LIFECO-HFC227

ENGINEERED HFC-227ea

FIRE SUPPRESSION SYSTEMS

DESIGN, INSTALLATION, OPERATION AND MAINTENANCE MANUAL

LICHFIELD FIRE & SAFETY EQUIPMENT CO LTD

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UNITED KINGDOM

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FOREWORD

This manual LF227MAL-0001 is a comprehensive guide that comprises all the information that need to install, design and maintain fire suppression systems manufactured by LIFECO that uses HFC-227ea pressurized at 25 Bar @ 21ºC (360 psi @ 70ºF).

LIFECO-HFC227 Engineered total flooding fire suppression systems shall be designed, inspected, tested, maintained and recharged by qualified and trained personnel in accordance with requirement as follow:

- National Fire Protection Association 2001 (NFPA 2001) "Standard on Clean Agent Fire Extinguishing Systems".
- UL 2166 Standard for Halocarbon Clean Agent Extinguishing System Units.
- FM 5600 Approval Standard for Clean Agent Extinguishing Systems
- All guidelines, limitations etc included in this manual P/N: LF227MAL-0001.
- Local Authority having jurisdiction.

DENOTATIONS

System
The text "system" in this manual refers to the fire suppression components and does not cover fire alarm and detection system which may trigger an agent discharge.

Engineered
Hydraulic flow program used to predict the flow of HFC-227ea through a pipe network.

HFC-227ea
HFC-227ea is the ISO name for Heptafluoropropane.

The following written remarks are used throughout this manual. They are important to the safe use of the Component described in this manual.

WARNING:
The instructions indicated under these remarks, which if not correctly adhered, could result in severe injury or death.

CAUTION:
The instructions indicated under these remarks, which if not correctly adhered, could result in minor injury or death.

IMPORTANT

Any questions concerning the information presented in this manual should be addressed to: -

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1.0 INTRODUCTION

LIFECO-HFC227 Engineered Fire Suppression systems are Underwriters Laboratories Inc. (UL) listed and FM Approved. These systems are designed for total flooding in accordance with NFPA 2001 "Standard on Clean Agent Fire Extinguishing Systems" and UL 2166 Standard for Halocarbon Clean Agent Extinguishing System Units. In any situation not specifically covered by this manual, the application and installation of the system must meet the requirements of the standard as stated or Local Authority Having Jurisdiction.

1.1 HFC-227ea SUPPRESSION AGENT

LIFECO-HFC227 Engineered Fire Suppression systems uses HFC-227ea (Heptafluoropropane) which is a combination of carbon, fluorine and hydrogen (CF_3CHFCF_3) is also known as a Halocarbon Clean Fire Extinguishing Agent. HFC-227ea is a colorless liquified compressed gas stored in welded cylinders and is super-pressurized with dry nitrogen to 25bar @ 21ºC (360 psi @ 70ºF). LIFECO-HFC227 systems are ideal for total flooding applications to suppress Class A, B and C hazards. The main extinguishing mechanism of HFC-227ea is achieved by 80% heat absorption and 20% direct chemical means to extinguish fire. Furthermore, it does not deplete the ozone layer therefore, makes it an environmentally adequate product.

HFC-227ea is listed under;

i. National Fire Protection Agency (NFPA®) 2001, Standard on Clean Agent Fire Extinguishing Systems.

ii. Underwriters Laboratories (UL)

iii. FM (Factory Mutual) Approved

iv. U.S. Environmental Protection Agency

1.2 PHYSICAL PROPERTIES HFC-227ea

Table 1.0 HFC-227ea Physical Properties

Physical Properties	HFC-227ea
Chemical Structure / Empirical Formula	CF_3-CHF-CF_3
Chemical Name	Heptafluoropropane
Molecular Weight	170.03 g/mol
Boiling Point	-16.36ºC (2.4ºF)
Freezing Point	-131ºC (-204 ºF)
Critical Temperature	101.7ºC (214ºF)
Viscosity Liquid @ 25ºC	0.226 Cp
Vapor Pressure @ 25ºC	457.7 kPa (66.4 psi)
Relative Density (water=1)	1.46
LC50 (V/V)	> 80%
Ozone Depleting Potential	0

1.3 PRODUCT SPECIFICATIONS

HFC-227ea is of high purity and residue free, it shall comply with the specification shown in Table 2.0

Table 2.0 HFC-227ea Quality Requirements

Properties	Requirement
Purity	99.9 % (min)
Acidity	1 ppm (max)
Moisture	10 ppm (max)
Non-volatile Residue	0.01g / 100ml (max)

1.4 SAFETY CONSIDERATIONS

LIFECO-HFC227 Engineered Total Flooding Fire Suppression Systems shall not be used for fires which involving the following materials such as: (refer to NFPA 2001 Standard on Clean Agent Fire Extinguishing Systems 2018 Edition – Clause 1.4.2.2)

Table 3.0 – Limitation of Use

- Certain chemicals or mixtures of chemicals such as cellulose nitrate and gunpowder, which are capable of rapid oxidation in the absence of air.
- Reactive metals such as lithium, sodium, potassium, magnesium, titanium, zirconium, uranium and plutonium
- Metal hydrides
- Chemicals capable of undergoing auto-thermal decomposition such as certain organic peroxides and hydrazine.

Based on NFPA 2001, HFC-227ea concentration are specifies by “No Observable Adverse Effect Level” (NOAEL) and “Lowest Observed Adverse Effect Level” (LOAEL).

Note: NOAEL is the highest concentration that no adverse physiological or toxicological effect has been observed.
LOAEL is the lowest concentration, which an adverse physiological or toxicological effect

Table 4.0 HFC-227ea NOAEL and LOAEL Values

Description	Concentration (% v/v)
No Observable Adverse Effect Level (NOAEL)	9.0
Lowest Observed Adverse Effect Level (LOAEL)	10.5

WARNING

Do not stand directly in front of the discharge line as the high pressure discharged HFC-227ea from the nozzles can create noise loud enough to startle occupants. The high velocity discharge of this agent can be enough to dislodge objects located directly in the discharge path. Turbulence may be created in the enclosure which capable to move the lighter objects and unsecured paper. Direct contact with the vaporizing agent discharged from the nozzles will leave a strong chilling effect on objects and can cause frostbite burns to the skin. The liquid phase vaporizes rapidly when mixed with air and limits the chilling hazard to the immediate vicinity of the nozzle.

Although HFC-227ea is colorless, discharge in humid atmospheres may cause a reduction of visibility for a short time due to the condensation of water vapor.

WARNING

When HFC-227ea is discharged, the vaporizing HFC-227ea discharge mixture will have a significant cooling effect which could cause skin irritation. Unnecessary exposure of personnel either to the natural form of clean agent or to the products of decomposition shall be avoided.

Emergency Aid

Refer to the HFC-227ea SDS within Appendix A.

Consult: LICHFIELD FIRE & SAFETY EQUIPMENT CO LTD

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2.0 LIFECO-HFC227 SYSTEM COMPONENTS

LIFECO-HFC227 Engineered Systems are intended to be designed and installed to suppress fire within the limitation mentioned in this manual. The systems described in this manual are FM approved and Underwriters Laboratories (UL) Listed. It is compiled in accordance with UL 2166 Standard for Halocarbon Agent Extinguishing System Units.

2.1 LIFECO-HFC227 CYLINDER ASSEMBLY

The cylinder assembly comprises of a cylinder factory fitted with a valve and syphon tube, filled with HFC-227ea and super-pressurized with dry nitrogen to 25 Bar @ 21°C (360 psi @ 70°F).

Table 5.0 DOT Cylinders Dimensions & Fill Range

Size (L)	Part Number	Valve Size (in)	Height (mm), A	Height (mm), B	Cylinder Diameter (mm), C	Min Fill (kg)	Max Fill (kg)	Nominal Tare Weight (kg)
16.7	LF-16HFCD-25	1	653 (25.7”)	564 (22.2”)	228.6 (9”)	8.4	16.7	17.3
28.3	LF-28HFCD-25	1	954 (37.6”)	865 (34”)	228.6 (9”)	14.2	28.3	24.9
52	LF-52HFCD-25	2	721 (28.4”)	597 (23.5”)	406 (16”)	26.1	52	52.4
106	LF-106HFCD-25	2	1159 (45.6”)	1029 (40.5”)	406 (16”)	53.1	106	78.6
147	LF-147HFCD-25	2	1494 (58.8”)	1364 (53.7”)	406 (16”)	73.6	147	100.1
180	LF-180HFCD-25	2	1774 (69.8”)	1644 (64.7”)	406 (16”)	90.1	180	116.3
240	LF-240HFCD-25	2	1860 (73.2”)	1729 (68.1”)	462 (18.2”)	120.1	240	156.5
270	LF-270HFCD-25	3	1390(54.7”)	1227 (48.3”)	610 (24”)	135.1	270	200.9
369	LF-369HFCD-25	3	1734 (68.3”)	1569 (61.8”)	610 (24”)	184.6	369	241.3
453	LF-453HFCD-25	3	1595(62.8”)	1437 (56.6”)	762 (30”)	226.6	453	323.9

Table 5.0b ASME Cylinders Dimensions & Fill Range

Size (L)	Part Number	Valve Size (in)	Height (mm), A	Height (mm), B	Cylinder Diameter (mm), C	Min Fill (kg)	Max Fill (kg)	Nominal Tare Weight (kg)
52	LF-52HFCS-25	2	721 (28.4”)	597 (23.5”)	406 (16”)	26.1	52	52.4
106	LF-106HFCS-25	2	1159 (45.6”)	1029 (40.5”)	406 (16”)	53.1	106	78.6
147	LF-147HFCS-25	2	1494 (58.8”)	1364 (53.7”)	406 (16”)	73.6	147	100.1
180	LF-180HFCS-25	2	1774 (69.8”)	1644 (64.7”)	406 (16”)	90.1	180	116.3

Table 5.0c TPED Cylinders Dimensions & Fill Range

Size (L)	Part Number	Valve Size (in)	Height (mm), A	Height (mm), B	Cylinder Diameter (mm), C	Min Fill (kg)	Max Fill (kg)	Nominal Tare Weight (kg)
16.6	LF-16HFCT-25	1	653 (25.7”)	564 (22.2”)	228.6 (9”)	8.4	16.6	17.3
28.3	LF-28HFCT-25	1	954 (37.6”)	865 (34”)	228.6 (9”)	14.2	28.3	24.9
52	LF-52HFCT-25	2	970 (38.2”)	840 (33.1”)	324 (12.76”)	26.1	52	52.4
106	LF-106HFCT-25	2	1159 (45.6”)	1029 (40.5”)	406 (16”)	53.1	106	78.6
150	LF-150HFCT-25	2	1554 (61.2”)	1425 (56.1”)	406 (16”)	75.1	150	100.1
180	LF-180HFCT-25	2	1447 (57”)	1317 (51.8”)	462 (18.2”)	90.1	180	116.3
240	LF-240HFCT-25	2	1860 (73.2”)	1729 (68.1”)	462 (18.2”)	120.1	240	156.5
369	LF-369HFCT-25	3	1734 (68.3”)	1569 (61.8”)	610 (24”)	184.6	369	241.3
453	LF-453HFCT-25	3	1595(62.8”)	1437 (56.6”)	762 (30”)	226.6	453	323.9

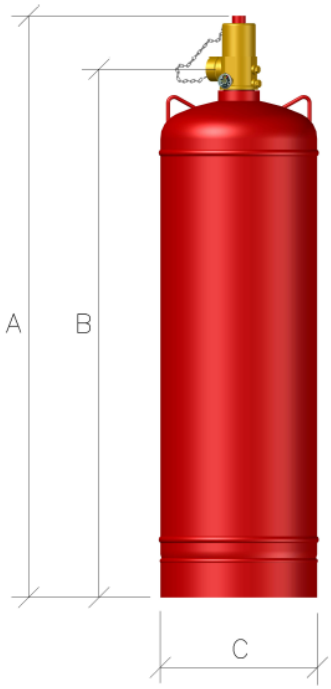


Figure 1 Cylinder Assembly

The filled and pressurized cylinder chosen location should protect against direct sunlight, mechanical, chemical or other types of damage. The suppression systems temperature limit from 0ºC (32ºF) to 50ºC (122ºF).

2.2 VALVE ASSEMBLY

These three types of valves operate (1 inch, 2 inch and 3 inch) by means of pressure differential piston. The valves incorporated with the features to enable it to be connected with removable electrical, manual and pneumatic actuator for actuation purpose.

Figure 2 Valve Assembly

Table 6.0 Discharge Valve Technical Information

Description	Valve Size		
Size	25mm (1 inch)	50mm (2 inch)	80mm (3 inch)
Part Number	LF-VA25	LF-VA50	LF-VA80
Outlet	1 inch BSPP	2 inch BSPP	3.5 inch – 12UN-2A
Material	Brass	Brass	Brass
Safety Disc Pressure	53.4 bar (774psi)		
Working Pressure	33.4 bar (484 psi)		
Gauge Port	1/8 inch NPT	1/8 inch NPT	1/8 inch NPT
Equivalent Length	6.10 m	10.67 m	25.91 m
Weight	3.3kg	7.8kg	16.8kg

2.3 PRESSURE GAUGE

There are two types of pressure gauge to be used in the LIFECO-HFC227 system namely:

1) Pressure gauge(Part Number: LF-PG21 / LF-PG22)
2) Pressure gauge complete with Contact Switch (Part Number: LF-PGLPS2),
   Pressure gauges with contact switch will give signal if pressure drops below 19.9 Bar (290psi).

Table 7.0 Pressure Gauge Technical Information

Description	Specification
Part Number	LF-PG21 (Miljoco) LF-PG22 (Keltron)
Body	Stainless Steel Case
Mechanical Gauge Materials	Stainless Steel Spiral Wound Bourdon Tube
Gauge Size	41 mm (1.6 inch)
Pressure Range	0 – 48.3 Bar (0 – 700 psi)
Std. Connection	1/8 inch NPT

Figure 3 Pressure Gauge

Table 8.0 Pressure Gauge complete with Contact Switch Technical Information

Description	Specification
Part Number	LF-PGLPS2
Body	Stainless Steel Case
Mechanical Gauge Materials	Stainless Steel Spiral Wound Bourdon Tube
Gauge Size	41 mm (1.6 inch)
Pressure Range	0 – 48.3 Bar (0 – 700 psi)
Std Output Cable	18 AWG type SXL wire
Std Connection	1/8 inch NPT
Approval	UL

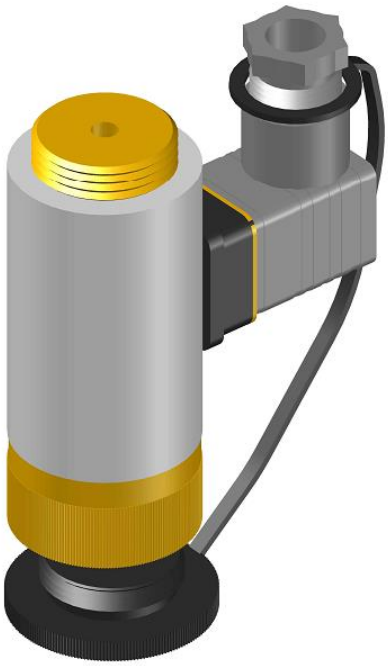
Figure 4 Pressure Gauge Complete With Contact Switch

2.4 REMOVABLE ELECTRICAL ACTUATOR c/w SUPERVISION SWITCH

This device incorporated with active detection switch and design to indicate proper placement of the electrical actuator. It is mount direct to discharge valve the body of the electrical actuator (between discharge valve and manual actuator). If the electrical actuator is not properly fitted or removed away from the discharge valve, it will trigger an audible and visual alarm on the control panel to alert the user or maintenance personnel. The control panel should be wired for active detection.

Table 9.0 Electrical Actuator Technical Information

Description	Specification
Part Number	LF-EASV-RS
Body Material	Mild Steel, Electroless Nickel Plated
Actuation Pin	Stainless Steel
Base nut	Brass CZ121
Retaining Clip	Beryllium Copper
Actuation Type	Latching
Reset Method	Via Reset Tool Supplied
Connection	1” BSPP (Brass End Fitting)
Nominal Voltage	24 Volts DC
Min Actuation Voltage	65% of nominal voltage
IP Rating	Tested to meet IP54
Nominal Current	0.25 A
Max Monitoring Current	25 mA
Manual Actuation Force	50N (11.24 lbf)
Nominal Pin Travel	4.4 mm (0.17 inch)
Electrical Connection	DIN 43 650-A / ISO 440 3PIN (4-pin PG 9.5mm Hirschmann DIN Plug Connector)
Back EMF Protection	Bridge Rectifier
Approval	EN12094-4, UL Recognized Component
Size	104mm (L) x 90mm (W) 4.09 inch(L) x 3.54 inch(W)
Weight	0.95kg



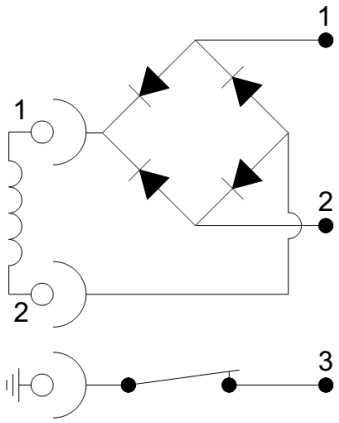


Figure 5 Electrical Actuator Complete with Supervision Switch & Wiring Diagram

2.5 SUPERVISED LATCHING SOLENOID ACTUATOR

This device is functioned the same as the electrical actuator complete with supervision switch and with the additional feature to be connected with conduit.

Table 10: Solenoid Actuator Technical Information

Description	Specification
Part Number	LF-EASV-LS
Body Material	Mild Steel, Electroless Nickel Plated
Actuation Pin	Stainless Steel
Base nut	Brass CZ121
Actuation Type	Latching
Reset Method	Via Reset Tool Supplied
Connection	1” BSPP (Brass End Fitting)
Nominal Voltage	24 Volts DC
Min Actuation Voltage	65% of nominal voltage
IP Rating	Tested to meet IP54
Nominal Current	0.5 A
Max Monitoring Current	<30 mA
Manual Actuation Force	50N (11.24 lbf)
Nominal Pin Travel	6.36 mm (0.25 inch)
Electrical Connection	1/2“ NPT Female Conduit with inbuilt bridge rectifier
Back EMF Protection	Bridge Rectifier
Approval	EN12094-4, UL Recognized Component
Size	124.2mm (L) x 88mm (W) 4.89 inch(L) x 3.46 inch(W)
Weight	1.0kg

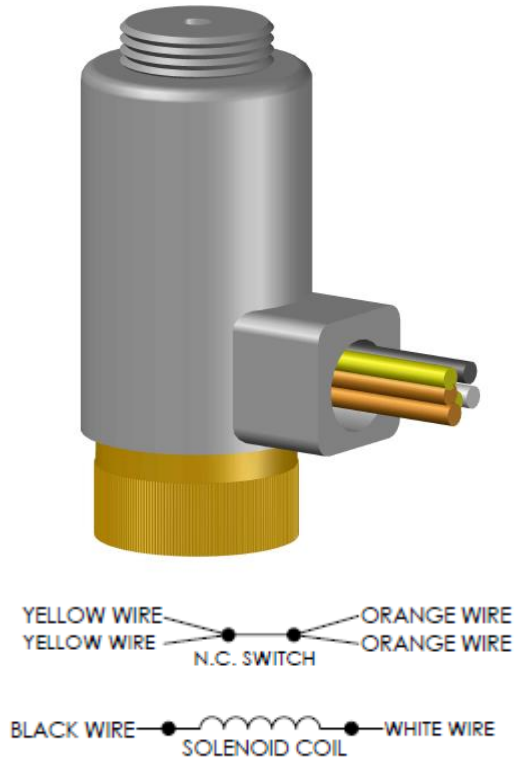


Figure 6 Electrical Actuator Complete with Supervision Switch & Wiring Diagram

2.6 MANUAL ACTUATOR

The manual actuator features a push button that used to depress the valve core and releases pressure from the cylinder discharge valve. This hardware is designed to be fitted on the top of the cylinder valve assembly or electrical actuator by hand tight only.

Figure 7 Manual Actuator

Table11.0 Manual Actuator Technical Information

Description	Specification
Part Number	LF-MA
Body	Brass C3604BD
Push Button	Brass C3604BD
Safety Pin	Stainless Steel
Piston Rod	Brass C3604BD
Overall Size	69 mm (L) x 41mm (Diameter) 2.72 inch (L) x 1.61 inch (Diameter)
Min Actuation Force	40 N (8.99 lbf)
Working temperature range	0ºC to 50ºC (0 ºF to 122 ºF)
Weight	0.42 kg

2.7 PNEUMATIC ACTUATOR

The pneumatic actuator features a pneumatically driven piston that used to depress the valve core and releases pressure from the cylinder discharge valve. This hardware is designed to be fitted on the top of the cylinder valve assembly by hand tight only. The pressure from the master cylinder is used to actuate the cylinder discharge valve of slave cylinder via flexible hose.

Figure 8 Pneumatic Actuator

Table 12.0 Pneumatic Actuator Technical Information

Description	Specification
Part Number	LF-PA
Body	Brass C3604BD
Actuation Pin	Brass C3604BD
Pneumatic Connection	1/4 inch NPT Female
Overall Size	48mm (L) x 41mm (Diameter) 1.89 inch (L) x 1.61 inch (Diameter)
Min Actuation Pressure	0.7 Bar (10.15 psi)
Working temperature range	0ºC to 50ºC (0 ºF to 122 ºF)
Weight	0.38 kg

2.8 1 inch and 2 inch DISCHARGE HOSE

The discharge hose is equipped with a female swivel fitting at the inlet and enable to connect the cylinders to the manifold in multiple cylinder arrangements. This facility has enables cylinder to be disconnected during maintenance without any effort to remove other manifold connection and pipework.

Table 13.0 1 inch Discharge Hose Technical Information

Description	Specification
Part Number	LF-DH25
Hose Material	Single braided high tensile steel wire oil resistant synthetic rubber core to EN 853 Type 1SN
Connection	1 inch NPT Male (Carbon steel) 1 inch BSPP Female 90º Swivel (Carbon steel)
Min Bend Radius	140mm (5.5 inch)
Max Working Pressure	90 Bar (1300 psi)
Temperature Range	-40ºC to + 100ºC (-40 ºF to 212 ºF)
Overall Size	405mm (L) x 92mm (W) 15.9 inch (L) x 3.6 inch (W)
Equivalent Length	3.14 m
Weight	1.25 kg

Figure 9

1 inch Discharge Hose

Table 14.0 2 inch Discharge Hose Technical Information

Description	Specification
Part Number	LF-DH50
Hose Material	Double braided high tensile steel wire oil resistant synthetic rubber core to EN 853 Type 2SN
Connection	2 inch NPT Male (Carbon steel) 2 inch BSPP Female 90º Swivel (Carbon steel)
Min Bend Radius	600mm (23.6 inch)
Max Working Pressure	90 Bar (1300 psi)
Temperature Range	-40ºC to + 100ºC (-40 ºF to 212 ºF)
Overall Size	530mm (L) x 155mm (W) 20.9 inch (L) x 6.1 inch (W)
Equivalent Length	5.36 m
Weight	5.05 kg

Figure 10

2 inch Discharge Hose

2.9 3 inch DISCHARGE HOSE

The discharge hose is used to connect the 3 inch cylinder discharge valve outlet and manifold.

Figure 11 3 inch Discharge Hose

Table 15.0 3 inch Discharge Hose Technical Information

Description	Specification
Part Number	LF-DH80
Hose Material	Double braid 304 stainless steel corrugated hoses
Connection	3 inch NPT Male 3 inch BSPP Female 90º Tube Bend
Min Bend Radius	750 mm (29.5 inch)
Max Working Pressure	35 Bar (508 psi)
Overall Size	530 mm (L) x 280 mm (W) 20.9 inch (L) x 11 inch (W)
Equivalent Length	15.85 m
Weight	6.0 kg

2.10 FLEXIBLE HOSE

The flexible hose is used to connect between the master cylinder valve port and slave cylinder pneumatic actuator and slave to slave cylinder pneumatic actuator. This flexible hose is act as a pressure connector.

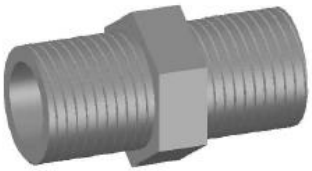
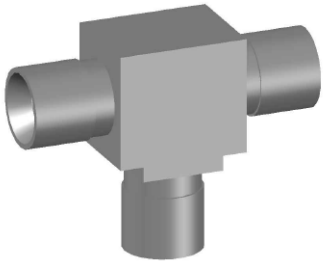
Figure 12 Flexible Hose

Table 16.0 Flexible Hose Technical Information

Description	Specification
Part Number	LF-FH710
Hose Material	Single braided high tensile steel wire oil resistant synthetic rubber core to EN 853 Type 1SN
Connection	1/4 inch BSPP Female Swivel
Min Bend Radius	38 mm (1-1/2 inch)
Max Working Pressure	225bar (3250psi)
Min. Burst Pressure	900 Bar (13000 psi)
Length	710 mm (28 inch)
Diameter	6.3 mm (1/4” inch)
Weight	0.25 kg

2.11 ACTUATION COMPONENTS

The following fittings are used for the actuation system and not limit to other acceptable fittings.

Picture	Part Number	Description	Technical Information
	LF-025N	¼" Nipple -Connect flexible hose (LF-FH710) to discharge valve assembly.	Material: Steel zinc passivated Connection: ¼" BSP x ¼" BSP Max. Working Pressure: 350Bar
	LF-025T	¼" Tee -Connect flexible hose (LF-FH710) to pneumatic actuator (LF-PA)	Material: Steel zinc passivated Connection: ¼" BSP x ¼" BSP x ¼" NPT Max. Working Pressure: 350Bar
	LF-025E	¼" Elbow -Connect flexible hose (LF-FH710) to pneumatic actuator (LF-PA)	Material: Steel zinc passivated Connection: ¼" BSP x ¼" NPT Max. Working Pressure: 350Bar

2.12 VALVE OUTLET ADAPTER

Valve outlet adaptor is available in various size and thread to connect cylinder valve outlet to the distribution pipe.

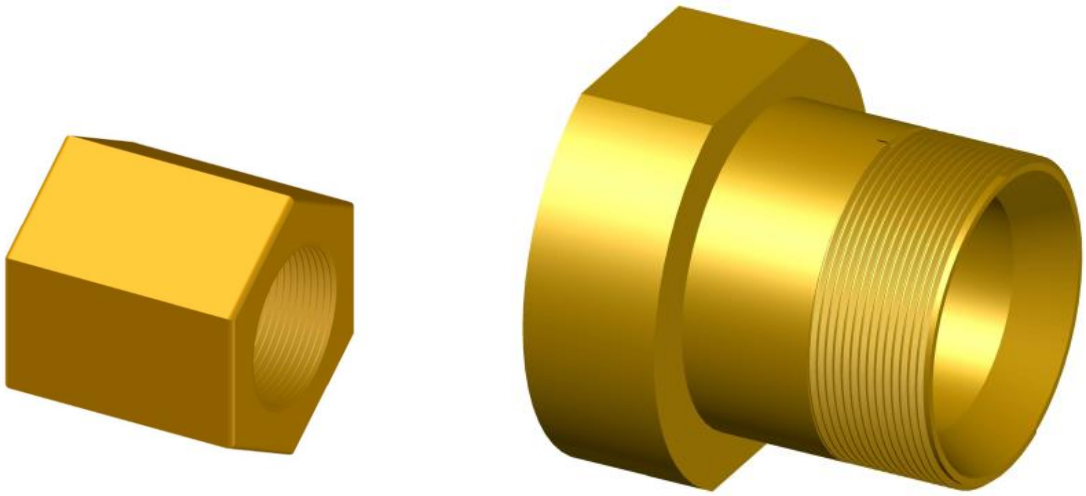


Figure 13 Valve Outlet Adapter

Description	Specification				
	1” NPT	2” NPT	3” NPT	3” BSP	3” Groove
Part Number	LF-1ADNPT	LF-2ADNPT	LF-3ADNPT	LF-3ADBSP	LF-3ADG
Material	Brass		Mild steel		
Connection	1”BSP X 1” NPT	2”BSP X 2” NPT	3.5 inch – 12UN X 3” NPT	3.5 inch – 12UN X 3” BSP	3.5 inch – 12UN X 3” Groove
Overall Size	68mm (L) x 45mm (W) 2.67 inch (L) x 1.77 inch (W)	79mm (L) x 76mm (W) 3.11 inch (L) x 3 inch (W)	108mm (L) x 118mm (W) 4.25 inch (L) x 4.65 inch (W)		

2.13 CHECK VALVES

Check Valves are hardware specially designed to be used when two or more cylinders are manifolded together with one common discharge piping configuration. The purpose of the check valve is to prevent loss of agent through manifold when any of the cylinder are not connected at the time of system discharge.

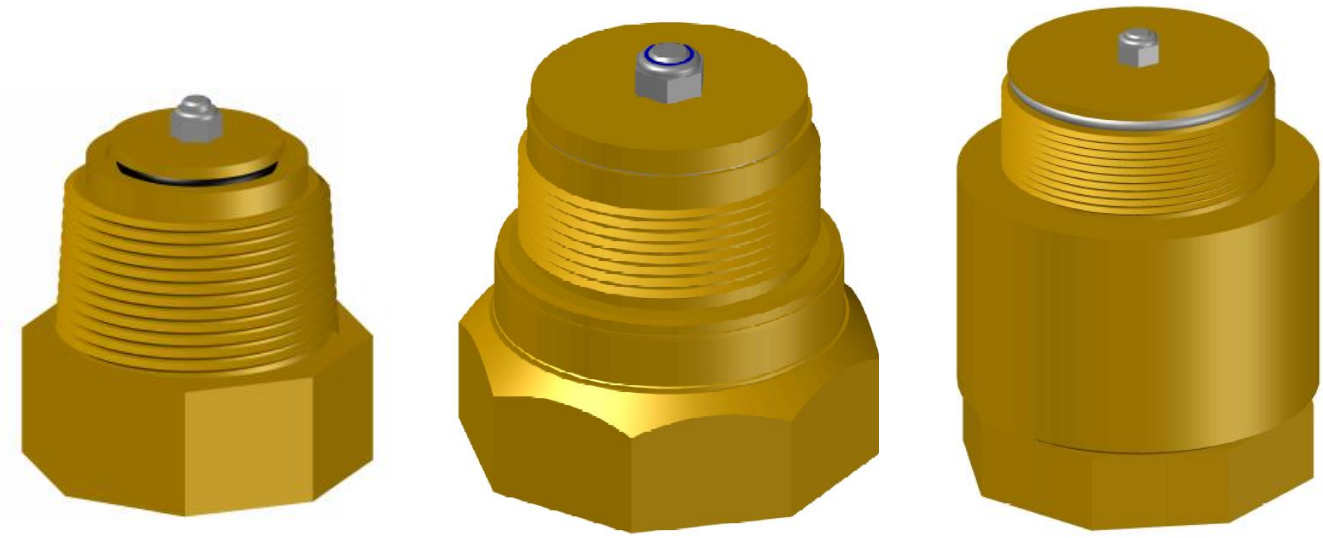


Figure 14 1 inch, 2 inch & 3 inch Check Valve

Table 17.0 1 inch, 2 inch & 3 inch Check Valve Technical Information

Description	Specification		
	25mm (1 inch)	50mm (2 inch)	80mm (3 inch)
Part Number	LF-CV25	LF-CV50	LF-CV80
Body	Brass C3604BD		
Spring	Stainless Steel 304		
Stem	Stainless Steel 304		
Seal	O- Ring (NBR)	Teflon	
Piston Plate	Brass C3604 BD		
Overall Size	73mm (L) x 55mm (W) 2.9 inch (L) x 2.2 inch (W)	92mm (L) x 76mm (W) 3.6 inch (L) x 3 inch (W)	150mm(L) x 112mm(W) 5.9inch(L) x 4.4inch(W)
Inlet Thread	1 inch NPT Female	2 inch NPT Female	3 inch NPT Female
Outlet Thread	1-1/2 inch NPT / BSPT Male	2 inch NPT / BSPT Male	3 inch NPT Male
Equivalent Length	0.4 m	6.7 m	15.85m
Weight	0.72 kg	1.00 kg	4.80 kg

2.14 DISCHARGE NOZZLES

Nozzles are devices through which the agent is discharged within the protected enclosure. Nozzles are made of brass with female threads.

Nozzles are available in 180º or 360º and available in size ½ inch, ¾ inch, 1 inch, 1 ¼ inch, 1 ½ inch and 2 inch. The nozzle can be installed either pendent or upright.

Figure 15 180º and 360º Discharge Nozzle

Table 18.0 Discharge Nozzle Technical Information

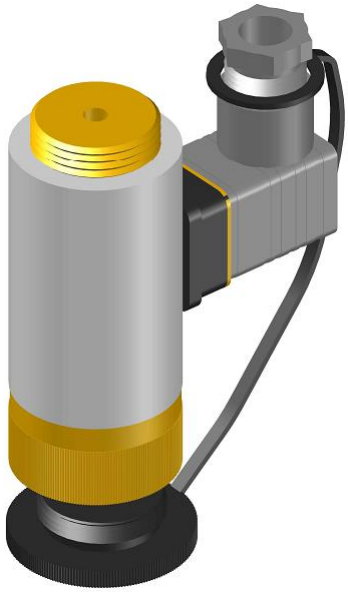
Nozzle Size	Part Number	Nozzle Type	Port	Nozzle Material	Type of Thread	Drill Size Range
15 mm (½ inch)	LF-180H-15	180º	7	Brass	NPT / BSPT	2.4 mm – 5.3 mm
20 mm (¾ inch)	LF-180H-20	180º	7	Brass	NPT / BSPT	3.1 mm – 7.0 mm
25 mm (1 inch)	LF-180H-25	180º	7	Brass	NPT / BSPT	3.9 mm – 9.0 mm
32 mm (1 ¼ inch)	LF-180H-32	180º	7	Brass	NPT / BSPT	5.2 mm – 11.8 mm
40 mm (1 ½ inch)	LF-180H-40	180º	7	Brass	NPT / BSPT	6.0 mm – 13.8 mm
50 mm (2 inch)	LF-180H-50	180º	7	Brass	NPT / BSPT	7.7 mm – 17.7 mm
15 mm (½ inch)	LF-360H-15	360º	8	Brass	NPT / BSPT	2.2 mm – 4.9 mm
20 mm (¾ inch)	LF-360H-20	360º	8	Brass	NPT / BSPT	2.9 mm – 6.6 mm
25 mm (1 inch)	LF-360H-25	360º	8	Brass	NPT / BSPT	3.7 mm – 8.5 mm
32 mm (1 ¼ inch)	LF-360H-32	360º	8	Brass	NPT / BSPT	4.8 mm – 11.0 mm
40 mm (1 ½ inch)	LF-360H-40	360º	8	Brass	NPT / BSPT	5.6 mm – 12.9 mm
50 mm (2 inch)	LF-360H-50	360º	8	Brass	NPT / BSPT	7.2 mm – 16.6 mm

2.15 ELECTRICAL ACTUATOR (BRIDGE RECTIFIER)

The electrical actuator is connect to the top of the cylinder discharge valve (place between valve and manual actuator) by hand tight only. The electrical actuator requires 24V DC for operation. **Approval: FM Only

Table 19.0 Electrical Actuator Technical Information

Description	Specification
Part Number	LF-EASV
Body Material	Mild Steel, Electroless Nickel Plated
Actuation Pin	Stainless Steel
Base nut	Brass CZ121
Retaining Clip	Beryllium Copper
Actuation Type	Latching
Reset Method	Via Reset Tool Supplied
Connection	1 inch BSPP (Brass End Fitting)
Nominal Voltage	24 Volts DC
Min Actuation Voltage	65% of nominal voltage
IP Rating	Tested to meet IP54
Nominal Current	0.25 A
Max Monitoring Current	25 mA
Manual Actuation Force	50N (11.24 lbf)
Nominal Pin Travel	4.4 mm (0.17 inch)
Electrical Connection	3-pin PG 9.5mm Hirschmann DIN Plug Connector)
Back EMF Protection	Bridge Rectifier
Approval	EN12094-4, UL Recognized Component
Size	104mm (L) x 90mm (W) 4.09 inch(L) x 3.54 inch(W)
Weight	0.95kg



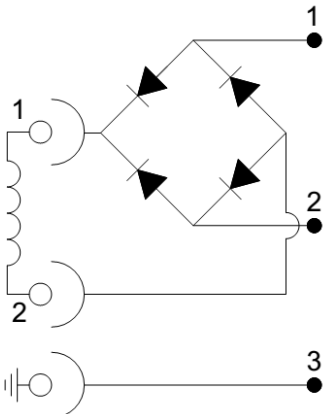


Figure 16 Electrical Actuator & Wiring Diagram

2.16 EXTERNAL MONITORING SWITCH

This device incorporated with push button switch and design to indicate proper placement of the electrical actuator. It is mount direct to the body of the electrical actuator. If the electrical actuator is not properly fitted or removed away from the discharge valve, it will trigger an audible and visual alarm on the control panel to alert the user or maintenance personnel for proper system functionality. **Approval: FM Only

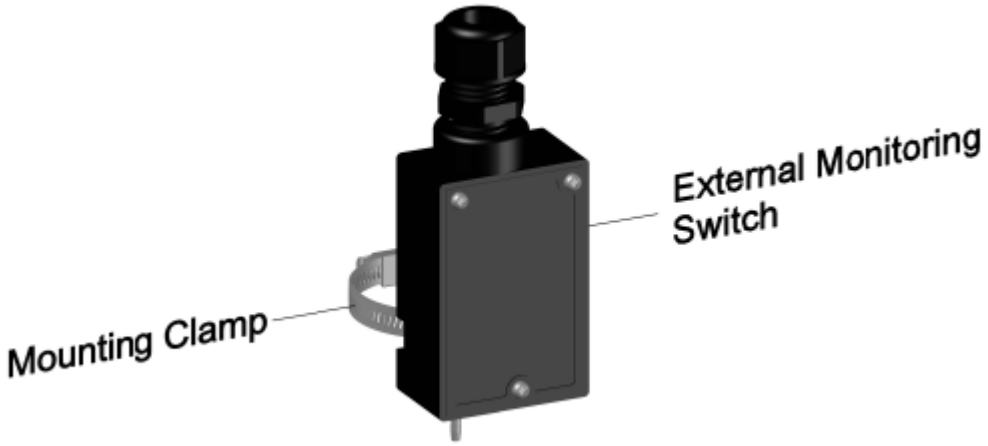


Figure 17 External Monitoring Switch

Table 20.0 External Monitoring Switch Technical Information

Description	Specification		
Part Number	LF-EMS1	LF-EMS2	LF-EMS3
Valve Size	1 inch	2 inch	3 inch
Housing Material	Unreinforced Nylon 6 Natural color Grade PA 1323 NC		
Housing Cover			
Electrical Connector	Pluggable terminal block		
Cable Gland Material	Nylon		
Cable Gland Thread	½ inch NPT		
Switch Plunger	Brass with Chrome Plating		
Switch Frame	Stainless Steel		
Operating Temperature	-10ºC to 70ºC (14ºF to 158ºF)		
Power Level	0.1A @ 28 VDC		

2.17 CYLINDER LABEL

The cylinder label consists of cylinder part number, cylinder serial number, filling date, tare weight, charge weight, gross weight, fill density and fill location.

HFC-227ea Label – UL / FM (Part No: LF-CL2)

Figure 18 Cylinder Label

2.18 CYLINDER BRACKET

The cylinder bracket assembly is made of mild steel. It consists of one Unistrut channel, M10 stud, wing nuts and half strap bracket. It is used to hold the cylinder securely in position against the reaction force of the LIFECO-HFC227 cylinder discharge. The cylinder must be mounted vertically and resting firmly on the floor. Cylinder required two set of bracket assemblies for this safety purpose.

Figure 19 Cylinder Bracket

Table 21.0 Cylinder Bracket Technical Information

Description	Specification
Material	Mild Steel
Paint	Epoxy Powder Coating (Black)
Mounting	Unistrut Channel

Part Number	Cylinder Size
LF- CB1	16.6L, 16.7L, 28.3L
LF- CB2	52L, 106L, 147L, 150L, 180L
LF- CB4	270L, 369L
LF- CB6	52L (TPED)
LF- CB3	180L (TPED), 240L
LF- CB5	453L

2.19 MANIFOLDS

Manifold is a steel pipework where contents of multiple cylinders discharged and direct connected to the appropriate pipe distribution system. The manifold does not include check valve.

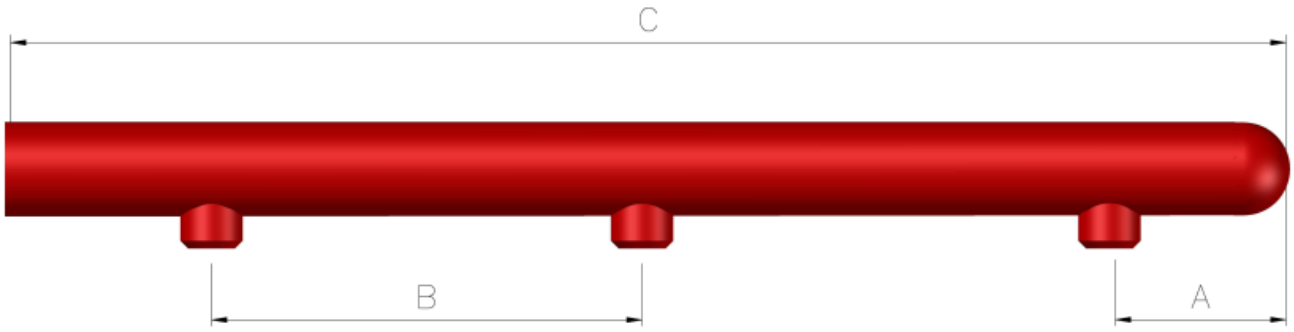


Figure 20 Manifold

Table 22.0 Manifold Technical Information

Description	No of Inlet	Inlet Thread Size	Part No.	Valve Size	Inlet to End Cap mm (A)	Inlet to inlet mm (B)	Overall Length mm (C)
65mm end manifold Assy	2	1 ½ in. NPT / BSPT	LF-2EMA65	1 inch	150(6”)	350(14”)	650(25.6”)
65mm end manifold Assy	3		LF-3EMA65	1 inch	150(6”)	350(14”)	1000(39.4”)
65mm end manifold Assy	4		LF-4EMA65	1 inch	150(6”)	350(14”)	1350(53.1”)
80mm end manifold Assy	2	2 in. NPT / BSPT	LF-2EMA80	2 inch	150(6”)	508(20”)	808(31.8”)
80mm end manifold Assy	3		LF-3EMA80	2 inch	150(6”)	508(20”)	1316(51.8”)
80mm end manifold Assy	4		LF-4EMA80	2 inch	150(6”)	508(20”)	1824(71.8”)
80mm end manifold Assy	5		LF-5EMA80	2 inch	150(6”)	508(20”)	2332(91.8”)
80mm end manifold Assy	6		LF-6EMA80	2 inch	150(6”)	508(20”)	2840(111.8”)
100mm end manifold Assy	2		LF-2EMA100	2 inch	150(6”)	508(20”)	808(31.8”)
100mm end manifold Assy	3		LF-3EMA100	2 inch	150(6”)	508(20”)	1316(51.8”)
100mm end manifold Assy	4		LF-4EMA100	2 inch	150(6”)	508(20”)	1824(71.8”)
100mm end manifold Assy	5		LF-5EMA100	2 inch	150(6”)	508(20”)	2332(91.8”)
100mm end manifold Assy	6		LF-6EMA100	2 inch	150(6”)	508(20”)	2840(111.8”)
100mm end manifold Assy	2	3 in. NPT / BSPT	LF-2EMA100B	3 inch	150(6”)	711(28”)	1011(40”)
100mm end manifold Assy	3		LF-3EMA100B	3 inch	150(6”)	711(28”)	1722(68”)
100mm end manifold Assy	4		LF-3EMA100B	3 inch	150(6”)	711(28”)	2433(96”)

Table 22.0 Manifold Technical Information (Continued)

Description	No of Inlet	Inlet Thread Size	Part No.	Valve Size	Inlet to End Cap mm (A)	Inlet to inlet mm (B)	Overall Length mm (C)
150mm end manifold Assy (Flange)	2	3 in. NPT / BSPT	LF-2EMA150	3 inch	150(6”)	711(28”)	1061(42”)
150mm end manifold Assy (Flange)	3		LF-3EMA150	3 inch	150(6”)	711(28”)	1772(70”)
150mm end manifold Assy (Flange)	4		LF-4EMA150	3 inch	150(6”)	711(28”)	2483(98”)
150mm end manifold Assy (Flange)	5		LF-5EMA150	3 inch	150(6”)	711(28”)	3192(126”)
150mm end manifold Assy (Flange)	6		LF-6EMA150	3 inch	150(6”)	711(28”)	3905(154”)

2.20 LIQUID LEVEL INDICATOR

Liquid level indicator is used to measure the level of the HFC-227ea fluid in 106L, 147L, 180L and 369L cylinders. The liquid level can be found by lifting the measuring tape from the tube and slowly pulled the tape until a magnetic interlock with the float is felt. The tape will remain in the lock position which it can read the measurement from the top of the housing. Weight of the HFC-227ea fluid in the cylinders then can be determined by converting the level measurement to the weight measurement by referring to the liquid level indicator chart (Appendix D). Cylinder with liquid level indicator can be easily determine the fluid weight without removing the cylinder from the fire suppression system. Optional item as per request.

Figure 21 Liquid level indicator

Table 23.0 Liquid level indicator Technical Information

Description	Specification	
Part Number	LF-LLI1	LF-LLI2
Thread	1.3125 – 12UN	
Material	Stainless Steel	
Length	885mm (34.85 inch)	1155mm (45.47 inch)
Working Temperature	0˚C - 50˚C	
Cylinder size	106L	147L, 180L, 369L

2.21 DISCHARGE PRESSURE SWITCH

The discharge pressure switch function by sending signal to a control panel during a system discharged. It activates by the agent pressure during discharged and can be reset manually by pushing the top stem after activation. To connect with actuation line hose, use a 1/4” BSP x 1/2" NPT adaptor (Part Number: LF-05ADNPT).

Table 24.0 Discharge Pressure Switch Technical Information

Description	Specification
Part Number	LF-DPS
Body Material	Brass
Cover Plate	Mild Steel
Connection	1/2” NPT
Switch Configuration	3PDT, Three Pole Double Throw
Minimum Actuation Pressure	4 bar (58psi)
Maximum Operating Pressure	60 bar (870psi)
Electrical Rating	10A 250VAC 15A 125VAC 3/4HP, 250VAC 1,2, or 3 phase
Overall Size	100 mm (L) x 92mm (W) x 123mm(H) 3.94 inch(L) x 3.62 inch(W) x 4.84 inch(H)

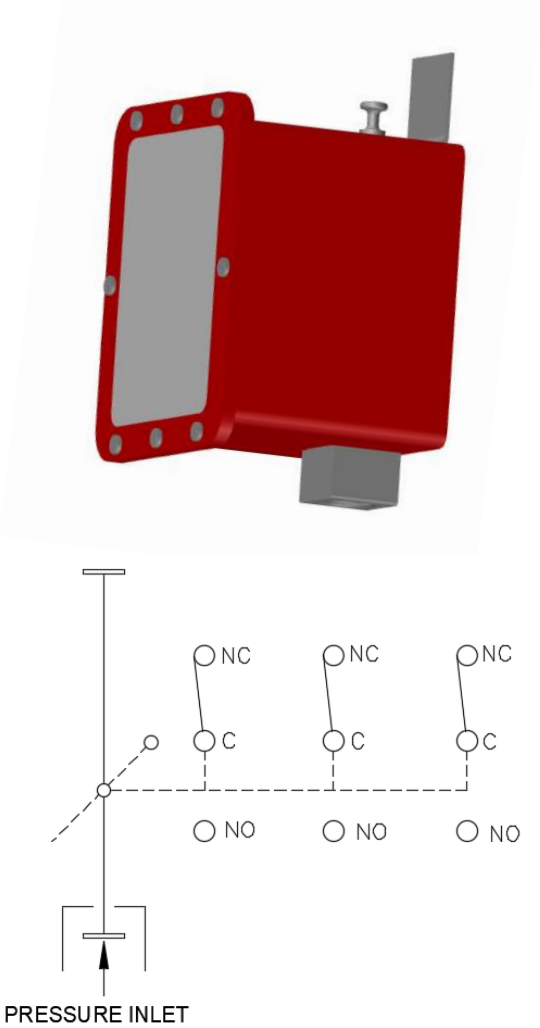


Figure 22 Discharge Pressure Switch & Wiring Diagram

3.0 SYSTEM DESIGN

The design section provides information to understand the characteristics of LIFECO-HFC227 especially its flow from storage cylinder to the piping network and discharge via nozzle. The systems shall be designed, installed and maintained in accordance with NFPA 2001 and all regulations mentioned in this manual.

3.1 ENCLOSURE DATA

The following are steps to follow to design a LIFECO-HFC227 Engineered Total Flooding Fire Suppression system:

3.1 It is important for system designer to conduct a hazard evaluation and survey of the enclosure that needs automatic suppression system protection to obtain specific information appertaining to the enclosure. In the absence of a site survey, the accurate information must be obtained from the drawing and customer confirmation prior to install.

3.2 Typical data and information such as enclosure volume, raised floor volume, above ceiling volume, Air conditioning and ventilation system configuration, smoke ventilator system and other related characteristic of the enclosure can be crucial to assist the LIFECO-HFC227 system designer to calculate and design to appropriate requirement.

3.3 Based on the hazard class fire (Class A, B & C), the design concentration by volume will be assigned. (Refer to Table 25.0)

3.4 The minimum and maximum ambient temperatures within the protected space. (Hazard enclosure temperature will affect the agent quantity required. The higher the enclosure temperature, the less HFC-227ea agent is required. Conversely, the lower the enclosure temperature, the more HFC-227ea agent is required.

3.5 Calculating HFC-227ea agent quantity shall require the net protected volume of the enclosure multiply by the design concentration at minimum ambient temperature.

3.6 The extinguishing requirements per volume of protected space are shown in Table 26.0 for various level of concentration.

When the system is discharged into a complete enclosure, normal gaps under doorways shall not affect system working performance. If there are openings in the protected volume, they must be sealed. Doors, air conditioner duct vents and dampers should be shut down prior to the time of discharge. Sufficient time must be allowed for the dampers to close before system discharge.

3.2 LIFECO-HFC227 DESIGN CONCENTRATIONS

Table 25.0 – LIFECO-HFC227 Fire Suppression Minimum Design Concentration Tested to UL2166

Hazard	HFC-227ea minimum design concentration, % v/v
Class A	6.7%
Class B (Commercial heptane fuel)	8.7%
Class C	7.0%

The minimum requirements for total flooding clean agent fire extinguishing systems are contained in NFPA 2001 Standard on Clean Agent Fire Extinguishing Systems. For Class C hazards, section 5.4.2.5 of the current 2018 Edition of NFPA 2001 requires that the minimum design concentration for Class C hazards shall be the minimum extinguishing concentration (MEC) for Class A fuels times a safety factor of 1.35 (5.2 x 1.35 = 7.0%).

The minimum design concentration for Class A surface fire hazard shall be determined by the minimum extinguishing concentration (MEC) for Class A times a safety factor of 1.2 or MEC for Heptane, whichever is greater. Hence, the minimum design concentration for Class A fire is 6.7%.
Note: According to Table A.5.4.2.1 indicated in NFPA 2001, cup burner extinguishing concentration of 6.7% for HFC-227ea for commercial heptane fuel.

The minimum design concentration for a class B fuel hazard shall be the extinguishing concentration times a safety factor of 1.3. (6.7 x 1.30 = 8.7%) based on the UL 2166 total flooding test program.

Table 26.0 – HFC-227ea Total Flooding Quantity (SI Units)

Temp t (°C)	Specific Vapor Volume S (m^3/kg)	Weight requirements of Hazard Volume W/V (kg/m^3), Design Concentration (% by volume)						
		6	7	8	9	10	11	12
-5	0.1241	0.5142	0.6064	0.7005	0.7987	0.8951	0.9957	1.0985
0	0.1268	0.5034	0.5936	0.6858	0.7800	0.8763	0.9748	1.0755
5	0.1294	0.4932	0.5816	0.6719	0.7642	0.8586	0.9550	1.0537
10	0.1320	0.4834	0.5700	0.6585	0.7490	0.8414	0.9360	1.0327
15	0.1347	0.4740	0.5589	0.6457	0.7344	0.8251	0.9178	1.0126
20	0.1373	0.4650	0.5483	0.6335	0.7205	0.8094	0.9004	0.9934
25	0.1399	0.4564	0.5382	0.6217	0.7071	0.7944	0.8837	0.9750
30	0.1425	0.4481	0.5284	0.6104	0.6943	0.7800	0.8676	0.9573
35	0.1450	0.4401	0.5190	0.5996	0.6819	0.7661	0.8522	0.9402
40	0.1476	0.4324	0.5099	0.5891	0.6701	0.7528	0.8374	0.9230
45	0.1502	0.4250	0.5012	0.5790	0.6586	0.7399	0.8230	0.9080
50	0.1527	0.4180	0.4929	0.5694	0.6476	0.7276	0.8093	0.8929
55	0.1553	0.4111	0.4847	0.5600	0.6369	0.7156	0.7960	0.8782

This information was taken from **NFPA 2001: 2018 Edition under Annex A**, Table A.5.5.1 (j) HFC-227ea Total Flooding Quantity (SI Units)[a].

W/V [agent weight requirements (kg/m^3)] = kilograms required per cubic meter of protected volume to produce indicated concentration at specified temperature.

$$W = \frac{V}{S} \times \left(\frac{C}{100 - C} \right)$$

t [temperature (°C)] = the design temperature in the hazard area

S [specific volume (m3/kg)] = specific volume of HFC-227ea vapor can be approximated by the formula:

S = 0.1269 + 0.0005*t, where t = temperature (°C)

C [Concentration (%)] = volumetric concentration of HFC-227ea in air at the temperature indicated.

The quantity of HFC-227ea agent designed shall be corrected to compensate for ambient pressure that vary more than 11 percent (equivalent to approximately 3000ft (915m) of elevation change) from standard sea level pressure. The corrected agent quantity is calculated by multiplying the calculated weight, W by the elevation correction factor. (See Table 27.0)

Table 27.0 Atmospheric Correction Factor

Altitude	Enclosure Pressure	Atmospheric Correction Factor
-3000ft (-0.92km)	16.25psi (840mm Hg)	1.11
-2000ft (-0.61km)	15.71psi (812mm Hg)	1.07
-1000ft (-0.30km)	15.23psi (787mm Hg)	1.04
0ft (0.00km)	14.70psi (760mm Hg)	1.00
1,000ft (0.30km)	14.18psi (733mm Hg)	0.96
2,000ft (0.61km)	13.64psi (705mm Hg)	0.93
3,000ft (0.91km)	13.12psi (678mm Hg)	0.89
4,000ft (1.22km)	12.58psi (650mm Hg)	0.86
5,000ft (1.52km)	12.04psi (622mm Hg)	0.82
6,000ft (1.83km)	11.53psi (596mm Hg)	0.78
7,000ft (2.13km)	11.03psi (570mm Hg)	0.75
8,000ft (2.45km)	10.64psi (550mm Hg)	0.72
9,000ft (2.74km)	10.22psi (528mm Hg)	0.69
10,000ft (3.05km)	9.77psi (505mm Hg)	0.66

3.3 LIFECO-HFC227 AGENT CALCULATION EQUATION

The quantity of agent required for hazard protection can be calculated from the equation below:

$W = (V/S) \times (C/100-C) \times EC$

Where,

W = Weight of agent required (kg)

V = Volume of the protected enclosure (m^3)

EC = Elevation Correction

C = Design Concentration of Agent Required

S = Specific Vapor Volume (m^3/kg)

= 0.1269 + 0.0005T

T = Design Temperature in the Hazard Area ^oC.

3.4 ENGINEERED SYSTEMS

The flow of HFC-227ea through the piping is a complex two-phase mixture of liquid and vapor. The characteristics of the mixture will vary with its composition. Hence, when it comes to contact with the pipe walls, the friction reduces the density of the mixture resulting in a non-linear pressure drop and increase in flow velocity. Furthermore, there is a potential for separation of this mixture. Proper designed pipe network will maintain the turbulent flow. However, if the pipe diameter selected is too large for the design flowrate, the tendency for these two phases may go for separation leading to two possible discharges of liquid and vapor or layering of the two phases. Hence, it is vital to proper sizing the piping in order to keep the HFC-227ea agent flow turbulence sufficient to prevent so called phase separation. The analysis of the flow process can be made by the use of LIFECO-UK Clean Agent Flow Calculation Software v4.00 (HFC-227ea) for predicting the two-phase flow of HFC-227ea and nitrogen through a pipe network from storage cylinder to the discharge nozzle developed by Jensen Hughes, Inc.

The calculation software requires the designer to input the information of the protected enclosure to calculate the required pipe sizes, nozzle sizes, nozzle drill sizes, average nozzle pressure and discharge time as well. Due to the system design calculation is important and critical to the success of the suppression system, hence, only trained designers are allowed to perform system calculations and these are conducted in house or by authorized suppliers. The system design shall be within the listed limitations.

Note: The calculation method has been investigated for specific types of fittings, types of pipe and pipe inside diameter. When the specified limitations are not maintained there is the risk that the system will not supply the required quantity of extinguishing agent.

3.5 PIPE & FLOW LIMITATIONS

The Hydraulic Flow Calculation Software will select the pipe sizes for each section in the piping network based on the HFC-227ea flowrate for each section. However, the pipe sizes also can be input manually into the program if desired. The selected pipe sizes must fall within the minimum and maximum range of flowrate as shown in general guideline in Table 28.0.

Table 28.0 Minimum and Maximum Flow Rate Guidelines

Nominal Pipe Size mm (in)	Flow Rate Range		Type of Pipe
	Lb./s	kg/s	
15 (1/2)	1.00 -3.00	0.454 – 1.361	Schedule 40
20 (3/4)	2.00 – 5.50	0.907 – 2.495	Schedule 40
25 (1)	3.50 – 8.50	1.588 – 3.855	Schedule 40
32 (1 -1/4)	6.00 – 12.50	2.722 – 5.670	Schedule 40
40 (1-1/2)	9.00 – 20.00	4.082 – 9.072	Schedule 40
50 (2)	14.00 – 30.00	6.350 – 13.610	Schedule 40
65 (2-1/2)	20.00 – 55.00	9.072 – 24.950	Schedule 40
80 (3)	30.00 – 99.00	13.610 – 44.920	Schedule 40
100 (4)	55.00 – 125.00	24.950 – 56.700	Schedule 40
125 (5)	90.00 – 200.00	40.820 – 90.720	Schedule 40
150 (6)	120.00 – 300.00	54.430 -136.10	Schedule 40

This guideline table is applied for the schedule 40 pipe and acts as an approximate only. An actual hydraulic calculation must be performed to confirm both pipe sizes and the feasibility of the piping network.

Table 29.0 Hydraulic Flow Calculation Program Limitation

Description	Program Parameters
Fill Density	0.5 kg/l – 1.0 kg/l (31.2 to 62.4 lb/ft^3)
Discharge Time Interval	6 – 10 seconds
Maximum Percent Agent in Pipe	100 %
Minimum Nozzle Orifice Area to Pipe Ratio	15%
Maximum Nozzle Orifice Area to Pipe Ratio	80%
Minimum Average Nozzle Pressure	6.9 Bar (100 psi)
Maximum Arrival Time Imbalance	1.02 second
Maximum Run-out Time Imbalance	2.3 seconds
Minimum Percent Agent in Pipe Before First Tee	7.4 %
Bull Tee Split	50:50 (Min); 25:75 (Max)
Side Tee Split	90:10 (Min); 65:35 (Max)

When the above conditions are not met, the computer screen displays a warning. It is then up to the designer to correct them.

3.6 TEE LIMITATIONS

To maintain the turbulent flow in piping and predictable flow characteristics at tee splits, certain guidelines relating to tee orientation must be taken into consideration. The exit branches of the tees must be in the horizontal plane. There are two type of tee used for this system, bull tee and side tee.

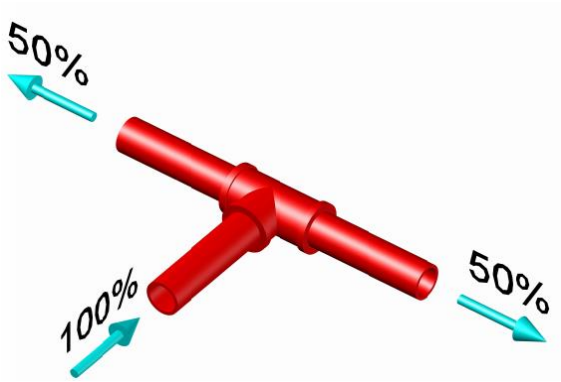


Figure 24 Minimum Bull Tee Imbalance

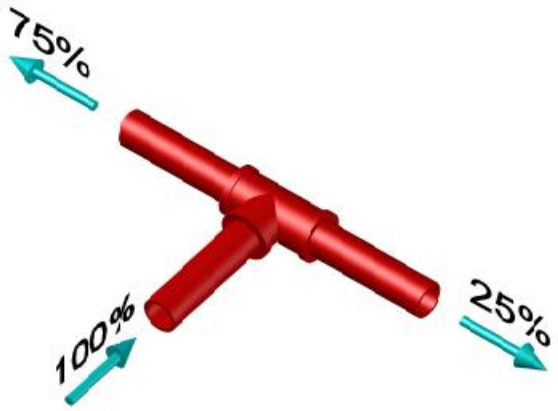


Figure 25 Maximum Bull Tee Imbalance

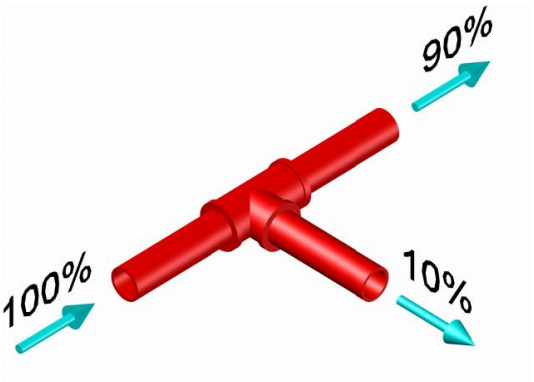


Figure 26 Minimum Side Tee Imbalance

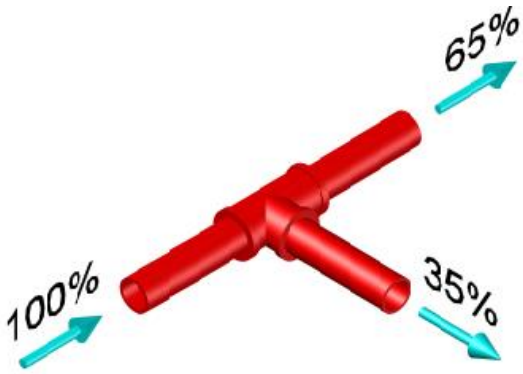


Figure 27 Maximum Side Tee Imbalance

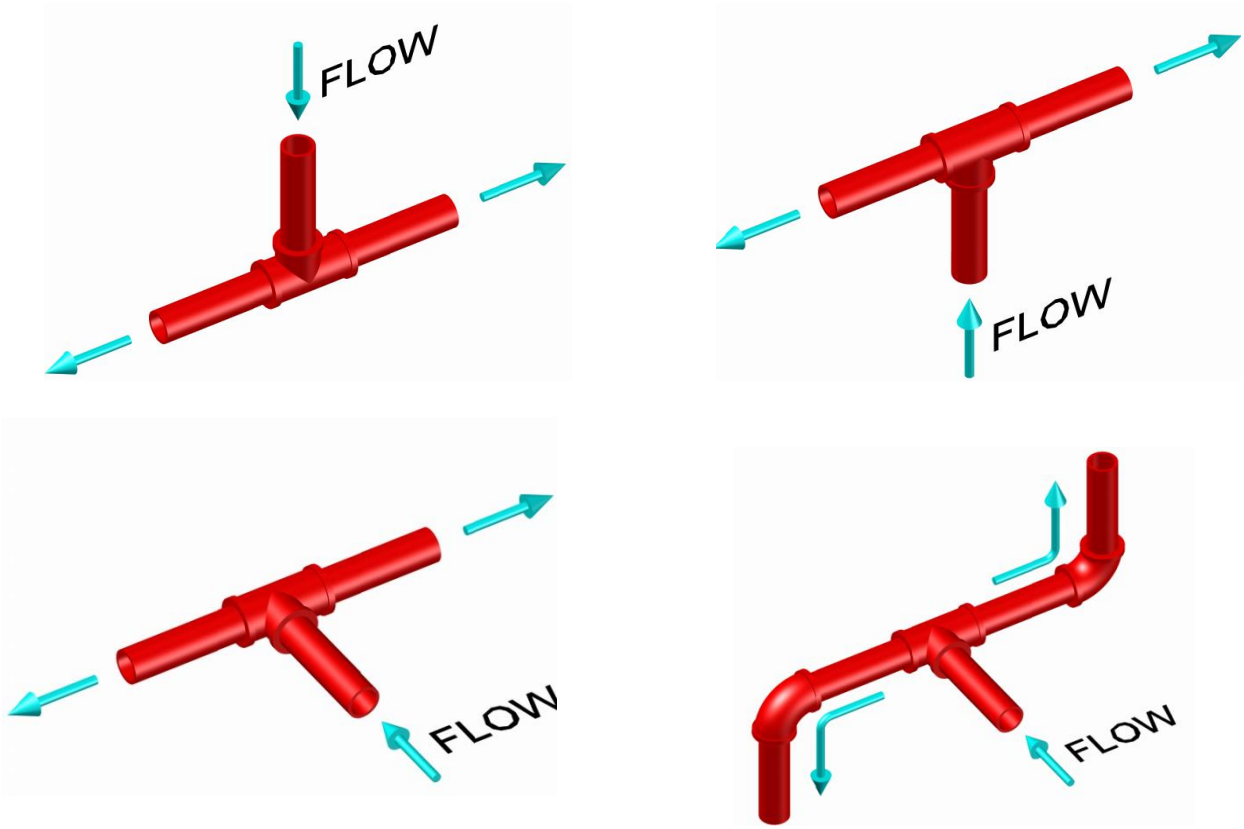


Figure 28 Correct Bull Tee Splits Orientation

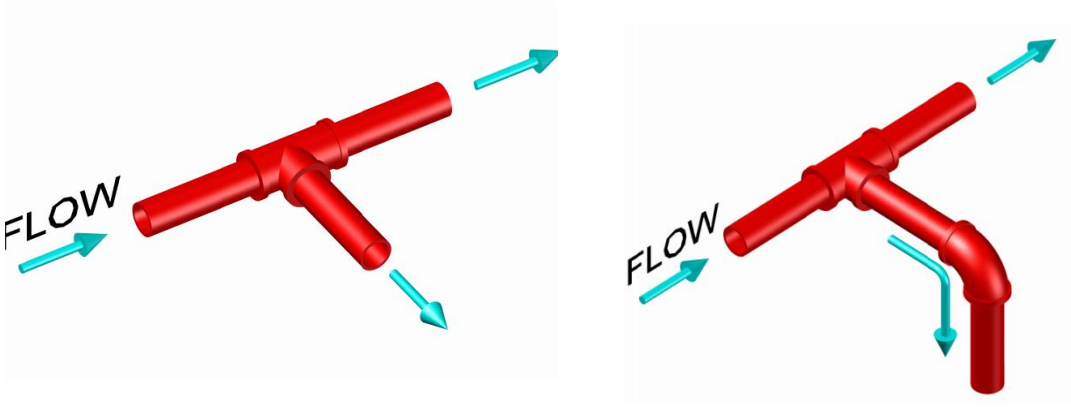


Figure 29 Correct Side Tee Splits Orientation

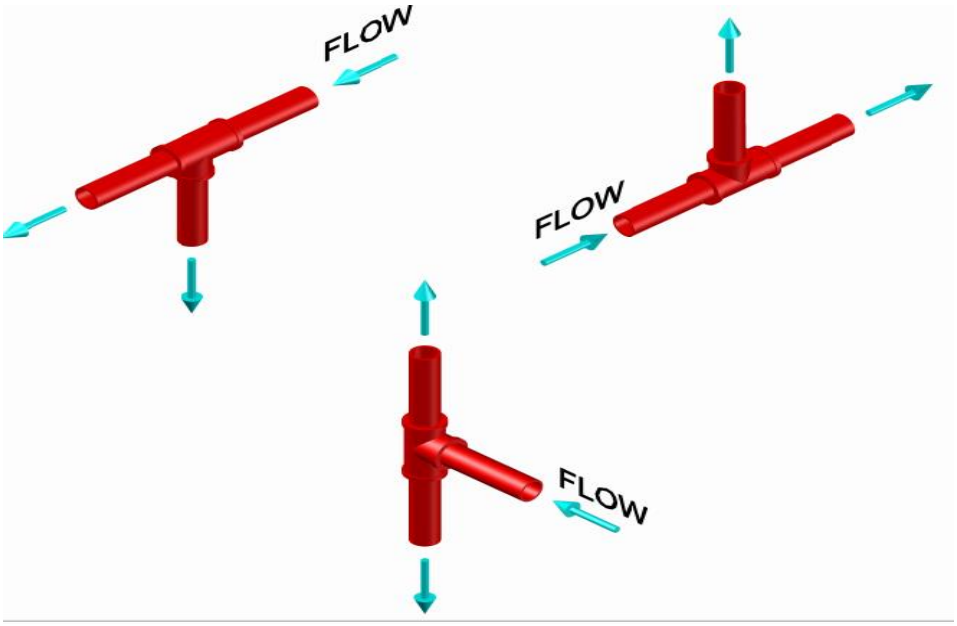


Figure 30 Incorrect Side Tee Splits Orientation

Table 30 Equivalent Length for Pipe Fittings

Nominal Size mm (in)	90° Elbow		45° Elbow		Through Tee		Side Tee		Union	
	ft	m	ft	m	ft	m	ft	m	ft	m
15 (1/2)	1.6	0.52	0.7	0.24	0.9	0.30	3.2	1.04	0.4	0.12
20 (3/4)	2.0	0.67	0.9	0.30	1.3	0.42	4.2	1.37	0.5	0.15
25 (1)	2.6	0.85	1.2	0.40	1.7	0.55	5.3	1.74	0.6	0.18
32 (1-1/4)	3.4	1.13	1.6	0.52	2.1	0.70	7.0	2.29	0.7	0.24
40 (1-1/2)	4.0	1.31	1.7	0.61	2.5	0.82	8.0	2.65	0.8	0.27
50 (2)	5.1	1.68	2.4	0.79	3.2	1.06	10.4	3.41	1.1	0.37
65 (2-1/2)	6.1	2.01	1.5	0.94	3.8	1.25	12.4	4.08	1.3	0.43
80 (3)	7.6	2.50	3.5	1.16	4.7	1.55	15.4	5.06	1.7	0.55
100 (4)	10.0	3.26	4.6	1.52	6.1	2.01	20.2	6.64	2.2	0.73
125 (5)	12.4	4.08	5.9	1.92	7.8	2.56	25.5	8.35	2.8	0.91
150 (6)	15.0	4.94	7.1	2.32	9.4	3.08	30.5	10.00	3.3	1.07

Table 31 Valve Equivalent Lengths

Valve Size (in)	Valve Equivalent Length (m)
1	6.096
2	10.668
3	25.91

3.7 DISCHARGE TIME

The discharge time is defined as the average liquid discharge time through all nozzles in the system. The maximum discharge time limit of 10 seconds is specified in NFPA 2001.

3.8 AGENT STORAGE CYLINDER

HFC-227ea shall be stored in approved cylinders to retain specific amount of liquified compressed gas at ambient temperature. The cylinders shall be filled within the range of fill density permitted (Refer to Table 5.0) and super-pressurized to 25 Bar @ 21ºC (360 psi at 70ºF).

The filled cylinders shall be allowed to be located within or outside the protected hazard enclosure. However, they shall not be placed where they can be rendered inoperable due to exposure to direct sunlight, chemicals, mechanicals and bad weather condition (temperature other than the operating temperature range of 0ºC to 50ºC (32ºF to 122ºF). The hydraulic flow calculations assume an agent temperature of 21ºC (70ºF). **When the storage temperature varies by ± 5.5ºC (42ºF) from the normal ambient temperature, there is the risk that the system will not supply the designated quantity of extinguishing agent.**

3.9 MANIFOLDS / PIPING

Manifold is used to reduce the amount of piping when designing a modular system. For a multiple cylinder system or main and reserve system arrangement, all cylinders are connected to the same manifold or pipe must be the same size and filled with same agent weight and fill density. Cylinder must be placed in a single row. Discharge hoses or pipe and check valve must be use at each manifold inlet. A connected reserve may be employed to provide as a secondary supply of agent.

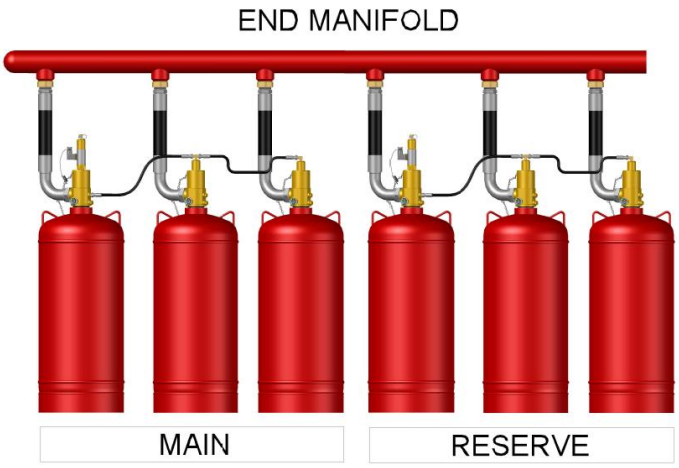


Figure 31 Main and Reserve (End Manifold)

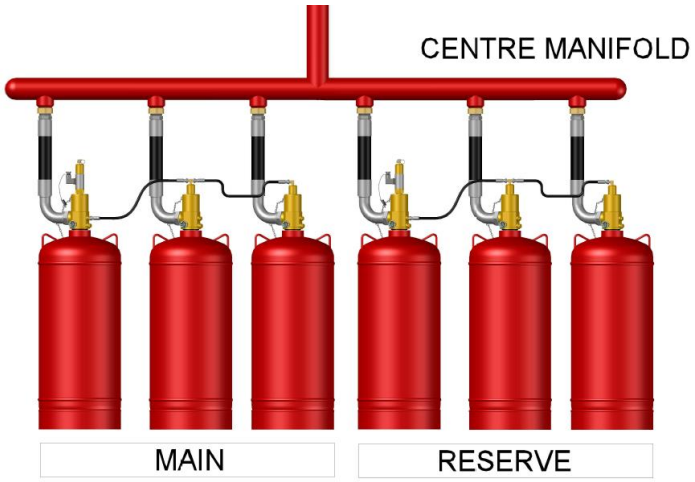


Figure 32 Main and Reserve (Centre Manifold)

3.10 DISCHARGE NOZZLE

There are two type of discharge nozzle configurations namely:

- The 180º discharge nozzle which provides a 180º discharge pattern and designed to be mounted adjacent to a wall of the hazard.
- The 360º discharge nozzle which provides a 360º discharge pattern and designed to be installed in the center of the hazard.

There are certain factors such as coverage area and height limitation must be observed with each nozzle configuration to ensure proper agent distribution during discharged.

Nozzle Maximum Coverage Area		105.35m^2 (1134 ft^2)
*Maximum Protection Height		4.85m (15.9ft)
Minimum Void Height		300mm
Nozzle Position (minimum void height)	180º	Upright
	360º	Pendant
Maximum Nozzle Spacing	180º	300mm from Wall
	360º	Centerline, 300mm from Ceiling

*If the hazard's height exceeds 4.85m (15.9ft), multiple tiers of nozzles must be used for each 4.85m (15.9ft) increment of the enclosure height.

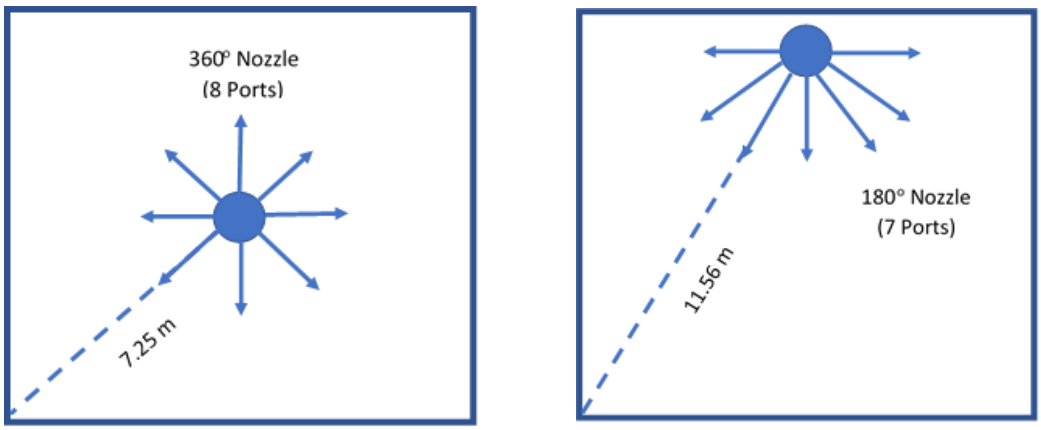


Figure 33 180º & 360º Nozzle Radius

Table 32 Discharge Nozzle Discharge Radius

Nozzle Configuration	Radius
180º	11.56 m (37.9 ft)
360º	7.25 m (23.8 ft)

- In the event that the discharge nozzles located above the cylinder outlet, the maximum elevation difference between the cylinder outlet and the farthest horizontal pipe run or discharge nozzle (which is furthest) shall not exceed 13.3 m (43.65 ft). Refer to Figure 34.

Figure 34 Nozzles Located Above the Cylinder Outlet

- In the event that the discharge nozzles located below the cylinder outlet, the maximum elevation difference between the cylinder outlet and the farthest horizontal pipe run or discharge nozzle (which is furthest) shall not exceed 13.3 m (43.6 ft). Refer to figure 35.

Figure 35 Nozzles Located Below the Cylinder Outlet

- In the event that discharge nozzles located above and below the cylinder outlet, the maximum elevation difference between the farthest horizontal pipe runs or nozzles (whichever is furthest) shall not exceed 13.3 m (43.65 ft). Refer to Figure 36.

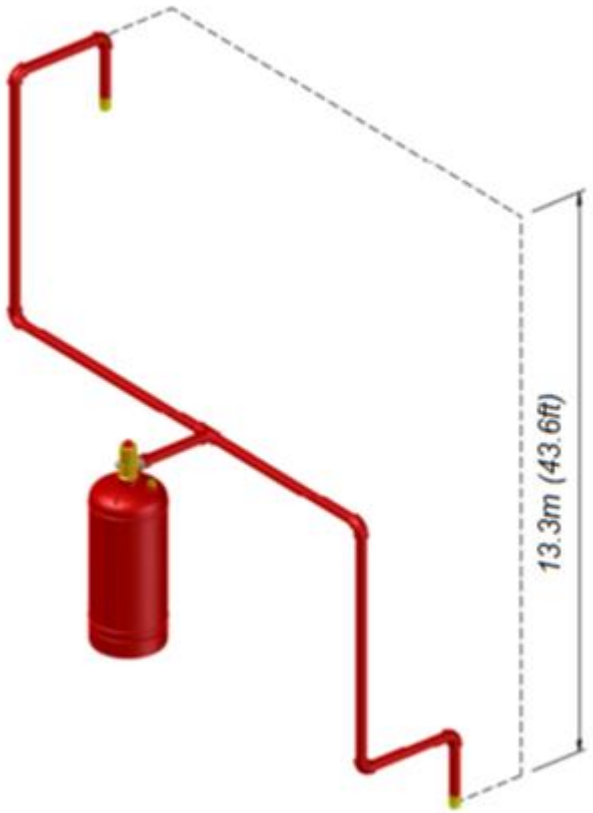


Figure 36 Nozzles Located Above and Below the Cylinder Outlet

3.11 AGENT CALCULATION SAMPLE

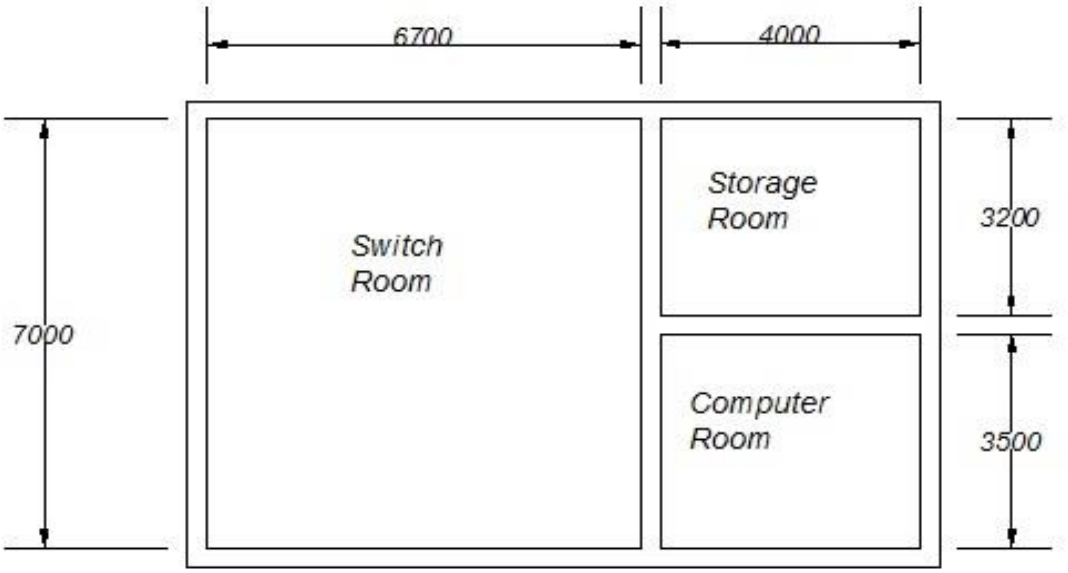


Figure 37 The Rooms size

The room is normally occupied. It is divided into 3 section namely switch room, storage room and computer room. These rooms are referring to Class C Fire. At minimum ambient temperature, 20ºC (68ºF), the flooding factor is 0.5478 kg/m^3.

Example:

To calculate the volume of Switch Room,

Switch Room Volume, V = 7.0 m x 6.7 m x 3.5 m

= 164.15 m^3

Hence, required HFC-227ea = 164.15 m^3 x 0.5478 kg/m^3

= 90 kg

To calculate the volume of Storage Room,

Storage Room Volume, V = 4.0 m x 3.2 m x 3.5 m

= 44.8 m^3

Hence, the required HFC-227ea = 44.8 m^3 x 0.5478 kg/m^3

= 24.6 kg

To calculate the volume of Computer Room,

Computer Room Volume, V = 4.0 m x 3.5 m x 3.5 m

= 49 m^3

Hence, the required HFC-227ea = 49 m^3 x 0.5478 kg/m^3

= 26.9 kg

Total HFC-227ea agent required to protect these three rooms is 141.5 kg. To obtain the cylinder size by refer to the Table 5. Hence, the suitable cylinder to be used for this system is 180L. The fill density is obtained (divide 141.5 kg by 180L = 0.79kg/l)

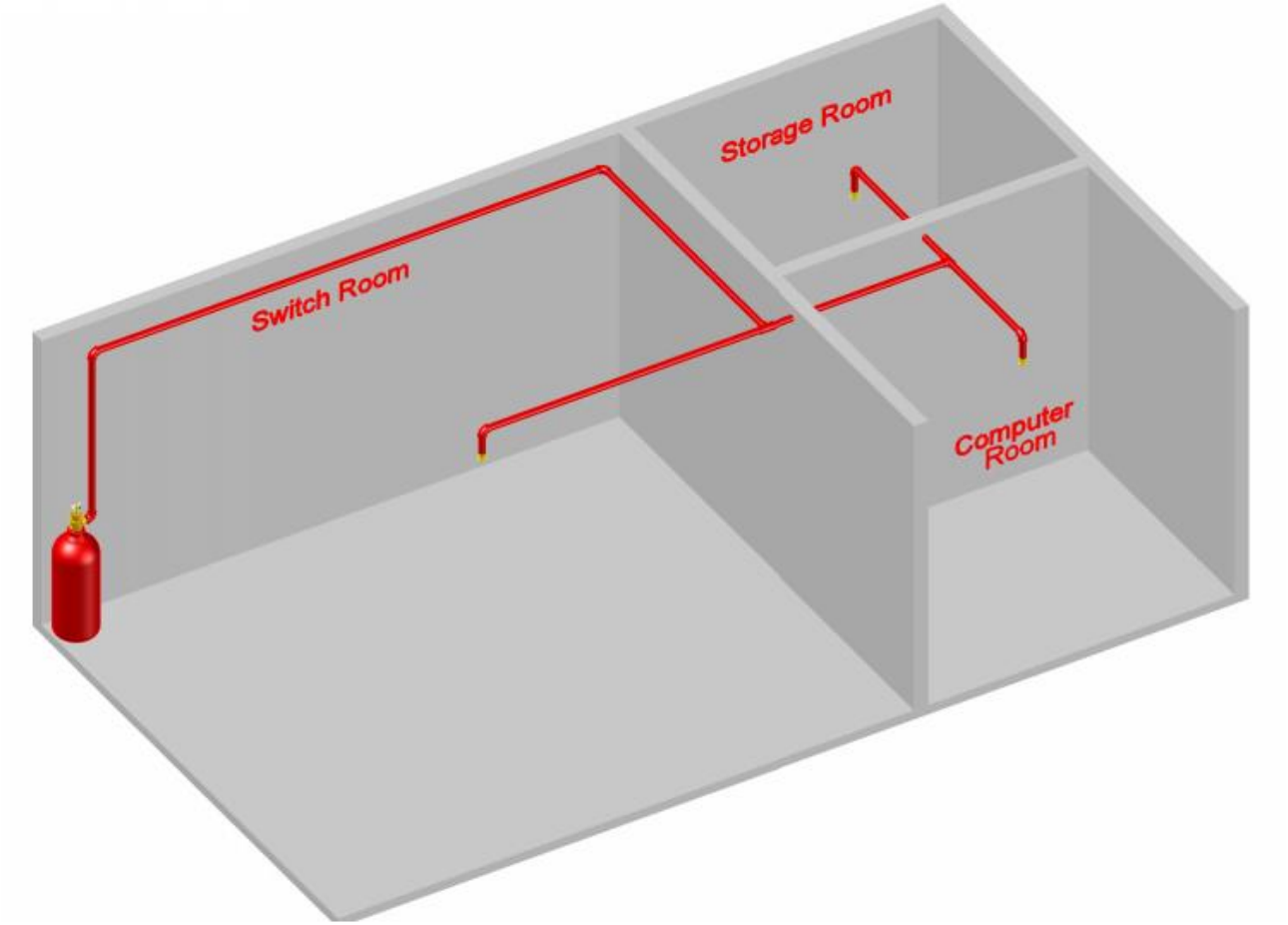


Figure 38 Cylinder and Discharge Nozzle Location

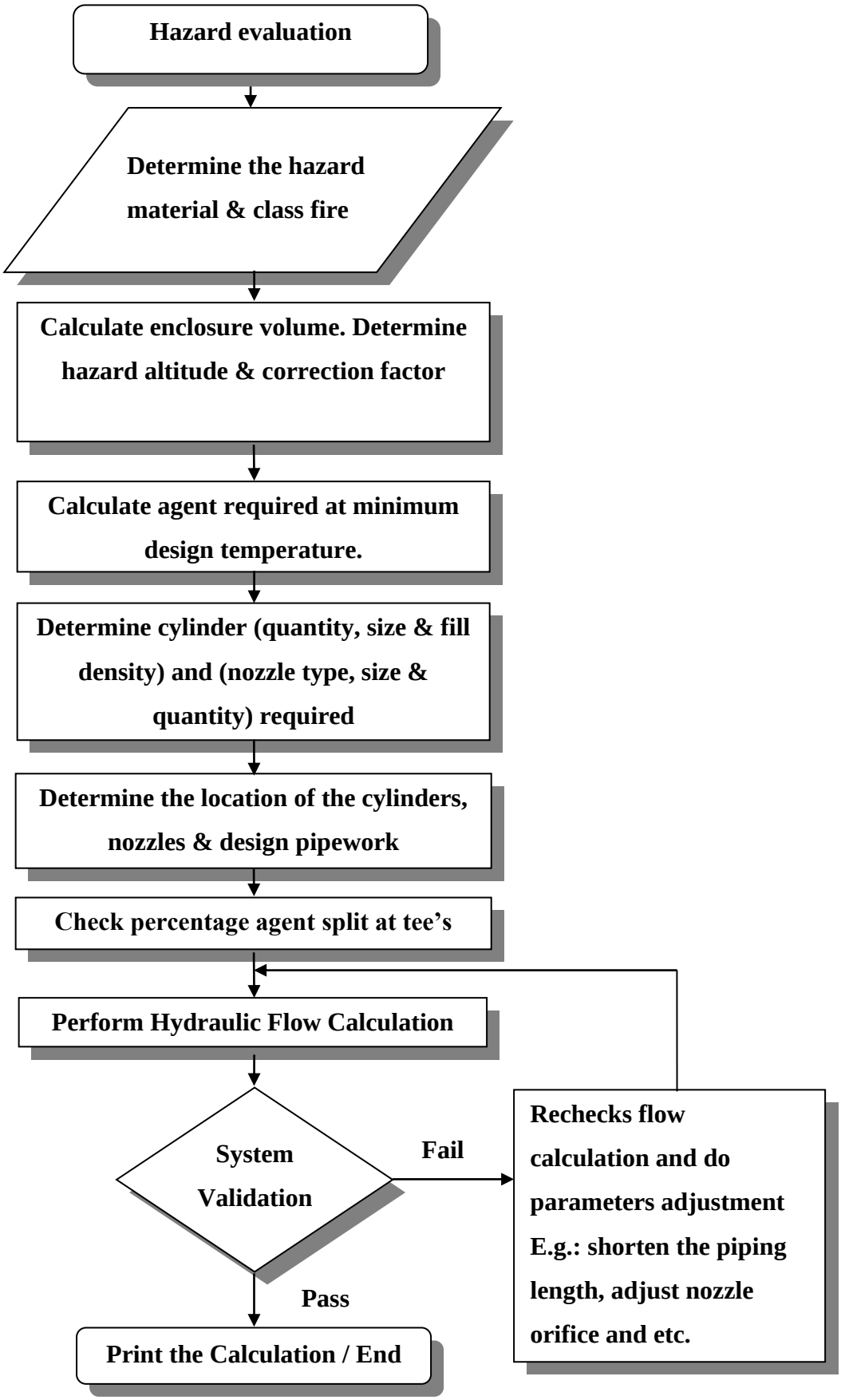


Figure 39 System Design Flow Chart

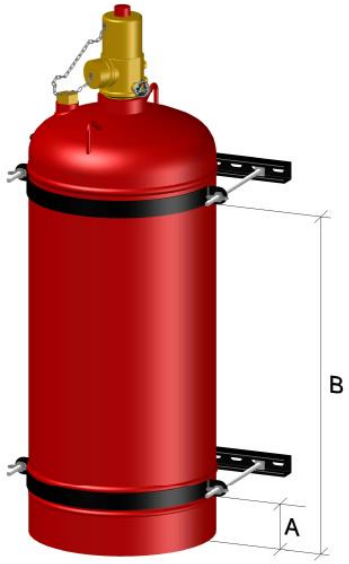
4.0 SYSTEMS MECHANICAL INSTALLATION

- General Information

  All mechanical installation work carried out shall be performed by a trained total flooding system installation contractor with the correct equipment and the relevant experience in gaseous extinguishing systems. Prior to installation commence, installing contractor shall refer to system installation drawing prepared for the specific hazard or appropriately endorsed working drawing and be satisfied with the system designed complies to requirement. Installation drawing shall contain information as follow:

  i. Detailed hazard's layout drawing
  ii. Net volume of enclosure
  iii. Quantity of Agent designed
  iv. Cylinder location with indication of master unit / slave units
  v. Detection system layout
  vi. Suppression control panel's line drawing

- For all installations requiring UL Listing, the detection, manual pull stations, and fire suppression control panel shall be UL Listed or Component recognized devices. For non-UL installations, all equipment must be accepted by the Authority Having Jurisdiction.
- The cylinder location is identified on the system drawings and should be protected from bad weather and easy for accessible when service and maintenance. The cylinders must be firmly secured to a wall in a vertical orientation only.
- The back channel of the mounting bracket is fitted to a wall by using suitable bolt.
- The cylinder is position with pressure gauge face outside / valve outlet pointing left.
- The cylinder is then strap and secure with bolt.
- Remove the safety cap from the discharge valve outlet.
- For the system with one single cylinder size ranging from 16.7L – 180L, fit the valve outlet with union coupling.
- For the system with one single cylinder size 369L, fit the valve outlet with BSP thread adaptor.
- The cylinder is disconnected and refit with safety cap. Once the pipework and nozzle has been installed, then reconnect the pipe to the cylinder.



Cylinder Size	Height from Floor to Bracket		Label Location from Floor
	A	B	
16.6, 16.7 L	100 mm (4 inch)	370 mm (14.6 inch)	350 mm (13.8 inch)
28.3 L	160 mm (6.3 inch)	660 mm (26 inch)	640 mm (25.2 inch)
52 L	50 mm (2 inch)	340 mm (13.4 inch)	320 mm (12.6 inch)
52 L (TPED)	130 mm (5.1 inch)	650 mm (25.6 inch)	630 mm (24.8 inch)
106 L	300 mm (11.8 inch)	760 mm (30 inch)	740 mm (29.1 inch)
180L(TPED) 147, 150L	300 mm (11.8 inch)	1100 mm (43.3 inch)	1080 mm (42.5 inch)
180 L	300 mm (11.8 inch)	1380 mm (54.3 inch)	1360 mm (53.5 inch)
369 L	300 mm (11.8 inch)	1210 mm (47.6 inch)	1190 mm (46.9 inch)
453L	360 mm (14.2 inch)	1100 mm (43.3 inch)	1080 mm (42.5 inch)

Figure 40 Bracket Fixing Heights

CAUTION

Do not tight the pipe to the valve outlet excessively. This may cause the valve outlet thread to be damaged and indirectly affected the system operation.

- For multiple cylinder, the check valve is installed into the manifold inlet. Then, fit the discharge hose in between the valve outlet and the manifold check valve by wrench tighten.

4.1 PIPE INSTALLATION

The pipework installs according to the as built installation drawing and followed to:

- The piping material must conform to the requirements of NFPA 2001. Joint compound, tape, or thread lubricant shall be applied only to the male threads of the joint.
- The piping system should comply with the pressure requirements specified in the Table below.

Table 33 Steel Pipe Requirements

Pipe Size	Connection	Pipe Class
½ inch – 6 inch	Threaded/Groove	Schedule 40

Fittings shall be the following:

- Class 300 threaded malleable iron for maximum pipe size to 3 inch NPS.
- Class 300 threaded ductile iron for all pipe size NPS.
- Groove type fitting

A dirt trap consisting of a tee with a capped nipple, at least 2 inch long, shall be installed at the end of each pipe run. (Source: section 4.2.1.6, NFPA 2001: 2018 Edition)

Each of the pipe section shall be cleaned internally after preparation and before assembly by means of swabbing, utilizing a suitable nonflammable cleaner. The pipe network shall be free of particulate matter and oil residue before installation of nozzles or discharge devices.

4.2 ACTUATION INSTALLATION

Installation of Removable Electrical Actuator

Location of Installation

The actuator is fitted to the top of the cylinder valve assembly (between valve and manual actuator).

- Carefully screw the removable electrical actuator onto the cylinder valve. **Prior to fitting, ensure the unit is reset in the non-fire position. (Normally height from end of pin to base is 4.8 to 5.2mm (See Figure 41)**

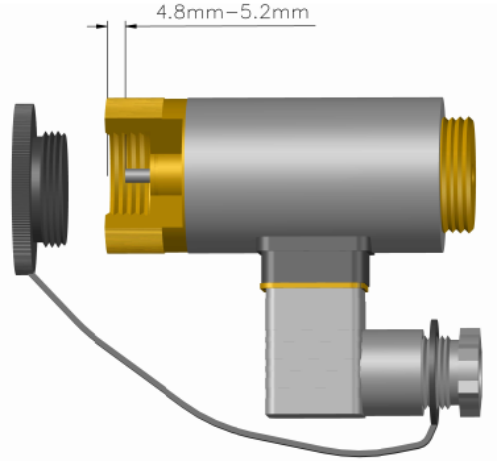


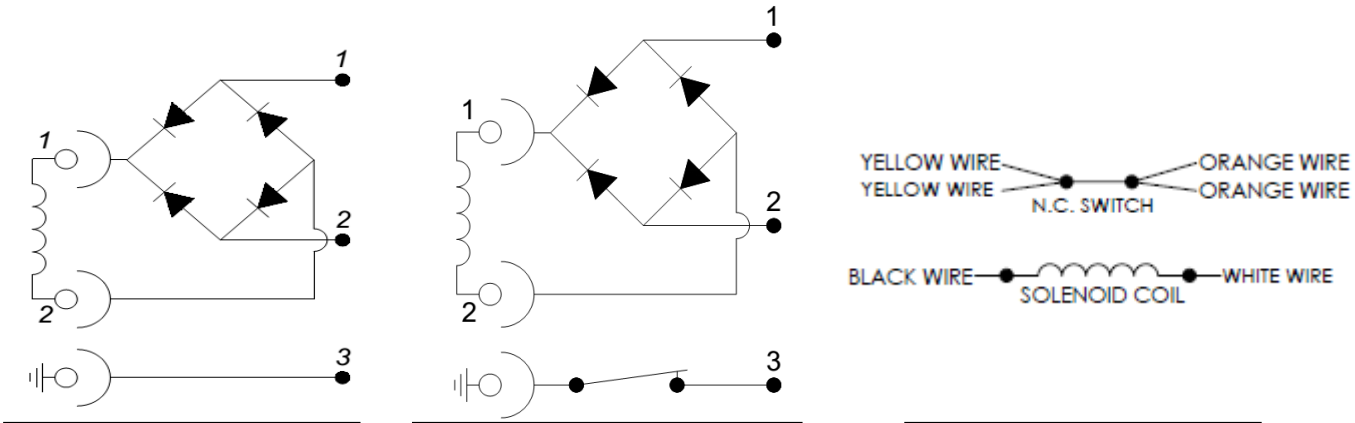
Figure 41 Removable Electrical Actuator Non-Fire Position

Note: Use the reset tool attached to the removable electrical actuator for reset purpose. Put the reset tool in place and turn the knurled swivel coupling until the reset tool threads are completely engaged. A sound tick will be heard when the actuator pin is reset.

CAUTION

If the removable electrical actuator is not fitted to the cylinder valve or no manual actuator is installed on the top of the removable electrical actuator, ensure the protective cap on the removable electrical actuator is maintained in position.

- The removable electrical actuator use in installation is bridge rectifier. Hence, the positive supply from control panel can be can be connected to either terminal with the reverse for negative supply.



Electrical Actuator (Bridge Rectifier) LF-EASV	Removable Electrical Actuator c/w Supervision switch LF-EASV-RS	Supervised Latching Solenoid Actuator LF-EASV-LS

Figure 42 Electrical Actuator Wiring Diagram

WARNING

Prior to the system is ready to operate, the removable electrical actuator is checked for functionality. To do this, **remove the electrical actuator from cylinder valve.** When the electrical actuator receiving a 24VDC nominal voltage signal from control panel. The electrical actuator will latch in the fire position (Firmly in down position). The electrical actuator can be reset by inserting / screwing in the reset tool. Make sure the electrical actuator is reset prior to fitting onto the cylinder valve. **Failure to reset the electrical actuator will cause system discharge accidentally even though no fire occurrence.**

Installation of Manual & Pneumatic Actuator

- The manual actuator is fitted on the top of the electrical actuator after removing the protective cap.

WARNING

Prior to fitting the manual actuator on the top of the electrical actuator, make sure the pin of the manual actuator is retracted and incorporate with safety pin seal. (See Figure 43)

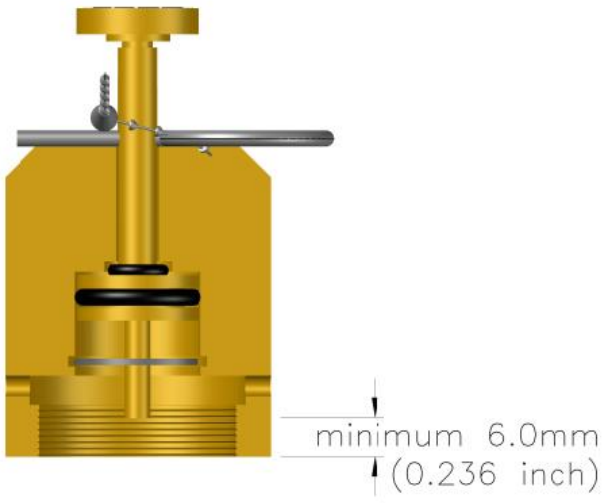


Figure 43 Manual Actuator in Non-Fire Position

- One master cylinder and others slave cylinders are designated for multiple cylinders installed for intended to discharge simultaneously. In case there is a fire occurs, the master cylinder can be activated either electrically or manually. Whereas, the slave cylinders are activated pneumatically from the discharge action of master cylinder.

  Note: Electrical actuator and manual actuator must be installed onto the master cylinder valve only. (See Figure 44)

  Pneumatic actuator must be installed onto the slave cylinder only. Make sure the pin of the pneumatic actuator is retracted prior to installation. (See Figure 45 & Figure 46)

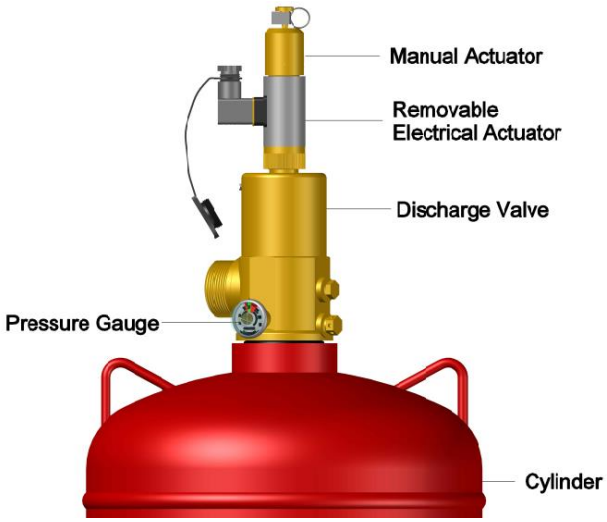


Figure 44 Installation of Electrical Actuator and Manual Actuator

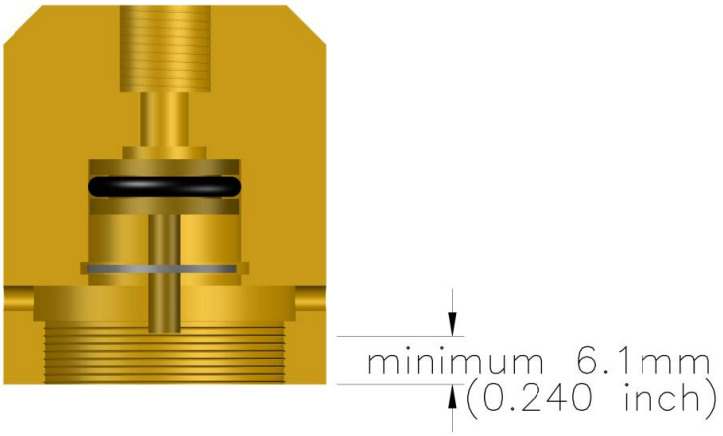


Figure 45 Pneumatic Actuator in Non-Fire Position

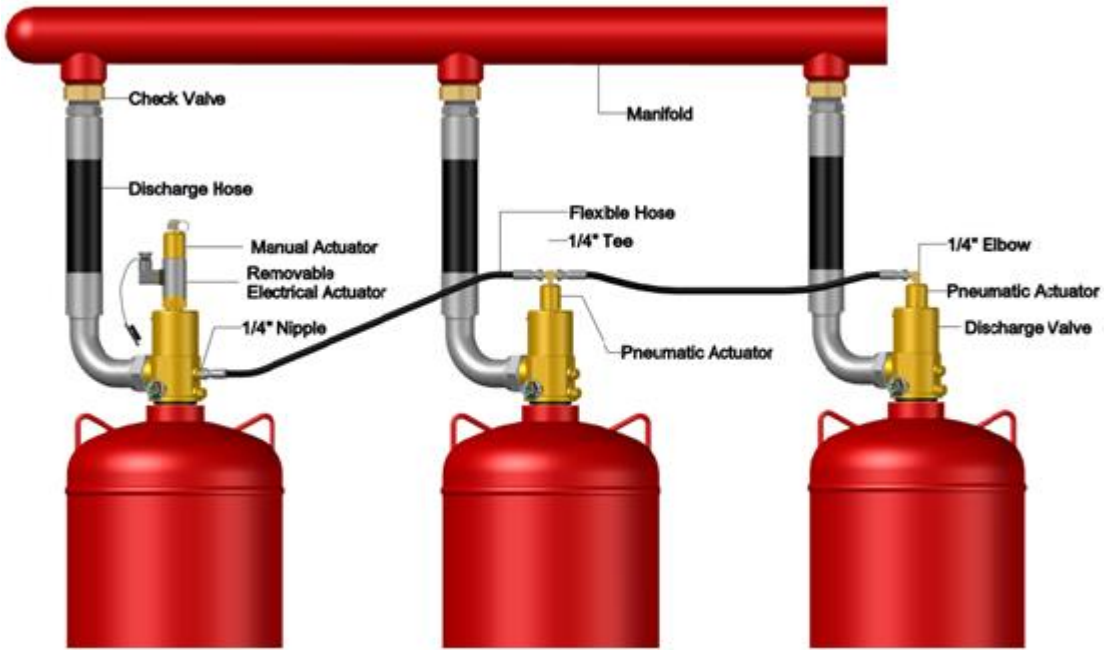


Figure 46 Installation of Pneumatic Actuator

- The pneumatic connection of slave cylinders is achieved by removing the ¼" pressure plug of the master cylinder valve and fit the male adaptor. Install tee adaptor onto the pneumatic actuators.
- Connect one end of flexible hose to the male adaptor on the master cylinder and another end to the tee adaptor on the pneumatic actuator.

Table 34 Multiple Cylinders

Valve Size	Master Cylinder (Quantity)	Maximum Slave Cylinder (Quantity)	Maximum Cylinder in total (Quantity)
1 inch	1	4	5
2 inch	1	5	6
3 inch	1	5	6

4.3 INSTALLATION OF EXTERNAL MONITORING SWITCH

Location of Installation

The external monitoring switch is mounted to the removable electrical actuator body for monitoring the proper installation of removable electrical actuator. The external monitoring switch will not function correctly if improper fitted to the discharge valve.

Follow the instruction carefully. Ensure the removable electrical actuator is connected correctly to the discharge valve.

Note: External Monitoring Switch is only applicable for FM Approved. Optional UL Listed monitoring switch that compile and compatible with electrical actuator (LF-EASV) can be use. Contact local supplier for more info.

Installation Instructions

a. Place the steel plate on the top of the cylinder valve. (For 1 inch & 2 inch discharge valve only)
b. Screw in the M4 fastener to attach the steel plate to the cylinder valve. (See Figure 47)

WARNING

Prior to installation, ensure cylinder is securely bracket to avoid serious personal injury or death.

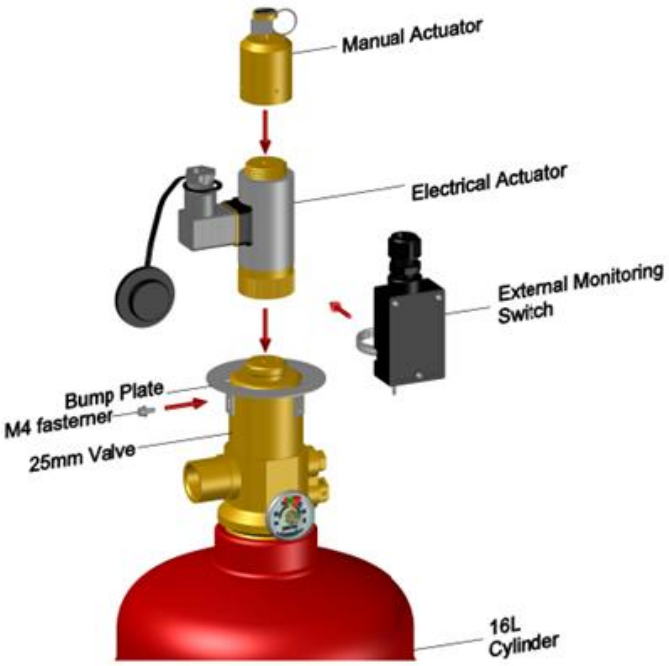


Figure 47 Attached Steel Plate onto the Cylinder Valve

c. Mount the external monitoring switch onto the electrical actuator body with mounting clamps. Tighten the mounting clamp to the electrical actuator body. (See Figure 48)

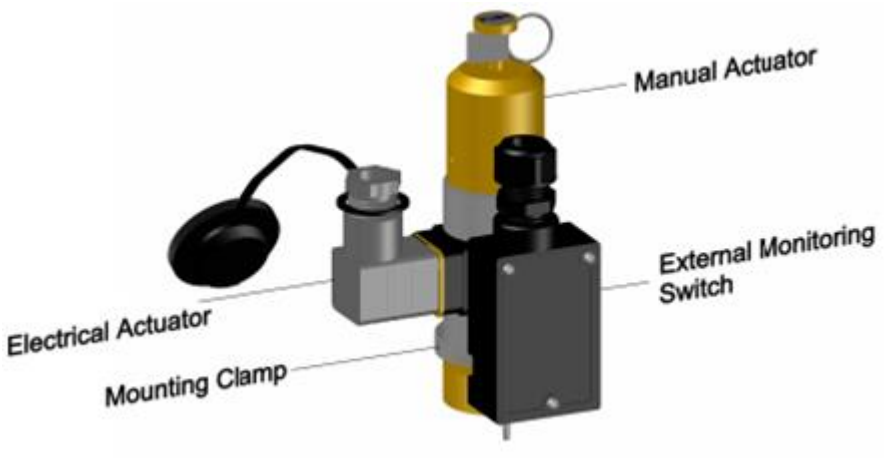


Figure 48: External Monitoring Switch Installation

d. Prior to installation of electrical actuator, ensure the unit is **reset in the non-fire position.** Ensure all the source of electric from fire alarm control panel to the electrical actuator has been disconnected to prevent the accidently activation of electrical actuator. The electrical actuator is hand tight only onto the cylinder valve. (See Figure 49 (a) & 49 (b)) Once the electrical actuator is fitted, the external monitoring switch button will fully depressed. (See Figure 50)

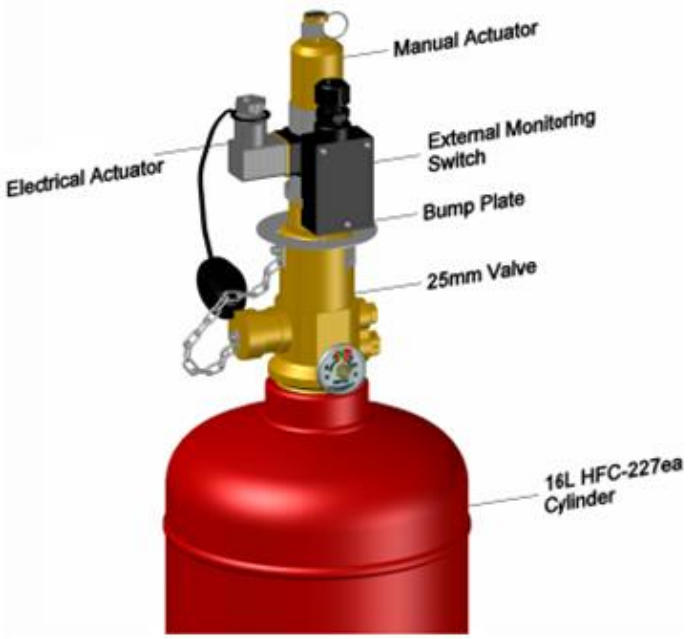


Figure 49 (a): Installation of External Monitoring for 1 inch & 2 inch Cylinder Valve.

Figure 49 (b): Installation of External Monitoring for 3 inch Cylinder Valves.

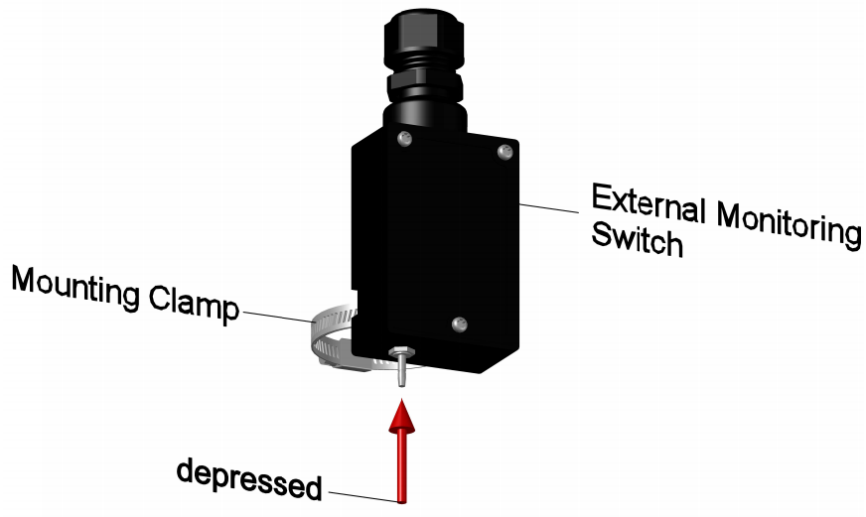


Figure 50: External Monitoring Switch Pin Depressed

e. Remove the screw located on the top and inner housing cover to open up the enclosure.
The terminal block is located inside the enclosure.

f. The end of line (EOL) resistor is fitted to the terminal block 2 & 3. At the same time, separate the two 22-14 AWG wires, strip and remove the wire covering from the ends. Insert these two wires through the ½ inch size conduit fitting into the terminal 1 & 4 for connecting to fire control panel. (See Figure 51 wiring diagram)

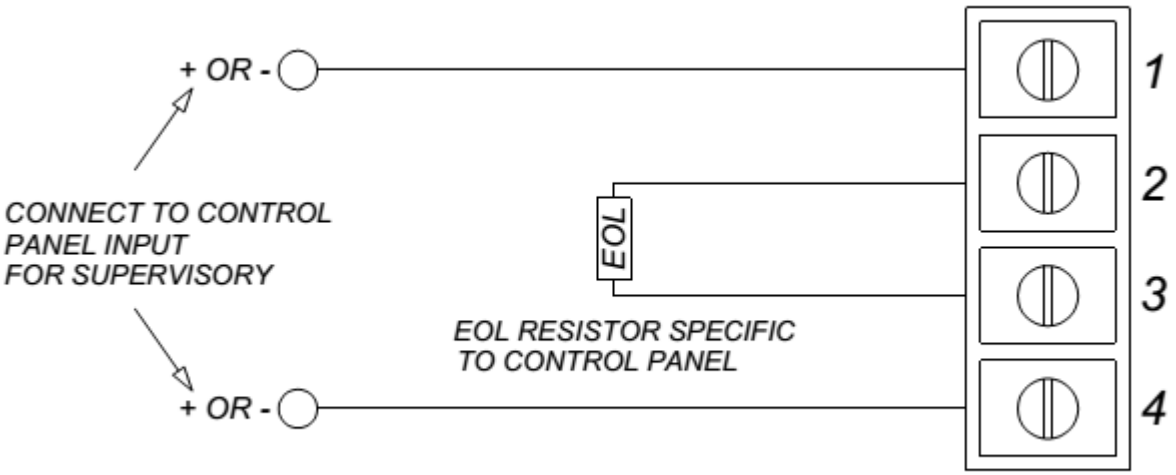


Figure 51: Wiring Diagram

g. Tighten the screw to cover the electrical parts with Nylon housing cover.

4.4 DETECTION OF CONTROL EQUIPMENT

- The design of a system for automatic detection, signal distribution, alarms, etc. is not always of LIFECO's supply. Therefore, details pertaining to fire detection and alarm operation and maintenance are not included in this manual.

- Control Devices require the use of a UL Listed Fire Alarm Control Panel, that is compatible with the electrical actuation devices and the manual pull stations used to operate LIFECO-HFC227 Engineered Total Flooding Fire Suppression System units. Reference the control panel manual for compatibility information.

- Detection and notification appliances and devices shall be UL Listed and compatible with the control panel. Reference the detectors manual for compatibility information.

- For installations and locations that do not require a UL Listed/NFPA Standard type control panel, detection, and notification, the authority having jurisdiction shall be consulted to determine the appropriate type of control panel, detectors, and notification appliances to be used.

4.5 INSTALLATION OF DISCHARGE PRESSURE SWITCH

There are 3 methods of installation for the discharge pressure switch.

a) Single Cylinder system

- Discharge pressure switch shall be installed by connect a flexible hose (Part Number: LF-FH710) with a 1/4"BSP x 1/2"NPT adaptor (Part Number: LF-05ADNPT) to the valve pneumatic port. Installed discharge pressure switch to the wall with suitable wall plug (Not provided).

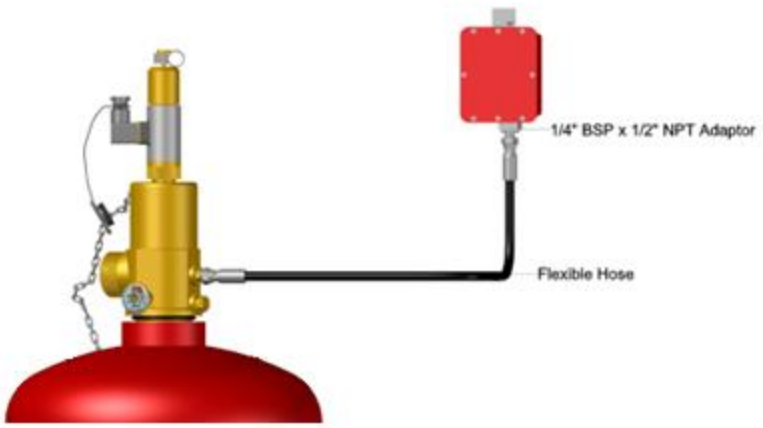


Figure 52: Single Cylinder System - Discharge Pressure Switch Installation

b) Multiple Cylinder system

- Discharge pressure switch is installed to the last slave cylinder. Connect a flexible hose (Part Number: : LF-FH710) with a 1/4"BSP x 1/2"NPT adaptor (Part Number: LF-05ADNPT) to the pneumatic actuation line tee. Installed discharge pressure switch to the wall with suitable wall plug (Not provided).

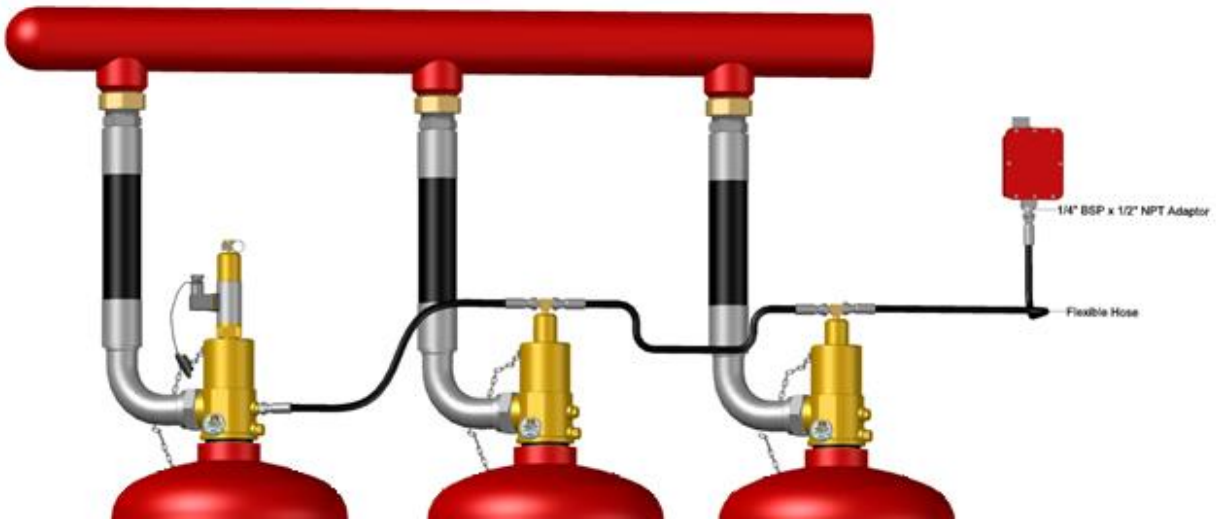


Figure 53: Multiple Cylinder System - Discharge Pressure Switch Installation

c) On the distribution pipe/ manifold

- Discharge pressure switch can be installed on the distribution pipe or manifold after the valve outlet.

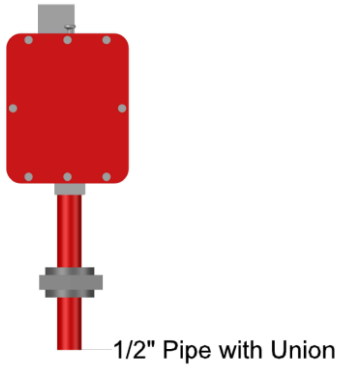


Figure 54: Distribution pipe / Manifold- Discharge Pressure Switch Installation

For electrical connection, remove the cover plate and refer to Figure 55.

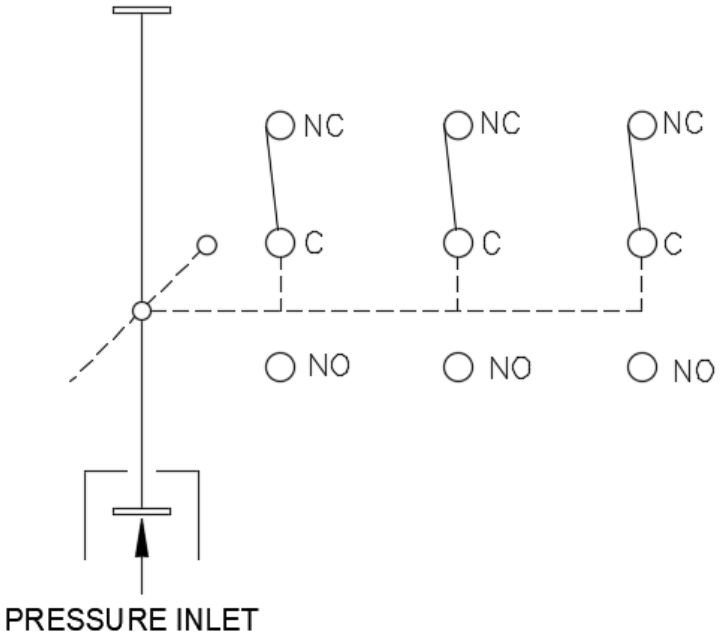


Figure 55: Discharge Pressure Switch Installation Wiring Diagram

IMPORTANT

Clause 8.1.2 Fire Protection Service Technician. Personnel that inspect, service, test, and maintain clean agent fire extinguishing systems shall have knowledge and experience of the maintenance and servicing requirements contained in this standard, of the equipment being serviced or maintained, and of the servicing or maintenance methods and requirements contained in the manufacturer's design, installation, and maintenance manual and any applicable bulletins.

Clause 8.8 Training All persons who could be expected to inspect, service, test, or maintain fire extinguishing systems shall be trained and kept trained in the functions they are expected to perform.
(Source: NFPA 2001:2018 Edition)

5.0 INSPECTION OF SYSTEM AFTER INSTALLATION

A regular program of systematic inspection is established for the continuous proper operation of all LIFECO-HFC227 systems installed. The inspection work shall be conducted by trained and competent personnel. This **system periodically be inspected by trained personnel.** The purpose of periodic inspection is to assure that the system is in full operating condition at all times. Its activity shall identify problems due to wear and tear, and accidental and environmental damages, tampering, changes to hazard characteristic or intended uses or other related changes that could adversely affect the proper performance of the LIFECO-HFC227 system. **This system is made up of units tested within limitations contained in the detailed installation manual. The system designer must be consulted whenever changes are planned for the system or area of protection. An authorized installer or system designer must be consulted after the system has discharged.**

- The openings or sources of agent loss such as cable and duct penetrations into the hazard area should be permanently sealed. Door entering the hazard area should be checked for tightness. Joints where walls contact floors should be sealed as these are potential leak points most often overlooked.

- Inspect hazard layout for any deviation of its initial designed volume. If there are any changes to its initial designed volume, the LIFECO-HFC227 system especially the quantity of the agent must be recalculated and corrected.

- Access passage to the fire suppression system must not be obstructed. A trained and competent personnel must be able to have access to the system within reasonable time determine by fire authorities, insurance authorities and/or by the system user.

- Make sure that the nozzle(s) is(are) cleared of obstruction and free from signs of corrosion or rust. The nozzle(s) must not be painted or tampered by a trained installer or the system user. Use the proper type of nozzle(s) and check that they are correctly installed and properly orientated.

- Inspect all LIFECO-HFC227 cylinders, valves, hoses and other equipment for damages such as cracks, dents, distortions, and worn out or missing parts.

- Cylinders must be weighted to determine for any loss of agent due to leakages if any of the above-mention is identified. Check cylinder weight information label against system's agent requirements.

- Check LIFECO-HFC227 cylinder safety brackets and mounting hardware for damages, broken parts, signs of corrosion and that all cylinder(s) and pipe works are securely fixed and able to hold them in position during system discharge. Ensure no welded pipe works are used for the system installation.

- Check actuator(s) for physical damages, corrosion or dirt. Check electric actuator's connecting wiring for wear and tear or damages. Check wiring voltage is correct for actuation when system is triggered. Check connection faulty if not fully assembled.

- Have a final check that the system is armed and the detecting and actuating systems are operational.

- Perform door fan testing to evaluate enclosure leakage and determine the system ability to maintain the design concentration after system discharge. The software provided for this testing is able to predict the time it will take for a descending interface to fall to a given height. The door fan testing provides a worst-case leakage estimation that is very useful for enclosures with complex hidden leaks, but will generally require more necessary sealing to pass a discharge test. (Refer to NFPA 2001, Appendix C Safety Bulletins)

6.0 OPERATION AND MAINTENANCE

WARNING

BEFORE PERFORMING OPERATION AND MAINTENANCE PROCEDURES, PLEASE REFER TO THE MATERIAL SAFETY DATA SHEET AND SAFETY BULLETINS IN THE APPENDIX AT THE BACK OF THIS MANUAL.

The user's maintenance program is intended to avoid the consequences of failure of equipment by preserving and/or restoring equipment reliability. This is to assure that the system and equipment is in full operating condition at all times. If inspection indicates areas of rust and corrosion is present, immediately contact your local supplier for the next course of action.

6.1 LIFECO-HFC227 OPERATION

LIFECO-HFC227 system are made up of agent cylinder fitted with a discharge valve and filled with HFC-227ea fire suppression agent. When the discharge valve is activated, the valve piston is displaced and the compressed liquid agent drive out of the cylinder through the outlet of the discharge valve and is directed through the distribution piping to the discharge nozzle. Discharge nozzle vaporized in air and released the agent into the protected area with a proper flow rate and distribution.

6.2 AUTOMATIC OPERATION

When a system is operated automatically through detection and control system, hazard area must be evacuated upon a predischarge alarm is heard. Hazard area must not be entered and fire department must be called immediately.

At the 1st stage when there’s a fire outbreak, smoke and heat detector upon detection will send a signal to the control panel which then it will send another signal to trigger the electrical actuator installed on the top of the discharge valve. Electrical actuator will actuate the discharge valve allowing the agent in the cylinder to flows through the distribution piping and nozzle which finally release into the hazard area.

6.3 MANUAL OPERATION

In case of emergency, manual operation can only be used as a last resort method.

6.3.1 Manual operation by manual station

a) Proceed to the remote manual station for the specific hazard area.

b) Ensure hazard area has been evacuated.

c) Operate the manual station.

d) Leave the hazard area immediately.

e) Hazard area must not be entered and fire department must be called immediately.

6.3.2 Manual operation by Discharge valve

a) Proceed to the agent cylinder for the specific hazard area.

b) Remove safety pin from discharge valve manual actuator.

c) Push the manual actuator to activate the agent cylinder.

d) Leave the hazard area immediately.

e) Hazard area must not be entered and fire department must be called immediately.

6.4 MONTHLY PREVENTIVE MAINTENANCE PROCEDURES

6.4.1 Make a general inspection survey of all cylinders and equipment for damage, leakage or missing parts.

6.4.2 Inspect the hazard area against the original layout to ensure that there have been no changes that might affect the proper performance of the LIFECO-HFC227 system. Changes might include partitioning, floor and/or ceiling voids, renovating and openings in an enclosure boundary that the HFC-227ea agent can flow out of.

6.4.3 Ensure access to hazard areas, control panel, manual pull stations, nozzle(s), and cylinder(s) are unobstructed and that there are no obstructions to the operation of the equipment or distribution of HFC-227ea agent.

6.4.4 Ensure warning signs, safety precautions and operating instructions are posted and clearly visible.

6.4.5 Inspect cylinder safety bracket and piping brackets for loose, damaged, or broken parts. Check cylinder brackets and associated parts for corrosion, oil, grease, grime, etc. Tighten loose hardware. Replace damaged parts.

6.5 SEMI-ANNUALLY PREVENTIVE MAINTENANCE PROCEDURES

6.5.1 Externally inspect cylinder(s) for signs of damage or unauthorized modifications. Check cylinder labels for damage and that the label descriptions are still visible. Check cylinder brackets and fittings.

6.5.2 HFC-227ea agent must be checked and weighed to ensure quantity tallies with charged weight as indicated on the cylinder label. If cylinder(s) cannot be easily weighed due to size or installation location, Portable Ultrasonic Liquid Level indicator can be use to determine the level of the agent. within the cylinder at a specific temperature. Alternatively, it can be measured by an inbuilt liquid level indicator (Refer to section 2.21).

6.5.3 Inspection procedures:

CAUTION

DISCONNECT ALL ELECTRICAL ACTUATOR(S) TO PREVENT ACCIDENTAL SYSTEM DISCHARGE. **FOR SYSTEM SUPERVISION – DO NOT USE LOOPED WIRE UNDER TERMINALS, BREAK WIRE RUN TO PROVIDE SUPERVISION OF CONNECTIONS.**

- Remove electrical actuator from the cylinder valve's actuation port.
- Loosen and disconnect the discharge pipe from the cylinder valve's outlet port.
- Install the safety cap onto the cylinder valve's outlet port.
- Loosen and remove the cylinder safety brackets.
- Place cylinder on a standard platform weighing scale. The scale must be calibrated and having a suitable capacity. Record gross weight and date on the log book.
- If the cylinder comes with an inbuilt liquid level indicator, removing the cylinder from the fire suppression system for weighing is not required. Remove protective cap from liquid level indicator. Measure cylinder temperature or ambient temperature only if cylinder has been stored at least 24 hours to obtain accurate reading. Lift the measuring tape to approximately 2 inches below the expected level (Refer to Appendix D). Then slowly pulled the tape until a magnetic interlock is felt. (Figure 56). Read the measurement on the tape at eye level height (Figure 57) and record the measurement.
- Reinstall the tape by quickly pull the tape upward to unlock the magnetic interlock. Slide the tape into the housing and cover back the protective cap.

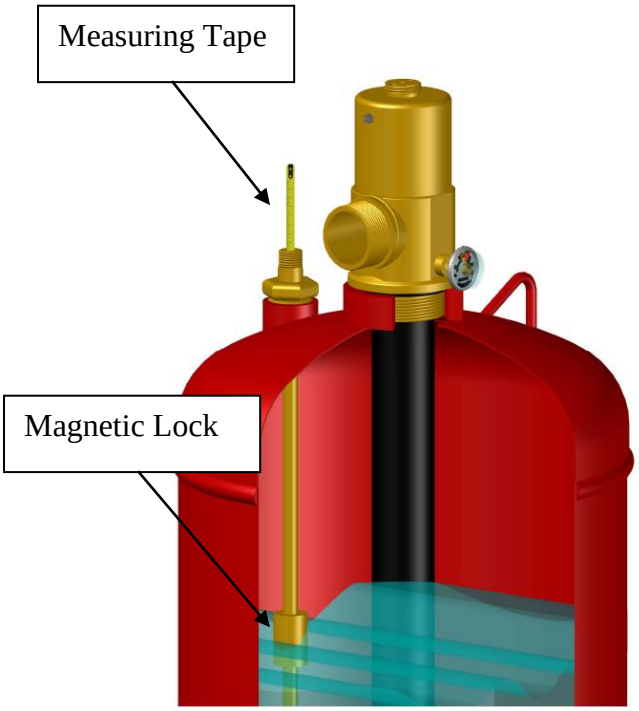


Figure 56: Liquid Level Tape and Lock

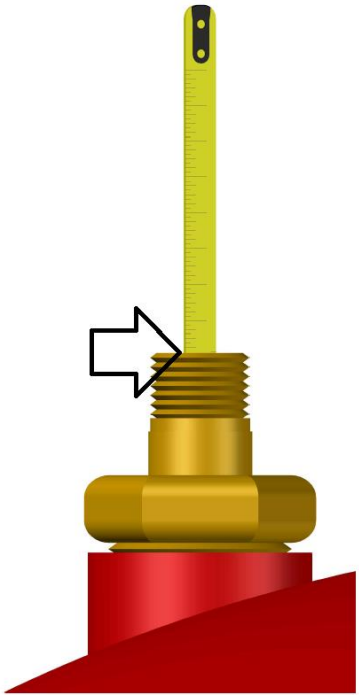


Figure 57: Liquid Level Reading

- If recorded agent net weight is less than 95% of original charged weight, please contact system supplier to replace cylinder with a fully charge LIFECO-HFC227 cylinder.
- If current cylinder net weight meets requirement, reinstall cylinder(s) according to the installation manual.
- Check the pressure gauge reading on each cylinder. The nominal pressure should be approximately 25 bar @ 21ºC (360 psi @ 70ºF). However, the pressure will vary depend on temperature. If pressure loss exceeds 10% of the nominal pressure, check the cylinder for leaks, repair and refill as necessary.
- Inspect discharge pipes for loose fittings, damaged threads, cracks, rust, kinks, and distortion.
- Tighten loose fittings and replace pipe(s) show corrosion or mechanical damage.

6.5.4 Inspect all the hoses installed for physical damages.

6.5.5 Inspect discharge nozzle(s) for dirt, dust, debris, and physical damage. Replace damaged or clogged nozzle(s) and clean out where necessary.

6.5.6 Check the condition of manual / pneumatic and electrical actuators and do replacement where appropriate. Check all valve assemblies for damages and leaks. If leaking occurs, the contents of the cylinder must be transferred to another cylinder before reconditioning the valve.

WARNING

NEVER ATTEMPT TO RECONDITION THE VALVE UNTIL THE CONTENTS OF THE CYLINDER HAVE BEEN TRANSFERRED AND THE PRESSURE GAUGE READS 0 BAR.

6.6 EVERY TWO YEARS PREVENTIVE MAINTENANCE PROCEDURES

WARNING

DO NOT USE OXYGEN OR WATER TO BLOW OUT PIPE LINES. THE USE OF OXYGEN IS ESPECIALLY DANGEROUS AS THE POSSIBLE PRESENCE OF OIL MAY CAUSE AN EXPLOSION.

CAUTION

DISCONNECT ALL ELECTRICAL ACTUATOR(S) TO PREVENT ACCIDENTAL SYSTEM DISCHARGE**. FOR SYSTEM SUPERVISION – DO NOT USE LOOPED WIRE UNDER TERMINALS, BREAK WIRE RUN TO PROVIDE SUPERVISION OF CONNECTIONS.**

6.6.1 Remove electrical actuator from the cylinder valve's actuation port.

6.6.2 Remove all cylinder(s) from the safety bracket including disconnecting its valve from the discharge pipes. Install safety cap onto the cylinder valve's outlet port.

6.6.3 Remove any nozzle(s) from the pipe network to allow any foreign matter to blow clear.

6.6.4 Blow out all distribution piping with dry nitrogen to ensure the pipe work is not blocked or clogged, verifying that dry nitrogen is discharging at the end of the pipe where the nozzle(s) is(are) supposed to be installed.

6.6.5 Reinstall the system according to the installation manual.

7.0 POST-FIRE OPERATION

WARNING

DO NOT ENTER A HAZARD AREA WITH AN OPEN FLAME OR LIGHTED CIGARETTE. THE POSSIBLE PRESENCE OF FLAMMABLE VAPORS MAY CAUSE A SPARK, RE-IGNITION OR EXPLOSION.

WARNING

ENSURE FIRE IS COMPLETELY EXTINGUISHED BEFORE VENTILATING THE ENCLOSURE. PERSONNEL MUST USE A BREATHING APPARATUS OR VENTILATE THE ENCLOSURE THOROUGHLY BEFORE ENTERING THE HAZARD AREA.

After system discharge, a qualified fire suppression system maintenance personnel must perform post fire maintenance by checking the hazard area for sources of ignition. Observe all warnings and notices as a safety precaution before entering the hazard area. Inspect system components and nozzle(s) for its functionality and condition.

7.0.1 Uninstallation of agent cylinder

a) Disconnect all connection, fitting, actuation tubes and actuator from the agent cylinder.
b) Install outlet anti-recoil cap.
c) Remove cylinder brackets.
d) Remove agent cylinder.

7.0.2 For cylinder refilling, contact local distributor to arrange for refilling at an authorized UL fill station. The following procedures to enable the refilling of a cylinder that has been discharged.

- Check that the cylinder is empty.
- Remove the removable electrical actuator from the actuation port.
- Recharging LIFECO-HFC227 Cylinder(s)

Note: Refilling of HFC-227ea agent can be done on condition that the respective cylinder condition permits and has undergone hydrostatic test less than 5 years.

WARNING

ONLY QUALIFIED (TRAINED) PERSONNEL SHOULD OPERATE CHARGING EQUIPMENT. EXERCISE EXTREME CARE WHEN WORKING WITH PRESSURE EQUIPMENT TO PREVENT INJURY TO PERSONNEL AND DAMAGE TO PROPERTY, RESULTING FROM CARELESS HANDLING OR POSSIBLE EQUIPMENT FAILURE. PERFORM ALL OPERATIONS IN AN ASSIGNED AREA CLEARED OF ALL UNAUTHORIZED PERSONNEL. MAKE SURE ALL EQUIPMENT IS PROPERLY SECURED AND ALL PERSONNEL SHOULD WEAR PERSONAL PROTECTIVE EQUIPMENT IN THE FILL STATIONS.

7.1 FILLING LIFECO-HFC227

- Filled cylinders to be provided with a cylinder label to indicate the cylinder part number, filled weight and etc.

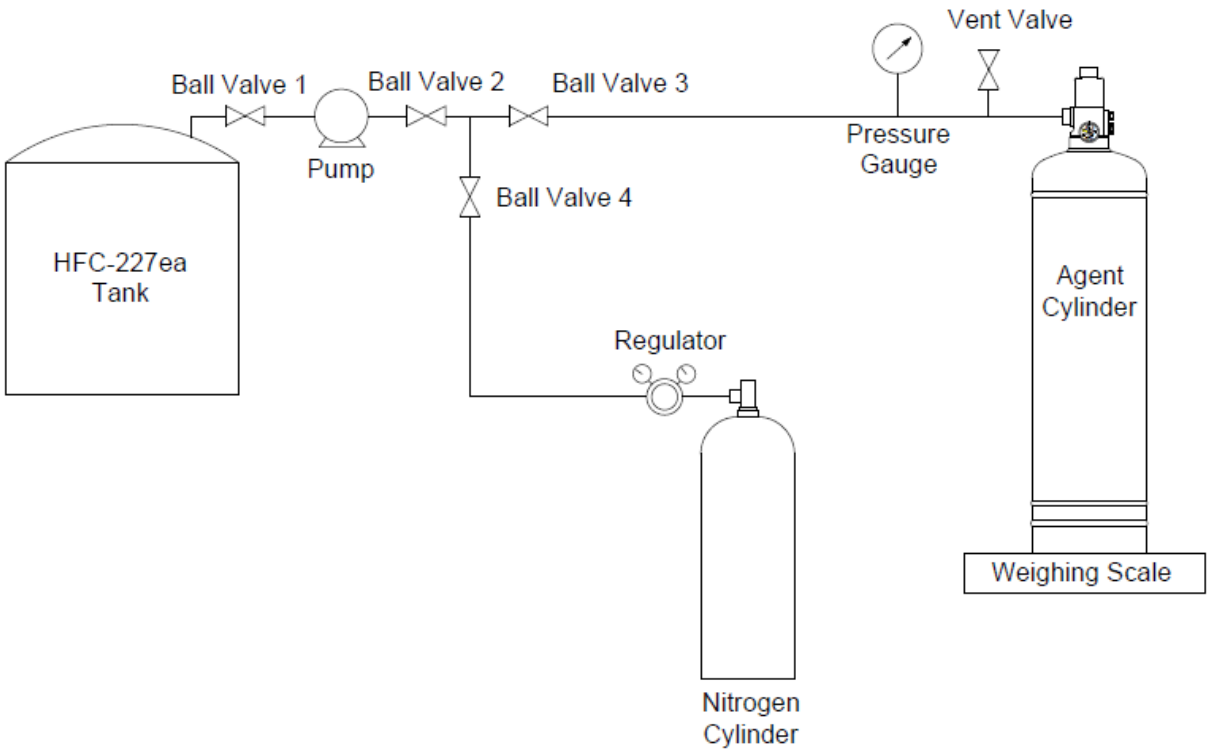


Figure 58: Filling Station Example Set Up

Note: The cylinder is filled through the valve discharge outlet. Once the filling is completed, Refit the valve outlet with safety cap for safety purpose.

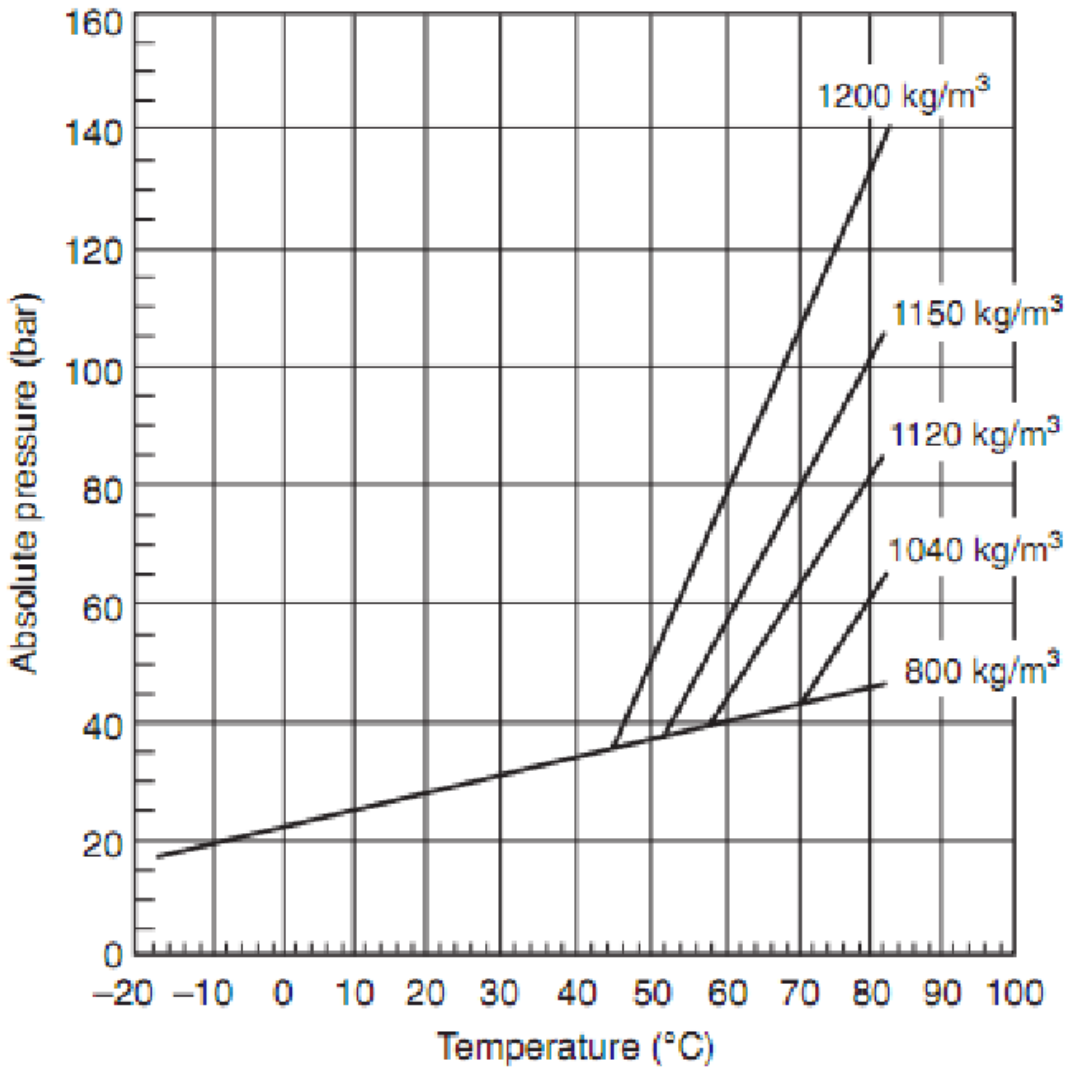
When Fill station equipment is not available,

- Manually fill can be done by using a suitable agent transfer pump with an externally calibrated pressure gauge which is use to verify the container intended charge pressure and a pressure regulator is required when the pressure source is a tank of high-pressure gas.

7.2 FILLING INFORMATION

The filling station for LIFECO-HFC227 systems is used to transfer the liquefied compressed gas HFC-227ea from bulk tank into system cylinders. Filling process can only be carried out by trained and authorized person. The filling procedure are as below:

- Issue work order to production person in-charged.
- Relocate the required cylinder to the fill station.
- Visual Inspection shall be done to ensure cylinder is in good condition.
- Place the cylinder on scale platform and strap with belt to secure the cylinder during filling operation for safety purpose to obtain empty cylinder weight.
- Attach appropriate filling adaptor to cylinder discharge outlet.
- Reset the weighing scale to zero.
- Key in all the required detailed of the cylinder serial no, filled weight, cylinder size, purchase order, work order, bulk tank serial number, empty cylinder weight into computer.
- Verify agent temperature by measuring cylinder temperature.
- Adjust the pressure according to pressure-temperature graph.
- Press start button to start the filling process.
- Agitate the filled cylinder to approximately 10 mins with 60 cycles agitation.
- Re-pressurizes the cylinder if pressure drop after agitation.
- Disconnect the filling adaptor and refit with valve outlet safety cap.
- Secure cylinder(s) on transport cage or pallets.
- Ship to customer or site as per order.



ISOMETRIC DIAGRAM OF HFC227EA PRESSURIZED TO 25 BAR, GAUGE AT 21℃

(Source: Graph 36: Pressure-Temperature Graph Provided By HFC-227ea Manufacturer)

8.0 WARRANTY

LIFECO warrants all of the system hardware which is supplies to the customers shall be free from defects in materials and workmanship for a period of one (1) year from the date of installation.

The limited warranty is based upon the customer satisfying the following conditions:

- The system hardware must be supplied, designed, installed and commissioned by LIFECO and its distributor, in accordance with the instructions contained in this manual or other data sheet / information supplied with LIFECO hardware.
- The LIFECO hardware has not been altered or modified.
- Within thirty (30) days after the customer's finding of what the customer believes is a manufacturing defect, the customer must notify LIFECO in writing and ship the hardware to LIFECO.
- LIFECO at its option and within 45 days of receipt, will repair, replace or refund the purchase price of that hardware or system found to be defective. Failure of customer to give such written notice and ship the hardware within thirty (30) days shall be deemed absolute and unconditional waiver of any and all claims of the customer arising out of such defect.

The warranty shall not apply in the following circumstances such as:

- The system cylinders filled or refilled by other parties than LIFECO or distributor approved by LIFECO.
- Any system hardware is found to be non-genuine or supplied other than LIFECO and its distributor.
- System hardware have been modified, serviced, or maintained by other parties than LIFECO and its qualified / certified distributor's technicians.

Limitation of Damages such as:

- LIFECO shall not be liable for incidental consequential, lost profit or other losses arising out of or alleged caused by the use of any LIFECO system hardware.
- LIFECO shall not be liable for, all personal injury and property damage in connected with handling, transportation, possession, or other use or resale of system hardware, whether used alone or in combination with any other products or materials.

9.0 DISCLAIMERS

The contents herein are reasonably believed to be correct at the time of issue but that may not have been independently verified and are subject to change. The information in this manual LF227MAL-0001 is subject to change without notice. Neither does this manual purport to contain all the information that a qualified clean agent installer or the system user may require. All issues are uncontrolled copies.

10.0 APPENDICES

APPENDIX A – LIFECO-HFC227 Hydraulic Flow Calculation Program

Flow Calculation Software v4.00 (HFC-227ea)

File Name:

Consolidated Report

Customer Information

Phone:
Contact:
Title:

Project Data

Project Name:
Designer:
Number:
Account:
Location:
Description:

Enclosure Report

Elevation: 0 m (relative to sea level)
Atmospheric Correction Factor: 1 (NFPA 2001)

Enclosure 1 Server Room

Enclosure Temperature:		Number of Nozzles:	1
Minimum:	20.0 C	Width:	0.00 m
Maximum:	20.0 C	Length:	0.00 m
Max. Concentration:	0.00 %	Height:	0.00 m
Design Concentration:		Volume:	0.00 m ³
Adjusted:	7.00 %	Non-permeable:	0.00 m ³

Calculation Date/Time: Monday, July 18, 2022, 11:40:00 AM
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Key ID: 2049470579

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Consolidated Report

Minimum:	7.00 %	Total Volume:	100.00 m ³
Min. Agent Required:	54.99 kg		
Adjusted Agent Required:	55.00 kg		

Agent Source Report

Agent:	HFC-227ea / Propellant N2
Cylinder Name:	106L DOT Cylinder
Cylinder Part Number:	
Agent Per Cylinder:	55.00 kg
Cylinder Pressure:	24.81429 bar
Fill Density:	0.519 kg / l
Number of Main Cylinders:	1
Number of Reserve Cylinders:	0
Cylinder Empty Weight:	78.60 kg
Weight, All Cylinders + Agent:	133.60 kg
Floor Area Per Cylinder:	0.13 m ²
Floor Loading Per Cylinder:	1028 kg /m ²

Calculation Date/Time: Monday, July 18, 2022, 11:40:00 AM

Key ID: 2049470579

Consolidated Report

Parts Report

Total Agent Required: 55.00 kg

Cylinder Name: 106L DOT Cylinder

Number of Cylinders: 1

Nozzle	Type	Nozzle Diameter	Nozzle Area	Part Number
E1-N1	360	25 mm	316.74 mm ²	

Nozzle	Drill Diameter	Drill Size
E1-N1	7.1000 mm	7.1 mm

Pipe & Fittings	Type	Diameter	Length	Elbows (90)	Elbows (45)	Tees	Unions
	40T	25 mm	4.60 m	3	0	0	0
	40T	32 mm	0.30 m	0	0	1	0

Other Objects	Name	Quantity	Part Number
	50 mm Flex Hose - 90° Bend	1	
	End Cap	1	EndCap

System Acceptance Report

System Discharge Time:	9.9 seconds
Percent Agent In Pipe:	16.0%
Percent Agent Before First Tee:	0.0%
Dead Volume:	0.0% (0.02 kg)

Enclosure Number:	1
Enclosure Name:	Server Room
Minimum Design Concentration:	7.00%
Adjusted Design Concentration:	7.00%

Calculation Date/Time: Monday, July 18, 2022, 11:40:00 AM

Key ID: 2049470579

Consolidated Report

Predicted Concentration: 7.00%
Maximum Expected Agent Concentration: 7.00% (At 20.0 C)

Nozzle	Minimum Agent Required	Adjusted Agent Required	Predicted Agent Delivered	Average Nozzle Pressure
E1-N1	54.99 kg	55.00 kg	54.98 kg	13.372 bar
Total	54.99 kg	55.00 kg	54.98 kg	

Calculation Date/Time: Monday, July 18, 2022, 11:40:00 AM

Key ID: 2049470579

Consolidated Report

Pipe Network Report

Description	Pipe Section	Start Node	End Node	Pipe Type	Pipe Diameter	Pipe Length	Union	Total Elevation Change	Total Equivalent Length	Nozzle Name	Nozzle Size	Nozzle Type	Nozzle Area
Cylinder - On	Man.	0	4		50 mm	1.03 m	0	1.03 m	10.67 m				
Flex Hose	Man.	4	5		50 mm	0.53 m	0	0.27 m	5.36 m				
Tee	Man.	2	6	40T	32 mm	------	0	------	0.70 m				
End Cap	Man.	1	2	40T	32 mm	0.10 m	0	------	999.00 m				
Tee	Man.	5	6	40T	32 mm	------	0	------	2.29 m				
Pipe	Man./End	6	7	40T	32 mm	0.30 m	0	------	0.30 m				
Pipe	System	7	8	40T	25 mm	0.30 m	0	------	0.30 m				
Elbow (90)	System	8	9	40T	25 mm	------	0	------	0.85 m				
Pipe	System	9	10	40T	25 mm	2.00 m	0	2.00 m	2.00 m				
Elbow (90)	System	10	11	40T	25 mm	------	0	------	0.85 m				
Pipe	System	11	12	40T	25 mm	2.00 m	0	------	2.00 m				
Elbow (90)	System	12	13	40T	25 mm	------	0	------	0.85 m				
Pipe&Nozzle	System	13	14	40T	25 mm	0.30 m	0	-0.30 m	0.30 m	E1-N1	25 mm	360	316.74 mm ²

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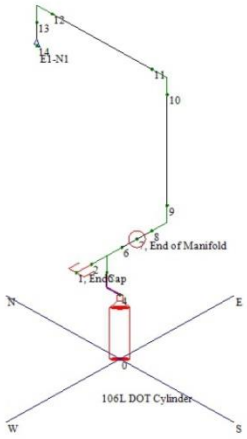
View #: 1 - Isometric View-Node

Consolidated Report



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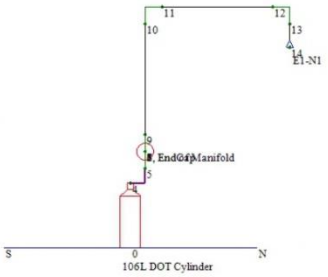
View #: 5 - Standard Elevation View

Consolidated Report



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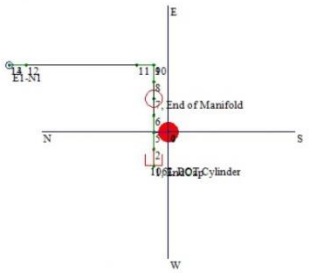
View #: 9 - Standard Plan View

Consolidated Report



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APPENDIX B –HFC-227ea SAFETY DATA SHEET

Safety Data Sheet

Section 1 – Chemical Product and Company Identification	
Product Name	LIFECO-HFC227 HFC-227ea Gas Suppression System (with Nitrogen expellant)
Agent	HFC-227ea
Chemical Name	1,1,1,2,3,3,3-Heptafluoropropane
Synonym	Heptafluoropropane; HFC-227ea
Product Use	Fire extinguishing agent
Agent Supplier	Lichfield Fire & Safety Equipment CO LTD
Supplier Address	Edmund House 12-22 Newhall Street, Birmingham, B3 3AS United Kingdom
Email	sales@lifeco-uk.com
Telephone	+44 (0) 1902 798 706
Fax	+44 (0) 1902 798 679

Section 2 –Hazard Identification	
OSHA/HCS status	This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200)
Classification of the substance or mixture	Gases under pressure - Liquefied gas
GHS label elements	
Hazard pictograms	
Signal word	Warning
Hazard statements	H280: Contains gas under pressure; may explode if heated
Precautionary statements	P210: Keep away from heat/sparks/open flame. – No smoking P233: Keep container tightly closed in a cool/well-ventilated place P260: Do not breathe dust/fumes/gas/vapours/spray P273: Avoid release to the environment P280: Wear protective gloves/protective clothing/eye protection/face protection P403: Use and store only in a well-ventilated area
	May cause frostbite May displace oxygen and cause rapid suffocation
Other Hazard	Overheating and over pressurizing may cause gas release or violent cylinder bursting

MSDS No: LF-MSDS-HFC227 Revision date: 28.11.2023 Version 2.0
- 1 -

Safety Data Sheet

In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation

Section 3 – Composition/Information on Ingredients

Ingredient name	CAS No.	%(weight)
1,1,1,2,3,3,3 - heptafluoropropane	431-89-0	≥99.90

Section 4 – First Aid Measures

Inhalation	Remove to fresh air Oxygen or artificial respiration if needed If unconscious, place in recovery position and get medical attention immediately
Skin	Flush exposed skin with lukewarm water (not hot), or use other means to warm skin slowly Remove contaminated clothing and shoes Get medical attention if frostbitten by liquid or if irritation persists
Eyes	Immediately flush with large amounts of water for at least 15 minutes Get medical attention if irritation occurs
Ingestion	As this product is a gas, refer to the inhalation section Immediate medical attention is not required
Note to physician	When symptoms persist or in all cases of doubt seek medical advice

Section 5 – Fire Fighting Measures

Extinguishing media	Heptafluoropropane is a fire extinguishing media. Use media appropriate for surrounding material
Special hazards arising from the substance or mixture	Thermal decomposition can lead to release of irritating or toxic gases/vapors: carbon oxides, halogenated compounds Contains gas under pressure. In a fire or if heated, a pressure increase will occur and the container may burst or explode
Special protective equipment for firefighters	Wear self-contained breathing apparatus with a full face-piece operated in positive pressure mode and chemical-protective clothing. Prevent fire extinguishing water from contaminating surface water or the ground water system

Section 6 – Accidental Release Measures

Personal precautions, protective equipment and emergency procedures	Refer to SECTION 8 for personal protective equipment. Prevention of skin and eye contact. Ensure adequate ventilation. Remove all sources of ignition.

Safety Data Sheet

	Shut off gas supply if this can be done safely. Isolate area until gas has dispersed
Environmental precautions	Do not discharge into drains/surface waters/groundwater
Methods and material for containment and cleaning up	Evacuate area. Keep upwind. Stop leak if without risk. Ventilate area especially low places remove open flames and heating elements. Disperse gas with floor level forced air
Reference to other SECTIONs	See SECTION 7 for information on safe handling See SECTION 8 for information on personal protection equipment See SECTION 13 for information on disposal

Section 7 – Handling and Storage

Handling	Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement
Storage	Keep container tightly closed and in a cool, well-ventilated place. Keep out of direct sunlight. Keep away from heat and ignition sources
Packing material	Steel drum

Section 8 –Exposure Controls/Personal Production

8.1 Control parameters

Occupational exposure limit values	Not established
DNEL (Derived No Effect Level) for workers and the general population	Not available
PNEC (Predicted No Effect Concentration) values	Not available

8.2 Exposure controls

Appropriate engineering controls	Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits
Personal protective equipment	
Respiratory Protection	In case of inadequate ventilation wear respiratory protection
Skin Protection	Wear protective gloves/clothing to prevent contact
Eye Protection	Safety glasses/chemical splash goggles
Environmental exposure controls	Do not empty into drains

Safety Data Sheet

Section 9 – Physical and Chemical Properties

9.1 Information on basic physical and chemical properties

Appearance	Liquefied gas
Color	colorless
Odour	inodorous
pH	Not available
Melting point	Not available
Boiling point	-16.36 °C
Flash point	Not available
Evaporation rate	Not available
Flammability (solid, gas)	Not flammable
Upper/lower flammability or explosive limits	Not available
Vapour pressure	457.7 Kpa (25°C)
Specific gravity（H_2O=1）	1.388 g/cm³
Solubility(ies)	Not available
Partition coefficient: n-octanol/water	log Kow = 2.11
Auto-ignition temperature	Not available
Viscosity	0.226 mPa.s (25°C)
Explosive properties.	Not available
Oxidising properties	Not available

9.2 Other information No data available.

Section 10 – Stability and Reactivity

Reactivity	Stable under recommended storage and handling conditions (see SECTION 7, handling and storage)
Chemical stability	Stable under normal conditions of use
Possibility of hazardous reactions	No known hazardous reactions
Conditions to avoid	Keep away from heat and ignition sources. Protect from sunlight
Incompatible materials	Strong oxidizing materials
Hazardous decomposition products	Thermal decomposition can lead to release of irritating or toxic gases/vapors: carbon oxides, halogenated compounds

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Section 11 – Toxicological Information

11.1 Information on toxicological effects Acute Toxicity

Ingredient name	LD50 Oral	LD50 Dermal	LC50 Inhalation
1,1,1,2,3,3,3 - heptafluoropropane	Not data available	Not data available	788,698 ppm/4h (rat).

Skin corrosion/irritation	No information available
Serious eye damage/irritation	No information available
Respiratory or skin sensitization	No information available
Germ cell mutagenicity	No information available
Reproductive toxicity	No information available
STOT-single exposure	No information available
STOT-repeated exposure	No information available
Aspiration hazard	No information available
Carcinogenicity	Not listed as a carcinogen by NTP, IARC, or OSHA

Section 12 – Ecological Information

Toxicity (Ecotoxicity Fish, LC_{50})	Not available
Degradability	Atmospheric lifetime is approximately 34.2 years
Bioaccumulation/ Accumulation	Bioaccumulation is not expected (Log Kow < 3)
Mobility in Environmental Media	Not available
Other adverse effects	Ozone Depletion Potential (CFC 11 = 1.0): 0.00 Global Warming Potential (CO_2 = 1.0): 3,220

Section 13 –Disposal Considerations

Waste Disposal Method

Disposal must be made according to local and national regulations. Empty containers should be taken for local recycling, recovery or waste disposal.

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Section 14—Transport Information

UN, IMDG, IATA No	UN 1058
UN, IMDG, IATA proper shipping name	Liquefied gases, non-flammable, charged with Nitrogen
Label	
Transport hazard class	2
Packing group	Not applicable
Packing instructions	Not applicable
Environmental hazards	Not classified as a Marine Pollutant
Special precautions for user	Before transporting - Ensure there is adequate ventilation - Ensure that containers are firmly secured. - Ensure cylinder valve is closed and not leaking. - Ensure valve outlet cap (where provided) is correctly fitted.
Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code	Not applicable

Section 15—Regulatory Information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture
Listed in international inventories:

Ingredient name	TSCA	DSL	NDSL	ELINCS	ENCS	CHINA	KECL	PICCS	AICS
1,1,1,2,3,3,3 - heptafluoropropane	YES	YES	NDA	YES	YES	YES	YES	NDA	YES

15.2. Other regulations

US. EPA Emergency Planning and Community Right-To-Know Act (EPCRA) SARA Title III Section 302 Extremely Hazardous Substance (40 CFR 355, Appendix A)

- not regulated.

US. EPA Emergency Planning and Community Right-To-Know Act (EPCRA) SARA Title III Section 313 Toxic Chemicals (40 CFR 372.65) - Supplier Notification Required

- not regulated.

US. EPA CERCLA Hazardous Substances (40 CFR 302)

- not regulated.

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US. New Jersey Worker and Community Right-to-Know Act (New Jersey Statute Annotated Section 34:5A-5)

- not regulated.

US. Pennsylvania Worker and Community Right-to-Know Law (34 Pa. Code Chap. 301-323)

- not regulated.

US. California Safe Drinking Water & Toxic Enforcement Act (Proposition 65)

- not regulated.

Section 16 – Other Information

HMIS Rating

Health: 1 Flammability:0 Physical Hazard:0

Disclaimer

In accordance with good practices of personal cleanliness and hygiene handle with the care and avoid unnecessary contact with this product. This information is being supplied to you under OSHA Hazard Communication Standard 29 CFR 1910.1200 and is offered in good faith as typical values and not as a product specification. The information contained herein is based on the data available to us and is believed to be true and accurate. No warranty expressed or implied regarding the accuracy of this data. The hazards connected with the use of the material or the results to be obtained from the use thereof are made. LIFECO assumes no responsibility for damage or injury from the use of the product described herein.

Appendix C – Safety Bulletins

LIFECO-HFC227 Engineered fire suppression system uses pressurized cylinders, therefore, personnel responsible for fire suppression systems must be aware of the dangers associated with the improper handling, installation and maintenance of the system equipment.

Fire suppression system service personnel must be thoroughly trained in the proper handling, installation and maintenance of LIFECO equipment and follow the instructions of this manual. Warnings, cautions and important notes written in this manual are to be adhered to at all times. Failure to do so may result in serious injury to personnel.

Important safety memos before handling a cylinder.

- PRESSURIZED CYLINDERS ARE EXTREMELY HAZARDOUS AND IF NOT HANDLED PROPERLY ARE CAPABLE OF VIOLENT DISCHARGE. THIS MAY RESULT IN SERIOUS BODILY INJURY, DEATH AND PROPERTY DAMAGE.
- Before handling LIFECO-HFC227 cylinder(s), all personnel must be thoroughly trained in the safe handling of the cylinder(s) as well as in the proper procedures for installation, removal, filling and connection of other components, such as a electrical actuator(s) to ensure **fault light doesn't show up** and connecting the discharge pipe to the valve outlet.
- READ, UNDERSTAND and ALWAYS FOLLOW this operation and maintenance manual.

Safe cylinder handling procedures

- When moving a cylinder or cylinders, they must be shipped compactly in the upright position and must be properly secured in place. Cylinder(s) must neither be rolled, dragged/slid, nor allowed to be slid from tailgates of moving vehicles. A suitable hand truck, forklift truck, roll platform or a similar transport equipment or vehicle must be used.
- When handling a cylinder or cylinders, they must not be dropped or permitted to strike violently against each other or other surfaces.
- Cylinder(s) must be stored in a standing upright position where they are not likely to be knocked over and they must be secured. Cylinder(s) should not be positioned in direct sunlight, area exceeding 50^{o}C (122^{o}F) or below 0^{o}C (32 ^{o}F).

Appendix D – LIFECO-HFC227 Liquid Level Indicator Chart

LIFECO-HFC227 HFC-227ea Liquid Level Chart - 106L

(in.)	Temperature(°C) / Weight of Agent (kg)										
	0	5	10	15	20	25	30	35	40	45	50
7.5											
7.75	50.5	49.9									
8	51.5	51.0	50.6	50.1	50.1						
8.25	52.6	52.0	51.6	51.2	51.1	50.7	49.9				
8.5	53.7	53.1	52.7	52.2	52.1	51.7	50.9	50.4	50.7		
8.75	54.8	54.1	53.7	53.2	53.1	52.7	51.9	51.3	51.6		
9	55.9	55.2	54.8	54.3	54.1	53.7	52.9	52.3	52.5	51.3	50.8
9.25	56.9	56.3	55.8	55.3	55.1	54.7	53.8	53.2	53.4	52.2	51.7
9.5	58.0	57.4	56.9	56.3	56.1	55.7	54.8	54.2	54.4	53.1	52.6
9.75	59.1	58.4	57.9	57.4	57.2	56.7	55.8	55.1	55.3	54.0	53.5
10	60.2	59.5	59.0	58.4	58.2	57.7	56.8	56.1	56.2	54.9	54.4
10.25	61.2	60.5	60.0	59.5	59.2	58.8	57.8	57.0	57.2	55.8	55.3
10.5	62.3	61.6	61.1	60.5	60.3	59.8	58.8	58.0	58.1	56.7	56.2
10.75	63.4	62.7	62.1	61.5	61.3	60.7	59.7	58.9	59.0	57.6	57.1
11	64.5	63.8	63.2	62.6	62.3	61.7	60.7	59.9	59.9	58.5	58.0
11.25	65.6	64.8	64.2	63.6	63.3	62.7	61.7	60.8	60.8	59.4	58.9
11.5	66.6	65.9	65.3	64.6	64.4	63.7	62.7	61.8	61.7	60.3	59.8
11.75	67.7	66.9	66.3	65.7	65.3	64.7	63.7	62.7	62.7	61.3	60.8
12	68.8	68.0	67.4	66.7	66.4	65.7	64.6	63.7	63.6	62.2	61.7
12.25	69.9	69.1	68.4	67.8	67.4	66.7	65.6	64.6	64.5	63.1	62.6
12.5	71.0	70.1	69.5	68.8	68.4	67.7	66.6	65.6	65.4	64.0	63.5
12.75	72.0	71.2	70.6	69.8	69.4	68.8	67.6	66.5	66.4	64.9	64.4
13	73.1	72.3	71.6	70.8	70.5	69.8	68.6	67.5	67.3	65.8	65.3
13.25	74.2	73.3	72.6	71.9	71.5	70.8	69.6	68.4	68.2	66.7	66.2
13.5	75.3	74.4	73.7	72.9	72.5	71.8	70.5	69.4	69.1	67.6	67.1
13.75	76.4	75.5	74.7	74.0	73.5	72.8	71.5	70.4	70.0	68.5	68.0
14	77.4	76.5	75.8	75.0	74.6	73.8	72.5	71.3	71.0	69.5	69.0
14.25	78.5	77.6	76.8	76.1	75.6	74.8	73.5	72.3	71.9	70.4	69.9
14.5	79.6	78.7	77.9	77.1	76.6	75.8	74.5	73.2	72.8	71.3	70.8
14.75	80.7	79.7	78.9	78.1	77.6	76.8	75.5	74.2	73.7	72.2	71.7
15	81.8	80.8	80.0	79.1	78.6	77.7	76.4	75.1	74.7	73.1	72.6
15.25	82.8	81.9	81.0	80.2	79.7	78.7	77.4	76.1	75.6	74.0	73.5
15.5	83.9	82.9	82.0	81.2	80.7	79.7	78.4	77.0	76.6	74.9	74.4
15.75	85.0	84.0	83.0	82.2	81.7	80.7	79.4	78.0	77.5	75.9	75.4
16	86.1	85.0	84.1	83.2	82.7	81.7	80.3	78.9	78.4	76.8	76.3
16.25	87.2	86.0	85.1	84.2	83.7	82.7	81.3	79.9	79.3	77.7	77.2
16.5	88.2	87.1	86.1	85.2	84.7	83.7	82.3	80.8	80.3	78.6	78.1

16.75	89.3	88.1	87.2	86.2	85.7	84.7	83.3	81.8	81.2	79.5	79.0
17	90.4	89.2	88.1	87.2	86.7	85.7	84.2	82.7	82.1	80.4	79.9
17.25	91.5	90.2	89.1	88.2	87.7	86.6	85.2	83.7	83.0	81.3	80.8
17.5	92.6	91.2	90.1	89.2	88.7	87.6	86.2	84.6	83.9	82.2	81.7
17.75	93.6	92.3	91.1	90.2	89.7	88.6	87.2	85.6	84.8	83.2	82.7
18	94.7	93.3	92.1	91.2	90.7	89.6	88.1	86.5	85.7	84.1	83.6
18.25	95.8	94.4	93.1	92.2	91.7	90.6	89.1	87.5	86.6	85.0	84.5
18.5	96.9	95.4	94.1	93.2	92.7	91.6	90.1	88.4	87.6	85.9	85.4
18.75	98.0	96.5	95.1	94.2	93.7	92.6	91.1	89.4	88.5	86.8	86.3
19	99.0	97.5	96.2	95.2	94.7	93.6	92.1	90.3	89.4	87.7	87.2
19.25	100.1	98.5	97.2	96.2	95.7	94.6	93.0	91.2	90.3	88.6	88.1
19.5	101.2	99.6	98.2	97.3	96.7	95.5	94.0	92.2	91.2	89.6	89.1
19.75	102.3	100.6	99.2	98.3	97.7	96.5	95.0	93.1	92.1	90.5	90.0
20	103.4	101.7	100.2	99.3	98.7	97.5	96.0	94.1	93.0	91.4	90.9
20.25	104.4	102.7	101.2	100.3	99.7	98.5	96.9	95.0	94.0	92.4	91.9
20.5	105.5	103.8	102.3	101.3	100.7	99.5	97.9	96.0	94.9	93.3	92.8
20.75	106.6	104.8	103.3	102.3	101.7	100.5	98.9	96.9	95.8	94.2	93.7
21	107.7	105.8	104.2	103.3	102.7	101.5	99.9	97.8	96.7	95.1	94.6
21.25	108.8	106.9	105.3	104.3	103.7	102.5	100.8	98.8	97.6	96.0	95.5
21.5	109.8	107.9	106.3	105.3	104.7	103.5	101.8	99.7	98.5	96.9	96.4
21.75		108.9	107.3	106.3	105.7	104.4	102.8	100.7	99.4	97.8	97.3
22			108.3	107.3	106.7	105.4	103.8	101.6	100.3	98.8	98.3
22.25				108.3	107.7	106.4	104.7	102.6	101.3	99.7	99.2
22.5					108.7	107.4	105.7	103.5	102.2	100.6	100.1
22.75							106.7	104.4	103.1	101.5	101.0
23							107.7	105.4	104.0	102.5	102.0
23.25							108.6	106.3	104.9	103.4	102.9
23.5							109.6	107.3	105.8	104.3	103.8
23.75									106.7	105.2	104.7
24									107.7	106.1	106.1
24.25									108.6	107.1	107.5
24.5										108.1	108.9
24.75										109.0	110.3
25										110.0	111.7

LIFECO-HFC227 HFC-227ea Liquid Level Chart - 147L

(in.)	Temperature(°C) / Weight of Agent (kg)										
	0	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**
10											
10.25	70.1	69.6									
10.5	71.2	70.7	70.8	70.3							
10.75	72.4	71.8	71.9	71.3	70.3	69.7					
11	73.5	72.9	73.0	72.4	71.3	70.7	70.5	69.7	69.3		
11.25	74.6	74.1	74.1	73.5	72.3	71.7	71.5	70.7	70.3		
11.5	75.8	75.1	75.2	74.6	73.4	72.8	72.5	71.7	71.3		
11.75	76.9	76.3	76.3	75.7	74.5	73.8	73.5	72.7	72.2		
12	78.0	77.4	77.3	76.7	75.5	74.8	74.5	73.7	73.2	72.3	69.4
12.25	79.2	78.5	78.5	77.8	76.6	75.8	75.5	74.7	74.2	73.3	70.4
12.5	80.3	79.6	79.6	78.9	77.6	76.9	76.5	75.6	75.1	74.2	71.4
12.75	81.4	80.7	80.7	80.0	78.7	77.9	77.5	76.6	76.1	75.2	72.3
13	82.6	81.9	81.7	81.1	79.7	78.9	78.5	77.6	77.1	76.2	73.3
13.25	83.7	83.0	82.8	82.1	80.8	80.0	79.5	78.6	78.0	77.1	74.3
13.5	84.8	84.1	83.9	83.2	81.9	81.0	80.5	79.6	79.0	78.1	75.3
13.75	86.0	85.2	85.1	84.3	82.9	82.0	81.5	80.6	80.0	79.1	76.2
14	87.1	86.3	86.1	85.3	84.0	83.0	82.5	81.5	80.9	80.0	77.2
14.25	88.2	87.4	87.2	86.4	85.0	84.1	83.5	82.5	81.9	81.0	78.2
14.5	89.4	88.6	88.3	87.5	86.1	85.1	84.5	83.5	82.9	82.0	79.2
14.75	90.5	89.7	89.4	88.6	87.1	86.1	85.5	84.5	83.8	82.9	80.1
15	91.6	90.8	90.5	89.6	88.2	87.2	86.5	85.5	84.8	83.9	81.1
15.25	92.8	91.9	91.6	90.7	89.2	88.2	87.5	86.5	85.8	84.9	82.1
15.5	93.9	93.1	92.7	91.8	90.3	89.2	88.5	87.5	86.7	85.8	83.1
15.75	95.1	94.1	93.8	92.8	91.3	90.2	89.5	88.4	87.7	86.8	84.0
16	96.2	95.3	94.9	93.9	92.4	91.2	90.5	89.4	88.7	87.8	85.0
16.25	97.3	96.4	96.0	95.0	93.4	92.3	91.5	90.4	89.6	88.7	86.0
16.5	98.5	97.5	97.1	96.1	94.5	93.3	92.5	91.4	90.6	89.7	87.0
16.75	99.6	98.6	98.2	97.1	95.6	94.3	93.5	92.4	91.6	90.7	87.9
17	100.7	99.8	99.3	98.2	96.6	95.4	94.5	93.3	92.6	91.7	88.9
17.25	101.9	100.9	100.4	99.3	97.6	96.4	95.5	94.3	93.5	92.6	89.9
17.5	103.0	102.0	101.5	100.4	98.7	97.4	96.5	95.3	94.5	93.6	90.9
17.75	104.2	103.1	102.6	101.4	99.8	98.5	97.5	96.3	95.5	94.6	91.8
18	105.3	104.2	103.7	102.5	100.7	99.5	98.5	97.2	96.4	95.5	92.8
18.25	106.4	105.3	104.8	103.6	101.9	100.5	99.5	98.2	97.4	96.5	93.8
18.5	107.6	106.4	105.9	104.7	103.0	101.5	100.5	99.2	98.4	97.5	94.8
18.75	108.7	107.6	107.0	105.7	104.0	102.5	101.5	100.2	99.3	98.4	95.7
19	109.8	108.7	108.1	106.8	105.0	103.6	102.5	101.2	100.3	99.4	96.7

19.25	111.0	109.8	109.1	107.9	106.1	104.6	103.5	102.2	101.3	100.4	97.7
19.5	112.0	110.9	110.2	109.0	107.2	105.6	104.5	103.1	102.2	101.3	98.7
19.75	113.1	112.0	111.3	110.0	108.2	106.7	105.5	104.1	103.2	102.3	99.6
20	114.2	113.0	112.3	111.1	109.3	107.7	106.5	105.1	104.2	103.3	100.6
20.25	115.2	114.1	113.4	112.1	110.3	108.7	107.5	106.1	105.1	104.2	101.6
20.5	116.3	115.1	114.4	113.1	111.3	109.7	108.5	107.1	106.1	105.2	102.5
20.75	117.4	116.1	115.4	114.2	112.3	110.7	109.5	108.1	107.1	106.2	103.5
21	118.4	117.2	116.4	115.2	113.3	111.7	110.5	109.0	108.0	107.1	104.5
21.25	119.5	118.3	117.4	116.2	114.3	112.7	111.5	110.0	109.0	108.1	105.5
21.5	120.6	119.3	118.4	117.1	115.3	113.6	112.4	111.0	110.0	109.1	106.4
21.75	121.7	120.4	119.5	118.2	116.3	114.6	113.4	111.9	110.9	110.0	107.4
22	122.7	121.4	120.5	119.2	117.3	115.6	114.4	112.9	111.9	111.0	108.4
22.25	123.8	122.5	121.5	120.2	118.3	116.6	115.3	113.8	112.8	111.9	109.4
22.5	124.9	123.5	122.5	121.2	119.3	117.6	116.3	114.8	113.7	112.8	110.3
22.75	126.0	124.6	123.6	122.2	120.3	118.5	117.2	115.8	114.6	113.7	111.3
23	127.1	125.6	124.6	123.2	121.3	119.5	118.2	116.7	115.5	114.6	112.2
23.25	128.1	126.7	125.6	124.2	122.3	120.5	119.2	117.6	116.5	115.6	113.1
23.5	129.2	127.7	126.6	125.2	123.3	121.5	120.1	118.6	117.4	116.5	114.1
23.75	130.3	128.7	127.6	126.3	124.3	122.5	121.1	119.5	118.3	117.4	115.0
24	131.3	129.8	128.6	127.3	125.3	123.4	122.0	120.5	119.3	118.4	115.9
24.25	132.4	130.8	129.7	128.3	126.3	124.4	123.0	121.4	120.2	119.3	116.9
24.5	133.5	131.9	130.7	129.3	127.3	125.4	124.0	122.3	121.1	120.2	117.8
24.75	134.5	133.0	131.7	130.3	128.2	126.4	124.9	123.3	122.0	121.1	118.7
25	135.6	134.0	132.7	131.3	129.2	127.4	125.9	124.2	122.9	122.0	119.7
25.25	136.7	135.1	133.8	132.3	130.2	128.3	126.8	125.1	123.9	123.0	120.6
25.5	137.8	136.1	134.8	133.3	131.2	129.3	127.8	126.1	124.8	123.9	121.6
25.75	138.8	137.1	135.8	134.3	132.3	130.3	128.8	127.0	125.7	124.8	122.5
26	139.9	138.2	136.8	135.3	133.2	131.3	129.7	128.0	126.7	125.8	123.4
26.25	141.0	139.2	137.8	136.3	134.2	132.3	130.7	128.9	127.6	126.7	124.4
26.5	142.1	140.3	138.8	137.3	135.2	133.2	131.6	129.9	128.5	127.6	125.3
26.75	143.2	141.4	139.9	138.3	136.2	134.2	132.6	130.8	129.4	128.5	126.2
27	144.2	142.4	140.9	139.4	137.2	135.2	133.5	131.8	130.3	129.4	127.2
27.25	145.3	143.4	141.9	140.4	138.2	136.2	134.5	132.7	131.3	130.4	128.1
27.5	146.4	144.5	142.9	141.4	139.2	137.1	135.5	133.6	132.2	131.3	129.0
27.75	147.4	145.5	144.0	142.4	140.2	138.1	136.4	134.6	133.1	132.2	130.0
28	148.5	146.6	145.0	143.4	141.2	139.1	137.4	135.5	134.0	133.1	130.9
28.25	149.5	147.7	146.0	144.4	142.2	140.1	138.3	136.5	135.0	134.1	131.9
28.5		148.7	147.0	145.4	143.2	141.1	139.3	137.4	135.9	135.0	132.8
28.75			148.1	146.4	144.2	142.0	140.3	138.3	136.8	135.9	133.7
29			149.0	147.4	145.2	143.0	141.2	139.3	137.7	136.8	134.7

29.25			150.1	148.4	146.2	144.0	142.2	140.2	138.2	137.3	135.6
29.5					147.2	145.0	143.2	141.2	139.6	138.7	136.5
29.75					148.2	146.0	144.1	142.1	140.5	139.6	137.5
30					149.2	146.9	145.1	143.1	141.4	140.5	138.4
30.25					150.2	147.9	146.1	144.0	142.3	141.4	139.3
30.5						148.9	147.0	145.0	143.3	142.4	140.3
30.75						149.9	148.0	145.9	144.2	143.3	141.2
31							148.9	146.8	145.1	144.2	142.1
31.25							149.9	147.8	146.1	145.2	142.1
31.5								148.8	147.0	146.1	143.1
31.75									147.9	147.0	144.0
32									148.8	147.9	145.0
32.25										148.8	145.9
32.5											146.8
32.75											147.8
33											148.8
33.25											149.8

LIFECO-HFC227 HFC-227ea Liquid Level Chart - 180L

(in.)	Temperature(°C) / Weight of Agent (kg)										
	0	5	10	15	20	25	30	35	40	45	50
2.5	86.6	85.9									
2.75	87.7	87.1	86.5	86.0	85.2						
3	88.9	88.2	87.6	87.1	86.3	86.2					
3.25	90.0	89.4	88.7	88.1	87.4	87.2					
3.5	91.1	90.5	89.8	89.2	88.5	88.2	87.0	86.3			
3.75	92.3	91.5	90.9	90.3	89.5	89.3	88.0	87.3			
4	93.4	92.7	92.0	91.4	90.6	90.3	89.0	88.3			
4.25	94.5	93.8	93.1	92.5	91.7	91.4	90.1	89.3			
4.5	95.7	94.9	94.3	93.6	92.7	92.4	91.1	90.3			
4.75	96.8	96.1	95.4	94.7	93.8	93.5	92.1	91.3	89.3	88.5	86.6
5	98.0	97.2	96.4	95.8	94.9	94.5	93.1	92.3	90.3	89.5	87.6
5.25	99.1	98.3	97.5	96.8	96.0	95.5	94.1	93.3	91.3	90.5	88.6
5.5	100.2	99.4	98.6	97.9	97.0	96.6	95.2	94.3	92.3	91.5	89.2
5.75	101.4	100.6	99.8	99.1	98.1	97.6	96.2	95.3	93.2	92.5	90.1
6	102.6	101.7	100.9	100.1	99.2	98.7	97.2	96.3	94.2	93.4	91.0
6.25	103.7	102.8	102.0	101.2	100.3	99.7	98.3	97.3	95.2	94.4	91.9
6.5	104.8	103.9	103.1	102.3	101.3	100.8	99.3	98.3	96.2	95.4	92.9
6.75	106.0	105.0	104.1	103.3	102.4	101.8	100.3	99.3	97.2	96.4	93.8
7	107.1	106.1	105.2	104.4	103.5	102.8	101.3	100.3	98.1	97.3	94.8
7.25	108.3	107.3	106.4	105.6	104.6	103.9	102.4	101.3	99.1	98.3	95.8
7.5	109.4	108.4	107.5	106.6	105.6	104.9	103.4	102.3	100.1	99.3	96.7
7.75	110.5	109.5	108.6	107.7	106.7	106.0	104.4	103.3	101.1	100.3	97.7
8	111.7	110.6	109.7	108.8	107.8	107.1	105.5	104.3	102.1	101.3	98.6
8.25	112.8	111.7	110.8	109.9	108.8	108.1	106.5	105.3	103.0	102.2	99.6
8.5	114.0	112.9	111.9	111.0	109.9	109.1	107.5	106.3	104.0	103.2	100.6
8.75	115.1	114.0	113.0	112.1	111.0	110.2	108.6	107.3	105.0	104.2	101.5
9	116.3	115.2	114.1	113.2	112.1	111.2	109.5	108.2	106.0	105.1	102.5
9.25	117.4	116.3	115.2	114.3	113.1	112.2	110.6	109.2	107.0	106.2	103.4
9.5	118.5	117.4	116.3	115.4	114.2	113.3	111.6	110.2	107.9	107.1	104.4
9.75	119.7	118.5	117.4	116.5	115.3	114.4	112.6	111.2	108.9	108.1	105.3
10	120.8	119.6	118.6	117.6	116.4	115.4	113.6	112.2	109.9	109.1	106.3
10.25	122.0	120.7	119.7	118.7	117.4	116.5	114.7	113.2	110.9	110.1	107.3
10.5	123.1	121.9	120.8	119.8	118.5	117.5	115.7	114.2	107.4	106.6	108.2
10.75	124.3	123.0	121.8	120.8	119.6	118.5	116.7	115.2	112.9	112.1	109.2
11	125.4	124.1	122.9	121.9	120.7	119.6	117.8	116.2	113.8	113.0	110.1
11.25	126.5	125.2	124.0	123.0	121.8	120.6	118.8	117.2	114.8	114.0	111.1
11.5	127.7	126.4	125.2	124.1	122.8	121.6	119.8	118.2	115.8	115.0	112.0

11.75	128.8	127.5	126.3	125.2	123.9	122.7	120.8	119.2	116.8	116.0	113.0
12	130.0	128.6	127.4	126.3	125.0	123.8	121.9	120.2	117.7	116.9	114.0
12.25	131.1	129.7	128.5	127.3	126.0	124.7	122.9	121.2	118.7	117.9	114.9
12.5	132.2	130.8	129.5	128.4	127.1	125.8	123.9	122.2	119.7	118.9	115.9
12.75	133.4	131.9	130.6	129.5	128.2	126.9	125.0	123.2	120.7	119.9	116.8
13	134.5	133.1	131.8	130.6	129.2	127.9	126.0	124.2	121.7	120.9	117.8
13.25	135.7	134.2	132.9	131.7	130.3	129.0	127.0	125.2	122.6	121.8	118.8
13.5	136.8	135.4	134.0	132.8	131.4	130.0	128.1	126.2	123.6	122.8	119.8
13.75	137.9	136.4	135.1	133.9	132.5	131.0	129.1	127.2	124.6	123.8	120.7
14	138.9	137.5	136.1	134.9	133.5	132.1	130.1	128.2	125.6	124.8	121.7
14.25	140.0	138.6	137.2	136.0	134.6	133.1	131.1	129.2	126.6	125.8	122.6
14.5	141.1	139.6	138.3	137.0	135.7	134.1	132.1	130.2	127.5	126.7	123.6
14.75	142.1	140.7	139.4	138.1	136.8	135.2	133.2	131.2	128.5	127.7	124.5
15	143.2	141.7	140.4	139.2	137.8	136.2	134.2	132.2	129.5	128.7	125.5
15.25	144.2	142.8	141.4	140.2	138.8	137.2	135.2	133.2	130.5	129.7	126.5
15.5	145.3	143.8	142.5	141.1	139.7	138.2	136.1	134.2	131.5	130.7	127.4
15.75	146.4	144.9	143.5	142.1	140.7	139.2	137.1	135.1	132.5	131.7	128.4
16	147.4	145.9	144.5	143.1	141.7	140.2	138.1	136.1	133.4	132.6	129.3
16.25	148.5	147.0	145.5	144.1	142.7	141.1	139.1	137.1	134.4	133.6	130.3
16.5	149.5	148.0	146.6	145.1	143.7	142.1	140.0	138.0	135.4	134.6	131.2
16.75	150.6	149.1	147.6	146.1	144.7	143.0	141.0	139.0	136.4	135.6	132.2
17	151.7	150.1	148.6	147.1	145.7	144.0	142.0	139.9	137.3	136.5	133.2
17.25	152.7	151.2	149.6	148.1	146.7	145.0	142.9	140.8	138.2	137.4	134.1
17.5	153.8	152.2	150.6	149.1	147.7	146.0	143.9	141.8	139.1	138.3	135.1
17.75	154.9	153.3	151.7	150.1	148.6	146.9	144.8	142.7	140.1	139.3	136.0
18	155.9	154.3	152.7	151.0	149.6	147.9	145.8	143.6	141.0	140.2	137.0
18.25	157.0	155.4	153.7	152.1	150.6	148.8	146.7	144.5	141.9	141.1	137.9
18.5	158.0	156.4	154.7	153.1	151.6	149.8	147.7	145.5	142.8	142.0	138.8
18.75	159.1	157.5	155.8	154.0	152.6	150.7	148.6	146.4	143.7	142.9	139.8
19	160.2	158.6	156.8	155.1	153.5	151.7	149.6	147.4	144.6	143.8	140.7
19.25	161.2	159.6	157.8	156.0	154.5	152.7	150.6	148.3	145.5	144.7	141.6
19.5	162.2	160.6	158.7	157.0	155.5	153.7	151.5	149.2	146.5	145.7	142.5
19.75	163.3	161.7	159.8	158.1	156.5	154.6	152.5	150.2	147.4	146.6	143.4
20	164.4	162.7	160.9	159.0	157.5	155.6	153.4	151.1	148.3	147.5	144.4
20.25	165.5	163.8	161.9	160.1	158.5	156.5	154.4	152.0	149.2	148.4	145.3
20.5	166.5	164.8	162.9	161.0	159.5	157.5	155.3	152.9	150.1	149.3	146.2
20.75	167.6	165.9	163.9	162.0	160.5	158.5	156.3	153.9	151.1	150.3	147.1
21	168.6	167.0	165.0	163.0	161.4	159.5	157.2	154.8	152.0	151.2	148.0
21.25	169.7	168.0	166.0	164.0	162.4	160.4	158.2	155.7	152.9	152.1	149.0
21.5	170.8	169.0	167.0	165.0	163.4	161.4	159.1	156.6	153.8	153.0	149.9

21.75	171.8	170.1	168.0	166.0	164.4	162.4	160.1	157.6	154.7	153.9	150.8
22	172.9	171.1	169.0	167.0	165.4	163.3	161.0	158.5	155.7	154.9	151.7
22.25	173.9	172.2	170.1	168.0	166.4	164.3	162.0	159.5	156.6	155.8	152.7
22.5	175.0	173.3	171.1	169.0	167.4	165.3	162.9	160.4	157.5	156.7	153.6
22.75	176.0	174.3	172.1	170.0	168.4	166.2	163.9	161.3	158.4	157.6	154.5
23	177.1	175.4	173.1	171.0	169.4	167.2	164.8	162.2	159.3	158.5	155.4
23.25	178.2	176.4	174.2	172.0	170.3	168.2	165.8	163.2	160.2	159.4	156.3
23.5	179.3	177.5	175.2	173.0	171.3	169.1	166.7	164.1	161.1	160.3	157.3
23.75	180.3	178.5	176.2	174.0	172.3	170.1	167.7	165.0	162.0	161.2	158.2
24	181.3	179.5	177.2	174.9	173.3	171.1	168.6	165.9	163.0	162.2	159.1
24.25	182.4	180.6	178.3	176.0	174.3	172.1	169.6	166.9	163.9	163.1	160.1
24.5	183.5	181.7	179.3	176.9	175.3	173.0	170.6	167.9	164.8	164.0	161.0
24.75	184.6	182.7	180.3	178.0	176.3	174.0	171.5	168.8	165.7	164.9	161.9
25	185.6	183.7	181.3	178.9	177.3	175.0	172.5	169.7	166.6	165.8	162.8
25.25			182.3	179.9	178.3	175.9	173.4	170.6	167.5	166.7	163.7
25.5			183.4	180.9	179.2	176.9	174.4	171.6	168.5	167.7	164.6
25.75			184.4	181.9	180.2	177.8	175.3	172.5	169.4	168.6	165.6
26					181.2	178.8	176.3	173.4	170.3	169.5	166.5
26.25					182.2	179.8	177.2	174.3	171.2	170.4	167.4
26.5					183.2	180.8	178.2	175.3	172.2	171.4	168.4
26.75					184.2	181.7	179.1	176.2	173.1	172.3	169.3
27					185.2	182.7	180.1	177.1	174.0	173.2	170.2
27.25							181.0	178.1	174.9	174.1	171.1
27.5							181.9	179.0	175.8	175.0	172.0
27.75							182.9	179.9	176.7	175.9	173.0
28							183.8	180.9	177.6	176.8	173.9
28.25							184.8	181.8	178.5	177.7	174.8
28.5							185.7	182.7	179.5	178.7	175.8
28.75									180.4	179.6	176.7
29									181.3	180.5	177.6
29.25									182.2	181.4	178.5
29.5											179.4
29.75											180.3
30											181.3
30.25											182.2

LIFECO-HFC227 HFC-227ea Liquid Level Chart - 369L

(in.)	Temperature(°C) / Weight of Agent (kg)										
	0	**5**	**10**	**15**	**20**	**25**	**30**	**35.0**	**40.0**	**45.0**	**50.0**
6	179.8	179.4	178.7	178.1	177.5	175.2	173.3	171.3	169.7	170.5	169.1
6.25	182.4	181.9	181.2	180.5	179.8	177.5	175.6	173.6	172.0	172.5	171.2
6.5	184.5	184.4	183.6	182.9	182.2	179.9	177.9	175.9	174.2	174.5	173.4
6.75	187.5	186.9	186.1	185.3	184.5	182.2	180.2	178.2	176.5	176.5	175.5
7	191.1	190.4	189.6	188.7	187.9	184.5	182.5	180.4	178.7	178.5	177.7
7.25	193.7	192.9	192.0	191.1	190.2	186.4	184.8	182.7	181.0	180.5	179.8
7.5	196.2	195.5	194.5	193.5	192.6	188.8	187.1	185.0	183.2	182.5	182.0
7.75	198.8	198.0	196.9	195.9	194.9	191.1	189.4	187.3	185.5	184.5	184.1
8	201.3	200.5	199.4	198.3	197.3	193.4	191.7	189.6	187.8	186.8	186.3
8.25	203.9	203.0	201.9	200.7	199.6	195.7	194.0	191.8	190.0	189.0	188.4
8.5	206.5	205.5	204.3	203.1	202.0	198.1	196.3	194.1	192.3	191.3	190.6
8.75	209.0	208.0	206.8	205.6	204.3	200.4	198.6	196.4	194.5	193.5	192.7
9	211.5	210.5	209.2	208.0	206.6	202.7	200.9	198.7	196.8	195.8	194.9
9.25	214.1	213.0	211.7	210.4	209.0	205.0	203.2	200.9	199.0	198.0	197.0
9.5	216.7	215.5	214.2	212.8	211.4	207.3	205.5	203.2	201.3	200.3	199.2
9.75	219.2	218.1	216.6	215.2	213.7	209.7	207.8	205.5	203.5	202.5	201.3
10	221.8	220.6	219.1	217.6	216.0	212.0	210.1	207.8	205.7	204.7	203.5
10.25	224.3	223.1	221.5	220.0	218.4	214.3	212.4	210.0	208.0	207.0	205.6
10.5	226.9	225.6	224.0	222.4	220.7	216.6	214.7	212.3	210.3	209.3	207.8
10.75	229.5	228.1	226.4	224.8	223.1	218.9	217.0	214.6	212.5	211.5	209.9
11	232.0	230.6	228.9	227.1	225.4	221.3	219.3	216.9	214.8	213.8	212.1
11.25	234.6	233.1	231.4	229.5	227.8	223.6	221.6	219.1	217.0	216.0	214.2
11.5	237.1	235.7	233.8	231.9	230.1	225.9	223.9	221.4	219.3	218.3	216.4
11.75	239.7	238.2	236.3	234.4	232.5	228.2	226.2	223.7	221.5	220.5	218.5
12	242.2	240.7	238.7	236.8	234.8	230.6	228.5	226.0	223.8	222.8	220.7
12.25	244.8	243.2	241.2	239.2	237.2	232.9	230.8	228.2	226.0	225.0	222.8
12.5	247.4	245.7	243.6	241.6	239.5	235.2	233.1	230.5	228.3	227.3	225.0
12.75	249.9	248.2	246.1	244.0	241.9	237.5	235.4	232.8	230.5	229.5	227.1
13	252.5	250.7	248.5	246.4	244.2	239.9	237.7	235.1	232.8	231.8	229.3
13.25	255.0	253.3	251.0	248.8	246.6	242.2	239.9	237.3	235.0	234.0	231.4
13.5	257.6	255.8	253.5	251.2	248.9	244.5	242.3	239.6	237.3	236.3	233.6
13.75	260.2	258.3	255.9	253.6	251.3	246.8	244.6	241.9	239.5	238.5	235.7
14	262.7	260.8	258.4	256.0	253.6	249.1	246.9	244.2	241.8	240.8	237.9
14.25	265.2	263.3	260.8	258.4	255.9	251.5	249.2	246.5	244.0	243.0	240.0
14.5	267.8	265.8	263.3	260.8	258.3	253.8	251.5	248.7	246.3	245.3	242.2
14.75	270.4	268.3	265.8	263.2	260.7	256.1	253.8	251.0	248.6	247.6	244.3
15	272.9	270.8	268.2	265.6	263.0	258.4	256.0	253.3	250.8	249.8	246.5

15.25	275.5	273.4	270.7	268.0	265.3	260.8	258.4	255.5	253.0	252.0	248.6
15.5	278.0	275.8	273.1	270.4	267.7	263.1	260.7	257.8	255.3	254.3	250.8
15.75	280.6	278.4	275.6	272.8	270.0	265.4	262.9	260.1	257.5	256.5	252.9
16	283.1	280.9	278.0	275.2	272.4	267.7	265.3	262.4	259.8	258.8	255.1
16.25	285.7	283.4	280.5	277.6	274.7	270.0	267.6	264.6	262.1	261.1	257.2
16.5	288.3	285.9	283.0	280.0	277.1	272.4	269.9	266.9	264.3	263.3	259.4
16.75	290.8	288.4	285.4	282.4	279.5	274.7	272.1	269.2	266.6	265.6	261.5
17	293.4	291.0	287.9	284.8	281.7	277.0	274.5	271.5	268.8	267.8	263.7
17.25	295.9	293.4	290.3	287.2	284.1	279.3	276.8	273.8	271.0	270.0	265.8
17.5	298.3	295.8	292.7	289.6	286.5	281.7	279.0	276.0	273.3	272.3	268.0
17.75	300.8	298.3	295.1	291.9	288.8	284.0	281.4	278.3	275.5	274.5	270.1
18	303.2	300.7	297.5	294.3	291.1	286.3	283.7	280.6	277.8	276.8	272.3
18.25	305.7	303.1	299.9	296.7	293.5	288.6	285.9	282.9	280.1	279.1	274.4
18.5	308.1	305.6	302.3	299.1	295.8	291.0	288.2	285.1	282.3	281.3	276.6
18.75	310.6	308.0	304.7	301.4	298.1	293.2	290.5	287.4	284.6	283.6	278.7
19	313.0	310.4	307.0	303.7	300.4	295.5	292.8	289.6	286.8	285.8	280.9
19.25	315.5	312.8	309.4	306.1	302.7	297.8	295.0	291.8	289.0	288.0	283.0
19.5	317.9	315.2	311.8	308.4	305.0	300.1	297.3	294.1	291.3	290.3	285.2
19.75	320.4	317.6	314.2	310.7	307.2	302.3	299.5	296.4	293.5	292.5	287.3
20	322.8	320.0	316.5	313.0	309.5	304.6	301.8	298.6	295.7	294.7	289.5
20.25	325.3	322.4	318.9	315.3	311.8	306.9	304.1	300.9	298.0	297.0	291.6
20.5	327.7	324.9	321.3	317.7	314.1	309.1	306.3	303.1	300.2	299.2	293.8
20.75	330.2	327.3	323.6	320.0	316.4	311.4	308.6	305.4	302.5	301.5	295.9
21	332.6	329.7	326.0	322.3	318.7	313.6	310.7	307.4	304.5	303.5	298.1
21.25	335.1	332.1	328.4	324.7	321.0	315.8	312.9	309.5	306.5	305.5	300.2
21.5	337.5	334.5	330.8	327.0	323.2	318.1	315.1	311.6	308.5	307.5	302.4
21.75	340.0	336.9	333.1	329.3	325.6	320.3	317.2	313.7	310.5	309.5	304.5
22	342.4	339.3	335.5	331.7	327.8	322.5	319.3	315.7	312.5	311.5	306.7
22.25	344.9	341.7	337.9	334.0	330.1	324.7	321.4	317.8	314.4	313.4	308.8
22.5	347.3	344.2	340.2	336.3	332.4	326.9	323.6	319.9	316.4	315.4	311.0
22.75	349.8	346.6	342.6	338.7	334.7	329.1	325.8	321.9	318.4	317.4	313.1
23	352.2	349.0	345.0	341.0	337.0	331.4	327.9	324.0	320.4	319.4	315.3
23.25	354.7	351.4	347.4	343.3	339.2	333.6	330.0	326.1	322.4	321.4	317.4
23.5	357.1	353.9	349.7	345.6	341.6	335.8	332.1	328.1	324.4	323.4	319.6
23.75	359.6	356.3	352.1	348.0	343.8	338.0	334.3	330.2	326.4	325.4	321.7
24	362.0	358.7	354.5	350.3	346.1	340.2	336.5	332.3	328.4	327.4	323.9
24.25	364.5	361.1	356.8	352.6	348.4	342.4	338.6	334.3	330.4	329.4	326.0
24.5	366.9	363.5	359.2	355.0	350.7	344.6	340.7	336.4	332.4	331.4	328.2
24.75	369.4	365.9	361.6	357.3	353.0	346.9	342.9	338.5	334.4	333.4	330.3
25	371.8	368.3	364.0	359.6	355.3	349.1	345.0	340.6	336.4	335.4	332.5

25.25	374.3	370.7	366.4	362.0	357.6	351.3	347.2	342.6	338.4	337.4	334.6
25.5	376.7	373.2	368.7	364.3	359.8	353.5	349.3	344.7	340.4	339.4	336.8
25.75	379.2	375.6	371.1	366.6	362.2	355.7	351.5	346.8	342.4	341.4	338.9
26	381.6	378.0	373.4	369.0	364.4	357.9	353.6	348.9	344.4	343.4	341.1
26.25	384.1	380.4	375.8	371.3	366.7	360.2	355.7	350.9	346.4	345.4	343.2
26.5	386.5	382.8	378.2	373.6	369.0	362.4	357.9	353.0	348.4	347.4	345.4
26.75	389.0	385.2	380.6	375.9	371.3	364.6	360.0	355.1	350.4	349.4	347.5
27	391.4	387.6	383.0	378.3	373.6	366.8	362.2	357.1	352.4	351.4	349.7
27.25	393.9	390.0	385.3	380.6	375.8	369.0	364.3	359.2	354.4	353.4	351.8
27.5	397.4	393.4	388.6	383.7	378.2	371.2	366.4	361.3	356.4	355.4	354.0
27.75	399.9	395.9	391.0	386.0	380.4	373.4	368.6	363.3	358.4	357.4	356.1
28	402.4	398.4	393.4	388.4	382.7	375.7	370.7	365.4	360.4	359.4	358.3
28.25	404.9	400.8	395.8	390.8	385.0	377.8	372.9	367.4	362.4	361.4	360.4
28.5	407.4	403.3	398.2	393.2	387.3	380.1	375.0	369.5	364.4	363.4	362.6
28.75	409.9	405.8	400.6	395.5	389.6	382.3	377.1	371.6	366.2	365.2	364.7
29	412.4	408.2	403.1	397.9	391.9	384.5	379.3	373.7	368.4	367.4	366.9
29.25			405.5	400.3	394.2	386.7	381.4	375.7	370.4	369.4	369.0
29.5			407.9	402.6	396.4	389.0	383.6	377.8	372.4	371.4	371.0
29.75			410.3	405.0	398.7	391.1	385.7	379.9	374.4	373.4	372.9
30				407.4	401.0	393.4	387.9	382.0	376.4	375.4	374.8
30.25				409.7	403.3	395.6	390.0	383.8	378.2	377.2	376.7
30.5					405.6	397.8	392.1	386.1	380.3	379.3	378.7
30.75					407.9	400.0	394.3	388.2	382.4	381.4	380.6
31					410.2	402.2	396.5	390.3	384.4	383.4	382.5
31.25							400.4	394.8	389.4	388.5	384.4
31.5							402.6	397.0	391.6	390.6	386.3
31.75							404.9	399.1	393.7	392.7	388.3

Appendix D – LIFECO-HFC227 System Components and their Part Numbers

Components Description	Part Number
16.7L DOT Cylinder Assembly (1-inch Valve Model LF-VA25) for LIFECO-HFC227 system, UL/FM, Model LF-16HFCD-25	LF-16HFCD-25
28.3L DOT Cylinder Assembly (1-inch Valve Model LF-VA25) for LIFECO-HFC227 system, UL/FM, Model LF-28HFCD-25	LF-28HFCD-25
52L DOT Cylinder Assembly (2-inch Valve Model LF-VA50) for LIFECO-HFC227 system, UL/FM, Model LF-52HFCD-25	LF-52HFCD-25
106L DOT Cylinder Assembly (2-inch Valve Model LF-VA50) for LIFECO-HFC227 system, UL/FM, Model LF-106HFCD-25	LF-106HFCD-25
147L DOT Cylinder Assembly (2-inch Valve Model LF-VA50) for LIFECO-HFC227 system, UL/FM, Model LF-147HFCD-25	LF-147HFCD-25
180L DOT Cylinder Assembly (2-inch Valve Model LF-VA50) for LIFECO-HFC227 system, UL/FM, Model LF-180HFCD-25	LF-180HFCD-25
240L DOT Cylinder Assembly (2-inch Valve Model LF-VA50), for LIFECO-HFC227 system, UL Listed, Model LF-240HFCD-25	LF-240HFCD-25
270L DOT Cylinder Assembly (3-inch Valve Model LF-VA80), for LIFECO-HFC227 system, UL Listed, Model LF-270HFCD-25	LF-270HFCD-25
369L DOT Cylinder Assembly (3-inch Valve Model LF-VA80) for LIFECO-HFC227 system, UL/FM, Model LF-369HFCD-25	LF-369HFCD-25
453L DOT Cylinder Assembly (3-inch Valve Model LF-VA80), for LIFECO-HFC227 system, UL Listed, Model LF-453HFCD-25	LF-453HFCD-25
52L ASME Cylinder Assembly (2-inch Valve Model LF-VA50), for LIFECO-HFC227 system, UL Listed, Model LF-52HFCS-25	LF-52HFCS-25
106L ASME Cylinder Assembly (2-inch Valve Model LF-VA50), for LIFECO-HFC227 system, UL Listed, Model LF-106HFCS-25	LF-106HFCS-25
147L ASME Cylinder Assembly (2-inch Valve Model LF-VA50), for LIFECO-HFC227 system, UL Listed, Model LF-147HFCS-25	LF-147HFCS-25
180L ASME Cylinder Assembly (2-inch Valve Model LF-VA50), for LIFECO-HFC227 system, UL Listed, Model LF-180HFCS-25	LF-180HFCS-25
16.7L TPED Cylinder Assembly (1-inch Valve Model LF-VA25), for LIFECO-HFC227 system, UL Listed, Model LF-16HFCT-25	LF-16HFCT-25
28.3L TPED Cylinder Assembly (1-inch Valve Model LF-VA25), for LIFECO-HFC227 system, UL Listed, Model LF-28HFCT-25	LF-28HFCT-25
52L TPED Cylinder Assembly (2-inch Valve Model LF-VA50), for LIFECO-HFC227 system, UL Listed, Model LF-52HFCT-25	LF-52HFCT-25
106L TPED Cylinder Assembly (2-inch Valve Model LF-VA50), for	LF-106HFCT-25

LIFECO-HFC227 system, UL Listed, Model LF-106HFCT-25	
150L TPED Cylinder Assembly (2-inch Valve Model LF-VA50), for LIFECO-HFC227 system, UL Listed, Model LF-150HFCT-25	LF-150HFCT-25
180L TPED Cylinder Assembly (2-inch Valve Model LF-VA50), for LIFECO-HFC227 system, UL Listed, Model LF-180HFCT-25	LF-180HFCT-25
240L TPED Cylinder Assembly (2-inch Valve Model LF-VA50), for LIFECO-HFC227 system, UL Listed, Model LF-240HFCT-25	LF-240HFCT-25
369L TPED Cylinder Assembly (3-inch Valve Model LF-VA80), for LIFECO-HFC227 system, UL Listed, Model LF-369HFCT-25	LF-369HFCT-25
453L TPED Cylinder Assembly (3-inch Valve Model LF-VA80), for LIFECO-HFC227 system, UL Listed, Model LF-453HFCT-25	LF-453HFCT-25
25mm Cylinder Valve Assembly, Model LF-VA25	LF-VA25
50mm Cylinder Valve Assembly, Model LF-VA50	LF-VA50
80mm Cylinder Valve Assembly, Model LF-VA80	LF-VA80
Electrical Solenoid Actuator, Model LF-EASV	LF-EASV
Removable Electrical Solenoid Actuator c/w Supervision Switch, Model LF-EASV-RS	LF-EASV-RS
Supervised Latching Solenoid Actuator, Model LF-EASV-LS	LF-EASV-LS
External Monitoring Switch 1 inch for Solenoid Valve, Model LF-EMS1	LF-EMS1
External Monitoring Switch 2 inch for Solenoid Valve, Model LF-EMS2	LF-EMS2
External Monitoring Switch 3 inch for Solenoid Valve, Model LF-EMS3	LF-EMS3
15mm (½-inch) 180° NPT Brass Discharge Nozzle, Model LF-180H-15	LF-180H-15
20mm (¾-inch) 180° NPT Brass Discharge Nozzle, Model LF-180H-20	LF-180H-20
25mm (1-inch) 180° NPT Brass Discharge Nozzle, Model LF-180H-25	LF-180H-25
32mm (1 ¼-inch) 180° NPT Brass Discharge Nozzle, Model LF-180H-32	LF-180H-32
40mm (1 ½-inch) 180° NPT Brass Discharge Nozzle, Model LF-180H-40	LF-180H-40
50mm (2-inch) 180° NPT Brass Discharge Nozzle, Model LF-180H-50	LF-180H-50
15mm (½-inch) 360° NPT Brass Discharge Nozzle, Model LF-360H-15	LF-360H-15
20mm (¾-inch) 360° NPT Brass Discharge Nozzle, Model LF-360H-20	LF-360H-20
25mm (1-inch) 360° NPT Brass Discharge Nozzle, Model LF-360H-25	LF-360H-25
32mm (1 ¼-inch) 360° NPT Brass Discharge Nozzle, Model LF-360H-32	LF-360H-32
40mm (1 ½-inch) 360° NPT Brass Discharge Nozzle, Model LF-360H-40	LF-360H-40
50mm (2-inch) 360° NPT Brass Discharge Nozzle, Model LF-360H-50	LF-360H-50
Manual Actuator, Model LF-MA	LF-MA
Pneumatic Actuator, Model LF-PA	LF-PA
25mm (1-inch) Discharge Hose, Model LF-DH25	LF-DH25

50mm (2-inch) Discharge Hose, Model LF-DH50	LF-DH50
80mm (3-inch) Discharge Hose, Model LF-DH80	LF-DH80
Flexible Hose Assembly,L710mm, D1/4" Model LF-FH710	LF-FH710
16.6, 16.7 & 28.3L Cylinder Bracket Assembly, Model LF-CB1	LF- CB1
52L, 106L, 147L and 180L Cylinder Bracket Assembly, Model LF-CB2	LF- CB2
270L & 369L Cylinder Bracket Assembly, Model LF-CB4	LF- CB4
52L TPED Cylinder Bracket Assembly, Model LF-CB6	LF- CB6
240L & (180L TPED) Cylinder Bracket Assembly, Model LF-CB3	LF- CB3
453L Cylinder Bracket Assembly, Model LF-CB5	LF- CB5
25mm (1-inch) Check Valve, Model LF-CV25	LF-CV25
50mm (2-inch) Check Valve, Model LF-CV50	LF-CV50
80mm (3-inch) Check Valve, Model LF-CV80	LF-CV80
Cylinder Label for LIFECO-HFC227 System Model LF-CL2	LF-CL2
Pressure gauge for LIFECO-HFC227 System, Model LF-PG21	LF-PG21
Pressure gauge for LIFECO-HFC227 System, Model LF-PG22	LF-PG22
Pressure gauge c/w contact switch for LIFECO-HFC227 System, Model LF-PGLPS2	LF-PGLPS2
¼" Nipple for pneumatic, Model LF-025N	LF-025N
¼" Tee for pneumatic, Model LF-025T	LF-025T
¼" Elbow for pneumatic, Model LF-025E	LF-025E
1" NPT Valve Outlet Adaptor, Model LF-1ADNPT	LF-1ADNPT
2" NPT Valve Outlet Adaptor, Model LF-2ADNPT	LF-2ADNPT
3" NPT Valve Outlet Adaptor, Model LF-3ADNPT	LF-3ADNPT
3" Groove Valve Outlet Adaptor, Model LF-3ADG	LF-3ADG
3" BSP Valve Outlet Adaptor, Model LF-3ADBSP	LF-3ADBSP
Liquid level indicator for 106L, Model LF-LLI1	LF-LLI1
Liquid level indicator for 147L and 369L, Model LF-LLI2	LF-LLI2
Discharge pressure switch, Model LF-DPS	LF-DPS
¼" BSP x ½" NPT Adaptor for Discharge Pressure Switch, Model LF-05ADNPT	LF-05ADNPT

Appendix E – Maintenance Program

Inspection File - Maintenance of Fire Suppression Systems

System Service Provider

Service Provide: _____ Project No: _____

Address: _____ Purchase Order: _____

_____ Installation Date: _____

City: _____ Inspection Date: _____

Postcode: _____ Clean Agent Systems: _____

Telephone: _____

Fax: _____

Installation Location

Installation Site Address: _____

_____

_____

City: _____

Postcode: _____

Telephone: _____

Fax: _____

Site Official Representative: _____

Period of Service (* Please circle where appropriate)**

Monthly	Semi-Annual	Annual

1. Protected Enclosure:

Inspect the project details / data of the protected enclosure to ensure the system suitability for the fire protection, no alterations or modifications with respect to the previous service report.

Property owner / contractor shall provide the required details prior to inspection.

*** *Every NO answer shall be explained in detail and indicate so under observations.*

No	Description	Findings		
		YES	N/A	NO
1.1	Dimension of protected enclosure.			
1.2	Area occupied by persons.			
1.3	Modification on protected enclosure.			
1.4	Protected enclosure equipped with automatic disconnection during system discharge.			
1.5	Any previously noted deficiencies / past defects have been corrected.			

Observations:

Inspection File - Maintenance of Fire Suppression Systems

2. Agent Storage Area

Inspect and check if there are any changes to the approved installation and general condition of hardware installed. Ensure the system is isolated electrically and mechanically, remove manual actuator, electrical actuator, manifold (if applicable) discharge hose and piping away from cylinder valves. Immediately fit the safety cap onto the cylinder valves outlet to prevent accidental discharge.

*** *Every NO answer shall be explained in detail and indicate so under observations.*

No	Description	Findings		
		YES	N/A	NO
2.1	All actuation hardware deactivated to prevent accidental system discharge during maintenance.			
2.2	Releasing control panel is powered and is free of supervisory, trouble or false alarm conditions.			
2.3	Cylinder safe from mechanical damage corrosion or unauthorised interference.			
2.4	Cylinder paint in good condition.			
2.5	Cylinder label in good condition and its description still visible.			
2.6	Cylinder brackets are fitted and all bolts tightened.			
2.7	Cylinder locate at area prevented from direct sunlight.			
2.8	Pressure gauges in the operable range.			
2.9	Storage area clean and not to expose to adverse weather condition.			
2.10	Cylinder, valve, pressure gauge and all manual controls for actuation located for easily accessible.			
2.11	Manual actuator has their safety cable tie in good condition to prevent accidental discharge.			
2.12	Warning signage fixed, legible and resistant to environment conditions.			
2.13	Flexible hoses are not kinked.			
2.14	Are the flexible hoses connected appropriately?			
2.15	Is the external monitoring switch proper mounted onto the electrical actuator?			
2.16	Are the wires proper connected to the terminal block inside the nylon housing?			
2.17	All actuators are in non-fire position prior to reconnection to the cylinder valves.			
2.18	Record cylinder details as below:			

No.	Protected Enclosure / Room Name	Cylinder Size	Cylinder Serial no.	Filled Weight	Pressure (Bar)	Temperature (°C)	Corrections Required		
							YES	N/A	NO

Observations:

Inspection File - Maintenance of Fire Suppression Systems

3. Distribution / Piping System

Pipe system carrying agent from cylinders to distribution nozzles inside the hazard area. Inspect and check if the distribution / piping system has undergone any changes / modification since previous inspection. The piping used shall be schedule 40 pipes.

**** Every NO answer shall be explained in detail and indicate so under observations.*

No	Description	Findings		
		YES	N/A	NO
3.1	Pipe length and diameter have not undergone changes from previous project inspection.			
3.2	Are pipes free from mechanical damages along its length?			
3.3	Piping layout as per initial approved system design.			
3.4	PTFE tape is used to apply on the pipe male thread.			
3.5	Is dirt trap install to the end of each pipe runs?			
3.6	Are the threaded pipes used for the distribution system?			
3.7	Supports used are those specified in the project.			
3.8	Any previous record of deficiencies have been corrected.			

Observations:

4. Discharge Nozzles

Visualize inspect and check the condition of discharge nozzles or if they have been undergone modification.

**** Every NO answer shall be explained in detail and indicate so under observations.*

No	Description	Findings		
		YES	N/A	NO
4.1	Quantity of discharge nozzles installed in accordance with the system design approved for earlier design and installation.			
4.2	Discharge nozzles installed conform with model of those specified in system design approved for earlier design and installation.			
4.3	Discharge nozzle condition clean (no foreign material), no debris and physical damages.			
4.4	Discharge nozzle orientation as per earlier design.			
4.5	Discharge nozzle is free from obstacles and any projecting parts.			
4.6	Discharge nozzle has not undergone any modifications.			

Observations: