time in accordance with our policy of continuous development. Chubb welcomes feedback regarding this manual and associated equipment.

For further information or feedback, contact Chubb on 13 15 98.

Contents

About this manual

This manual is written for those who design, install and commission PEFS F3**N** Vehicle Fire Suppression Systems ("PEFS F3**N**"). It is intended as a guide only. While reasonable care has been taken in the preparation of this manual, Chubb Fire & Security Pty Limited ("Chubb") does not represent or warrant that the information and data contained in this manual is complete, accurate or up to date. Chubb reserves the right to make changes to the manual at any time without notice.

PEFS F3**N** Systems should only be designed, installed and commissioned by technicians that have been endorsed by Chubb Fire & Security Pty Ltd.

IMPORTANT

Warranty

Chubb warrants to the original system purchaser ("Customer") that each new PEFS F3**N** system is free from defects in material and workmanship under normal use for a period of twelve (12) months from the date of commissioning. This warranty does not cover any fault, damage or malfunction resulting from:

- a party's negligence, fault, misuse, abuse, neglect (including lack of or improper maintenance) or incorrect use of the PEFS F3**N** System;
- fair wear and tear;
- replacement of consumables;
- modification of the PEFS F3**N** System after it has been installed and commissioned;
- modification of the use, condition and environment of the PEFS F3**N** System after it has been installed and commissioned;
- use, alteration, repair or maintenance by any party that is not suitably authorised, trained and qualified; or
- vandalism, fire, water, accidental damage, power surge or any other circumstance or event outside of Chubb's control.

This warranty is conditional upon documented evidence of proper maintenance, performed in accordance with the PEFS F3**N** Owner's Manual and Maintenance Manual by qualified and trained personnel, using replacement parts that conform to original design specifications.

Where Chubb breaches its obligations under this warranty, Chubb may in its sole direction elect to re-supply the PEFS F3**N** System, or to replace or repair the PEFS F3**N** System.

To the extent permitted by law, Chubb will have no liability for any statements, representations, guarantees, conditions or warranties not expressly stated in writing by Chubb.

Consumer Guarantees

Nothing in this warranty excludes, restricts or modifies the application of the provisions of any statute (including the Competition and Consumer Act 2010 (Cth) and the Australian Consumer Law contained therein) where to do so would contravene that statute or cause any part of this warranty to be void. If the Customer is a "consumer" as defined in the Australian Consumer Law, the following provisions will apply.

Chubb's products and services come with guarantees that cannot be excluded under the Australian Consumer Law. If the PEFS F3**N** System is believed to be defective, the Customer must notify Chubb as soon as possible and provide a detailed explanation of the problem.

The Customer is entitled to a replacement or refund for a major failure and to compensation for any other reasonably foreseeable loss or damage. The Customer is also entitled to have the PEFS F3**N** System repaired or replaced if the PEFS F3**N** System fails to be of acceptable quality and the failure does not amount to a major failure. Chubb reserves the right to replace any PEFS F3**N** System under warranty with a new, refurbished or remanufactured PEFS F3**N** System.

If the failure is not a major failure and Chubb elects to repair the PEFS F3N System:

- goods presented for repair may be replaced by refurbished goods of the same type rather than being repaired. Refurbished parts may be used to repair the goods; and
- if the goods are capable of retaining user-generated data, the repair of the goods may result in the loss of the data.

The benefits given to the Customer under this warranty are in addition to other rights and remedies the Customer has under the Australian Consumer Law and other laws applicable to the products and services. This warranty is provided by Chubb Fire & Security Pty Ltd.

Intended use

The PEFS F3N System is a fire suppression system, installed as part of an overall fire risk reduction strategy, as defined in the fire system specifications and or risk assessment outcomes. As such, it is designed to suppress a fire occurring in the specified risk area only within the documented coverage area of each installed nozzle.

Introduction

Mining, Off-Road, Forestry and Construction equipment operating in harsh outdoor environments can be subjected to the threat of fire at any time. Fire may spread rapidly through the equipment, endangering life and resulting in damage to capital equipment and loss of production. The installation of a fire detection and suppression system is essential to minimise the risk to both operator and equipment.

PEFS F3**N** is a pre-engineered aspirating foam spray suppression system designed specifically to cope with the harsh operating conditions experienced by mobile and transportable equipment. PEFS F3**N** systems consist of pressurised cylinders containing fluorine free foam solution, actuation devices to initiate discharge and a discharge network which includes aspirating spray nozzles to direct the foam spray onto the hazard. PEFS F3**N** systems may be configured for both manual and automatic operation.

PEFS F3**N** systems offer impressive fire suppression capabilities using **fluorine free** foam through specially designed naturally aspirating spray nozzles that generate an improved foam application over standard foam spray systems. Strategically positioned nozzles direct the aspirated foam spray and provide "three-dimensional" firefighting properties, allowing the system to suppress pressure fires such as might occur from a ruptured fuel or hydraulic line. The air aspirated droplets of foam are extremely efficient at absorbing large amounts of heat and turn to steam which further enhances the three-dimensional firefighting properties of the PEFS F3**N** system.

Typical applications

The PEFS F3**N** system can be configured to provide protection for many applications. PEFS F3**N** systems are suitable for, but not limited to, the following equipment and industries:

(a) Commercial and recreational vehicles, including the following:
- (i) Buses.
- (ii) Four-wheel drives.
- (iii) Road haulage.
- (iv) Motor homes.
- (v) Forklifts.
- (vi) Road registered plant.
- (vii) Pleasure craft.

(b) Mobile and transportable equipment used in, but not limited to the following industry sectors:
- (i) Mining.
- (ii) Forestry.
- (iii) Waste management.
- (iv) Construction.
- (v) Railway.
- (vi) Agriculture.
- (vii) Defence.

Limitations of use

PEFS F3**N** systems are suitable for use to combat Class A and Class B (hydrocarbon fuels only) fires when storage cylinders are maintained in a temperature range of 5°C to 60°C.

Cylinders shall be pressurised to 1,700kPa @ 21°C.

A maximum of ten (10) cylinders are permitted to be operated by any actuation device detailed in this manual.

Only rated hose which meets U.S. MSHA 2G flame resistance requirements shall be used in actuation and discharge systems.

Only Chubb PEFS F3**N** Foam Concentrate is to be used for filling PEFS F3**N** systems. The fluorine free foam solution within each storage cylinder shall be as detailed in Table 5 - PEFS F3N cylinder specifications of this manual.

Only PEFS F3**N** discharge nozzles with integrated aspirating shrouds shall be used in PEFS F3**N** discharge systems. Nozzles shall be positioned and aimed to provide coverage over the nominated hazard area. Nozzle discharge coverage and maximum range shall be in accordance with Figure 25 – Nozzle range and coverage details. The maximum nozzles per cylinder shall be in accordance with Table 1 – Maximum number of nozzles supplied by a single cylinder. Discharge systems shall be installed in compliance with Table 4 – Maximum allowable discharge network limits per cylinder.

A commissioning discharge test of the complete PEFS F3**N** system shall be completed for all installations.

FIRE SYSTEM SPECIFICATION

Fire Risk Assessments

A Fire Risk Assessment is the starting point in the process to determine the fire protection measures required for any piece of equipment or machinery. The fire risk management process should be carried out in accordance with the methodology detailed in AS5062 (see Figure 1 below) and AS/NZS ISO 31000.

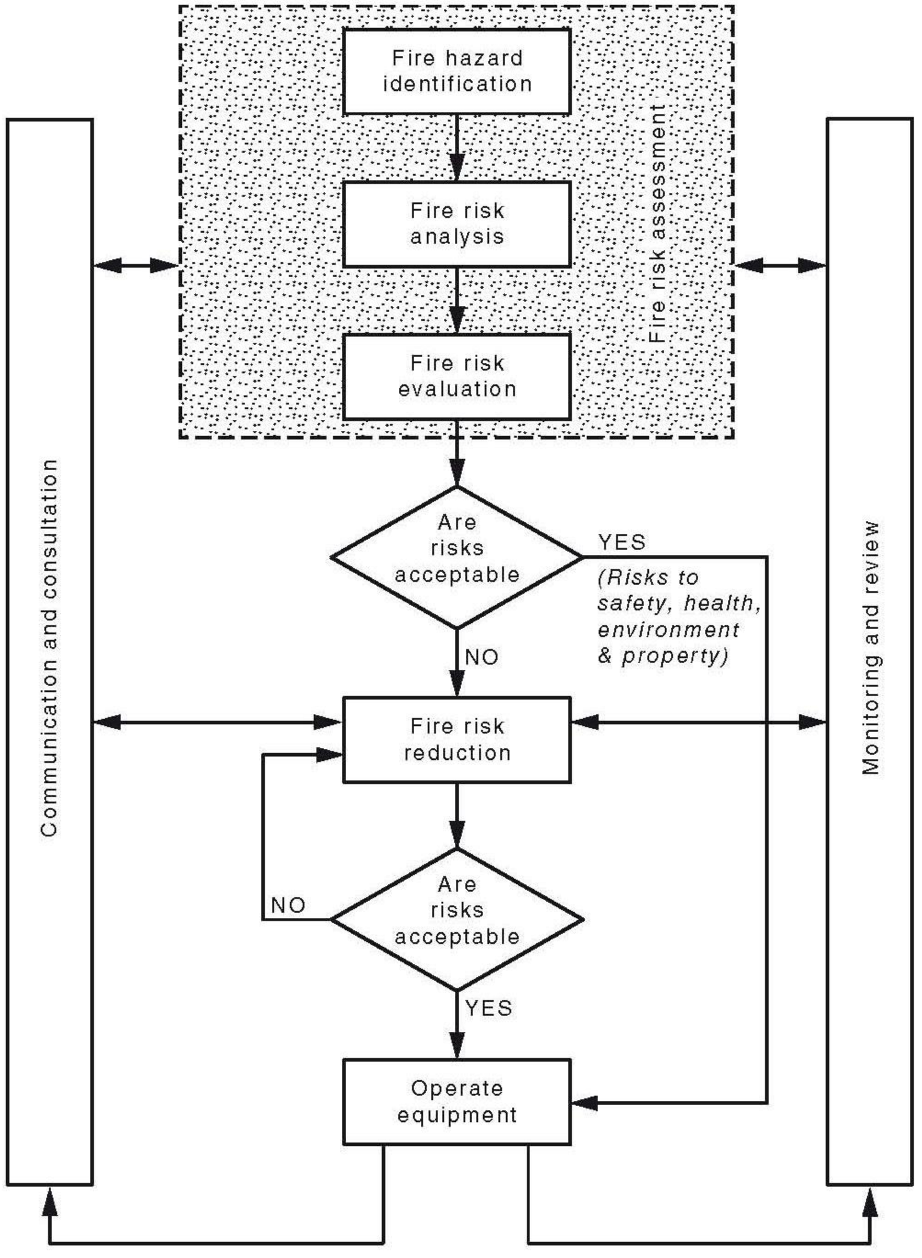


Figure 1 – Fire Risk Management Process

The fire risk assessment needs to consider:

- Design of equipment
- Operating Environment
- Operating practices
- Maintenance of equipment
- History of fire incidents.

The fire risk assessment should be carried out by personnel competent in risk-assessment and may involve consultation with the following persons where applicable:

- Owner
- Operator
- Maintenance personnel
- Manufacturer / Supplier
- Insurer
- Specialist fire consultant.

The organization, or a person appointed by the organization, that operates the equipment is responsible for ensuring that the fire risk assessment is completed and for the implementation of any recommended control measures. The residual risk should be as low as reasonably acceptable to that organization.

Fire System Specification

The Fire Risk Assessment will identify the high fire risk areas of the equipment and the type of risk reduction measures required. This forms the basis of a Fire System Specification.

A Fire System Specification needs to be established for every PEFS F3**N** foam system design. An organisation or owner of the equipment may develop their own specification or one can be developed in consultation with the fire system designer. As a minimum the Fire System Specification needs to include the following information:

1. What are mandatory fire protection requirements for the system? Ie Federal / State / Local Legislation, Australian (or other) Standards and or customer specific requirements.
2. The fire hazard area to be protected
3. The high-risk fuel sources within the fire hazard area. Potential sources to be considered are:
    a. Pressurised fuel lines
    b. Pressurised hydraulic lines
    c. Wiring Looms
    d. Engine valleys where grease, lubricants, rags and other Class A material can accumulate.
4. Materials of construction in the risk areas to be protected that may contribute to the growth of a fire.
5. The high-risk ignition sources within the fire hazard area. Potential sources to be considered are:
    a. Hot surfaces – turbo, exhaust manifolds, etc.
    b. Electrical – batteries, switch gear, fuses, motors, alternators etc.
6. Minimum discharge time. Need to consider the following:
    a. Owner/operator specified
    b. Engine shut down time
    c. Time for equipment operators to evacuate safely.
7. System operation:
    a. Manual activation
    b. Automatic pneumatic detection and activation
    c. Automatic electric detection and activation (generally required for more complex system designs where alternative electrical detection devices are required or where integration is required to auxiliary electrical devices)
8. Number and location of manual actuators
9. Type and location of Fire Panel:
    a. Basic monitoring panel
    b. Basic monitoring panel with engine shut down
    c. Fully functional monitoring and control panel
10. Any additional portable fire equipment requirements:
    a. Portable Fire Extinguishers
    b. Fire Blankets

A PEFS F3**N** Fire System Specification template document is available for use in completing the fire system specification.

DISCHARGE SYSTEM DESIGN

The following simple calculation process can be used to establish which PEFS F3N cylinder/s and discharge system components should be employed for protecting a particular hazard.

Step 1 – Review the "Fire System Specification"

A review of the fire system specification must be completed prior to undertaking a detailed PEFS F3N system design. As a result of the review, identify:

- Those parts of the equipment to be protected (the fire hazard areas).
- The required system configuration:
  - single hazard area (single protection zone)
  - multiple hazard areas
    - System to protect all hazard areas simultaneously or
    - System to protect each hazard area independently
- And where applicable, the minimum effective discharge time requirements.

NOTE: The results of the risk assessment for the vehicle may require a longer discharge time to be provided to allow for equipment shutdown and provide additional cooling.

Step 2 – Determine the number of nozzles required

Determine the number of nozzles required to cover hazard/s to be protected. The PEFS F3N nozzle has a wide discharge pattern and will provide a maximum coverage area of 800mm x 800mm square when mounted at distances greater than 500mm. The maximum permitted range is 1000mm.

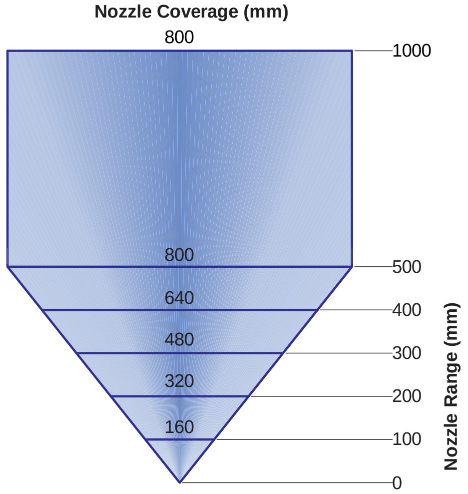
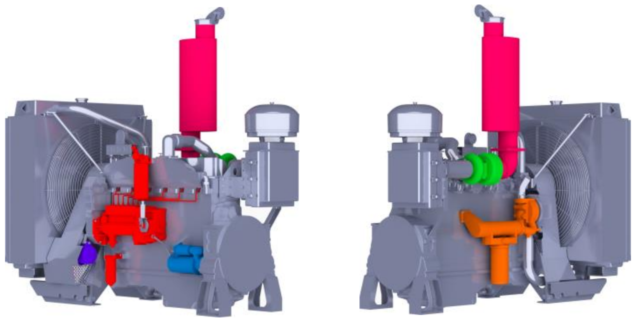


Figure 2 –Nozzle range and coverage details

Nozzles should be positioned and aimed to cover the high-risk items identified and detailed in the Fire System Specification. Such items may include:

- Fuel Injector pumps, lines and Injectors.
- Oil lines, pumps and filters.
- Hydraulic lines and pumps.
- Turbochargers.
- Starter Motor
- Exhaust components.
- Alternators.



For convenience it may assist to assume the object to be protected is enclosed in a rectangular box and determine the number of nozzles required to cover the surface area of the box. Not all surfaces of the object may need to be protected. For example, the underside of the hazard is not normally included in the surface area to be protected unless there is a specific hazard or component that requires nozzle coverage.

NOTE: Foam spray patterns may be disturbed by fan draught etc. if discharged when the engine is operating. Allowances may need to be made when positioning nozzles to ensure the foam spray reaches the target area.

Step 3 – Cylinder Assembly Selection

Having determined the total number of nozzles required, select the cylinder/s required to supply the total number of nozzles.

Cylinder	Maximum number of nozzles per cylinder	Maximum Area Coverage
C23	4	$2.56m^2$
C30	6	$3.84m^2$
C45	7	$4.48m^2$
C65	10	$6.40m^2$
C106	12	$7.68m^2$

Table 1 – Maximum number of nozzles supplied by a single cylinder

Where the number of nozzles required exceeds the maximum allowed by a single cylinder:

- Multiple cylinders can be used to supply a common distribution system provided all the cylinders are the same size and are activated simultaneously; or,
- Multiple cylinders of the same size or differing sizes can be used with their own distribution systems. These can be configured to activate simultaneously from a single detection zone or they can be configured to activate independently using the listed fire control systems.

Step 4 – Determine approximate Effective Discharge Time (EDT)

The Effective Discharge Time is the time from the activation of the cylinder valve until the discharge changes from predominately liquid to gas and the discharge pattern from the nozzle collapses. The approximate Effective Discharge Time for the system can be estimated using Table 2 – Approximate effective discharge times.

	Approximate EDT (seconds) Cylinder Size				
Number of nozzles per cylinder	C23	C30	C45	C65	C106
1	179	221			
2	87	115	159	218	384
3	57	84	113	145	267
4	45	62	87	112	208
5		54	74	90	174
6		49	64	69	146
7			57	66	131
8				58	113
9				52	106
10				50	95
11					90
12					89

Table 2 – Approximate effective discharge times

NOTE: The effective discharge times tabulated above are the result of testing at maximum hose volume limits for each cylinder using water. Effective discharge times for systems configured at less than the maximum discharge network volume limits may be slightly less than those presented in Table 2. To ensure the effective discharge time of the installed system meets the minimum required discharge time established from the fire system specification, it is recommended that the discharge times tabulated above are reduced by 10% for estimating purposes.

To use Table 2 for multiple cylinder installations, which supply a common distribution network;

- Select the closest EDT for each cylinder size and note the corresponding quantity of nozzles allowed for each size.
- Divide the total number of nozzles required to cover the hazard area with the number of nozzles allowed for each cylinder size and round up the result. This will give you the minimum number of cylinders required.
- Divide the total number of nozzles required to cover the hazard area with the number of required cylinders and round up. This will give you the number of nozzles per cylinder.
- Use Table 2 to determine the new estimated discharge time for the system based on the cylinder size and number of nozzles per cylinder.
- From the results, select a size solution that uses the minimum quantity of cylinders.

NOTE: Calculations should be made from largest cylinder to the smallest.

Example:

If 24 nozzles are required to cover a hazard area and the system is required to discharge for a minimum of 50 seconds, what size cylinder should be used and how many are required?

Starting from the C106 column, the closest EDT is 89 seconds with 12 nozzles. Divide 24 by 12 and round up the result to the nearest whole number. The solution using C106 cylinders is 2 cylinders supporting 12 nozzles each, in a common distribution network. The new EDT for this arrangement would be 89 seconds (approx.).

Using the C65 column, the closest EDT is 50 seconds with 10 nozzles. Taking into consideration the potential 10% variance in the EDT it is safer to work to 55 seconds making the closest EDT being 58 seconds with 8 nozzles. Divide 24 by 8 and round up the result to the nearest whole number gives 3 cylinders. The solution using C65 cylinders is 3 cylinders supporting 8 nozzles each, in a common distribution network. The new EDT for this arrangement would be 58 seconds (approx.).

Calculating from the largest cylinder to the smallest ensures that the least number of cylinders is used in the design. Adding cylinders to a system increases the system complexity, weight and the size (space that the cylinder will be occupying on the equipment being protected).

NOTE: A full system discharge test must be carried out during commissioning to determine the actual Effective Discharge Time of the system.

Step 5 – Compare approximate (EDT) to that required from the fire system specifications

If the approximate EDT (taking into consideration a potential 10% variation) determined in Step 4 above is less than the discharge time stipulated in the fire system specifications for the equipment being protected, select a larger cylinder or add an additional cylinder of the same size and recalculate until the minimum required EDT is achieved.

Consideration of engine shut down times should also be taken into account when reviewing the EDT. It is important that the system discharge time is longer than the time for the engine to shut down. Use larger cylinders or increase the quantity of cylinders used to increase the system discharge time. In cases where it is not possible to increase the system discharge time to be longer than the engine shut down time, consider using delayed system activation via the use of a listed fire control system.

Step 6 – Determine Distribution System Configuration

Having determined the number of required cylinders and nozzles to be located on the equipment, it is necessary to work out how to install the distribution system.

There are three basic rules in determining distribution system configuration:

- The maximum permissible hose/tube distribution network volume per cylinder.
- The maximum permissible length of ½" hose/tube per cylinder
- The maximum number of nozzles that can be installed along a single ½" hose/tube branch

Discharge network configurations can be either single line or ring configurations. Typical configurations are shown in Figure 3 – Typical discharge system configurations. Where possible it is always better to use ¾" hose as the supply line from the cylinder valve. All configurations should be balanced where possible.

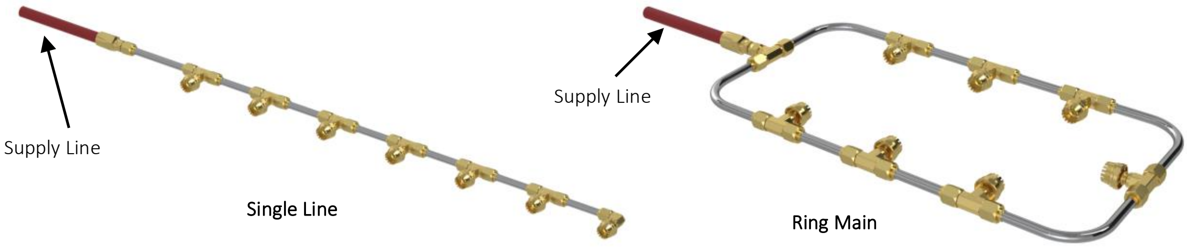


Figure 3 – Typical discharge system configurations

The length of ¾" hose used in a network distribution is limited only by the maximum discharge network volume listed in Table 4.

The discharge network volume can be calculated using Table 3 – Discharge network volume per metre.

Hose/Tubing ID	Volume (litres / m)
1/2"	0.13
3/4"	0.28

Table 3 – Discharge network volume per metre

The length of ½" hose / tubing used in a network distribution is limited to that listed in Table 4 below. Table 4 also details the maximum number of nozzles that can be installed for each cylinder size and along runs of ½" hose or tubing.

Cylinder Size	Maximum Discharge Network Volume	Maximum Allowable Length of ½" Hose/Tube	Maximum number of nozzles per ½" Hose/Tube Run	Maximum number of nozzles per cylinder
C23	0.94 ltrs	7.2m	4	4
C30	1.20 ltrs	9.2m	6	6
C45	1.75 ltrs	13.5m	7	7
C65	2.50 ltrs	16.0m	6	10
C106	4.00 ltrs	20.0m	6	12

Table 4 – Maximum allowable discharge network limits per cylinder

Where multiple cylinders are used for a common discharge network:

- the maximum allowable hose volume for the network and the maximum length of ½" hose/tube is that tabulated above multiplied by the number of cylinders.
- each cylinder must supply into separate locations around the common discharge network. The feed in points should be located equally spaced around the ring main
- cylinders must never be manifolded together into a common supply line.

Maximum Distribution Limits for Each Cylinder Size

C23 Cylinder

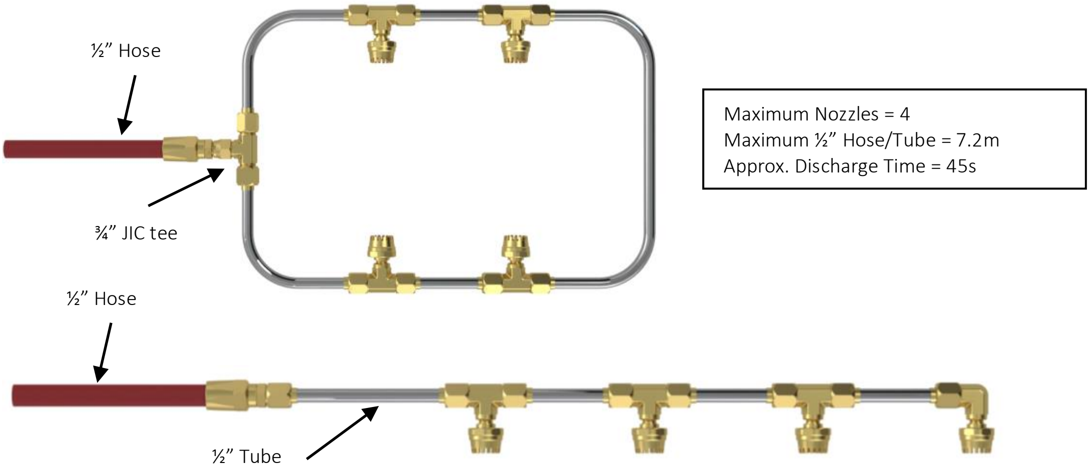


Figure 4 Max Distribution Limits for C23 Cylinder

C30 Cylinder

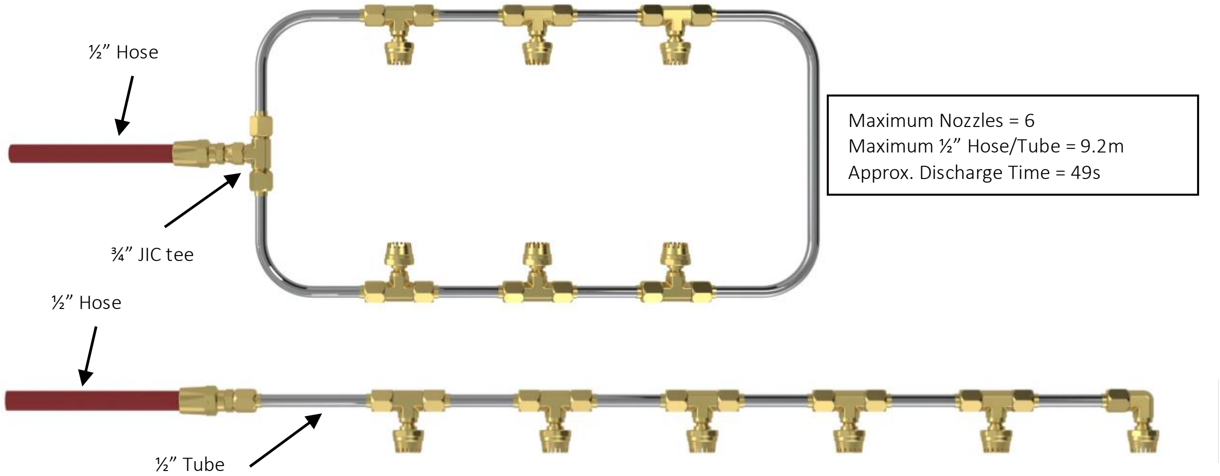


Figure 5 Max Distribution Limits for C30 Cylinder

C45 Cylinder

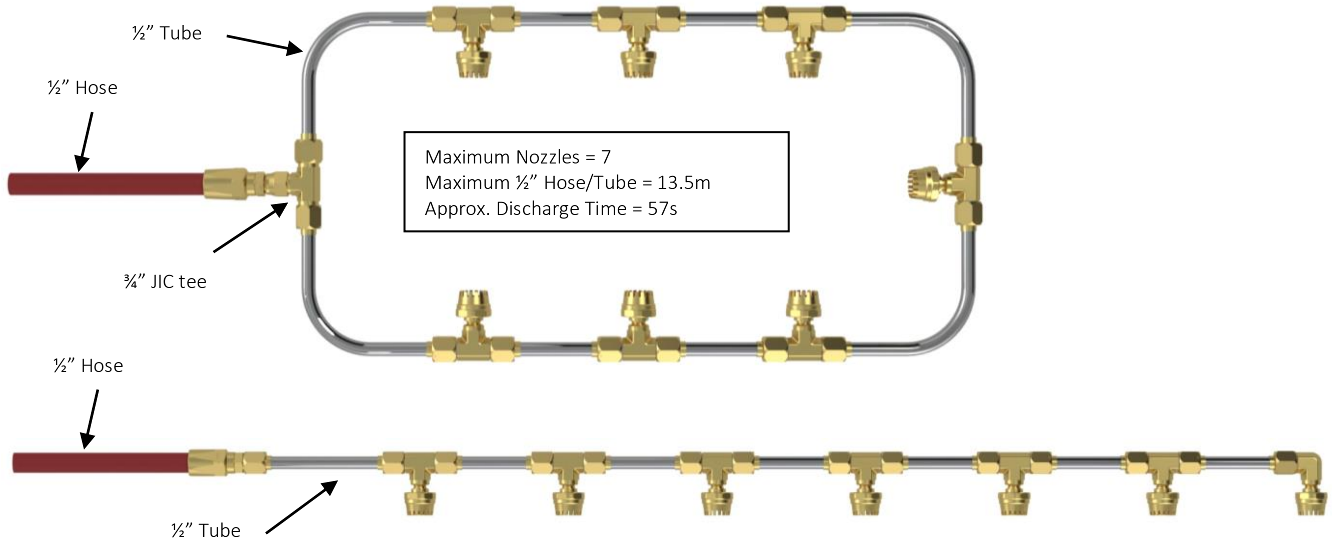


Figure 6 Max Distribution Limits for C45 Cylinder

C65 Cylinder

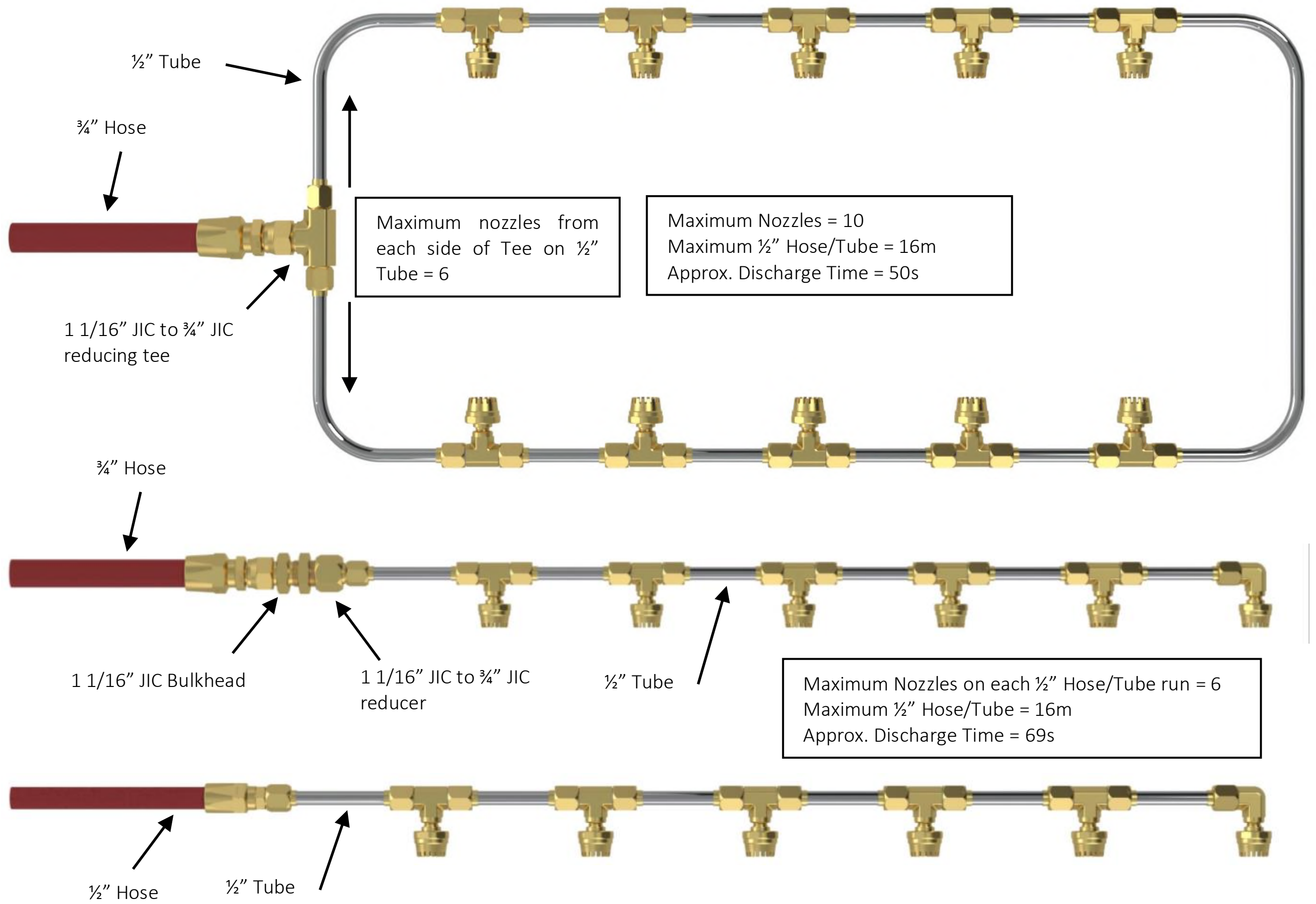


Figure 7 Max Distribution Limits for C65 Cylinder

C106 Cylinder

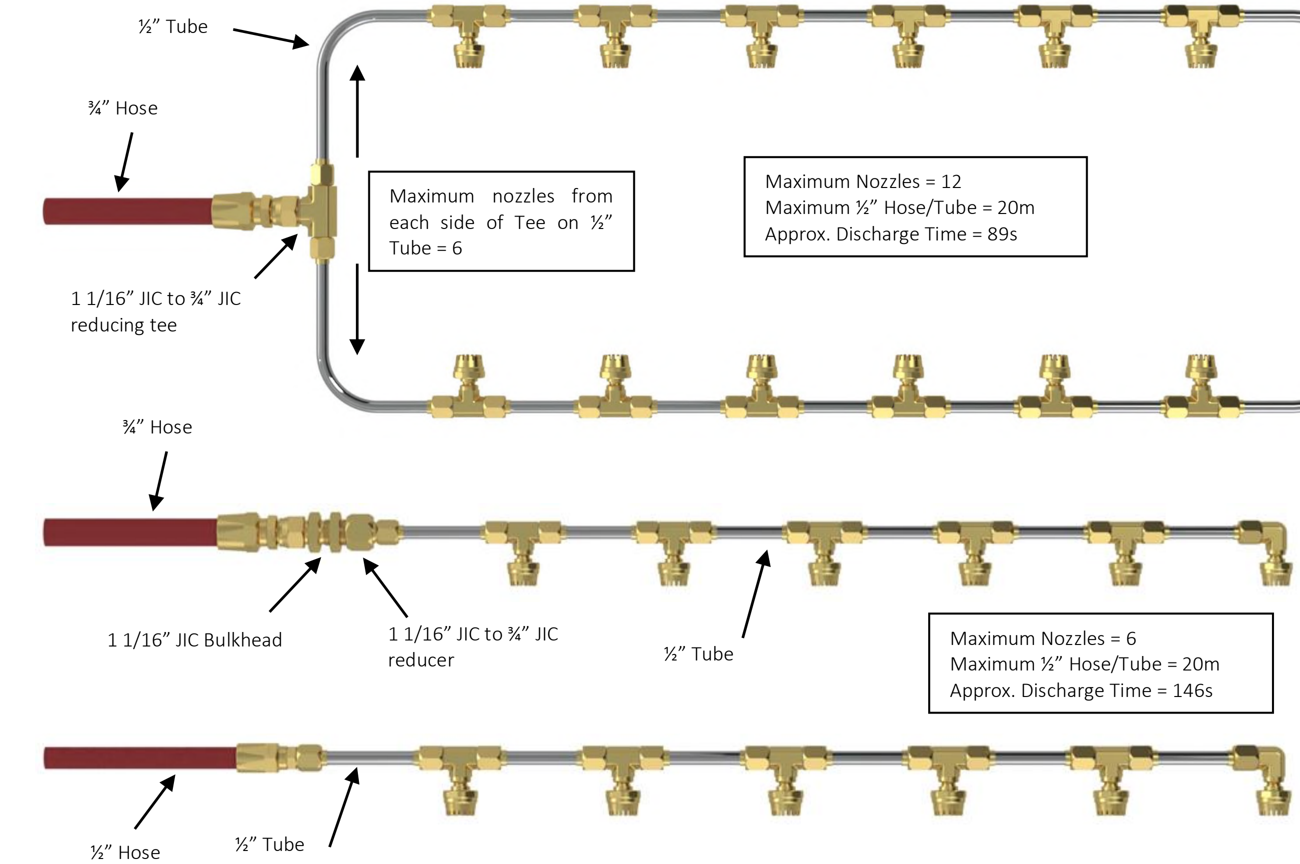


Figure 8 Max Distribution Limits for C106 Cylinder

Multiple Cylinder Systems

It is permissible to connect multiple cylinders of the same size into a common discharge network, provided the rules regarding maximum number of nozzles and maximum hose volumes are observed. The maximum number of cylinders which can be used in a single system is 10.

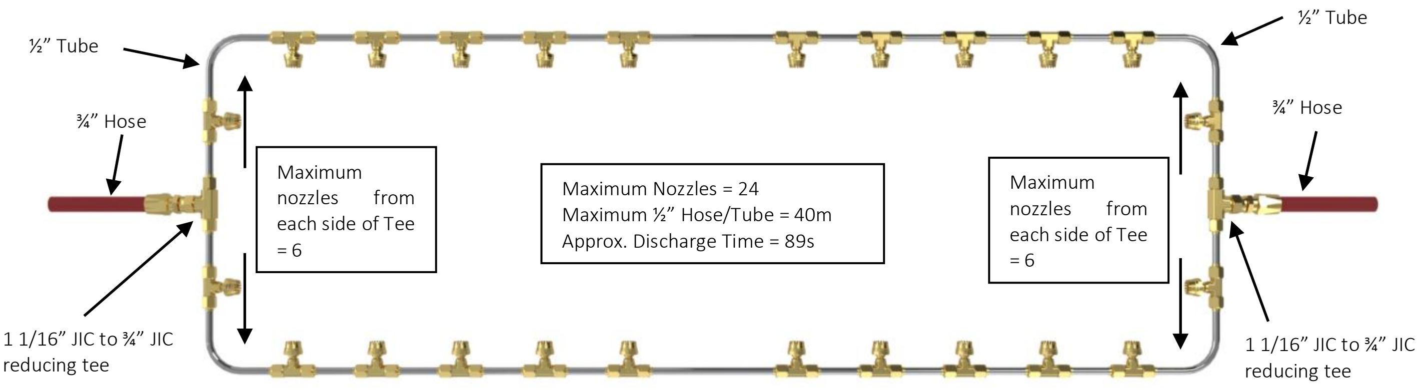


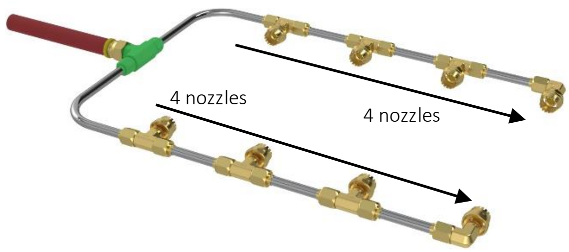
Figure 9 Maximum Distribution Limits for a 2 x C106 configuration

Distribution Network Line Balancing

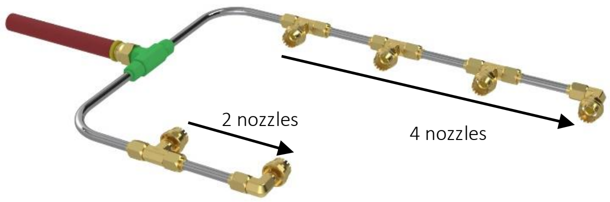
The preferred distribution design is a ring main. Using a balanced arrangement, such as a ring main, will ensure a similar quantity of foam solution is delivered from each nozzle. Where individual line branches are used instead of a ring configuration, the length and number of nozzles on each single line should be kept balanced from any tee junction. The maximum allowable imbalance of nozzles from any tee shall not exceed a difference of two (x2), that is there can only be two additional nozzles on one side of a tee connection to that on the other side of a tee connection.

Ring Main: Preferred

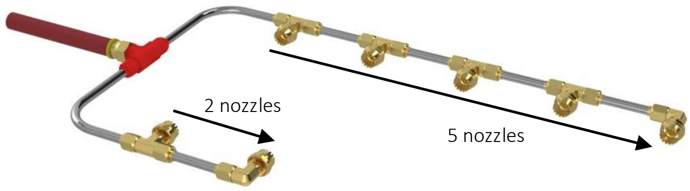
Balanced Single Lines: Good



Two Nozzle Imbalance: Acceptable



Three Nozzle Imbalance: Not Acceptable



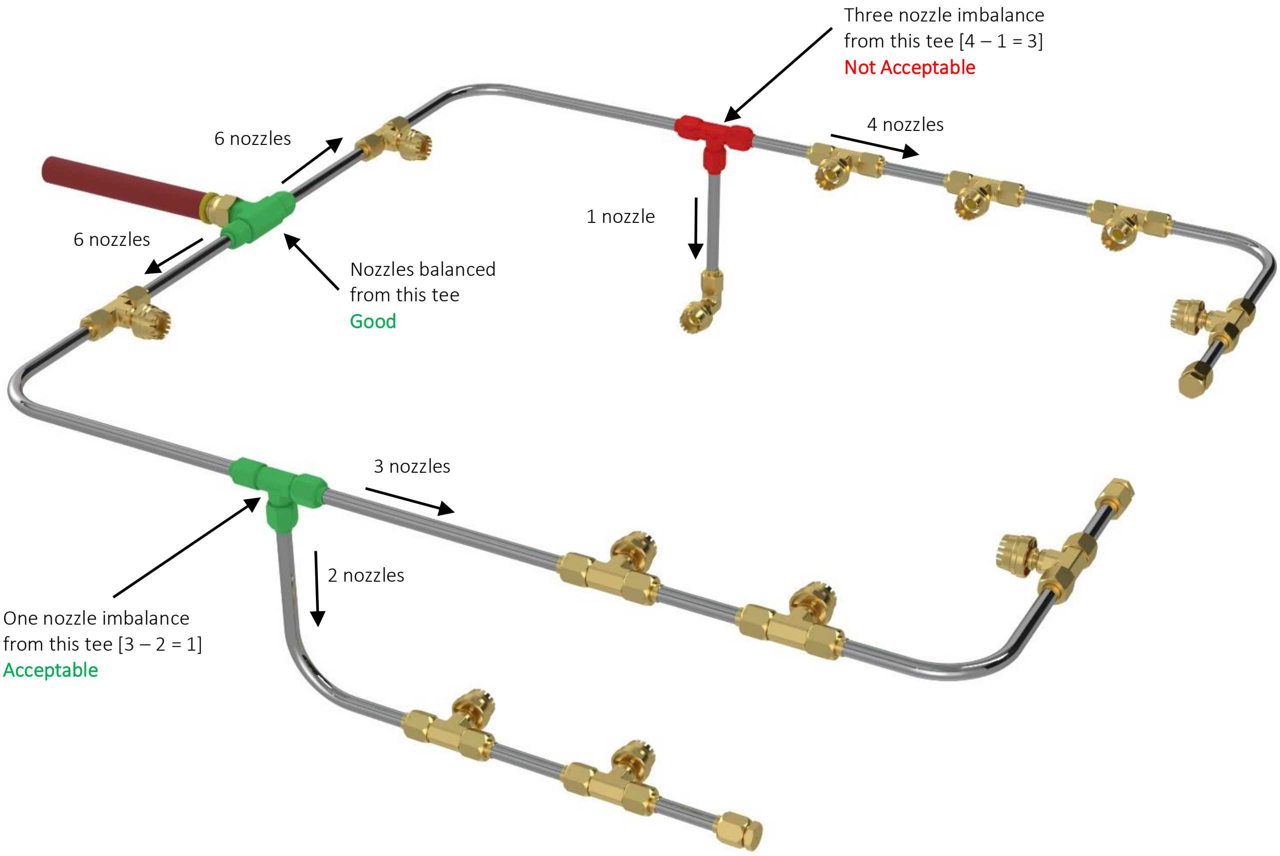


Figure 10 – Balance of nozzles from tees

When running an inline tee branch from a single ring main:

- The maximum number of nozzles allowed along the branch is two

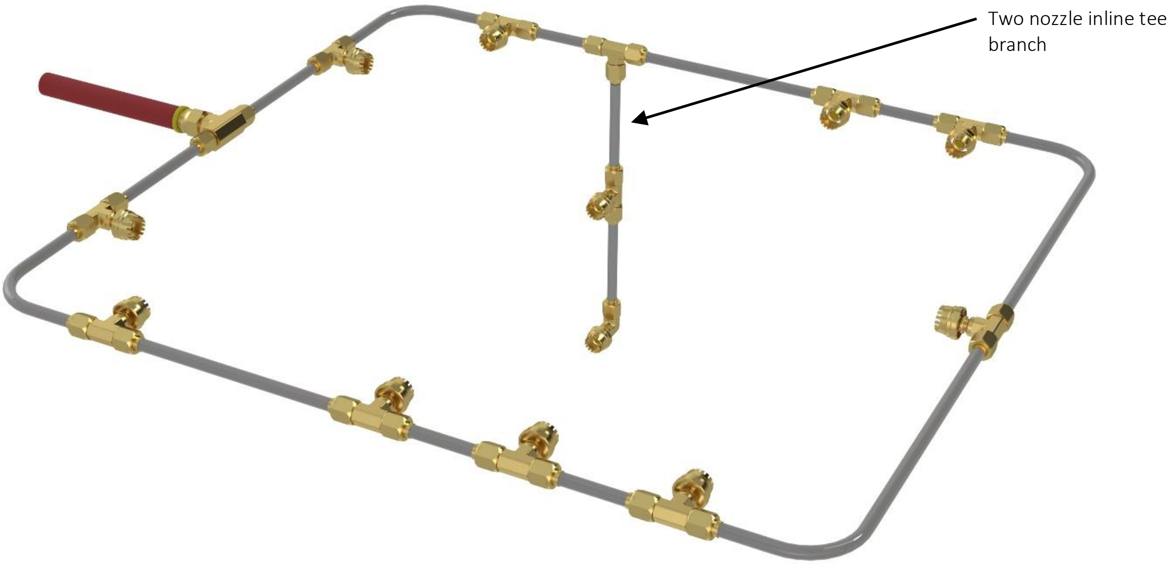


Figure 11 Single inline tee branch

- If multiple inline tee branches are used these should be balanced. That is, they should branch off the ring main as close as possible to equal opposite sides.

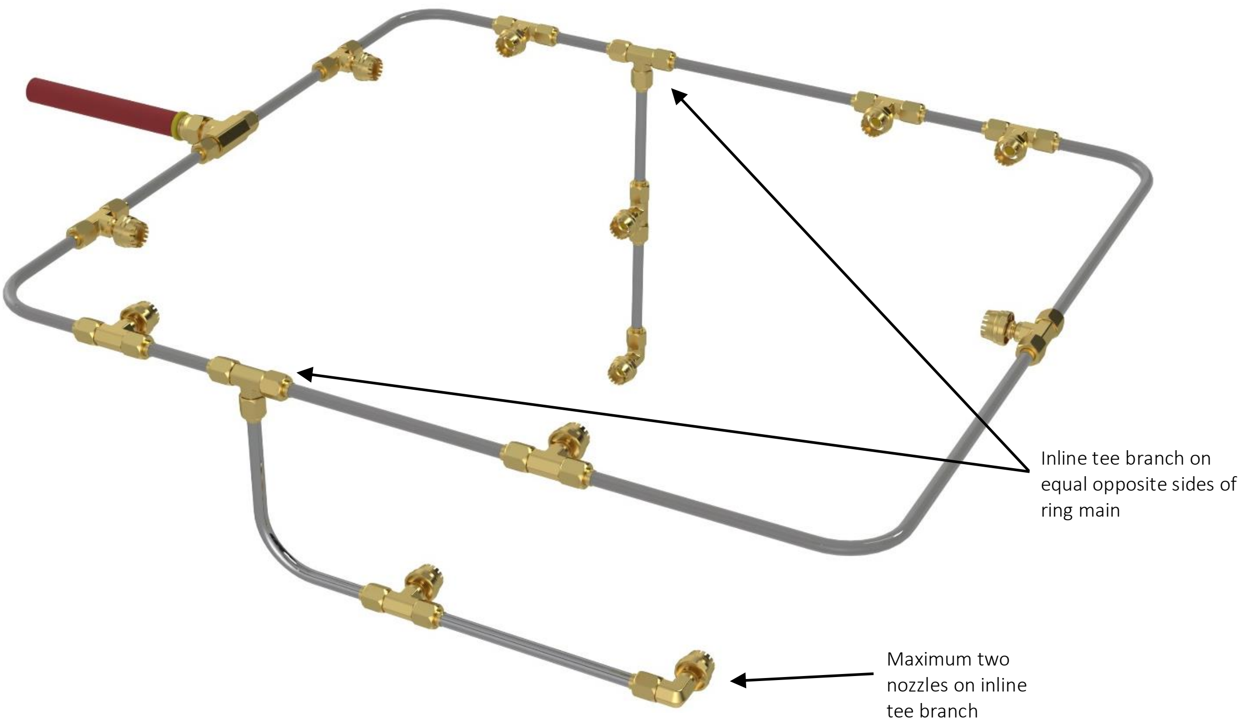


Figure 12 – Balanced inline tee branches

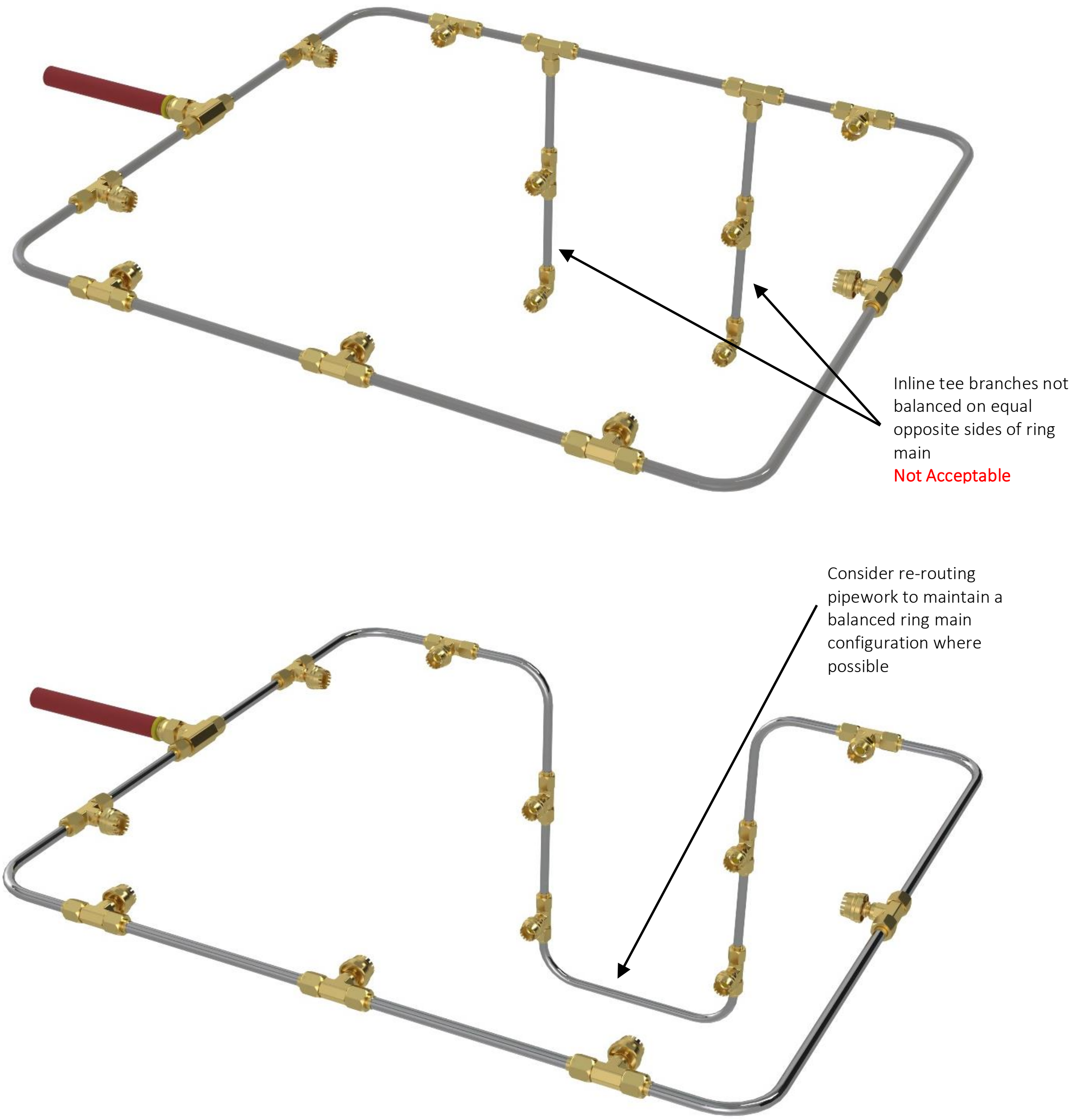


Figure 13 – Multiple inline tee branches

COMPONENTS

Cylinder Assemblies & Brackets

Cylinders Assembles

PEFS F3**N** cylinder assemblies are available in five different sizes. All cylinder assemblies are compliant to AS2030. PEFS F3**N** cylinders have a fill ratio of 80% of their water capacity and are pressurised to a nominal pressure of 1,700kPa @ 21^{o}C (see Table 14 for correct filling pressures at different temperatures).

Each cylinder assembly consists of the following:

- Cylinder manufactured from stainless steel grade 304
- Pressure relief burst disk
- Filler Plug Assembly
- Blue Band

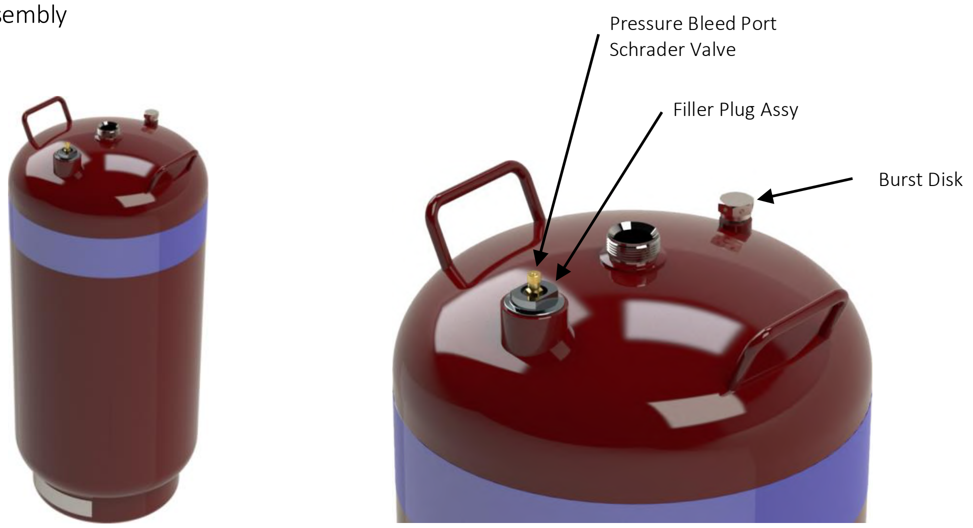


Figure 14

Cylinder Assembly Details:

Part Number	109508	109510	109511	109512	111045
Description	C23 Cylinder	C30 Cylinder	C45 Cylinder	C65 Cylinder	C106 Cylinder
Water Capacity	23 lt.	30 lt.	45 lt.	65 lt.	106 lt.
Height (mm)	726	512	572	772	1188
Height with Valve	960	740	820	1020	1440
Diameter (mm)	216	318	360	360	360
Design Registration[1]	V1061-84 / V1301719	V881-82 / V1301721	V376-84 / V1301718	V376-84 / V1301718	V376-84 / V1301718
Test Pressure[1]	6 MPa / 3.3 MPa	3.3 MPa / 3.3 MPa	3.6 MPa / 3.3 MPa	3.6 MPa / 3.3 MPa	3.6 MPa / 3.3 MPa
Total Fill	18 lt.	24 lt.	35 lt.	50 lt.	85 lt.
Water quantity	17 lt.	22.5 lt.	33 lt.	47 lt.	80 lt.
Foam quantity	1 lt.	1.5 lt.	2 lt.	3 lt.	5 lt.
Pressure @ 21^{o}C	1700 kPa	1700 kPa	1700 kPa	1700 kPa	1700 kPa
Empty Mass (incl Valve Assy)	10.9 kg	12.1 kg	13.5 kg	17.6 kg	24.3 kg
Gross Mass (incl Fill)	28.9 kg	36.1 kg	48.5 kg	67.6 kg	109.3 kg
Total Mass (incl Fill & Bracket)	38.9 kg	45.5 kg	65.5 kg	84.6 kg	134 kg

Table 5 - PEFS F3N cylinder specifications

[1] Cylinders are manufactured at different factories. Please check Name Plate for Design Registration and Test Pressure for the particular cylinder supplied.

LOP Cylinder Valve

The LOP valve assembly (Part Number 26023) is a solid forged brass valve that is chrome plated for additional corrosion resistance. The LOP valve assembly complies with the applicable mechanical and pressure testing requirements of AS2473. The valve assembly features:

- loss of pressure pneumatic actuation port
- pressure indicator (1700kPa)
- charging port
- pressure switch port (for discharge indication)

Each valve is stamped with the year and date of manufacture.

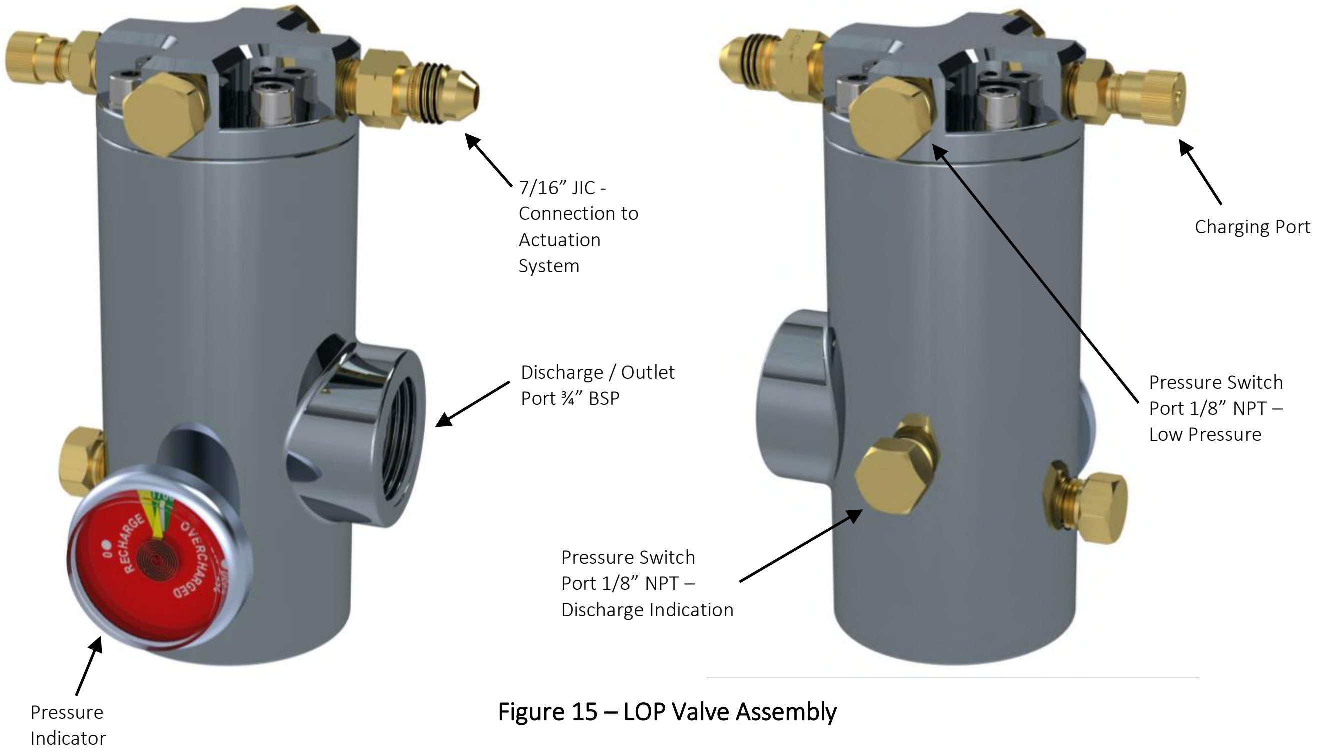


Figure 15 – LOP Valve Assembly

Siphon Tubes

PEFS F3N cylinder assemblies are fitted with flexible siphon tubes to allow the cylinders to be mounted either vertically or horizontally. The siphon tubes are manufactured from reinforced flexible hose with brass end fittings.

Figure 16 – Siphon tube

Cylinder Size	Siphon Tube Part Number	Tube Length (±2mm)
C23	109298	719
C30	110281	485
C45	110282	546
C65	110283	745
C106	112040	1156

Table 6 – Siphon tube details

Filling Kits

A Fill Kit is available for each size cylinder. Each filling kit consists of the following:

- Chubb PEFS F3**N** Foam Concentrate
- Cylinder Main Label
- Over-fill Tube

Cylinder Size	Fill Kit Part Number
C23	51015
C30	51016
C45	51017
C65	51018
C106	51019

Table 7 – Fill Kits

Each filling kit contains the correct amount of foam concentrate as per Table 5 - PEFS F3N cylinder specifications. The Chubb PEFS F3**N** foam is a non-persistent, fluoro-surfactant free, newtonian firefighting foam. It is suitable for use in the suppression of Class A (ordinary combustible) and Class B (hydrocarbon fuels only) fires.

The Over-fill tubes are to assist in the correct filling of cylinders. These are for use when access to a set of scales is not available for filling. The tubes are fitted into the filling port. The cylinders are filled with water to the correct volume when the water overflows from the top of the filler port. The cylinder then requires the correct volume of foam concentrate to be added and then mixed. Each cylinder size has a different length over-fill tube. Each over-fill tube is engraved with the cylinder size for identification.

The main label is a universal label that can be used for any of the cylinder sizes. Each main label consists of a space where the fill quantity for the applicable cylinder it is applied to can be recorded.

Cylinder Brackets

PEFS F3**N** cylinder brackets are manufactured from welded carbon steel and painted black. Each bracket is stamped with the date of manufacture near the top right-hand corner.

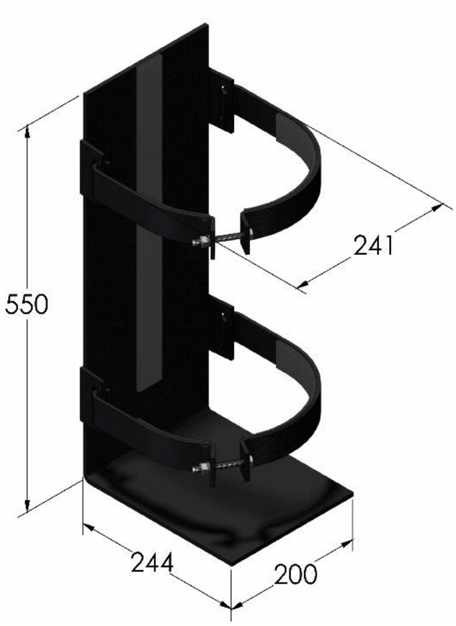


Figure 18 – C23 Cylinder Bracket

(part number 128735)

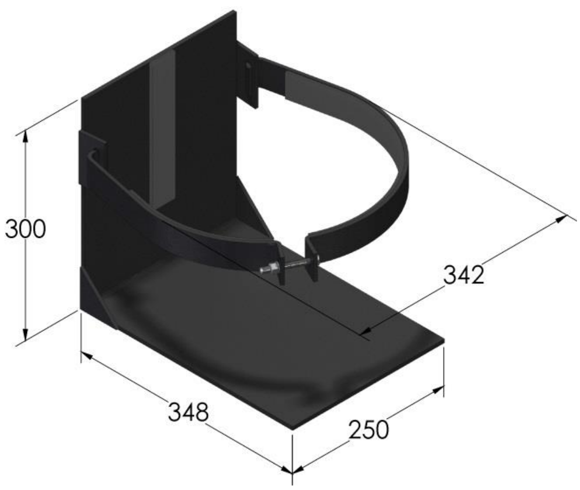


Figure 17 – C30 Cylinder Bracket

(part number 128736)

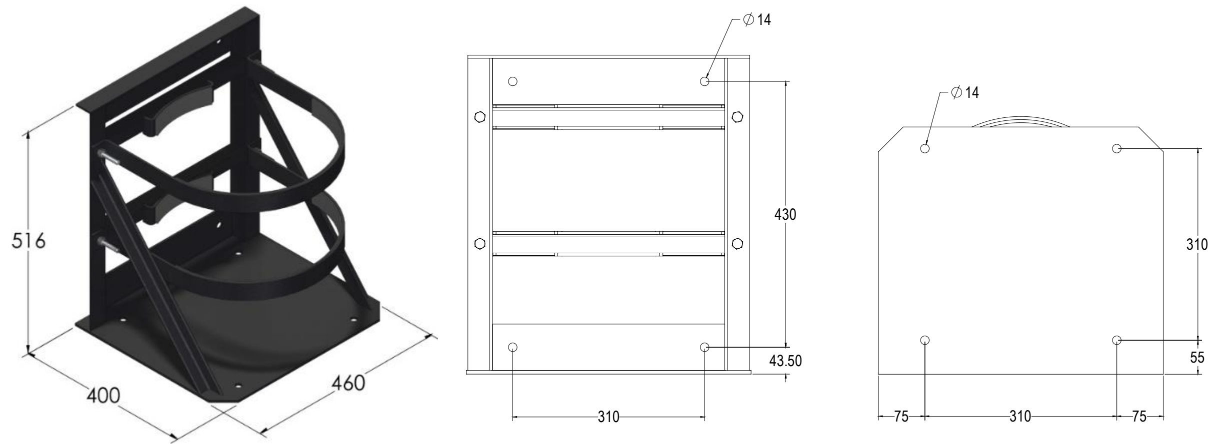


Figure 19 – C45 & C65 Cylinder Bracket

(part number 128737)

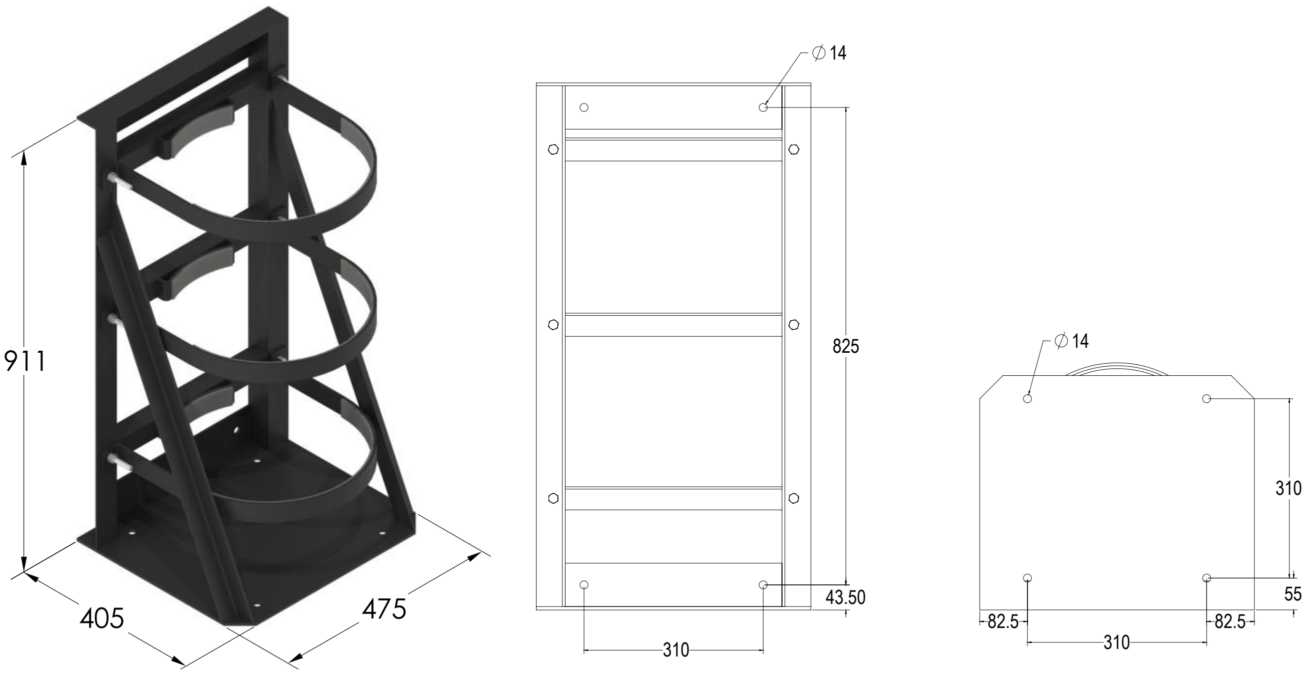


Figure 20 – C106 Cylinder Bracket

(part number 128738)

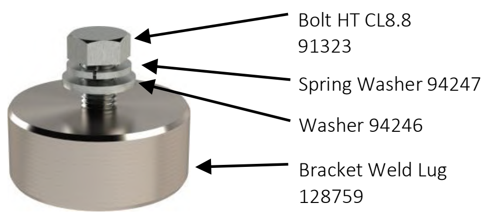


Figure 21 – Bracket Weld Lug Assembly

LOP Valve Actuation Bypass Kit (Optional)

The LOP Valve Actuation Bypass Kit (Part Number 28059) is an optional modification for a PEFS LOP system.

The piston in the standard LOP valve has a small orifice and an internal floating check valve. This allows the cylinders to be pressurised and allows the pressure in the cylinders to be balanced with the pressure in the actuation pipework. The purpose of the floating check valve is to allow pressure to pass between the cylinder(s) and the actuation system to account for pressure changes that can occur during system pressurising, temperature changes, and when minute leaks occur. A result of this important function is that small amounts of foam solution can pass through the piston over time and enter the actuation pipework. This effect does not impact the functionality of the PEFS F3N System.

The LOP Valve Actuation Bypass Kit changes the pathway for pressure to flow to and from the PEFS cylinders during charging and pressure balancing. The bypass relocates the floating check valve from the valve piston to the filler port plug. Instead of the pressure balancing occurring through the valve it now occurs through the filler port plug. The bypass prevents the foam solution in the cylinder from entering the actuation system that can occur with the use of the standard LOP valve.

It is recommended for use where there is a concern for a small amount of foam solution to discharge from a manual actuator poses an issue in locations such as the operator cabins or where contact with sensitive equipment will occur. However, this modification will increase the time it takes to pressurise the cylinders and should only be used on cylinders mounted vertically. If the bypass is used on a cylinder that is installed horizontally, foam solution is still likely to flow into the actuation system during pressure balancing.

The LOP Valve Actuation Bypass Kit includes the following components:

- A new Piston Assembly
- A new Filler Plug Assembly
- A Stainless-Steel braided connection hose
- A connection adaptor to fit LOP valve
- A connection Tee for use on older LOP Valves
- Installation Instructions

Figure 22 LOP Valve Actuation Bypass

Discharge Components

PEFS F3**N** discharge systems may be installed using stainless steel tubing and flame-resistant flexible hose. Although the discharge hose specified in this manual is flame resistant, it is NOT fire proof. For this reason, it is preferred to use stainless steel tubing in the fire hazard areas and any other areas which may be prone to mechanical damage and exposure to high temperatures.

Stainless Steel Tube

½"' Stainless Steel tube should be used in the fire hazard areas to supply the PEFS F3**N** discharge nozzles. The tube is 12.7mm outside diameter x 0.9mm wall thickness annealed seamless type 304 or 316 stainless steel tubing (part number 112108 for 2m lengths). The minimum bend radius of ½" stainless steel tubing is 50mm.

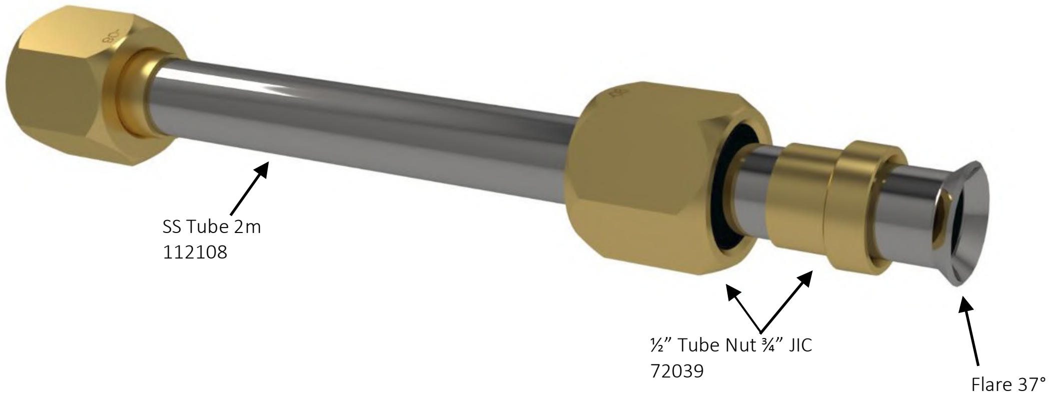


Figure 23 – Stainless steel tube and fittings

Discharge Hose

The PEFS F3**N** discharge hose is red and branded 'FIRE SUPPRESSION'. It is oil resistant with braided reinforcement and meets U.S. MSHA 2G flame resistance requirements.

PEFS F3**N** discharge hoses are available in ½" and ¾" sizes. The ½" hose is used to supply the nozzles in either a single line configuration or a ring main configuration. The ¾" hose is used to connect the discharge system ring main to the cylinder valve.

Use of hose in fire risk areas should be avoided if possible; where this cannot be avoided the use of a fire-retardant sleeve should be used. In areas where discharge hose may be subjected to abrasion or impact, hose protection spiral guards should be used.

	Hose Size	Part Number	Minimum Bend Radius	Temperature Rating (Air/Water)
	½"	118097	180mm (7")	-40°C – 71°C
	¾"	118098	240mm (9.5")	

Table 8 – Discharge hose

<u>Nozzles</u>

The PEFS F3**N** discharge nozzle is a brass foil rupture nozzle fitted with a brass air aspirating shroud for improved foam blanket generation. The nozzle incorporates a brass foil seal to prevent ingress of dirt and grease. Upon system discharge, the foil seal is designed to rupture allowing the nozzle to discharge foam solution. Nozzles are stamped with the designation SNE488025

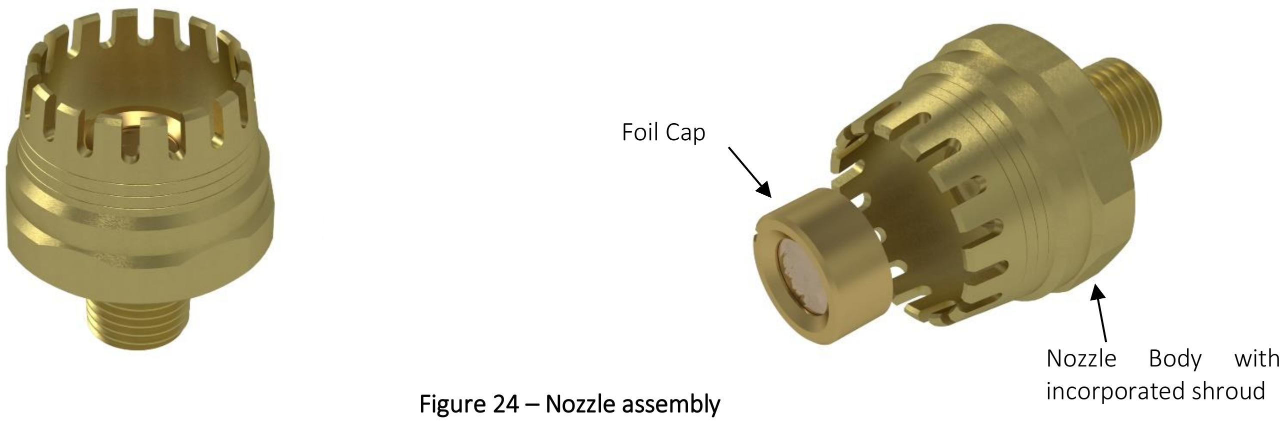


Figure 24 – Nozzle assembly

Part Number	Description
46128	Nozzle brass ¼" BSP 1-piece c/w Foil Cap
46129	Replacement Foil Cap

Table 9 Nozzle Parts

The nozzle has a wide angled solid cone discharge pattern and has a maximum range of 1,000mm.

Please note that although the spray from the nozzle is cone shaped, the nozzles have been tested based on protecting a square area as per the requirements of AS5062. At a distance of 500 - 1000mm a single nozzle can protect an 800mm x 800m square area.

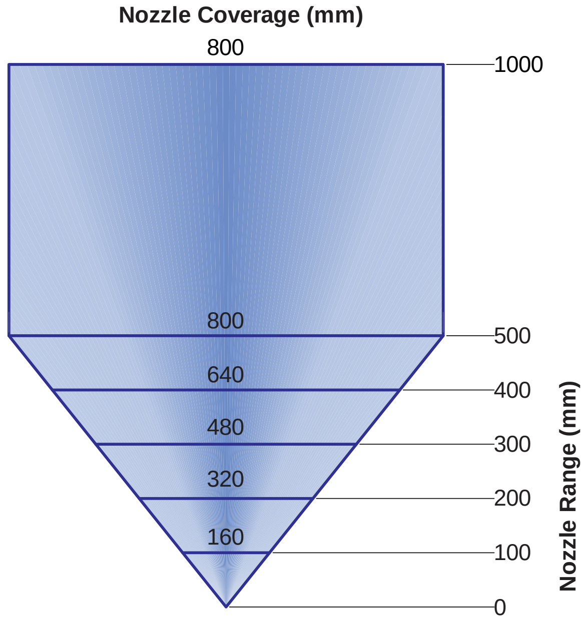


Figure 25 – Nozzle range and coverage details

Nozzle Kits

A range of standard nozzle discharge configurations are available in the form of nozzle kits.

Nozzle kit single straight (part number 72008)

Nozzle kit single end 90° (part number 72031)

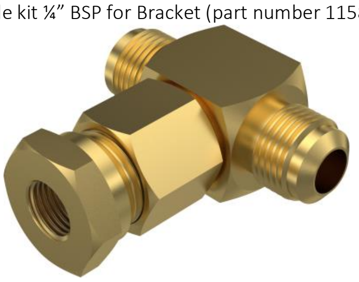
Nozzle kit single straight 90°(part number 72400)

Nozzle kit single end 45° (part number 72033)

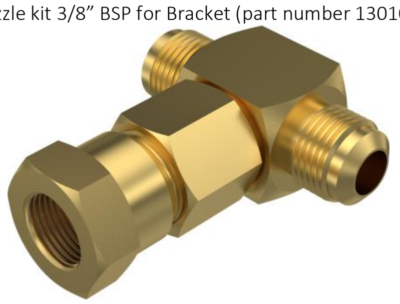
Nozzle kit double straight 90° (part number 72403)

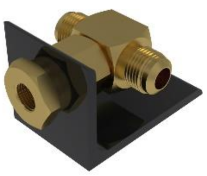
Nozzle kit double straight 90°/45° (part number 72404)

Nozzle kit ¼” BSP for Bracket (part number 115815)



Nozzle kit 3/8” BSP for Bracket (part number 130104)





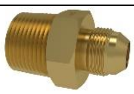
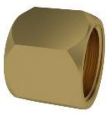
Nozzle bracket (part number 104592) [supplied separately]

Figure 26 – Standard nozzle kit configurations

Discharge Hose and Tube fittings

The following hose and tube fittings supplied by Chubb meet minimum levels of quality and corrosion resistance. Fittings listed in the PEFS F3 Design Manual are also acceptable for use but do not offer the same level of corrosion resistance.

NOTE: Fittings from non-approved suppliers may not offer the same levels of quality and corrosion resistance and could result in blockage of hose or tubing due to corrosion.

Type	Image	Part No.	Description
Hose Protector		40155	20mm Red - Suitable for ½" hose
		40154	25mm Red - Suitable for ¾" hose
Couplings (Field Attachable)		87070	1/2" Hose x 3/4" JIC (f) swivel
		87071	3/4" Hose x 1 1/16" JIC (f) swivel
		87072	1/2" Hose x 3/4" JIC (m)
Cap/Nut		72039	3/4" JIC Nut & Sleeve to suit 1/2" Tube
Reducing Adaptor		72022	3/4" JIC (m) x 1 1/16" JIC (f)
Unions		72000	3/4" JIC
		72011	3/4" JIC Bulkhead
		72012	1 1/16" JIC Bulkhead
		72020	3/4" JIC x 3/4" BSP
		72021	1 1/16" JIC x 3/4" BSP
Plug/Cap		72009	3/4" JIC (m)
		72002	3/4" JIC (f)
		72003	1 1/16" JIC cap
Tees		72005	3/4" JIC (m)
		72006	1 1/16" JIC (m)
		72007	¾" JIC (m) x ¾" JIC (m) x 1 1/16" JIC (m)
		72013	¾" JIC (m) bulkhead
		72014	1 1/16" JIC (m) bulkhead
		72008	3/4" JIC (m) x 3/4" JIC (m) x 1/4" BSP (f)

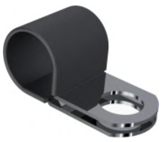
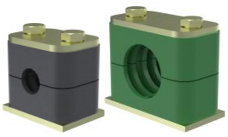
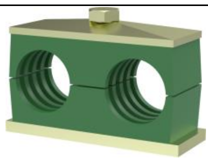
<table>
<tr><th>Type</th><th>Image</th><th>Part No.</th><th colspan="2">Description</th></tr>
<tr><td rowspan="4"></td><td></td><td>72024</td><td colspan="2">3/4” JIC (m) x 3/4” JIC (m) x 3/4” JIC (f)swv</td></tr>
<tr><td></td><td>72026</td><td colspan="2">3/4” JIC (f)swv x 3/4” JIC (m) x 3/4” JIC (m)</td></tr>
<tr><td></td><td>72027</td><td colspan="2">3/4” JIC (f)swv x 3/4” JIC (m) x 1 1/16” JIC (m)</td></tr>
<tr><td></td><td>72032</td><td colspan="2">3/4” JIC (f)swv x 3/4” JIC (m) x 1/4” BSP (f)</td></tr>
<tr><td rowspan="6">Elbows</td><td rowspan="2"></td><td>72016</td><td colspan="2">3/4” JIC (m & f) swivel</td></tr>
<tr><td>72017</td><td colspan="2">1 1/16” JIC (m & f) swivel</td></tr>
<tr><td></td><td>72001</td><td colspan="2">3/4” JIC (m)</td></tr>
<tr><td rowspan="2"></td><td>72029</td><td colspan="2">45° 3/4” JIC (m & f) swivel</td></tr>
<tr><td>72030</td><td colspan="2">45° 1 1/16” JIC (m & f) swivel</td></tr>
<tr><td></td><td>72033</td><td colspan="2">45° 1/4” BSP (f) x 3/4” JIC (m)</td></tr>
<tr><td>Nozzle Bracket</td><td></td><td>104592</td><td colspan="2">Size: 76x51x5 angle, 50mm width, Zinc plated</td></tr>
<tr><td rowspan="5">Insulated P-Clip</td><td rowspan="5"></td><td></td><td>Size</td><td>Spacing</td></tr>
<tr><td>103198</td><td>½” Hose</td><td>0.7</td></tr>
<tr><td>130080</td><td>½” Hose with Hose Protector</td><td>0.7</td></tr>
<tr><td>103199</td><td>¾” Hose</td><td>0.7</td></tr>
<tr><td>130081</td><td>¾” Hose with Hose Protector</td><td>0.7</td></tr>
<tr><td>Weld Lug</td><td></td><td>129578</td><td colspan="2">M8 Weld Lug c/w bolt and washer for mounting P-Clips</td></tr>
<tr><td rowspan="8">Welded Clamp Blocks</td><td rowspan="4"></td><td></td><td>Size</td><td>Spacing</td></tr>
<tr><td>132823</td><td>½” Tube</td><td>0.5</td></tr>
<tr><td>112113</td><td>½” Hose</td><td>0.7</td></tr>
<tr><td>128818</td><td>¾” Hose</td><td>0.7</td></tr>
<tr><td></td><td>94435</td><td colspan="2">Bolt on Base to suit 132823</td></tr>
<tr><td rowspan="3"></td><td></td><td>Size</td><td>Spacing</td></tr>
<tr><td>130073</td><td>Double ½” Tube</td><td>0.5</td></tr>
<tr><td>130074</td><td>Double ¾” Hose</td><td>0.7</td></tr>
</table>

Table 10 – PEFS F3N discharge hose & tube fittings

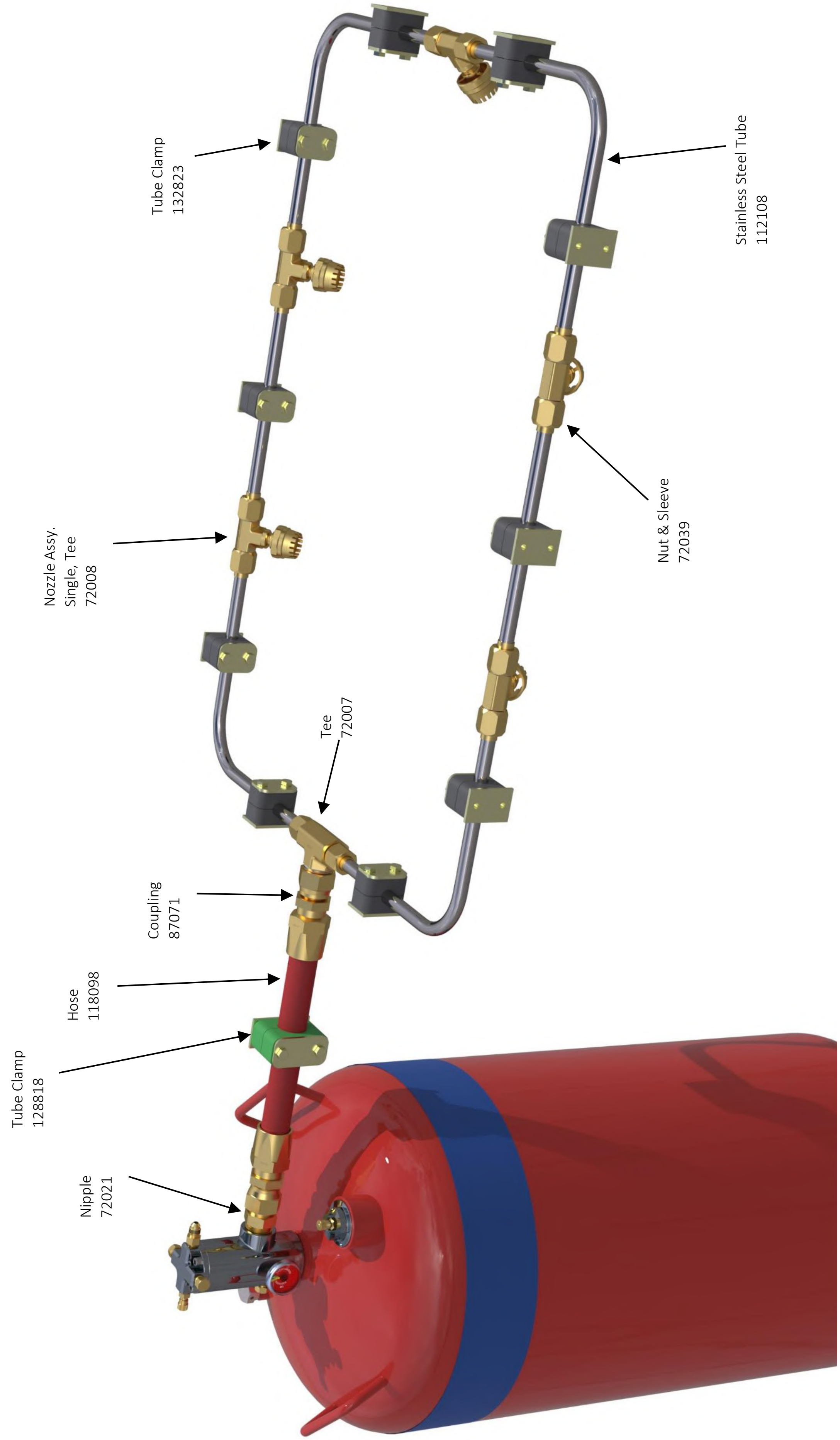


Figure 27– Typical Discharge System – (LOP Cylinder Valve shown)

Detection and Actuation Components

A maximum of ten (10) cylinder assemblies are permitted to be operated by any actuation device detailed in this manual. The maximum permitted length of ¼" actuation hose used in any actuation system is 100m.

Loss of Pressure Detection Tubing

LOP tubing (part number 118837) is a heat detector, which is active along its entire length, used for automatic activation of LOP systems. LOP tubing is pressurised to the same pressure as the cylinder and is used to keep the cylinder valve closed. When heated to in excess of 130° - 150° the LOP tubing melts, the resulting loss of pressure allows the PEFS F3N LOP cylinder valve to open. In addition to system activation, the pressure loss resulting from the rupture of the LOP detection tubing may be used to operate switches, relays and other devices.

LOP detection tubing has an installed life of 1 year and must therefore be replaced annually as part of the regular maintenance routine.

Manual LOP Actuator

The manual LOP actuator is suitable for internal and external vehicle mounting. Manual LOP actuators are manufactured from red powder coated stainless steel housing and incorporates a pressure gauge and a foil rupture discharge nozzle to prevent ingress of dirt. It is designed for mounting on a vertical surface, using 4 x M6 fasteners. When activated by pushing down on the top red button the actuator releases pressure from the actuation system and allows the PEFS F3N LOP cylinder valve to open.

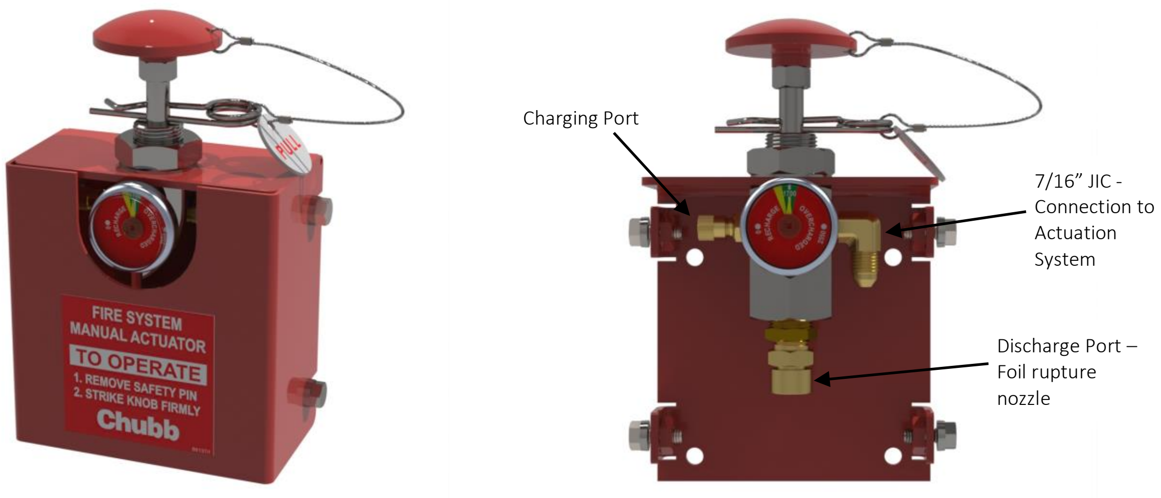


Figure 28 – LOP Actuator (part number 47130)

A manual actuator (electric or pneumatic) must be fitted at the driver/operator's station. Additional remote actuators should be located at suitable external locations on the equipment. Typical locations include the bottom of the cabin access steps and on structural framework surrounding the hazard. Manual actuators must be easily accessible and operating instruction signs provided.

The manual actuator can be flush mounted if required. The maximum allowable wall thickness is 2.0mm with enclosure removed. The hole size required for flush mounting is Ø22mm.

Figure 29 LOP Actuator Flush Mount (part number 47131)

Electric Solenoid Valve Assembly

Electric actuation of the PEFS F3N system is achieved using a 12V DC10W solenoid operated valve assembly.

Figure 30- LOP solenoid valve assembly (part number ES9014-D)

The LOP solenoid valve assembly may be fitted anywhere in the LOP actuation system and includes a foil rupture discharge nozzle fitted to the solenoid valve outlet to prevent blockage of the valve outlet by contaminants. When electrically activated the actuator releases pressure from the actuation system and allows the PEFS F3N LOP cylinder valve to open

Care should be taken to direct the outlet of the solenoid valve so that its discharge does not cause a hazard to personnel.

Terminals 1 and 2 of the solenoid coil are used to connect to the listed fire control system; the earth terminal of the coil is not used. The solenoid valve is non-latching. The solenoid valve must remain activated in the open position for a minimum of 10 seconds.

A single LOP solenoid valve assembly can be used to actuate a maximum number of ten (10) cylinder assemblies.

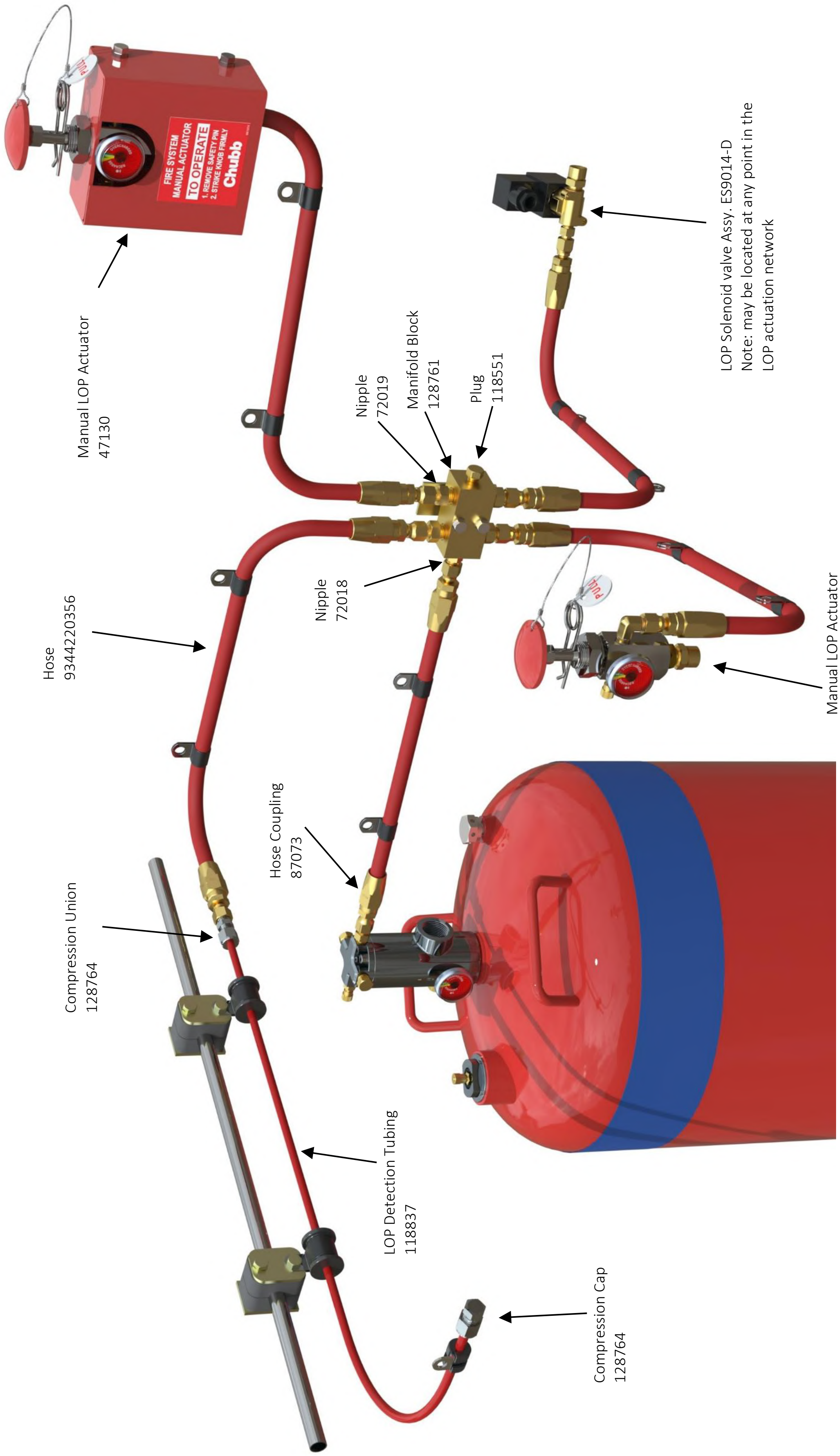


Figure 31 – Typical LOP combined pneumatic detection & solenoid actuation arrangement

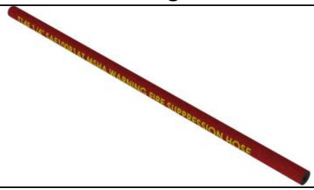
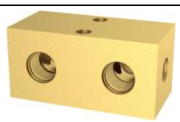
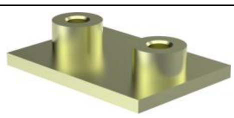
Figure 33 - LOP multiple cylinder actuation arrangement

Actuation System Fittings

Listed below are fittings required to assemble most configurations of LOP pneumatic actuation system.

The hose and tube fittings supplied by Chubb meet minimum levels of quality and corrosion resistance.

NOTE: Fittings from non-approved suppliers may not offer the same levels of quality and corrosion resistance and could result in blockage of hose or tubing due to corrosion.

Type	Image	Part No.	Description
¼" actuation hose		9344220356	¼" red coloured, 'FIRE SUPPRESSION' branded, oil resistant synthetic rubber with high tensile steel wire braid reinforcement meeting SAE 100R1AT specifications and U.S. MSHA 2G and AS2660 flame resistance requirements.
Hose Protector		40156	16mm Red - Suitable for ¼" hose
Hose Fittings (Field Attachable)		87073	1/4" Hose x 7/16" JIC (f)swv Field Attachable
LOP Tubing Coupling		128763	1/4" LOP tube x 7/16" JIC (m) Compression AN Union
LOP Tubing Cap		128764	1/4" LOP Tube EOL Compression Cap
Manifold Blocks		128760	6 x ¼" NPT(f), 2 x 1/8" NPT(f)
		128761	4 x ¼" NPT(f), 2 x 1/8" NPT(f)
Weld Clamp Plates		128841	20mm ctr to ctr (to suit 6 port Manifold Block)
		128842	33mm ctr to ctr (to suit 8 port Manifold Block)
Bolts		91319	M6 x 35mm Hex Head (for Manifold Block)
		91320	M6 x 40mm Hex Head (for Manifold Block)

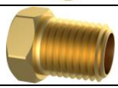
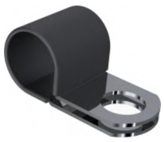
<table>
<tr><th>Type</th><th>Image</th><th>Part No.</th><th colspan="2">Description</th></tr>
<tr><td rowspan="4">Tee</td><td></td><td>72004</td><td colspan="2">7/16” JIC (m)</td></tr>
<tr><td></td><td>72025</td><td colspan="2">7/16” JIC (f) x 7/16” JIC (m) x 7/16” JIC (m)</td></tr>
<tr><td></td><td>72023</td><td colspan="2">7/16” JIC (m) x 7/16” JIC (m) x 7/16” JIC (f)</td></tr>
<tr><td></td><td>112149</td><td colspan="2">1/4” NPT (f)</td></tr>
<tr><td rowspan="3">Elbow</td><td></td><td>72015</td><td colspan="2">7/16” JIC (m & f) swv</td></tr>
<tr><td></td><td>72028</td><td colspan="2">45° 7/16” JIC (m & f) swv</td></tr>
<tr><td></td><td>72043</td><td colspan="2">7/16” JIC (m) x 1/8” NPT (m)</td></tr>
<tr><td rowspan="2">Plug</td><td rowspan="2"></td><td>118551</td><td colspan="2">1/8” NPT</td></tr>
<tr><td>119568</td><td colspan="2">1/4” NPT</td></tr>
<tr><td rowspan="4">Nipple</td><td></td><td>72010</td><td colspan="2">7/16” JIC Bulkhead</td></tr>
<tr><td rowspan="2"></td><td>72018</td><td colspan="2">1/8” NPT x 7/16” JIC</td></tr>
<tr><td>72019</td><td colspan="2">1/4” NPT x 7/16” JIC</td></tr>
<tr><td></td><td>115443</td><td colspan="2">1/8” NPT (m)</td></tr>
<tr><td>Socket</td><td></td><td>130131</td><td colspan="2">1/8” NPT (f)</td></tr>
<tr><td>Adaptor</td><td></td><td>72045</td><td colspan="2">1/4" NPT (m) x 7/16” JIC (f)swv</td></tr>
<tr><td rowspan="5">Insulated P-Clip</td><td rowspan="5"></td><td></td><td>Size</td><td>Maximum Spacing (m)</td></tr>
<tr><td>128819</td><td>¼” Tube</td><td>0.5</td></tr>
<tr><td>103197</td><td>¼” Hose</td><td>0.5</td></tr>
<tr><td>103198</td><td>Use with Grommet 103248</td><td>0.5</td></tr>
<tr><td>130078</td><td>¼” Hose with hose protector</td><td>0.5</td></tr>
<tr><td>Grommet</td><td></td><td>103248</td><td colspan="2">Grommet to hold LOP tubing.
Use with P-Clip 103198.</td></tr>
<tr><td>Weld Lug</td><td></td><td>129578</td><td colspan="2">M8 Weld Lug c/w bolt and washer for mounting P-Clips</td></tr>
</table>

Table 11 – PEFS F3N pneumatic actuation hose and tube fittings

Monitoring Components

Pressure Switches

There are two pressure switches available for use in PEFS F3**N** systems. The pressure switches have a 1/8" NPT connection, a 320mm armoured fly lead with a Deutsch DT06-2S series connector.

- "Cylinder low pressure", 1450kPa NO Blue (part number 87067)
- "Fire Alarm/Discharge", 200kPa NC Black (part number 87069)

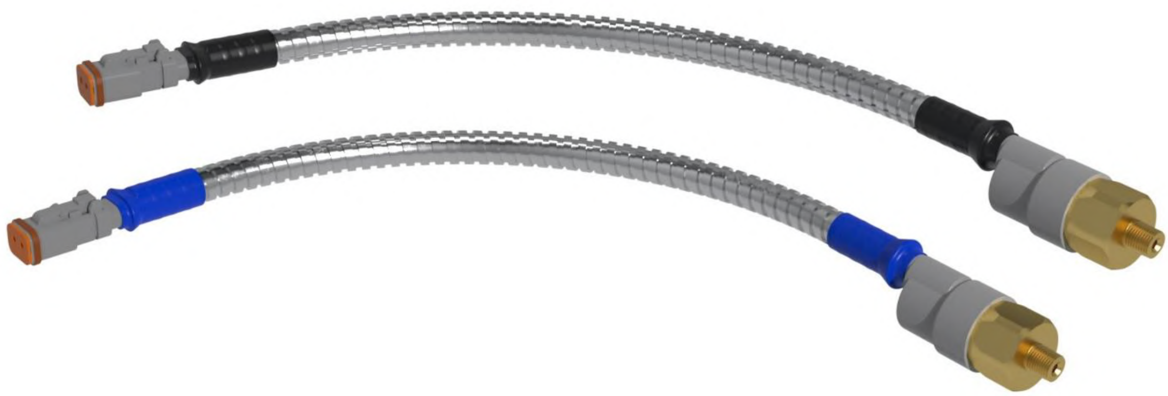


Figure 32 – Pressure Switches

The Fire Alarm/Discharge pressure switch is connected directly to the cylinder valve as shown below. For multiple LOP cylinder system a "Fire Alarm / Discharge" pressure switch **MUST** be fitted to each cylinder valve

Figure 33 –Pressure Switch mounting location on cylinder valve

The Cylinder Low Pressure switch must be installed in the actuation system.

The switch can be installed in any part of the actuation system but for practical purposes the best locations are in components that already have an available 1/8" NPT port:

Option 1: Actuation system (manifold block);
Option 2: Top port in the LOP Valve or;
Option 3: Pressuring port in the LOP Manual Actuator

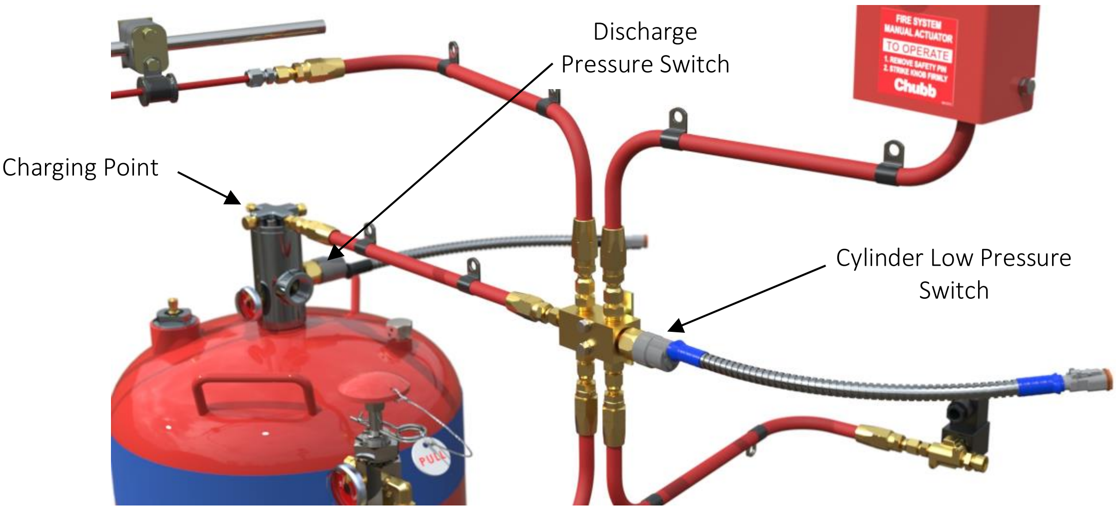


Figure 34 – Cylinder Low Pressure switch fitted to manifold block

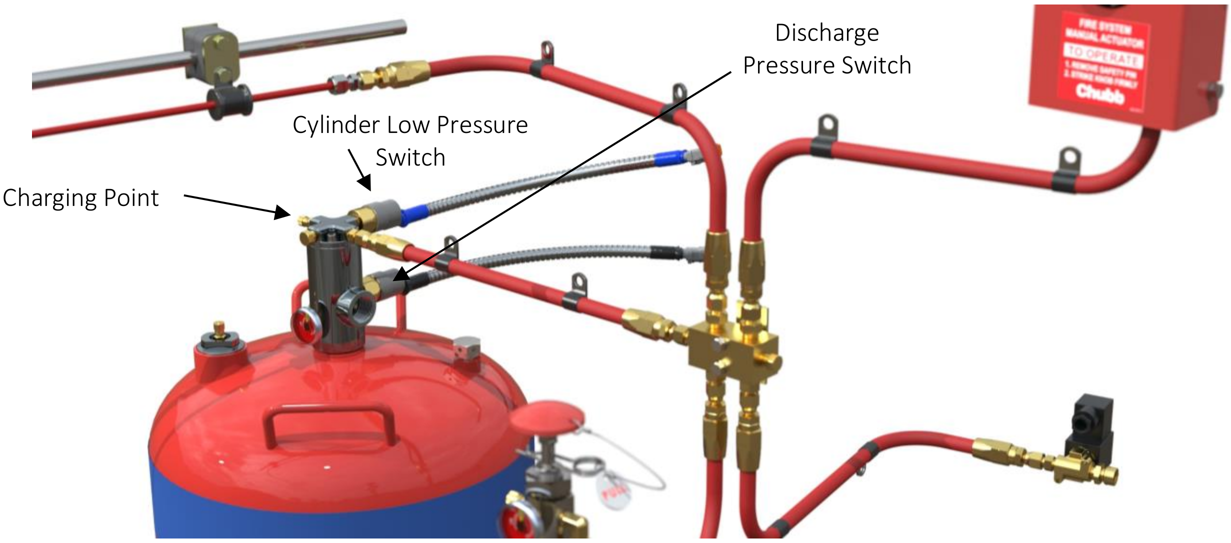


Figure 35 – Cylinder Low Pressure switch fitted to LOP Valve

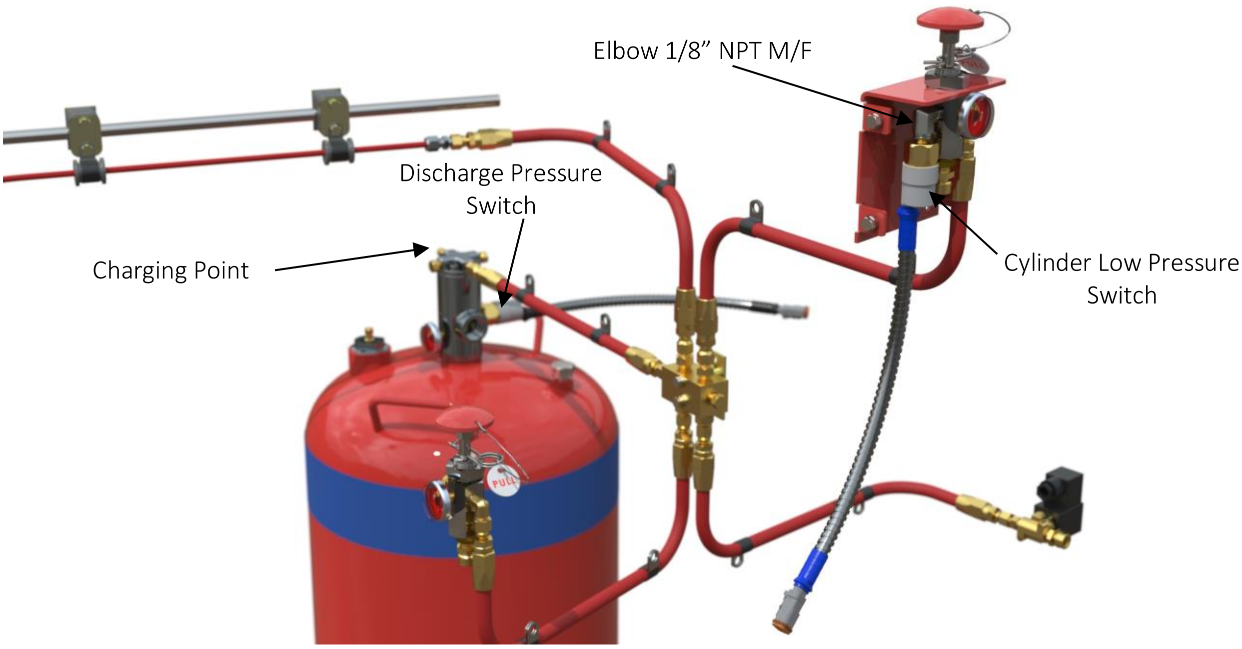


Figure 36 – Cylinder Low Pressure switch fitted to LOP Manual Actuator

Identification & Instruction Labels

PEFS F3N System identification and instruction labels are shown in the below table. Instruction signs are required to be located adjacent to each manual action point.

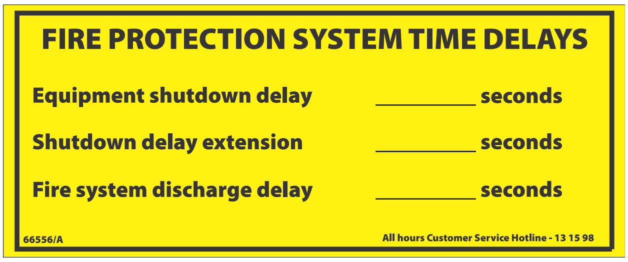
part number 66534

part number 66535

part number 66536

part number 66537

part number 66137



part number 66556

part number 66557

Table 12 - Identification & instruction labels

INSTALLATION

Recommended Tool List

The following tool list is provided as a guide only.

PEFS F3N Tools

Description	Part Number
Pressurising Rig	87033
Charging Adaptor	130632
Nozzle Cap Tool - Tee Handle	95003
Nozzle Cap Tool - Socket	95004
Over-Fill Tube F3N C23	36210
Over-Fill Tube F3N C30	36211
Over-Fill Tube F3N C45	36212
Over-Fill Tube F3N C65	36213
Over-Fill Tube F3N C106	36214
Over-Fill Tube O-ring	90127

Recommended Common Tools

Description
Tape measure (5m minimum)
Portable tube bender (to suit 12.7mm OD tube)
Flaring tool - 37° (to suit 12.7mm OD tube)
Hand / Drill type deburring tool 2-14mm
Angle grinder 100 mm
Drill (Heavy duty) - 12.7 mm chuck
Drill Set 1mm - 13mm x 0.5mm (high speed)
Socket set - metric 4mm - 19mm, A/F 3/16” - 15/16”
Spanner Set - metric 7mm - 22mm, A/F 1/4" - 1”
Adjustable Spanners 250mm & 450mm
Files - Round and Flat (medium bastard) 250mm
Hex Wrench set (Allen keys) Metric & Imperial
Portable drop saw
Hacksaw
Safety knife
Screwdriver set 13 Piece
Hammer - Ball Pein
Side cutters 250mm
Funnel and measuring jug
Digital scales
Pliers (combination) 225mm
Multigrips 250mm
Cable cutters
Lock-Out devices
Loctite 577 pipe thread sealant or Loctite 569 hydraulic thread sealant
Molykote 111 lubricant or equivalent silicon-based o-ring lubricant.
Loctite C5-A Anti-Seize Lubricant

Table 13 – Recommended Tool List

Installation Guidelines

The following guidelines are intended to assist you. They are not a complete set of "how to install" instructions as each installation is different and the requirements of each customer vary. This section is limited to an overview of the major considerations and parameters that effect the location and fitting of the PEFS F3N foam system equipment.

Precautions

Prior to commencing any installation activity, the following precautions shall be carried out as applicable:

(a) Inform the owner or agent that installation is to be carried out and expected duration of the equipment impairment.
(b) On equipment that is remotely monitored, advise the monitoring service provider where installation activities may cause a signal to be transmitted.
(c) "Lock-Out" the equipment to prevent its operation and movement whilst performing any installation activities in and around the equipment.

Brackets

Cylinder assemblies should be located away from the hazard area in an area with enough strength to support the weight of the cylinders and brackets.

Cylinders should be mounted in the vertical position and shall be secured using all the mounting points on both the base and back plate of the bracket. If horizontal mounting is required, the cylinder should be positioned so that its axis is transverse to the most encountered grade or slope which will be experienced by the equipment on which it is installed. For example, for haul trucks, which drive up and down inclines, the cylinders should be positioned at right angles to the direction of travel (i.e. across the vehicle). Conversely on a forestry vehicle which may travel from side to side on a slope, it is preferable to have the cylinder positioned in line with the direction or travel (i.e. along the length of the vehicle).

Cylinder brackets should be secured by bolting or welding to the equipment. Any bolting or welding must be in accordance with the OEM's requirements.

Cylinder Assemblies

Assemble siphon tube to valve and secure to cylinder. Place cylinders into the cylinder brackets and orientate so that valve outlet is facing desired direction. Where possible the cylinder should be positioned so that the pressure gauges are easily visible. Secure cylinders into bracket. Fit PEFS F3N main label onto cylinder located between bracket straps so that it is visible. Mark correct fill volume on label.

Never assume any cylinder assembly is empty. Bleed any residual pressure out of the cylinder assemblies. Pressure can be bled out of the cylinder via the Filler Plug:

- Depress the Schrader valve core fitted to the Filler Plug
- The Fill Plug has a groove cut into the thread that will allow pressure to escape as it is being removed – only unscrew the Filler Plug a couple of turns just until you can hear pressure being released. DO NOT FULLY UNSCREW THE FILLER PLUG until the gauge reads zero pressure and you can no longer hear and feel pressure being released from the cylinder.

Fit the Cylinder Discharge Pressure Switches as detailed in the "Pressure Switches" section of this manual.

Cylinder Filling

The cylinder assemblies can be filled via two methods. Table 5 - PEFS F3N cylinder specifications details correct water and foam concentrate volumes to be used for each cylinder size. When filling cylinders:

- Ensure correct Over-Fill Tube is being used for the size cylinder being filled
- Cylinders must only be filled with clean potable water (chloride ion content <150ppm)
- Only use the approved foam concentrate

1. Remove Filler Plug Assembly.
2. Filling by Scales:
    a. Remove Over-fill tube (if fitted) from filling port.
    b. Fill cylinder with water to required volume as per Table 5 - PEFS F3N cylinder specifications.
    c. Add complete contents of foam from the Filling Kit.
3. Filling by Over-fill tube (LOP valve must be fitted to cylinder in closed position):
    a. Ensure Over-fill tube is correctly seated in filling port.
    b. Add water to cylinder slowly until it initially over-flows. (Do not insert water supply hose below the bottom of the Over-fill tube.)
    c. Remove Over-fill tube from filling port.
    d. Add complete contents of foam from the Filling Kit.
4. Refit Filler Plug Assembly.

Cylinder Pressurising

Pressurise the cylinders with nitrogen. The nominal charging pressure is 1,700kPa @ 21°C however, as pressure varies with temperature, Table 14 - PEFS F3N cylinder charging pressure versus ambient temperature has been provided to assist in determining the correct charging pressure for the prevailing ambient temperature at the time the time of filling.

Ambient Temperature (°C)	Charge Pressure (kPa)
5	1602
10	1633
15	1663
21	1700
25	1725
30	1755
35	1786
40	1816
45	1847
50	1878

Table 14 - PEFS F3N cylinder charging pressure versus ambient temperature

The pressurising procedure in general consists of:

- Cap off all discharge ports to prevent solution loss in the event of an accidental discharge.
- Check to ensure that all electrical actuation devices have been isolated.
- Connect a regulated source of nitrogen through an approved charging rig to either:
    - the cylinder valve assembly charging point (refer Figure 15).
    - The charging point on one of the LOP manual actuators (refer Figure 28).
- Pressurise the system to the correct listed pressure – refer Table 14 above
- Check the needle position on the valve pressure indicator reads in the Green Zone
- Confirm the needle position on the in-line gauge (Rig) is the same.
- Hold pressure for over one minute and ensure the needle position remains steady. The pressure may need to be held for longer until it is fully equalised and the needle position remains steady.
- Shut off supply at the control valve and unscrew the charging adaptor (internal)
- Vent pressure from the charging rig prior to disconnecting adaptor then disconnect the pressure source.
- Check the system for any leaks. The following items need to be leak tested using liquid leak detection solution. Allow liquid leak detection solution to sit for a minimum of 5 minutes whilst inspecting for leaks.
    - Filler Plug Assembly.
    - Burst Disk.
    - All plugs and fittings on the Valve Assembly including the pressure gauge.
    - All actuation hose connections and actuators

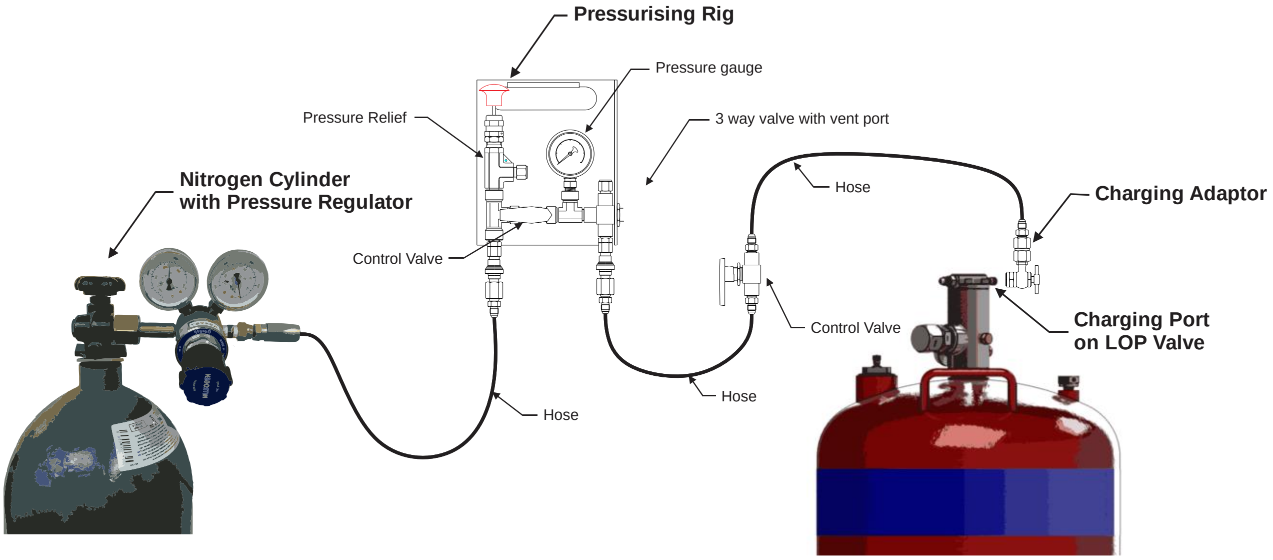


Figure 37 – Typical Pressurising Rig

More detailed instructions on the filling and pressurising of the cylinder assemblies can be found in the PEFS F3N Maintenance Manual.

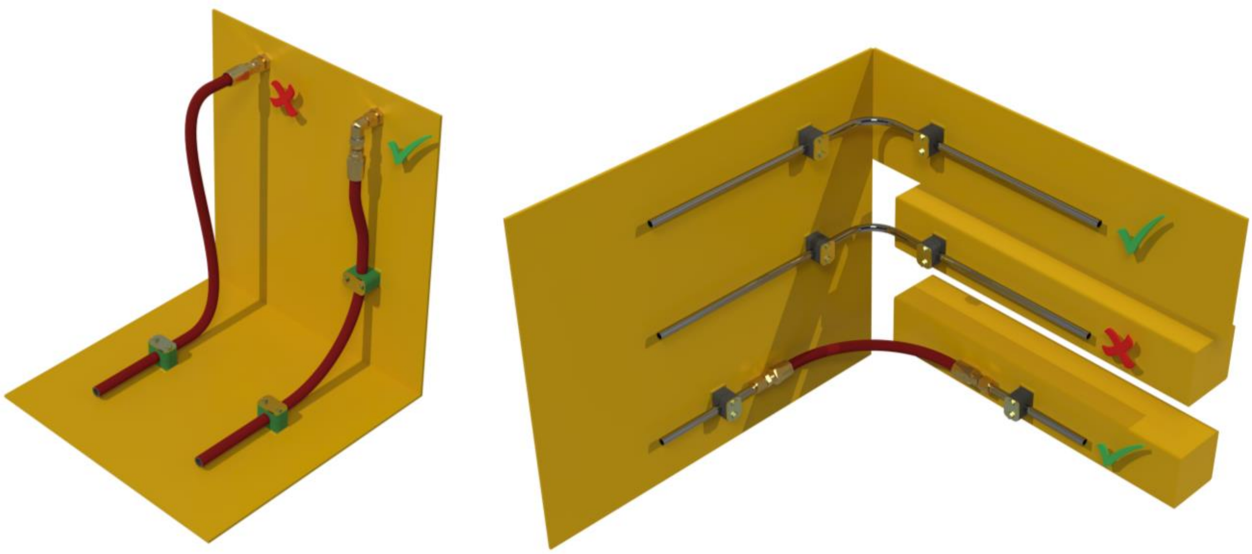
Hose & Tubing

Hose and tubing must be securely fastened using the clamping specified in Table 10 – PEFS F3N discharge hose & tube fittings and Table 11 – PEFS F3N pneumatic actuation hose and tube fittings. Ensure minimum clamp spacing is adhered to. A clamp block should be used on either side of each nozzle kit. Depending on the environmental conditions, Loctite C5-A Anti-Seize Lubricant may be used on the Clamp Block bolts to assist with future maintenance. P-Clips are NOT to be used to secure the stainless-steel tubing. Only Clamp Blocks are to be used to secure stainless steel tubing.

Stainless steel tubing must be cut to the required length with a tube cutter, its ends flared with an SAE 37° (JIC) flaring tool. The tubing should only be bent using a tube bender. The minimum bend radius is 50mm for ½" tube.

Hose must be installed without kinking or twists. Use of hose in fire hazard areas should be kept to a minimum. Blow air or nitrogen through the discharge lines and actuation lines prior to fitting nozzles and actuators.

Hose Assembly – Good Practice



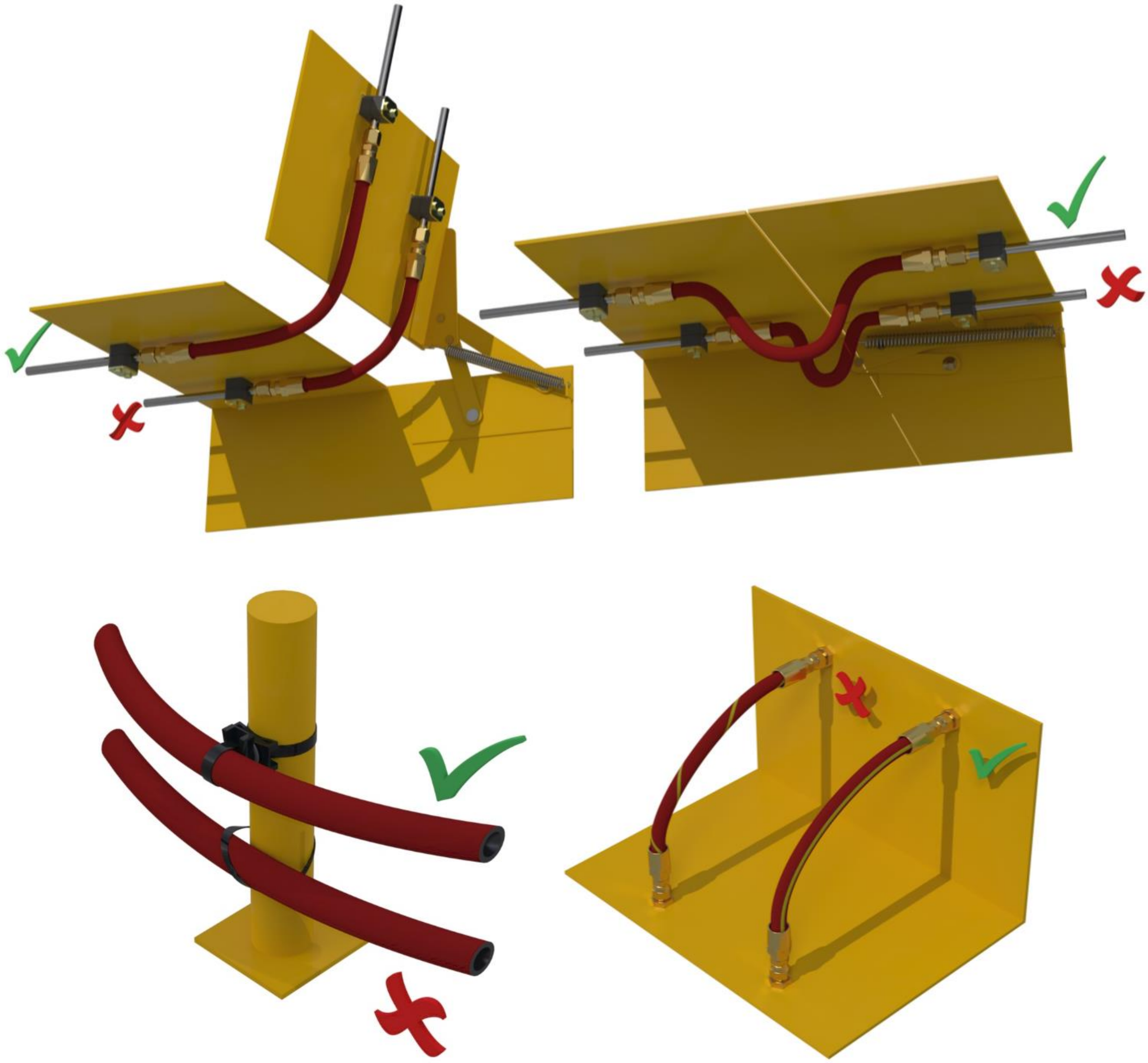


Table 15 – Hose Assembly – Good Practice

Nozzles

Position the nozzles to allow the discharge pattern to completely cover the hazard to be protected, e.g. fuel pumps, oil pumps, fuel & oil line and turbochargers. The nozzle discharge patterns should overlap slightly over the protected surface. Firmly secure nozzles to prevent them being knocked or vibrated out of alignment.

Only use double nozzle assemblies if there is a lack of suitable mounting points and if you have nozzles to spare. Suppression can be achieved with just a single nozzle.

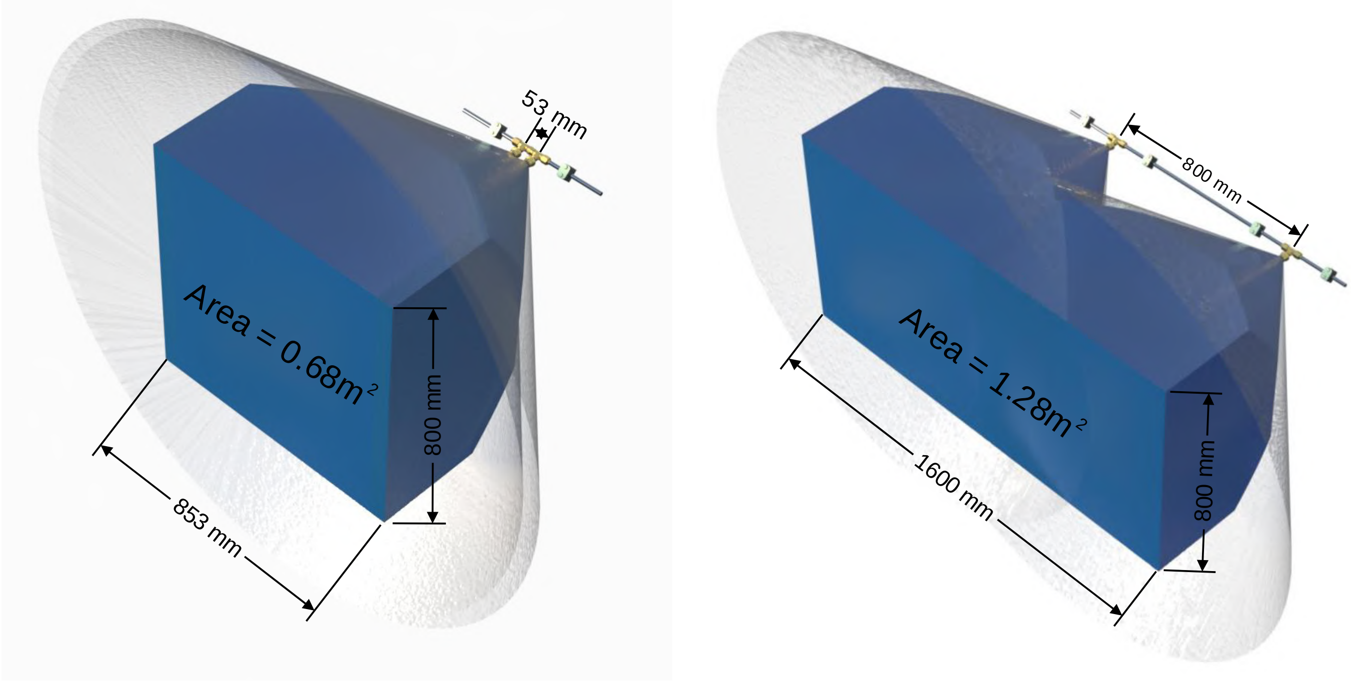


Figure 38 – Nozzle Spray Patterns – One Double versus Two Singles

In terms of hydraulic performance, a discharge system utilising single nozzles, will be better balanced when discharging and have greater pressure available at each nozzle.

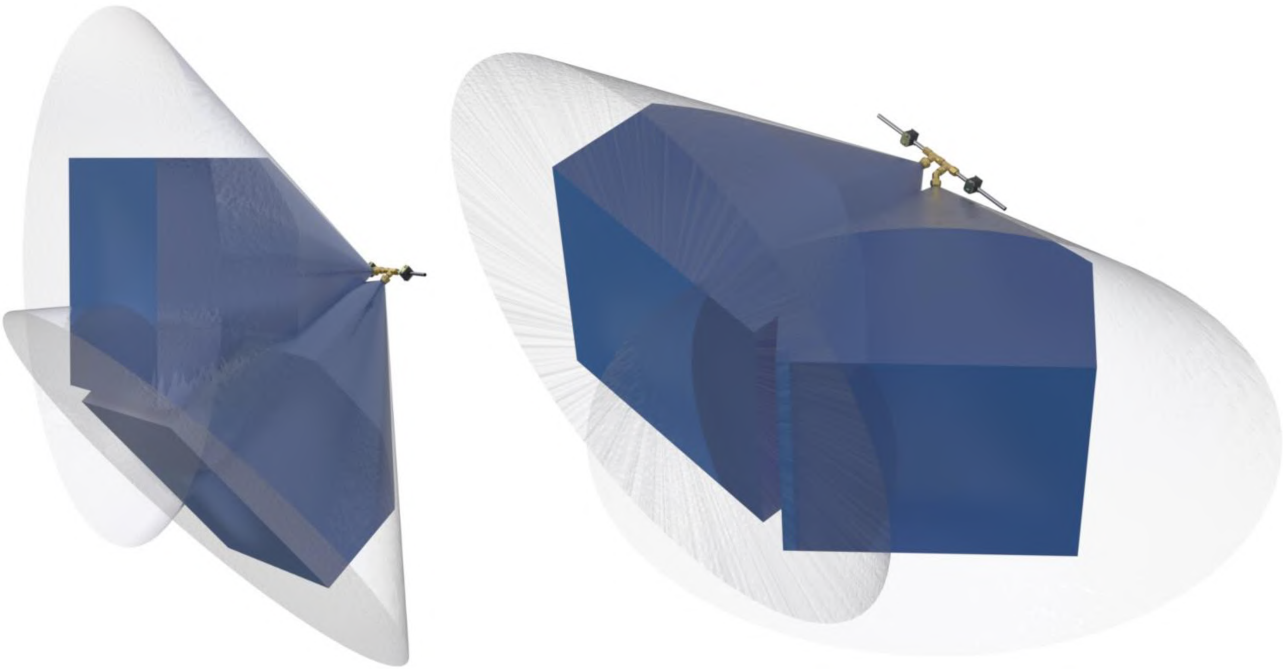


Figure 39 –Ideal Nozzle Coverage using Double 90°/90° and 90°/45° Nozzle Kits

Achieving the maximum coverage with single and/or double nozzle assemblies will more than likely require experimentation with different angles. When locating nozzles to provide the best possible coverage, you will need to measure all nozzle distances at different ranges, angles and orientations using a suitable measuring device such as a tape measure, straight rule, and or IR tool.

Step by Step Guide

Step 1

Decide where your first nozzle will be located by firstly checking for suitable mounting points and where your discharge hose & pipe can be routed. At this point it would be advisable to sketch out your plan. After deciding on the location of the first nozzle, measure the distance between the nozzle tip and the hazard area along the nozzle axis.

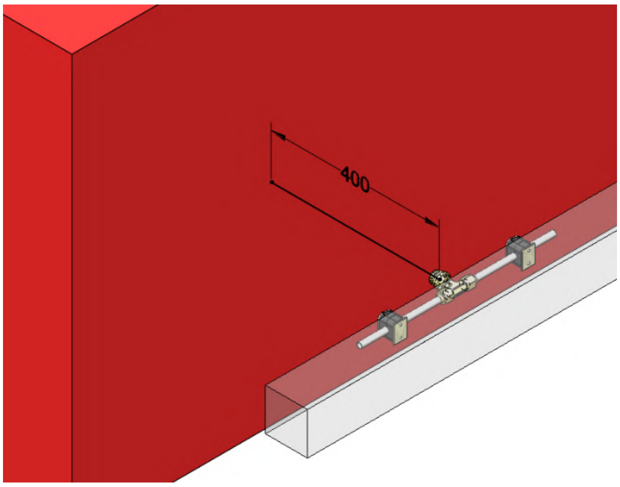


Figure 40

Step 2.

This distance will determine the nozzle coverage area. Always round down to the nearest increment and remember that the protection coverage is square (based on fire tests) and not on the actual cone spray shape produced by the nozzle.

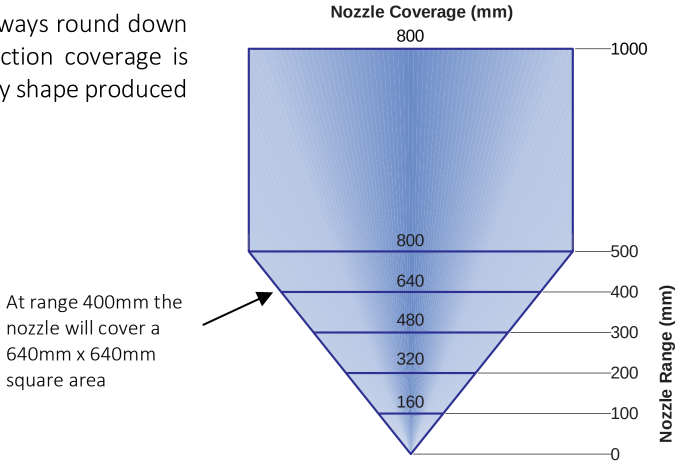


Figure 41

Step 3.

On the equipment, mark the position of the first nozzle. If your 2nd nozzle is going to be located on a different pipe route, then you should mark the hazard with the extents (edges) of the expected coverage area of the 1st nozzle spray - This will be covered further in Step 5.

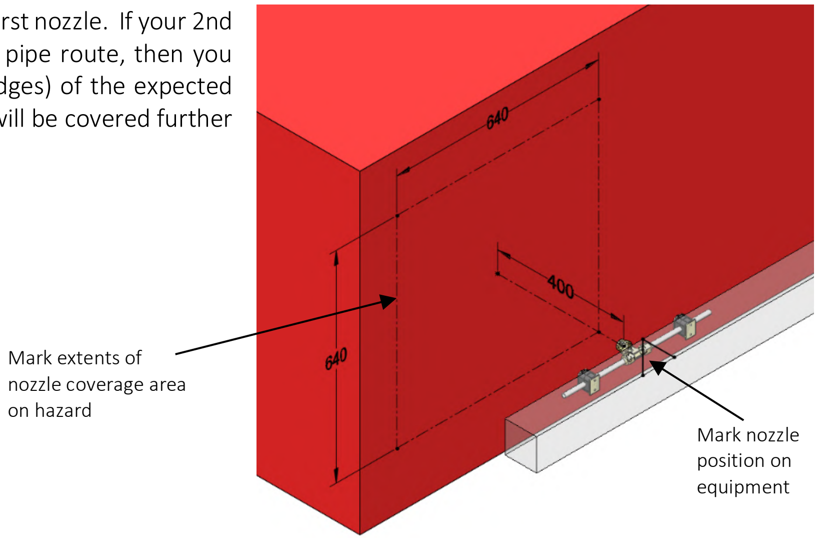


Figure 42

Step 4.

If your planned discharge pipe or hose route is located reasonably parallel to the hazard, you can use the expected coverage area measurement (In this example - 640mm) to mark the position of your next nozzle.

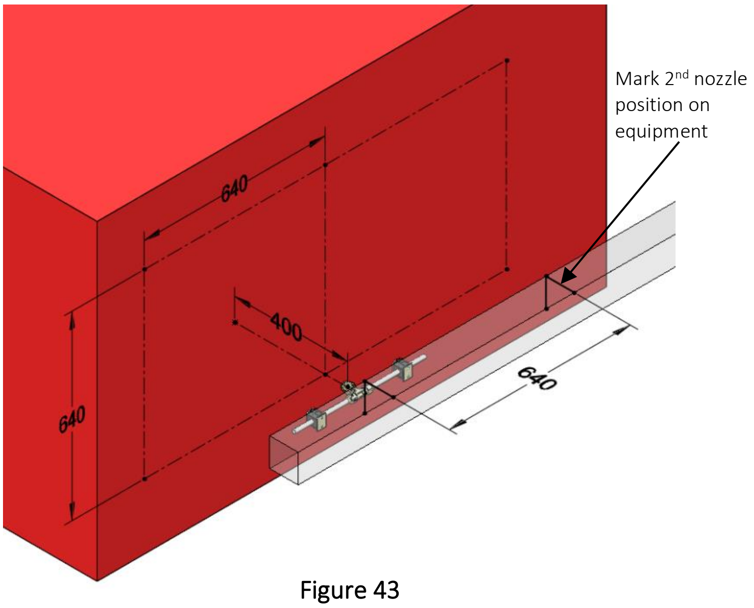


Figure 43

Step 5.

If your 2nd nozzle is going to be located on a different pipe route, or you are at the end of a parallel run, then you should mark the hazard with the extents (edges) of the expected coverage area of the last nozzle spray from the run. Mark the position of the next nozzle and measure the range and coverage distances to ensure that an overlap will occur with the last nozzle. Repeat the process for subsequent nozzles.

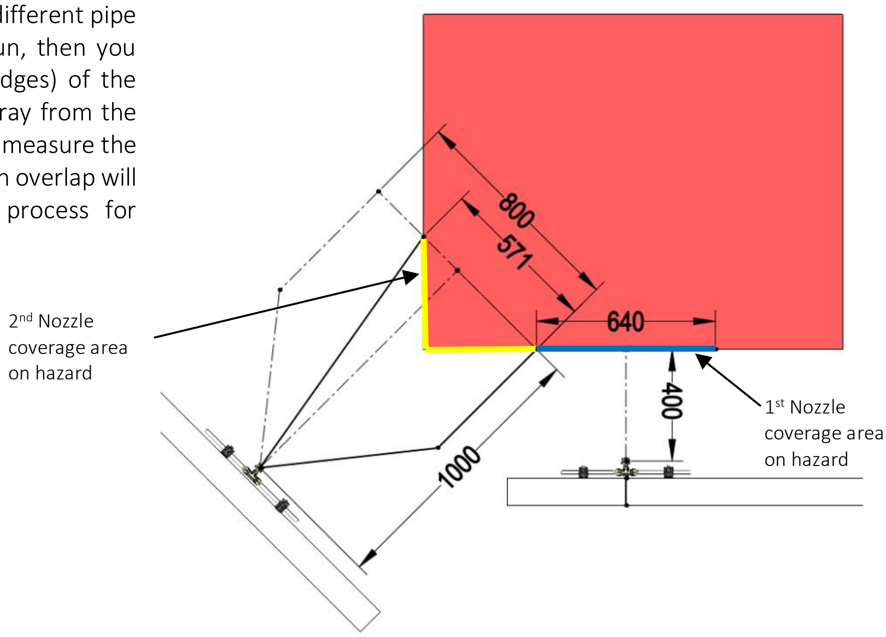


Figure 44

Step 6.

Repeat the previous steps for all of the remaining nozzles. Record all of the measurements on your sketch/plan.
Note: Remember to re-check all distances prior to fixing any nozzle brackets or clamps.

2D vs 3D

Remember that the area or component that you trying to protect is not normally a flat sided object. The nozzle spray pattern will likely distort relative to its position, orientation and the angle of projection. Overlapping should be achieved on all of the surfaces of the hazard or component that requires protection.

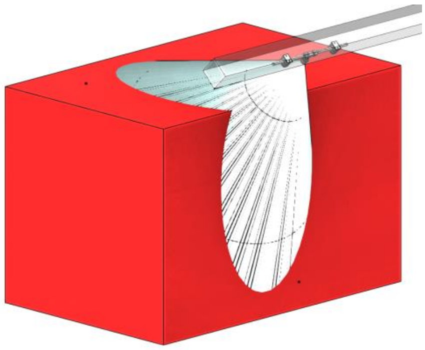


Figure 45

Obstructions

Where obstructions exist and or the lack of a suitable mounting point, some hazard areas or components may not be able to be fully protected with just one nozzle. Check for shadowing or coverage gaps particularly on potential ignition sources such as turbo chargers and exhaust manifolds.

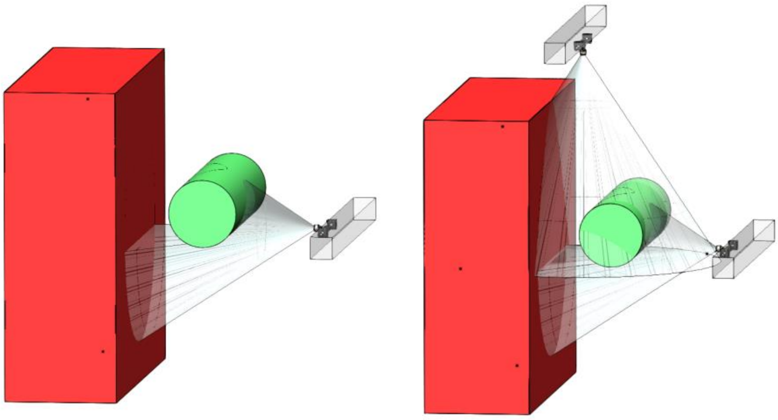


Figure 46

LOP Actuators

A LOP Manual actuator should be installed in reach of the machine operator and also at the point of egress into and out of the machine. Install actuator location signage at each manual actuator. The electrical LOP actuator can be installed anywhere within the actuation network but it is best installed as close as possible to the cylinder assemblies.

All LOP actuators and actuation lines must be manifolded together to make one complete actuation system. Actuation lines from LOP manual actuators should be segregated as far as practical. It is best practice to connect each LOP actuation line into the manifold block to provide a common point for testing. Install the manifold block as close to the cylinder/s as possible to keep the length of actuation hose from the manifold block to the cylinders as short as possible.

Leak test the LOP actuation network prior to making the final connection to the cylinder valve.

LOP Detection Tubing

LOP detection tubing should be located as close as possible above and/or around the fire hazards that are being protected by the PEFS F3**N** system. The LOP detection tubing should not be placed any further away from the fire hazard than the furthest nozzle. It also must be located so that it is not subjected to machine operating temperatures greater than 90°C.

LOP detection tubing must not be installed in close proximately to high heat sources such as turbochargers and exhaust systems. It is recommended prior to installing a PEFS F3**N** system to establish the typical operating temperatures reached around the fire hazard areas during normal machine operation. If this data is unavailable, Temperature Indicator Stickers or thermal data loggers can be used to survey the area prior to installation. This will let you know where you can and cannot run the LOP Detection Tubing.

Multiple lengths of LOP detection tubing may be used to cover more than one fire hazard area.

LOP manual actuators should not be installed at the end of any actuation line containing LOP Detection Tubing. This is to avoid the restriction of releasing the actuation pressure through the narrow LOP Detection Tubing which will only increase the delay of activating the LOP Valve.

LOP Detection Tubing must be securely mounted using pipe clips with a synthetic sheathed surface to avoid chafing. The distance between support clips should be 500mm or less. The LOP Detection Tubing has a minimum internal bend radius of 50mm.

Electrical Monitoring and Control Systems

For the installation of monitoring or control system panels and auxiliary electrical detectors and devices please refer to the relevant Chubb product manuals.

COMMISSIONING

Commissioning of PEFS F3N systems must be completed prior to placing the system in service to ensure that the system is installed correctly, meets design specifications and is fully functional. The commissioning checklist should be used to confirm that:

1. Installation requirements have been adhered to.
2. System components have been correctly installed and tested.

Discharge Testing

As part of the commissioning procedure a discharge test is to be performed. This can be performed by using water only. When using water only, please note that, the discharge time will be slightly shorter (approximately 10%) than when foam solution is used.

Where multiple actuation devices are installed, the furthest actuation device should be used to initiate the discharge test. All other actuators just need to be tested for correct functioning during commissioning.

System Design Baseline Data

At the completion of commissioning the following system design documentation needs to be recorded and provided to the owner of the equipment. It is recommended that this data be included and updated into the fire system specification for the equipment being protected and establishes the baseline data required for future service activities.

1. Hazard areas or items of equipment protected.
2. Location, number and capacity of agent containers.
3. Quantity of agent and pressure of each container.
4. Location and aiming point of each discharge nozzle.
5. Sketch or drawing of distribution system layout
6. Location and type of fire detectors (if fitted).
7. Location and type of manual and electric actuators.
8. Sketch or drawing of actuation system layout
9. Location and type of monitoring or fire control panels (if fitted).
10. Location of audible and visual detection and discharge alarms (if fitted).
11. Location and type of system labels.
12. Fire system interface, shutdowns and time delays (if fitted).

Service Tag

At the completion of commissioning a Service Tag (part no 60402) shall be attached to either the handle on the cylinder or to the pull pin on the remote manual actuator installed inside the vehicle cabin. The service tag is to be punched with a hole in the corresponding year and month.

PEFS F3N System Commissioning Report & Completion Certificate

The system has been designed and installed in accordance with Chubb Fire & Security's PEFS F3**N** Design, Installation & Commissioning Manual. Details of the system coverage and configuration are provided in the Owner's Manual for this machine.

Name of client ....

Equipment being protected (make/model) ....

Equipment identification/serial number ....

Fire hazard locations being protected ....

PEFS F3**N** cylinder serial numbers..

Discharge time ....

Equipment shutdown delay period...

Additional remarks: ....

....

....

System Commissioned By: ____________________ ____________________ __________

Name Signature Date

The customer acknowledges that the PEFS F3N system will assist in fire risk reduction in the areas identified in the fire system specification but will not prevent a fire occurring.

Customer: ____________________ ____________________ __________

Name Signature Date

Commissioning Checklist

Pneumatic LOP Detection and Actuation System

• Manual actuators installed at specified locations and easily accessible	☐
• Manual actuator piston moves freely	☐
• Actuator discharge ports fitted with foil nozzles and foil seal is in place	☐
• Pull pins fitted	☐
• Detectors fitted in fire hazard areas	☐
• Actuators, actuation and detection lines securely fastened and bracketed	☐
• Leak test of actuation lines completed	☐

Distribution System

• Distribution system provides protection of identified fire hazard areas	☐
• Distribution system configuration complies with installation limits (hose volume, size and number of nozzles per cylinder)	☐
• Joints, connections and supports are secure	☐
• Clear passage test completed prior to fitting nozzles	☐
• Correct nozzle type installed and correctly oriented	☐

Cylinder Assemblies

• Correct location, type, number, size and fill	☐
• Cylinders and brackets securely fastened and correctly orientated	☐
• Cylinder labels fitted and clearly visible	☐
• Pressure switches fitted (low pressure and discharge)	☐
• Cylinder burst discs installed	☐
• Valve piston moves freely	☐
• Cylinders pressurised	☐

System Configuration and Signage

• System configuration as per design	☐
• Signs and warning labels installed	☐

Discharge Test

• Confirm all nozzles discharge	☐
• Confirm nozzle discharge patterns cover the fire hazard area	☐
• Effective Discharge time recorded	_____sec.
• Cylinders refilled and recharged	☐