



AFC-227
AFC-P227

FM-200™ / HFC-227ea

Engineered Clean Agent Fire Extinguishing System

Design, Installation, Operation, and Maintenance Manual



LISTED

EX29550

Clean Agent Extinguishing System Unit



APPROVED



AMERICAN FIRE CONTROL LLC.
255 S Orange Ave, Orlando FL32801, USA.
Tel: +1 607 252 6814

sales@american-afc.com
www.american-afc.com

All Rights Reserved.

CONTENTS

1. INTRODUCTION 7

 1.1. About this Manual 7

 1.2. AFC-227and AFC-P227..... 7

 1.2.1 AFC-227..... 7

 1.2.2 AFC-P227..... 7

 1.3. HFC-227ea Extinguishing Agent 8

 1.3.1. General Characteristics 8

 1.3.2. Toxicity 9

 1.3.3. Exposure 9

 1.3.4. Decomposition 9

 1.3.5. Other Safety Considerations 9

 1.3.6. Storage 9

 1.4. Application..... 10

 1.5. Approvals..... 10

2. SYSTEM COMPONENTS 12

 2.1. Agent Cylinder 13

 2.1.1. Agent Discharge Valve 16

 2.1.2. Agent Pressure Gauge 17

 2.1.3. Nitrogen Inlet Valve 18

 2.2. Agent Needle Cylinder 19

 2.3. Nitrogen Cylinder 20

 2.3.1. Nitrogen Discharge Valve 21

 2.3.2. Nitrogen Pressure Gauge 22

 2.4. Nitrogen Needle Cylinder 23

 2.5. Flexible Hose (20A) 24

 2.6. Flexible Hose (50A) 25

 2.7. Union Elbow 26

 2.8. Union Elbow Adapter 27

 2.9. Pipe Adapter 28

 2.10. Check Valve 50A..... 29

 2.11. Manifold Welding Socket 30

 2.12. Selector Valve 31

 2.13. Actuation Box 34

2.13.1. Solenoid Cutter	35
2.13.2. Actuation Cylinder	36
2.13.3. Discharge Pressure Switch (Optional).....	37
2.13.4. Solenoid Cutter Supervisor	37
2.14. Discharge Pressure Switch (Recommended)	38
2.15. Manual Station	39
2.16. Discharge Nozzle	40
2.17. Pressure Relief Device	41
2.18. Relief Valve 6A	41
2.19. Check Valve 6A	42
2.20. Tee 6A	42
2.21. Copper Tube and Fittings	43
2.22. Cylinder Strap	44
3. SYSTEM DESIGN	45
3.1. Design Concentration	45
3.2. Agent Quantity	46
3.3. Atmospheric Correction Factor	47
3.4. Discharge Time	48
3.5. Agent Cylinder	48
3.6. Piping	49
3.7 Tee Splits	49
3.8. Equivalent Length	51
3.9. Percent Agent in Piping and Pipe Length	51
3.10. Nozzle Selection and Location	53
3.11. System Design Limitations Summary	54
3.12. System Design Flow Summary	54
4. INSTALLATION	57
4.1. Agent Cylinder Installation	57
4.2. Nitrogen Cylinder Installation	62
4.3. Agent Needle Cylinder Installation.....	62
4.4. Nitrogen Needle Cylinder Installation	63
4.5. Nitrogen Actuation Tube Installation.....	63
4.6. Agent Actuation Tube Installation	64
4.7. Selector Valve Actuation Tube Installation	65
4.8. Discharge Pressure Switch Installation	65

CONTENTS

4.8.1. Compact Pressure Switch.....	65
4.8.2. Explosion-Proof Pressure Switch.....	65
4.8.3. Optional Pressure Switch.....	66
4.9. Actuation Box/Solenoid Cutter Installation.....	66
4.9.1. With Temper Seal and Releasing Circuit Disable Switch	66
4.9.2. With Solenoid Cutter Supervisor	68
4.9.2.1. Installing the Solenoid Cutter Supervisor in a New Valve or System	68
4.9.2.2. Installing the Solenoid Cutter Supervisor in an Existing Valve or System	68
4.10. Manual Station Installation	69
4.11. Pipe and Fittings Installation	70
4.12. Nozzle Installation	71
4.13. Detection Devices and Fire Signal/Control Panel Installation	71
4.14. Post-Installation Check	72
5. OPERATION AND MAINTENANCE.....	73
5.1. Operation	73
5.1.1. AFC-227 Operation	73
5.1.2. AFC-P227 Operation	74
5.1.3. Automatic Operation.....	75
5.1.4. Manual Operation via the Manual Station.....	75
5.1.5. Manual Operation via the Solenoid Cutter	76
5.1.6. Manual Operation via the Agent Discharge Valve	76
5.2. Maintenance	76
5.2.1. Use of Releasing Circuit Disable Switch.....	76
5.2.2. Maintenance Schedule	76
5.2.3. Daily Maintenance	76
5.2.4. Weekly Maintenance	77
5.2.4.1. Hazard or Protected Area	77
5.2.4.2. System Components	77
5.2.5. Monthly Maintenance	77
5.2.5.1. Needle Cylinders	77
5.2.5.2. Agent and Nitrogen Cylinder Assemblies.....	78
5.2.5.3. Cylinder fixtures.....	78
5.2.5.4. Flexible Hoses	78

5.2.5.5. Actuation Copper Tube Lines	78
5.2.5.6. Discharge Nozzles	78
5.2.5.7. Manual Station	78
5.2.3.8. Pressure switch	78
5.2.6. Semi-Annual Maintenance	78
5.2.6.1. Agent Cylinder.....	78
5.2.6.2. System Actuation Test	78
5.2.6.3. Solenoid Cutter Functional/Operational Test	79
5.2.6.4. Resetting the Solenoid Cutter	79
5.2.6.5. Re-installation of Solenoid Cutter	80
5.2.6.6. Flexible Hoses	80
5.3. Post-discharge maintenance.....	80
5.3.1. Uninstallation of Agent Cylinder	80
5.3.2. Cartridge Packing Replacement	81
5.3.3. Recharging Agent Cylinder	81
5.3.4. Nitrogen Superpressurization	82
5.3.5. Leakage Test	83
6. PARTS LIST	84
APPENDIX A: AFC-227 Sample Calculation	91
APPENDIX B: AFC-P227 Sample Calculation.....	99
APPENDIX C: FM-200™ / HFC-227ea Safety Data Sheet.....	107

1. INTRODUCTION

1.1 About this Manual

This manual contains all necessary information for the design, installation, operation, and maintenance of the clean agent extinguishing systems, AFC-227 and AFC-P227 manufactured by American Fire Control LLC. Users who are not familiar with the equipment must first read this manual. In any situation not specifically covered by this manual, all system components must be installed and operated by qualified and trained professionals and in accordance with National Fire Protection Association (NFPA) 2001, Standard on Clean Agent Fire Extinguishing Systems and acceptable to the authority having jurisdiction.

In this manual, where not elaborated “system” refers AFC-227 or AFC-P227 fire extinguishing system without the detection system. The term “agent” refers to the fire extinguishing clean agent HFC-227ea.

1.2 AFC-227 and AFC-P227

1.2.1 AFC-227

AFC-227 is developed for total flooding automatic gaseous fire extinguishing system.

AFC-227 utilize clean and safe fire extinguishing agent heptafluoropropane (HFC-227ea). Since the enforcement of Montreal Protocol in 1989, HFC-227ea had been widely regarded as one of the most cost-effective replacement for Halon 1301 as fire extinguishing agent.

In AFC-227, the agent is stored in cylindrical storage cylinder and pressurized with nitrogen to about 25 bar. This kind of system is also commonly known as standard flow system.

1.2.2 AFC-P227

Conventional installation of the clean agent fire extinguishing system is constrained by the size of protected area and distance for agent delivery. This is because for such protected area, the quantity of agent becomes insufficient for fire extinguishing when the agent and the propelling nitrogen are contained in a single cylinder and pressurized to about 25 bar. To overcome this limitation, the development of AFC-P227 in which a separate cylinder is added to contain the propelling nitrogen. The two cylinders are interconnected by suitable tube, hose and valves such that during discharge the high-pressure nitrogen superpressurizes and pushes the extinguishing agent like a gas piston in order to sustain the required pressure and agent mass flow rate. AFC-P227 configuration enables the system to discharge more than 95% of the extinguishing agent over a wider protected area requiring longer agent flow distances within 10 seconds.

1.3. HFC-227ea Extinguishing Agent

1.3.1 General Characteristics

HFC-227ea is highly effective, electrically non-conductive, non-corrosive, low toxicity fire extinguishing agent, and when discharged, leaves no residue in the protected area. It suppresses fire by a combination of heat absorption and chemical reaction that interferes with the flame, preventing the flame from reignition. HFC-227ea is highly suitable for fire protection of high-value equipment and facilities such as, electrical machineries, telecommunication switch rooms, computer and electronic rooms. It is also best for environments where valuable items must not be damaged by a fire extinguishing agent such as libraries, cultural facilities, storage rooms, archives and museums.

HFC-227ea has zero ozone-depletion potential which makes it a leading environment-friendly and preferred fire extinguishing agent. It is a recommended alternative agent to Halon by Significant New Alternatives Policy (SNAP) of Environmental Protection Agency (EPA), USA. HFC-227ea is listed by Underwriter's Laboratories (UL) and approved by Factory Mutual (FM), USA. The physical properties of HFC-227ea are listed in Table 1.1.

Table 1.1. Physical properties of HFC-227ea

Molecular mass	170
Boiling point at 1013 bar	-16.4°C
Freezing point	-127°C
Critical temperature	101.7°C
Critical pressure	29.3 bar (abs)
Critical volume	1.61 cm ³ /mol
Critical density	594 kg/m ³
Vapor pressure at 20°C	3.90 bar (abs)
Liquid density at 20°C	1410 kg/m ³
Saturated vapor density at 20°C	31.035 kg/m ³
Specific volume of superheated vapor at 1013 bar and 20°C	0.1374 m ³ /kg
Ozone Depletion Potential (CFC-11)	0
Atmospheric lifetime	34.2 years
LC ₅₀ (4hr, rat) properties	>800,000 ppm

1.3.2 Toxicity

The US EPA and the UK Halon Alternatives Group (HAG) accept the use of HFC-227ea in occupied spaces up to 9% concentration for total flooding fire suppression system. In such design concentration, HFC-227ea has negligible toxicity and since it does not act by removing oxygen in the fire zone, it poses no oxygen-deprivation hazard. Refer to NFPA 2001 for more information.

1.3.3 Exposure

Exposure to HFC-227ea at the design concentration of 9% is not hazardous to health. However, NFPA recommends that unnecessary exposure to clean agents is to be avoided. In a very unlikely event where the clean agent system should discharge HFC-227ea unexpectedly into the occupied area, all personnel should evacuate the area immediately.

1.3.4 Decomposition

Decomposition of HFC-227ea occurs when it is exposed to high temperatures, producing halogen acids. The halogen acids are known to be characterized by unpleasant odor prior to reaching hazardous levels. If HFC-227ea is discharged in 10 seconds or less, fire is rapidly extinguished, minimizing the formation of by-products.

1.3.5 Other safety considerations

Noise loud enough to cause startling to occupants can be created when the high-pressure HFC-227ea is discharged from the nozzles. However, this sort of noise is unlikely to cause any permanent injury. High velocity discharge of HFC-227ea can cause substantial objects directly on its path to dislodge and enough turbulence to move unsecured paper and light objects within the protected area. Direct skin contact with the liquid or cold gas HFC-227ea has chilling effect and possibly cause frostbite. HFC-227ea when discharged and mixed with humid air may cause minor reduction in visibility for brief period of time due to condensation of water vapor. For further information, refer to HFC-227ea material safety data sheet contained in Appendix B.

1.3.6 Storage

In AFC-227 and AFC-P227, the agent is stored in steel cylinders as a liquid and pressurized with nitrogen to a maximum total pressure of 25 bar at 21 °C. Care must be taken in handling, filling and transporting storage cylinders as they are pressurized vessels. The pressure of HFC-227ea varies significantly with temperature as shown in Figure 1.1.

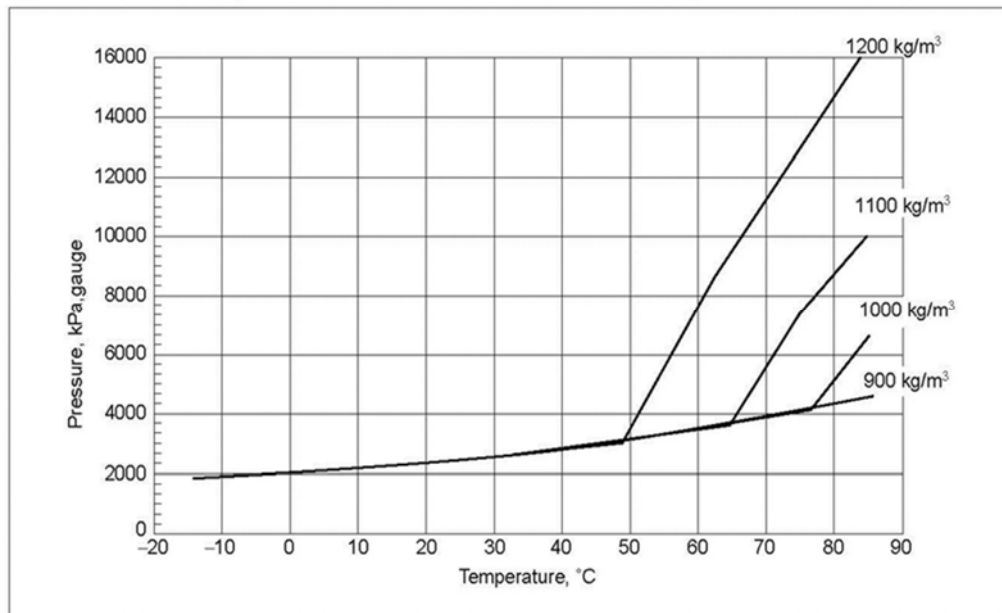


Figure 1.1 HFC-227ea pressure-temperature curve

1.4. Application

AFC-227 and AFC-P227 are designed for the protection of areas where the following classes of fires as categorized by NFPA may occur:

- **Class A fires** - involve ordinary combustibles such as paper, wood, cloth, and rubber.
- **Class B fires** - involve flammable liquids and gases such as gasoline, oil, grease, paint, etc.
- **Class C fires** - involve energized electrical equipment such as motors, generators, and other appliances.

AFC-227 and AFC-P227 are suitable for the protection of following specific areas among others:

- | | | |
|-------------------------|-------------------------|---------------|
| · Electrical rooms | · Dead rooms | · Museums |
| · Computer rooms | · Chemical laboratories | · Libraries |
| · Communication centers | · Hospitals | · Bank vaults |
| · Broadcasting centers | · Pharmacies | |

1.5 Approvals

AFC-227 and AFC-P227 are certified compliant with at least the minimum requirements of UL and FM Approvals standards for engineered clean agent fire extinguishing systems. It should be noted that system components that are **not** included within the scope of UL or FM certifications for AFC-227 and AFC-P227 are properly indicated.

WARNING!

AFC-227 and AFC-P227 must not be installed in places where:

- reactive metals such as magnesium, zirconium, lithium, sodium, titanium, uranium, plutonium, etc are stored;
- chemical substances that are capable of oxidation such as nitrate are stored;
- metal hydrides are present;
- chemical drugs that are prone to natural thermal decomposition such as organic peroxides or hydrogen compounds are stored.

2. SYSTEM COMPONENTS

This chapter describes the components that AFC-227 and AFC-P227 comprise. Typical AFC-227 and AFC-P227 systems are illustrated in Figure 2.1 and Figure 2.2, respectively. The components are listed as follows:

- Agent cylinder
 - Agent discharge valve
 - 20A Plug^[A]
 - Nitrogen inlet valve^[B]
- Nitrogen cylinder^[B]
 - Nitrogen discharge valve^[B]
- Agent needle valve
- Nitrogen needle valve^[B]
- Selector valve
- Check valve 50A
- Check valve 6A
- Tee 6A
- Relief valve 6A
- Pressure relief device
- Discharge pressure switch
- Flexible hose
- Actuation box
- Union elbow
- Discharge nozzle
- Distribution piping (supplied separately)
- Detector (supplied separately)
- Control panel (supplied separately)
- Manual station (supplied separately)

* ^[A] only installed with AFC-227

* ^[B] only installed with AFC-P227

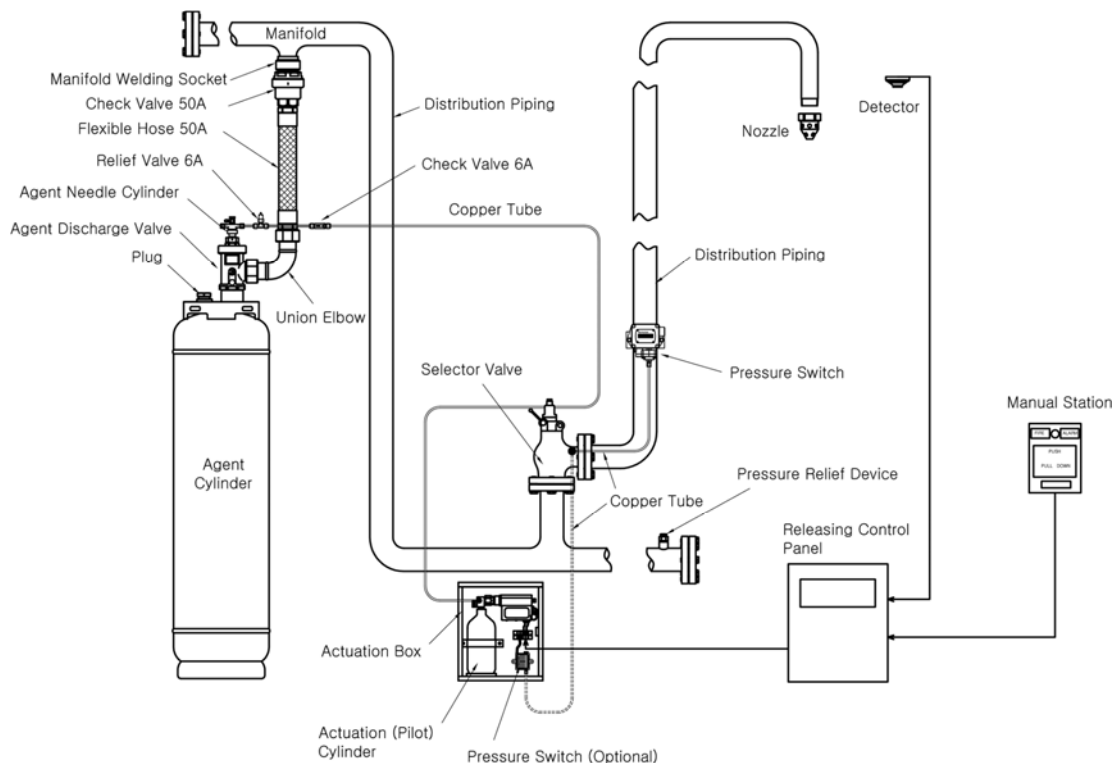


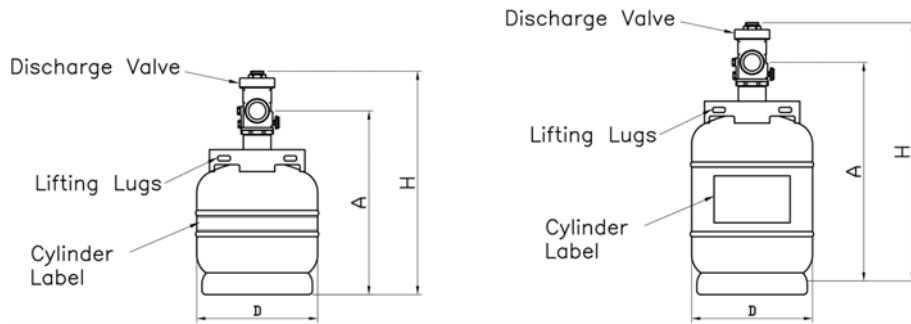
Figure 2.1. Schematic of a typical AFC-227.



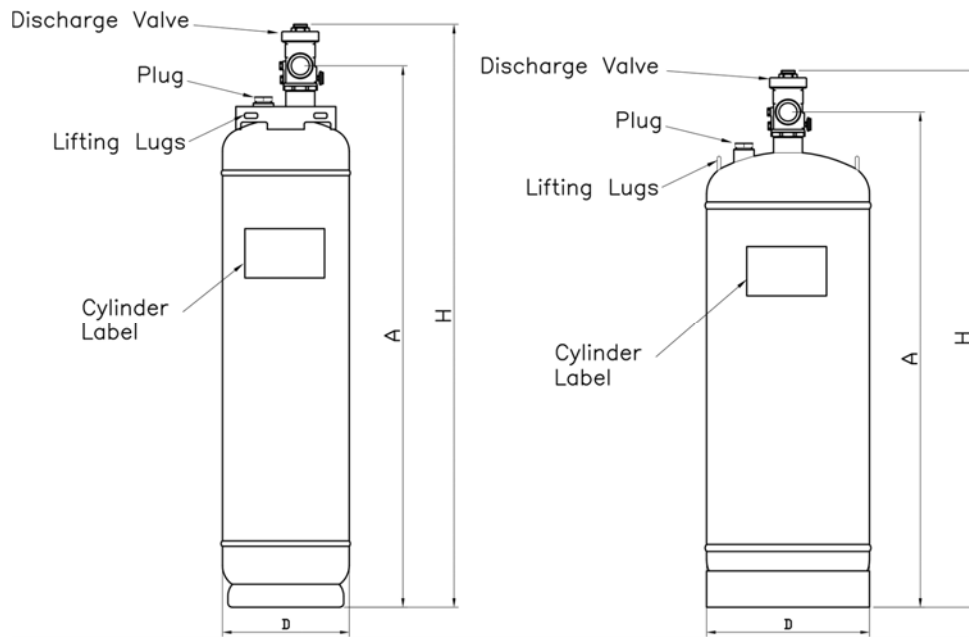
Figure 2.2. Schematic of a typical AFC-P227.

2.1. Agent Cylinder

HFC-227ea extinguishing agent is stored in steel cylindrical container as liquid superpressurized with nitrogen to 25 bar at 21°C. Except for the 26.8 L and 40.2 L cylinders, basically, both AFC-227 and AFC-P227 utilize identical agent cylinders. The agent cylinders have two threaded openings known as neckrings. One neckring is factory-fitted with an agent discharge valve while the other is plugged for AFC-227 or fitted with nitrogen inlet valve for AFC-P227. The nitrogen inlet valve facilitates sufficient supply of pressurized nitrogen into the agent cylinder during agent discharge. The agent cylinder is also equipped with a pressure gauge and rupture disc-fitted safety valves. Additionally, as part of its safety feature, the agent cylinder is equipped with safety plugs and protection caps to prevent accidental discharge and protect the inlet/outlet valves from physical damage when the cylinder is not connected to the system. A nameplate indicating the product name of the stored extinguishing agent, pressure rating, and nominal volume capacity, is attached to the exterior of the cylinder. Agent cylinders for installation with AFC-227 or AFC-P227 are available in various sizes, all designed and tested in accordance with international standards. The agent cylinders are illustrated in Figure 2.3 and Figure 2.4 and the corresponding technical data are summarized in Table 2.1.



(a) Agent cylinder for 26.8 L AFC-227 (b) Agent cylinder for 40.2 L AFC-227



(c) Agent cylinder for 63 L, 68 L, 89 L, 115.4 L AFC-227

(d) Agent cylinder for 175 L AFC-227

Figure 2.3. Agent cylinders for AFC-227.

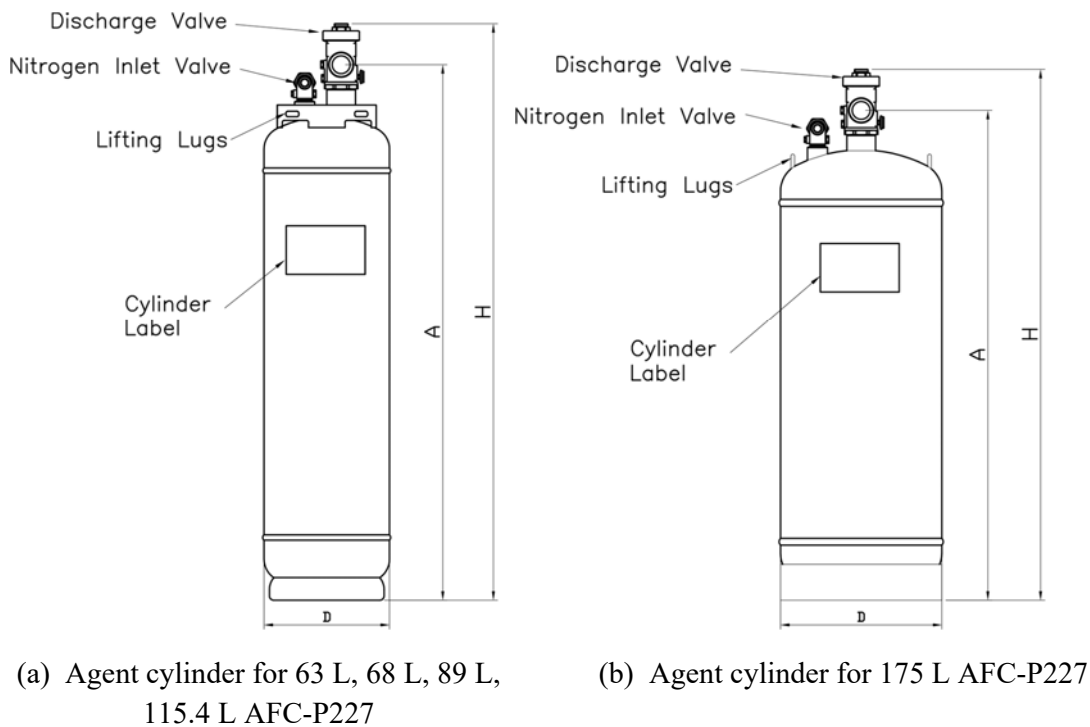


Figure 2.4. Agent cylinders for AFC-P227.

Table 2.1. Agent cylinder technical data.

Model No.	Internal Volume (L)	Fill range (kg)	Dimensions (mm)			Valve Models		Empty Weight (kg)	
			D	H	A	Agent Discharge	Nitrogen Inlet		
AFC-227	AFC-26	26.8	13.3 - 25.6	350	608	508	ADV-40, ADV-R40	N/A	20.3
	AFC-40	40.2	19.9 - 38.4	350	755	655	ADV-40, ADV-R40	N/A	31.6
	AFC-63	63.0	31.2 - 60.6	350	1005	905	ADV-40, ADV-R40	N/A	52.9
	AFC-68	68.0	33.7 - 65.4	350	1060	960	ADV-40, ADV-R40	N/A	55.5
	AFC-89	89.0	44.1 - 85.6	350	1290	1190	ADV-40, ADV-R40	N/A	66.3
	AFC-115	115.4	57.2 - 111.0	350	1610	1495	ADV-50, ADV-R50	N/A	83.6
	AFC-175	175.0	86.7 - 168.3	450	1512	1397	ADV-50, ADV-R50	N/A	122.2
AFC-P227	AFC-P63	63.0	31.2 - 60.6	350	1005	905	ADV-40, ADV-R40	NDV-F20	53.4
	AFC-P68	68.0	33.7 - 65.4	350	1060	960	ADV-40, ADV-R40	NDV-F20	56.0
	AFC-P89	89.0	44.1 - 85.6	350	1290	1190	ADV-40, ADV-R50	NDV-F20	66.8
	AFC-P115	115.4	57.2 - 111.0	350	1610	1495	ADV-50, ADV-R50	NDV-F20	84.1
	AFC-P175	175.0	86.7 - 168.3	450	1512	1397	ADV-50, ADV-R50	NDV-F20	122.7

2.1.1. Agent Discharge Valve

The agent cylinder is factory-fitted with a discharge valve that is used to enable agent outflow during discharge. The agent discharge valve is equipped with a pressure gauge, safety plug and protection caps as part of the safety features of agent cylinder. The pressure gauge can be either a standard or 2n1 gauge type. The 2n1 gauge type is a bourdon tube-type gauge fitted with low pressure switching mechanism that can be readily connected to the fire alarm control panel to monitor significant drop in cylinder pressure. Two types of agent discharge valve are available to ensure that the pressure gauge is readily visible relative to the installation position of the agent cylinder, thus allowing convenient reading of cylinder pressure during system periodic inspection. The agent discharge valves are illustrated in Figure 2.5 and the corresponding technical data summarized in Table 2.2.

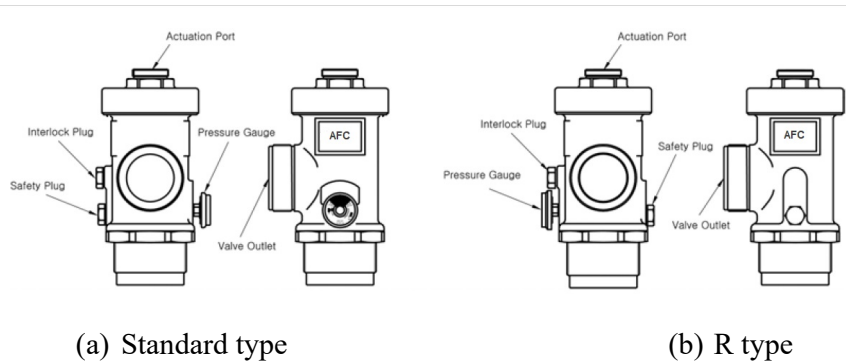


Figure 2.5. Types of agent discharge valves.

Table 2.2. Agent discharge valve technical data.

Model No.	Inlet/Outlet Diameter, (mm)	Agent Cylinder	Safety valve burst pressure (bar)	Discharge Valve Pressure Gauge Options
ADV-40, ADV-R40	40	AFC-26, AFC-40, AFC-63, AFC-P63, AFC-68, AFC-P68 AFC-89, AFC-P89	56	1. Standard gauge 2. 2n1 gauge (gauge w/ low pressure switch)
ADV-50, ADV-R50	50	AFC-115, AFC-P115 AFC-175, AFC-P175		

NOTE: After the agent discharge valve has operated, it must be disconnected from the system and the seat ring be carefully checked for damage before re-installation.

2.1.2. Agent Pressure Gauge

The agent pressure gauge is installed in the agent discharge valve to indicate the pressure of agent in the storage cylinder. As an option to the standard type pressure gauge, the 2n1 type is a bourdon tube-type pressure gauge fitted with low pressure switching mechanism that can be readily connected to the fire alarm control panel to monitor significant drop in cylinder pressure. The standard and 2n1 24.8 bar pressure gauges are illustrated in Figure 2.6 and the corresponding technical data are summarized in Table 2.3.

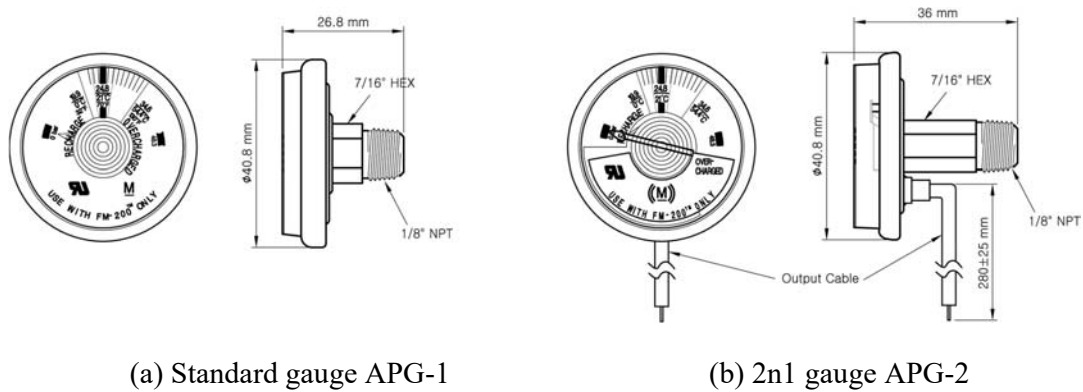


Figure 2.6. Types of discharge valve pressure gauges.

Table 2.3. Discharge valve pressure gauge technical data.

Manufacturer Model No.	American AFC Model No.	Description	Working Pressure (bar)	Switch Set Pressure, decreasing (bar)
1-03367	APG-1	Standard type agent gauge	24.8	N/A
1-04697-2N1	APG-2	2n1 type agent gauge (gauge w/ low pressure switch)	24.8	19.9 ± 1.5

2.1.3. Nitrogen Inlet Valve (for use only with AFC-P227)

The nitrogen inlet valve is installed in the AFC-P227 agent cylinder to enable the inflow of nitrogen and continuous agent pressurization during discharge. The nitrogen inlet valve is equipped with a nitrogen distributor and protection caps as part of the safety features of the cylinder. The nitrogen inlet valve is illustrated in Figure 2.7 and the corresponding technical data are summarized in Table 2.4.

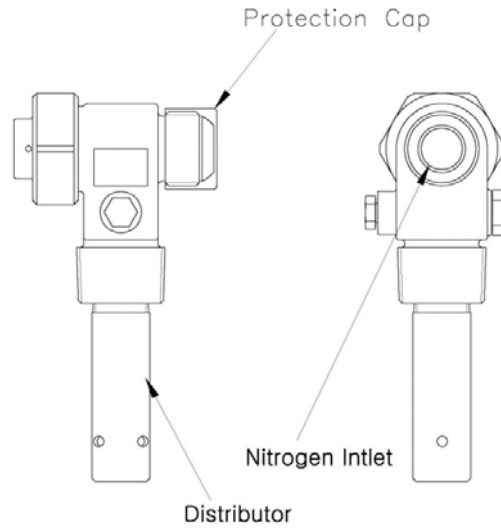


Figure 2.7. Nitrogen inlet valve.

Table 2.4. Nitrogen inlet valve technical data.

Model No.	Inlet Diameter (mm)	Agent Cylinder	Threaded Connection
NDV-F20	20	AFC-P63, AFC-P68, AFC-P89, AFC-P115 AFC-P175	M36 x 2.0

2.2. Agent Needle Cylinder

The discharge valve is opened by the needle cylinder installed to its actuation port. Pressure from the actuating fluid in the master cylinder or pilot cylinder is used to actuate the agent needle cylinder through copper tube line. The agent needle cylinder is equipped with a PUSH button that is used for manual actuation. The discharge needle cylinder is illustrated in Figure 2.8 and the corresponding technical data are summarized in Table 2.5.

CAUTION!

Manually actuating the discharge valve needle cylinder will activate the extinguishing system. Manual actuation should **ONLY** be performed in case of emergency as the last course of action.

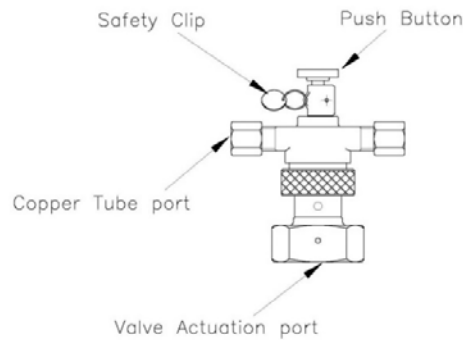


Figure 2.8. Agent needle cylinder.

Table 2.5. Agent needle cylinder technical data.

Model No.	Maximum Installation Quantity			Discharge Valve	Threaded Connection
	Master/Slave	Pilot/Slave			
		Single Zone	Multi-Zone		
AFC-NC-15	6	30	25	ADV-40, ADV-R40, ADV-50, ADV-R50	M38×1.5

2.3. Nitrogen Cylinder (for use only with AFC-P227)

Nitrogen is stored in separate steel cylindrical cylinder at 60/70/80 bar depending on the model of AFC-P227 agent cylinder partner. The cylinder is factory-fitted with nitrogen discharge valve that enables nitrogen delivery into the agent cylinder. Nitrogen cylinder is approved DOT-3AA type. The nitrogen cylinder is illustrated in Figure 2.9 and corresponding technical data are summarized in Table 2.6.

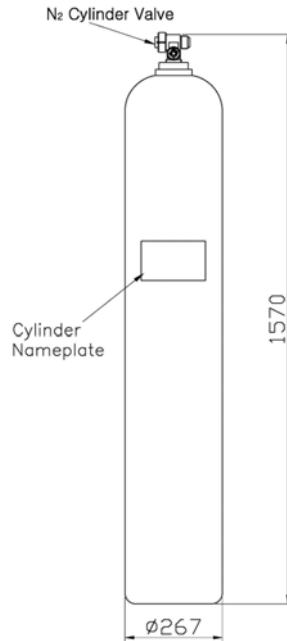


Figure 2.9. Nitrogen cylinder.

Table 2.6. Nitrogen cylinder technical data.

Model No.	Internal Volume (L)	Valve (mm)	Empty weight (kg)	Fill Pressure (bar)	AFC-P227 Agent Cylinder Partner
ANC68-60	68	NDV-N20	74.5	60	AFC-P63 AFC-P68
ANC68-70				70	AFC-P89
ANC68-80				80	AFC-P115 AFC-P175

2.3.1. Nitrogen Discharge Valve (for use only with AFC-P227)

Nitrogen cylinder is also factory-fitted with discharge valve that enables nitrogen supply to agent cylinder. The nitrogen discharge valve is equipped with a pressure gauge, safety plug and protection caps as part of the safety features of the cylinder. The pressure gauge can be either a standard or 2n1 gauge type. The 2n1 gauge type is a bourdon tube-type gauge fitted with low pressure switching mechanism that can be readily connected to the fire alarm control panel to monitor significant drop in cylinder pressure. The nitrogen discharge valve is illustrated in Figure 2.10 and the corresponding technical data are summarized in Table 2.7.

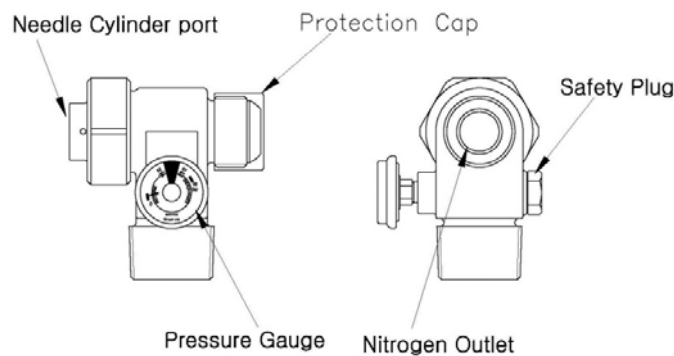


Figure 2.10. Nitrogen valve.

Table 2.7. Nitrogen valve technical data.

Model No.	Inlet/Outlet Diameter (mm)	Nitrogen Cylinder	Safety valve burst pressure (bar)	Pressure Gauge Options
NDV-N20	20	ANC-68	210	1. Standard gauge 2. 2n1 gauge (gauge w/ low pressure switch)

2.3.2. Nitrogen Pressure Gauge

The nitrogen pressure gauge is installed in the nitrogen valve to indicate the pressure of nitrogen gas in the storage cylinder. As an option to the standard type pressure gauge, the 2n1 type is a bourdon tube-type pressure gauge fitted with low pressure switching mechanism that can be readily connected to the fire alarm control panel to monitor significant drop in cylinder pressure. The standard and 2n1 nitrogen pressure gauges are illustrated in Figure 2.11 and the corresponding technical data are summarized in Table 2.8.

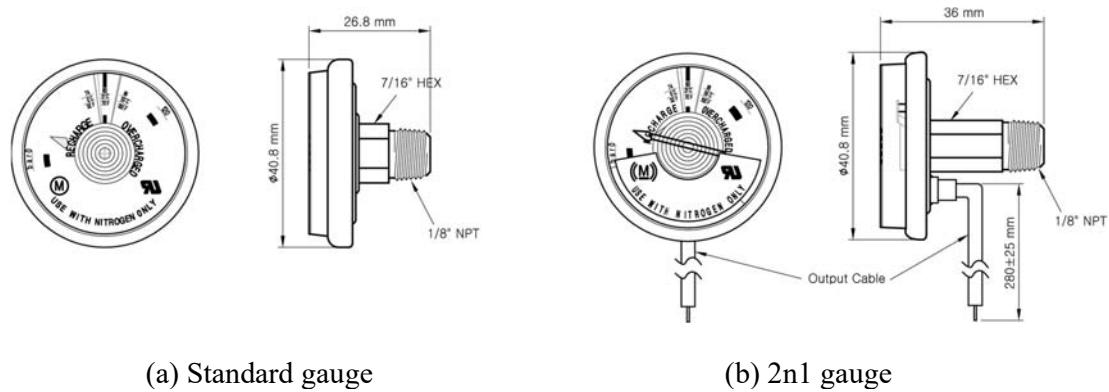


Figure 2.11. Types of nitrogen valve pressure gauges.

Table 2.8. Nitrogen valve pressure gauge technical data.

Manufacturer Model No.	American AFC Model No.	Description	Working Pressure (bar)	Switch Set Pressure, decreasing (bar)
1-05732	ANPG-N60	Standard type nitrogen gauge	60	N/A
1-05734	ANPG-N70		70	N/A
1-05736	ANPG-N80		80	N/A
1-05738-2N1	ANPG2-N60	2n1 type nitrogen gauge (gauge w/ low pressure switch)	60	56 ± 3.6
1-05740-2N1	ANPG2-N70		70	65 + 0.7/-3.5
1-05742-2N1	ANPG2-N80		80	74 ± 2.8

2.4. Nitrogen Needle Cylinder (for use only with AFC-P227)

Nitrogen discharge valve is opened by the needle cylinder installed to its actuation port. Pressure from the discharged agent is used to actuate the nitrogen needle cylinder through copper tube line. The nitrogen needle cylinder is illustrated in Figure 2.12 and the corresponding technical data are summarized in Table 2.9.

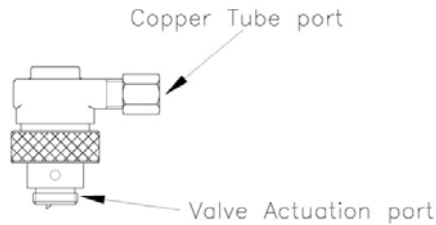


Figure 2.12. Nitrogen needle cylinder.

Table 2.9. Nitrogen valve needle cylinder technical data.

Model No.	Nitrogen Discharge Valve	Threaded Connection
NNC-06	NDV-N20	M18x1.5

2.5. Flexible Hose 20A (for use only with AFC-P227)

Flexible hose 20A is used to easily connect the agent and nitrogen cylinders through the nitrogen intake and discharge valves. It is also used to enable the flow and supply of nitrogen into the agent cylinder for continuous agent pressurization during discharge. The flexible hose 20A is illustrated in Figure 2.13 and corresponding technical data are summarized in Table 2.10.

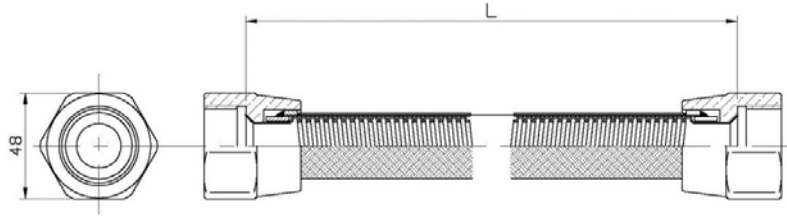


Figure 2.13. Flexible hose 20A.

Table 2.10. Flexible hose 20A technical data.

Model No.	Length (mm)	Minimum Bending Radius (mm)	Threaded Connection
AFC-FH-600	600	75	M36x2.0
AFC-FH-700	700		
AFC-FH-900	900		

2.6. Flexible Hose 50A

Flexible hose 50A is used to easily connect the agent cylinder and the manifold. It is also used to enable the flow of agent from its cylinder to the distribution piping via the manifold (supplied separately) during discharge. At one end, the flexible hose 50A has external metric threads and is connected to a union elbow (see Section 2.7) while the other end has external pipe threads (PT) and is connected to the check valve (see Section 2.10). The flexible hose 50A is illustrated in Figure 2.14 corresponding technical data are summarized in Table 2.11.

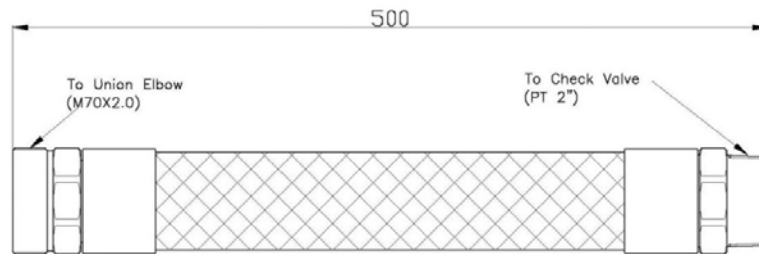


Figure 2.14. Flexible hose 50A.

Table 2.11. Flexible hose 50A technical data.

Model No.	Length (mm)	Minimum Bending Radius (mm)	Threaded Connection	
			Elbow side	Check Valve side
AFC-FH-50	500	350	M70x2	PT 2" (50A)

2.7. Union Elbow

The union elbow is used to connect the flexible hose 50A to the outlet of agent discharge valve. Only one model of union elbow is available and is provided with necessary adapter (see Section 2.8), that enables it to be fitted to any model of agent cylinder. The union elbow is illustrated Figure 2.15 and corresponding technical data are summarized in Table 2.12.

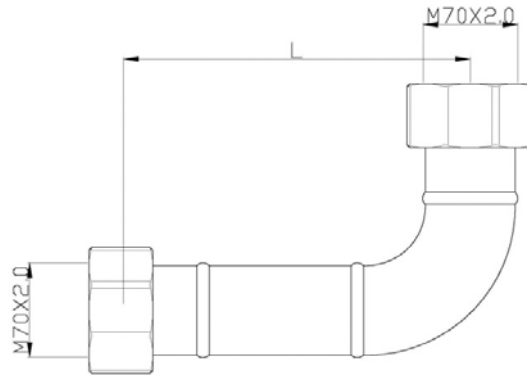


Figure 2.15. Union elbow.

Table 2.12. Union elbow technical data.

Model No.	Length, L (mm)	Diameter Inlet/Outlet (mm)	Thread Connection
AFC-UE-125	125	50	M70x2
AFC-UE-225	225	50	

2.8. Union Elbow Adapter

The union elbow adapter is used when an agent cylinder having size 40A discharge valve is to be connected to the distribution piping via the flexible hose 50A. The external straight-threaded end of the union elbow adapter is connected to the union elbow while the internal straight-threaded end is connected to the outlet of size 40A agent discharge valve. The union elbow adapter is illustrated in Figure 2.16 and the corresponding technical data are summarized in Table 2.13.

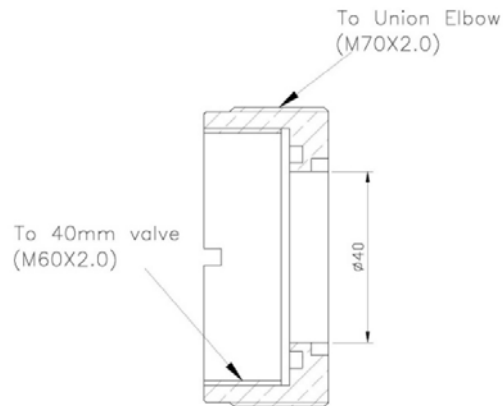


Figure 2.16. Union elbow adapter.

Table 2.13. Union elbow adapter technical data

Model No.	Threaded connection	
	Elbow side	Valve side
AFC-UEA-40	M70x2	M60x2

2.9. Pipe Adapter

The pipe adapter provides for direct threaded connection of agent cylinder to the distribution piping. It is designed for use in system installation where union elbow, flexible hose 50A, check valve 50A and manifold welding socket are not needed. The pipe adapter assembly consists a stainless-steel body and rubber o-ring seal. The body features a pipe connection side that is internally threaded to standard NPT/PT and a valve connection side with metric internal threads for connection with the 40A or 50A discharge valve. The pipe adapter is illustrated in Figure 2.17 and the corresponding technical data are summarized in Table 2.14.

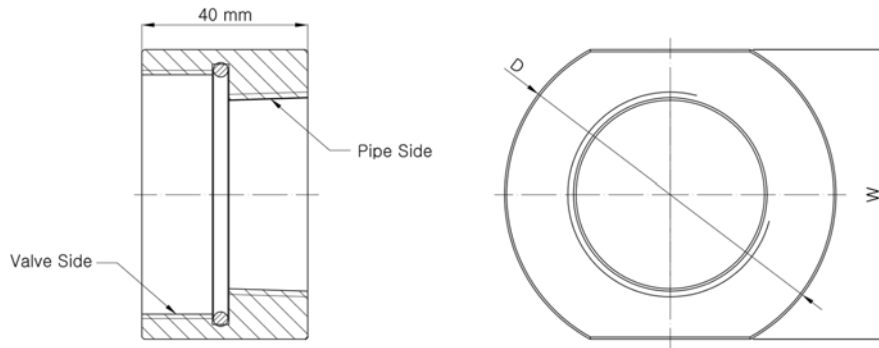


Figure 2.17. Pipe adapter.

Table 2.14. Pipe adapter technical data.

Model No.	Threaded connection		D, mm	W, mm
	Pipe Side	Valve Side		
PA-4025	1" NPT/PT (25A)	40A, M60x2	80	70
PA-4032	1-1/4" NPT/PT (32A)			
PA-4040	1-1/2" NPT/PT (40A)			
PA-5032	1-1/4" NPT/PT (32A)	50A, M70x2.5	90	80
PA-5040	1-1/2" NPT/PT (40A)			
PA-5050	2" NPT/PT (50A)			

2.10. Check Valve 50A

When multiple agent cylinders are connected to manifold, the check valve 50A is used to prevent the loss of agent and injury of personnel if the system is operated and discharged when an agent cylinder is disconnected or removed for maintenance. The check valve inlet has internal pipe threads (PT) and is connected to the flexible hose 50A (see Section 2.6) while the outlet has external metric threads and is connected to the manifold (supplied separately) via the manifold welding socket (see Section 2.11). The check valve is illustrated in Figure 2.18 and the corresponding technical data are summarized in Table 2.15.

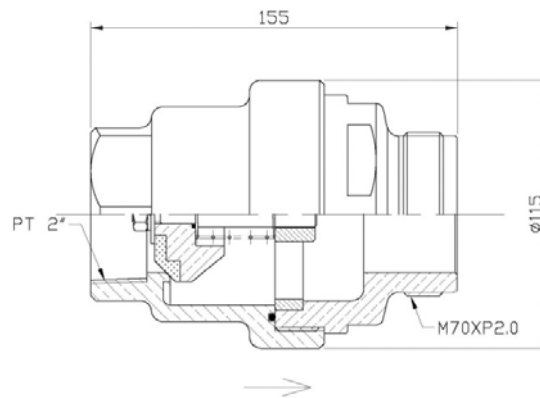


Figure 2.18. Check valve.

Table 2.15. Check valve technical data.

Model No.	Diameter Inlet/Outlet (mm)	Flexible Hose Connect	Welding Socket Connect
AFC-CV50	50	PT 2"	M70x2

2.11. Manifold Welding Socket

The manifold welding socket is used as an intermediate connection device between the check valve 50A (see Section 2.10) and manifold (supplied separately). The outlet of the socket is welded to the manifold while the inlet that has internal metric threads and is connected to the check valve 50A (see Section 2.10). The manifold welding socket is illustrated in Figure 2.19 and the corresponding technical data are summarized in Table 2.16.

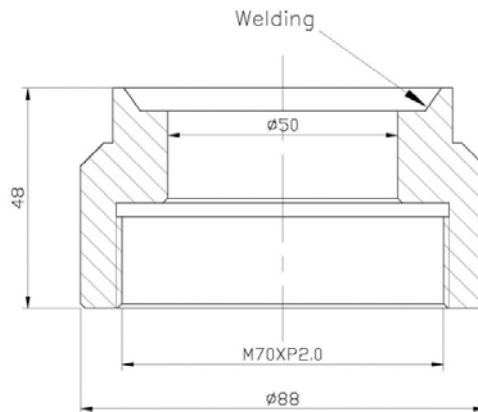


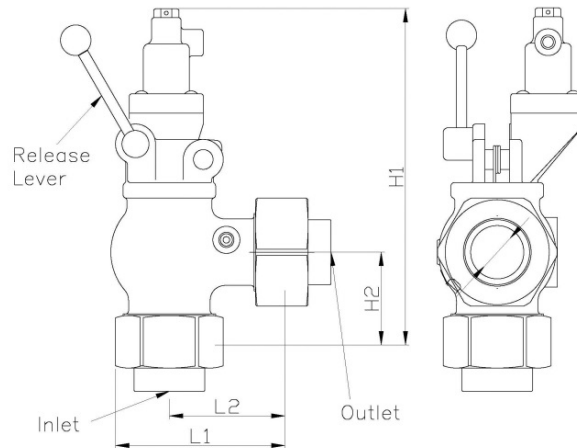
Figure 2.19. Manifold welding socket.

Table 2.16. Manifold welding socket technical data.

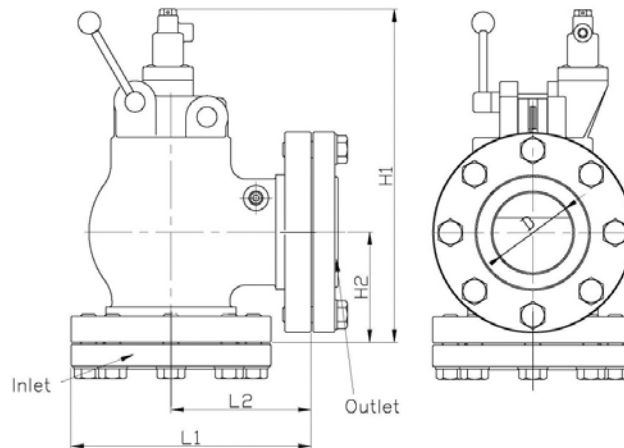
Model No.	Connection	
AFC-MWS50	Valve	Manifold
	M70x2	Welding

2.12. Selector Valve

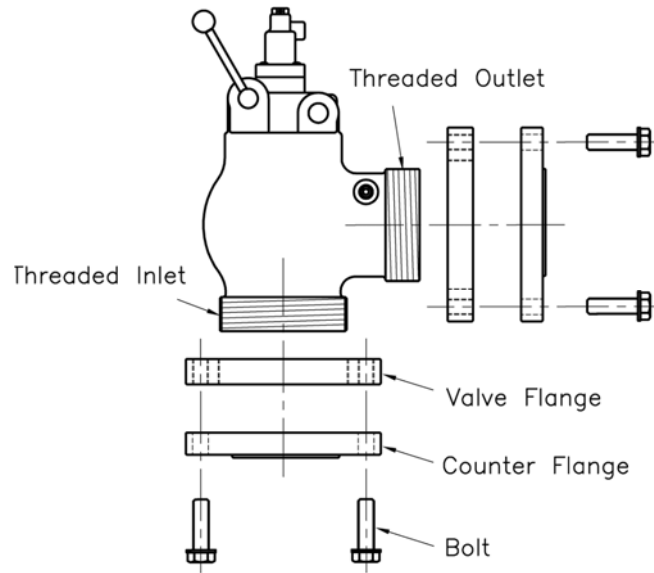
In multi-zone/enclosure system, where a battery of agent cylinders protect the selector valve is used to direct the flow of agent from the designated agent cylinders to the corresponding enclosure during agent discharge. Pressurized actuation gas release by the actuation device (see Section 2.13) is used to actuate the selector valve. The selector valve is fitted with a release lever that is used for local manual operation. The available selector valves are illustrated in Figure 2.20 and the corresponding technical data are summarized in Table 2.17.



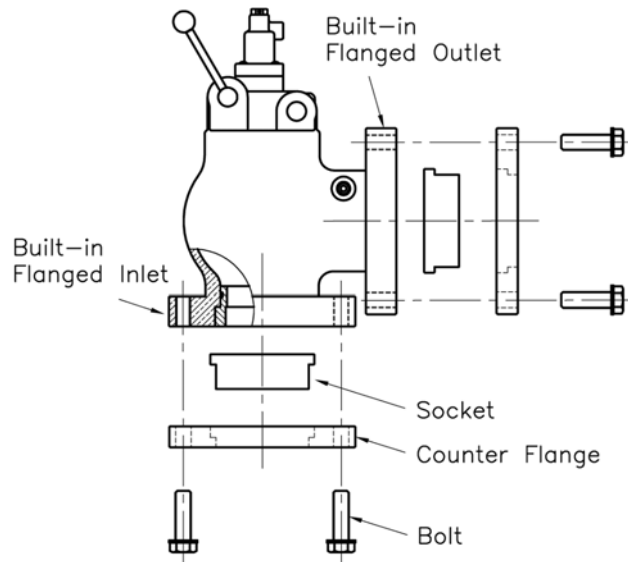
a. Model AFC-SV-32, AFC-SV-40
End Connection: Union Nut



b.1. Model AFC-SV-50, AFC-SV-65, AFC-SV-80, M-AFC-SV-100, AFC-SV-125, M-AFC-SV-150
End Connection: Threaded Flange



b.2. Model AFC-SV-50, AFC-SV-65, AFC-SV-80, AFC-SV-100, AFC-SV-125, AFC-SV-150 with threaded end flanges disassembled.



c. Model AFC-SV-50B, AFC-SV-65B, AFC-SV-80B, AFC-SV-100B, AFC-SV-125B, AFC-SV-150B End Connection: Built-in Flange (*FM Approved, Not UL Listed*)

Figure 2.20. Selector valve.

Table 2.17. Selector valve technical data.

Model No.	Diameter Inlet/Outlet (mm)	L1	L2	H1	H2	Inlet/Outlet Connector	Material
AFC-SV-32	32	142	90	249	70	Hex Union Nut	Bronze Casting, Brass
AFC-SV-40	40	142	90	249	70		
AFC-SV-50	50	190	110	247	68	Threaded Flange	
AFC-SV-65	65	215	125	286	85		
AFC-SV-80	80	240	140	328	110		
AFC-SV-100	100	303	175	396	135		
AFC-SV-125	125	350	200	438	158		
AFC-SV-150	150	395	230	461	168		
AFC-SV-50B	50	182	110	247	68	Built-in Flange	
AFC-SV-65B	65	204	125	286	85		
AFC-SV-80B	80	230	140	328	110		
AFC-SV-100B	100	290	175	396	135		
AFC-SV-125B	125	335	200	438	158		
AFC-SV-150B	150	380	230	461	168		

NOTE: After the selector valve has operated, it must be disconnected from the system and the seat ring be carefully checked for damage before re-installation.

2.13. Actuation Box

The actuation box is used to trigger the automatic operation of the system by releasing actuation medium (pressurized CO₂) that is then used to actuate the discharge valve needle cylinder. In a multi-zone system, the pressure from the actuation medium opens the associated selector valve prior to reaching the agent discharge valve needle cylinder as illustrated in Figure 2.2. It can also be used to activate the agent discharge alarm (system). The actuation box assembly consists of a steel enclosure, solenoid cutter (see Section 2.13.1), an actuation (pilot) cylinder (see Section 2.13.2), a pressure switch (see Section 2.13.3), and remove/tamper seals or solenoid cutter supervisor. The actuation box is factory-pre-assembled and shipped with the solenoid cutter uninstalled. The solenoid cutter is packed separately and shall be installed onsite according to the manufacturer’s installation instructions. **NOTE:** After the installation of solenoid cutter, or when the solenoid cutter has been removed and replaced for servicing/maintenance, the remove/tamper seal, if applicable, must be attached immediately. If the solenoid cutter supervisor is installed, the use of remove/tamper seal is not required. The actuation box assembly is illustrated in Figure 2.21 and the corresponding technical data are summarized in Table 2.18.

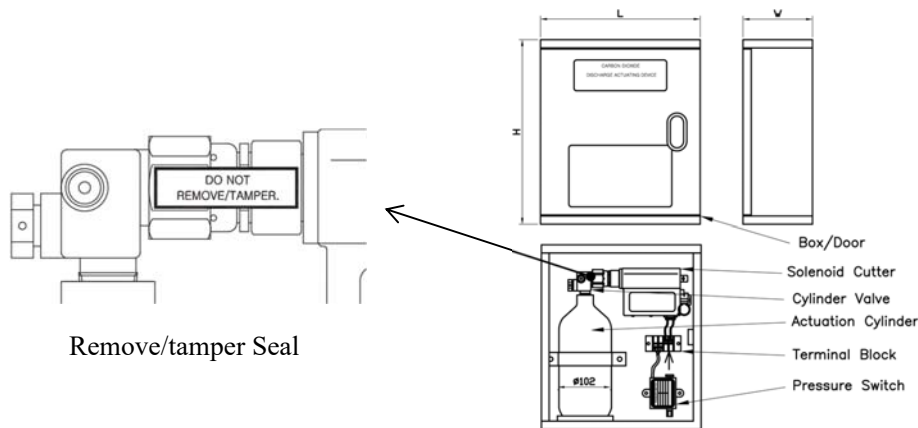


Figure 2.21. Actuation box.

Table 2.18. Actuation box technical data.

Model No.	Enclosure Dimension (LxWxH)	Cylinder Internal Volume (L)	Solenoid Cutter	Pressure Switch
AFC-AB01	310x135x360	1.1	24 Vdc, 1.7A	24 Vdc, 3A
AFC-AB02	390x155x380			

2.13.1. Solenoid Cutter

The solenoid cutter is used to actuate the actuation cylinder (see Section 2.13.2). It is an integral component of the actuation box (see Section 2.13) and is activated via electric signal that is sent by the control panel (supplied separately) upon detection. The solenoid cutter is fitted with PUSH button that is and should only be used for emergency manual activation should the electronics fail (see Section 5.1.2 for manual operating procedure). The solenoid cutter is illustrated in Figure 2.22 and the corresponding technical data are summarized in Table 2.19. **NOTE:** After the installation of solenoid cutter, the remove/tamper seal must be attached immediately.

CAUTION!
 Manually activating the solenoid cutter will activate the extinguishing system. Manual activation should **ONLY** be performed in case of emergency as the last course of action.

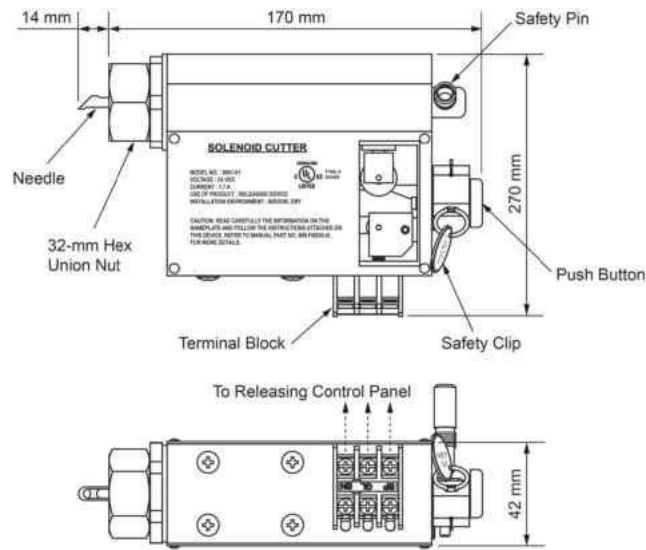


Figure 2.22. Solenoid cutter.

Table 2.19. Solenoid cutter technical data

Model No.	Dimension (mm)	Power Supply Rating
AFC-SC01	As shown (Figure 2.19)	24 Vdc, 1.7A

2.13.2. Actuation Cylinder

The actuation (pilot) cylinder is an integral part of the actuation box that is used to provide for the storage of liquid CO₂ as the actuation medium. When released, the CO₂ pressure is used to operate the corresponding selector valve, if any, and agent needle cylinders. The actuation cylinder is factory-fitted with a discharge valve that is opened via the activation of solenoid cutter (see Section 2.12.1). As part of the cylinder safety feature, the actuation cylinder valve is fitted with rupture disc-fitted safety plug to prevent unsafe pressure built-up and damage of the device. The actuation cylinder is illustrated in Figure 2.23 and the corresponding technical data are summarized in Table 2.20.

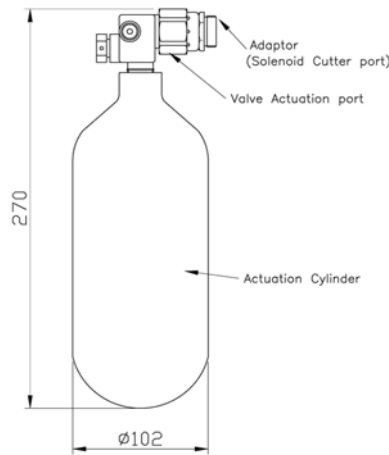


Figure 2.23. Actuation cylinder.

Table 2.20. Actuation cylinder technical data.

Model No.	Dimension (mm)	Internal Volume (L)	Fill Capacity (kg)	Safety valve burst pressure (bar)
AFC-PC01	As shown (Figure 2.20)	1.1	0.7 (CO ₂)	210

2.13.3. Discharge Pressure Switch (Optional)

An optional discharge pressure switch illustrated in Figure 2.24 comes with the actuation box (see Figure 2.21) and is used to activate the discharge alarm system. It is connected to the selector valve outlet port or discharge piping via copper tube line. Upon system discharge, pressure from the extinguishing agent flows through the selector valve outlet port and is used to operate the pressure switch. Operation of the pressure switch enables the flow of electrical signal via the electrical wiring that results to the activation of the discharge alarm system.

Note: Not UL Listed, not FM Approved

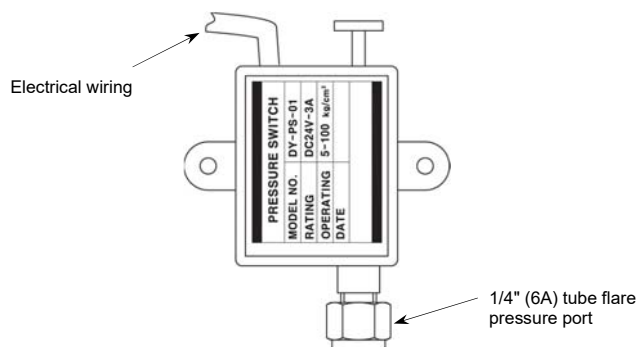


Figure 2.24. Optional pressure switch for AFC-227 and AFC-P227.

2.13.4. Solenoid Cutter Supervisor

The solenoid cutter supervisor is a highly recommended alternative to the remove/tamper seal. The solenoid cutter supervisor is used to monitor the position of the solenoid cutter (electric actuator) in the agent cylinder discharge valve or pilot cylinder valve. It is fitted with a normally closed water-resistant micro switch such that when properly installed and connected to a releasing control panel, complete removal or significant disengagement due to improper installation or loosening of the solenoid cutter from the valve it actuates causes the switch to activate, transmit electrical signal and triggers the audible and visual supervisory notification at the control panel. The solenoid cutter supervisor can be quickly installed in existing solenoid cutter and valve assemblies or new installations. The solenoid cutter supervisor is illustrated in Figure 2.25 and the corresponding technical data are summarized in Table 2.21.

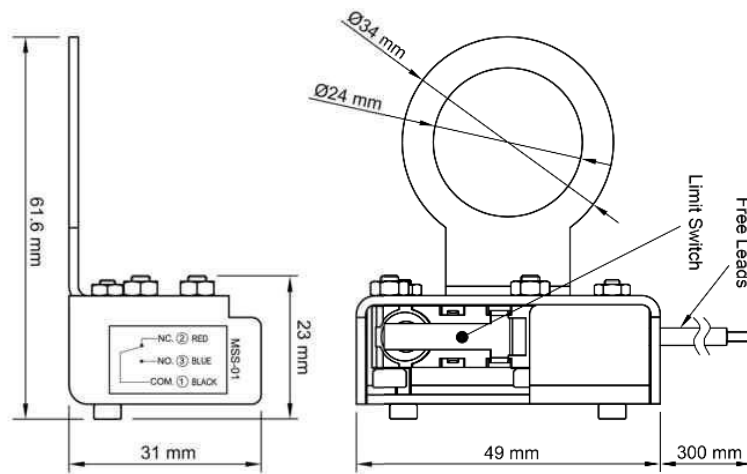
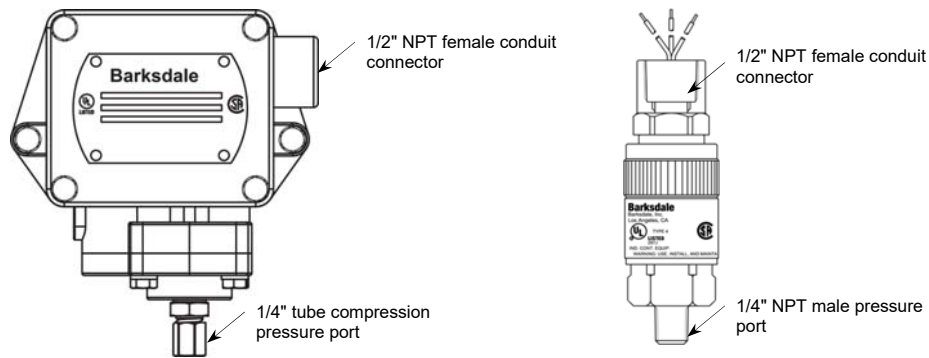


Table 2.21. Solenoid cutter supervisor technical data.

Model No.	Limit Switch		Mounting	
	Electrical Rating	Protection Code	Material	Compatibility
AFC-SS01	6A 125/250VAC; 5A 30VDC	IP67	Stainless steel	40A/50A Agent discharge valve, Pilot cylinder valve

2.14. Discharge Pressure Switch (Recommended)

It is preferred for AFC-227 and AFC-P227 to use UL Listed and/or FM Approved pressure switch for use in hazardous location that is compatible with the system operating pressure and the agent releasing or fire alarm control panel. If other pressure switch models are to be used, the designer and installer are strongly advised to refer to the pressure switch manual for compatibility information and contact American AFC for confirmation. The recommended pressure switch models for AFC-227 and AFC-P227 are illustrated in Figure 2.26.



- (a) Explosion-proof type pressure switch
(Model: P1X-B30; UL file no. E158638;
*Explosion-proof rating not FM Approved)
- (b) Compact type pressure switch
(Model: 96211-BB2; UL file no. E42186)

Figure 2.26. Recommended pressure switches for AFC-227 and AFC-P227.

2.15. Manual Station

Manual station provides for the manual override operation of fire extinguishing systems. AFC-227 and AFC-P227 enable the installation of any UL listed/FM approved manual station for releasing applications. Figure 2.27 shows the front panel of a typical manual station.

NOTE:

AFC-227 and AFC-P227 require the use of UL listed/FM approved agent release manual station that is compatible with the detection, alarm, actuation devices and fire alarm control panel. For example, it is recommended to use dual action type, UL listed, non-coded boxes (UNIU.S6569), model RMS-1T series manufactured by Potter. If other manual station models are to be used the designer and installer are strongly advised to refer to the control panel manual for compatibility information.

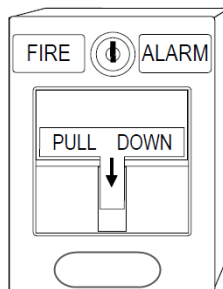


Figure 2.27. Typical manual station.

2.16. Discharge Nozzle

Discharge nozzle is used to provide for the discharge of extinguishing agent at suitable flow rate and distribution required to flood the protected area. It is installed at the designated terminal of the agent distribution pipe. The discharge nozzle is available in two types with varied sizes each intended for a specific area of enclosure/hazard. The 180° nozzle is designed for sidewall installations, while the 360° nozzle is installed at the location in the center of enclosure. The discharge nozzles are illustrated in Figure 2.28 and the corresponding technical data are summarized in Table 2.22. Complete list of available models for designated sizes of enclosures/hazards are shown in the Parts List section (see Chapter 6).

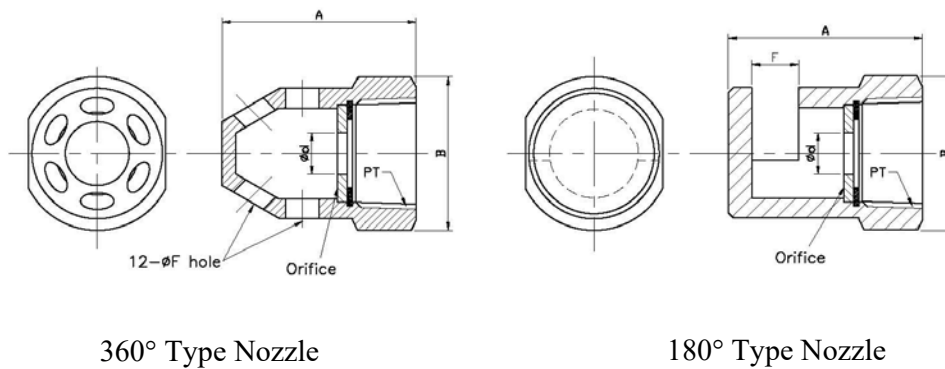


Figure 2.28. Discharge nozzle.

Table 2.22. Discharge nozzle technical data.

Nominal Size	PT	A	B	F(360°)	F(180°)	Orifice Diameter, <i>d</i>
15A	1/2"	45	32	5	10	See Parts List.
20A	3/4"	50	38	8	12	
25A	1"	58	46	10	14	
32A	1 1/4"	68	58	12	16	
40A	1 2/3"	74	63	14	18	
50A	2"	84	75	16	20	

2.17. Pressure Relief Device

The pressure relief device shown in Figure 2.29 is used in multi-zone systems where the piping section between the manifold check valve and the selector valve(s) may be closed off. To prevent entrapment of agent in such section of closed piping and over-pressurization when exposed to high temperature, the pressure relief device is fitted with a rupture disc that operates at predefined burst pressure.

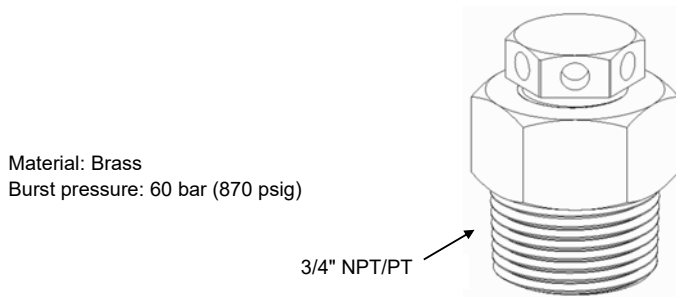


Figure 2.29. Pressure relief device.

2.18. Relief Valve 6A

The relief valve 6A shown in Figure 2.30 is used for bleeding off pressure that may build-up in the pneumatic actuation line if very small amount of leak in the pilot cylinder or master cylinder valve occurs. The relief valve is normally open and automatically closes when pressure reaches 1.5 bar. In a multi-zone system wherein check valves are installed in the actuation line, after the system has discharged, the relief valve must be manually operated to release the pressure in the actuation line prior to performing any related post-discharge maintenance.

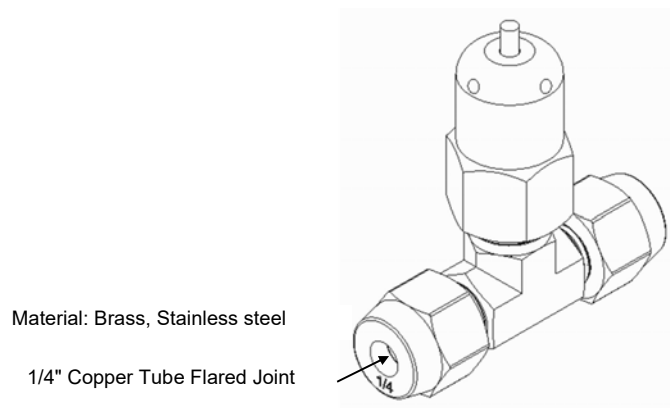


Figure 2.30. Relief valve 6A.

2.19. Check Valve 6A

The check valve 6A shown in Figure 2.31 is used in the pneumatic actuation tubing in a multi-zone system to ensure that the actuation pressure is delivered only to the intended needle cylinders (pneumatic valve actuators) on the agent cylinder valves. In main/reserve systems, the check valve is used to prevent the actuation of the reserve system when the main system is discharged. It is also used to make sure that the needle cylinder(s) stay pressurized throughout the duration of discharge. The maximum quantity of check valve 6A that can be installed in a single pneumatic actuation line is 10.

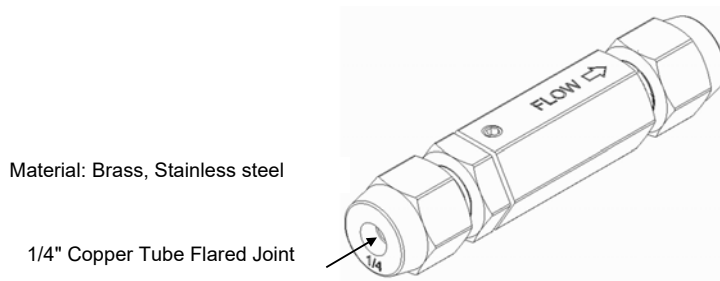


Figure 2.31. Check valve 6A.

2.20. Tee 6A

The Tee 6A shown in Figure 2.32 is used to branch and connect copper tubing in the pneumatic actuation lines.

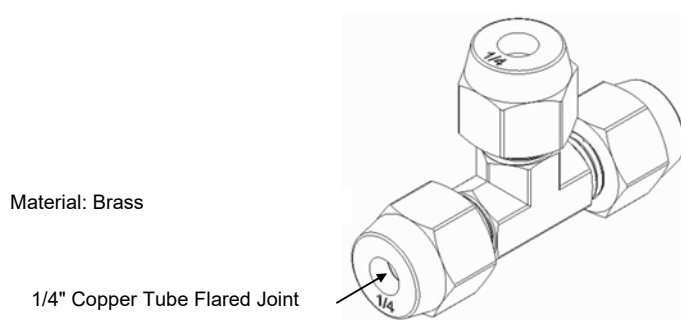
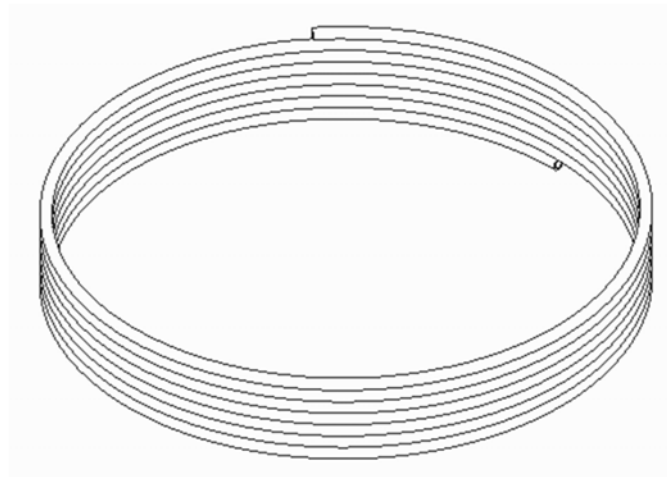


Figure 2.32. Tee 6A.

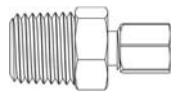
2.21. Copper Tube and Fittings

Copper tube is used to direct the flow of the actuating fluid i.e. extinguishing agent or compressed carbon dioxide in pneumatic actuation lines. Optionally, the copper tube may be factory pre-cut and bent to shape into one or more of the following: nitrogen actuation tube (interlock tube), agent actuation tube, agent interconnect tube, selector valve actuation tube and pressure switch actuation tube. The fittings provide for connection of the copper tube between the source and the actuator or switch. The plug pin is used to shut off the end of actuation line at the needle cylinder. The copper tube and fittings are illustrated in Figure 2.33.



1/4" (6.4 mm OD) copper tube

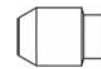
Copper tube minimum thickness: 0.70 mm



3/8" PT x 1/4" tube compression
(install in agent cylinder valve)



1/4" PT x 1/4" tube flare
(install in selector valve)



Plug pin
(install in needle cylinder)

Fittings material: Brass

Figure 2.33. Copper tube and fittings.

3. SYSTEM DESIGN

This chapter outlines the procedures needed for the design of AFC-227 and AFC-P227.

Generally, the following data must be determined in order to design an AFC-227 or AFC-P227:

- Type of hazard that the area is to be protected from
- Volume of enclosure
- Ventilation, openings, and other characteristics of the enclosure that may potentially affect the quantity of agent during discharge
- Design concentration required for the hazard and enclosure characteristics
- Needed additional system components:
 - Agent cylinders
 - Selector valve specifications
 - Discharge nozzle sizes and locations

AFC-227 and AFC-P227 are designed in accordance with NFPA 2001.

3.1. Design Concentration

The agent minimum design concentrations (MDC) for AFC-227 and AFC-P227 are calculated based on minimum flame extinguishing concentrations (MEC) plus safety factor of 20% for Class A, 30% for Class B, and 35% for Class C fire hazards in accordance with NFPA 2001. The flame extinguishing concentrations are determined by testing for Class A and C fire hazards while by cup burner method for Class B fire hazard.

The n-heptane cup burner extinguishing concentration for HFC-227ea is 6.7% (see Table A.5.4.2.2 (b), NFPA 2001, 2015 Edition). The agent extinguishing concentrations used in nozzle verification testing for AFC-P227 and AFC-227 were 6.9% and 7.28% (Class B extinguishing concentration), respectively. Accordingly, the calculation to determine the minimum design concentrations are carried out as follows:

$$\text{AFC-P227 Efficiency factor} = \frac{\text{Class B fire test concentration}}{\text{Cup burner value for n-heptane}} = \frac{6.9}{6.7} = 1.03$$

$$\text{AFC-227 Efficiency factor} = \frac{\text{Class B fire test concentration}}{\text{Cup burner value for n-heptane}} = \frac{7.28}{6.7} = 1.087$$

The minimum design concentrations for all other fuels (except n-heptane) are increased in the same proportion such that

for AFC-P227 :

$$\text{Class A design concentration: } 5.2\% * 1.2 * 1.03 = 6.43\%$$

(Use 6.7% in compliance with NFPA 2001, 2015 Edition)

$$\text{Class B design concentration: } 6.9\% * 1.3 = 8.97\%$$

$$\text{Class C design concentration: } 5.2\% * 1.35 * 1.03 = 7.23\%$$

for AFC-227 :

Class A design concentration: $5.2\% * 1.2 * 1.087 = 6.78\%$

Class B design concentration: $7.28\% * 1.3 = 9.46\%$

Class C design concentration: $5.2\% * 1.35 * 1.087 = 7.63\%$

Note that the Class B design concentration mentioned above is for n-Heptane fuel. For other Class B fuels, the minimum design concentration is determined by multiplying the cup burner extinguishing concentration of the fuel with the efficiency factor of the system (AFC-227 or AFC-P227) then increased by the 30% safety factor i.e.

$$\begin{aligned} &\text{Class B design concentration (other than n-Heptane)} \\ &= \text{cup burner extinguishing concentration} \times \text{efficiency factor} \times 1.3 \end{aligned}$$

Refer to the data sheet of listed or approved agent manufacturer for the Class B fuel cup burner extinguishing concentrations.

3.2. Agent Quantity

The quantity of agent required to achieve the design concentration for a given enclosure and temperature is calculated as

$$W = \frac{V}{S} \left(\frac{C}{100 - C} \right) \quad (3.1)$$

where:

W = weight of agent (kg)

V = enclosure volume (m^3)

S = specific volume (m^3/kg) of superheated HFC-227ea vapor can be approximated by

$S = 0.1269 + 0.0005t$, where t = temperature ($^{\circ}\text{C}$)

C = agent concentration (%)

Table 3.2 shows the calculated kilograms of agent per cubic meter of protected volume. The total quantity of agent required at a specific temperature and design concentration is calculated by multiplying the enclosure volume by the values in Table 3.2.

Table 3.1. HFC-227ea total flooding quantity.

Temp. <i>t</i> (°C)	Specific Volume <i>s</i> (m ³ /kg)	Weight Requirements of Hazard Volume, <i>W/V</i> (kg/m ³) HFC-227ea Design Concentration (% per Volume)									
		6%	7%	8%	9%	10%	11%	12%	13%	14%	15%
-10	0.1215	0.5254	0.6196	0.7158	0.8142	0.9147	0.0174	1.1225	1.2301	1.3401	1.4527
-5	0.1241	0.5142	0.6064	0.7005	0.7967	0.8951	0.9957	1.0985	1.2038	1.3114	1.4216
0	0.1268	0.5034	0.5936	0.6858	0.78	0.8763	0.9748	1.0755	1.1785	1.2839	1.3918
5	0.1294	0.4932	0.5816	0.6719	0.7642	0.8586	0.955	1.0537	1.1546	1.2579	1.3636
10	0.132	0.4834	0.57	0.6585	0.749	0.8414	0.936	1.0327	1.1316	1.2328	1.3364
15	0.1347	0.474	0.5589	0.6457	0.7344	0.8251	0.9178	1.0126	1.1096	1.2089	1.3105
20	0.1373	0.465	0.5483	0.6355	0.7205	0.8094	0.9004	0.9934	1.0886	1.1859	1.2856
25	0.1399	0.4564	0.5382	0.6217	0.7071	0.7944	0.8837	0.975	1.0684	1.164	1.2618
30	0.1425	0.4481	0.5284	0.6104	0.6943	0.78	0.8676	0.9573	1.049	1.1428	1.2388
35	0.145	0.4401	0.519	0.5996	0.6819	0.7661	0.8522	0.9402	1.0303	1.1224	1.2168
40	0.1476	0.4324	0.5099	0.5891	0.6701	0.7528	0.8374	0.9239	1.0124	1.1029	1.1956
45	0.1502	0.425	0.5012	0.579	0.6586	0.7399	0.823	0.908	0.995	1.084	1.1751
50	0.1527	0.418	0.4929	0.5694	0.6476	0.7276	0.8093	0.8929	0.9784	1.066	1.1555
55	0.1553	0.4111	0.4847	0.56	0.6369	0.7156	0.796	0.8782	0.9623	1.0484	1.1365
60	0.1578	0.4045	0.477	0.551	0.6267	0.7041	0.7832	0.8641	0.9469	1.0316	1.1183
65	0.1604	0.398	0.4694	0.5423	0.6167	0.6929	0.7707	0.8504	0.9318	1.0152	1.1005
70	0.1629	0.3919	0.4621	0.5338	0.6072	0.6821	0.7588	0.8371	0.9173	0.9994	1.0834
75	0.1654	0.3859	0.455	0.5257	0.5979	0.6717	0.7471	0.8243	0.9033	0.9841	1.0668
80	0.1679	0.3801	0.4482	0.5178	0.589	0.6617	0.736	0.812	0.8898	0.9694	1.0509
85	0.1704	0.3745	0.4416	0.5102	0.5803	0.6519	0.7251	0.8	0.8767	0.9551	1.0354
90	0.173	0.369	0.4351	0.5027	0.5717	0.6423	0.7145	0.7883	0.8638	0.9411	1.0202

3.3. Atmospheric Correction Factor

For AFC-227 and AFC-P227 installed at locations above sea level, less agent is required to achieve a specified design concentration compared to that at sea level. Atmospheric correction factors are used to adjust design concentration for such elevated system installations. According to NFPA 2001, these correction factors are summarized in Table 3.3.

Table 3.2. Atmospheric Correction Factors

Altitude (m)	Correction Factor
-914	1.11
-609	1.07
-304	1.04
0	1.00
305	0.96
610	0.93
915	0.89
1220	0.86
1525	0.82
1830	0.78
2130	0.75
2440	0.72
2745	0.69
3050	0.66

3.4. Discharge Time

AFC-227 and AFC-P227 is designed to achieve 95% of minimum design concentration in the protected area in a minimum of 6 seconds but not over 10 seconds (9 seconds - FM Approved for AFC-227 only) from the time the agent is discharged from the nozzles. This design concentration is based on a 20%~35% safety factor for fire suppression.

3.5. Agent Cylinder

Agent cylinder is selected based on the calculated required quantity of agent for the AFC-227 and AFC-P227 being designed. See Table 2.1 for the sizes, and fill ranges of available agent cylinders.

Should a single agent cylinder insufficient to store the required agent quantity or a connected reserve cylinder is required, additional cylinders shall be obtained. Note that, for AFC-227 and AFC-P227 requiring multiple agent cylinders, the cylinders are connected to the same set of distribution piping via a manifold. Agent cylinders to be connected to the same manifold shall be of the same size, fill, and pressure.

CAUTION!

The calculation method was evaluated for a temperature range of $21^{\circ}\text{C} \pm 5.5^{\circ}\text{C}$. When the piping network and container storage temperature is outside this range, there is a risk that the system will not supply the designated amount of extinguishing agent.

3.6. Piping

Pipe sizes to be used for the agent distribution piping are determined within the recommended agent flow range at the nozzle as shown in Table 3.4. Note that the information in Table 3.4 is only for reference in order to quickly establish preliminary design of the piping system. Agent flow rate in the preliminary piping shall be verified using the AFC-227 and AFC-P227 Design Program.

CAUTION!

The calculation method was evaluated for use with NPT/ISO type piping and associated fittings. When additional types of pipe and fittings are used, there is a risk that the system will not supply the designated amount of extinguishing agent.

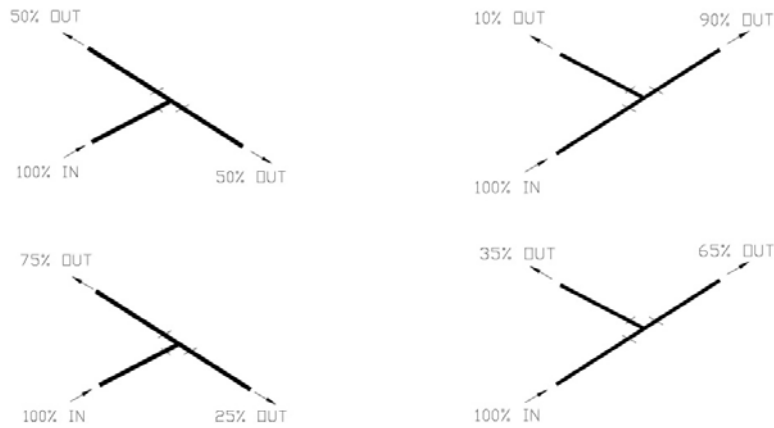
Table 3.3. Agent flow ranges

Pipe Nominal Size	Flow Rate (kg/s) Min. - Max.	Flow Rate at Manifold(kg/s) Min. - Max.
15A	0.32 - 1.36	-
20A	0.91 - 2.50	-
25A	1.54 - 3.86	0.92 - 3.86
32A	2.63 - 5.67	1.58 - 5.67
40A	3.81 - 9.07	2.29 - 9.07
50A	5.90 - 13.61	3.59 - 13.61
65A	8.85 - 24.95	5.31 - 24.95
80A	14.97 - 40.82	8.98 - 40.82
100A	26.31 - 56.70	15.79 - 56.70
125A	43.09 - 90.72	25.85 - 90.72
150A	57.61 - 136.1	34.57 - 136.1

3.7. Tee Splits

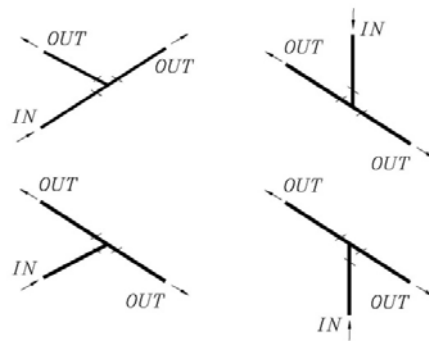
Bull head tee splits shall have minimum of 25-50%. Side tee splits shall have a minimum of 10-35% and shall be only imposed to the branch or transverse direction relative to the flow direction.

All outlets in tee splits must be oriented in the same horizontal plane. Examples of correct tee split designs are shown in Figure 3.1.

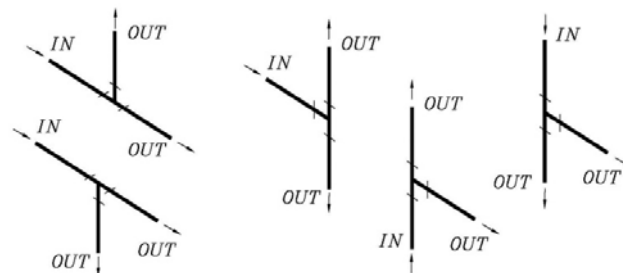


(a) Bull tee splits

(b) Side tee splits



(c) Correct tee split



(d) Incorrect tee split

Figure 3.1 Examples of tee splits design.

3.8. Equivalent Length

The equivalent length values of all fittings and other system equipment through which the agent flows are listed in Table 3.5.

Table 3.4. Equivalent length for valves, fittings, and hoses.

Name	Size	Model No.	Equivalent Length (m)
Agent Discharge Valve	40 mm	ADV-40	3.0
	50 mm	ADV-50	6.0
Check Valve	50 mm	AFC-CV-50	5.0
Union Elbow	125 mm	AFC-UE-125	3.36
	225 mm	AFC-UE-225	3.36
Selector Valve	32 mm	AFC-SV-32	3.0
	40 mm	AFC-SV-40	4.1
	50 mm	AFC-SV-50	4.5
	65 mm	AFC-SV-65	5.2
	80 mm	AFC-SV-80	5.9
	100 mm	AFC-SV-100	7.5
	125 mm	AFC-SV-125	11.5
	150 mm	AFC-SV-150	11.9
Flexible Hose	50A	AFC-FH-50	10.0

3.9. Percent Agent in Piping and Pipe Length

The percentage of agent in the piping shall not exceed 100% for AFC-227 and 326% AFC-P227 as calculated using the formula,

$$\text{percent agent in pipe} = \frac{V_P}{V_E} \times 100 \quad (3.2)$$

where:

V_P = piping internal volume (L)

V_E = volume of liquid agent in the cylinder

= 0.7107 (L/kg) * agent weight (kg); where 0.7107 L/kg is the specific volume of HFC-227ea at 20°C

AFC-227 and AFC-P227 design program checks whether the ratio between the percent agent in pipe and percent agent before the first tee split fall within the acceptable design region as depicted in Figure 3.2. If not, the program will display a warning.

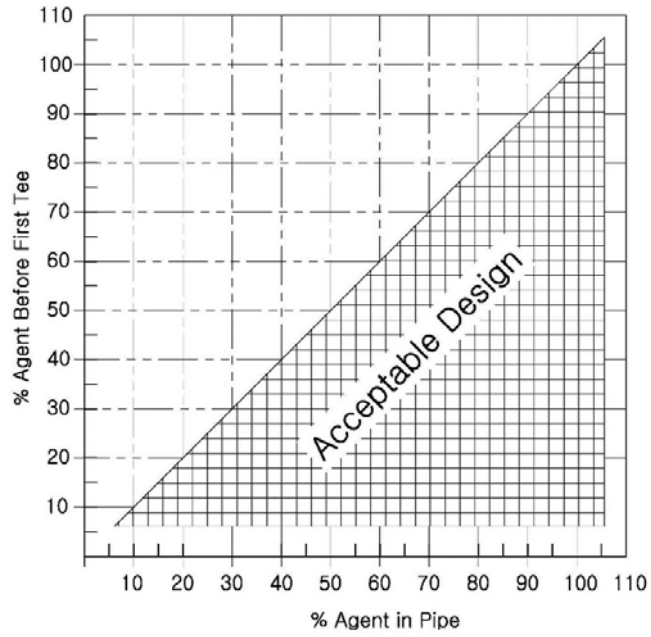


Figure 3.2. Percent agent before first tee of AFC-227.

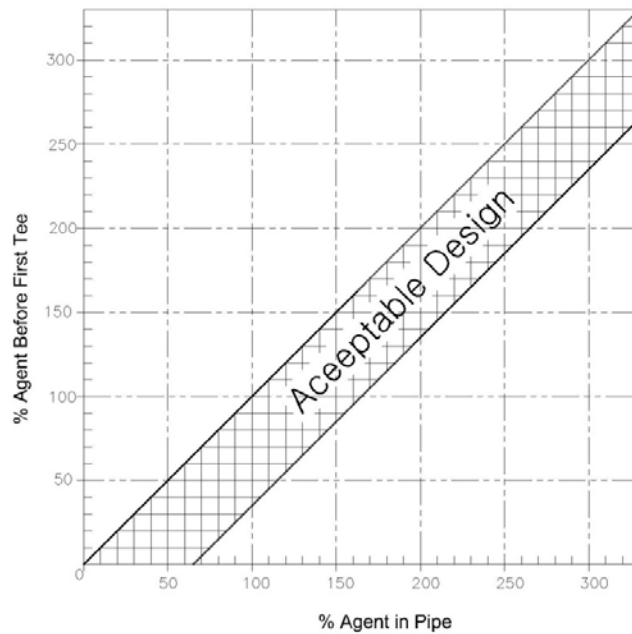


Figure 3.3. Percent agent before first tee of AFC-P227.

3.10. Nozzle Selection and Location

The nozzles are designed to provide specific agent discharge pattern and maximum coverage area. The 360° nozzle is designed to provide a full 360° discharge pattern and is installed in the center of enclosure. The 180° nozzle is designed to provide 180° discharge pattern and is used in sidewall installations.

The orifice area and number of nozzles required are determined based on the size and layout of the protected area. Use the AFC-227 and AFC-P227 design program to determine the orifice area and number of nozzles.

The following factors must be considered when designing the nozzle locations:

- The maximum coverage area for 360° nozzle is determined as a rectangle/square that can be inscribed in a circle with radius of 8.9 m. For 180° nozzle, the maximum coverage area is determined as any rectangle/square that can be inscribed in a semicircle with radius of 14.1 m. The nozzle maximum coverage areas are illustrated in Figure 3.2.
- 360° nozzles must be installed a maximum of 0.3 m below the ceiling and as close as possible to the center of coverage area.
- Maximum protection height for a 360° and 180° nozzle is 4.5 m. Additional nozzle shall be installed at different rows for enclosure with ceiling higher than 4.5 m.
- 180° nozzles shall be installed 0.3 m from the wall (measured from the wall to the center of nozzle) with the orifices directed towards the hazard area.
- Minimum average pressure at the nozzle during discharge shall be 8.3~9.2 bar.
- Multiple nozzles shall be installed to ensure complete coverage of the protected area. Two adjacent nozzles shall be located at a maximum of 12.62 m apart as illustrated in Figure 3.3(a) and 3.3(b).
- Depending on the configuration of protection area, 360° and 180° nozzles may be combined and shall be located in such a way that entire protected area is completely covered (total flooding). Examples of multiple nozzle installation is shown in Figure 3.4.
- Regardless of nozzle location design, it must be ensured that agent discharge time is kept to a minimum of 6 seconds but not more than 10 seconds to achieve 95% agent concentration as described in Section 3.3.

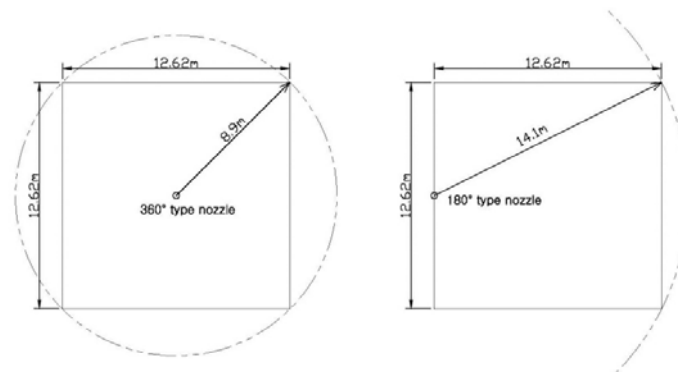


Figure 3.2. Discharge nozzle coverage radius.

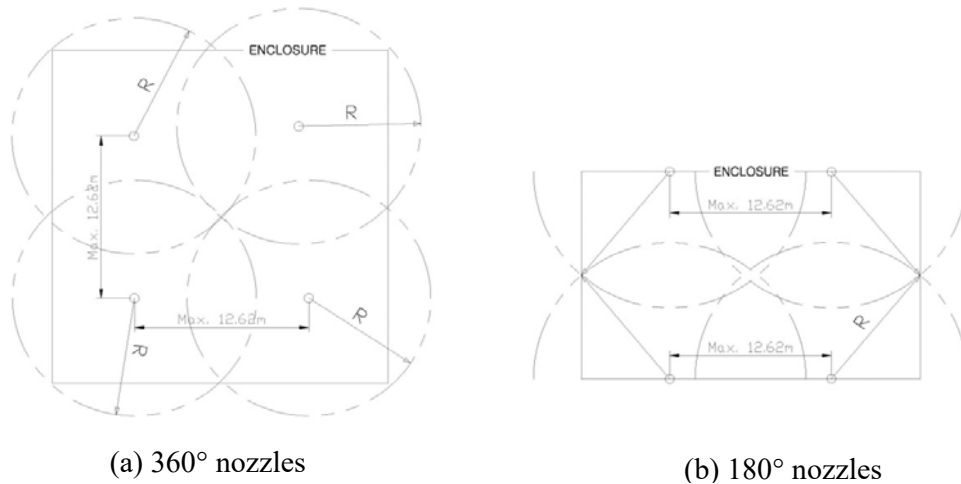


Figure 3.3. Nozzle location in a protected area.

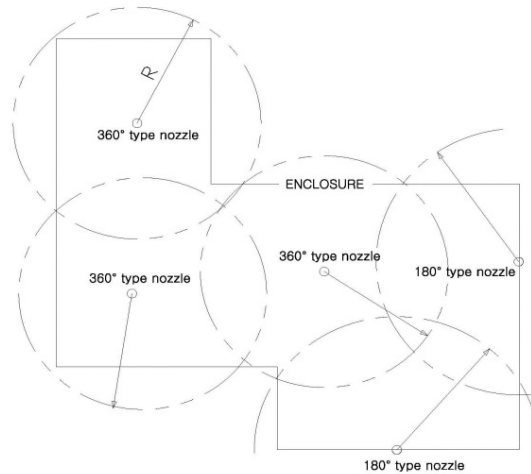


Figure 3.4. Example installation of multiple nozzles depending on protected area configuration.

3.11. System Design Limitations Summary

The flow calculation and design limitations described in this manual are in accordance with NFPA 2001 and have been implemented in AFC-227 and AFC-P227 design program. The limitations for the design of AFC-227 and AFC-P227 are summarized in Table 3.6.

3.12. System Design Flow Summary

The AFC-227 and AFC-P227 design procedures outlined in the preceding sections and are implemented in the flow calculation program can be graphically summarized as shown in Figure 3.5. A sample calculation problem, the corresponding computer input and output information are shown in Appendix A, B.

Table 3.6. System design limitation summary.

System limits	AFC-227	AFC-P227
▪ Minimum design concentration, Class A (Class C):	6.78% (7.63%)	6.7% (7.23%)
▪ Minimum design concentration, Class B:	9.46%	8.97%
▪ Maximum design concentration for occupied enclosure:	10.5%	
▪ Extinguishing agent discharge time:	6 - 10 seconds (FM Approved discharge time for AFC-227 is 9 sec.)	
▪ Filling range of extinguishing agent cylinder:	495 kg/m ³ - 955 kg/m ³ (63 L, 89 L, 115.4 L, 175 L)	
▪ Agent flow rate in pipe and manifold:	Depending on pipe size. Refer to Table 3.3	
▪ Minimum pressure at discharge nozzle:	360° type : 9.17 bar / 180° type : 8.34 bar	
▪ Minimum nozzle discharge radius, 360° nozzle:	8.9 m	
▪ Minimum nozzle discharge radius, 180° nozzle:	14.1 m	
▪ Nozzle installation height:	0.3 m - 4.5 m	
▪ Maximum pressure deviation between discharge nozzles:	6.0 bar	4.5 bar
▪ Deviation of maximum arrival time of extinguishing agent to discharge nozzle:	1.0 second	0.9 second
▪ Deviation of maximum ending time of extinguishing agent discharge between discharge nozzles:	2.0 seconds	1.5 second
▪ Discharge nozzle orifice area:	25% - 70% (Ratio of nozzle orifice area to pipe area)	
▪ Maximum percent agent in pipe (volume ratio of extinguishing agent vs pipe volume):	106%	326%
▪ Percent of agent volume in pipe to first tee:	Minimum 5.9%	62% lower than total percent agent in pipe
▪ Length of pipe before and after tee split:	Minimum of 10D (D is the outside diameter of pipe)	
▪ Tee flow split, Bull head tee:	50% : 50% - 25% : 75%	
▪ Tee flow split, Side tee:	35% : 65% - 10% : 90%	
▪ Tee split in the selection valve outlet:	Horizontal tee split	
▪ Maximum pipe size of manifold:	150A	
▪ Operating temperature:	0°C - 55°C	

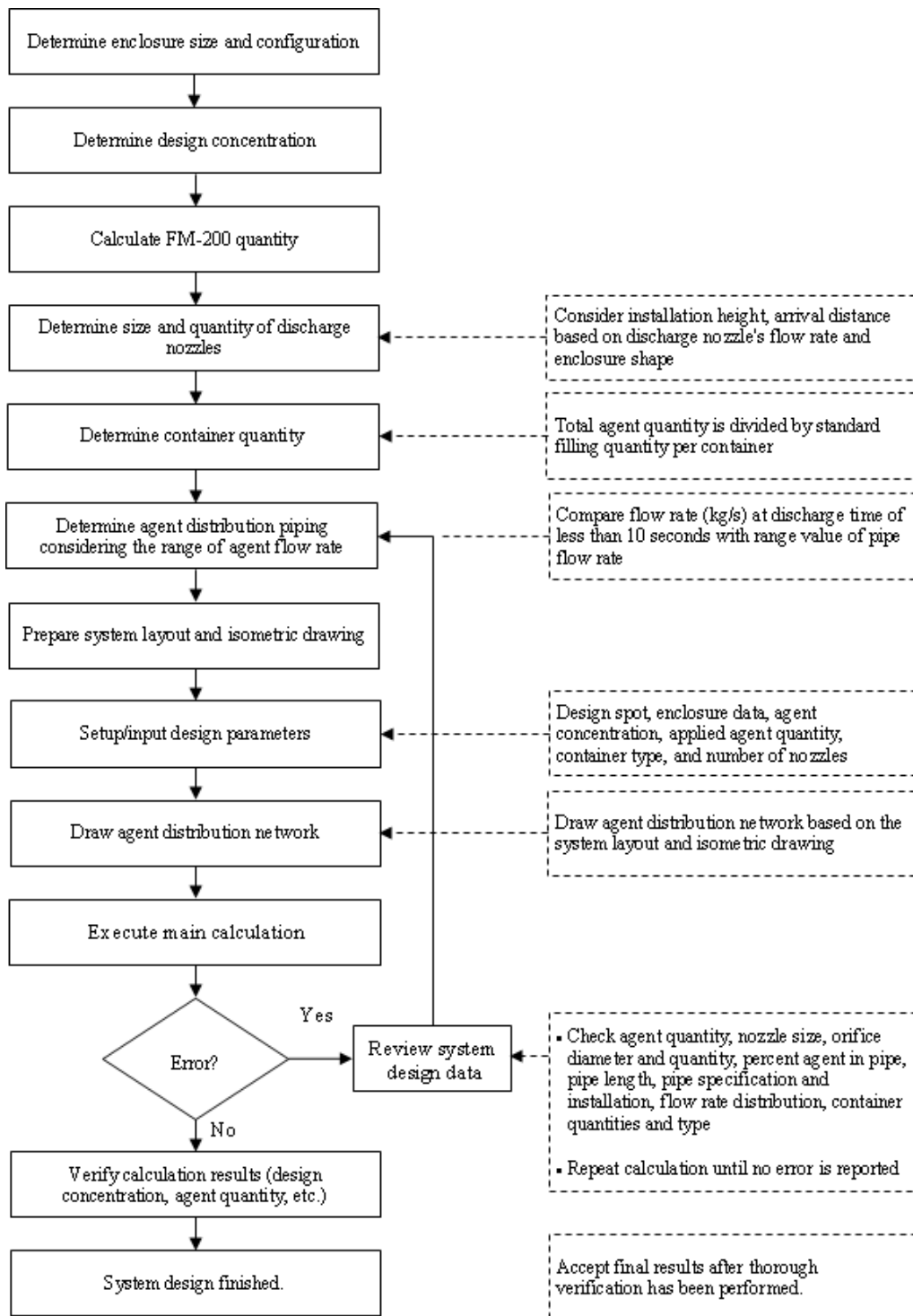
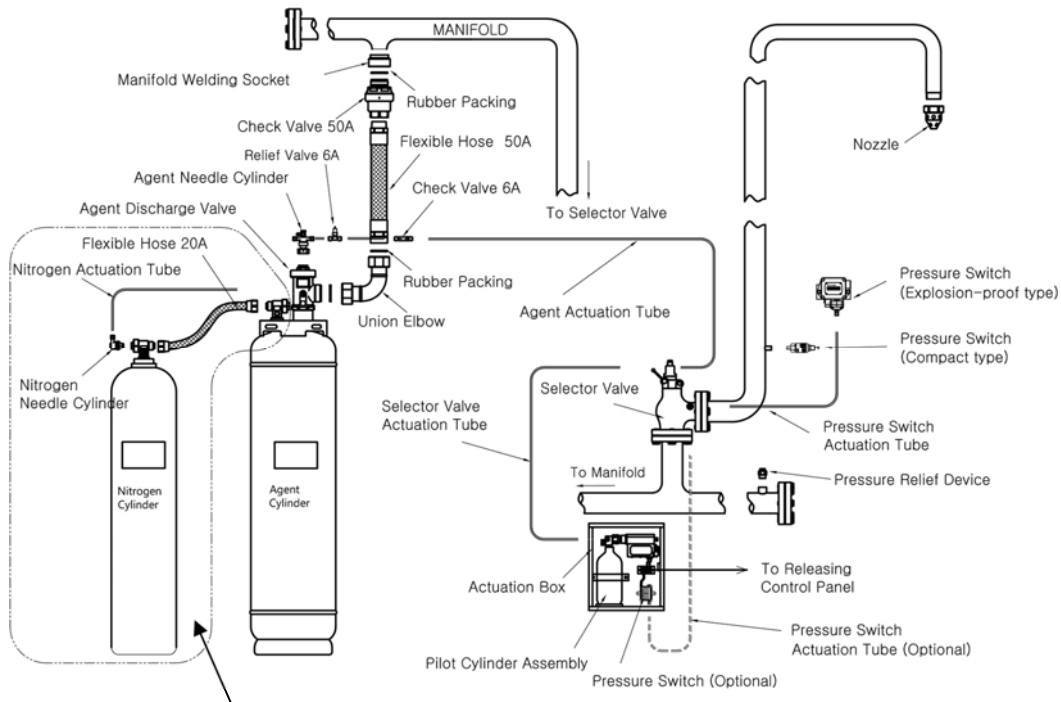


Figure 3.5. AFC-227 and AFC-P227 design flow.

4. **PUVCNNCVKQP**

This chapter outlines the instructions for the installation of components comprising AFC-227 and AFC-P227. Since both systems can be installed in almost the same fashion, as an illustrative guide, Figure 4.1 shows the exploded view of a typical AFC-227 and AFC-P227.



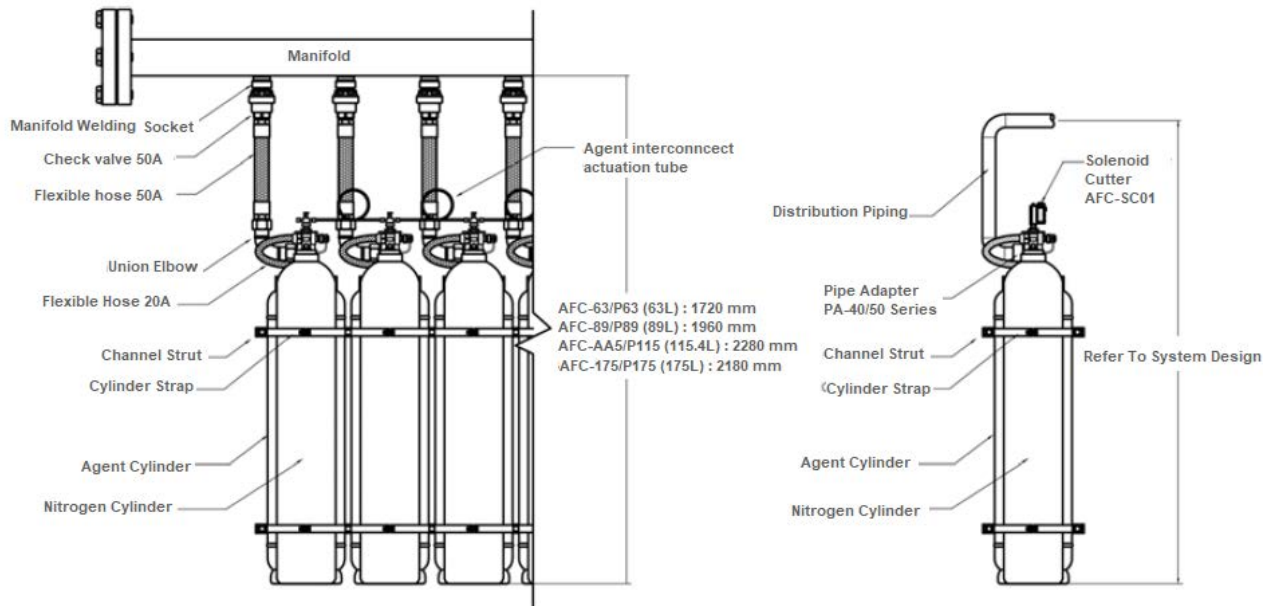
*Only installed in AFC-P227

Figure 4.1 Exploded view of a typical AFC-227 and AFC-P227.

60B0Ci gpv'E{ nlpf gt 'kpuvcncvkqp"

1. If a steel frame is to be used to hold a group of multiple cylinders, position the cylinder frame (not supplied in some regions) with reference to manifold location. Refer to Figure 4.2 for the recommended height of manifold relative to the agent cylinder model being installed.
2. Bolt the cylinder channel struts to the appropriate location in the steel frame or rigid wall (refer to Figure 4.3).
3. Position the cylinder in place and install the cylinder straps as illustrated in Figure 4.3. Tighten the bolts just enough to prevent the straps from falling and enable movement of the cylinders for proper positioning.
4. Install the check valve (AFC-CV50) and packing (PCK-50) to the manifold welding socket (AFC-MWS50). **PQVG**: The manifold welding socket should be welded with manifold prior to performing this step.
5. Connect the flexible hose (AFC-FH-50) to the check valve (AFC-CV50). **PQVG'1**: Use the end of flexible hose with PT (refer to Figure 2.10).

- PQVG'2:** For single enclosure installation, flexible hoses (AFC-FH-50) can be directly connected to the main pipe without the check valve (AFC-CV50).
6. Install the union elbow (AFC-UE-125/225) with packing (PCK-50) to the flexible hose (AFC-FH-50). **PQVG:** Use the end of flexible hose with metric threads (refer to Figure 2.10).
 7. Install the union elbow (AFC-UE-125/225) and packing (PCK-50) to the outlet of agent cylinder assembly (AFC-63//68/89/115/175/P63/P68/P89/P115/P175). **PQVG:** Use the adapter (AFC-UEA-40) if AFC-63/68/89/P63/P68/P89 agent cylinder is installed.
 8. Connect the flexible hose (AFC-FH-50) to the union elbow (AFC-UE-125/225).
 9. To install more agent cylinders, repeat steps 3-6. Otherwise, proceed to step 8.
 10. Secure the agent cylinder(s) by properly the bolts of the cylinder straps.
- Refer to Figure 4.2 - 4.10. for examples of agent cylinder installation.



(a) Multiple cylinder installation

(b) Single cylinder installation

Figure 4.2. Agent cylinder, joints, fittings and manifold or main pipe setup for multiple and single-cylinder installation.

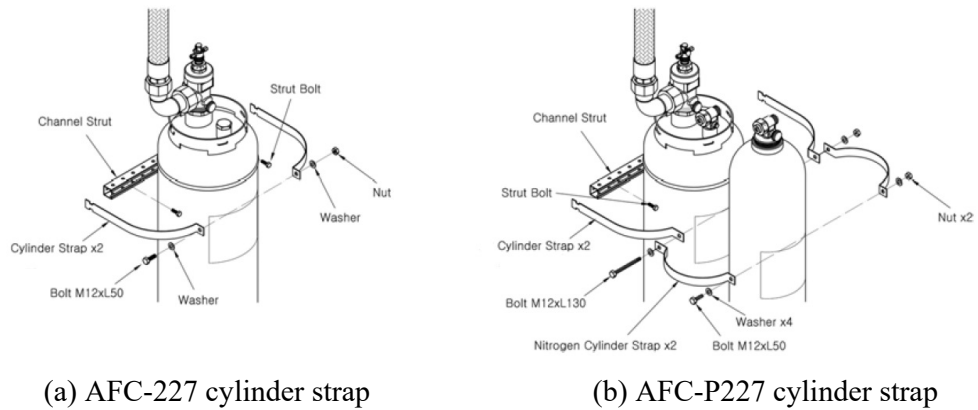


Figure 4.3. Installation of cylinder straps

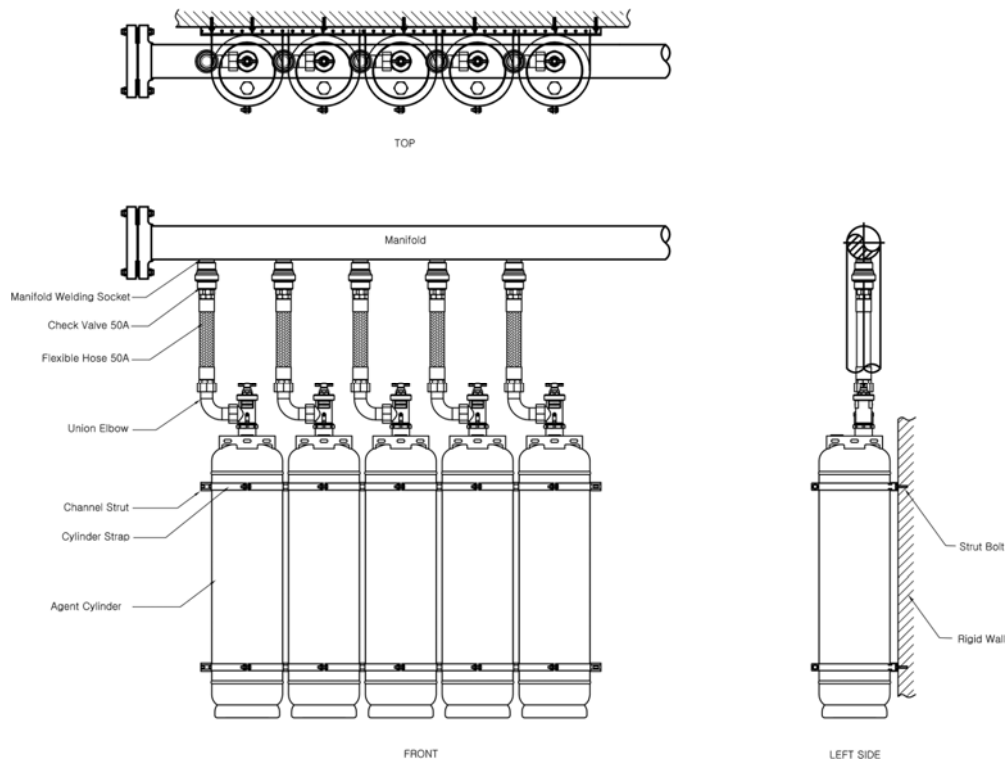


Figure 4.4. Agent cylinders single-row installation (*AFC-227 only).

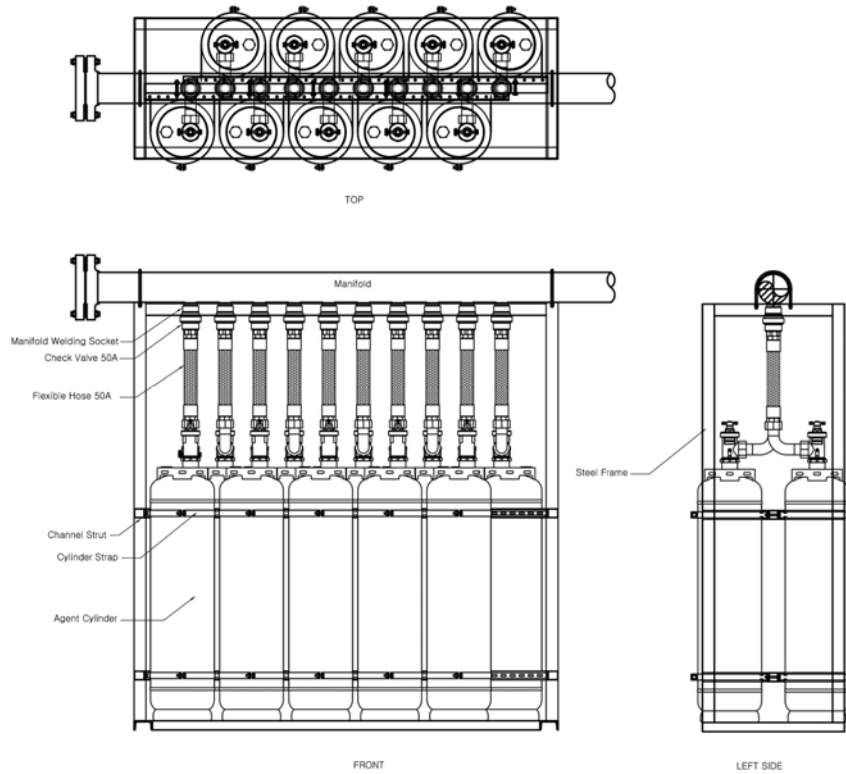


Figure 4.5. Agent cylinders two-row installation (*AFC-227 only).

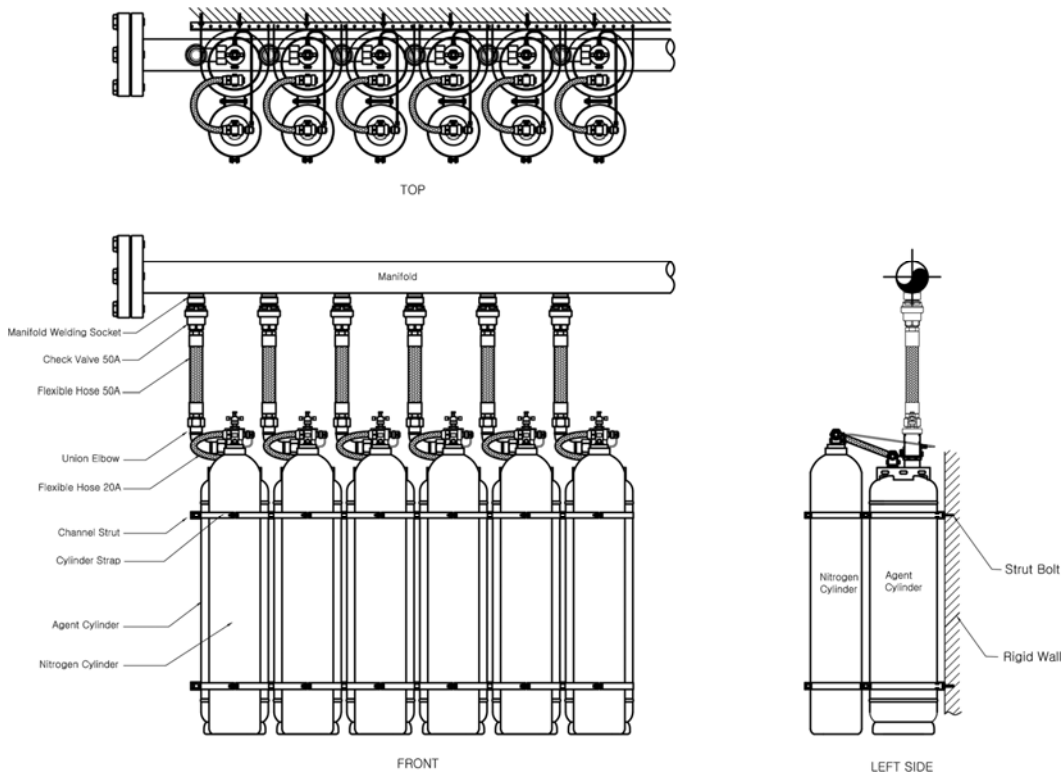


Figure 4.6. Agent and nitrogen cylinders single-row installation (*AFC-P227 only).

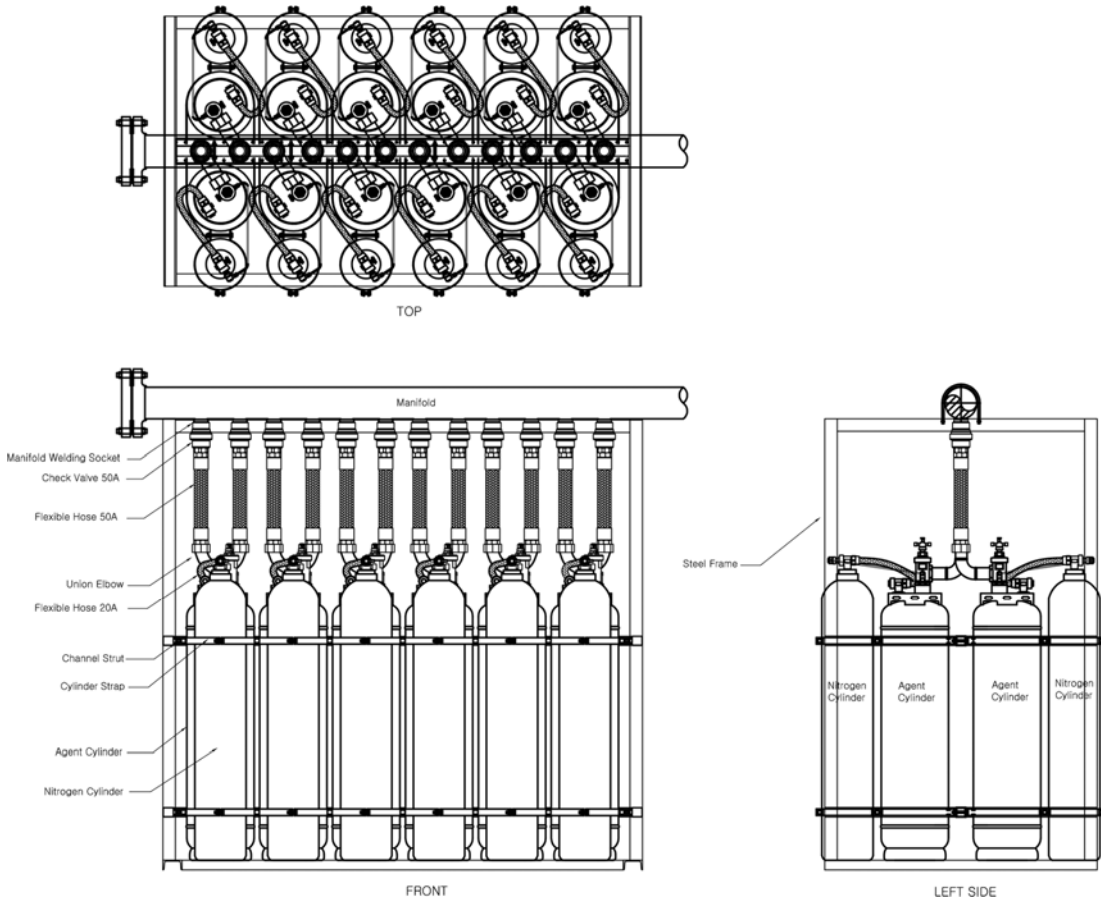


Figure 4.7. Agent and nitrogen cylinders two-row installation (*AFC-P227 only).

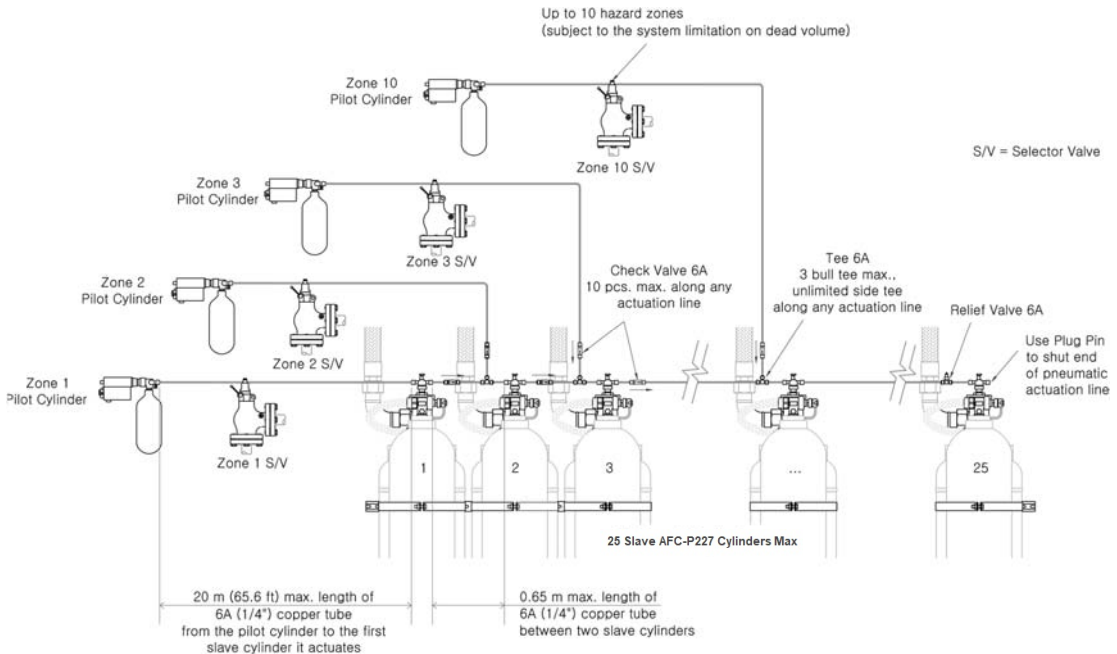


Figure 4.8. Pilot/slave configuration for multi-zone system

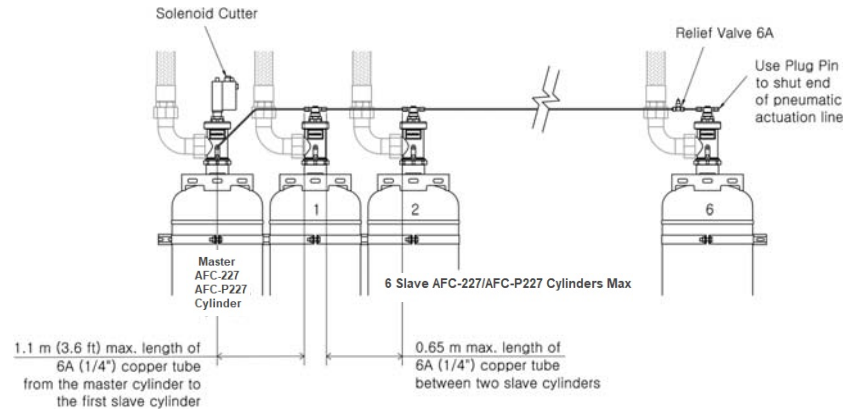


Figure 4.9. Master/slave configuration for multi-cylinder single-zone system

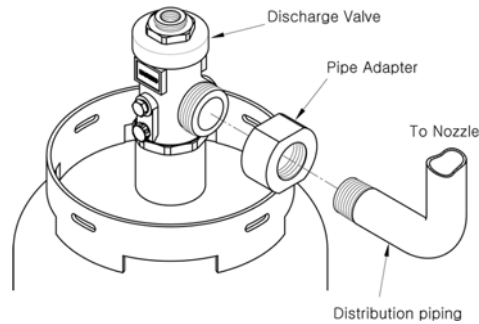


Figure 4.10 Direct installation of agent cylinder to distribution piping

4.2. Nitrogen Cylinder Installation (*AFC-P227 only)

1. Position the nitrogen cylinder assembly beside the agent cylinder.
2. Connect the flexible hose (AFC-FH-600/700/900) to the nitrogen outlet and intake valves in nitrogen cylinder and agent cylinder, respectively.
3. To install more nitrogen cylinders, repeat steps 1-2. Otherwise proceed to step 4.
4. Secure the nitrogen cylinder(s) by properly installing the supplied cylinder straps.

Refer to Figure 4.3 - 4.7 for examples of nitrogen cylinder installations.

4.3. Agent Needle Cylinder Installation

1. Remove the protection cap from the actuation port of agent discharge valve (ADV-40/50).
2. Install the agent needle cylinder (AFC-NC-15).

WARNING!

Make sure that the actuating needle of agent needle cylinder is fully retracted and the safety clip is securely fastened prior to installation. Failure to follow this instruction will result to agent discharge when the needle cylinder is installed to the valve and may cause personal injury, death, or damage to property.

4.4. Nitrogen Needle Cylinder Installation (*AFC-P227 only)

1. Remove the protection cap from the actuation port of nitrogen discharge valve (NDV-N20).
2. Install the nitrogen needle cylinder (AFC-NC-15).

WARNING!

Make sure that the actuating needle of nitrogen needle cylinder is fully retracted and the safety clip is securely fastened prior to installation. Failure to follow this instruction will result to nitrogen (and agent) discharge when the needle cylinder is installed to the valve and may cause personal injury, death, or damage to property.

4.5. Nitrogen Actuation Tube Installation (*AFC-P227 only)

1. Remove (unscrew) the interlock port protection plug (TU-060) from the agent discharge valve body (see left image of Figure 4.11).
2. Install the interlock tube union (TU-061) to the agent discharge valve interlock port.
3. Connect the terminals of nitrogen actuation tube to the agent discharge valve and nitrogen needle cylinder.

The completed installation of nitrogen actuation tube (CT-500/530/600) is shown in the right image of Figure 4.11.

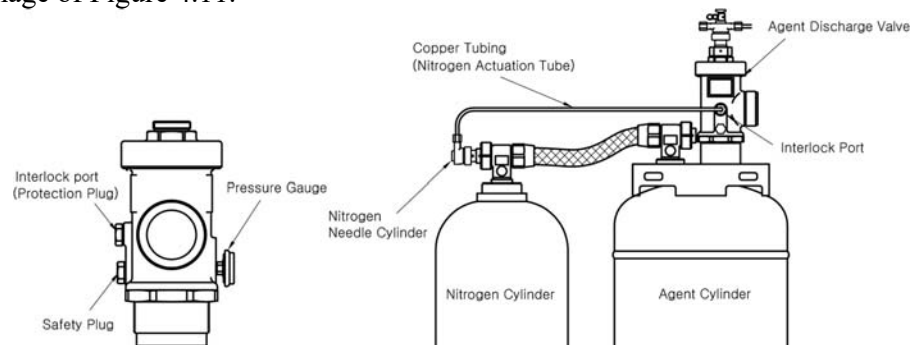


Figure 4.11. Nitrogen actuation tube installation (*AFC-P227 only).

4.6. Agent Actuation Tube Installation

1. Connect the agent actuation tube (CT-001) to the selector valve (AFC-SV-/32/40/50/65/80/100/125/150) and agent needle cylinder (AFC-NC-15) via the corresponding copper tube ports (see Figure 4.12).
2. When multiple-cylinder single-enclosure AFC-P227 is installed, interconnect the agent needle cylinders using the agent interconnect actuation tube (FT-320) via the corresponding copper tube ports (refer to Figure 4.13.).
3. When multiple-cylinder multiple-enclosure AFC-P227 is installed, perform all the procedures stated above for each enclosure.

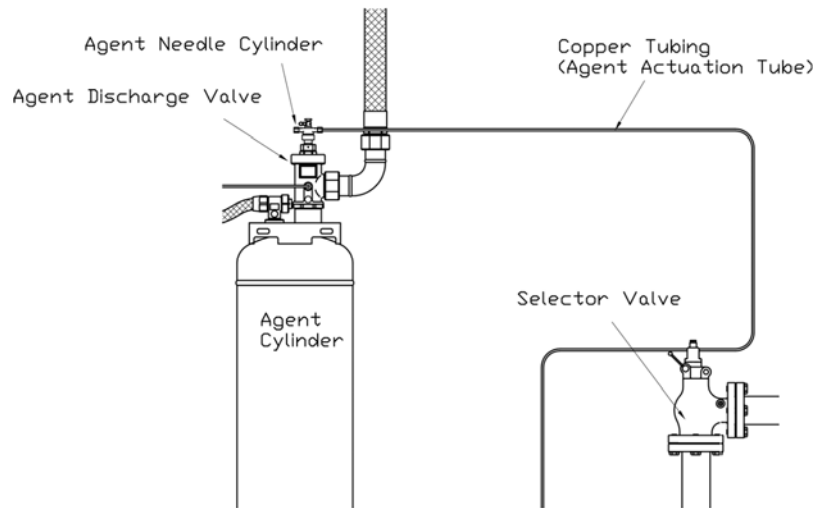


Figure 4.12. Installation of agent actuation tube.

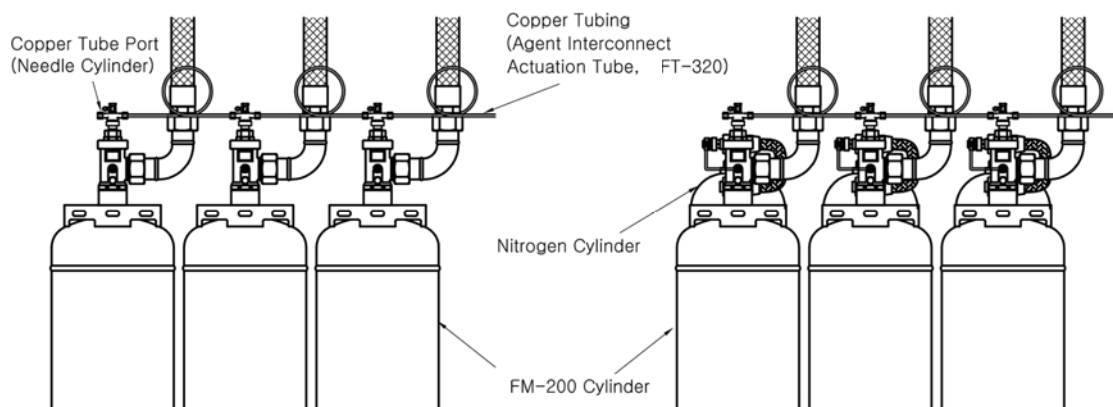


Figure 4.13. Installation of interconnected agent needle cylinders for multiple-cylinder single enclosure system.

4.7. Selector Valve Actuation Tube Installation

- For single-enclosure system, the selector valve (AFC-SV-32/40/50/65/80/100/125/150) may not be installed. In this case, connect the agent actuation tube (CT-001) to the outlet of pilot cylinder assembly (AFC-PC01) and agent needle cylinder (AFC-NC-15).
- For multiple-enclosure system, a selector valve (AFC-SV-32/40/50/65/80/100/125/150) and an actuation box (AFC-AB01) must be installed for each enclosure. In this case, connect the selector valve actuation tube (CT-002) to the outlet of corresponding pilot cylinder assembly (AFC-PC01).

The completed installation of selector valve actuation tube is shown in Figure 4.14.

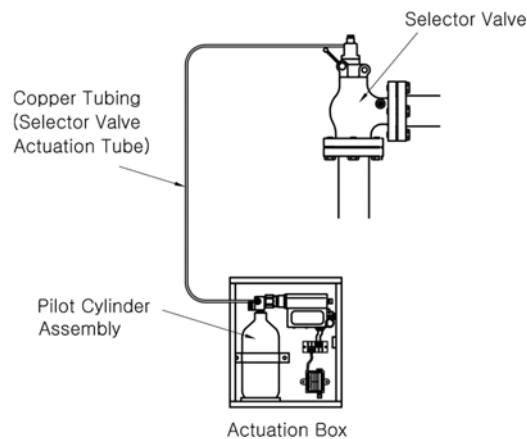


Figure 4.14. Installation of selector valve actuation tube.

4.8. Discharge Pressure Switch Installation

Three types of discharge pressure switches are available for installation in AFC-227 and AFC-P227:

4.8.1. Compact Pressure Switch

The compact pressure switch may be installed at the discharge piping (downstream) or at the manifold (upstream) of selector valve depending on system design. Prior to installing the compact pressure switch, a 1/4" NPT female socket must be attached (by welding or any equivalent means) to the piping. When a selector valve is used, make sure that the outlet port in the selector valve is properly shut off using the supplied 1/4" PT plug. If the system does not use a selector valve, the compact pressure switch must be installed in the manifold or discharge piping.

4.8.2. Explosion-Proof Pressure Switch

The explosion-proof pressure switch may be installed either on the vertical discharge piping or on a nearby rigid wall. Use the supplied pipe strap to mount the pressure switch on the piping or remove the strap and screw the bracket to the wall. Once the pressure switch is

fixed, connect the pressure switch actuation tubes to the 3/8" PT x 1/4" tube compression fitting in the selector valves outlet port and pressure switch then tighten the nuts appropriately.

4.8.3. Optional Pressure Switch

Connect the pressure switch actuation tube (CT-003) to the optional pressure switch (AFC-PS-01) in the actuation box (AFC-AB01) and copper tube outlet port in the selector valve body or in distribution pipe line if selector valve is not installed. A completed installation of optional pressure switch is illustrated in Figure 4.15.

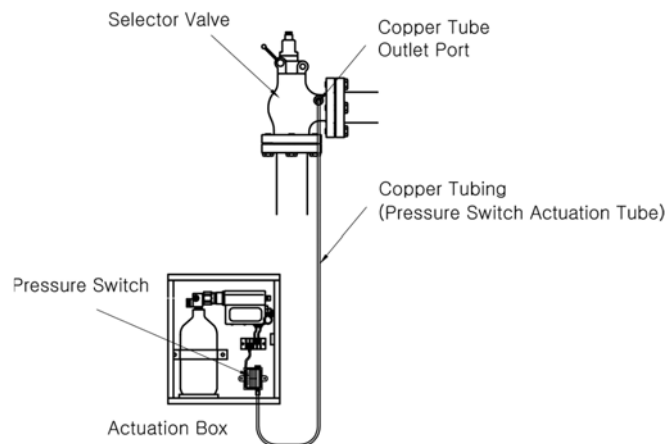


Figure 4.15. Installation of optional pressure switch.

4.9. Actuation Box/Solenoid Cutter Installation

4.9.1. With Tamper Seal and Releasing Circuit Disable Switch

1. Install the actuation box in vertical position at the designated location. Use the supplied fasteners. Contact nearest local distributor for additional fastening device.
2. Install the solenoid cutter to the actuation cylinder valve. *The following instructions can also be found in the installation instruction manual that is provided with the device.*

WARNING!

Before installing the solenoid cutter (P/N AFC-SC01) on actuation cylinder valve, ensure that the solenoid cutter is in SET position (that is the needle is fully retracted). Failure to put the solenoid cutter (P/N AFC-SC01) in the SET position will result to accidental discharge of actuation gas and subsequent actuation of agent cylinder valve and may result to damage to property, serious physical injury or death.

- 2.1 Pull-out (unscrew) the safety pin and insert into the hole in the needle base to secure the solenoid cutter in SET position.
- 2.2 Open the actuation box and connect the solenoid cutter to actuation cylinder valve. Tighten the swivel nut by hand.
- 2.3 Make all wiring connections in accordance with NFPA 72 National Fire Alarm and Signaling Code. For supervision when the solenoid cutter is removed or electrical wiring is disconnected during service/maintenance, use of UL listed releasing device disable switch shall be installed accordingly. It is recommended that the releasing device disable switch be installed such that it is in visual site from the actuation box. American AFC also recommends the use of releasing circuit disable switch model RCDS-1 from Potter (UL File No. S293). Refer to Figure 4.16 for the wiring diagram.

NOTE:

- The disable/disconnect switch shall be wired so that its operation shall cause the annunciation of a supervisory signal at a required operator interface for the releasing service alarm control panel.
- If the Potter RCDS-1 is not used, a UL Listed disable switch that is compatible with the fire alarm control panel (FACP) shall be used and all other sections still apply.

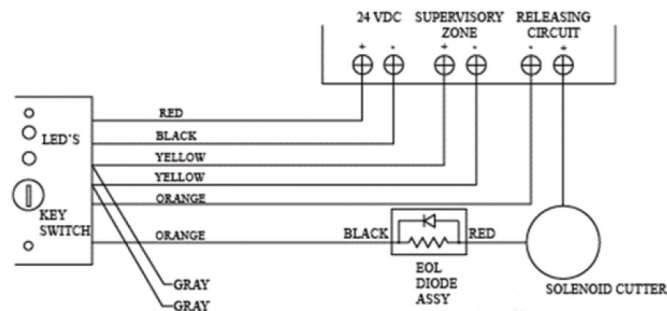


Figure 4.16. Wiring diagram for connecting the solenoid cutter with releasing circuit disable switch (Model No.: RCDS-1 from Potter)

- 2.4 Once wiring connection is completed, pull-out the safety pin and screw it back to its place in the solenoid cutter.
- 2.5 Attach the tamper seal making sure that it properly stick with the solenoid cutter and actuation cylinder valve as illustrated in Figure 4.17.

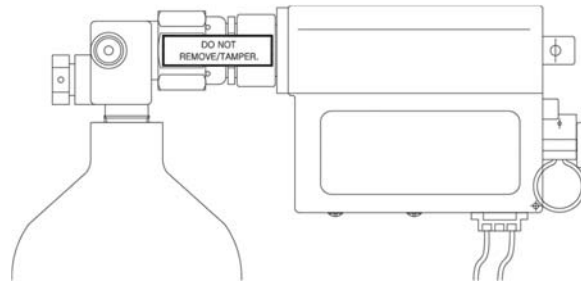


Figure 4.17. Solenoid cutter-cylinder actuation valve tamper sealing.

4.9.2. With Solenoid Cutter Supervisor

NOTE: Installation of the Solenoid Cutter Supervisor requires making electrical connection with the releasing control panel. Make all wiring connections in accordance with NFPA 72 National Fire Alarm and Signaling Code.

4.9.2.1. Installing the Solenoid Cutter Supervisor in a New Valve or System

1. Referring to Figure 4.18, mount the adapter to the corresponding valve and hand-tighten it.
2. Mount the Solenoid Cutter Supervisor onto the adapter with the switch facing the solenoid cutter as shown in Figure 4.18.
3. Verify that the solenoid cutter is in safety mode (see section 5.2.6.4).
4. While holding the safety pin in-place, mount the solenoid cutter onto the adapter and hand-tighten the swivel nut as much as possible. Note: Use of wrench or similar tool is unnecessary.
5. Connect the output cable to the releasing control panel such that the switch is in normally closed mode. Refer to the wiring diagram label attached on the device.

4.9.2.2. Installing the Solenoid Cutter Supervisor in an Existing Valve or System

1. Notify the appropriate office or personnel that the solenoid cutter will be removed from the system.
2. Activate the releasing circuit/device disable switch if installed. Proceed to the solenoid cutter, detach the tamper seal (if any) and all external wiring connection.
3. Unscrew the safety pin from the holder and insert it onto the hole at the needle base (refer to section 5.2.6.4).
4. While holding the safety pin in-place, hand-loosen the swivel nut until it is completely unfastened from the adapter.
5. Pull out the solenoid cutter until the tip of the needle clears the adapter.
6. Mount the Solenoid Cutter Supervisor onto the adapter with the switch facing the solenoid cutter as shown in Figure 4.18.
7. Reinstall the solenoid cutter and hand-tighten the nut as much as possible. Note: Use of

wrench or similar tool is unnecessary.

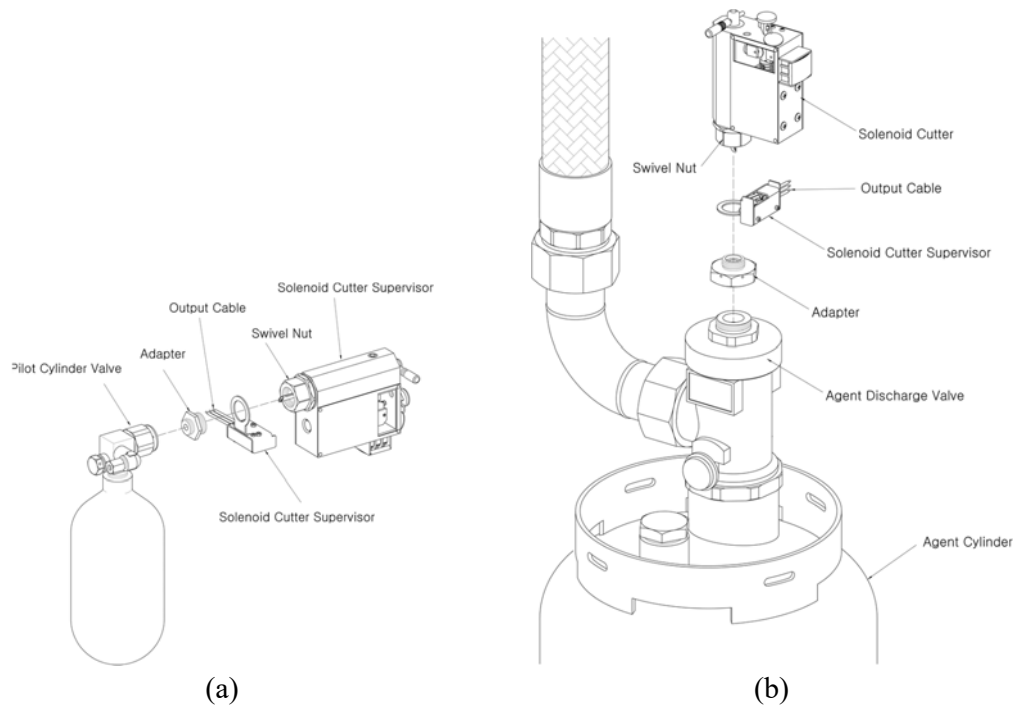


Figure 4.18. Installation of Solenoid Cutter Supervisor in (a) pilot cylinder (b) agent discharge valve

4.10. Manual Station Installation

1. Position the manual station as specified in the system design drawing and your device manual.

NOTE: Per NFPA, manual station shall be installed in readily accessible location, accurately identified, and properly protected to prevent damage. See your device manual for more information.

2. Connect the manual station cable to the fire signal panel in accordance to your device installation manual.

4.11. Pipe and Fittings Installation

Pipe and fittings for AFC-227 and AFC-P227 shall be installed in accordance with NFPA 2001 and the requirements of authority having jurisdiction. Minimum acceptable pipe materials, pipe sizes, joints/end connections and fittings are summarized in Table 4.1. Use of other equivalent pipes, joints/end connections and fittings are permitted if they satisfy the pressure requirements, conform to NFPA 2001 and the requirements of authority having jurisdiction. Where necessary, the thickness of the pipe shall be calculated in accordance to ASME B31.1. Refer to the important notes for additional information.

Table 4.1 Acceptable pipes, fittings and joints/end connections for AFC-227/AFC-P227.

Min. Piping Design Pressure, psig (bar)	416 (29)																						
Piping	<ul style="list-style-type: none"> • Schedule 40, Schedule 80 • ASTM A106, Seamless, Grade A/B/C • ASTM A53, Seamless, Grade A/B • ASTM A53, ERW, Grade A/B • ASTM A53, Class F, Furnace Weld 																						
Pipe Sizes	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: right;">in</td> <td style="text-align: left;">(mm)</td> </tr> <tr> <td style="text-align: right;">½</td> <td style="text-align: left;">(15)</td> </tr> <tr> <td style="text-align: right;">¾</td> <td style="text-align: left;">(20)</td> </tr> <tr> <td style="text-align: right;">1</td> <td style="text-align: left;">(25)</td> </tr> <tr> <td style="text-align: right;">1¼</td> <td style="text-align: left;">(32)</td> </tr> <tr> <td style="text-align: right;">2</td> <td style="text-align: left;">(50)</td> </tr> <tr> <td style="text-align: right;">2½</td> <td style="text-align: left;">(65)</td> </tr> <tr> <td style="text-align: right;">3</td> <td style="text-align: left;">(80)</td> </tr> <tr> <td style="text-align: right;">4</td> <td style="text-align: left;">(100)</td> </tr> <tr> <td style="text-align: right;">5</td> <td style="text-align: left;">(125)</td> </tr> <tr> <td style="text-align: right;">6</td> <td style="text-align: left;">(150)</td> </tr> </table>	in	(mm)	½	(15)	¾	(20)	1	(25)	1¼	(32)	2	(50)	2½	(65)	3	(80)	4	(100)	5	(125)	6	(150)
in	(mm)																						
½	(15)																						
¾	(20)																						
1	(25)																						
1¼	(32)																						
2	(50)																						
2½	(65)																						
3	(80)																						
4	(100)																						
5	(125)																						
6	(150)																						
Joints/End Connections	Welded, Flanged, Threaded, Grooved Flanges shall be ANSI/ASME B16.5, Class 300, Forged Steel																						
Fittings	<ul style="list-style-type: none"> • ANSI B16.3, Class 300, Malleable Iron Threaded Fittings • Class 300, Ductile Iron Threaded Fittings • ANSI/ASME B16.5, Class 300, Forged Steel Flanged Fittings 																						
	<ul style="list-style-type: none"> • ANSI B16.9, STD Carbon Steel Buttweld Fittings • ANSI/AWWA C606 Groove Type Fittings (see notes) 																						
Flange Gasket	• Commercially-available non-asbestos or PTFE type with size conforming to ASME B16.21																						
Flange Bolts and Nuts	• Suitable for ANSI B16.5, Class 300 Flanges																						
Pipe Size Reducer	• Concentric Bell Reducers or Concentric Reducing Coupling																						

Important Notes:

- Cast iron pipe and ASTM A120 steel pipe or nonmetallic pipe shall not be used.
- Threads in all pipes, joints and fittings shall be of tapered type such that they conform to ANSI/ASME B1.20.1 Pipe Threads, General Purpose.
- Apply tape or thread lubricant only to external threads of joints.
- Class 150 and cast iron fittings shall not be used.
- Welding shall be performed in accordance with ASME Boiler and Pressure Vessel Code, Section IX, “Qualification Standard for Welding and Brazing Procedures, Welders, Brazer and Welding and Brazing Operators.”
- Groove type fittings with suitable pressure rating as indicated by the manufacturer shall be used.
- Groove type pipe joints shall be listed or approved.
- Pipe size reduction shall be made at the fittings. Pipe size reducers shall be located after a tee split or a union along the direction of flow of fire extinguishing agent from agent storage cylinder to nozzles. Subject to the approval of authority having jurisdiction, pipe size reducers maybe located away from the tee split at a minimum distance of 10 times the pipe nominal diameter.
- Pipe hangers shall be provided to suitably support the piping and shall be installed in accordance with accepted industry practices and manufacturer’s installation instructions.

4.12. Nozzle Installation

1. Locate the designated discharge pipe terminal where the nozzle is to be installed.
2. Verify that for the corresponding discharge pipe terminal, the model number of the nozzle to be installed is the same as that specified in the system design drawing.
3. Thoroughly clean the nozzle to ensure that it is free from dust and other foreign objects.
4. Install the nozzle.

4.13. Detection Devices and Fire Signal/Control Panel Installation

1. Position the detection devices and fire signal/control panel (supplied separately) as specified in the system design drawing.
2. Make all necessary electrical cable connections.

Detection devices and control panel shall be installed in accordance with the instructions contained in the manufacturer’s installation manual.

NOTE:

The AFC-227 and AFC-P227 require the use of UL Listed detection devices and a UL Listed Fire Alarm Control Panel that is compatible with the detection and actuation devices. Refer to the control panel manual for compatibility information.

4.14. Post-Installation Check

When the installation of AFC-P227 has been completed, perform the following check to ensure that all system components have been properly installed and in strict compliance with the instructions in this manual:

- Check if the installed agent cylinder and nitrogen cylinder (*only for AFC-P227) have the correct weight and pressure as specified in the system installation drawing.
- Ensure that the cylinders are firmly secured within the brackets and frames.
- Inspect the agent distribution piping network for compliance with the system drawings.
- Check that the manifold and piping are securely fastened to the hangers.
- Check if agent distribution piping network is thoroughly cleaned free from dust, oil, and other foreign objects.
- Check that the check valve is properly installed and in accordance with the system drawing.
- Ensure that the nozzles installed have the correct location and model numbers as specified in the system drawing.
- Confirm that the manual station is properly installed at accessible location.
- Perform system actuation test outlined in Section 5.2.6.2 and Section 5.6.2.3.

5. OPERATION AND MAINTENANCE

5.1. Operation

5.1.1. AFC-227 Operation

In AFC-227 (refer to Figure 5.1), agent is contained in agent cylinder fitted with agent discharge valve. When the agent discharge valve is activated, nitrogen gas at 25 bar (21°C) on the vapor space of the agent cylinder drives the liquid agent out of the cylinder through the discharge valve and into the piping system. Subsequently, the liquid agent reaches the discharge nozzle(s) where it is released into the protected area and instantly vaporizes in air.

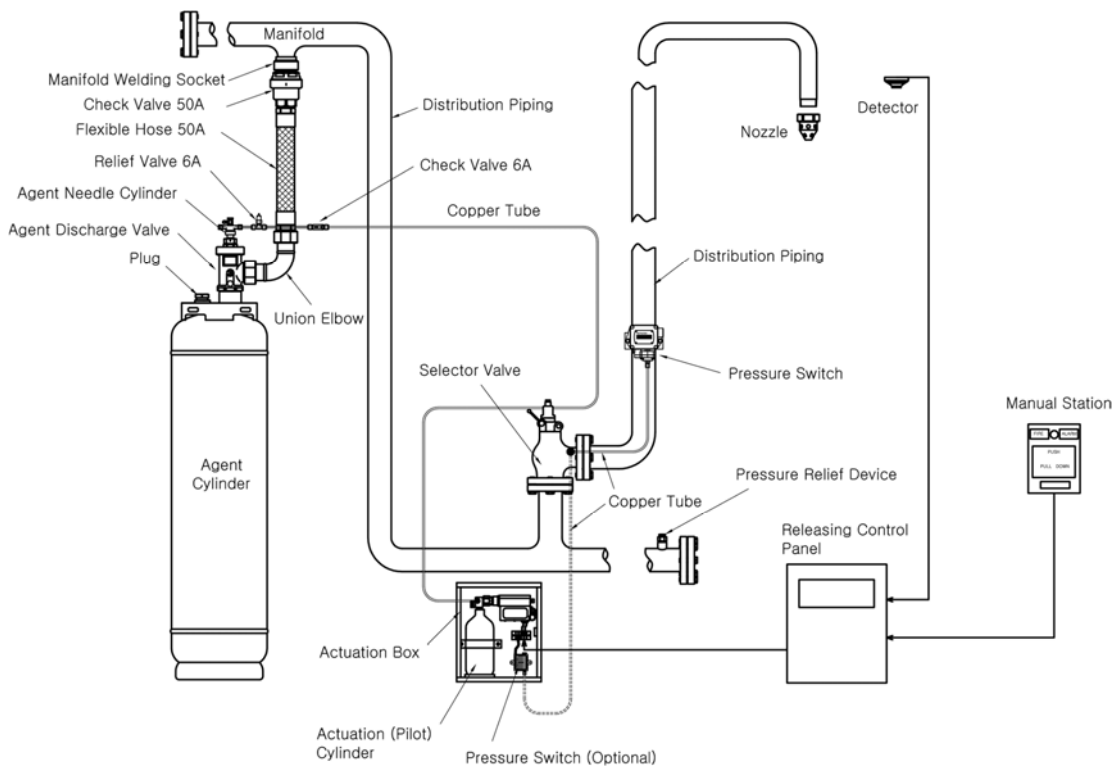


Figure 5.1. AFC-227 system schematic (Figure 2.1 repeated).

5.1.2. AFC-P227 Operation

In AFC-P227 (refer to Figure 5.2), agent is contained in agent cylinder fitted with agent discharge valve and nitrogen inlet valve. The nitrogen gas is contained in a separate high-pressure cylinder fitted with high-pressure nitrogen valve. When the agent discharge valve is activated, liquid agent is pushed out of its cylinder due to superpressurization. At the same instant, the discharged agent is used to activate the nitrogen discharge valve. The high-pressure nitrogen gas enters the vapor space of agent cylinder for continuous superpressurization and push of the agent out of the cylinder through the cylinder discharge valve and into the agent distribution piping system. Through the discharge nozzle(s), agent is released into the protected area and instantly vaporizes in air.

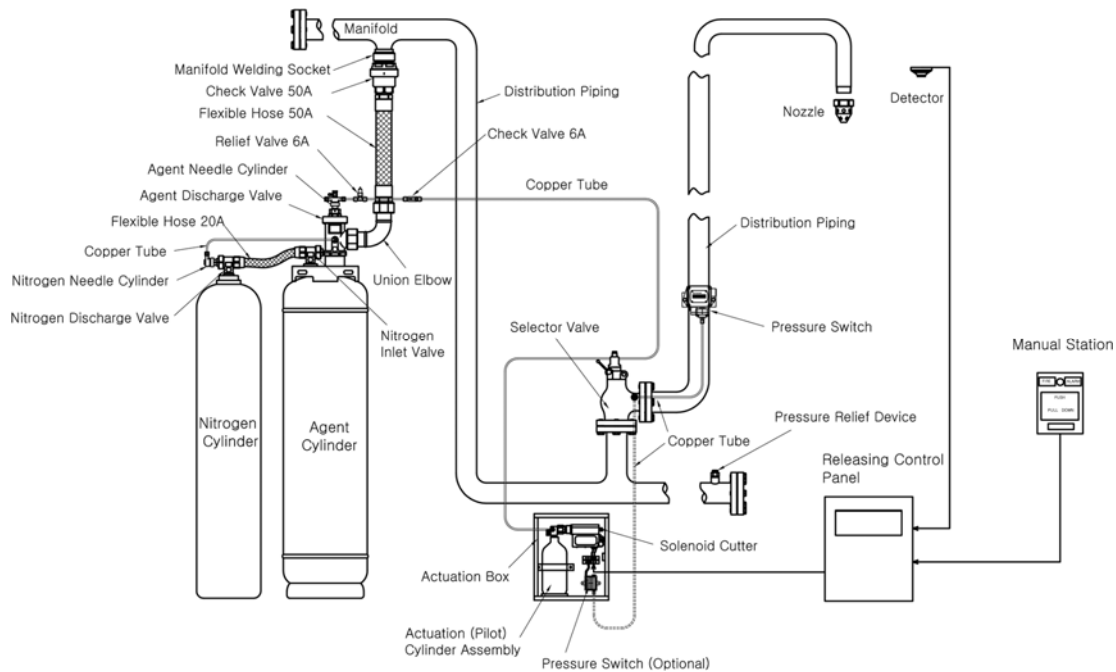


Figure 5.2. AFC-P227 system schematic (Figure 2.2 repeated).

5.1.3. Automatic Operation

With all components fully functional and installed as outlined in this manual, the system is operated automatically through detection and control system. The series of events are outlined as follows:

1. Upon detection, the control panel sends electrical signal that triggers the solenoid cutter (releasing device) in the actuation box.
2. The pilot cylinder valve is actuated by the energized solenoid cutter (releasing device), enabling the discharge of pressurized actuation gas into the actuation copper tube lines.
3. The selector valve is opened by the flowing pressurized actuation gas. (for system with selector installed)
4. Pressure from the flowing actuation gas is used to actuate the agent needle cylinder, opening the agent discharge valve and allowing agent to be discharged.
5. The discharged agent flows out of the cylinder through the discharge valve and into the nitrogen actuation tube, actuating the nitrogen needle cylinder and subsequently opening the nitrogen valve (for AFC-P227 only).
6. The high-pressure nitrogen enters the agent cylinder via the nitrogen inlet valve, pressurizing the liquid agent (for AFC-P227 only).
7. Pressure from the discharged agent is used to actuate the pressure switch via the pressure switch actuation tube as the agent flows through the selector valve. The actuated pressure switch enables the activation of discharge alarm.
8. The discharged agent flows through the distribution piping system, through the nozzles and finally to the protected area where the liquid agent quickly turns into vapor.

5.1.4. Manual Operation via the Manual Station

1. Proceed to the manual station.
2. Ensure that all personnel have evacuated the protected area.
3. Operate the manual station by following the operating instructions stamped on the body of the device.

CAUTION!

Ensure that the personnel in-charge for operating the manual station is properly trained and familiar with the device. Unable to properly operate the manual station may cause significant delay of fire suppression and may result to serious personal injury and damage to property.

5.1.5. Manual Operation via the Solenoid Cutter

1. Proceed to the actuation box.
2. Open the actuation box.
3. Remove the safety clip from the solenoid cutter.
4. Press the PUSH button.

NOTE: In accordance with NFPA 2001, instructions on how to manually operate the solenoid cutter (similar to above) shall be posted in the actuation box. Ensure that they are properly displayed and visible.

5.1.6. Manual Operation via the Agent Discharge Valve

1. Proceed to the appropriate agent cylinder.
2. Remove the safety pull-out pin from the agent needle cylinder.
3. Press the PUSH button forcefully to puncture the rupture disc in the discharge valve actuation port.

CAUTION!

All manual operating procedures for system actuation should **ONLY** be performed in case of emergency as the last sort of action.

5.2. Maintenance

This section outlines the procedures for performing maintenance activities for AFC-227 and AFC-P227. These procedures must be performed in a regular period in accordance with regulations. Corrective measures must be taken when problems arise.

5.2.1. Use of Releasing Circuit Disable Switch

Whenever the system needs to be disabled/disconnected for maintenance/servicing, the releasing circuit disable switch must be used to disable the releasing circuit. Refer to the operation manual of the switching device for proper operation. **NOTE:** The solenoid cutter must never be removed for the purpose of disabling the system during such maintenance/servicing.

5.2.2. Maintenance Schedule

A systematic maintenance program must be created and the schedule should be followed strictly to ensure continuous and proper operation of AFC-227 and AFC-P227.

5.2.3. Daily Maintenance

Conduct visual inspection of the remove/tamper seal on the solenoid cutter. If the seal is found missing/tampered, perform a functional/operational test of the solenoid cutter (5.3.6.3) before reinstalling it and replacing the seal.

5.2.4. Weekly Maintenance

5.2.4.1 Hazard or Protected Area

Check that the hazard or protected areas are free from obstruction, and that easy access to the manual station and actuation box is maintained. Also check that there are no changes in protected area based on the original layout that might affect system performance such as the configuration and contents of area, openings, and floor or ceiling voids.

5.2.4.2. System Components

Perform visual check of the system components, distribution piping and nozzles. Check the immediate surroundings of the equipment for any sign of damage or modification.

5.2.5. Monthly Maintenance

5.2.5.1. Needle Cylinders

Check that the needle cylinders are intact and free from any signs of physical deterioration such as corrosion and cracks. Confirm that safety clip of the PUSH button is secure fastened. If damage is found replace the needle cylinder.

5.2.5.2. Agent and Nitrogen Cylinder Assemblies

Check the cylinders for any sign of damage or unauthorized modification. Check the valves, pressure gauges, and safety plugs for any sign of damage. If any damage is found, replace the cylinder.

Check agent cylinder pressure gauge for proper pressure. The nominal pressure should be 24.8 bar at 21°C. However, the pressure will vary with temperature as shown in Table 5.1. If the pressure (adjusted for temperature correction) shows a loss of more than 10%, refill or replace the cylinder.

Table 5.1. Agent cylinder pressure variation with respect to temperature.

Temp. (°C)	Pressure (bar)
0	19.9
4	20.9
10	22.1
16	23.4
21	24.8
27	26.2
32	27.7
38	29.3
43	31
49	32.8
54	34.6

5.2.5.3. Cylinder fixtures

Check the cylinder frames, brackets and straps for loose fasteners or broken parts. Inspect for any sign of damage. If any parts are loose or damaged, replace immediately.

5.2.5.4. Flexible Hoses

Check the flexible hoses for leaks or any signs of damage. Verify that the threaded connections are securely tightened. If any parts are loose or damaged, replace immediately.

5.2.5.5. Actuation Copper Tube Lines

Check all actuation copper tube lines (agent actuation tube, nitrogen actuation tube, selector valve actuation tube, and pressure switch actuation tube) for any signs of damage, and loose fittings. Tighten loose fittings and replace damaged components.

5.2.5.6. Discharge Nozzles

Check all discharge nozzles for dirt and any signs of damage. Replace damaged nozzle and make sure that the replacement part bears the same model number.

5.2.5.7. Manual Station

Check manual station for any signs of damage and dirt. If any damage is found, replace the manual station.

5.2.5.8. Pressure switch

Check pressure switch for any signs of damage and dirt. If any damage is found replace the pressure switch.

5.2.6. Semi-Annual Maintenance**5.2.6.1. Agent Cylinder**

Check agent quantity and pressure in agent cylinder. If agent quantity shows a loss of more than 5% or cylinder pressure (adjusted for temperature correction) shows a loss of more than 10%, refill or replace the cylinder.

5.2.6.2. System Actuation Test

1. Remove all agent needle cylinders let them hang freely by the actuation tube lines.
2. Operate the system electrically from either the fire alarm control panel or electric manual station.
3. Verify that all agent needle cylinders are activated, that is the tip of the needle has moved out and longer portion is exposed.
4. If any of the agent needle cylinders have not activated, check the actuation line for gas leak or blockage.
5. When testing is completed re-install the needle cylinders.
6. Replace the actuation cylinder assembly.

7. Reset the solenoid cutter (see 5.2.6.4)

5.2.6.3. Solenoid Cutter Functional/Operational Test

After maintenance/servicing of the solenoid cutter such as when the remove/tamper seal is found missing/tampered or the solenoid cutter supervisor replaced functional/operational test must be performed before reinstalling the device.

1. Place the solenoid cutter in a stable position. Make sure it is not connected to the actuation cylinder valve.
2. Remove the safety pin from the needle head (see instructions on label).
3. Energize the solenoid cutter either via the control panel or external source with equivalent electrical power output specification.
4. Verify that the needle is released indicating proper operation of the solenoid cutter. If it did not operate and electrical supply is not the problem replace the solenoid cutter.

5.2.6.4. Resetting the Solenoid Cutter

After system actuation test or the system has been operated normally, the solenoid cutter should be reset. Below are the steps for resetting the solenoid cutter.

1. Detach the tamper seal (if any) from the solenoid cutter and actuation cylinder valve.
2. Remove the solenoid cutter from the actuation cylinder valve. Note that if the solenoid cutter supervisor is installed, removal of the solenoid cutter may activate the releasing device supervisory alarm at the releasing control panel. Referring to Figure 5.2, perform the following:
3. Pull-out (unscrew) the safety pin ① and cap the needle ② with the safety pin ①.
4. Press the device as shown in Figure 5.2 until the needle is fully retracted or in SET position. Make sure that PUSH button ⑤ is securely fastened.
5. Insert the safety pin ① into the hole at the needle base ③. Make sure that SET position is secured.
6. Reconnect the solenoid cutter with the actuation cylinder valve. See Section 4.9 for installation instruction.

NOTE: Instructions for resetting the solenoid cutter must be visibly posted on the actuation box.

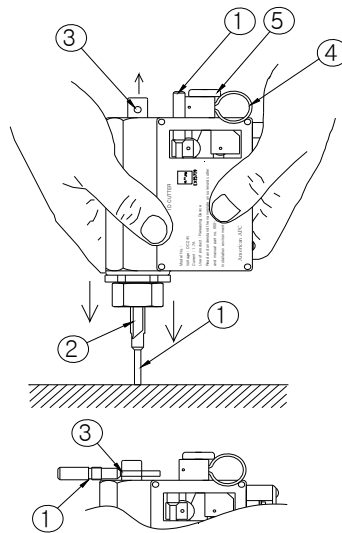


Figure 5.2. Resetting the Solenoid Cutter.

5.2.6.5. Re-installation of Solenoid Cutter

When a solenoid cutter is found to be defective after routine maintenance or actuation test, a replacement component must be obtained and installed immediately. See Section 4.9, step 2 for the instruction for installing the solenoid cutter.

5.2.6.6. Flexible Hoses

Check the flexible hoses for leaks or any signs of damage. If any signs of damage are detected, the hose should be replaced or tested in accordance with NFPA 2001.

5.3. Post-discharge Maintenance

After AFC-227 or AFC-P227 has been operated and agent has been discharged, the following procedures for recharging and parts replacement shall be performed.

CAUTION!

Carefully check the agent containers year of manufacture prior to charging. Retest of containers maybe required in accordance with NFPA 2001 and DOT 4BW500.

5.3.1. Uninstallation of Agent Cylinder

1. Disconnect the union elbow and all actuation tubes from the agent cylinder and needle valve assembly.
2. Install protection caps.
3. Unfasten the cylinder brackets, straps and other fixtures.
4. Remove the agent cylinder.

5.3.2. Cartridge Packing Replacement

1. Remove the agent needle cylinder from the agent discharge valve.
2. Using a cartridge wrench (CW-01), remove the cartridge packing (CYV-H40-11) from the top of agent discharge valve and install a new cartridge packing (CYV-H40-11).
3. Re-install the cartridge packing to the top of agent discharge valve.
4. Install protection cap to the actuation port.

5.3.3. Recharging Agent Cylinder

The typical setup for charging agent cylinder is shown in Figure 5.3.

WARNING!

Only qualified and trained personnel should operate the charging equipment. Perform all procedures in designated charging area where unauthorized personnel are restricted access while charging is ongoing.

NOTE: Prior to charging the agent cylinder, ensure that the needle cylinder has been removed and a new rupture disc has been installed (see Section 5.3.2 for instructions on rupture disc replacement).

1. Place the agent cylinder on the weighing scale.
2. Monitor the weighing scale. The weight indicated on the scale less the weight of protection caps installed shall be recorded and stamped as tare weight on the cylinder label.
3. Connect the charging adapter and hose to the discharge port of agent discharge valve.
4. Open the agent shipping tank liquid valve Ball Valve 1.
5. Subsequently open Ball Valve 2, and Ball Valve 3.
6. Charge the agent cylinder to its fill range. Monitor the weighing scale. Refer to Table 2.1 for specific fill range of the corresponding agent cylinder model being charged.

NOTE: While charging the agent cylinder, the weighing scale data includes the weight of charged agent and the attached charging device. The weight of the charging device must be properly taken into account when recording the actual agent weight.

7. Close Ball Valve 3 and subsequently Ball Valve 2.
8. Confirm the gross weight and agent weight. Record and stamp the weight data accordingly on the cylinder label.
9. Proceed to superpressurization procedure. Refer to Section 5.4.4 for instructions.

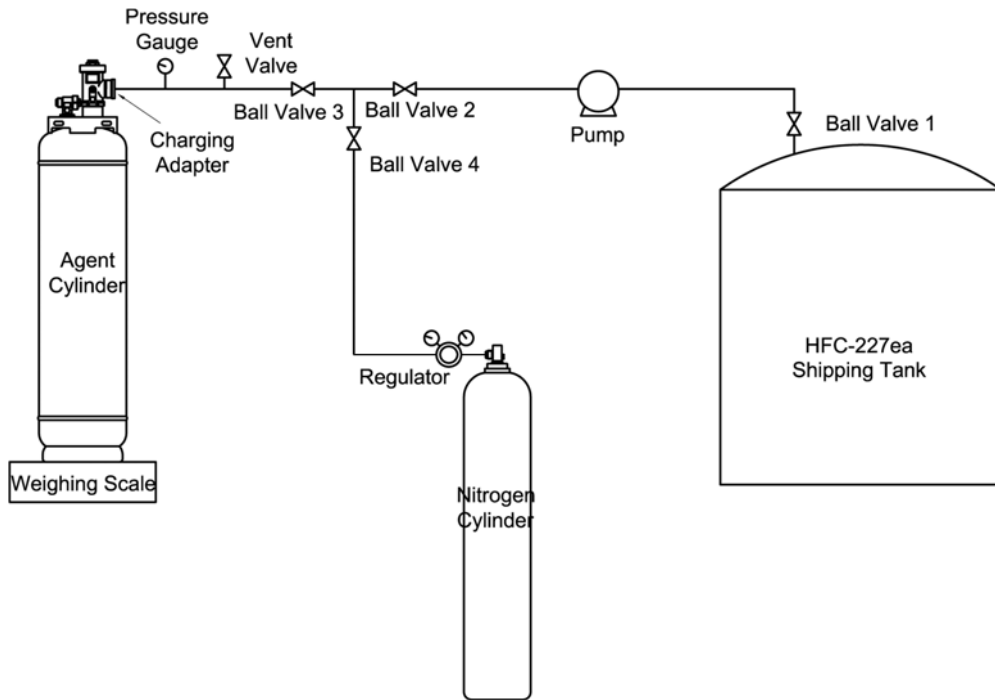


Figure 5.3. Typical setup for charging and superpressurization of HFC-227ea.

5.3.4. Nitrogen Superpressurization

Immediately following the agent cylinder charging, nitrogen gas shall be supplied to the cylinder at 25 bar, 21°C. Depending on the model of agent cylinder, the weight of nitrogen required for superpressurization of HFC-227ea agent is shown in Table 5.2.

Table 5.2. Weight of Nitrogen Required for Superpressurization of HFC-227ea to 25 bar (gauge) at 21°C.

Fill Density (kg/m ³)	Weight of Nitrogen per kg of HFC-227ea (g)
600	36.4
700	30.3
800	25.7
900	22.2
1000	19.3
1100	17.0
1200	15.1

NOTE: High-pressure compressed nitrogen gas used for pressurization of agent is stored in nitrogen cylinder. Pressure regulator must be used.

1. Charge the agent cylinder to its fill range (see Section 5.4.3).
2. Open Ball Valve 4 and subsequently Ball Valve 3.
3. Open the Regulator valve and regulate the pressure until the pressure gauges indicate 25 bar. N₂ will be added to the agent cylinder.
4. Monitor the weighing scale. Once the desired nitrogen weight has been added, close Ball Valve 3, and subsequently the Regulator.
5. Verify that the pressure indicated in the Pressure Gauge is 25 bar (at 21°C).

NOTE: The pressure gauge attached to the extinguishing system is not to be used to determine when the intended charging pressure has been reached. Install suitable pressure gauge for such purpose (See Figure 5.3.).

6. Open the Vent Valve to release any remaining nitrogen on the charging line.
7. Disconnect the agent cylinder from the charging device and immediately install the protection cap.
8. Stamp the charging or filling date on the cylinder label.

5.3.5. Leakage test

After agent charging and pressurization, at least two different methods for leak tests must be performed. Below are two common leak test methods.

Bubble Check. Spray the leak-critical areas (threaded areas) of the valves, safety and protection plugs of charged agent cylinder with soap bubbles. Agent leakage is indicated by bubbles.

Leak Detector. Use leak detecting device.

6. PARTS LIST

The following is a complete list of components for use with AFC-227 and AFC-P227. The list includes components both as delivered or optional that are made available upon order.

Model Description	Model/Part No.
AGENT CYLINDER (Assembly)	
26.8 L cylinder factory-fitted with agent discharge valve 40A	AFC-26
40.2 L cylinder factory-fitted with agent discharge valve 40A	AFC-40
63 L cylinder factory-fitted with agent discharge valve 40A and plug	AFC-63
68 L cylinder factory-fitted with agent discharge valve 40A and plug	AFC-68
89 L cylinder factory-fitted with agent discharge valve 40A and plug	AFC-89
115.4 L cylinder factory-fitted with agent discharge valve 50A and plug	AFC-115
175 L cylinder factory-fitted with agent discharge valve 50A and plug	AFC-175
63 L cylinder factory-fitted with agent discharge and nitrogen inlet valves for use with nitrogen cylinder filled to 60 bar, ANC68-60	AFC-P63
68 L cylinder factory-fitted with agent discharge and nitrogen inlet valves for use with nitrogen cylinder filled to 60 bar, ANC68-60	AFC-P68
89 L cylinder factory-fitted with agent discharge and nitrogen inlet valves for use with nitrogen cylinder filled to 70 bar, ANC68-70	AFC-P89
115.4 L cylinder factory-fitted with agent discharge and nitrogen inlet valves for use with nitrogen cylinder filled to 80 bar, ANC68-80	AFC-P115
175 L cylinder factory-fitted with agent discharge and nitrogen inlet valves for use with nitrogen cylinder filled to 80 bar, ANC68-80	AFC-P175
Associated Components	
Agent Discharge Valve	
40-mm valve, standard type for use with AFC-26/40/63/P63/P68/89/P89 agent cylinders	ADV-40
40-mm valve, R type for use with AFC-26/40/63/P63/P68/89/P89 agent cylinders	ADV-R40
50-mm valve, standard type for use with AFC-115/P115/175/P175 agent cylinders	ADV-50
50-mm valve, R type for use with AFC-115/P115/175/P175 agent cylinders	ADV-R50
Agent Pressure Gauge, standard type	APG-1
Agent Pressure Gauge, 2n1 type	APG-2
Cartridge Packing	CYV-H40-11
Cartridge Tool	VCT-01
Interlock Port Protection Plug	TN-060
Nitrogen Inlet Valve (only installed with AFC-P227)	NDV-F20
AFC-227 Cylinder Strap Ø350 (for use with AFC-26/40/63/68/89/115)	AFC-ST01
AFC-227 Cylinder Strap Ø450 (for use with AFC-175)	AFC-ST02
AFC-P227 Cylinder Strap Ø350 (for use with AFC-P63/P68/P89/P115)	AFC-PST01

6. PARTS LIST

AFC-227 & AFC-P227

AFC-P227 Cylinder Strap Ø450 (for use with AFC-P175)	AFC-PST02
AFC-227 CYLINDER LABEL (UL/ULC without French Caution Statement; for use with any model of AFC-227 agent cylinders)	AFE-L1
AFC-P227 CYLINDER LABEL (UL/ULC without French Caution Statement; for use with any model of AFC-P227 agent cylinders)	CLP-L1
NITROGEN CYLINDER LABEL (UL/ULC without French Caution Statement)	ANP-L1
AFC-227 CYLINDER LABEL (UL/ULC with Supplementary French Caution Statement; for use with any model of AFC-227 agent cylinders)	AFE-L1B
AFC-P227 CYLINDER LABEL (UL/ULC with Supplementary French Caution Statement; for use with any model of AFC-P227 agent cylinders)	AFP-L1B
NITROGEN CYLINDER LABEL (UL/ULC with French Caution Statement)	ANP-L1B
AGENT CYLINDER SUPPLEMENTAL FRENCH CAUTION LABEL	AFF-L1F
NITROGEN CYLINDER SUPPLEMENTAL FRENCH CAUTION LABEL	ANF-L1F
AFC-227 CYLINDER LABEL FM-200	AFC-200-CL
AFC-227 CYLINDER LABEL HFC-227ea	AFC-227-CL
AFC-P227 CYLINDER LABEL FM-200	AFC-P200-CL
AFC-P227 CYLINDER LABEL HFC-227ea	AFC-P227-CL
AFC-P227 CYLINDER LABEL N2	MLP-N2A
AGENT CYLINDER STRAP	ACS-F01
NITROGEN CYLINDER STRAP	ACS-N01
AGENT NEEDLE CYLINDER (for use with any model of agent cylinders)	AFC-NC-15
NITROGEN CYLINDER (only installed with AFC-P227)	
68 L (internal volume) cylinder factory-fitted with nitrogen valve, filled to 60 bar (for use with 63 L/68 L agent cylinders, AFC-P63/P68)	ANC68-60
68 L (internal volume) cylinder factory-fitted with nitrogen valve, filled to 70 bar (for use with 89 L agent cylinder, AFC-P89)	ANC68-70
68 L (internal volume) cylinder factory-fitted with nitrogen valve, filled to 80 bar (for use with 115.4 L agent cylinder, AFC-P115, AFC-P175)	ANC68-80
Associated Components	
Nitrogen Discharge Valve	NDV-N20
Nitrogen Pressure Gauge, standard type, 60 bar	ANPG-N60
Nitrogen Pressure Gauge, standard type, 70 bar	ANPG-N70
Nitrogen Pressure Gauge, standard type, 80 bar	ANPG-N80
Nitrogen Pressure Gauge, 2n1 type, 60 bar	ANPG2-N60
Nitrogen Pressure Gauge, 2n1 type, 70 bar	ANPG2-N70
Nitrogen Pressure Gauge, 2n1 type, 80 bar	ANPG2-N80
NITROGEN NEEDLE CYLINDER (only installed with AFC-P227) (for use with any model of nitrogen cylinders)	NNC-06
FLEXIBLE HOSE (20A) (only installed with AFC-P227)	

600 mm (for use with 115.4 L agent cylinder and 68 L @ 80 bar nitrogen Cylinder, AFC-P115 + ANC68-80 combination)	AFC-FH-600
700 mm (for use with 89 L agent cylinder and 68 L @ 70 bar nitrogen cylinder, AFC-P89 + ANC68-70 combination)	AFC-FH-700
900 mm (for use with 63 L, 68 L or 175 L agent cylinder and 68 L @ 60 bar nitrogen cylinder, AFC-P63 or AFC-P175 + ANC68-60 combination)	AFC-FH-900
FLEXIBLE HOSE (50A)	AFC-FH-50
UNION ELBOW	
125 mm	AFC-UE-125
225 mm	AFC-FH-225
Associated components	
Packing	PCK-50
UNION ELBOW ADAPTER (for use with 63 L/AFC-63/P63, 68 L/AFC-68/P68 and 89 L/MFC-89/P89 agent cylinders)	AFC-UEA-40
PIPE ADAPTER	
40A x 1" NPT/PT (25A)	PA-4025
40A x 1-1/4" NPT/PT (32A)	PA-4032
40A x 1-1/2" NPT/PT (40A)	PA-4040
50A x 1-1/4" NPT/PT (32A)	PA-5032
50A x 1-1/2" NPT/PT (40A)	PA-5040
50A x 2" NPT/PT (50A)	PA-5050
CHECK VALVE	AFC-CV50
Associated components	
Packing	PCK-50
MANIFOLD WELDING SOCKET	AFC-MWS50
PRESSURE RELIEF DEVICE	MSF-20
CHECK VALVE 6A	AFC-CV06
TEE 6A	T-06
RELIEF VALVE 6A	RV-06
COPPER TUBE AND FITTINGS	
Nitrogen Actuation Tube (only installed with AFC-P227)	
500 mm (for use with 115.4 L agent Cylinder and 68 L @ 80 bar nitrogen cylinder, AFC-P115 + ANC68-80 combination)	TN-500
530 mm (for use with 89 L agent Cylinder and 68 L @ 70 bar nitrogen cylinder, AFC-P89 + ANC68-70 combination)	TN-530
600 mm (for use with 63 L agent Cylinder and 68 L @ 60 bar nitrogen cylinder, AFC-P63/P68 + ANC68-60 combination)	TN-600
Agent Interconnect Actuation Tube	FT-320
Agent Actuation Tube	CT-001
Selector Valve Actuation Tube	CT-002

6. PARTS LIST

AFC-227 & AFC-P227

Pressure Switch Actuation Tube	CT-003
3/8" PT x 1/4" Tube Compression (Interlock Union)	TU-061
1/4" PT x 1/4" Tube Flare (selector valve - pressure switch union)	SVU-01
Plug Pin	PP-01
SELECTOR VALVE	
32-mm inlet/outlet	AFC-SV-32
40-mm inlet/outlet	AFC-SV-40
50-mm inlet/outlet, threaded flange type	AFC-SV-50
50-mm inlet/outlet, built-in flange type	AFC-SV-50B
65-mm inlet/outlet, threaded flange type	AFC-SV-65
65-mm inlet/outlet, built-in flange type	AFC-SV-65B
80-mm inlet/outlet, threaded flange type	AFC-SV-80
80-mm inlet/outlet, built-in flange type	AFC-SV-80B
100-mm inlet/outlet, threaded flange type	AFC-SV-100
100-mm inlet/outlet, built-in flange type	AFC-SV-100B
125-mm inlet/outlet, threaded flange type	AFC-SV-125
125-mm inlet/outlet, built-in flange type	AFC-SV-125B
150-mm inlet/outlet, threaded flange type	AFC-SV-150
150-mm inlet/outlet, built-in flange type	AFC-SV-150B
Associated components	
1/4" PT Outlet Port Plug	SPP-01
ACTUATION BOX (Assembly)	
Size 310x135x360	AFC-AB01
Size 390x155x380	AFC-AB02
Associated Components	
Solenoid Cutter	AFC-SC01
Remove/Tamper Seal	ATS-01
Actuation (Pilot) Cylinder Assembly	AFC-PC01
Pressure Switch (Optional)	AFC-PS-01
Solenoid Cutter Supervisor	AFC-SS-01
PRESSURE SWITCH (Barksdale)	
Explosion-proof Type	P1X-B30
Compact Type	96211-BB2

MANUAL STATION (Potter)			RMS-1T					
DISCHARGE NOZZLES (360° type: AFN-00-00(0), 180° type: AFN-R00-00(0))								
No.	Orifice Diameter (mm)	Area(mm ²)	Size and model number					
			15A	20A	25A	32A	40A	50A
1	8.2	52.81	AFN-15-82					
2	8.4	55.42	AFN-15-84					
3	8.6	58.09	AFN-15-86					
4	8.8	60.82	AFN-15-88					
5	9	63.62	AFN-15-90					
6	9.2	66.48	AFN-15-92					
7	9.4	69.4	AFN-15-94					
8	9.6	72.38	AFN-15-96					
9	9.8	75.43	AFN-15-98					
10	10	78.54	AFN-15-100					
11	10.2	81.71	AFN-15-102					
12	10.4	84.95	AFN-15-104					
13	10.6	88.25	AFN-15-106					
14	10.8	91.61	AFN-15-108	AFN-20-108				
15	11	95.03	AFN-15-110	AFN-20-110				
16	11.2	98.52	AFN-15-112	AFN-20-112				
17	11.4	102.07	AFN-15-114	AFN-20-114				
18	11.6	105.68	AFN-15-116	AFN-20-116				
19	11.8	109.36	AFN-15-118	AFN-20-118				
20	12	113.1	AFN-15-120	AFN-20-120				
21	12.2	116.9	AFN-15-122	AFN-20-122				
22	12.4	120.76	AFN-15-124	AFN-20-124				
23	12.6	124.69	AFN-15-126	AFN-20-126				
24	12.8	128.68	AFN-15-128	AFN-20-128				
25	13	132.73	AFN-15-130	AFN-20-130				
26	13.2	136.85	AFN-15-132	AFN-20-132				
27	13.4	141.03	AFN-15-134	AFN-20-134				
28	13.6	145.27		AFN-20-136	AFN-25-136			
29	13.8	149.57		AFN-20-138	AFN-25-138			
30	14	153.94		AFN-20-140	AFN-25-140			
31	14.2	158.37		AFN-20-142	AFN-25-142			
32	14.4	162.86		AFN-20-144	AFN-25-144			
33	14.6	167.42		AFN-20-146	AFN-25-146			
34	14.8	172.03		AFN-20-148	AFN-25-148			
35	15	176.71		AFN-20-150	AFN-25-150			
36	15.2	181.46		AFN-20-152	AFN-25-152			
37	15.4	186.27		AFN-20-154	AFN-25-154			
38	15.6	191.13		AFN-20-156	AFN-25-156			
39	15.8	196.07		AFN-20-158	AFN-25-158			

6. PARTS LIST

AFC-227 & AFC-P227

40	16	201.06		AFN-20-160	AFN-25-160			
41	16.2	206.12		AFN-20-162	AFN-25-162			
42	16.4	211.24		AFN-20-164	AFN-25-164			
43	16.6	216.42		AFN-20-166	AFN-25-166			
44	16.8	221.67		AFN-20-168	AFN-25-168			
45	17	226.98		AFN-20-170	AFN-25-170			
46	17.2	232.35		AFN-20-172	AFN-25-172			
47	17.4	237.79		AFN-20-174	AFN-25-174			
48	17.6	243.28		AFN-20-176	AFN-25-176			
49	17.8	248.85		AFN-20-178	AFN-25-178			
50	18	254.47			AFN-25-180			
51	18.2	260.16			AFN-25-182			
52	18.4	265.9			AFN-25-184			
53	18.6	271.72			AFN-25-186			
54	18.8	277.59			AFN-25-188			
55	19	283.53			AFN-25-190			
56	19.2	289.53			AFN-25-192			
57	19.4	295.59			AFN-25-194			
58	19.6	301.72			AFN-25-196			
59	19.8	307.91			AFN-25-198			
60	20	314.16			AFN-25-200			
61	20.2	320.47			AFN-25-202			
62	20.4	326.85			AFN-25-204			
63	20.6	333.29			AFN-25-206			
64	20.8	339.79			AFN-25-208			
65	21	346.36			AFN-25-210			
66	21.2	352.99			AFN-25-212			
67	21.4	359.68			AFN-25-214			
68	21.6	366.44			AFN-25-216			
69	21.8	373.25			AFN-25-218			
70	22	380.13			AFN-25-220			
71	22.2	387.08			AFN-25-222			
72	22.4	394.08			AFN-25-224			
73	22.6	401.15			AFN-25-226			
74	18	254.47				AFN-32-180		
75	18.5	268.8				AFN-32-185		
76	19	283.53				AFN-32-190		
77	19.5	298.65				AFN-32-195		
78	20	314.16				AFN-32-200		
79	20.5	330.06				AFN-32-205		
80	21	346.36				AFN-32-210	AFN-40-210	
81	21.5	363.05				AFN-32-215	AFN-40-215	
82	22	380.13				AFN-32-220	AFN-40-220	
83	22.5	397.61				AFN-32-225	AFN-40-225	
84	23	415.48				AFN-32-230	AFN-40-230	

85	23.5	433.74				AFN-32-235	AFN-40-235	
86	24	452.39				AFN-32-240	AFN-40-240	
87	24.5	471.44				AFN-32-245	AFN-40-245	
88	25	490.87				AFN-32-250	AFN-40-250	
89	25.5	510.71				AFN-32-255	AFN-40-255	
90	26	530.93				AFN-32-260	AFN-40-260	
91	26.5	551.55				AFN-32-265	AFN-40-265	AFN-50-265
92	27	572.56				AFN-32-270	AFN-40-270	AFN-50-270
93	27.5	593.96				AFN-32-275	AFN-40-275	AFN-50-275
94	28	615.75				AFN-32-280	AFN-40-280	AFN-50-280
95	28.5	637.94				AFN-32-285	AFN-40-285	AFN-50-285
96	29	660.52				AFN-32-290	AFN-40-290	AFN-50-290
97	29.5	683.49				AFN-32-295	AFN-40-295	AFN-50-295
98	30	706.86					AFN-40-300	AFN-50-300
99	30.5	730.62					AFN-40-305	AFN-50-305
100	31	754.77					AFN-40-310	AFN-50-310
101	31.5	779.31					AFN-40-315	AFN-50-315
102	32	804.25					AFN-40-320	AFN-50-320
103	32.5	829.58					AFN-40-325	AFN-50-325
104	33.0	855.3					AFN-40-330	AFN-50-330
105	33.5	881.41					AFN-40-335	AFN-50-335
106	34.0	907.92					AFN-40-340	AFN-50-340
107	34.5	934.82						AFN-50-345
108	35.0	962.11						AFN-50-350
109	35.5	989.8						AFN-50-355
110	36	1017.9						AFN-50-360
111	36.5	1046.4						AFN-50-365
112	37	1075.2						AFN-50-370
113	37.5	1104.5						AFN-50-375
114	38	1134.1						AFN-50-380
115	38.5	1164.2						AFN-50-385
116	39	1194.6						AFN-50-390
117	39.5	1225.4						AFN-50-395
118	40	1256.6						AFN-50-400
119	40.5	1288.3						AFN-50-405
120	41	1320.3						AFN-50-410
121	41.5	1352.7						AFN-50-415
122	42	1385.4						AFN-50-420
123	42.5	1418.6						AFN-50-425
124	43	1452.2						AFN-50-430
125	43.5	1486.2						AFN-50-435
126	44	1520.5						AFN-50-440

APPENDIX A
AFC-227 Sample Calculation



AFC HFC-227ea Flow Calculation (AFC-227 HFC-227ea)

UL: EX29550 / Component of FM Approved System

File Name: Test AFC-227.FC4

Consolidated Report
Customer Information

Company Name:
Address:

Phone:
Contact:
Title:

Project Data

Project Name: Test AFC-227
Designer:
Number:
Account:
Location:
Description:

Enclosure Report

Elevation: 0 m (relative to sea level)

Atmospheric Correction Factor: 1 (NFPA 2001)

Enclosure 1 No Name Entered

Enclosure Temperature:	Number of Nozzles:	1
Minimum: 20.0 C	Width:	0.00 m
Maximum: 20.0 C	Length:	0.00 m
Max. Concentration: 6.41% (At 20.0 C)	Height:	0.00 m

Calculation Date/Time: Tuesday, February 11, 2025, 1:24:45 PM

Copyright (c) Jensen Hughes, Inc.

Key ID: 589646911

Page: 1 of 8



Consolidated Report

Design Concentration:	Volume:	0.00 m ³
Adjusted: 6.41 %	Non-permeable:	0.00 m ³
Minimum: 6.25 %	Total Volume:	100.00 m ³
Min. Agent Required: 48.70 kg		
Adjusted Agent Required: 50.00 kg		

Agent Source Report

Agent: HFC-227ea/ Propellant N2
 Cylinder Name: 63L Agent Cylinder
 Cylinder Part Number: Assembly AFC-63
 Agent Per Cylinder: 50.00 kg
 Cylinder Pressure: 24.821 bar
 Fill Density: 0.794 kg / l
 Number of Main Cylinders: 1
 Number of Reserve Cylinders: 0

 Cylinder Empty Weight: 52.90 kg
 Weight, All Cylinders + Agent: 102.90 kg
 Floor Area Per Cylinder: 0.10 m²
 Floor Loading Per Cylinder: 1070 kg / m²

Calculation Date/Time: Tuesday, February 11, 2025, 1:24:45 PM

Copyright (c) Jensen Hughes, Inc.

Key ID: 589646911

Page: 2 of 8



Consolidated Report Parts Report

Total Agent Required: 50.00 kg
 Cylinder Name: 63L Agent Cylinder Assembly (Part: AFC-63)
 Number of Cylinders: 1

Nozzle	Type	Nozzle Diameter	Nozzle Area	Part Number
E1-N1	360	25A	289.53 mm ²	AFN-25-192

Nozzle	Drill Diameter	Drill Size
E1-N1	19.2 mm	19.2 mm

Pipe & Fittings	Type	Diameter	Length	Elbows (90)	Elbows (45)	Tees	Unions
	40T	25A	2.30 m	2	0	0	0
	40W	32A	1.00 m	0	0	1	0

Other Objects	Name	Quantity	Part Number
	50 mm Flexible Hose	1	AFC-FH-50
	50 mm Union Elbow	1	AFC-UE-125
	50 mm Check Valve	1	AFC-CV-50
	End Cap	1	N/A

System Acceptance Report

System Discharge Time: 9.5 seconds
 Percent Agent In Pipe: 6.6%
 Percent Agent Before First Tee: 0.0%
 Dead Volume: 0.0% (0.01 kg)

Enclosure Number: 1
 Enclosure Name: No Name Entered
 Minimum Design Concentration: 6.25%

Calculation Date/Time: Tuesday, February 11, 2025, 1:24:45 PM

Copyright (c) Jensen Hughes, Inc.

Key ID: 589646911

Page: 3 of 8



Consolidated Report

Adjusted Design Concentration: Predicted 6.41%
 Concentration: 6.41%
 Maximum Expected Agent Concentration: 6.41% (At 20.0 C)

Nozzle	Minimum Agent Required	Adjusted Agent Required	Predicted Agent Delivered	Average Nozzle Pressure
E1-N1	48.70 kg	50.00 kg	49.99 kg	10.110 bar
Total	48.70 kg	50.00 kg	49.99 kg	

Calculation Date/Time: Tuesday, February 11, 2025, 1:24:45 PM

Copyright (c) Jensen Hughes, Inc.

Key ID: 589646911

Page: 4 of 8



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		40A	0.92 m	0	0.92 m	3.00 m				
Flex Hose	Man.	4	5		50A	0.24 m	0	0.20 m	3.36 m				
Flex Hose	Man.	5	6		50A	0.50 m	0	0.50 m	10.00 m				
Check Valve ->	Man.	6	7		50A	0.16 m	0	0.16 m	5.00 m				
Tee	Man.	7	8	40W	32A	-----	0	-----	1.40 m				
Pipe	Man./End	8	9	40W	32A	1.00 m	0	-----	1.00 m				
Elbow (90)	System	9	10	40T	25A	-----	0	-----	1.71 m				
Pipe	System	10	11	40T	25A	2.00 m	0	-----	2.00 m				
Elbow (90)	System	11	12	40T	25A	-----	0	-----	1.71 m				
Pipe&Nozzle	System	12	13	40T	25A	0.30 m	0	-0.30 m	0.30 m	E1-N1	25A	360	289.53 mm ²
Tee	Man.	2	8	40W	32A	-----	0	-----	0.46 m				
End Cap	Man.	1	2	40W	32A	0.10 m	0	-----	999.00 m				

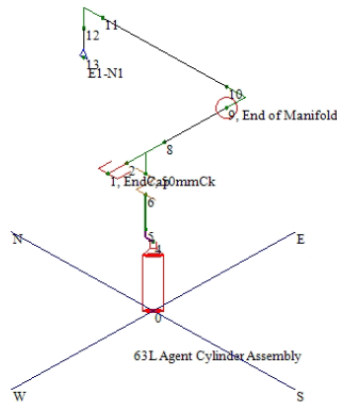
Key ID: 589646911

Page: 5 of 8



Consolidated Report

View #: 1 - Isometric View-Node



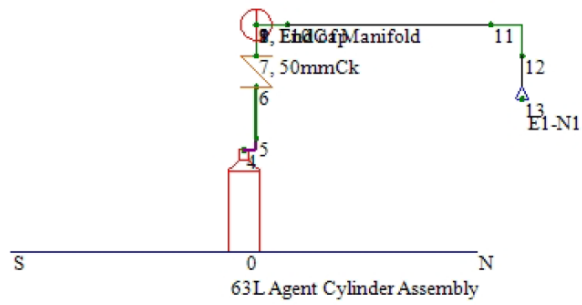
Key ID: 589646911

Page: 6 of 8



Consolidated Report

View #: 5 - Standard Elevation View



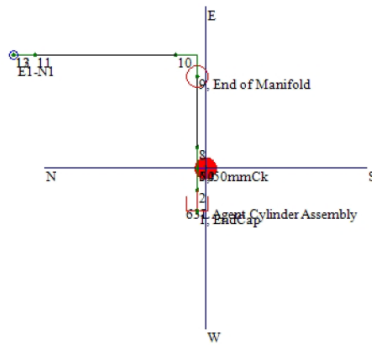
Key ID: 589646911

Page: 7 of 8



Consolidated Report

View #: 9 - Standard Plan View



Key ID: 589646911

Page: 8 of 8

APPENDIX B
AFC-P227 Sample Calculation



AFC HFC-227ea Flow Calculation (AFC-P227 HFC-227ea)

UL: EX29550/ Component of FM Approved System

File Name: Test AFC-P227.FC4

Consolidated Report
Customer Information

Company Name:
Address:
Phone:
Contact:
Title:

Project Data

Project Name: Test AFC-P227
Designer:
Number:
Account:
Location:
Description:

Enclosure Report

Elevation: 0 m (relative to sea level)

Atmospheric Correction Factor: 1 (NFPA 2001)

Enclosure 1 Test

Enclosure Temperature:	Number of Nozzles:	1
Minimum: 20.0 C	Width:	0.00 m
Maximum: 20.0 C	Length:	0.00 m
Max. Concentration: 6.40% (At 20.0 C)	Height:	0.00 m

Calculation Date/Time: Tuesday, February 11, 2025, 1:21:11 PM

Copyright (c) Jensen Hughes, Inc.

Key ID: 589646911

Page: 1 of 8



Consolidated Report

Design Concentration:	Volume:	0.00 m ³
Adjusted: 6.41 %	Non-permeable:	0.00 m ³
Minimum: 6.25 %	Total Volume:	100.00 m ³
Min. Agent Required: 48.70 kg		
Adjusted Agent Required: 50.00 kg		

Agent Source Report

Agent: HFC-227ea/ Propellant N2
 Cylinder Name: 68L Agent Cylinder Assembly
 Cylinder Part Number: AFC-68
 Agent Per Cylinder: 50.00 kg
 Cylinder Pressure: 24.821 bar
 Fill Density: 0.735 kg / l
 Number of Main Cylinders: 1
 Number of Reserve Cylinders: 0

Cylinder Empty Weight: 56.00 kg
 Weight, All Cylinders + Agent: 106.00 kg
 Floor Area Per Cylinder: 0.10 m²
 Floor Loading Per Cylinder: 1102 kg /m²

Nitrogen Cylinder Name: 68L N2 Cylinder (60 Bar)
 Nitrogen Cylinder Part Number: ANC68-60
 Number of Main Nitrogen Cylinders: 1
 Number of Reserve Nitrogen Cylinders: 0

Calculation Date/Time: Tuesday, February 11, 2025, 1:21:11 PM

Copyright (c) Jensen Hughes, Inc.

Key ID: 589646911

Page: 2 of 8



**Consolidated Report
Parts Report**

Total Agent Required: 50.00 kg
 Cylinder Name: 68L Agent Cylinder Assembly (Part: AFC-P68)
 Number of Cylinders: 1
 Nitrogen Cylinder Name: 68L N2 Cylinder (60 Bar) (Part: ANC68-60)
 Number of Nitrogen Cylinders: 1
 Nitrogen Restrictor Plate: 58.90 mm ² (Part: N/A)
 Number of Nitrogen Restrictor Plates: 1

Nozzle	Type	Nozzle Diameter	Nozzle Area	Part Number
E1-N1	360°	25A	314.16 mm ²	AFN-25-200

Nozzle	Drill Diameter	Drill Size
E1-N1	20.0 mm	20 mm

Pipe & Fittings	Type	Diameter	Length	Elbows (90)	Elbows (45)	Tees	Unions
	40T	25A	2.30 m	2	0	0	0
	40W	32A	0.30 m	0	0	1	0

Other Objects	Name	Quantity	Part Number
	50 mm Flexible Hose	1	AFC-FH-50
	50 mm Union Elbow	1	AFC-UE-125
	50 mm Check Valve	1	AFC-CV-50
	End Cap	1	N/A

System Acceptance Report

System Discharge Time: 6.1 seconds
 Percent Agent In Pipe: 4.6%
 Percent Agent Before First Tee: 0.0%
 Dead Volume: 0.0% (0.02 kg)

Calculation Date/Time: Tuesday, February 11, 2025, 1:21:11 PM
 Copyright (c) Jensen Hughes, Inc.
 Key ID: 589646911



Consolidated Report

Enclosure Number: 1
 Enclosure Name: Test
 Minimum Design Concentration: 6.25%
 Adjusted Design Concentration: 6.41%
 Predicted Concentration: 6.40%
 Maximum Expected Agent Concentration: 6.40% (At 20.0 C)

Nozzle	Minimum Agent Required	Adjusted Agent Required	Predicted Agent Delivered	Average Nozzle Pressure
E1-N1	48.70 kg	50.00 kg	49.98 kg	18.973 bar
Total	48.70 kg	50.00 kg	49.98 kg	

Calculation Date/Time: Tuesday, February 11, 2025, 1:21:11 PM

Copyright (c) Jensen Hughes, Inc.

Key ID: 589646911

Page: 4 of 8



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		40A	0.96 m	0	0.96 m	3.00 m				
Flex Hose	Man.	4	5		50A	0.24 m	0	0.20 m	3.36 m				
Flex Hose	Man.	5	6		50A	0.50 m	0	0.50 m	10.00 m				
Check Valve ->	Man.	6	7		50A	0.16 m	0	0.16 m	5.00 m				
Tee	Man.	7	8	40W	32A	-----	0	-----	1.40 m				
Pipe	Man./End	8	9	40W	32A	0.30 m	0	-----	0.30 m				
Elbow (90)	System	9	10	40T	25A	-----	0	-----	1.71 m				
Pipe	System	10	11	40T	25A	2.00 m	0	-----	2.00 m				
Elbow (90)	System	11	12	40T	25A	-----	0	-----	1.71 m				
Pipe&Nozzle	System	12	13	40T	25A	0.30 m	0	-0.30 m	0.30 m	E1-N1	25A	360°	314.16 mm ²
Tee	Man.	2	8	40W	32A	-----	0	-----	0.46 m				
End Cap	Man.	1	2	40W	32A	0.10 m	0	-----	999.00 m				

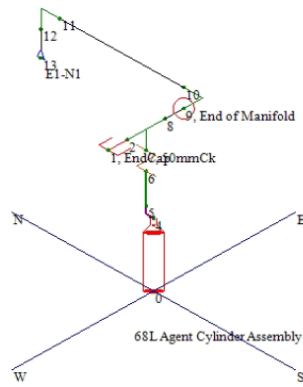
Key ID: 589646911

Page: 5 of 8



Consolidated Report

View #: 1 - Isometric View-Node



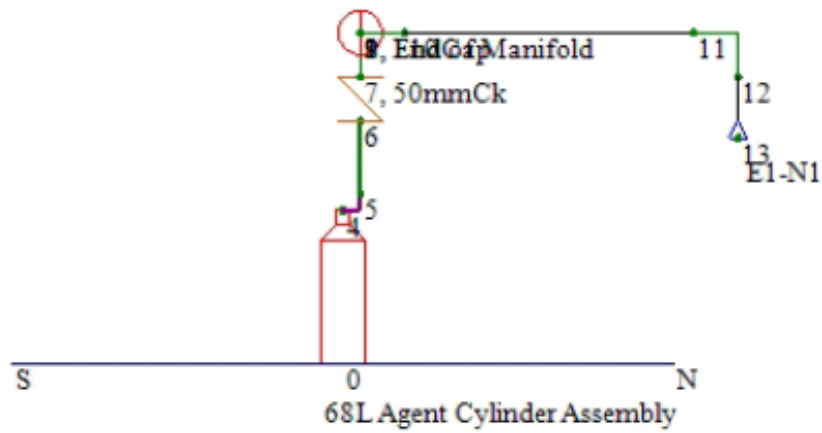
Key ID: 589646911

Page: 6 of 8



Consolidated Report

View #: 5 - Standard Elevation View



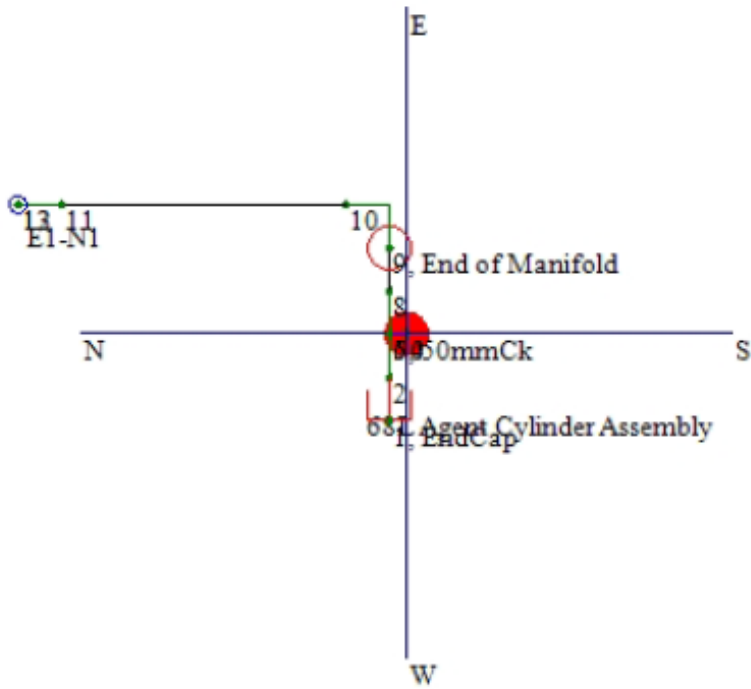
Key ID: 589646911

Page: 7 of 8



Consolidated Report

View #: 9 - Standard Plan View



Key ID: 589646911

Page: 8 of 8

APPENDIX C
FM-200/ HFC-227ea Safety Data Sheet




Safety Data Sheet
FM-200™/HFC-227ea

Safety Data Sheet

SECTION 1. IDENTIFICATION

Product identifier:	HFC-227ea
Chemical name:	1,1,1,2,3,3,3-Heptafluoropropane
Trade name/synonym:	Heptafluoropropane, HFC-227ea, R-227ea, FM-200™, FE-227™, MH227®
Product use:	Fire extinguishing agent
Manufacturer/supplier/importer:	AMERICAN FIRE CONTROL LLC. 255 S Orange Ave, Orlando FL32801, USA Tel: +1 607 252 6814 sales@american-afc.com www.american-afc.com

SECTION 2. HAZARDS IDENTIFICATION

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

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Component:	1,1,1,2,3,3,3-Heptafluoropropane
CAS No.:	431-89-0
Concentration:	100%

**SECTION 4. FIRST AID MEASURES**

Skin contact:	In case of contact, immediately flush skin with plenty of water for at least 15 minutes. Take off all contaminated clothing immediately. Consult a physician. Wash contaminated clothing before re-use. Treat for frostbite if necessary by gently warming affected area.
Eye contact:	Safety glasses/chemical splash goggles. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Consult a physician if necessary.
Inhalation:	Move to fresh air, lie down. Keep patient warm and at rest. Artificial respiration and/or oxygen may be necessary. Consult a physician.
Ingestion:	Is not considered a potential route of exposure.
General advice:	Never give anything by mouth to an unconscious person. When symptoms persist or in all cases of doubt seek medical advice.
Notes to physician:	Because of possible disturbances of cardiac rhythm, catecholamine drugs, such as epinephrine, that may be used in situations of emergency life support should be used with special caution.

SECTION 5. FIREFIGHTING MEASURES

Fire and explosion hazard:	The product is not flammable.
Hazardous decomposition products:	Hydrogen fluoride, Carbonyl fluoride
Suitable extinguishing media:	This material is a fire extinguishing agent.
Notes to fire-fighters:	Wear full protective clothing, including helmet, self-contained breathing apparatus, protective clothing, and face mask. Use water to cool fire-exposed containers.

SECTION 6. ACCIDENTAL RELEASE MEASURES

NOTE:	Review FIRE FIGHTING MEASURES and HANDLING (PERSONNEL) sections before proceeding with clean-up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean-up.
Safeguards (personnel):	Evacuate personnel, thoroughly ventilate area, and use self-contained breathing apparatus. Keep upwind of leak – evacuate until gas has dispersed.
Spill cleanup:	Ventilate area using forced ventilation, especially low or enclosed places where heavy vapors might collect.

SECTION 7. HANDLING AND STORAGE

Handling (personnel):	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. Do not breathe gas. Avoid contact with skin, eyes and clothing. For personal protection see section 8. Wash hands thoroughly after handling. Wash clothing after use. Decomposition will occur when the product comes in contact with open flame or electrical heating elements. Handle in
-----------------------	---



Safety Data Sheet
FM-200™/HFC-227ea

	accordance with good industrial hygiene and safety practice.
Storage:	Keep container tightly closed and in a cool, well-ventilated place. Keep out of direct sunlight. Keep away from heat and ignition sources Valve protection caps and valve outlet threaded plugs must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Never attempt to lift cylinder by its cap. Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Keep at temperature not exceeding 130°F (54°C). Keep container tightly closed in a dry and well-ventilated place. Store in original container. Protect from contamination. Avoid area where salt or other corrosive materials are present.
Storage temperature:	32°F (0°C) to 130°F (< 54°C)

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering controls:	Keep container tightly closed. 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:	Wear NIOSH approved respiratory protection as appropriate.
Hand protection:	Additional protection: Impervious gloves
Eye protection:	Safety glasses with side-shields, additionally wear a face shield where the possibility exists for face contact due to splashing, spraying or airborne contact with this material.
Skin and body protection:	Where there is potential for skin contact, have available and wear as appropriate, impervious gloves, apron, pants, jacket, hood and boots.
Protective measures:	Self-contained breathing apparatus (SCBA) is required if a large release occurs. Exposure Guidelines
Exposure limit values	Not Established.
Environmental exposure controls	Do not empty into drains

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Form:	Clear liquefied gas
Odor:	none
Boiling point:	-16.3 °C (2.7 °F)
Vapor pressure:	4,547 hPa at 25 °C (77 °F)
Density:	1.388 g/cm ³ at 25 °C (77 °F) (as liquid)

www.american-afc.com

3 of 6

AFC-SDS-227 February 12, 2025

**SECTION 10. STABILITY AND REACTIVITY**

Stability:	Stable at normal temperatures and storage conditions.
Incompatibility:	Alkali metals Alkaline earth metals, powdered metals, powdered metal salts Hazardous Decomposition
Products:	Hydrogen fluoride, Carbonyl fluoride, Carbon monoxide, Carbon dioxide
Hazardous reactions:	Polymerization will not occur.

SECTION 11. TOXICOLOGICAL INFORMATION

Inhalation 4 h LC50:	> 788698 ppm, rat
Inhalation:	dog Cardiac sensitization
Dermal:	not applicable
Oral:	not applicable
Skin irritation:	No skin irritation, not tested on animals Not expected to cause skin irritation based on expert review of the properties of the substance.
Eye irritation:	No eye irritation, not tested on animals Not expected to cause eye irritation based on expert review of the properties of the substance.
Sensitization:	Does not cause skin sensitization, not tested on animals Not expected to cause sensitization based on expert review of the properties of the substance. Did not cause sensitization on laboratory animals. There are no reports of human respiratory sensitization.
Repeated dose toxicity:	Inhalation, rat, No toxicologically significant effects were found.
Carcinogenicity:	Overall weight of evidence indicates that the substance is not carcinogenic.
Mutagenicity:	Did not cause genetic damage in animals. Did not cause genetic damage in cultured mammalian cells. Did not cause genetic damage in cultured bacterial cells.
Reproductive toxicity:	Animal testing showed no reproductive toxicity. Information given is based on data obtained from similar substances.
Teratogenicity:	Animal testing showed no developmental toxicity.
Further information:	Cardiac sensitization threshold limit: 730190 mg/m3

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 (CO2 = 1.0): 3,220

SECTION 13. DISPOSAL CONSIDERATIONS

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

SECTION 14. TRANSPORT INFORMATION

DOT/TDG/IATA/ICAO/IMDG	
UN number:	3296
Proper shipping name:	Heptafluoropropane
Class:	2.2 (Non-Flammable Gas)
Labelling No. :	2.2

SECTION 15. REGULATORY INFORMATION

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

Ingredient name:	1,1,1,2,3,3,3 - Heptafluoropropane
TSCA:	YES
DSL:	YES
ELINCS:	YES
ENCS:	YES
CHINA:	YES
KECL:	YES
AICS:	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.

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.

Safety Data Sheet
FM-200™/HFC-227ea**SECTION 16. OTHER INFORMATION**

HMIS

Health: 1

Flammability: 0

Reactivity/Physical hazard: 0

PPE: Personal Protection rating to be supplied by user depending on use conditions.

DISCLAIMER

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.