Honeywell

# HFC-227EA CLEAN AGENT FIRE EXTINGUISHING SYSTEM



# HW-227

## Design, Installation, Operation

## Maintenance and Refilling Manual

Rev.0

PN: HSN-MNL-H1-R0
February 2025

UL FM APPROVED

# A Foreword

This manual is written for those who own or are responsible for HFC-227ea Fire Extinguishing System. We assume no responsibility for the application of any systems other than those addressed in this manual. The technical data contained herein is limited strictly for information purposes only. We believe this data to be accurate, but it is published and presented without any guarantee or warranty whatsoever. We disclaim any liability for any use that may be made of the data and information contained herein by any and all other parties.
The HFC-227ea Fire Extinguishing System is to be designed, installed, inspected, maintained, tested and recharged by qualified, trained personnel in accordance with the following:

**NFPA 2001, Standard for Clean Agent Fire Extinguishing Systems**
**NFPA 72, National Fire Code**
**NFPA 70, National Electrical Code**
**EN15004-1, Fixed firefighting systems - Gas extinguishing systems**
**ISO14520, Gaseous fire-extinguishing systems - Physical properties and system design**

Storage, handling, transportation, service, maintenance, recharge and test of agent storage cylinders shall be per-formed only by qualified and trained personnel in accordance with the information in this manual and TPED Directive 2010/35/EU.

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


**Honeywell Middle East FZE**
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# B Attention Installer

This form must be signed by the system owner indicating that he/she has received a copy of this Owner's Manual Copy. Have the system installer fill-out this form.

Note: Retain a copy of this form for your records.

A System Installed:

_____

_____

_____

_____

B Listing of Major System Components:

_____

_____

_____

_____

C Description of Hazard Protected by System:

_____

_____

_____

_____

_____ _____

Owner or Authorized Representative Date

_____

Title

# C History of Revisions

| Table C.1 History of Revisions | | | |
|---|---|---|---|
| **Version** | **Revision Date** | **Revision Detail** | **Revised by** |
| R.0 | 19 / 02 / 2025 | Document is created | Y.Koc |

# HFC-227ea Clean Agent Fire Extinguishing System

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**Appendix A** / Material Safety Data sheet for HFC-227ea

# 0. General Introduction

This manual is a comprehensive guide the contains all the information needed to design, install and maintain the HFC-227ea Fire Extinguishing System. Users of this manual are assumed to be competent fire engineers with a basic knowledge of such systems. The contents are arranged in a logical order describing the various procedures in turn, alternatively specific sections can be referred to as required. Users who are not familiar with the equipment should first read the complete manual. HFC-227ea is a clean, safe firefighting agent for use in total flooding automatic extinguishing systems. It is in-tended as a long-term replacement for Halon 1301 and, whilst maintaining the excellent fire extinguishing properties of Halon, has none of the environmental problems. Storage and distribution requirements are similar to Halon and the majority of system components are identical. However, HFC-227ea is not a direct replacement for existing Halon 1301 installations due to the difference in agent quantity and discharge characteristics.

Systems may be activated mechanically or electrically. Mechanical manual actuation is via a strike knob attached to the container valve. Electrical actuation is via a removable side mounted solenoid. The solenoid can be energized automatically by a signal from a detection and alarm control panel. Users of this manual should find that sufficient information is provided to plan, design, purchase components, install, operate and maintain the system. However, in the event that part of the document is not understood, or if there is any concern as to the suitability of the protection, do not hesitate to contact one of our specialist engineers for the matter to be quickly resolved. HFC-227ea Fire Extinguishing systems are employed to protect critical installations formerly protected by Halon 1301. These include:

- Data Processing Centers
- Telecommunication Switch Centers
- Process Control Rooms
- Art and Historical Collections
- MRI Room in Hospital
- Process Control Station of Oil Refinery
- Marine Engine Rooms and Drone Control Center of Military
- An ideal supplement for sprinkler systems to protect any type of assets that could be damaged by water.

# 1. Concept

## 1.1. Application

HFC-227 fire extinguishing system is designed, installed, maintained and tested for total flooding in accordance EPA and EN15004 standards. This is the time-tested agent available in the market. HFC-227ea fire extinguishing system are designed to extinguishes fires in specific hazards or equipment located where an electrically non-conductive agent is required, where agent cleanup creates a problem, where extinguishing capability with low weight is a factor and where the hazard is normally occupied by personnel.

Features of HFC-227ea Clean Agent :

- Ozone Depleting Potential (ODP) of Zero
- Requires minimal storage space
- No post-fire residue or clean up
- No damage to protected equipment
- Is electrically non-conductive
- Safe for use in a wide range of normally occupied hazard areas
- SNAP List Approved
- Atmospheric lifetime of approximately 34.2 years
- Low global warming potential

Typical Application:

- Telecommunication switch rooms
- Computer and electronic control rooms
- Banking Data Centre
- Marine Engine Rooms and Drone Control Center of Military
- Control Rooms in Power Generation Plants
- Control Rooms in Petrochemical Installations

## 1.2. System Description

### 1.2.1. General

HFC-227ea fire extinguishing system is a time-tested clean agent Halon alternative. It combines outstanding extinguishing performance with an excellent environmental profile. HFC-227ea has zero ozone depletion potential, a global warming potential of 34.5 years atmospheric lifetime, and a large margin of safety for occupied spaces. HFC-227ea clean agent extinguishes fire by a combination of chemical and physical action without affecting the available oxygen. It is also electrically non-conductive.

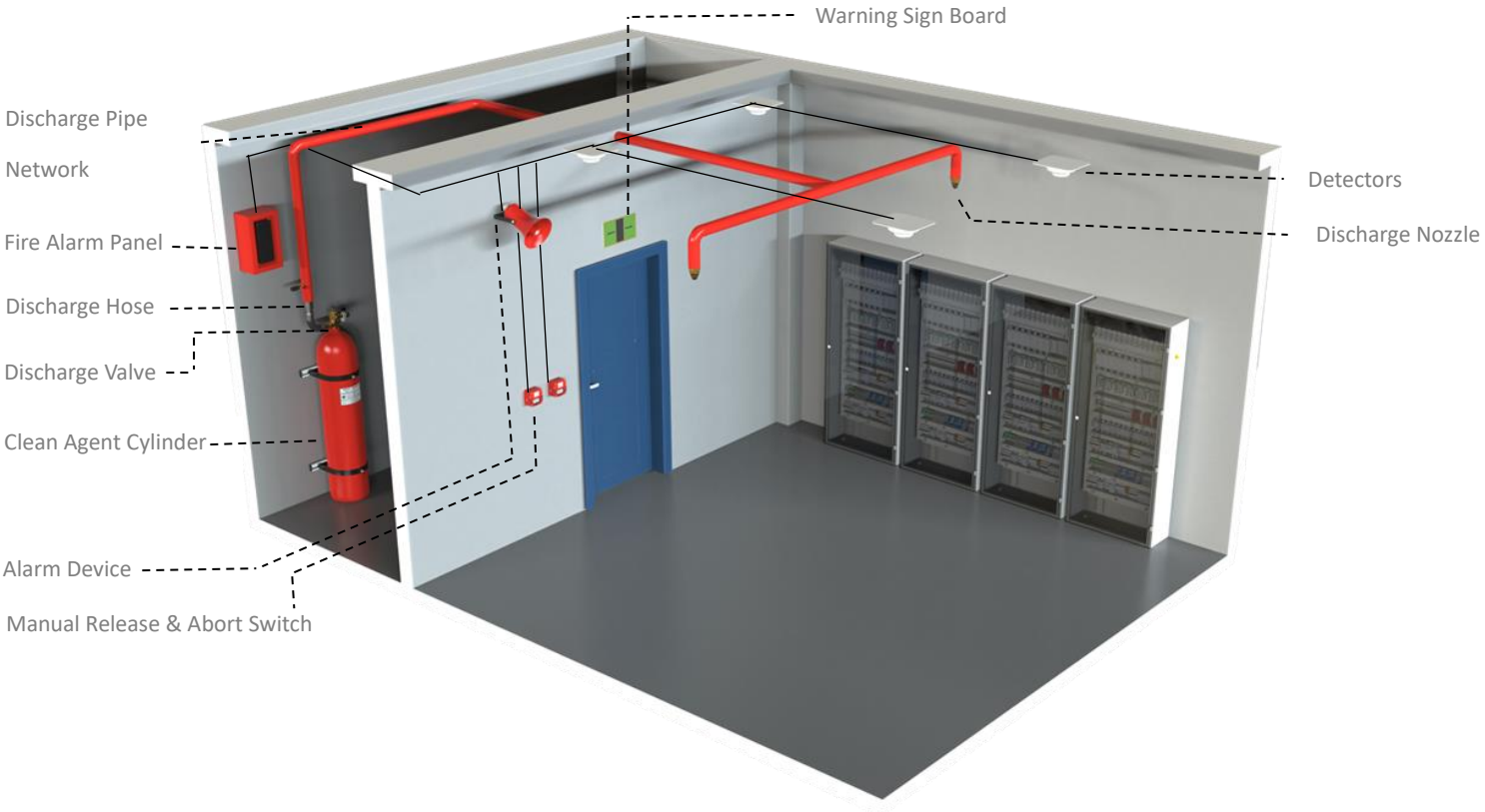



Figure 1.1.: Typical HFC-227ea Clean Agent Fire Extinguishing Systems

HFC-227ea Clean Agent Systems are designed for the following classes of fire:

- Class A; Surface Type Fires; Wood, cloth, rubber, paper and many plastics.
- Class B; A fire in flammable liquids, combustible liquids, petroleum greases, tars, oils, oil-based paints, solvents, lacquers, alcohols, and flammable gases.
- Class C; A fire that involves energized electrical equipment.

## 1.2.2. Extinguishing Agent

HFC-227ea clean agent, referenced as HFC-227ea in EN15004 and ISO 14250, is a compound of carbon, fluorine and hydrogen with a chemical structure of CF3CHFCF3. It is a clear, colorless, odorless, liquid that is super-pressurized with nitrogen and stored in high-pressure cylinders. This agent extinguishes fire by a combination of Chemical and physical mechanisms with minimal effect on the available oxygen. This allows people to see and breathe, permitting them to leave the fire area safely.

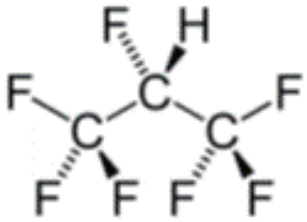



Figure 1.2.: HFC-227ea Molecule

### 1.2.2.1. Toxicity

Unnecessary exposure to clean agents is to be avoided in accordance with the requirements of EN15004. HFC-227ea use concentration is much lower than its No Observable Adverse Effects Level (NOAEL), HFC-227ea offers the largest margin of safety of any halon replacement available on the market today. As such, upon operation of a system pre-discharge alarm, all personnel should immediately exit the protected space. In no case shall personnel remain in a room in which there is a fire. In the very unlikely instance where a clean agent system should discharge unexpectedly into an occupied room, all personnel should proceed in a calm and orderly manner to an exit and leave the room.

**Table 1.1. Toxicity Information**

| Agent | LC50 or ALC (%) | NOAEL | LOAEL |
|---|---|---|---|
| HFC-227ea | > 80 | 9.0 % | 10.5 % |
| NOTE.1: LC50 is the concentration lethal to 50 % of a rat population during a 4 h exposure. The ALC is the approximate lethal concentration.<br>NOTE.2: The cardiac sensitization levels are based on the observance or non-observance of serious heart arrhythmias in a dog. The usual protocol is a 5 min exposure followed by a challenge with epinephrine.<br>NOTE.3: High concentration values are determined with the addition of oxygen to prevent asphyxiation. | | | |
| Reference: EN15004-1, Table G.1 — Toxicity information for halocarbon clean agents.<br>NFPA2001 Table 1.5.1.2.1.(a) — Information for halocarbon clean agents. | | | |

### 1.2.2.2. Environmentally Friendly

HFC-227ea has zero ozone depletion potential, 34.5 years atmospheric lifetime, HFC-227ea is the preferred clean agent halon replacement to offer a viable, long-term, sustainable technology for special hazards fire protection.

| Table 1.2. Environmental Properties | | | | |
|---|---|---|---|---|
| **Description** | **FK-5-1-12** | **Halon 1301** | **HFC-125** | **HFC-227ea** |
| Ozone Depletion Potential | 0.0 | 12.0 | 0.0 | 0.0 |
| Global Warming Potential | 1 | 7140 | 3500 | 3220 |
| Atmospheric Lifetime (Years) | 0.014 (5 days) | 65 | 29 | 34.2 |
| SNAP (YES/NO) | | | | |
| Reference: World Meteorological Organization (WMO) 1998, Model-Derived Method Intergovernmental Panel on Climate Change (IPCC) 2007 Method, 100-year ITH | | | | |

***IMPORTANT NOTICE:***

HFC-227ea is discharged through the nozzle orifices. Direct eye or skin contact with the liquid or cold gas can cause chilling or possibly frostbite on exposed tissues. Misuse or intentional inhalation abuse can cause suffocation or death. Do not stand directly in front of the discharge lines as the discharge pressure could cause injury. The nozzles are used to discharge the HFC-227ea in a horizontal direction. The flow of HFC-227ea should not be blocked by any obstructions. Please read and follow the precautions and the safety related information in the Material Safety Data Sheet (MSDS).

### 1.2.2.3. Storage

HFC-227ea Clean Agent has a low vapor pressure 3 bar (44 psi) @ 21 ºC (70 ºF). To displace the extinguishing clean agent out of the steel containers through the pipelines to the nozzles in protected hazard, nitrogen is added as a propellant to improve the discharge characteristics. HFC-227ea clean agent system is available for only 42 bar system.

• 42 Bar system: HFC-227ea clean agent is stored in seamless cylinder as liquid, super pressurize with dry nitrogen to 42 Bar at 21°C (610 psi at 70 °F).

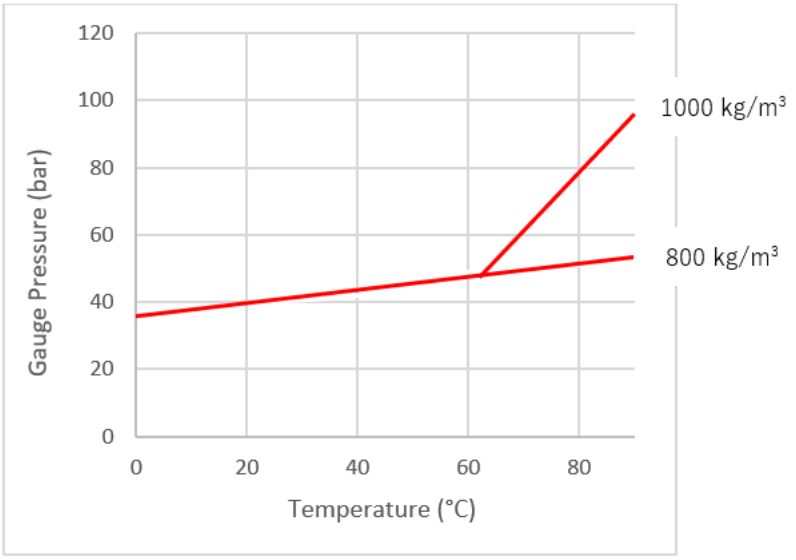



Figure 1.3.: Pressure vs. Temperature curves for HFC-227ea clean agent to 42 bar at 20 °C

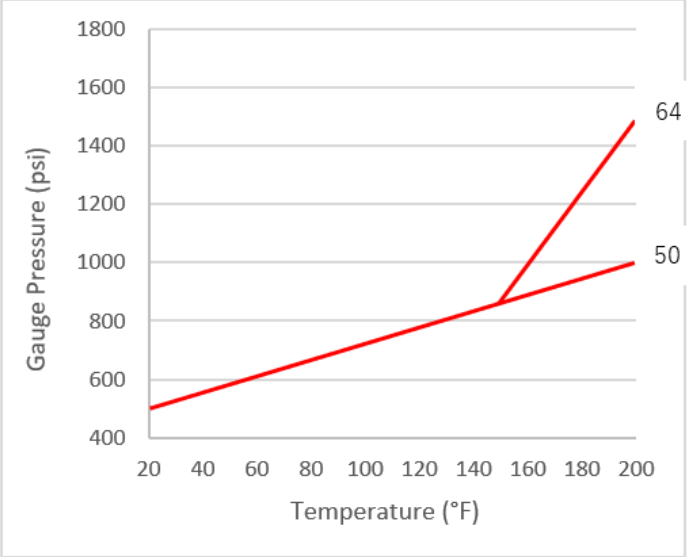



Figure 1.4.: Pressure vs. Temperature curve for HFC-227ea clean agent to 610 psi at 70 °F

| Table 1.3. Physical Properties of HFC-227ea | |
|---|---|
| **Properties** | **HFC-227ea** |
| Chemical Name | 1,1,1,2,3,3,3-Heptafluoropropane |
| Chemical Formula | CF3CHFCF3 |
| Molecular Weight | 170.03 |
| Boiling Point @ 1 atm | -17 °C (1.4 °F) |
| Freezing Point | -131 °C (-204 °F) |
| Critical Temperature | 101.75 °C (215.1 °F) |
| Critical Pressure | 2925.0 kPa (424.24 psia) |
| Liquid Density @ 1 atm | 1.46 g/cm3 |
| Vapor Density @ 1 atm | 6.04 g/mL |
| Vapor Pressure | 457.7 kPa (66.4psi) @ 25 °C (77 °F) |
| Solubility of Water in HFC-227ea @ 25 °C (77 °F) | 260 mg/L |
| Ozone Depletion Potential | 0.0 |
| Global Warming Potential, GWP (100yr ITH.for $Co_2$, GWP=1) | 3220 |
| Atmospheric Lifetime | Approximate 34.2 years |
| TSCA Inventory Status | Reported / Included |
| European List of New Chemical Substances | EINECS, Listed (207-079-2) |
| SNAP Status | Listed |
| Inhalation Exposure Limit (AELa) | 1000 ppm 8 hr and 12 hr TWA |
| Reference : HFC-227ea clean agent manufacturer's MSDS | |

# 2. Component Descriptions

## 2.1. Introduction

This chapter provides a functional description of the components and assemblies of the HFC-227ea Fire Extinguishing System.

**Table 2.1. Part List**

| Description | Part Number |
|---|---|
| **42 Bar Cylinder Sets** | |
| 8L Seamless TPED Cylinder Set (with DN12 solenoid integrated valve, Label, Protection Cap, Bracket) | HSN-HF-US-SM-008-1 |
| 13.4L Seamless TPED Cylinder Set (with DN12 solenoid integrated valve, Label, Protection Cap, Bracket) | HSN-HF-US-SM-013-1 |
| 26.8L Seamless TPED Cylinder Set (with DN33 Valve, Label, Protection Cap, Brackets) | HSN-HF-US-SM-026-1 |
| 40L Seamless TPED/DOT Cylinder Set (with DN33 Valve, Label, Protection Cap, Brackets) | HSN-HF-US-SM-040-1 |
| 67L Seamless TPED/DOT Cylinder Set (with DN33 Valve, Label, Protection Cap, Brackets) | HSN-HF-US-SM-067-1 |
| 80L Seamless TPED/DOT Cylinder Set (with DN33 Valve, Label, Protection Cap, Brackets) | HSN-HF-US-SM-080-1 |
| 120L Seamless TPED Cylinder Set (with DN33 Valve, Label, Protection Cap, Brackets) | HSN-HF-US-SM-120-1 |
| 180L Seamless TPED Cylinder Set (with DN50 Valve, Label, Protection Cap, Brackets) | HSN-HF-US-SM-180-1 |
| 220L Seamless TPED Cylinder Set (with DN50 Valve, Label, Protection Cap, Brackets) | HSN-HF-US-SM-220-1 |
| **Pressure Gauges** | |
| Ø50mm Contacted pressure gauge 38bar NO | HSN-PGV-NOC-3880 |
| Ø50mm Contacted pressure gauge 38bar NC | HSN-PGV-NCC-3880 |
| **Actuators** | |
| Manual Actuator (release device) for DN33&50 valves | HSN-ACT-M01 |
| Manual Actuator (release device) for DN12 valve on board solenoid | HSN-ACT-M02 |
| Solenoid Actuator for DN33&50 valve (24V DC) | HSN-ACT-S03 |
| Pneumatic Actuator (release device) | HSN-ACT-P01 |
| **Cylinder Discharge Line Hose** | |
| Discharge Hose, DN12, L:400mm (8L to 13.4L) | HSN-DH-12-400 |
| Discharge Hose, DN33, L:400mm, (26.8L to 120L) | HSN-DH-33-400 |
| Discharge Hose, DN50, L:400mm, (180L to 220L) | HSN-DH-50-400 |
| **Check Valves** | |
| Check Valve DN33 | HSN-CHV-033 |
| Check Valve DN50 | HSN-CHV-050 |

| Table 2.1. Part List (continued) | |
|---|---|
| **Description** | **Part Number** |
| **Actuation Line Accessories** | |
| Pilot Hose DN5 500 mm - 360bar | HSN-PLH-01-500 |
| Pilot Line Nipple Adaptor (Screw-in fitting straight) G1/8" - M12x1,5 | HSN-PNA-01 |
| Bleed Valve G1/8" | HSN-BLD-01 |
| **Clean Agents** | |
| HFC-227ea Clean Agent (Factory Filled in Kg) | HSN-HFC227-01 |
| HFC-227ea Clean Agent (Bulk Agent in GB Tank) | HSN-HFC227-1000 |
| **Discharge Nozzles** | |
| Nozzle, Ø15mm, 1/2", 180D, 5xØ6.7 | HSN-NOZ-01-15 |
| Nozzle, Ø15mm, 1/2", 360D, 8xØ5.4 | HSN-NOZ-02-15 |
| Nozzle, Ø20mm, 3/4", 180D, 9xØ6.7 | HSN-NOZ-01-20 |
| Nozzle, Ø20mm, 3/4", 360D, 16xØ5 | HSN-NOZ-02-20 |
| Nozzle, Ø25mm, 1", 180D, 9xØ8.4 | HSN-NOZ-01-25 |
| Nozzle, Ø25mm, 1", 360D, 16xØ6.3 | HSN-NOZ-02-25 |
| Nozzle, Ø32mm, 11/4", 180D, 9xØ10.7 | HSN-NOZ-01-32 |
| Nozzle, Ø32mm, 11/4", 360D, 16xØ8 | HSN-NOZ-02-32 |
| Nozzle, Ø40mm, 11/2", 180D, 14xØ10.7 | HSN-NOZ-01-40 |
| Nozzle, Ø40mm, 11/2", 360D, 24xØ8.2 | HSN-NOZ-02-40 |
| Nozzle, Ø50mm, 2", 180D, 14xØ13.4 | HSN-NOZ-01-50 |
| Nozzle, Ø50mm, 2", 360D, 24xØ10.2 | HSN-NOZ-02-50 |
| **Switches** | |
| Discharge Pressure Switch | HSN-DPS-01 |
| Monitoring Device for Solenoid (Releasing Circuit Control) | HSN-MDS-02 |
| **Label** | |
| HFC-227ea Label | HSN-LBL-H1 |
| **Caution Signs** | |
| HFC-227ea Protected Room Caution Sign | HSN-CS-HFC-01 |
| Manual Release Point Caution Sign | HSN-CS-MRP-01 |

## 2.2. Component Descriptions

### 2.2.1. Seamless Cylinder

In 42 Bar HFC-227ea System, clean agent is stored as liquid in seamless cylinder designed specifically for the application and charged to a fill density of between 0.50 kg/ltr. (31.2 lb/ft3) and 1.00 kg/ltr. (62.4 lb/ft3). To ensure optimal performance, each cylinder is super pressurized with dry nitrogen to 42 bar at 21°C (610 psi at 70 °F).

An identification label is affixed to the cylinder body indicating the fill quantity of HFC-227ea, charging pressure and date of fill. Many variations in cylinder capacities (Refer Table 2.2.) to select the best as per project requirement. Fire extinguishing systems utilizing HFC-227ea clean agent is

designed to be discharged within 6-10 seconds into a room or an enclosure with the structural integrity to retain the agent.

The HFC-227ea clean agent uniformly mixes throughout the protected area achieving a minimum concentration level in accordance with NFPA2001.

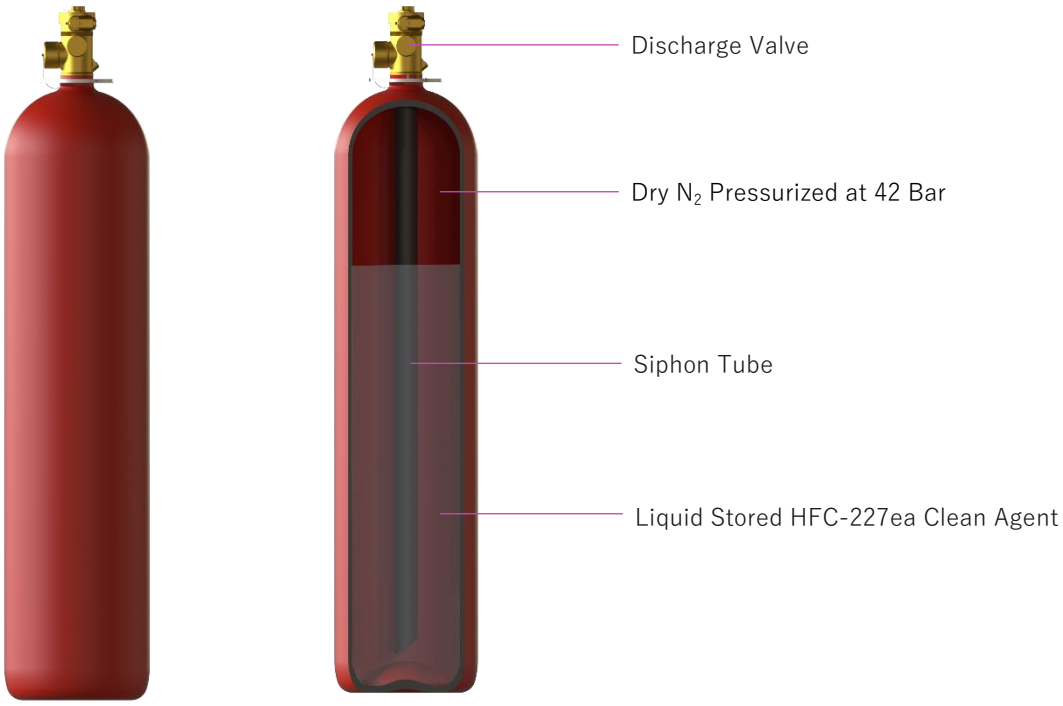



Figure 2.1.: Typical seamless cylinder & valve assembly

**Table 2.2. 42 Bar HFC-227ea Clean Agent Seamless Cylinders**

| Part Number | Valve Size mm | Cylinder Volume liter | Cylinder Diameter mm** | Empty Weight kg*** | System Pressure bar | Filling Range kg |
|---|---|---|---|---|---|---|
| HSN-EU-SM-008-12 | 12 | 8.0 | 140 | 10.4 | 42 | 4.8-8.0 |
| HSN-EU-SM-013-12 | | 13.4 | 140 | 16.0 | | 6.7-13.4 |
| HSN-EU-SM-026-33 | 33 | 26.8 | 219 | 35.0 | | 13.4-26.8* |
| HSN-EU-SM-040-33 | | 40 | 219 | 48.0 | | 20.0-40.0 |
| HSN-EU-SM-067-33 | | 67.5 | 267 | 68.0 | | 33.5-67.5 |
| HSN-EU-SM-080-33 | | 80 | 267 | 77.5 | | 40.0-80.0 |
| HSN-EU-SM-120-33 | | 120 | 356 | 115.0 | | 60.0-120.0 |
| HSN-EU-SM-180-50 | 50 | 180 | 406 | 176.0 | | 90.0-180.0 |
| HSN-EU-SM-220-50 | | 220 | 406 | 162.0 | | 110.0-220.0 |

** According to FM system approval, the minimum filling quantity for 26.8L cylinder starts from 19kg.*

*** Cylinder diameters have tolerance +/- 5 % according to cylinder manufacturer.*

**** Cylinder weights are approximately.*

***IMPORTANT NOTICE:*** HFC-227ea clean agent fire extinguishing system equipment's are designed for an operating temperature range of 0°C to 50°C (32°F to 122°F).

## 2.2.2. Valve Assembly

The automatic release of HFC-227ea clean agent is controlled by a forged brass, differential pressure operated cylinder valve connected to the neck of the cylinder. Each cylinder and valve assembly are provided with a safety cap and a protection cap which is a safety feature to prevent uncontrolled, accidental discharge. Discharge valve assembly is available in three sizes DN12, DN33 and DN50.

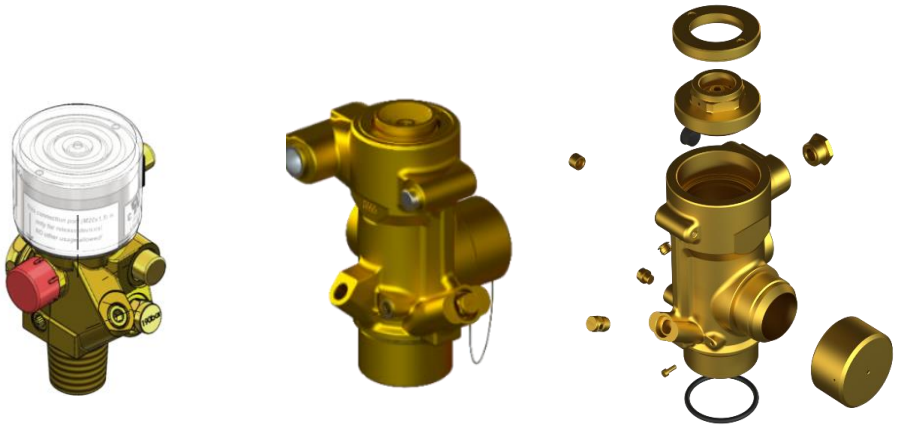
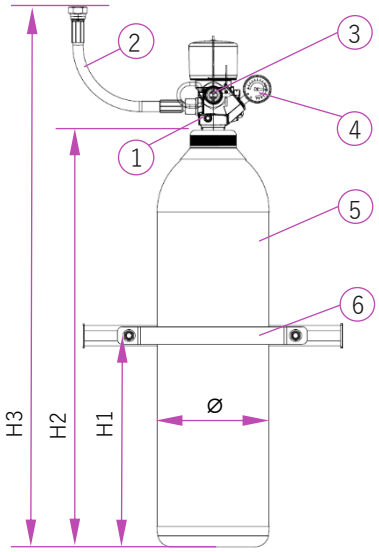


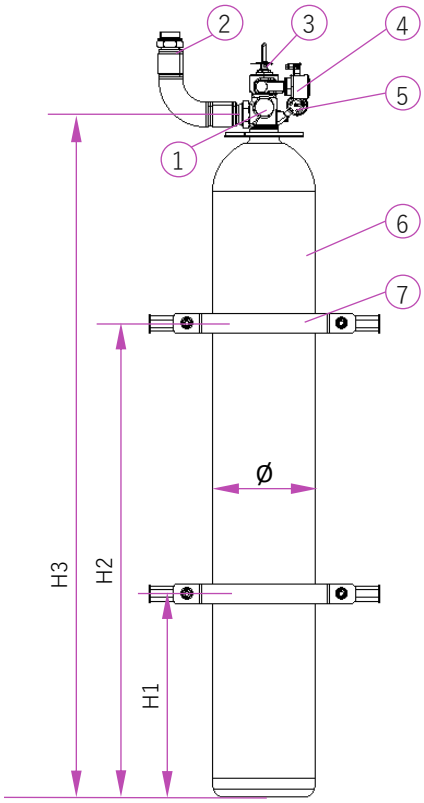
Figure 2.2.: General Arrangement of Discharge Valves




| Table 2.3. Hardware for 8L & 13.4L Cylinders | | |
|---|---|---|
| **No.** | **Description** | **Part Number** |
| 1 | DN12 Solenoid (Integrated) Discharge Valve | HSN-VLV-HS-2-12 |
| 2 | Discharge Hose, L:400mm, 16mm | HSN-DH-12-400 |
| 3 | Manual Actuator for DN12 Valve | HSN-ACT-M02 |
| 4.1 | Ø50mm contacted pressure gauge 38bar NO | HSN-PGV-NOC-3880 |
| 4.2 | Ø50mm contacted pressure gauge 38bar NC | HSN-PGV-NCC-3880 |
| 5.1 | 8L Seamless TPED Cylinder Set | HSN-HF-US-SM-008-1 |
| 5.2 | 13.4L Seamless TPED Cylinder Set | HSN-HF-US-SM-013-1 |
| 6.1 | 8L Seamless Cylinder Bracket | HSN-BRC-140 |
| 6.2 | 13.4L Seamless Cylinder Bracket | |

Figure 2.3.: General Arrangement of Assembly of 8L & 13.4L System

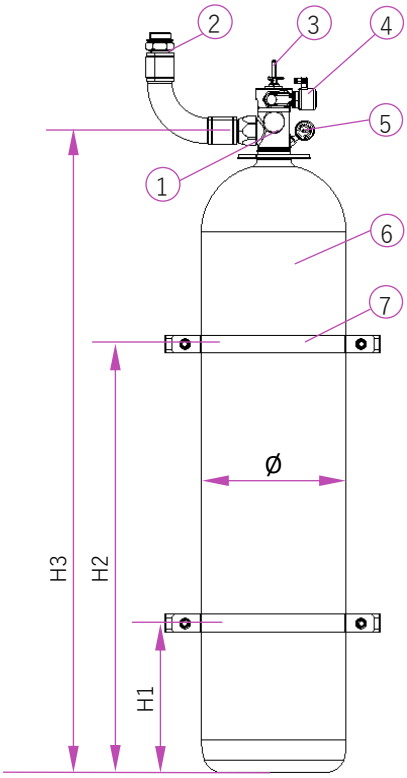
| Table 2.4. Dimensions for 8L & 13.4L Cylinders | | | | |
|---|---|---|---|---|
| **Type** | **H1 (mm)** | **H2 (mm)** | **H3 (mm)** | **Ø (mm)** |
| 8L | 400-500 | 670 | 890 | 140 |
| 13.4L | 700-800 | 1070 | 1290 | 140 |




| Table 2.5. Hardware for 26.8, 40, 67, 80, 120L Cylinders | | |
|---|---|---|
| **No.** | **Description** | **Part Number** |
| 1 | DN33 Discharge Valve | HSN-VLV-H-2-33 |
| 2 | Discharge Hose DN33, L:400mm | HSN-DH-33-400 |
| 3 | Manual Actuator | HSN-ACT-M01 |
| 4 | Solenoid Actuator, 24V DC | HSN-ACT-S03 |
| 5.1 | Ø50mm contacted pressure gauge 38bar NO | HSN-PGV-NOC-3880 |
| 5.2 | Ø50mm contacted pressure gauge 38bar NC | HSN-PGV-NCC-3880 |
| 5.3 | 26.8L Seamless TPED Cylinder Set | HSN-HF-US-SM-026-1 |
| 6.1 | 40L Seamless TPED Cylinder Set | HSN-HF-US-SM-040-1 |
| 6.2 | 67L Seamless TPED Cylinder Set | HSN-HF-US-SM-067-1 |
| 6.3 | 80L Seamless TPED Cylinder Set | HSN-HF-US-SM-080-1 |
| 6.4 | 120L Seamless TPED Cylinder Set | HSN-HF-US-SM-120-1 |
| 7.1 | 26.8L Seamless Cylinder Bracket | HSN-BRC-232 |
| 7.2 | 40L Seamless Cylinder Bracket | |
| 7.3 | 67L Seamless Cylinder Bracket | HSN-BRC-267 |
| 7.4 | 80L Seamless Cylinder Bracket | |
| 7.5 | 120L Seamless Cylinder Bracket | HSN-BRC-356 |

Figure 2.4.: General Arrangement of Assembly of 26.8L, 40L, 67L, 80L, 120L System

| Table 2.6. Dimensions for 26, 40, 67, 80, &120L Cylinders | | | | |
|---|---|---|---|---|
| **Type** | **H1 (mm)** | **H2 (mm)** | **H3 (mm)** | **Ø (mm)** |
| 26L | N/A | 650 | 900 | 219 |
| 40L | N/A | 865 | 1330 | 219 |
| 67L | 400 | 1140 | 1490 | 267 |
| 80L | 400 | 1390 | 1740 | 267 |
| 120L | 400 | 1170 | 1520 | 356 |



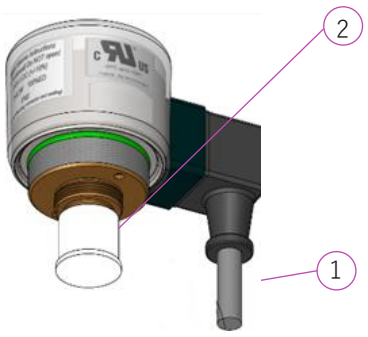

| Table 2.7. Hardware for 180L Cylinder | | |
|---|---|---|
| **No.** | **Description** | **Part Number** |
| 1 | DN50 Discharge Valve | HSN-VLV-H-2-50 |
| 2 | Discharge Hose DN50, L:400mm | HSN-DH-50-400 |
| 3 | Manual Actuator | HSN-ACT-M01 |
| 4 | Solenoid Actuator, 24V DC | HSN-ACT-S03 |
| 5.1 | Ø50mm contacted pressure gauge 38bar NO | HSN-PGV-NOC-3880 |
| 5.2 | Ø50mm contacted pressure gauge 38bar NC | HSN-PGV-NCC-3880 |
| 6.1 | 180L Seamless TPED Cylinder Set | HSN-HF-US-SM-180-1 |
| 6.2 | 220L Seamless TPED Cylinder Set | HSN-HF-US-SM-220-1 |
| 7.1 | 180L Seamless Cylinder Bracket | HSN-BRC-406 |
| 7.2 | 220L Seamless Cylinder Bracket | |

Figure 2.5.: General Arrangement of Assembly of 180L & 220L System

| Table 2.8. Dimensions for 180L & 220L Cylinders | | | | |
|---|---|---|---|---|
| **Type** | **H1 (mm)** | **H2 (mm)** | **H3 (mm)** | **Ø (mm)** |
| 180L | 500 | 1350 | 1700 | 406 |
| 220L | 600 | 1600 | 2040 | 406 |

## 2.2.3. Solenoid Actuator (P/N: HSN-ACT-S03)

The Solenoid Actuator attaches to the primary cylinder at the valve actuation connection and is utilized to automatically open the cylinder valve upon receipt of a signal from the control panel or other source.




| Table 2.9. Solenoid Actuator | |
|---|---|
| **No.** | **Description** |
| 1 | Connector plug for wiring |
| 2 | Connection to cylinder valve |

Figure 2.6.: Solenoid actuator

**Materials:**

Body, screws, cap nuts, seals: Brass, stainless steel, nickel-plated steel, elastomeric seals, plastic

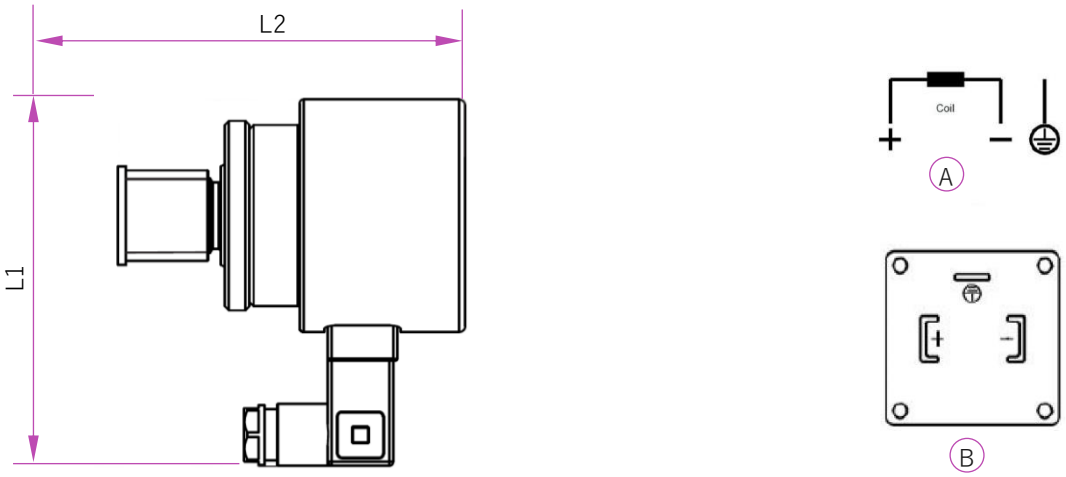



Figure 2.7.: Solenoid actuator features

| Table 2.10. Solenoid Actuator Features | |
|---|---|
| L1 | 89mm |
| L2 | 85mm |
| A | Solenoid circuit |
| B | Male connector plug socket DIN EN 175301-803 Form A |

***IMPORTANT NOTICE:***

The solenoid actuator shall be installed during the commissioning phase only so to avoid incorrect manipulation and possible accidental activation of the system, which would discharge the agent. This type of solenoid actuator does not need to be reset by a special tool. The solenoid actuator will be automatic reset when 24V DC energy is off.

| Table 2.11. Electrical Data of Solenoid Actuator | |
|---|---|
| Voltage | 24 VDC (+/-10%) |
| Temperature range | -20 ºC to +50 ºC |
| Max. current at union and RT | 0.4 A |
| Power consumption at union and RT | 9.5 W |
| Duty cycle | 100% ED |
| Class of insulation | F |
| Protection class (DIN 40050) | IP 65 (With assembled cable connector and attached sealing) |

***IMPORTANT NOTICE:***

Be sure that the threaded ring is screwed into the end stop, before assembling the actuator.

Hand-tight, without any additional tool. While tightening the solenoid actuator to valve, don't use the nickel-plated surface, only use brass knurled surface. (refer to Figure 2.9.)

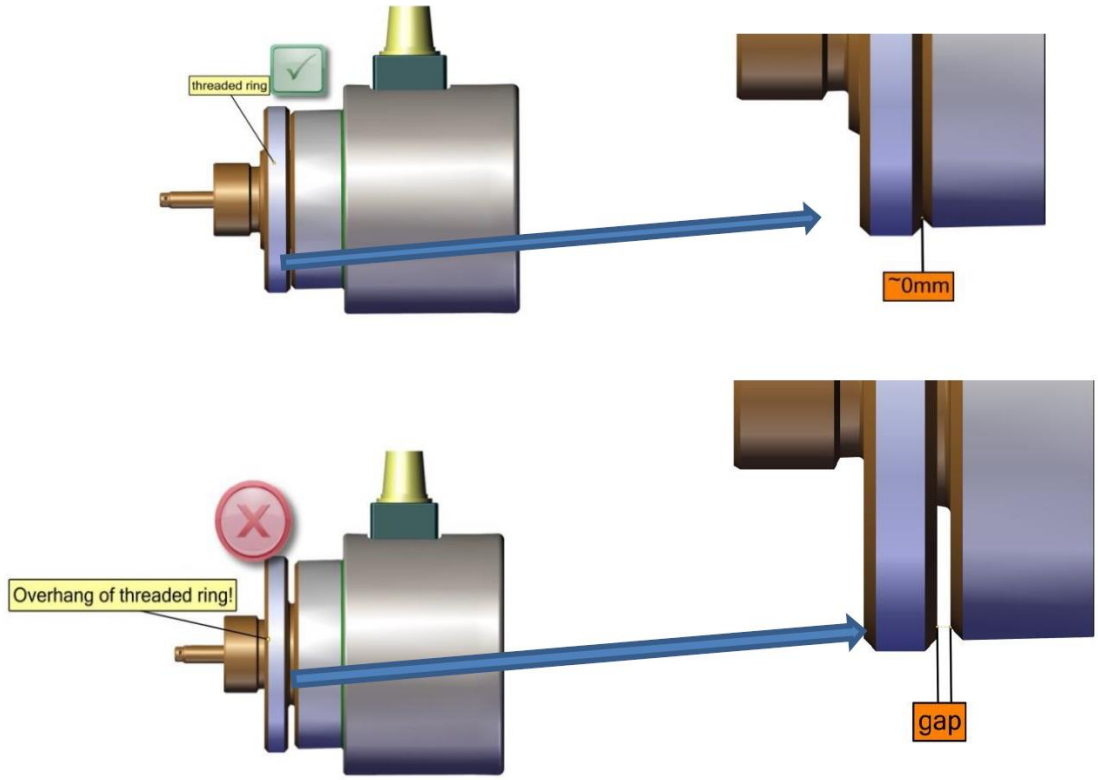



Figure 2.8.: Solenoid actuator assembling

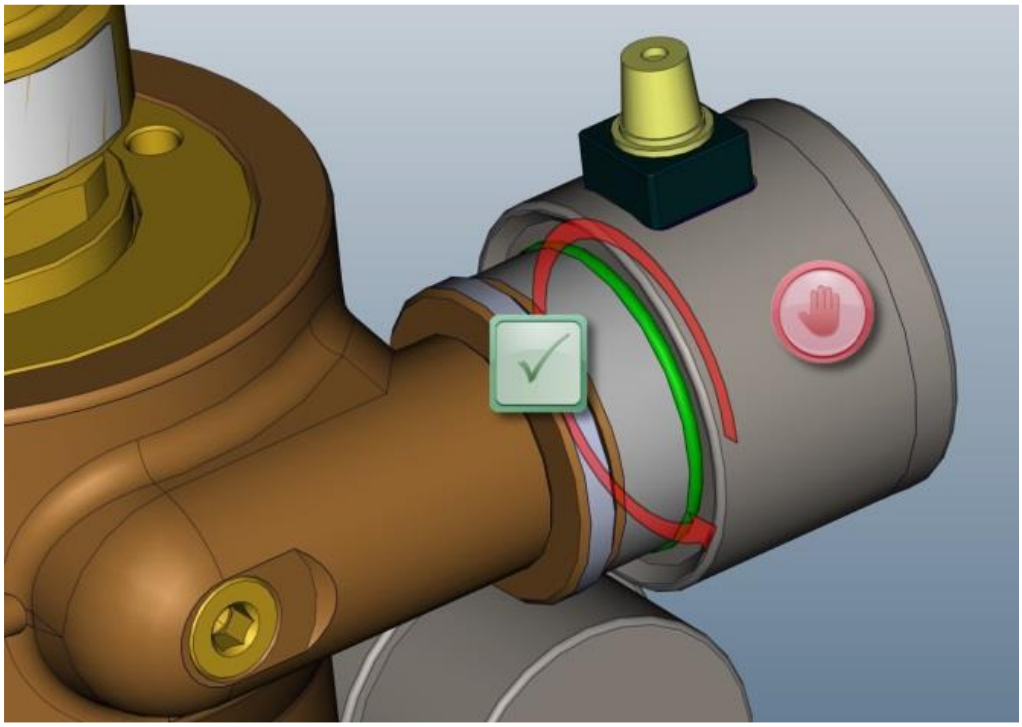
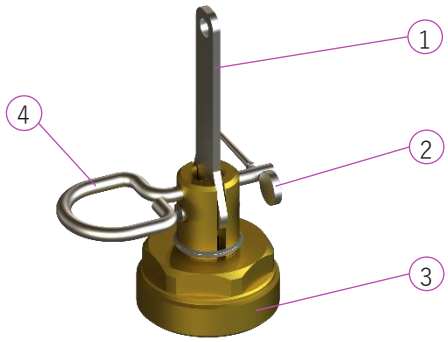


Figure 2.9.: Solenoid actuator tightening

## 2.2.4. Manual Actuator for DN33&DN50 Valves (P/N: HSN-ACT-M01)

The manual actuator allows manual activation of the cylinder valve. It is compulsory to always include such an actuator. Located on top of the cylinder valve or solenoid valve, the lever is manually operated to open the valve and activate the system. It includes a safety pin to prevent accidental activation, and this safety pin incorporates a safety seal to avoid incorrect manipulation.

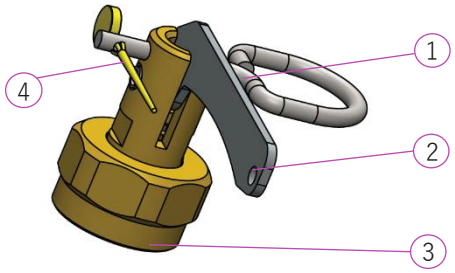



| Table 2.12. Manual Actuator for DN33&DN50 Valves | |
|---|---|
| **No.** | **Description** |
| 1 | Lever |
| 2 | Safety lock |
| 3 | Connection to cylinder valve or solenoid actuator |
| 4 | Safety pin |

Figure 2.10.: Manual actuator for DN33 & DN50 valves

## 2.2.5. Manual Actuator for DN12 Solenoid Valve (P/N: HSN-ACT-M02)

The manual actuator allows manual activation of the cylinder solenoid valve. It is compulsory to always include such an actuator. Located on the cylinder solenoid valve, the lever is manually operated to open the valve and activate the system. It includes a safety pin to prevent accidental activation, and this safety pin incorporates a safety seal to avoid incorrect manipulation.




| Table 2.13. Manual Actuator for DN12 Solenoid Valve | |
|---|---|
| **No.** | **Description** |
| 1 | Safety pin |
| 2 | Lever |
| 3 | Connection to cylinder solenoid valve |
| 4 | Safety lock |

Figure 2.11.: Manual actuator for DN12 solenoid valve

***IMPORTANT NOTICE:***

This manual actuator (HSN-ACT-M02) is only suitable with DN12 solenoid (integrated) discharge valve.

## 2.2.6. Pneumatic Actuator (P/N: HSN-ACT-P01)

On multiple cylinder systems, the Solenoid Actuator will actuate the master (primary) cylinder and then, in a rapidly occurring sequence, the pneumatic actuator will actuate all other slave cylinders valve, using pressure of the master (primary) cylinder.

A pneumatic actuator attaches to the valve actuation connection of each slave cylinder. It receives pressure from the actuation port of the master (primary) cylinder through the pilot actuation hose. The body of the pneumatic actuator is made from brass and an internal mechanism consists of brass piston and pin.

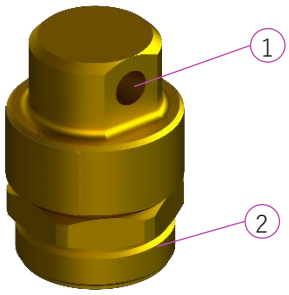
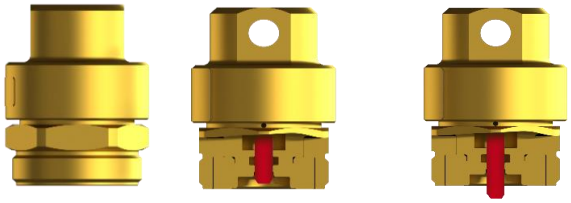



Figure 2.12.: Pneumatic actuator

| Table 2.14. Pneumatic Actuator | |
|---|---|
| **No.** | **Description** |
| 1 | Pilot actuation hose connection |
| 2 | Connection to cylinder valve |




***IMPORTANT NOTICE:***

After the pneumatic actuator is activated, the pin will fall downwards. The falling pin must be reset by pushing up as before activation. Otherwise, if the pneumatic actuator assembly to top on valve with falling pin, the system will discharge incorrectly.

Figure 2.13.: Pneumatic actuator activation before vs after

## 2.2.7. Discharge Hoses and Adaptors

The discharge hose is used to connect the cylinder valve to the manifold so to direct the agent flow to the pipe network. It is installed between the cylinder valve and the check valve. In the case of a modular cylinder, it is installed directly to the discharge pipe.

***IMPORTANT NOTICE:***

It is recommended to replace the discharge hoses after a maximum period of use of 8 years.
The minimum permissible bending radius must not be undercut.
Minimum bending radius R 100mm.

### 2.2.7.1. Discharge hose for DN12 valve (P/N: HSN-DH-12-400)

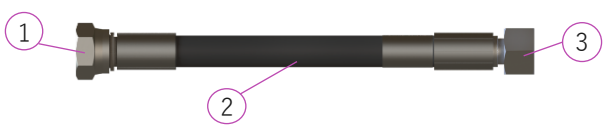



Figure 2.14.: Discharge hose for DN12 valve

| Table 2.15. Discharge Hose for DN12 Valve | |
|---|---|
| **No.** | **Description** |
| 1 | Swivel female W21,8 x 1/14” |
| 2 | Flexible hose, DN12, L: 400mm |
| 3 | Swivel female G3/4” |

| Table 2.16. Features of Discharge Hose for DN12 Valve | |
|---|---|
| Working pressure PS | Max. 360 bar inlet pressure |
| Inlet thread | W21,8 x 1/14” |
| Outlet thread | BSP 3/4" |
| Length | 400 mm |
| Temperature range | -20°C up to +50°C |
| Material hose | Synthetic rubber |
| Screwing materials | Coated steel |

### 2.2.7.2. Discharge hose for DN33 valve (P/N: HSN-DH-33-400)

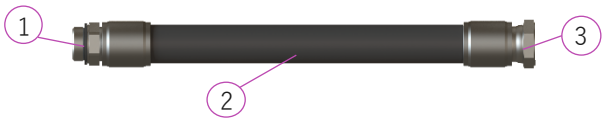
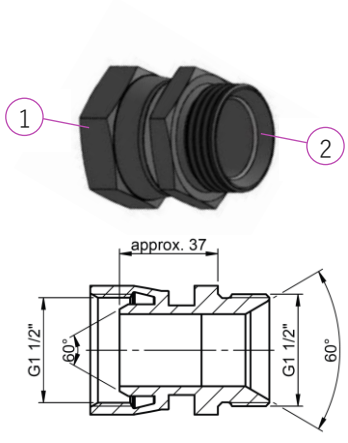



Figure 2.15.: Discharge hose for DN33 valve

| Table 2.17. Discharge Hose for DN33 Valve | |
|---|---|
| **No.** | **Description** |
| 1 | Outlet G1 1/2" male thread (rigid) |
| 2 | Flexible hose, DN38, L: 400mm |
| 3 | Inlet 1 7/8" 12UN swivel female |

| Table 2.18. Features of Discharge Hose for DN33 Valve | |
|---|---|
| Working pressure PS | Max. 70bar inlet pressure |
| Inlet thread | 1 7/8” – 12UN |
| Outlet thread | Male thread BSP – G 1 ½” |
| Length | 400 mm |
| Temperature range | -20°C up to +50°C |
| Material hose | Synthetic rubber |
| Screwing materials | Coated steel |

### 2.2.7.3. Discharge hose adaptor for DN33 valve (P/N: HSN-DHA-33-001)




| Table 2.19. Hose Adaptor for DN33 Valve | |
|---|---|
| **No.** | **Description** |
| 1 | Inlet G1 1/2" swivel female |
| 2 | Outlet G1 1/2" male thread (rigid) |

Figure 2.16.: Discharge hose adaptor for DN33 valve

### 2.2.7.4. Discharge hose for DN50 valve (P/N: HSN-DH-50-400)

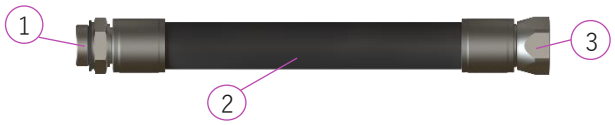



Figure 2.17.: Discharge hose for DN50 valve

| Table 2.20. Discharge Hose for DN50 Valve | |
|---|---|
| **No.** | **Description** |
| 1 | Outlet G11/2" male thread (rigid) |
| 2 | Flexible hose, DN50, L: 400mm |
| 3 | Inlet 21/2" 12UN swivel female |

| Table 2.21. Features of Discharge Hose for DN50 Valve | |
|---|---|
| Working pressure PS | Max. 70bar inlet pressure |
| Inlet thread | 2,5” – 12UN |
| Outlet thread | Male thread BSP – G2 ” |
| Length | 400 mm |
| Temperature range | -20°C up to +50°C |
| Material hose | Synthetic rubber |
| Screwing materials | Coated steel |

### 2.2.7.5. Discharge hose adaptor for DN50 valve (P/N: HSN-DHA-50-001)

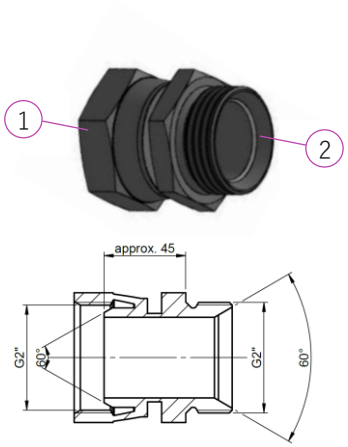



Figure 2.18.: Discharge hose adaptor for DN50 valve

| Table 2.22. Hose Adaptor for DN50 Valve | |
|---|---|
| **No.** | **Description** |
| 1 | Inlet G2" swivel female |
| 2 | Outlet G2" male thread (rigid) |

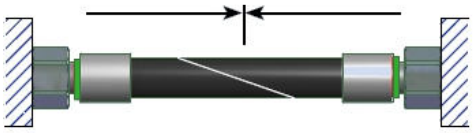
***IMPORTANT NOTICE:***

When using discharge hoses, discharge hose adaptors HSN-DHA-33-001 and HSN-DHA-50-001 must be used to ensure the possibility of orientation of the hose while connecting to check valves. This is requirement for only multiple cylinder arrangements which are including check valves. This is not necessary for single cylinder arrangements.

**Example of installation for Discharge Hoses**

**Inccorrect application**

Pressure and torsion load



**Correct application**

Tensile stress



**Inccorrect application**

Bent installation



**Correct application**

Bent installation



Figure 2.19.: Discharge line hose example of installation

## 2.2.8. Pilot Line Hose (P/N: HSN-PLH-01-500)

The Pilot Line Hose is a flexible connection in the release circuit to activate the valves pneumatically. It is installed between the pilot line connection from the Master cylinder valve to the pneumatic actuators and/or pneumatic-manual actuator on the slave cylinders.




Figure 2.20.: Pilot line hose

| Table 2.23. Pilot Line Hose | |
|---|---|
| **No.** | **Description** |
| 1 | Swivel female M12x1.5 |
| 2 | Flexible hose, DN5, L: 500mm |
| 3 | Swivel female M12x1.5 |

***IMPORTANT NOTICE:***

It is recommended to replace the pilot lines after a maximum period of use of 8 years.

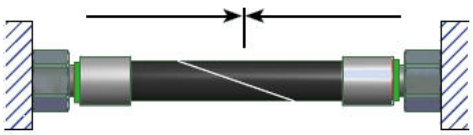
The minimum permissible bending radius must not be undercut. Minimum bending radius R 30mm.

| Table 2.24. Features of Pilot Hose | |
|---|---|
| Nominal width | DN5 |
| Connection type | Connection type |
| Temperature range TS | -20°C to +50°C |
| Working pressure PS | Max. 360 bar inlet pressure |
| Materials | Polyurethan, polyester, plastic, steel galvanized or zinc-nickel coated<br>Type: SAE100 R1 TP1<br>Pressure absorber: Braiding of brass-coated, high strength steel wires<br>Inner liner: Seamless extruded polyester-tube (PEL)<br>Outer liner: Polyurethane, black |
| Mounting torque at the outlet thread | The reference value for the mounting torque is max. 8Nm<br>The correct torque can differ from the reference value and is subjected to the responsibility of the operator. |

**Example of installation for Pilot Hose**

**Inccorrect application**

Pressure and torsion load



**Correct application**

Tensile stress



**Inccorrect application**

Bent installation



**Correct application**

Bent installation



Figure 2.21.: Pilot line hose example of installation

## 2.2.9. Pilot Line Nipple Adaptor (P/N: HSN-PNA-01)

The Pilot Line Nipple Adaptor is a flexible connection in the release circuit to activate the valves pneumatically. It is installed between the pilot line connection from the Master cylinder valve to the pneumatic actuators and/or pneumatic-manual actuator on the slave cylinders. The Pilot Line Nipple Adaptor available working pressure is 360bar.

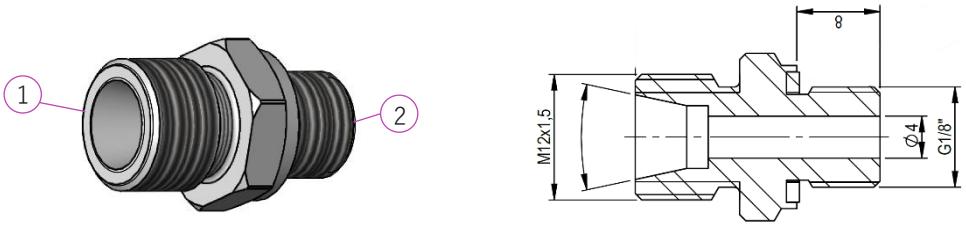



Figure 2.22.: Pilot line nipple adaptor

| Table 2.25. Pilot Line Nipple Adaptor | |
|---|---|
| **No.** | **Description** |
| 1 | M12 x 1.5 male threaded connection (connect to pilot hose) |
| 2 | G1/8" male threaded connection (connect to release device) |

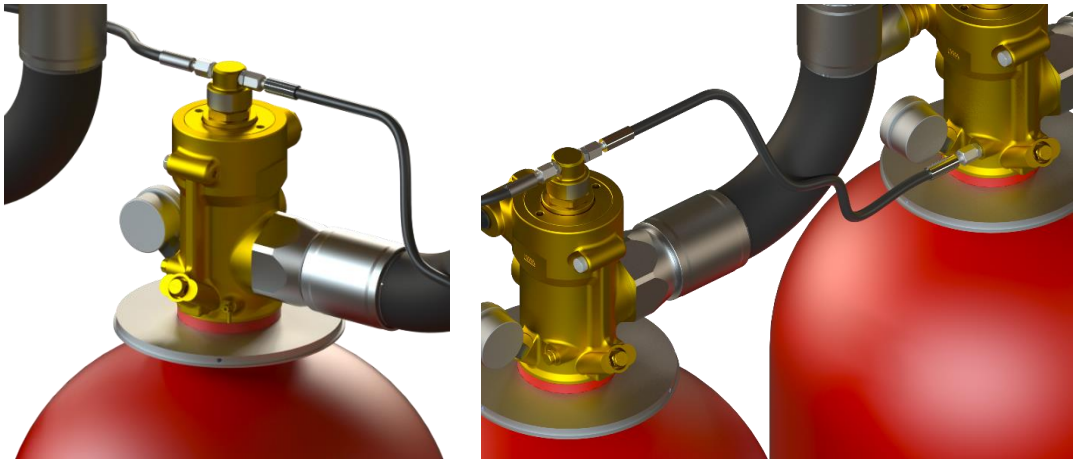


Figure 2.23.: Pilot line nipple adaptor connection

## 2.2.10. Bleed Valve (P/N: HSN-BLD-01)

The Bleed Valve vents pressure or releases small leaking gas from pilot line to protect the system from fault actuation when one or more cylinder leak gas into the pilot actuation line.

Pw max 360bar and Reseating Volume Flow ~30l/min.

Reseating Pressure 0,5bar (Static) / ~ 0,7bar (Dynamic)




Figure 2.24.: Bleed Valve

| Table 2.26. Bleed Valve | |
|---|---|
| **No.** | **Description** |
| 1 | G1/8" male threaded connection |

The bleed valve is a venting valve, which is in the "open" position in the unpressurized state and allows creeping gas to escape into the atmosphere. If the fire extinguishing system is switched off, the bleed valve will close to the atmosphere. If the control line is deaerated and thus pressure less, the bleed valve opens independently.

It is visually visible whether the bleed valve is open or closed. If the bleed valve is closed, the pin is visible in the recess.

***IMPORTANT NOTICE:***

When assembling the bleed valve into the control circuit of a fire extinguishing system, it is important to ensure that the recess is free, that means the bleed valve is open. Otherwise, the pressure in case of any leaks occurring at the bottle valve of the pilot bottle cannot be adequately dissipated and the function of the bleed valve is thus not present.

If the bleed valve is open, the recess is free. (See Figure 2.22.: Position of Bleed Valve)

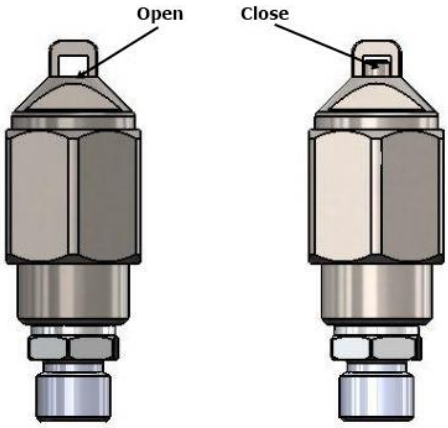
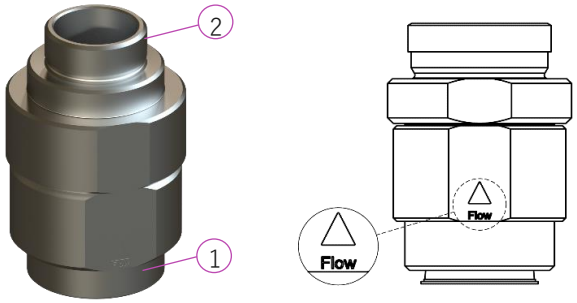



Figure 2.25.: Position of Bleed Valve

## 2.2.11. Check Valves

Check Valves are installed at the discharge manifold in a multiple cylinder arrangement to allow removal of any HFC-227ea cylinder from the manifold while still retaining a closed system. Check valves are used only in banks of cylinders. It prevents the gas backflowing from the manifold pipe into the cylinders, thus ensuring a complete discharge of all the cylinders. It also acts as a safety element during maintenance operations, in case cylinders are disconnected from the manifold and an accidental discharge is produced it prevents the gas from being released and injuring personnel.




***IMPORTANT NOTICE:***

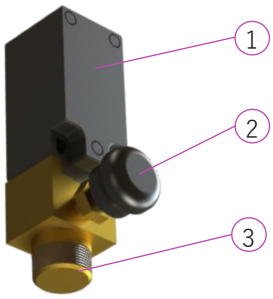
Make sure that check valve flow direction is showing right position. To be sure about that, follow the flow direction arrow; it must be assembled while arrow showed the flow direction from downward to upward.

Figure 2.26.: Check valves

| Table 2.27. Check Valves | | | |
|---|---|---|---|
| **Description** | **Part Number** | **1** | **2** |
| DN33 Check Valve | HSN-CHV-033 | G11/2" BSP Female Inlet | G2" BSP Male Outlet |
| DN50 Check Valve | HSN-CHV-050 | G2" BSP Female Inlet | G2" BSP Male Outlet |

## 2.2.12. Discharge Pressure Switch (P/N: HSN-DPS-01)

Discharge Pressure Switch closes or opens an electric circuit when a discharge from the manifold takes place. Notifying gas flow has occurred. The electric signal may be monitored by a control panel to operate and/or shut down other electrical devices. Once activated it is rearmed manually by pulling the rearming button which incorporates the latching mechanism. This switch can be mounted in any position though the preferred installation is upright. Wiring diagram for connection of switch is shown in below figure.




| Table 2.28. Discharge Pressure Switch | |
|---|---|
| **No.** | **Description** |
| 1 | Electrical switch body |
| 2 | Reset button |
| 3 | Connection to manifold, G1/2" male thread |

Figure 2.27.: Discharge pressure switch

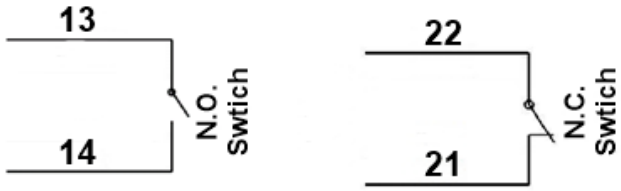



Figure 2.28.: Wiring diagram for discharge pressure switch

| Table 2.29. Electrical Data of Discharge Pressure Switch | |
|---|---|
| Max voltage | 400V AC/DC |
| Temperature range | -20 ºC to +60 ºC |
| Thermal current | 10 A |
| Conditional short circuit current | 100 A acc. to EN 60947-5-1 |
| Protection against short circuits | Type aM fuse 10 A 500 V |
| Protection degree | IP 67 acc. to EN 60529 (With cable gland presenting same or higher protection degree) |

***IMPORTANT NOTICE:***

While installation of the Discharge Pressure Switch, gas leakage must be prevented from the connection point. Discharge Pressure Switch maximum working pressure is 360 bar. Discharge Pressure Switch body material are brass, nickel-plated steel, elastomeric seals and plastic.

## 2.2.13. Monitoring & Releasing Circuit Control Devices

### 2.2.13.1. Releasing circuit control (monitoring) device (P/N: HSN-MDS-02)

To meet NFPA 2001 monitoring requirements, a supervised disconnect switch shall be provided and the disconnect switch shall cause a supervisory signal to be announced on the operator interface required for the release service fire alarm control panel (See diagram below for connection details). The disconnect switch and fire alarm control panel shall be compatible with each other. Both devices shall be UL listed.




**Operation**

The green LED indicates in the **normal** condition and the release circuit is enabled

The amber LED indicates that the release circuit is **disabled**.

**Installation**

1. Connect the red and black leads to the 24 VDC auxiliary power terminals on the release panel. Be certain to observe polarity.
2. Connect the yellow wires to the supervisory zone on the panel.

Figure 2.31.: Releasing circuit control device

Electrically operated release devices (actuators, solenoids, etc.) that activate the system must not be removed from the valve during installation and maintenance of the system. The valve body and electrically operated release devices will be fixed with special adhesive that protects the threaded connection against mechanical disassembly during initial assembly.

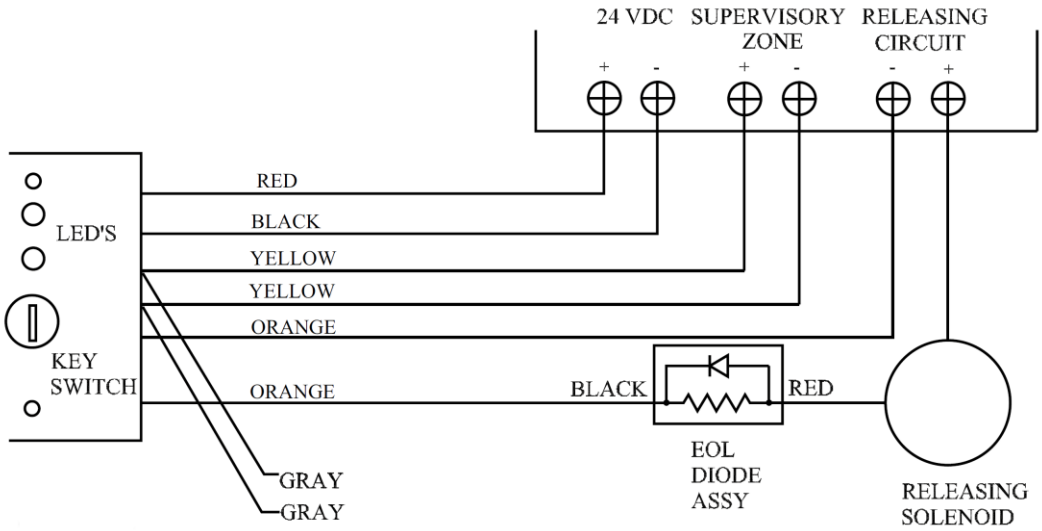



Figure 2.32.: Wiring diagram for release circuit control (monitoring) device

| Table 2.30. Releasing Circuit Control Device Technical Specifications | |
|---|---|
| Dimensions | 70mm (W) x 115mm (H) x 50mm (D) (Approximate)<br>Mounts on single gang or handy box |
| Contact Rating | 1 Amp @ 40 VDC |
| Power Requirements | 24 VDC, 10mA |
| Environmental Specifications | Indoor use only<br>Temperature range -30°C to 60°C |

***IMPORTANT NOTICE:***

The connection for the supervisory circuit has 4 wires: 2 yellow and 2 gray. The 2 yellow wires are for connection to the supervisory circuit. The 2 gray wires are for connection to additional supervisory devices or the EOLR for the supervisory zone.

## 2.2.14. Pressure Gauges

A pressure gauge is provided with each cylinder valve to indicate the pressure inside the cylinder. Its electrical contact allows real time monitoring notifying in case of leaks.

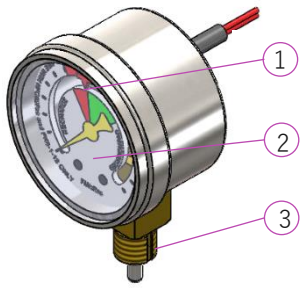


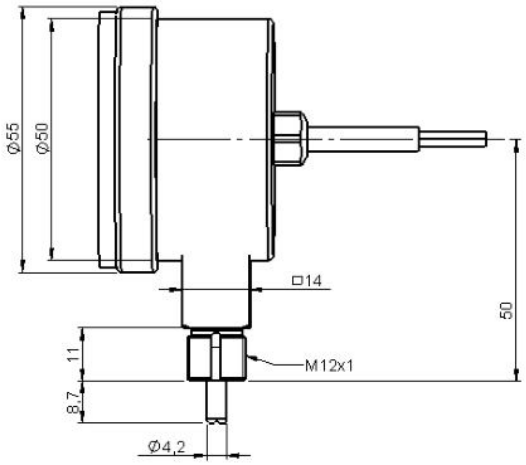

Figure 2.33.: Pressure gauge

| Table 2.31. Pressure Gauges | |
|---|---|
| **No.** | **Description** |
| 1 | Contacted point indicator |
| 2 | Gauge display screen |
| 3 | Connection to cylinder valve |

***IMPORTANT NOTICE:***

- Use only pressure gauges supplied by Honeywell.
- The pressure gauges can be assembled and disassembled under pressure.
- Before mounting the pressure gauge, the plug screw at the pressure gauge connection on the valve shall be unscrewed. When dismounting the pressure gauge the plug screw shall be screwed back in place.

| Table 2.32. Available Types of Pressure Gauges | | |
|---|---|---|
| **Description** | **Part Number** | **Contacted Switch** |
| 0-80 Bar Pressure gauge with low pressure switch *Available for 42bar storage system | HSN-PGV-NOC-3880 | Gives NO contact at 38bar |
| 0-80 Bar Pressure gauge with low pressure switch *Available for 42bar storage system | HSN-PGV-NCC-3880 | Gives NC contact at 38bar |




***IMPORTANT NOTICE:***

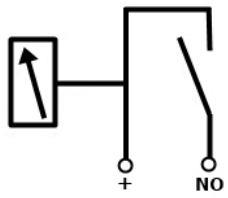
- Switch point tolerances: 2,5% (full scale value)
- Accuracy class: 1,6
- Nominal size: 50mm
- Operating temperature range: -20°C to +55°C

Figure 2.34.: Dimensions of pressure gauge

| Table 2.33. Features of Pressure Gauges | |
|---|---|
| Connection | M12x1 thread, brass, radial |
| Case | Stainless steel |
| Pressure element | Copper alloy |
| Movement | Copper alloy |
| Dial | Aluminum white |
| Pointer | Yellow plastic |
| Window | Polycarbonate |

The contact type shown on the pressure gauge have to be regarded;

**status of switch at minimum scale value:**

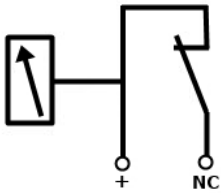



Pressure below switching point = contact is **open**

Pressure above switching point = contact is **closed**

**Normally Opened**

**status of switch at minimum scale value:**




Pressure below switching point = contact is **closed**

Pressure above switching point = contact is **open**

**Normally Closed**

Figure 2.34.: Wiring diagram for pressure gauge

| Table 2.34. Electrical Data of Pressure Gauges | |
|---|---|
| Switching voltage | 4.5 ... 24 V DC/AC |
| Switching current | 5 ... 100 mA |
| Contact load | max. 2.4 W |
| Permissible temperature | -20 ºC to +60 ºC |
| Cable | 2-core (red/black) 1m length; PVC coated |
| Ingress protection | Indoor, dry environment |

***IMPORTANT NOTICE:***

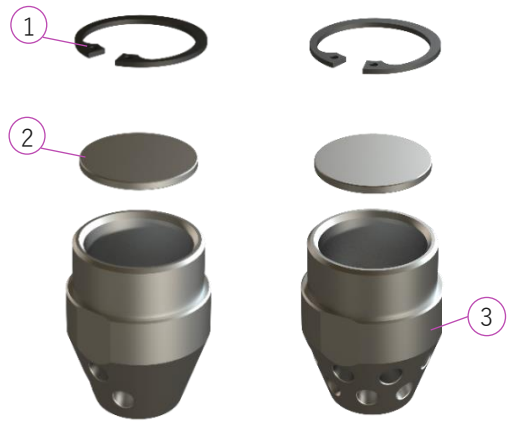
- Pressure gauges must be included to the potential equalization of the whole plant
- Pressure gauges must be protected against strong electromagnetic fields

## 2.2.15. Discharge Nozzles

Discharge nozzles are used to uniformly distribute the HFC-227ea clean agent. They are performance tested to ensure that the agent is discharged within 6-10 seconds and properly dispersed throughout the protected area.

HFC-227ea clean agent is distributed within the protected area by the discharge nozzle which is sized to ensure the correct flow of agent for the risk. Nozzles are available with 180º and 360º discharge patterns. The 180º nozzle is engineered to provide 180º discharge pattern for sidewall applications. The 360º nozzle offers a full 360º discharge pattern for installations where nozzles are located in the center of the hazard. Nozzles are supplied as standard in brass with BSPT female thread. The agent flow is controlled by a calibrated diaphragm disc inside the nozzle body,

determined by the results from The Honeywell HFC-227ea Flow Calculation 7.8.0 Software. It guarantees a homogenous gas distribution throughout the volume.




| Table 2.35. Discharge Nozzle Parts | |
|---|---|
| **No.** | **Description** |
| 1 | Circlip for Diaphragm Disc Assembly |
| 2 | Diaphragm Disc |
| 3 | 180/360 Degree Nozzle |

Figure 2.35.: Discharge nozzles 180 degree & 360 degree

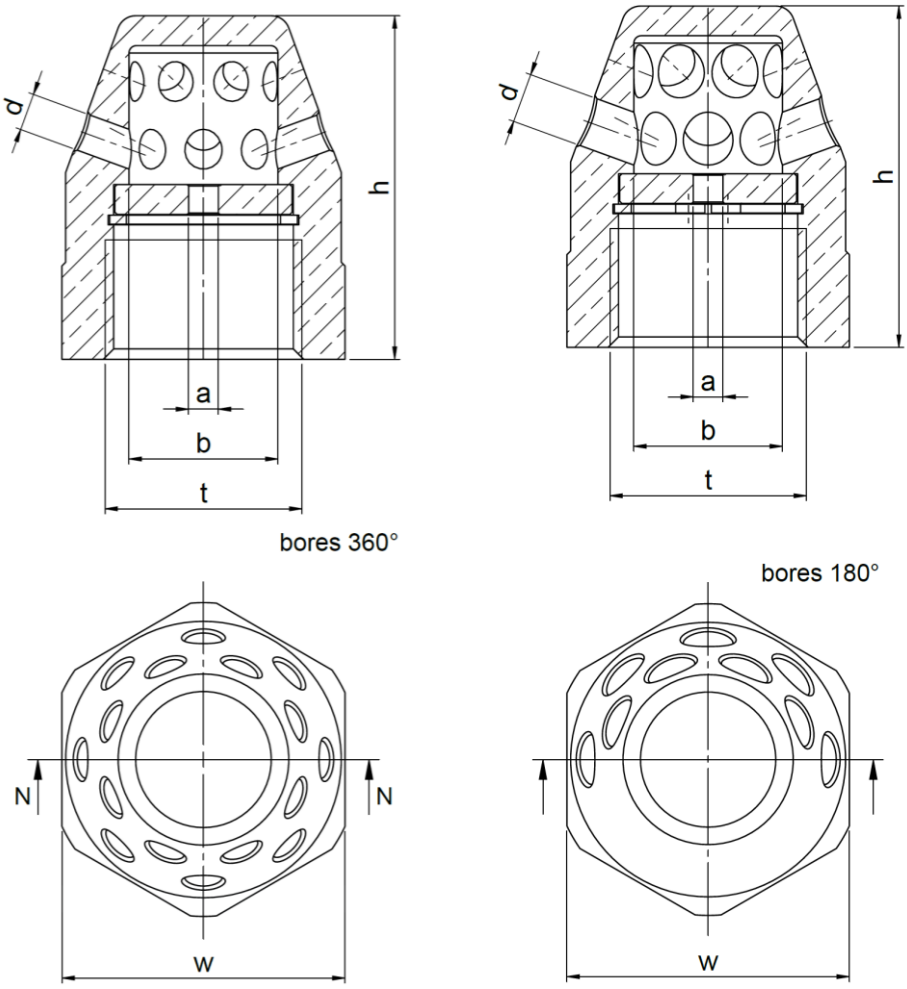



Figure 2.36.: Discharge nozzles dimensions for 180 & 360 degree

| Table 2.36. Discharge Nozzles | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Part Number | Nozzle Size | | Orifice Holes (d) | Type | Orifice Diameters (a) | | Dimensions | |
| | mm (b) | in. (t) | | | Min. ø (mm) | Max. ø (mm) | h (mm) | W (mm) |
| HSN-NOZ-01-15 | 15 | 1/2" | 5 x ø 6,7 | 180° | 5.2 | 10.9 | 36 | 30 |
| HSN-NOZ-01-20 | 20 | 3/4" | 9 x ø 6,7 | | 9.5 | 14.5 | 46 | 38 |
| HSN-NOZ-01-25 | 25 | 1″ | 9 x ø 8,4 | | 12.0 | 18.0 | 55 | 45 |
| HSN-NOZ-01-32 | 32 | 1 1/4" | 9 x ø 10,7 | | 15.5 | 23.7 | 64 | 50 |
| HSN-NOZ-01-40 | 40 | 1 1/2" | 14 x ø 10,7 | | 18.5 | 27.7 | 77 | 60 |
| HSN-NOZ-01-50 | 50 | 2″ | 14 x ø 13,4 | | 23.5 | 35.6 | 94 | 80 |
| HSN-NOZ-02-15 | 15 | 1/2" | 8 x ø 5,4 | 360° | 5.2 | 10.9 | 36 | 30 |
| HSN-NOZ-02-20 | 20 | 3/4" | 16 x ø 5,0 | | 9.5 | 14.5 | 46 | 38 |
| HSN-NOZ-02-25 | 25 | 1″ | 16 x ø 6,3 | | 12.0 | 18.0 | 55 | 45 |
| HSN-NOZ-02-32 | 32 | 1 1/4" | 16 x ø 8,0 | | 15.5 | 23.7 | 64 | 50 |
| HSN-NOZ-02-40 | 40 | 1 1/2" | 24 x ø 8,2 | | 18.5 | 27.7 | 77 | 60 |
| HSN-NOZ-02-50 | 50 | 2″ | 24 x ø 10,2 | | 23.5 | 35.6 | 94 | 80 |

The required orifice diameter must be determined by Honeywell HFC-227ea Flow Calculation 7.8.0 Software and drilled out to the calculated orifice size.

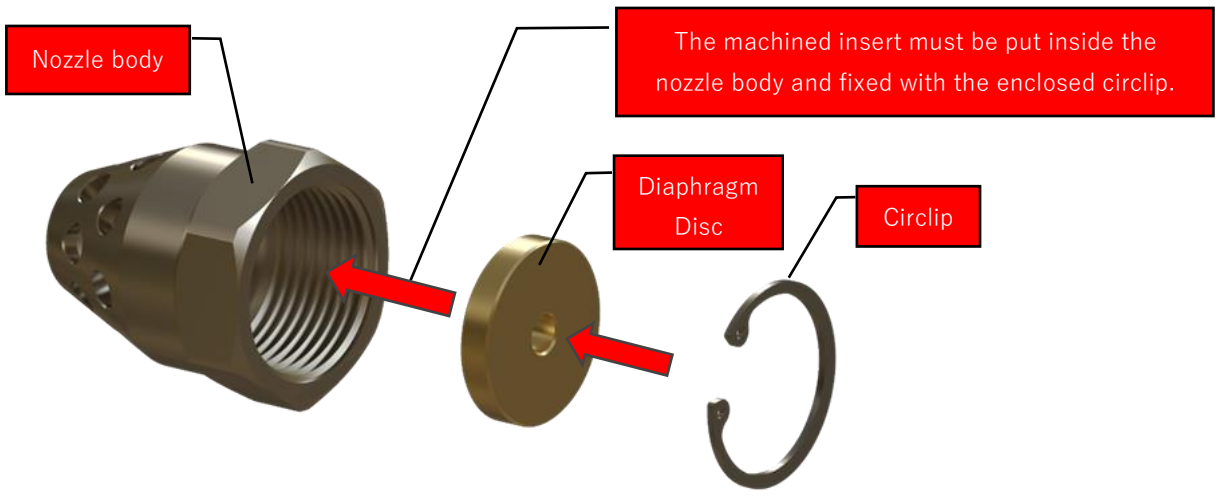



Figure 2.37.: Parts of the nozzle

➡ The Diaphragm Disc must be drilled out to the required cross-section (as described above). Afterwards the drilling must be deburred (consider the specifications below).




Figure 2.38.: Nozzle drilling details

**Nozzles are consisting below materials;**

Nozzle body: Nickel-plated brass

Diaphragm disc: Brass

Circlip: Stainless steel

## 2.2.16. Label (P/N: HSN-LBL-H1)

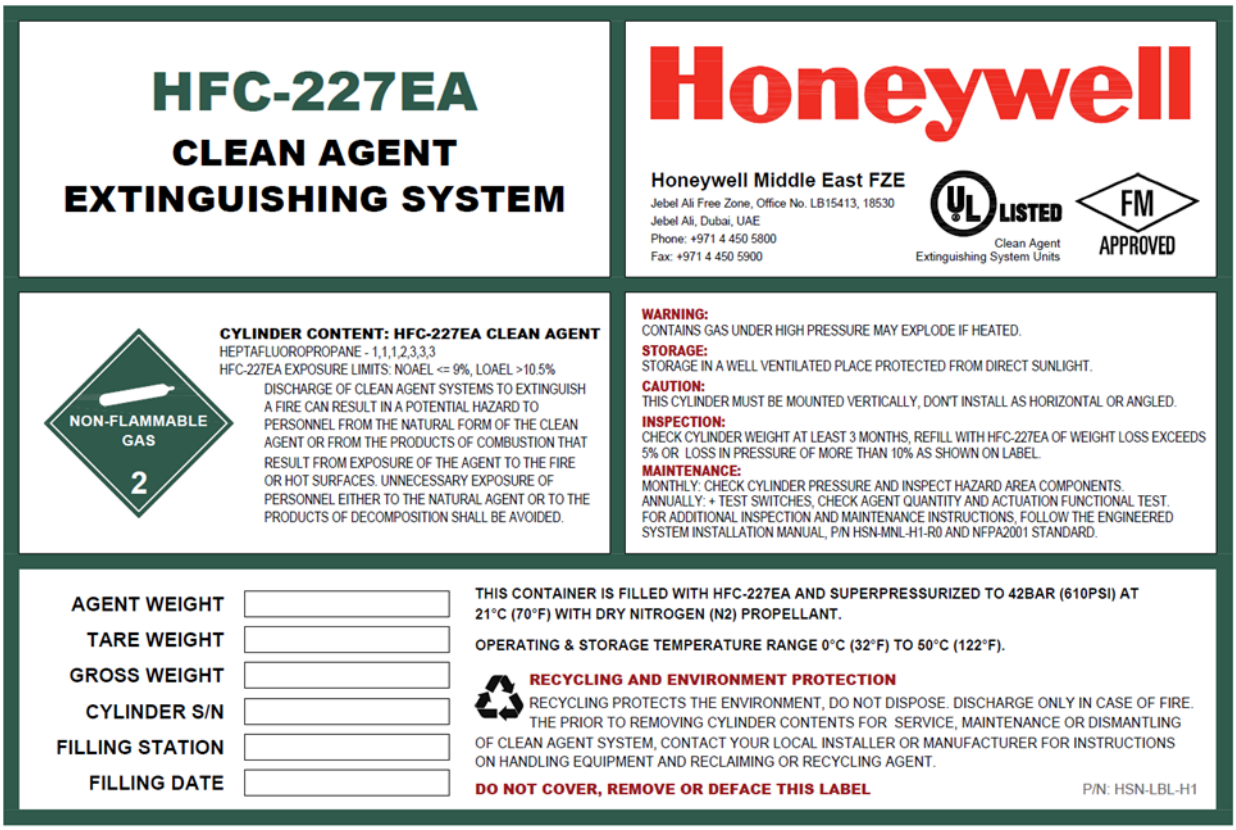



Figure 2.39.: Label for HFC-227ea

## 2.2.17. Caution Signs

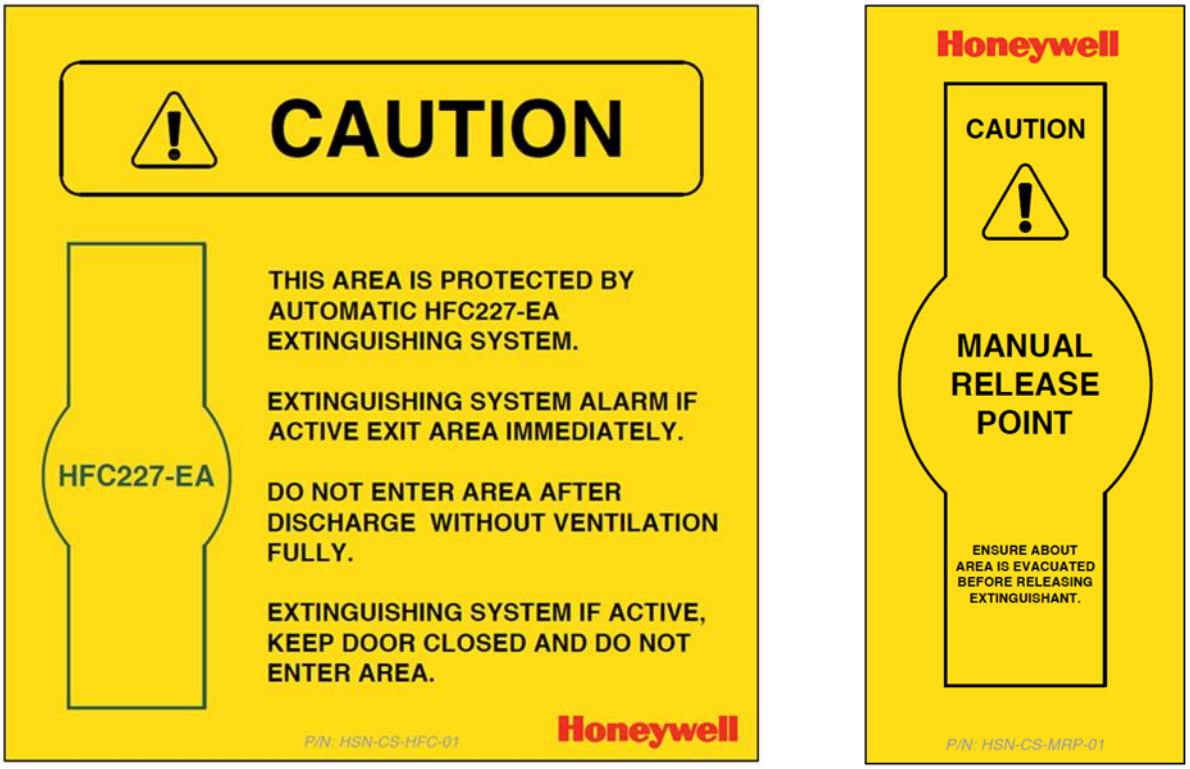



Figure 2.40.: Caution Signs

| Table 2.37. Caution Signs | |
|---|---|
| **Description** | **Part Number** |
| HFC-227ea Protected Room Caution Sign | HSN-CS-HFC-01 |
| Manual Release Point Caution Sign | HSN-CS-MRP-01 |

## 2.2.18. Filling Adaptor Set

Filling adapters are specially manufactured equipment according to the dimensions and features of the valves to be filled. These products must be used during the initial filling or refilling. Filling adapters with different features for different valves are listed as follows. Each filling adaptor set has 60bar maximum working pressure.

***IMPORTANT NOTICE:***

Filling adapters are equipment that includes special connections according to the valve types they will be used on and are factory hydrostatically tested after production. Alternative filling adapters not supplied by Honeywell should never be used; this may cause serious damage to the products or the filling personnel!

### 2.2.18.1. Filling adaptor set for DN12 valve (P/N: HSN-FLA-12-01)

Adapters will be used to fill the valves located on the cylinders with capacity of 8L & 13.4L.

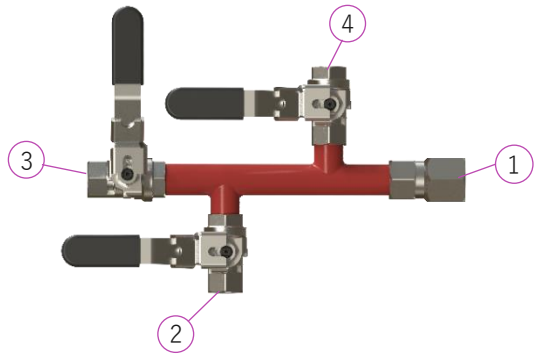



Figure 2.41.: Filling adaptor set for DN12 valve

**Table 2.38. Filling Adaptor Set for DN12 Valve**

| No. | Description |
|---|---|
| 1 | Connection to cylinder filling line |
| 2 | Connection to nitrogen source |
| 3 | Connection to clean agent source |
| 4 | Venting to the atmosphere |

### 2.2.18.2. Filling adaptor set for DN33 valve (P/N: HSN-FLA-33-01)

Adapters will be used to fill the valves located on the cylinders with capacities of 26.8L, 40L, 67.5L, 80L and 120L.

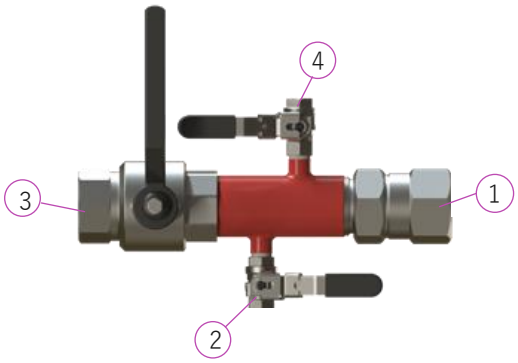



Figure 2.41.: Filling adaptor set for DN33 valve

**Table 2.39. Filling Adaptor Set for DN33 Valve**

| No. | Description |
|---|---|
| 1 | Connection to cylinder filling line |
| 2 | Connection to nitrogen source |
| 3 | Connection to clean agent source |
| 4 | Venting to the atmosphere |

### 2.2.18.3. Filling adaptor set for DN50 valve (P/N: HSN-FLA-50-01)

Adapters will be used to fill the valves located on the cylinders with capacities of 180L & 220L.

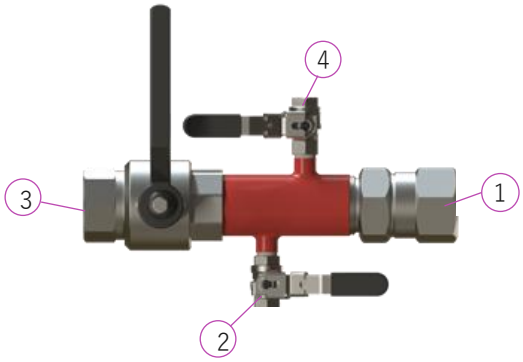



Figure 2.41.: Filling adaptor set for DN50 valve

**Table 2.40. Filling Adaptor Set for DN33 Valve**

| No. | Description |
|---|---|
| 1 | Connection to cylinder filling line |
| 2 | Connection to nitrogen source |
| 3 | Connection to clean agent source |
| 4 | Venting to the atmosphere |

# 3. System Design

## 3.1. Introduction

There are two main elements of system design. The first is the risk assessment, determining the type of protection required, considerations such as ventilation, openings and restrictions, equipment location etc. The second is calculating the quantity of HFC-227ea clean agent required, including floor and / or ceiling voids, positioning of nozzles, electrical requirements, etc. The system design is based on the requirements of NFPA2001, ISO14520 and EN15004-1 & EN15004-5 (current editions).

### 3.1.1. Hazard Analysis

The following steps must be taken to design HFC-227ea clean agent system.

1. Perform a hazard analysis of protected area.
2. Determine the class of fire hazards.
3. Determine the minimum and maximum ambient temperature for the hazard.
4. Calculate HFC-227ea agent quantity to provide required design concentration at minimum expected ambient temperature in protected area. Calculate the quantity of HFC-227ea clean agent required to provide the proper design concentration at the minimum expected hazard temperature.

All system design calculations are calculated at minimum design concentration to determine HFC-227ea agent quantity. Agent quantity shall be adjusted if system is installed at altitudes > 1000m. If hazard altitude is not listed in the table, find the altitude next lower than the hazard altitude and determine the correction factor. See following to the altitude correction factor.

**Table 3.1. Altitude Correction Factors – NFPA2001**

| Altitude (m) | Sea Level | 300 | 610 | 910 | 1220 | 1520 | 1830 | 2130 | 2450 | 2740 | 3050 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Correction Factor | 1.000 | 0.960 | 0.930 | 0.890 | 0.860 | 0.820 | 0.780 | 0750 | 0.720 | 0.690 | 0.660 |

**Table 3.2. Altitude Correction Factors - ISO 14520 / EN 15004**

| Altitude (m) | Sea Level | 1000 | 1500 | 2000 | 2500 | 3000 | 3500 | 4000 | 4500 | - | - |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Correction Factor | 1.000 | 0.885 | 0.830 | 0.785 | 0.735 | 0.690 | 0.650 | 0.610 | 0.565 | | |

Maximum design concentration should be at the maximum anticipated enclosure temperature, for comparison see NOAEL / LOAEL values. (Refer to Table 1.1.)

HFC-227ea clean agent fire extinguishing system is suitable for use with the following materials.

**Class A: Surface Type Fires:** Fires involving solid materials usually of an organic nature, in which combustion normally takes place with the formation of glowing embers.

**Class B:** Fires involving flammable liquids or liquefiable solids and flammable gases.

**Class C:** Fires involving energized electrical equipment where the electrical no conductivity of the extinguishing media is of importance.

| Table 3.3. Design Concentrations - NFPA2001 | | |
|---|---|---|
| **Class** | **Minimum Design Concentrations** | |
| | **UL** | **FM** |
| **Class A** | 6.7 | 6.7 |
| **Class B*** (n-Heptane) | 8.7 | 8.7 |
| **Class C** | 7.0 | 7.0 |
| *: For other Class B fuels, contact with Honeywell Technical Team | | |
| Reference: NFPA2001 Table A.5.4.2.1 | | |

| Table 3.4. Design Concentrations – ISO 14520 / EN 15004 | |
|---|---|
| **Class** | **Minimum design** % by volume |
| **Class B** Heptane (cup burner) Heptane (room test) | 9.0 |
| **Surface Class A** Wood crib PMMA PP ABS | 7.9 |
| **Higher Hazard Class A** | 8.5 |
| a: The minimum design concentration for Higher Hazard Class A fuels shall be the higher of Surface Class A or 95 % of the Class B minimum design concentration | |
| Reference: EN15004-5, Table 4 — HFC-227ea reference extinguishing and design oncentrations | |

## 3.1.2. Determine Which Components Are Required

Cylinder volume, quantity and fill requirements. Refer to Table 2.2

Cylinder framing, mounting brackets, etc.

Detection and control equipment required.

Other system requirements, such as reserve supply, pressure switches, etc.

### 3.1.3. Positioning of Nozzles

Locate nozzles based on the following:

• Ceiling height [Maximum Height 4.4m (14.31ft), Minimum Height 0.3m (0.98ft)]

• Nozzle area coverage [10.1m (33.14ft) x 10.1m (33.14ft)]

• Special hazard area layout considerations

### 3.1.4. Positioning of Cylinders

• Locate cylinders based on the following: Number of cylinders required.

• Storage temperature/environmental considerations, such as weather, area classification and corrosive environment.

• Floor loading.

### 3.1.5. Positioning of Piping

• Nozzle location.

• Structural members for bracing the pipe.

### 3.1.6. Pipe Size and Layout

• Draw piping isometric.

• Dimensions of all pipe sections.

• Locate all fittings.

• Note all elevation changes. The preceding information will be entered into the computer program.

### 3.1.7. Manifolds

It may be necessary to manifold agent cylinders to provide the required amount of agent for a hazard, or to make available the proper increments of agent weight for the protection of multiple hazards. Whenever cylinders are manifolded, the following rules must be observed.

1. All cylinders connected to the same manifold or pipe must be the same size and filled with the same agent weight, pressure and filling density.

2. Agent cylinders must be in a single row and spaced according to section.

3. A connected reserve may be employed in some circumstances providing a secondary supply of agent.

4. Flexible discharge hoses and check valves must be used at each inlet.



Figure 3.1.: General arrangements of manifold

***IMPORTANT NOTICE:***

Class 150 and cast-iron fittings must not be used. Manifold available working pressure must be at least 100 bar (1450 psi). Manifolds must be tested at 1.5 times of available working pressure. Check Valves are required for each cylinder being connected to a manifold.

| Table 3.5. Technical Information for Manifolds | |
|---|---|
| Material | ASTM A53 or ASTM A106 Grade B |
| Maximum working pressure | 100bar (or higher) |
| Test pressure | 150bar (or higher) |
| Inlet-Outlet Size | 50, 65, 80, 100 and 150mm |
| Surface | Black smooth or equivalent surface ready to paint |

Cylinders are assembled together on manifold for three main reasons;

- To reduce the amount of piping required by connection to one feeder pipe.
- For systems that require main and reserve system configuration.
- Combining the correct cylinders to obtain the required quantity of agent within a specific hazard area.

1. Fix the back channels of the mounting brackets to the wall at the appropriate heights using suitable anchor type bolts.
2. Position the cylinders against the back channels with the valve outlets pointing left at the required spacing for the manifold ports.
3. Insert the cylinders straps at top and bottom and secure with the nut bolts.
4. Remove the safety cap from one cylinder outlet port and connect the flexible discharge hose to the cylinder outlet port.
5. Remove the protection caps from the cylinder actuation ports.

The manifolds that may be recommended for Honeywell HFC-227ea gas extinguishing system are listed in the table below. The design of the manifolds should be made in accordance with the limitations specified.

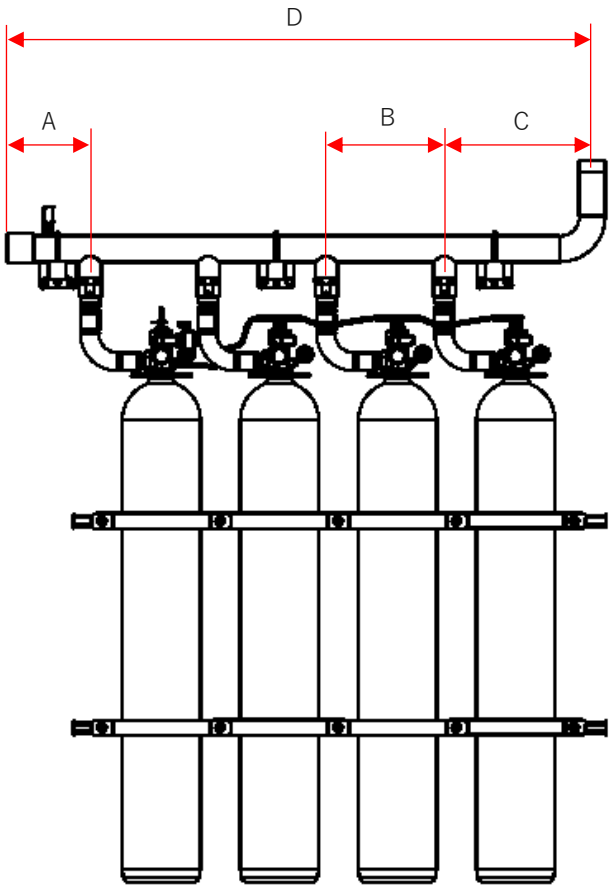



Figure 3.2.: Manifold details

**Table 3.6. Recommended Manifold Configurations**

| Number of Inlets (pcs) | Inlet to End Cap Distance (A) | Inlet to Inlet Distance (B) | Last Inlet to End Distance (C) | Overall Length (D) |
|---|---|---|---|---|
| 2 | 250mm | 500 mm | 300-400mm | 1050-1100mm |
| 3 | 250mm | 500 mm | 300-400mm | 1550-1600mm |
| 4 | 250mm | 500 mm | 300-400mm | 2050-2100mm |
| 5 | 250mm | 500 mm | 300-400mm | 2550-2600mm |
| 6 | 250mm | 500 mm | 300-400mm | 3050-3100mm |
| 7 | 250mm | 500 mm | 300-400mm | 3550-3600mm |
| 8 | 250mm | 500 mm | 300-400mm | 4050-4100mm |
| 9 | 250mm | 500 mm | 300-400mm | 4550-4600mm |

### 3.1.8. Mounting Bracket

The brackets are used to secure cylinders to a wall or other suitable mounting surface. The cylinders shall be mounted only on the floor.

***IMPORTANT NOTICE:***

The Bolts and nuts are not part of the cylinder mounting assembly. Honeywell will not be supplying these parts to customers. The bolts or fixing components must be corrosion resistant stainless steel 316.



Figure 3.3.: Bracket

**Table 3.7. Brackets and cylinder sizes**

| Part Number | Cylinder Size (L) | Length (A) (mm) | Width (B) (mm) |
|---|---|---|---|
| HSN-BRC-140 | 8 | 350 | 184 |
| | 13.4 | | |
| HSN-BRC-232 | 26.8 | 400 | 264 |
| | 40 | 600 | 330 |
| HSN-BRC-267 | 67.5 | | |
| | 80 | | |
| HSN-BRC-356 | 120 | | 420 |
| HSN-BRC-406 | 180 | | 470 |
| | 220 | | |

** All diameters have tolerance +/- 5% according to manufacturers.*

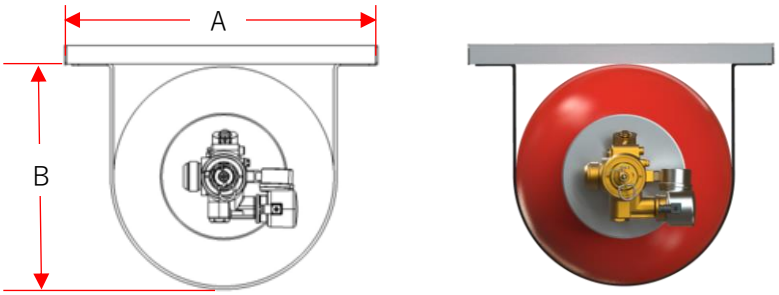



Figure 3.4.: Dimension of the bracket

### 3.1.9. Nitrogen Super-Pressurization

Nitrogen is added to the HFC-227ea clean agent cylinders. This addition of nitrogen, known as super-pressurization, will cause a portion of the nitrogen to mix with the HFC-227ea, the remaining portion of the nitrogen will remain in the vapor space above the liquid providing the increased propulsion necessary to discharge the HFC-227ea clean agent from the cylinder.

### 3.1.10. Flow in Pipe

In a properly designed distribution piping network, the flow of HFC-227ea clean agent will consist of a two-phase mixture of liquid and vapor. The properties of this mixture will vary with its composition; therefore, when the mixture contacts the pipeline walls, the friction decreases the density of the mixture resulting in a non-linear pressure drop and an increase in flow velocity. Another consequence of two- phase flow is the potential for separation of liquid and vapor. In a properly designed pipe network, the velocity of the mixture will be high enough to maintain highly turbulent flow. However, if the pipeline diameter is too large for the design flow rate, the two phases may separate, leading to alternate discharges of liquid and vapor (slugging) or layering of the two phases. Therefore, the pipeline must be properly sized to keep the HFC-227ea clean agent flows turbulent enough to prevent phase separation.

### 3.1.11. Design Criteria

The complexity of two-phase flow formulas does not allow for any simple method of manual calculation. For this reason, the flow calculations and design criteria described in this manual have been programmed into computer software. To determine the proper procedures for applying the input parameters to the HFC-227ea clean agent computer software. There are several limitations to these input parameters which must be observed if accurate results are to be obtained. Most of these limitations are in the program. However, there are certain restrictions that must be addressed by the system designer before applying the input data.

### 3.1.12. Design Example and Calculations

Minimum agent quantity is based on the hazard volume at the minimum anticipated temperature and concentration required. To determine the minimum agent quantity the following equation is used: $W = (V/S) \times [C/(100-C)] \times CAlt$

W = Weight of Agent required (kg)

V = Hazard Volume (m3)

S = Specific Vapor Volume (m3/kg)

S = 0,1269 + 0,000513t

t = Design Temperature in Hazard Area (ºC)

C = Required HFC-227ea concentration. (% by volume

Calculation for two rooms and floor void with the following dimensions:
Switch Room: 7,0m x 7,0m x 3,50m = 171,5$m^3$
Computer Room: 16,0m x 12,0m x 3,85m = 739,2$m^3$
Floor Void: 16,0m x 12,0m x 0,35m = 67,2$m^3$
T = 21°C (70°F) for calculation example, where S = 0,1377 ($m^3$/kg)
The altitude correction factor of sea level is 1.00. (see Table 3.1 or Table 3.2)

Switch Room: (7.0 % required design concentration example only)
W: (171,5 / 0,1377) x [7.0 / (100-7,0)] = 93,8 kg

Computer Room: (7.0 % required design concentration example only)
W: (739,2 / 0,1377) x [7.0 / (100-7,0)] = 404 kg

Floor Void: (7.0 % required design concentration example only)
W: (67,2 / 0,1377) x [7.0 / (100-7,0)] = 36,8 kg

It is determined from the above that both the Switch Room and the Computer Room can be fed by one manifolded system using 5 x 120L containers, each filled with 99,6 kg of agent. The Floor Void would use 1 x 40L container filled with 36,8 kg. (From Table 2.2.)

Example using the flooding factors:
Minimum Design Temperature = 21°C (70°F)
Minimum Design Concentration = 7,0 %
Flooding Factor=0,5447 kg/L (refer to Table 3.8)

Switch Room:
W: 176,4 x 0,5465 = 93,8 kg

Computer Room:
W: 739,20 x 0,5465 = 404 kg

Floor Void:
W: 67,2 x 0,5465 = 36,8 kg
The altitude correction factor of sea level is 1.00. (see Table 3.1)

It is determined from the above that both the Switch Room and the Computer Room can be fed by one manifolded system using 5 x 120L containers, each filled with 99,6 kg of agent. The Floor Void would use 1 x 40L container filled with 36,8 kg. (From Table 2.2.)

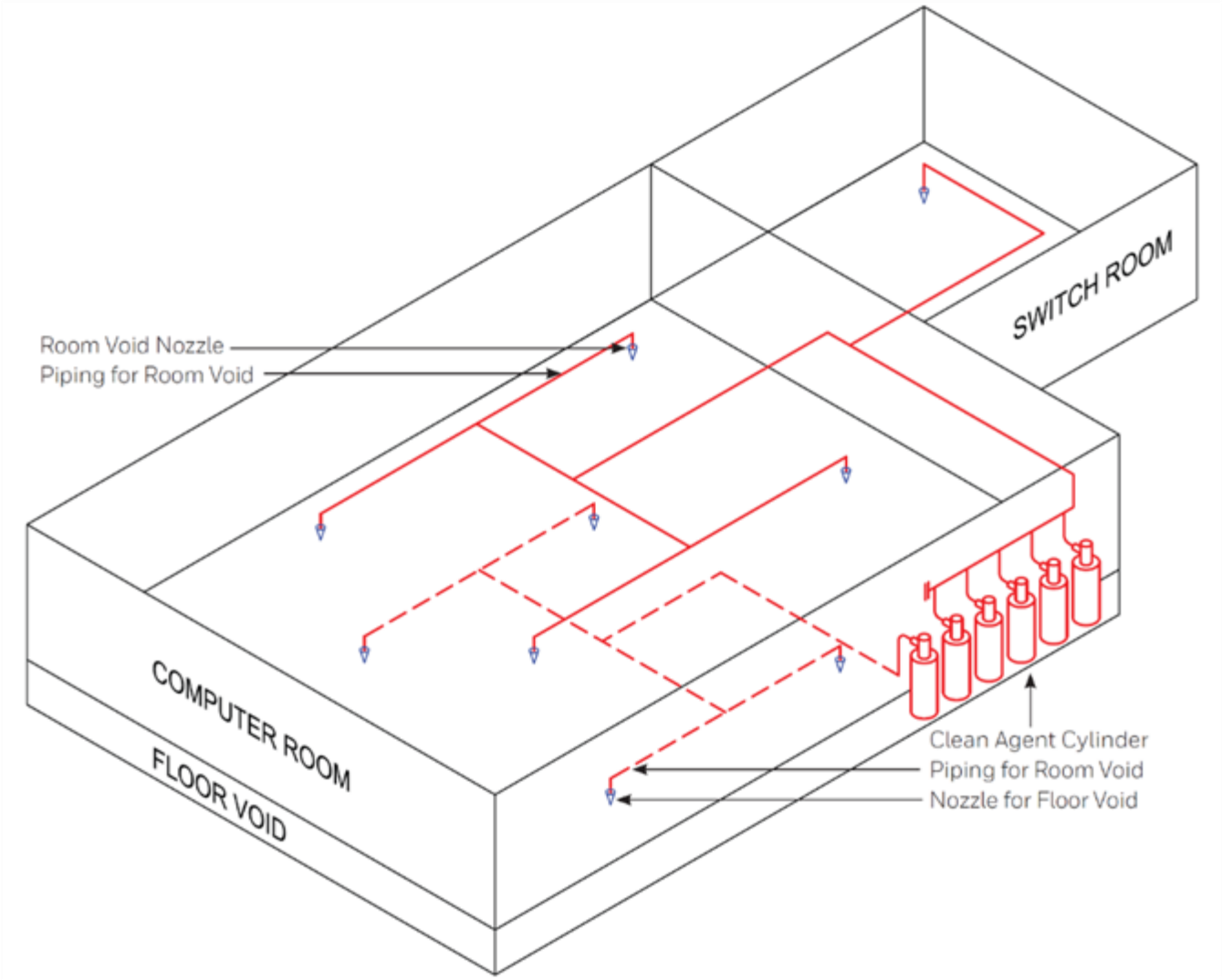



Figure 3.5.: Example of system

### 3.1.13. Duration of Discharge

Per NFPA2001, the liquid agent discharge shall be completed in a nominal ten seconds or less. Discharge times shorter than 10 seconds are desirable to minimize production of breakdown products. Discharge times are as short as 6 seconds are permitted.

## Table 3.2. HFC 227ea total flooding quantity

| Temp. | Specific Vapor Volume S, | HFC 227ea mass requirements per unit volume of protected space, m/V (kg/m³) This information refers only HFC-227ea and may not represent any other products containing 1,1,1,2,3,3,3-heptafluoropropane as a component. | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T °C | (m³/kg) | Design Concentrations (% - by volume) | | | | | | | | | | | | |
| | | 6 | 6.7 | 7 | 7.9 | 8 | 8.5 | 8.7 | 9 | 10 | 11 | 12 | 13 | 14 |
| -10 | 0.1215 | 0.5253 | 0.5910 | 0.6195 | 0.7060 | 0.7157 | 0.7646 | 0.7843 | 0.8140 | 0.9145 | 1.0172 | 1.1223 | 1.2298 | 1.3398 |
| -5 | 0.1241 | 0.5143 | 0.5787 | 0.6065 | 0.6912 | 0.7007 | 0.7486 | 0.7679 | 0.7969 | 0.8953 | 0.9959 | 1.0988 | 1.2041 | 1.3118 |
| 0 | 0.1268 | 0.5034 | 0.5663 | 0.5936 | 0.6765 | 0.6858 | 0.7326 | 0.7515 | 0.7800 | 0.8763 | 0.9747 | 1.0754 | 1.1784 | 1.2838 |
| 5 | 0.1294 | 0.4933 | 0.5550 | 0.5817 | 0.6629 | 0.6720 | 0.7179 | 0.7364 | 0.7643 | 0.8587 | 0.9551 | 1.0538 | 1.1548 | 1.2580 |
| 10 | 0.1320 | 0.4836 | 0.5440 | 0.5702 | 0.6498 | 0.6588 | 0.7038 | 0.7219 | 0.7493 | 0.8418 | 0.9363 | 1.0331 | 1.1320 | 1.2333 |
| 15 | 0.1347 | 0.4739 | 0.5331 | 0.5588 | 0.6368 | 0.6456 | 0.6897 | 0.7074 | 0.7342 | 0.8249 | 0.9176 | 1.0124 | 1.1093 | 1.2085 |
| 20 | 0.1373 | 0.4649 | 0.5230 | 0.5482 | 0.6247 | 0.6333 | 0.6766 | 0.6940 | 0.7203 | 0.8093 | 0.9002 | 0.9932 | 1.0883 | 1.1857 |
| **21** | 0.1377 | 0.4634 | **0.5214** | **0.5465** | **0.6228** | 0.6314 | **0.6745** | **0.6919** | **0.7181** | 0.8067 | 0.8974 | 0.9901 | 1.0849 | 1.1820 |
| 25 | 0.1399 | 0.4563 | 0.5133 | 0.5380 | 0.6131 | 0.6216 | 0.6640 | 0.6811 | 0.7069 | 0.7942 | 0.8835 | 0.9747 | 1.0681 | 1.1636 |
| 30 | 0.1425 | 0.4479 | 0.5039 | 0.5282 | 0.6019 | 0.6102 | 0.6519 | 0.6687 | 0.6940 | 0.7797 | 0.8673 | 0.9569 | 1.0486 | 1.1424 |
| 35 | 0.1450 | 0.4402 | 0.4953 | 0.5191 | 0.5916 | 0.5997 | 0.6407 | 0.6572 | 0.6821 | 0.7663 | 0.8524 | 0.9404 | 1.0305 | 1.1227 |
| 40 | 0.1476 | 0.4325 | 0.4865 | 0.5100 | 0.5811 | 0.5891 | 0.6294 | 0.6456 | 0.6701 | 0.7528 | 0.8374 | 0.9239 | 1.0124 | 1.1029 |
| 45 | 0.1502 | 0.4250 | 0.4781 | 0.5011 | 0.5711 | 0.5789 | 0.6185 | 0.6344 | 0.6585 | 0.7398 | 0.8229 | 0.9079 | 0.9948 | 1.0838 |
| 50 | 0.1527 | 0.4180 | 0.4703 | 0.4929 | 0.5617 | 0.5695 | 0.6084 | 0.6240 | 0.6477 | 0.7276 | 0.8094 | 0.8930 | 0.9786 | 1.0661 |
| 55 | 0.1553 | 0.4110 | 0.4624 | 0.4847 | 0.5523 | 0.5599 | 0.5982 | 0.6136 | 0.6368 | 0.7155 | 0.7959 | 0.8781 | 0.9622 | 1.0482 |
| 60 | 0.1578 | 0.4045 | 0.4551 | 0.4770 | 0.5436 | 0.5511 | 0.5887 | 0.6039 | 0.6267 | 0.7041 | 0.7832 | 0.8642 | 0.9469 | 1.0316 |
| 65 | 0.1604 | 0.3979 | 0.4477 | 0.4693 | 0.5348 | 0.5421 | 0.5792 | 0.5941 | 0.6166 | 0.6927 | 0.7705 | 0.8501 | 0.9316 | 1.0149 |
| 70 | 0.1629 | 0.3918 | 0.4408 | 0.4621 | 0.5266 | 0.5338 | 0.5703 | 0.5850 | 0.6071 | 0.6821 | 0.7587 | 0.8371 | 0.9173 | 0.9993 |

m/V is the agent mass requirement (in kilograms per cubic meter); i.e. mass, m, in kilograms of agent required per cubic meter of protected volume V to produce the indicated concentration at the temperature specified.

V is the net volume of hazard (in cubic meters); i.e. the enclosed volume minus the fixed structures impervious to extinguishant. m = (c/(100-c). V/S

T is the temperature (in degrees Celsius); i.e. the design temperature in the hazard area.

S is the specific volume (in cubic meters per kilogram); the specific volume of superheated HFC 227ea vapor at a pressure of 1,013 bar may be approximated by the formula: S = k1 + k2 ·T

where; k1 = 0,1269; k2 = 0,000513.

c is the concentration (in percent); i.e. the volumetric concentration of HFC 227ea in air at the temperature indicated, and a pressure of 1,013 bar absolute.

## 3.2. System Limitations

The information presented below details the steps necessary to design a Honeywell Clean Agent Fire Suppression System with HF-227ea agent within the limitations set by UL & FM and NFPA 2001.

### 3.2.1. Hazard Classification

| Table 3.9. Design Concentrations - NFPA2001 | | |
|---|---|---|
| **Class** | **Minimum Design Concentrations** | |
| | **UL** | **FM** |
| **Class A** | 6.7 | 6.7 |
| **Class B*** (n-Heptane) | 8.7 | 8.7 |
| **Class C** | 7.0 | 7.0 |
| *: For other Class B fuels, contact with Honeywell Technical Team | | |
| Reference: NFPA2001 Table A.5.4.2.1 | | |

| Table 3.10. Design Concentrations – ISO 14520 / EN 15004 | |
|---|---|
| **Class** | **Minimum design** % by volume |
| **Class B** Heptane (cup burner) Heptane (room test) | 9.0 |
| **Surface Class A** Wood crib PMMA PP ABS | 7.9 |
| **Higher Hazard Class A** | 8.5 |
| a: The minimum design concentration for Higher Hazard Class A fuels shall be the higher of Surface Class A or 95 % of the Class B minimum design concentration | |
| Reference: EN15004-5, Table 4 — HFC-227ea reference extinguishing and design oncentrations | |

***IMPORTANT NOTICE:***

The Honeywell HFC-227ea Flow Calculation 7.8.0. Software will automatically calculate concentration at the max. temperature entered.

### 3.2.2. Concentration at Maximum Temperature

The expected concentration at maximum temperature can be determined by the following formula:

**C = 100 x W x S / (W x S + V)**

W = Weight of Agent required (kg)

V = Hazard Volume ($m^3$)

C = Required HFC-227ea concentration (% by volume).

S = Specific Vapor Volume ($m^3$/kg) (Refer to Flooding Factor Table 3.8. to determine the S value)

***IMPORTANT NOTICE:***

The Honeywell HFC-227ea Flow Calculation 7.8.0 Software will automatically calculate concentration at the max. temperature entered.

### 3.2.3. Temperature Limitation

| Table 3.11. Limitation of temperature | | |
|---|---|---|
| **Minimum** | **Maximum** | **Notes** |
| 0°C (32°F) | 50°C (122°F) | At temperatures outside of this range, the system may not supply the desired quantity of agent or discharge due to over-pressure. |

### 3.2.4. System Discharge Time

Per NFPA2001, the liquid agent discharge shall be completed in a nominal 10 seconds or less.

| Table 3.12. System Discharge Time | |
|---|---|
| **Minimum** | **Maximum** |
| 6 seconds | 10 seconds |

### 3.2.5. Nozzle Location and Limitation

The number of nozzles required is connected to the hazard volume, configuration and the coverage provided by the nozzle. Nozzles are installed on the pipe the same way as the pipe fitting. Nozzles must be placed in the correct location in accordance with the installation drawings to supply the correct amount of HFC-227ea to the designated area.

The required orifice diameter must be determined by Honeywell HFC-227ea Flow Calculation 7.8.0 Software and drilled out to the calculated orifice size.

| Table 3.13. Minimum & Maximum Nozzle Orifice Sizes (for Schedule 40 pipe) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Part Number | Nozzle Size | | Orifice Holes | Type | Orifice Diameters | | Min. Nozzle Orifice Area to Pipe Area Ratio | Max. Nozzle Orifice Area to Pipe Area Ratio |
| | mm | in. | | | Min. ø (mm) | Max. ø (mm) | | |
| HSN-NOZ-01-15 | 15 | 1/2" | 5 x Ø 6,7 | 180° | 5.2 | 10.9 | 11% | 48% |
| HSN-NOZ-01-20 | 20 | 3/4" | 9 x Ø 6,7 | | 9.5 | 14.5 | 21% | 48% |
| HSN-NOZ-01-25 | 25 | 1″ | 9 x Ø 8,4 | | 12.0 | 18.0 | 20% | 46% |
| HSN-NOZ-01-32 | 32 | 1 1/4" | 9 x Ø 10,7 | | 15.5 | 23.7 | 20% | 46% |
| HSN-NOZ-01-40 | 40 | 1 1/2" | 14 x Ø 10,7 | | 18.5 | 27.7 | 20% | 46% |
| HSN-NOZ-01-50 | 50 | 2″ | 14 x Ø 13,4 | | 23.5 | 35.6 | 20% | 46% |
| HSN-NOZ-02-15 | 15 | 1/2" | 8 x Ø 5,4 | 360° | 5.2 | 10.9 | 11% | 48% |
| HSN-NOZ-02-20 | 20 | 3/4" | 16 x Ø 5,0 | | 9.5 | 14.5 | 21% | 48% |
| HSN-NOZ-02-25 | 25 | 1″ | 16 x Ø 6,3 | | 12.0 | 18.0 | 20% | 46% |
| HSN-NOZ-02-32 | 32 | 1 1/4" | 16 x Ø 8,0 | | 15.5 | 23.7 | 20% | 46% |
| HSN-NOZ-02-40 | 40 | 1 1/2" | 24 x Ø 8,2 | | 18.5 | 27.7 | 20% | 46% |
| HSN-NOZ-02-50 | 50 | 2″ | 24 x Ø 10,2 | | 23.5 | 35.6 | 20% | 46% |

***IMPORTANT NOTICE:***

The specified flow rates are estimated values. For actual flow rates, please refer to The Honeywell HFC-227ea Flow Calculation 7.8.0 Software.

## 3.2.6. Nozzle Coverage Area

Designers may desire to increase the nozzle quantity to provide a more even distribution agent while the protected room is oddly shaped. If the nozzle velocity is an issue, the designer may desire to add additional nozzles to lower the individual nozzle velocity to an acceptable limit.

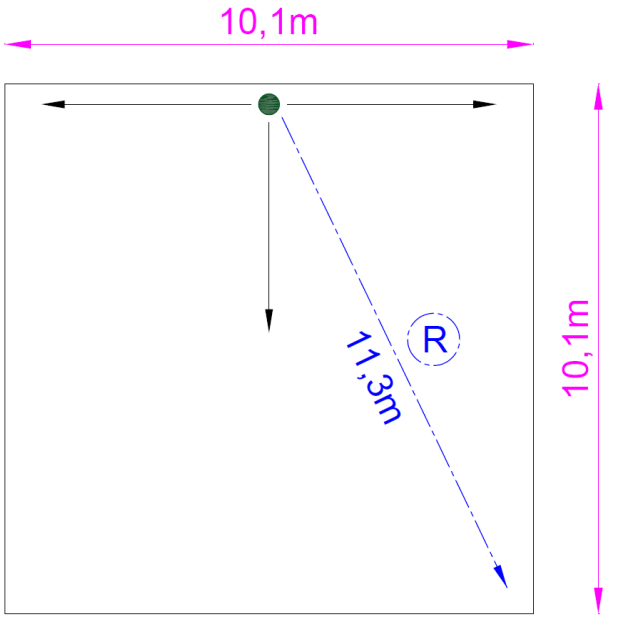



Figure 3.6.: 180º nozzles located

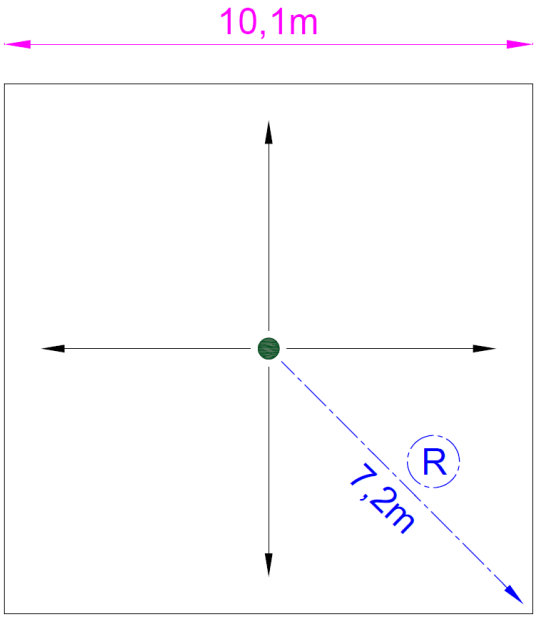



Figure 3.7.: 360º nozzles located

| Table 3.14. Nozzle Coverage Area | | | | | |
|---|---|---|---|---|---|
| Part Number | Type | Radius | | Ceiling Height Range | |
| | | m | ft. | m | ft. |
| HSN-NOZ-01-15 | 180° | 11.3 | 37,1 | 0.3 to 4.4 | 1.0 to 14.4 |
| HSN-NOZ-01-20 | | | | | |
| HSN-NOZ-01-25 | | | | | |
| HSN-NOZ-01-32 | | | | | |
| HSN-NOZ-01-40 | | | | | |
| HSN-NOZ-01-50 | | | | | |
| HSN-NOZ-02-15 | 360° | 7.2 | 23.6 | | |
| HSN-NOZ-02-20 | | | | | |
| HSN-NOZ-02-25 | | | | | |
| HSN-NOZ-02-32 | | | | | |
| HSN-NOZ-02-40 | | | | | |
| HSN-NOZ-02-50 | | | | | |

***IMPORTANT NOTICE:***

- The maximum coverage area is 102 m2 (1098 ft2) for each type of nozzle.
- The shape of the hazard area affects the nozzle location.
- Nozzles must not be placed where their discharge performance may be effected by objects.
- If nozzle velocity is a concern, additional nozzles may be added to lower the individual nozzle velocity.
- Nozzles can be installed up to a maximum of 300 mm (12 in.) below the ceiling.
- Maximum nozzle height above floor level for a single row of nozzles is 4.3 m (14 ft). For ceiling heights above 4.3 m (14 ft) additional rows of nozzles may be added.
- 180-degree nozzles must be mounted within 300 mm (12 in.) of the wall and point at the center of the hazard.
- The minimum ceiling height, for subfloors, false ceilings, for example, is 300 mm (12 in.).
- Nozzles are positioned vertically, either up or down.
- The maximum elevation difference between the cylinder outlet and the furthest horizontal pipe run or discharge nozzle shall not exceed 15,8 m (51,8 ft), see Figure 3.13.
- The maximum elevation difference between the furthest horizontal pipe runs or discharge nozzles shall not exceed 15,8 m (51,8 ft), see Figure 3.14.
- If the room is an odd shape, the designer may increase the nozzle quantity to provide a more even agent distribution.

The nozzle should be placed as close to the center of the hazard as possible. On the multiple nozzle system, the nozzle should be as equally spaces as possible.

The 180º nozzle is engineered to provide a 180º discharge pattern for sidewall applications. The 360º nozzle offers a full 360º discharge pattern for installations where nozzles are located in the center of the hazard.

180º nozzles should be located in a symmetrical, or near symmetrical, pattern within the protected area. 180º nozzles should be located along the perimeter of the area – discharging along the perimeter and toward the opposite side. These nozzles can be located a maximum of 1’-0” (0.3 m) out from the wall.

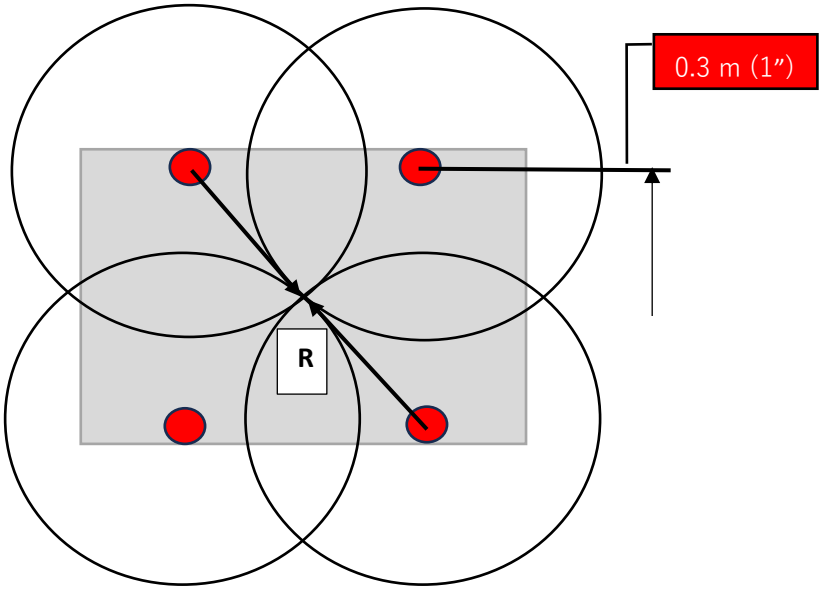



Figure 3.8.: 180º Nozzles

360º Nozzles should be located in a symmetrical, or near symmetrical, pattern within the protected area. Nozzle patterns need to overlap, to adequately cover the area without any “blind spots” due to nozzle locations. Apply to all Nozzle types.

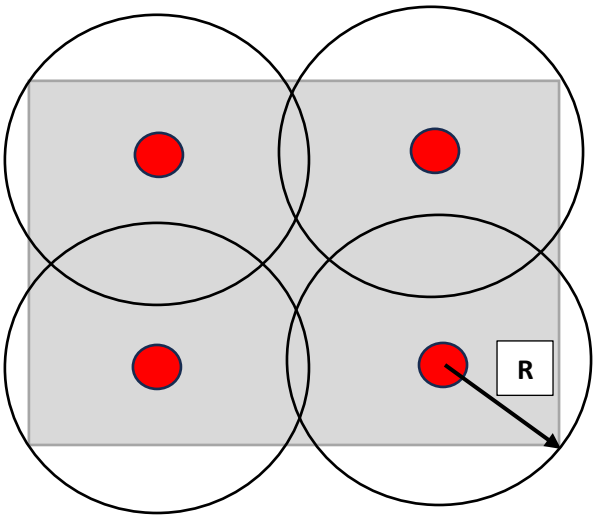



Figure 3.9.: 360º Nozzles

Back-to-back application:

180°Nozzles can be installed in a back-to-back arrangement within the following limitations:

- Maximum distance between nozzles = 1.0’ (0.3 m)
- Agent supplied and flow rate from both nozzles are the same.
- Pipe size from tee to both nozzles are the same.

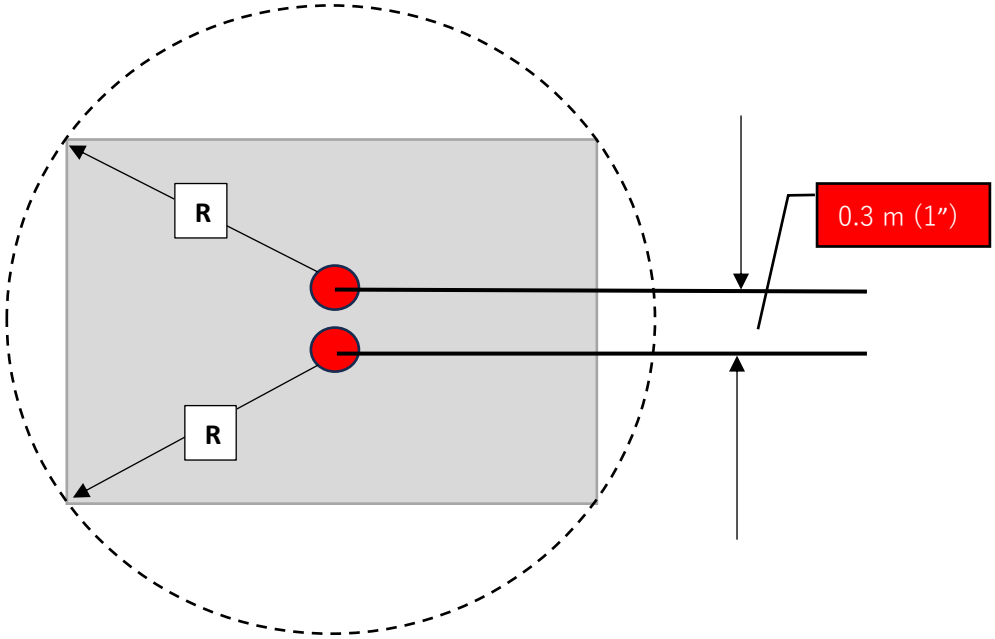



Figure 3.10.: Back-to-back nozzles application

## 3.2.7. Ceiling Height and Levels of Nozzles

The maximum nozzle height above floor level for a single row of nozzles is 4.4m. For ceiling heights above 4.4m additional rows of nozzles may be added. The minimum ceiling height is 0,3m. For instance, for false ceilings, sub-floors and plenum spaces.

**Table 3.15. Nozzle Levels**

| Ceiling Height | Levels of Nozzles Required |
|---|---|
| 1.0’ (0.3 m) to 14.4’ (4.4 m) | 1 |
| Over 14.4’ (4.4 m) to 28.8’ (8.8 m) | 2 (See Maximum Elevation Differences in Pipe Runs Limitation) |

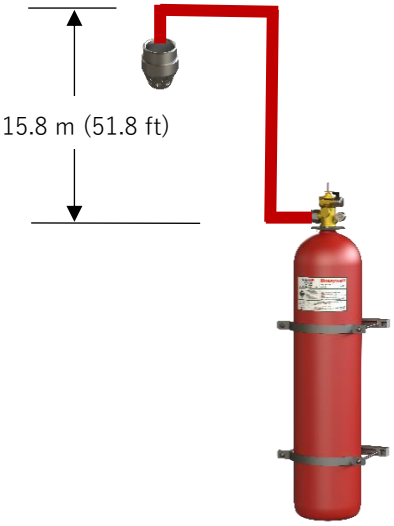



Figure 3.11.: Maximum elevation between between nozzles and cylinder outlet

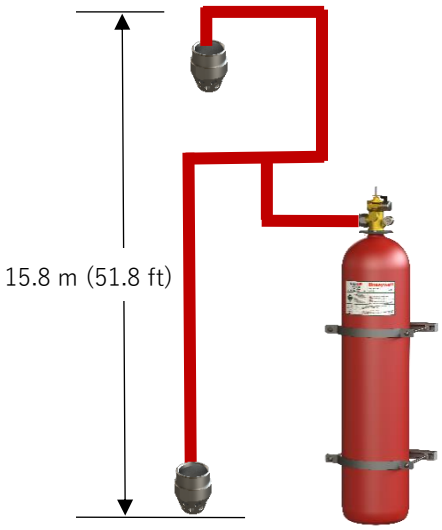



Figure 3.12.: Maximum elevation horizontal pipe runs and nozzles

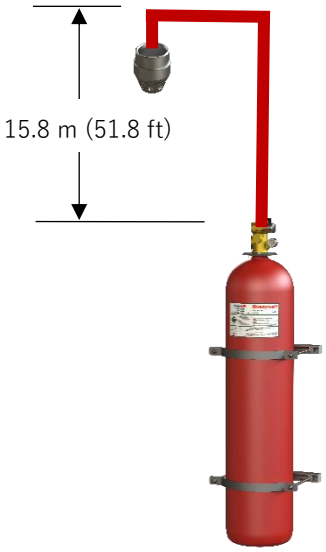



Figure 3.13.: Example 1
System with a single row of nozzle/s above cylinder outlet

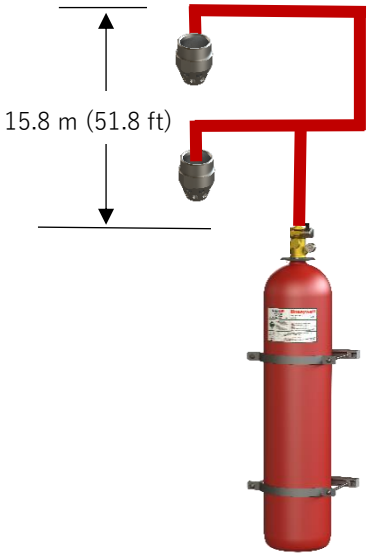



Figure 3.14.: Example 2
System with a multiple row of nozzle/s above outlet

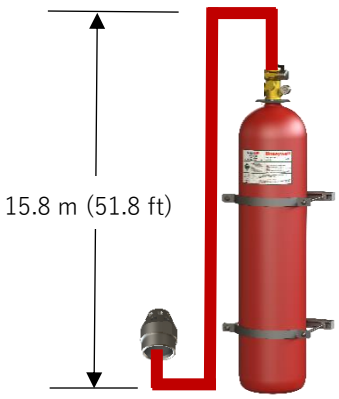



Figure 3.15.: Example 3
System with a single row of nozzle/s below cylinder outlet

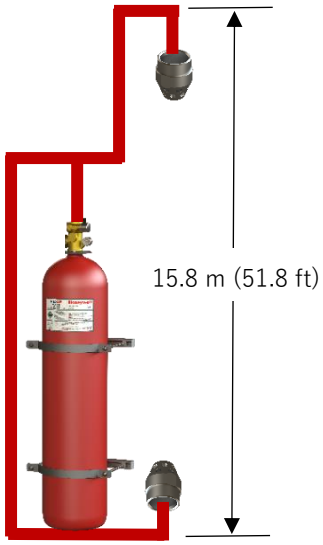



Figure 3.16.: Example 4
System with a multiple row of nozzle/s below outlet

## 3.2.8. Tee Split Ratios

**Table 3.16. Tee Split Ratios**

| Type of Tee | Major-Flow Outlet | | Minor-Flow Outlet | | |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | Orientation |
| Bull Tee | %50 | %50 | %30 | %70 | Standard |
| Side-Thru | %31 | %69 | %10 | %90 | Standard |

***IMPORTANT NOTICE:***

Designs will be made only in the given split ratios. Other percentages such as 41% & 59% etc. are not correct. And it is also not correct to change the 90% and 10% splits in the pipeline.

Every outlet of each tee must be oriented in the horizontal plane.

**Table 3.17. Type of Fittings**

| Type of Fitting | Type of Tee | Range |
|---|---|---|
| Equal Tee | Bull Tee | Starting from 1/2" up to 6" |
| | Side Tee | Starting from 1/2" up to 6" |
| 45° Elbow | Standard | Starting from 1/2" up to 6" |
| 90° Elbow | Standard | Starting from 1/2" up to 6" |

### 3.2.9. Tee Configurations

#### Bull Tee

Where the two-outlet branches change direction from the incoming piping inlet.

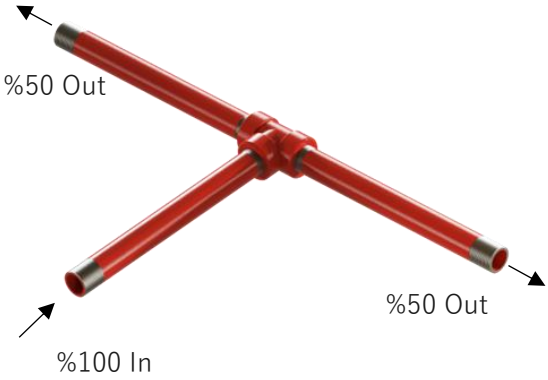



Figure 3.17.: Bull Tee %50-%50

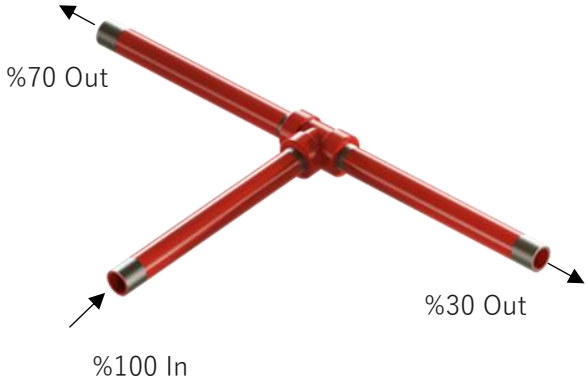



Figure 3.18.: Bull Tee %70-%30

#### Side Tee

Where one outlet branch changes direction from the inlet and the other continues straight through in the same direction as the inlet.




Figure 3.19.: Side-Thru Tee %90-%10




Figure 3.20.: Side-Thru Tee %69-%31

Correct & In-correct designs:

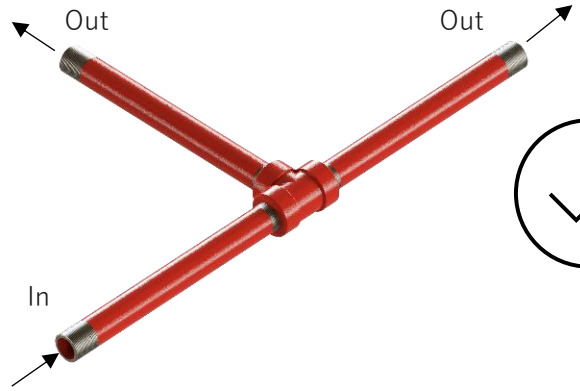



Figure 3.21.: Correct configuration-1




Figure 3.22.: Correct configuration-2

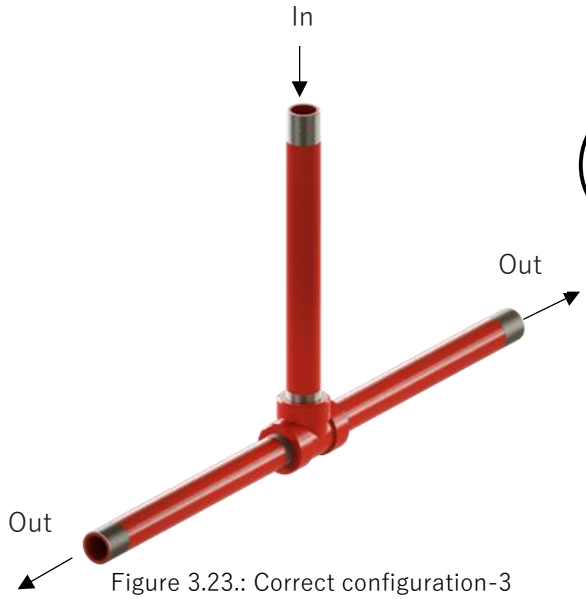



Figure 3.23.: Correct configuration-3

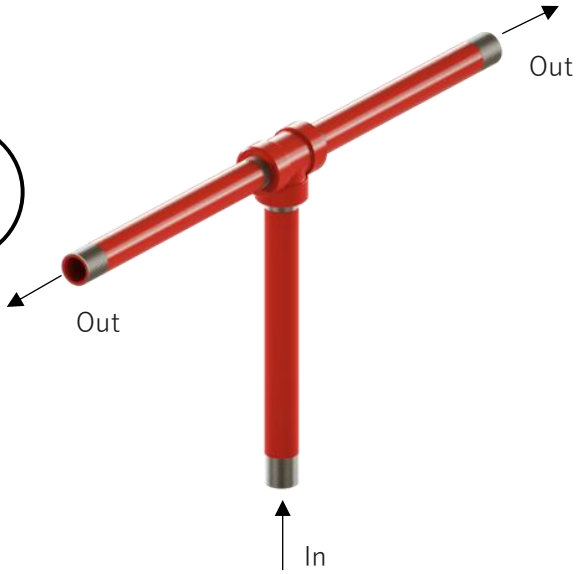



Figure 3.24.: Correct configuration-4

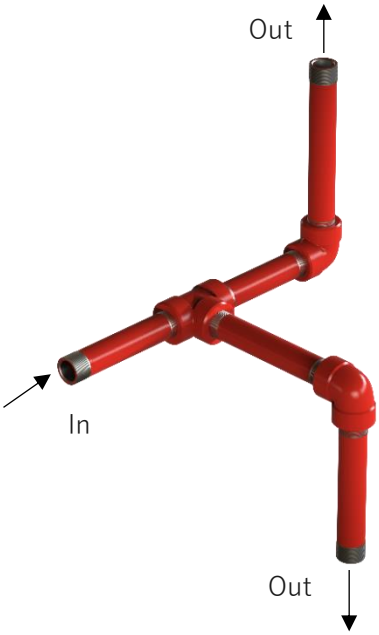



Figure 3.25.: Correct configuration-5

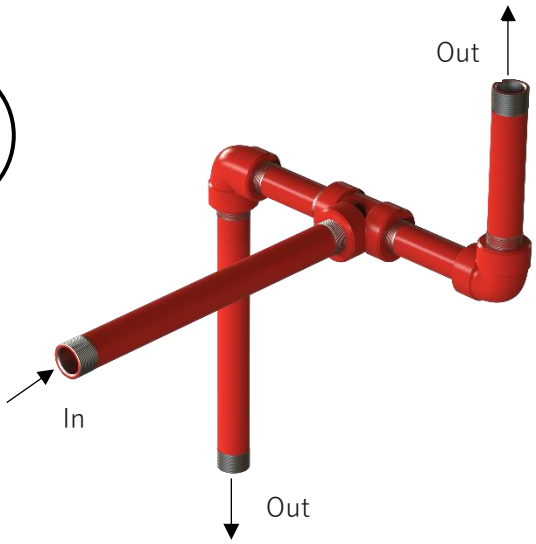



Figure 3.26.: Correct configuration-6

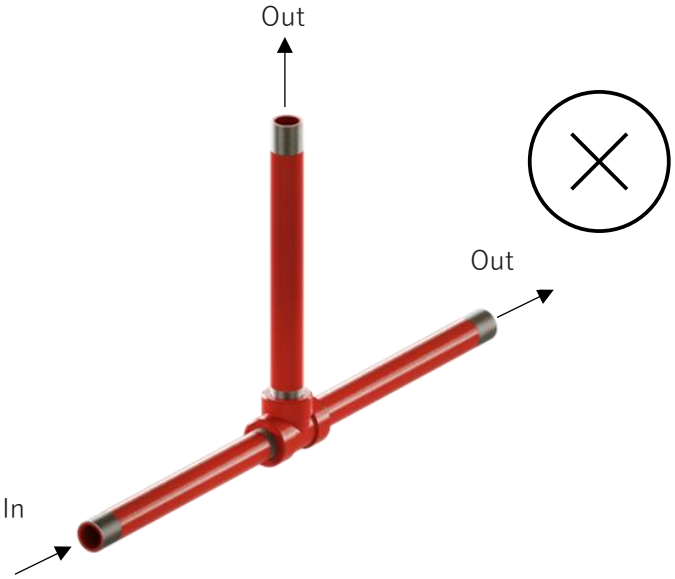



Figure 3.27.: In-correct configuration-1

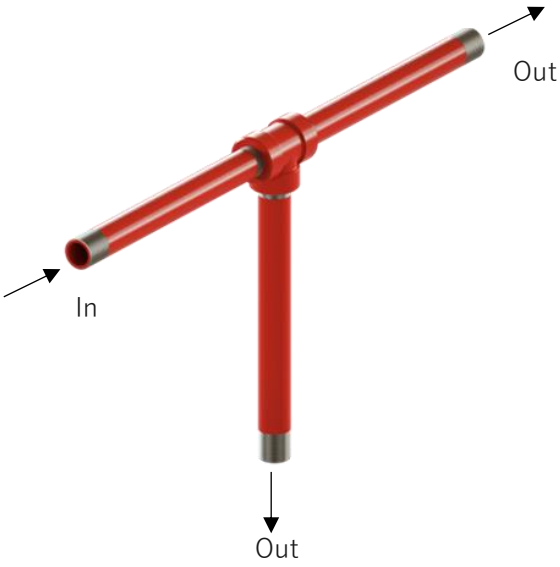



Figure 3.28: In-correct configuration-2

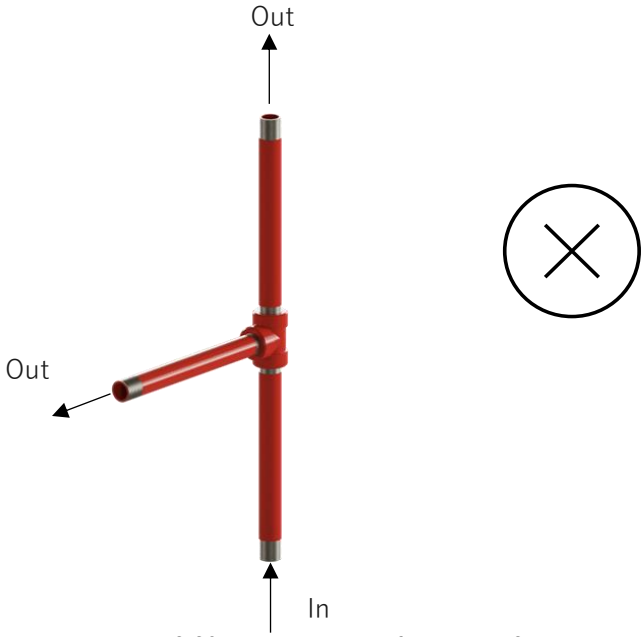



Figure 3.29.: In-correct configuration-3

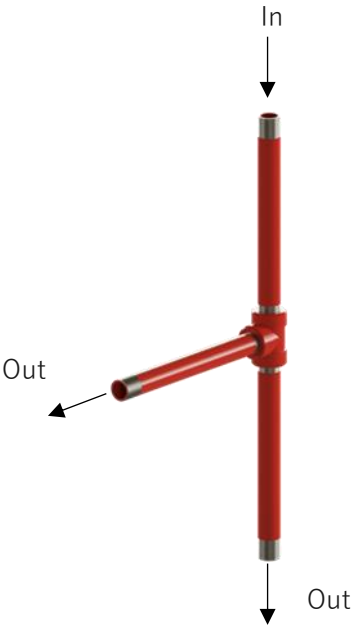



Figure 3.30.: In-correct configuration-4

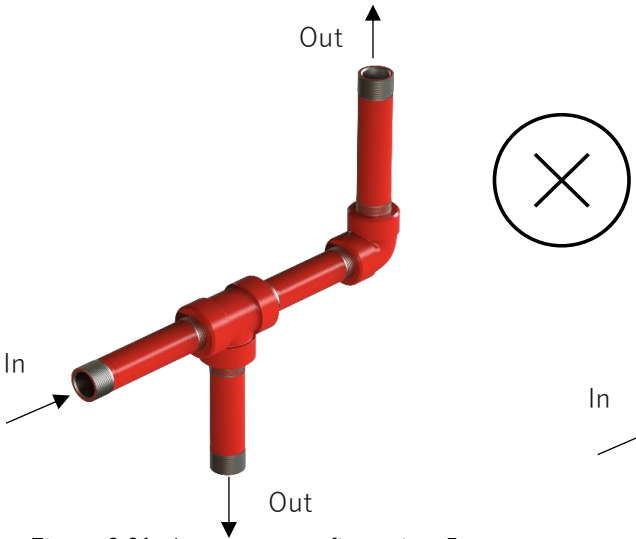



Figure 3.31.: In-correct configuration-5

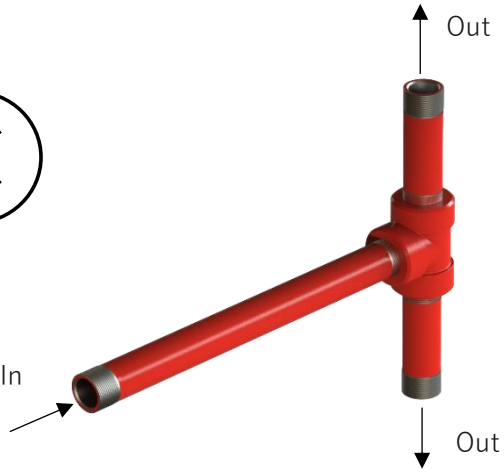



Figure 3.32.: In-correct configuration-6

## 3.2.10. Estimated Pipe Size

| Table 3.18. Estimated Pipe Size for Schedule 40 | | | | | |
|---|---|---|---|---|---|
| **Pipe Size** | | **Minimum Design Flow Rate** (System Limitation) | | **Maximum Design Flow Rate** (System Limitation) | |
| **mm** | **in.** | **kg/s** | **lb/s** | **kg/s** | **lb/s** |
| 15 | 1/2" | 0.48 | 1.1 | 1.19 | 2.6 |
| 20 | 3/4" | 0.89 | 2.0 | 2.16 | 4.8 |
| 25 | 1″ | 1.45 | 3.2 | 3.89 | 8.6 |
| 32 | 1 1/4" | 2.20 | 4.8 | 5.45 | 12.0 |
| 40 | 1 1/2" | 3.24 | 7.1 | 7.79 | 17.1 |
| 50 | 2″ | 5.48 | 12.1 | 13.61 | 29.9 |
| 65 | 2 1/2" | 10.05 | 22.1 | 24.95 | 54.9 |
| 80 | 3" | 16.40 | 36.1 | 40.82 | 89.8 |
| 100 | 4" | 22.80 | 50.2 | 56.70 | 124.7 |
| 125 | 5″ | 36.50 | 80.3 | 90.72 | 199.6 |
| 150 | 6″ | 54.80 | 120.6 | 136.10 | 299.4 |

***IMPORTANT NOTICE:***

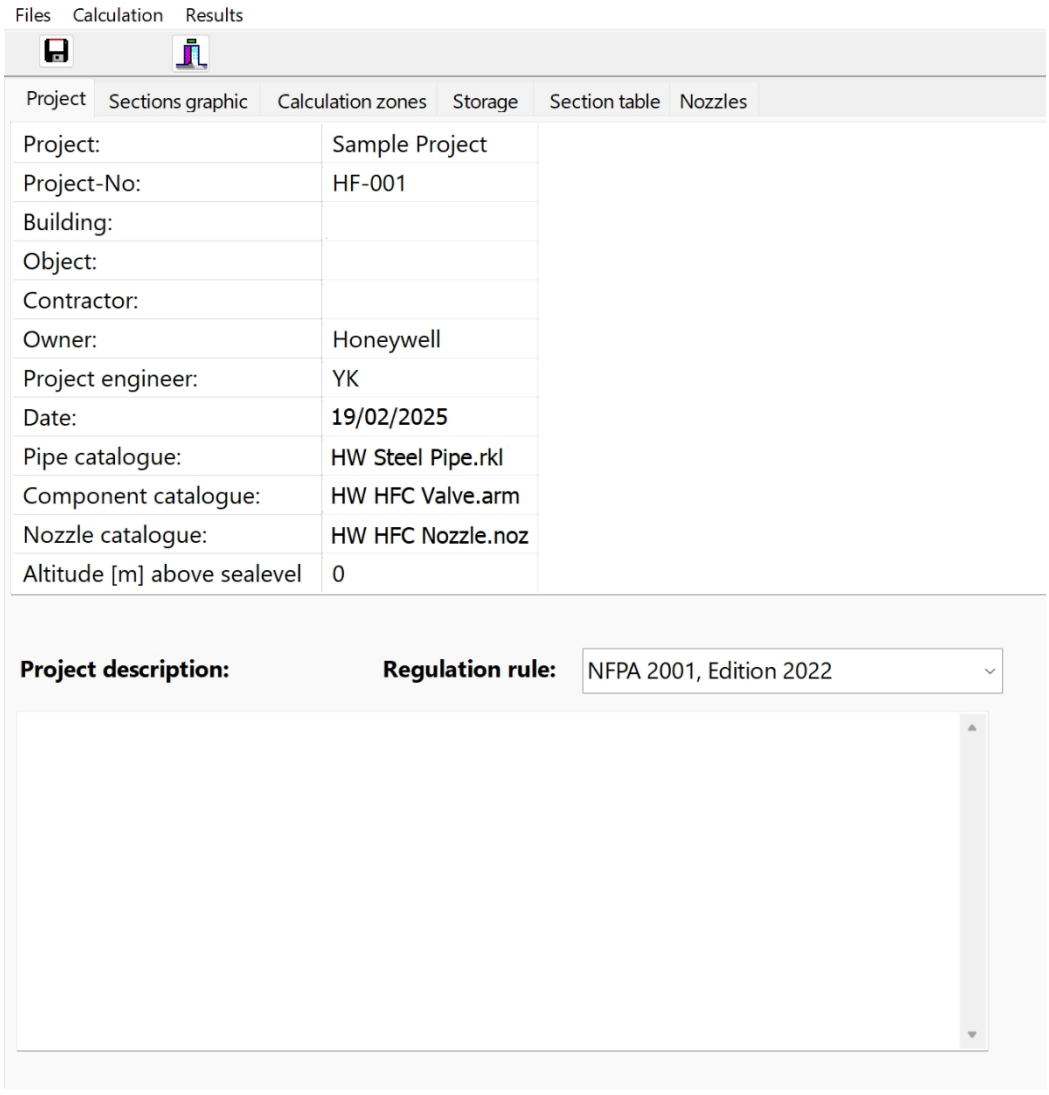
The Honeywell HFC-227ea Flow Calculation 7.8.0 Software must be used to determine the final pipe sizes. Please use this table for the estimations.

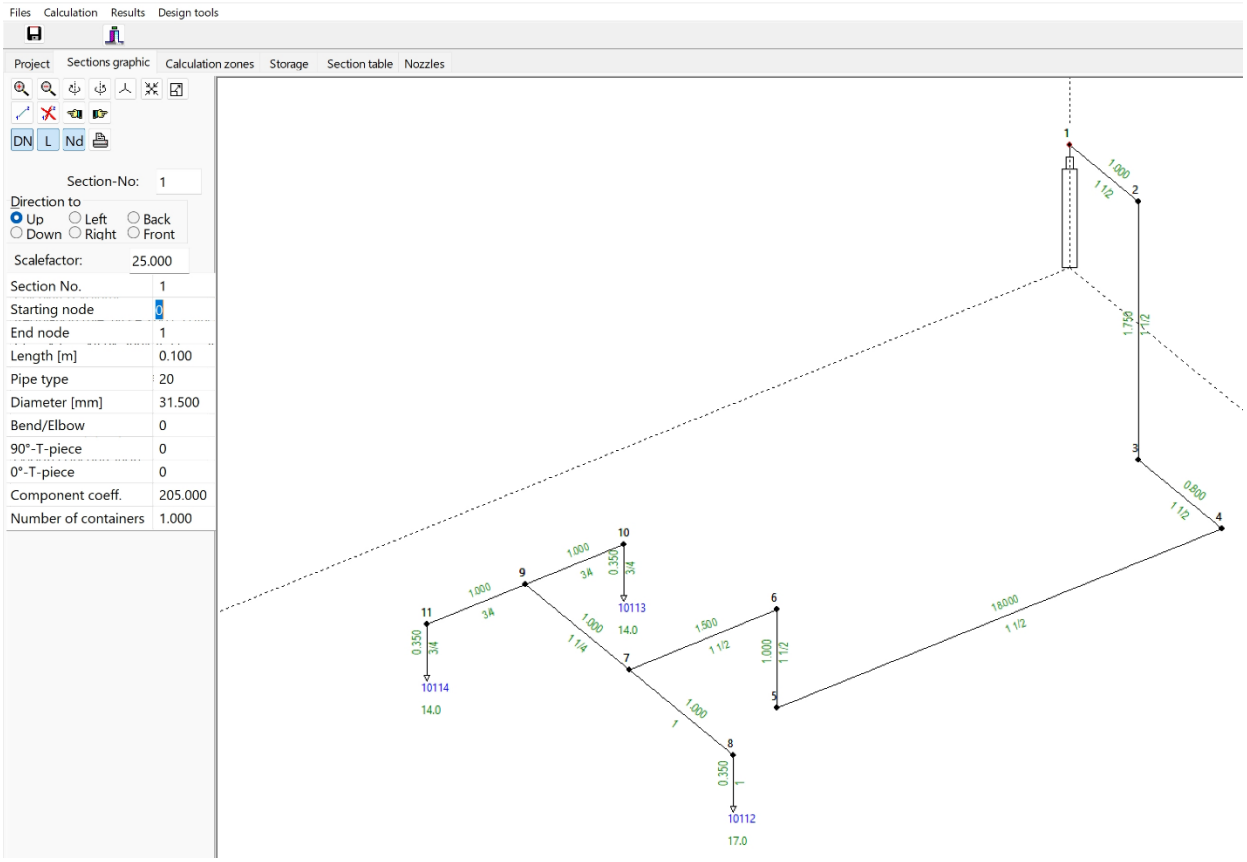
## 3.2.11. Honeywell HFC-227ea Flow Calculation 7.8.0 Software

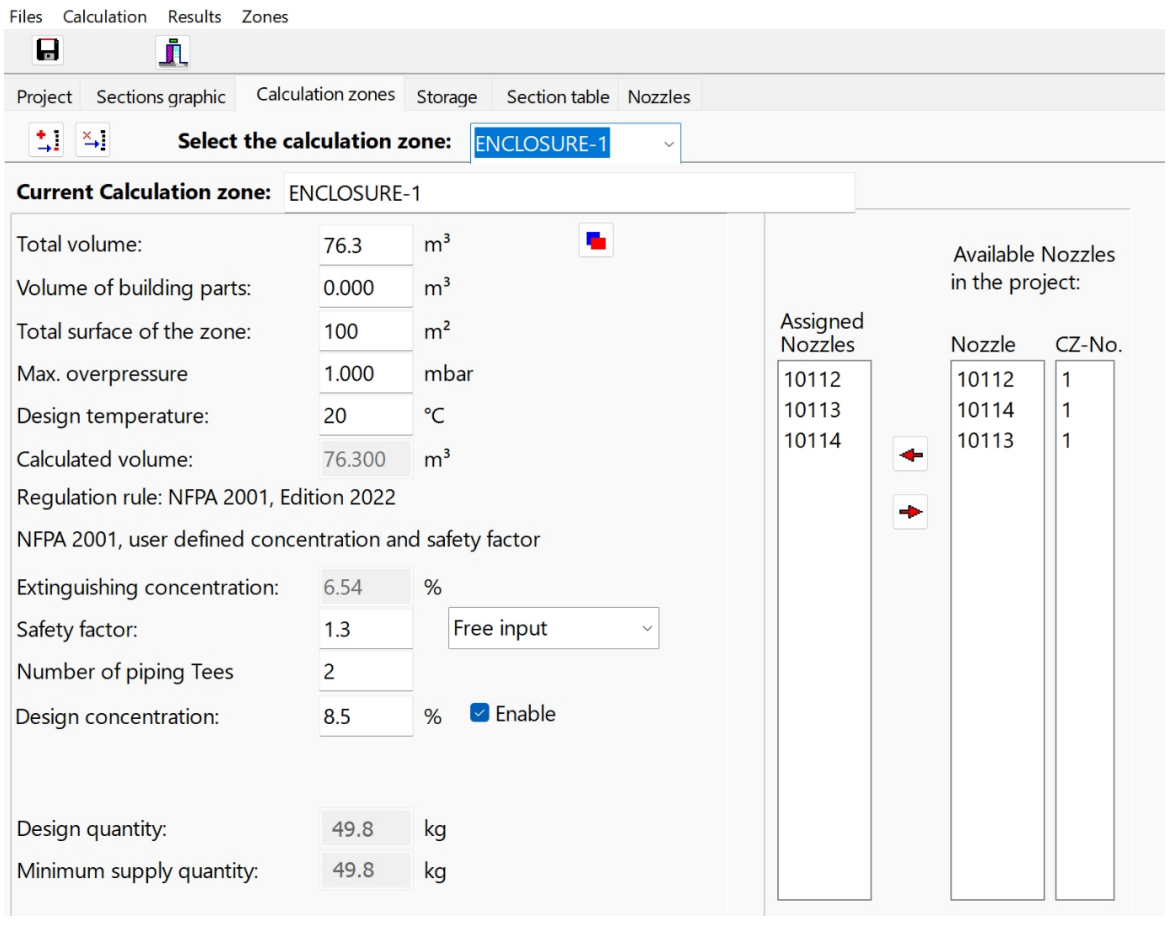
### Design / Flow Calculation Limitations

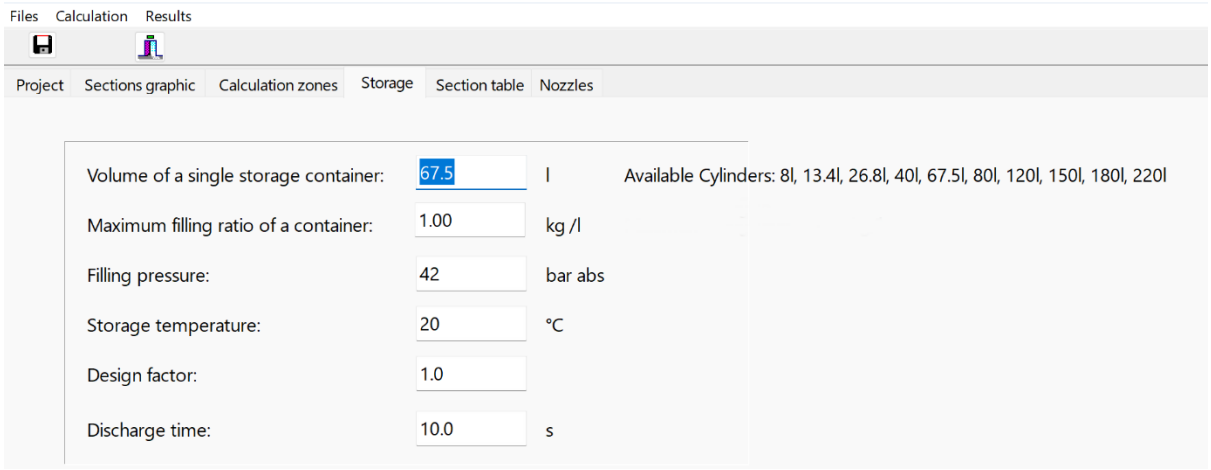
| | |
|---|---|
| • Minimum nozzle pressure: | 10.73 bar (155.58psi) |
| • Maximum Piping Variance for Each Nozzle: | %22.7 |
| • Maximum Pressure Variance for Each Nozzle: | 4.32 bar (62.64psi) |
| • Agent percentage in pipe (filling portion ratio): | %61 |
| • Minimum pipe volume ratio before first tee: | %18.8 |
| • Maximum agent arrival time imbalance: | 1 s |
| • Side tee split limit: | Side tee (%11 to %31),<br>Through tee (%90 to %69), |
| • Bull tee split limit: | %30 to %70 |
| • Minimum fill density: | 0.5 kg/L (31.2 lb/ft$^3$) |
| • Maximum fill density: | 1.0 kg/L (62.4 lb/ft$^3$) |
| • Discharge time: | 6s to 10s |
| • Maximum configurable cylinder arrangement: | 1 pc Master + 8 pcs slave |
| • Minimum pipe lengths after fittings: | 10 x internal pipe diameter |
| • Maximum elevation in pipe run: | 15.8 m (51.84 Ft) |
| • Maximum horizontal pipe run: | 18.5 m (60.70 Ft) |


Files Help
Honeywell
VdS
Calculation of HFC-227ea - systems
Version 7.8.0
Licenced to: Honeywell
Serial no: [Dongle]
Copyright by VdS Schadenverhütung


Files Calculation Results
Project
Sections graphic
Calculation zones
Storage
Section table
Nozzles
Project: Sample Project
Project-No: HF-001
Building:
Object:
Contractor:
Owner: Honeywell
Project engineer: YK
Date: 19/02/2025
Pipe catalogue: HW Steel Pipe.rkl
Component catalogue: HW HFC Valve.arm
Nozzle catalogue: HW HFC Nozzle.noz
Altitude [m] above sealevel 0
Project description:
Regulation rule: NFPA 2001, Edition 2022


Files Calculation Results Design tools
Project Sections graphic Calculation zones Storage Section table Nozzles
DN L Nd
Section-No: 1
Direction to
Up Left Back
Down Right Front
Scalefactor: 25.000
Section No. 1
Starting node 0
End node 1
Length [m] 0.100
Pipe type 20
Diameter [mm] 31.500
Bend/Elbow 0
90°-T-piece 0
0°-T-piece 0
Component coeff. 205.000
Number of containers 1.000
10113
14.0
10114
14.0
10112
17.0

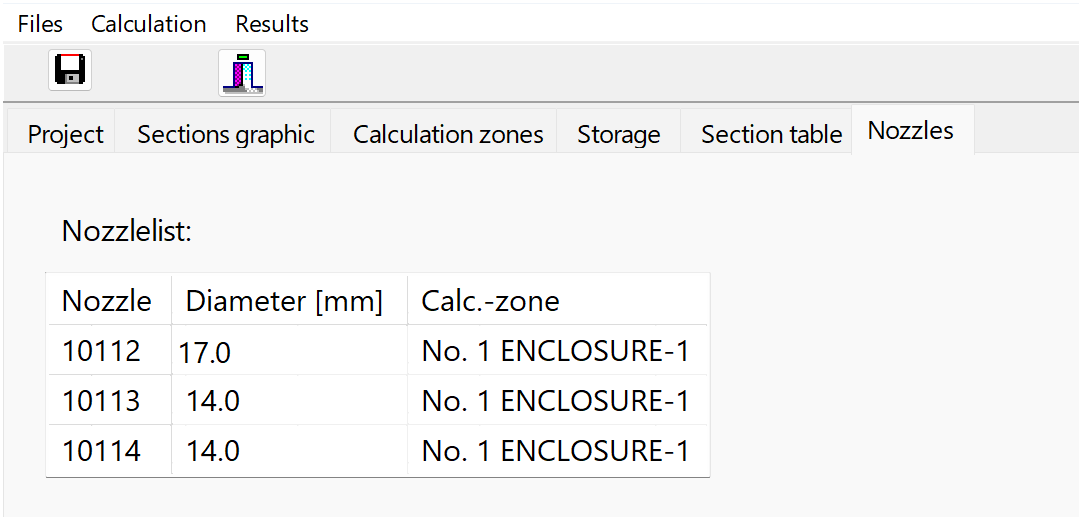

Files Calculation Results Zones
Project Sections graphic Calculation zones Storage Section table Nozzles
Select the calculation zone: ENCLOSURE-1
Current Calculation zone: ENCLOSURE-1
Total volume: 76.3 m³
Volume of building parts: 0.000 m³
Total surface of the zone: 100 m²
Max. overpressure 1.000 mbar
Design temperature: 20 °C
Calculated volume: 76.300 m³
Regulation rule: NFPA 2001, Edition 2022
NFPA 2001, user defined concentration and safety factor
Extinguishing concentration: 6.54 %
Safety factor: 1.3 Free input
Number of piping Tees 2
Design concentration: 8.5 % Enable
Design quantity: 49.8 kg
Minimum supply quantity: 49.8 kg
Available Nozzles in the project:
Assigned Nozzles
10112
10113
10114
Nozzle CZ-No.
10112 1
10114 1
10113 1




Files Calculation Results Sections

Project Sections graphic Calculation zones Storage Section table Nozzles

| No. | Start | End | Orientation | Length [m] | Heigthdiff. [m] | Pipe type | Diameter [mm] | Bend/Elbow | 90°-T | 0°-T | Component | Number of container |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 1 | up | 0.100 | 0.100 | 20 | 31.5 | 0 | 0 | 0 | 245 | 1.000 |
| 2 | 1 | 2 | right | 1.000 | 0.000 | 23 | 40.9 | -1 | 0 | 0 | 0.000 | 0.000 |
| 3 | 2 | 3 | down | 1.750 | -1.750 | 23 | 40.9 | -1 | 0 | 0 | 0.000 | 0.000 |
| 4 | 3 | 4 | right | 0.800 | 0.000 | 23 | 40.9 | -1 | 0 | 0 | 0.000 | 0.000 |
| 5 | 4 | 5 | front | 18.000 | 0.000 | 23 | 40.9 | -1 | 0 | 0 | 0.000 | 0.000 |
| 6 | 5 | 6 | up | 1.000 | 1.000 | 23 | 40.9 | -1 | 0 | 0 | 0.000 | 0.000 |
| 7 | 6 | 7 | front | 1.500 | 0.000 | 23 | 40.9 | -1 | 0 | 0 | 0.000 | 0.000 |
| 8 | 7 | 8 | right | 1.000 | 0.000 | 23 | 26.6 | 0 | 1 | 0 | 0.000 | 0.000 |
| 9 | 8 | 10112 | down | 0.350 | -0.350 | 23 | 26.6 | -1 | 0 | 0 | 0.000 | 0.000 |
| 10 | 7 | 9 | left | 1.000 | 0.000 | 23 | 35.0 | 0 | 1 | 0 | 0.000 | 0.000 |
| 11 | 9 | 11 | front | 1.000 | 0.000 | 23 | 20.9 | 0 | 1 | 0 | 0.000 | 0.000 |
| 12 | 11 | 10114 | down | 0.350 | -0.350 | 23 | 20.9 | -1 | 0 | 0 | 0.000 | 0.000 |
| 13 | 9 | 10 | back | 1.000 | 0.000 | 23 | 20.9 | 0 | 1 | 0 | 0.000 | 0.000 |
| 14 | 10 | 10113 | down | 0.350 | -0.350 | 23 | 20.9 | -1 | 0 | 0 | 0.000 | 0.000 |



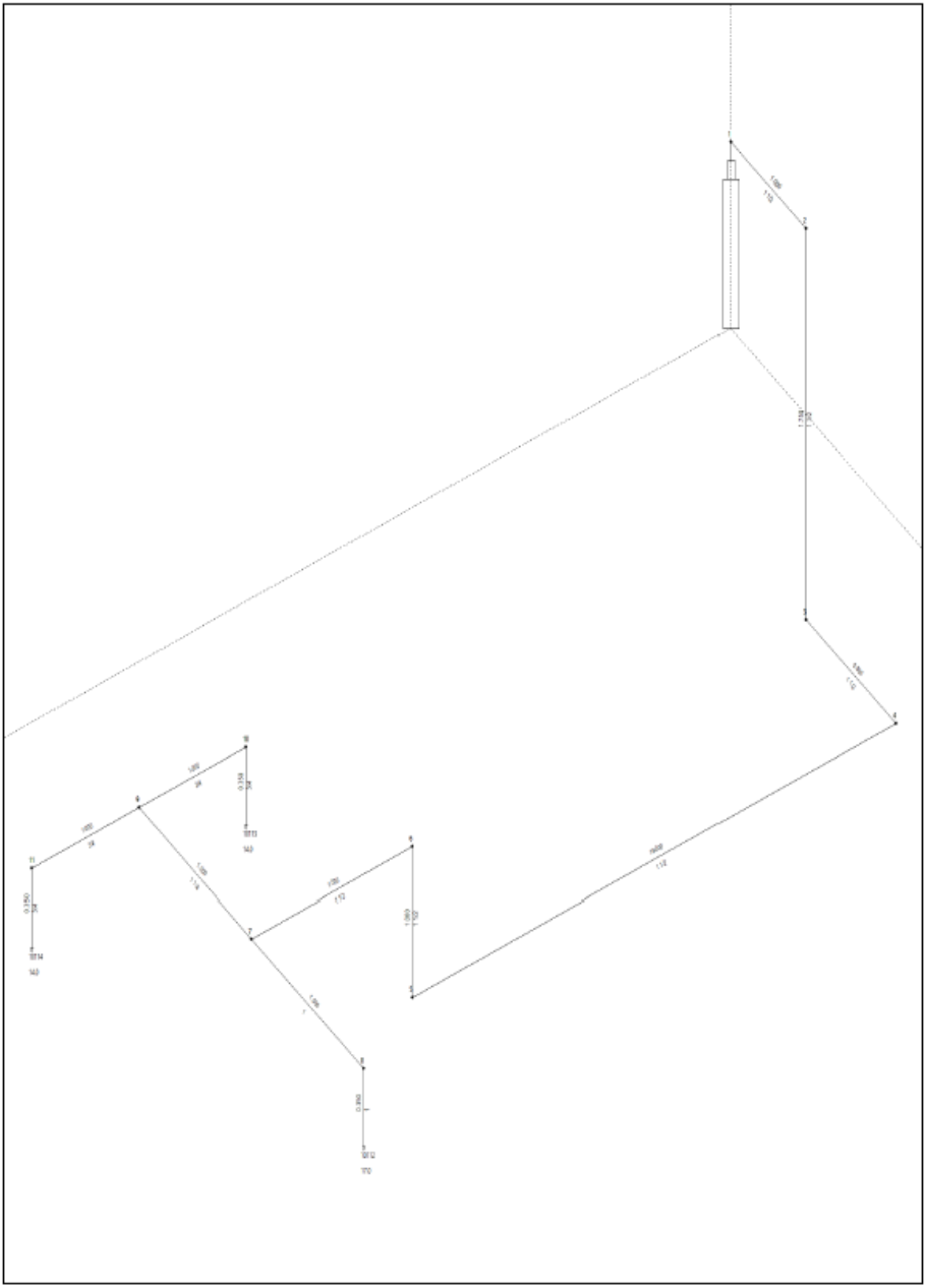

Nozzlelist:

| Nozzle | Diameter [mm] | Calc.-zone |
|---|---|---|
| 10112 | 17.0 | No. 1 ENCLOSURE-1 |
| 10113 | 14.0 | No. 1 ENCLOSURE-1 |
| 10114 | 14.0 | No. 1 ENCLOSURE-1 |

Example of The Hydraulic Calculation Reports:



| | |
|---|---|
| Project: | |
| Project-No: | |
| Building: | |
| Object: | |
| Contractor: | |
| Owner: | Honeywell |
| Project engineer: | YK |
| Date: | 19/02/2025 |
| Regulation rule for calculation of HFC227ea quantities: | NFPA 2001, Edition 2022 |
| Altitude above sealevel: | 0 m |
| | |
| Pipe catalogue: | HW Steel Pipe.rkl |
| Component catalogue: | HW HFC Valve.arm |
| Nozzle catalogue: | HW HFC Nozzle.noz |



# Input data

## Pipe system data:

| Section-No. | Start node | End Node/ Nozzle | Length [m] | Height-diff. [m] | Pipe type | Dia-meter [mm] | Fitting * | Component Code | Component Coeffi-cient | Number of containers |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 1 | 0.100 | 0.100 | 10 | 31.5 | C | 245 | 6.710 | 1 |
| 2 | 1 | 2 | 0.500 | 0.000 | 23 | 40.9 | E | - | - | 0 |
| 3 | 2 | 3 | 1.400 | -1.400 | 23 | 40.9 | E | - | - | 0 |
| 4 | 3 | 4 | 0.800 | 0.000 | 23 | 40.9 | E | - | - | 0 |
| 5 | 4 | 5 | 18.500 | 0.000 | 23 | 40.9 | E | - | - | 0 |
| 6 | 5 | 6 | 1.000 | 1.000 | 23 | 40.9 | E | - | - | 0 |
| 7 | 6 | 7 | 1.500 | 0.000 | 23 | 40.9 | E | - | - | 0 |
| 8 | 7 | 8 | 1.000 | 0.000 | 23 | 26.6 | T-90° | - | - | 0 |
| 9 | 8 | 10114 | 0.350 | -0.350 | 23 | 26.6 | E | - | - | 0 |
| 10 | 7 | 9 | 1.000 | 0.000 | 23 | 35.0 | T-90° | - | - | 0 |
| 11 | 9 | 11 | 1.000 | 0.000 | 23 | 20.9 | T-90° | - | - | 0 |
| 12 | 11 | 10112 | 0.350 | -0.350 | 23 | 20.9 | E | - | - | 0 |
| 13 | 9 | 10 | 1.000 | 0.000 | 23 | 20.9 | T-90° | - | - | 0 |
| 14 | 10 | 10113 | 0.350 | -0.350 | 23 | 20.9 | E | - | - | 0 |

* C=Component, B=Bend, T=T-Piece, E=Elbow, R=Restrictor

## Legend of pipetypes

| Type | Pipeclass | Pipe roughness |
|---|---|---|
| 10 | SIPHONE TUBE | smooth |
| 23 | ASTM SCH40 | black pipe |

## Legend of components

| Code | Type | Resistamce coefficient |
|---|---|---|
| 245 | HW HFC227 DN33 Assem | 6.710 |



| Calculation Zone | No. | Diameter [mm] |
|---|---|---|
| ENCLOSURE-1 | 10112 | 17 |
| ENCLOSURE-1 | 10114 | 14 |
| ENCLOSURE-1 | 10113 | 14 |

## Calculation zone data:

Calculation of design quantity:

| Zone | Total volume [m3] | Volume of building parts [m3] | Calculated volume [m3] | Max. Over-pressure [mbar] | Design temp. [°C] | Temp. corr. factor | Extinguish-conc. [% Vol] | Design factor | Design conc. [% Vol] | Design quantity [kg] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 ZON-1 | 73.6 | 0.0 | 73.6 | 1.000 | 20.0 | 1.000 | 6.5 | 1.30 | 8.5 | 49.79 |

Regulation rule for calculation of HFC227ea quantities: NFPA 2001, Edition 2022

# Calculation results:

### HFC227ea storage input data:

| | |
|---|---|
| Design quantity: | 49.8 kg |
| Supplement factor: | 1 |
| Minimum storage quantitiy: | 49.8 kg |
| Container volume: | 67.5 l |
| Filling ratio: | 0.74 kg/l |
| Filling pressure: | 42.0 bar abs |
| HFC227ea -mass per container: | 49.8 kg |
| Number of containers: | 1 |
| Actual storage quantity: | 49.8 kg |
| Storage temperature: | 21.0 °C |
| Starting container pressure: | 42.0 bar abs |

### Discharge time:

| | |
|---|---|
| Discharge time air: | 0.5s |
| Total gas discharge time: | 0.5s |
| Two-phase discharge time: | 6.9s |
| Total discharge time: | 7.3s |

### System information:

| | |
|---|---|
| Container working pressure: | 17.6 bar abs |
| Container working temperature: | 18.6 °C |
| Total network volume: | 33.8 l |
| Medium pipe content: | 32.7 kg HFC227ea |
| Filling portion in pipe system: | 0.66 kg HFC227ea/kg HFC227ea-storage |

## Pipe system:

| Section-No: | Starting-node | Endnode Nozzle | Pressure [bar abs] | Flowrate [kg/s] | Pipedimension Di [mm] | DN |
|---|---|---|---|---|---|---|
| 1 | 0 | 1 | 15.24 | 6.87 | 31.5 | 1 1/4 |
| 2 | 1 | 2 | 14.98 | 6.87 | 40.9 | 1 1/2 |
| 3 | 2 | 3 | 14.82 | 6.87 | 40.9 | 1 1/2 |
| 4 | 3 | 4 | 14.54 | 6.87 | 40.9 | 1 1/2 |
| 5 | 4 | 5 | 13.40 | 6.87 | 40.9 | 1 1/2 |
| 6 | 5 | 6 | 13.00 | 6.87 | 40.9 | 1 1/2 |
| 7 | 6 | 7 | 12.65 | 6.87 | 40.9 | 1 1/2 |
| 8 | 7 | 8 | 12.20 | 4.23 | 26.6 | 1 |
| 9 | 8 | 10114 | 11.42 | 4.23 | 26.6 | 1 |
| 10 | 7 | 9 | 12.36 | 2.64 | 35.0 | 1 1/4 |
| 11 | 9 | 11 | 12.22 | 1.32 | 20.9 | 3/4 |
| 12 | 11 | 10112 | 11.98 | 1.32 | 20.9 | 3/4 |
| 13 | 9 | 10 | 12.22 | 1.32 | 20.9 | 3/4 |
| 14 | 10 | 10113 | 11.98 | 1.32 | 20.9 | 3/4 |

## Nozzle data:

| Calculation-zone no. | Nozzle no. | Nozzle type | Number of orifices | Pipeconnection Di [mm] | Pipeconnection DN | Orifice [mm] | HFC227ea output [kg] |
|---|---|---|---|---|---|---|---|
| 1 | 10112 | 1 | 1 | 20.9 | 3/4 | 14 | 9.6 |
| 1 | 10113 | 1 | 1 | 20.9 | 3/4 | 14 | 9.6 |
| 1 | 10114 | 1 | 1 | 26.6 | 1 | 17 | 30.6 |

Two-phase discharge time: 6.9 s
Released two-phase HFC227ea : 49.8 kg

MAXIMUM TRANSPORT TIME DIFF. BETWEEN NOZZLES: 11014./ 11013. IS 0.45 S

| Calculation-zone no: | Nozzle no. | Outlet velocity [m/s] | Transport time [s] | Jetdistance [m] |
|---|---|---|---|---|
| 1 | 11012 | 23.1 | 5.02 | 4.7 |
| 1 | 11013 | 23.1 | 5.02 | 4.7 |
| 1 | 11014 | 22.3 | 4.57 | 8.6 |

## Concentrations:

| Calculation-zone no: | Gascomposition after the discharge [%] O2 | HFC227ea | N2 |
|---|---|---|---|
| 1 | 19.1 | 8.5 | 71.5 |

## Pressure relief opening:

| Calculation-zone no: | Recommended area against overpressure Area [m2] | Overpressure [mbar] | Max. flow [kg/s] |
|---|---|---|---|
| 1 | 0.123 | 1 | 6.9 |

# Component list:

## Cylinder Valve Assemblies and Selector Valves

| Type | Amount | Code | Coefficient |
|---|---|---|---|
| HW HFC227ea DN33 Assem | 1 | 245 | 6.700 |

| Nozzle-type | Number | C1 | C2 | C3 | C4 | C5 | C6 |
|---|---|---|---|---|---|---|---|
| 1 | 3 | 0.17600 | 0.19660 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |

| Pipe-type | Di [mm] | DN | Length [m] |
|---|---|---|---|
| 10 | 31.50 | 11/4 | 0.100 |
| 23 | 40.90 | 1 1/2 | 23.700 |
| 23 | 26.60 | 1 | 1.300 |
| 23 | 35.00 | 1 1/4 | 1.000 |
| 23 | 20.90 | 3/4 | 2.600 |

## Pipe Bends (+) and Elbows (-)

| Bend-type | DI [mm] | DN | Number |
|---|---|---|---|
| -90 | 40.9 | 1 1/2 | 6 |
| -90 | 26.6 | 1 | 1 |
| -90 | 20.9 | 3/4 | 2 |

## Number of T-distributors (in- and outdiameter)

| Number | Input | 90-out | 90-out | 0-out |
|---|---|---|---|---|
| 1 | 40.9 | 26.6 | 35 | 0 |
| 1 | 35 | 20.9 | 20.9 | 0 |

# 4. Installation

## 4.1. General Equipment Installation

HFC-227ea clean agent fire extinguishing system must be installed to facilitate proper inspection, testing, manual operation, recharging and any other required maintenance as may be necessary.

Equipment must not be subject to severe weather conditions or mechanical, chemical or other damage that could render the equipment inoperative. Equipment must be installed in accordance with NFPA2001 (current edition).

## 4.2. Order of Installation

- Cylinder installation
- Piping and nozzles
- Actuation controls
- Ancillary equipment
- Completion procedures

Specific installation drawings must be prepared for the hazard area in accordance with system design as calculated by The Honeywell HFC-227ea Flow Calculation 7.8.0 Software. These drawings should be followed closely to ensure the system meets its design criteria. The pipe network is sized to obtain correct discharge time, nozzle pressures, agent quantity and various other design considerations. If for any reason, the pipe network requires. Modifications to the system must be recalculated before proceeding with installation. Installation drawings contain the following information.

- Enclosure volumes
- Agent quantities
- Scaled pipe network plan
- Pipe network isometric
- Pipe diameters, pipe length drops and rises
- Nozzle data
- Cylinder data
- Actuator technical data
- Low pressure switch wiring chart
- Fittings data

Installation drawings shall be submitted for approval to the appropriate authority prior to system installation. The cylinder weight is checked at the factory prior to dispatch and recorded on the label attached to the cylinder. If there is any doubt regarding the weight, or leakage is suspected, the cylinder should be weighed to confirm there is no weight loss.

### 4.2.1. Cylinder installation

The cylinder location is identified on the system drawings and should be protected from extremes of temperature and be accessible for service and maintenance. The cylinders must be installed vertically on the floor and firmly secured to a wall or bulkhead. No safety outlet and actuation caps should be removed at this stage.

#### 4.2.1.1. Single cylinder installation

1. Fix the back channels of the mounting brackets to the wall at the appropriate heights using suitable anchor type bolts.
2. Position the cylinder against the back channel with the valve outlet pointing left.
3. Insert the cylinder brackets at top and bottom and secure with the bolts.
4. Remove the safety outlet cap from the valve outlet adaptor.
5. With the outlet cap removed from the valve outlet adaptor, connect flexible discharge hose or valve outlet adapter.
6. Remove the protection cap from the cylinder valve actuation port.
7. Install the manual and solenoid actuator to the cylinder valve actuation port.

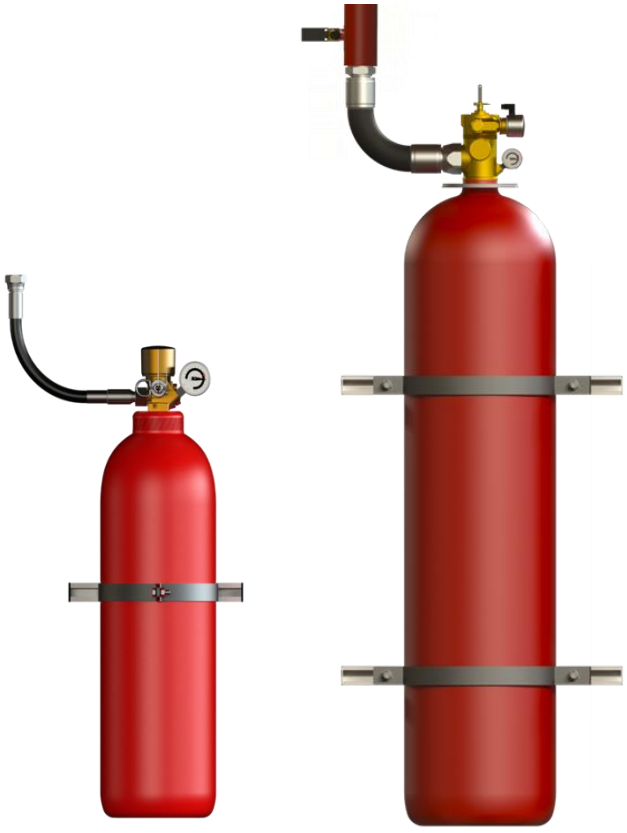


Figure 4.1.: Single cylinder assembly

### 4.2.1.2. Multiple cylinders installation

Cylinders are manifolded together for three main reasons:

• To reduce the amount of piping required by connection to one feeder pipe.

• For systems that require main and reserve system configuration.

• Combining the correct cylinders to obtain the required quantity of agent within a specific hazard area.

1. Fix the back channels of the mounting brackets to the wall at the appropriate heights using suitable anchor type bolts. (see Figure 4.2)

2. Position the cylinders against the back channels with the valve outlets pointing left at the required spacing for the manifold ports. (see Figure 4.3)

3. Insert the cylinder brackets at top and bottom and secure with the nut bolts. (see Figure 4.3)

4. Remove the safety cap from one cylinder outlet port and connect the flexible discharge hose to the cylinder outlet port. (see Figure 4.4 and 4.5)

5. Remove the protection caps from the cylinder actuation ports. (see Figure 4.5)

6. Install the manual, solenoid and pneumatic actuators to the cylinder valve actuation ports. (see Figure 4.5 and 4.6)



Figure 4.2.: Manifold and bracket assembly for multiple cylinder



Figure 4.3.: Cylinder assembly with cylinder protection cap



Figure 4.4.: Cylinder assembly after removing cylinder protection cap.



Figure 4.5.: Discharge and actuation line assembly for multiple cylinder

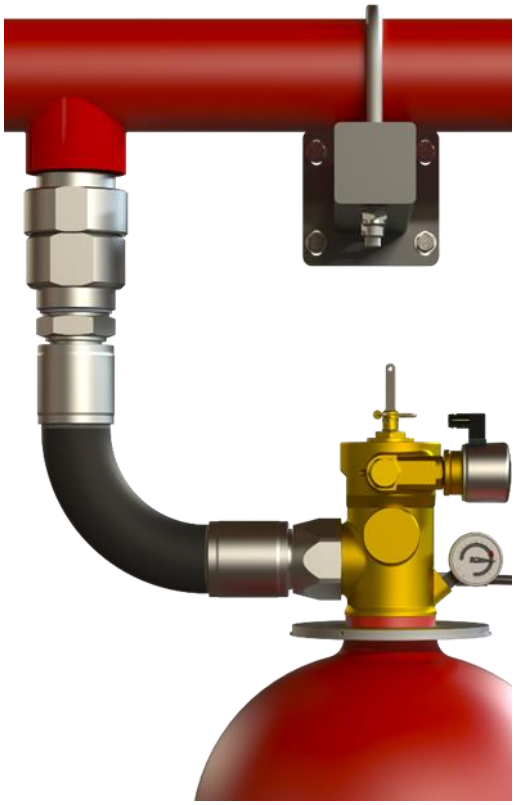


Figure 4.6.: Assembly of discharge hose & check valve with cylinder

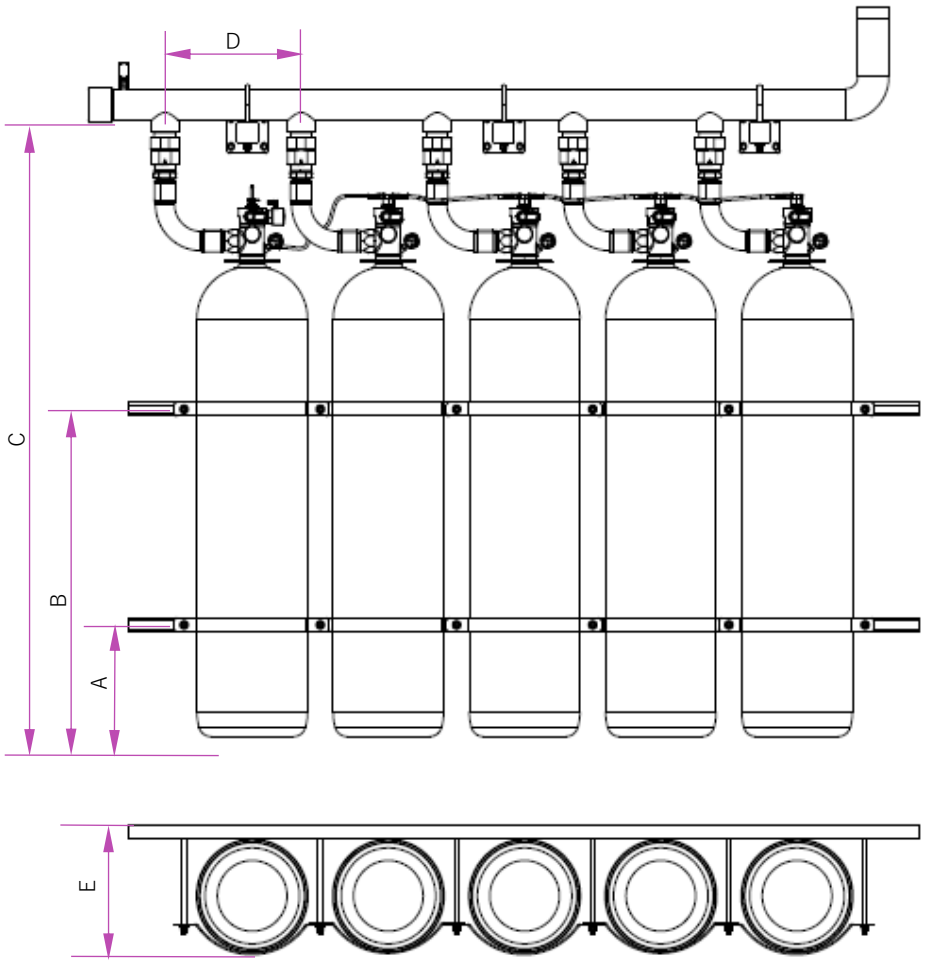



Figure 4.7.: Multiple cylinder installation dimensions

| Table 4.1. Multiple Cylinder Installation Dimensions | | | | | |
|---|---|---|---|---|---|
| **Type** | **A (mm)** | **B (mm)** | **C (mm)*** | **D (mm)** | **E (mm)** |
| 67.5L | 400 | 1150 | 1740 | 500 | 330 |
| 80L | 400 | 1250 | 1740 | 500 | 330 |
| 120L | 400 | 1200 | 1500 | 500 | 420 |
| 180L | 500 | 1350 | 1950 | 500 | 470 |
| 220L | 500 | 1350 | 2300 | 500 | 470 |

**These can change according to manifold dimension and discharge hose length.*

### 4.2.2. Pipe installation

In general, the installation should commence at the union elbow/manifold assembly and progress along to the discharge nozzles. Install the pipework to the installation drawings provided, ensuring that the following is adhered to:

1. The piping material must conform to the requirements of NFPA2001.
2. The pipe must be reamed, blown clear and swabbed with an appropriate solvent to remove mill varnish and cut oil before assembly.

### 4.2.2.1. Pipe type

Piping must be of noncombustible material having physical and chemical characteristics, such that its integrity under stress can be predicted with reliability. The computer flow program has only been verified for the specific types and schedule of pipe and fittings covered in this manual.
There is a risk that the system may not supply the required quantity of agent in unbalanced.

***IMPORTANT NOTICE:*** Cast iron and non-metallic pipes shall not be used.

### 4.2.2.2. Piping joints and fittings

The type of piping joint shall be suitable for the design conditions and shall be selected with consideration of joint tightness and mechanical strength.
Fittings shall have a minimum rated working pressure equal to or greater than the minimum design working pressure specified in NFPA2001 for the system pressure being used.

***IMPORTANT NOTICE:*** Class 150 and cast-iron fittings must not be used.

### 4.2.2.3. Installation of pipe and fittings

Pipe and fittings must be installed in strict accordance with the system drawings and good commercial practices. The piping between the cylinder and the nozzles must be the shortest route possible, with a minimum of fittings. Any deviations in the routing or number of fittings must be approved by the design engineer before installation. Piping must be reamed free of burrs and ridges after cutting, welding or threading. Joint compound or thread tape must be applied only to the male threads of the joint, excluding the first two threads. All piping must be blown clear with dry nitrogen or compressed air before installing the discharge nozzles.

### 4.2.2.4. Piping support installation

Pipe supports shall be of a non-combustible material, shall be suitable for the expected temperature and shall be able to withstand the dynamic and static forces involved. Due allowance shall be made for the stresses induced in the pipe work by temperature variations (From -20 °C to +50 °C). Adequate environmental protection shall be given to support and associated steelwork. The distance between pipe supports shall be as the following table:

**Table 4.2. Maximum Pipework Support Distance**

| Pipe Diameter | Max. Distance (m) | Pipe Diameter | Max. Distance (m) |
|---|---|---|---|
| 15mm (1/2″) | 1.5 | 65mm (21/2″) | 3.5 |
| 20mm (3/4″) | 1.8 | 80mm (3″) | 3.7 |
| 25mm (1″) | 2.1 | 100mm (4″) | 4.3 |
| 32mm (11/4″) | 2.4 | 125mm (5″) | 4.8 |
| 40mm (11/2″) | 2.7 | 150mm (6″) | 5.2 |

### 4.2.3. Master / Slave Cylinder Installation

1. Position the cylinder in designated location and secure in place with cylinder bracket and attaching hardware (see Figure 4.2 and Table 4.1) Orient cylinder with valve outlet angled toward system piping.

2. Remove the safety cap from the cylinder valve outlet port.

3. Connect a flexible discharge hose or valve outlet adapter to the cylinder outlet port.

4. Install the master / slave cylinder actuator kit.

5. Remove the protection cap from the cylinder valve actuation port.

6. Install pneumatic actuator and actuation line hose; do not attach solenoid actuator to slave cylinder valve actuation port at this time.

7. Install solenoid actuator and actuation line hose to slave cylinder.

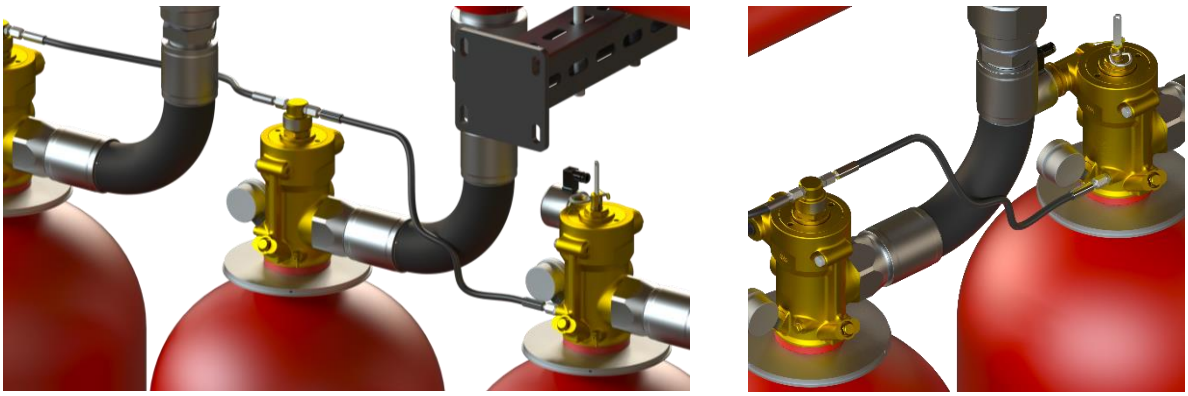


Figure 4.8.: Assembly of actuation line with master and slave cylinders

***IMPORTANT NOTICE:***

Maximum configurable cylinder arrangement shall be 1 pc Master + 8 pcs slave

### 4.2.4. Installation of Pressure Switch

Pressure switches must be connected to the discharge manifold or piping in an upright position. Pressure switches have DN15 (1/2") BSP pressure inlets to connect to the system piping.

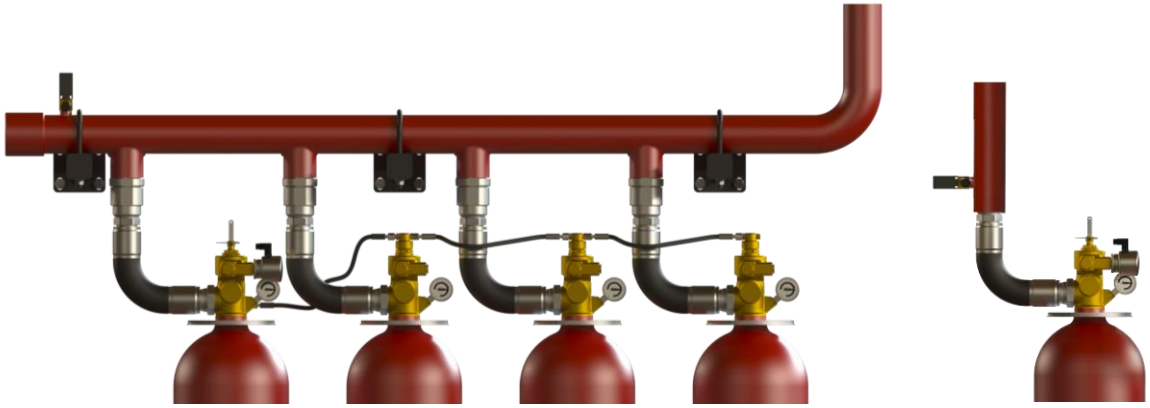


Figure 4.9.: Typical discharge pressure switch assembly on manifold or/and single cylinder

### 4.2.5. Installation of Nozzles

Nozzle type, style, and orifice diameter are determined based upon flow calculations made by the HFC-227ea clean agent flow software during the system design. Discharge nozzles are female BSP thread. Due to the thrust generated from a 180° corner or 360° sidewall nozzle, a rigid hanger or support must be located within 300mm (12") of the nozzle to prevent pipe movement and / or nozzle rotation during discharge.

### 4.2.6. Discharge Piping Pressure Test

All fittings be checked for tightness and pressure tested. Remove the nozzles and install pipe caps. Remove the discharge piping from the cylinder valve and install the safety cape onto the cylinder discharge outlet. Connect a source of dry compressed air or nitrogen to the distribution piping. Slowly increase the pressure in the piping to 3 Bar (43.5 psi) and then close the valve supplying pressure. Check the pressure after 10 minutes. If the pressure is above 2.7 Bar (39.2 psi) (80 % of test pressure) the system is considered sealed. If it drops below 2.7 Bar (39.2 psi) check and tighten all fittings then re-run the test. After completing the test, remove pipe caps, reinstall nozzles, and reconnect discharge piping to cylinder.

Dry compressed air or nitrogen must be discharged through the piping network and nozzles to verify the flow is continuous and that the piping and nozzles are unobstructed. Make certain air/nitrogen is discharging from all nozzles. Check all nozzles to be sure the correct nozzles are installed as shown on the installation drawing, installed securely to the pipe, properly anchored, and properly oriented. Check all nozzles for any obstructions or objects placed in the direct pattern of discharge. NFPA2001 should be considered in all other matters not specified.

Perform a full functional test of the control system in accordance with the appropriate technical manual and system design drawings including verification that all control functions such as damper and door closure, HVAC shut down, and power shut down occur as intended. If the HVAC is not being shutdown prior to system discharge it must be of the re-circulating close loop type and enough agent must be provided to compensate for the volume of the duct and plenum.

### 4.2.7. Hand-Over Procedures

The entire system shall be thoroughly inspected to make sure that it is complete and that all tests required during installation have been properly carried out. NFPA2001 should also be consulted. Additional procedures may be required by the local Authority Having Jurisdiction (AHJ). In addition, the following items are particularly important.

1. Conduct a room integrity (door fan) test in accordance with NFPA2001. The results of this test will provide equivalent leakage area and, when conducted in accordance with the manufacturer's instructions, will predict the timeline for a descending interface to fall to a given height and estimate how long the extinguishing concentration will be maintained in the protected room.

2. A cylinder should be refilled or replaced when it shows a loss in agent quantity of more than 5 % or loss in pressure (Table 7.6. Filling Pressure vs Temperature Chart) of more than 10 %.

3. Check security and tightness of cylinder mounting brackets to a solid structure and cylinder brackets.
4. Piping should be checked for correct size, length, and grade and compared to the installation drawings, HFC-227ea clean agent flow calculation results, and manual limitations.
5. Check pipe supports for proper type, mounting, and spacing.
6. Check that nozzle location, size, and drill diameters of orifices match both installation / design drawings and calculations.
7. Check the cylinder weight information label according to the system requirement. If there is any doubt or loss of pressure, the cylinder must be weighed.
8. Ensure that the system is in operation and that the operating systems are functioning.

Ensure that adequate escape routes are provided with directional signs. Issuance of appropriate documentation will mean that the handover procedure has been completed. Appropriate records will be issued by firefighting teams or area by insurance authorities on the hazard suitability, acceptability and availability of the system.

### 4.2.8. Warning Notification

Appropriate warning notices should be affixed inside the protected room informing its occupants about the type of protection and modes of actuation in case of fire. All these signs should be clearly legible and resistant to environmental conditions. It is advisable to provide adhesive labels with a red or green background and white letters. Notices should incorporate at least the following messages:

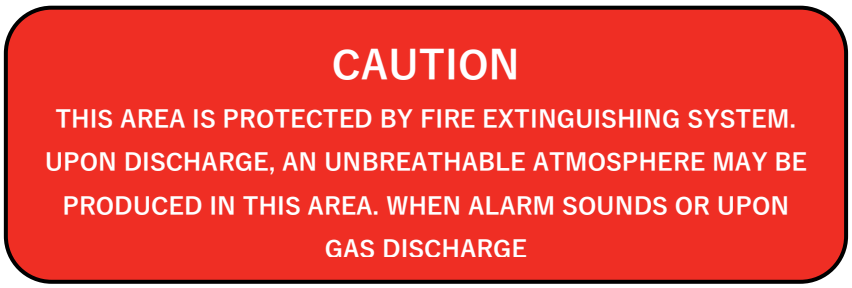
Typical sign inside the protected enclosure:




Typical sign outside the protected enclosure:



Typical sign affixed near the protected areas:




Typical signs placed at every manual actuation device:




Figure 4.10.: Caution sign variations for protected rooms

# 5. System Operation

## 5.1. General Comments

The personnel required to work in the protected area should be conversant with the detection and extinguishing equipment installed and trained in fire procedures. All life-saving equipment must be properly maintained. The method of system operation is chosen at the design stage to suit the protection required for the hazard area and the environmental factors appropriate to that area. This part of the document provides information relevant to all the standard operational systems to cover the eventuality of changes to, or expansion of the original design.

## 5.2. System Actuation

Each system is designed to suit the hazard area, whether the area is normally manned or unmanned, and whether the detection / actuation devices are to be manual or automatic. The permutation of systems is large but from an operational point of view, the systems are best grouped as:

- Manual
- Fully Automatic
- Automatic with Manual Intervention

### 5.2.1. Manual system

Manual systems depend on human detection of a fire in the hazard area and prompt action to actuate the local or remote strike knob for the HFC-227ea system to discharge and flood the protected area and extinguish the fire. In case of fire, detection system will generate audio-video alarm, and it will indicate person present in the hazard to evacuate from the hazard area.

On the total evacuation, the system can be triggered with the help of manual actuator, mounted on the master cylinder of clean agent system unit. Since the system is designed for manual actuation. A nominated person must be there, who should be fully aware of how to trigger the system manually. On periodic time fire drill to be performed with the staff, who are working in this hazard area or and around.

All other instructions associated with manual operation form part of the user's procedures on safety precautions and fire drill.

### 5.2.2. Fully Automatic System

Where a sensitive fire detection system is included for the automatic release of extinguishing agent, the system shall only be capable of automatic release when two or more sensors detect the fire. The number of detectors and their spacing is designed to ensure a satisfactory response time. To ensure personnel may safely evacuate the risk area an adjustable time delay should be fitted such that sufficient time may elapse prior to system discharge. Ideally, the delay period shall not exceed 30 seconds. Prior to system discharge (and at the commencement of any time delay period) a clearly audible alarm different from any other used shall sound and continue until the complete

system is reset. In areas of high ambient noise level, a visual indication may also be required, in addition to the audible warning.

### 5.2.3. Fully Automatic System with Manual Intervention

Manual intervention of an automatic system may be included for the following condition;

Where personnel are required to work within the protected area.

In protected areas where personnel are present and the concentration is greater than NOAEL, it is recommended that the automatic feature of the system is isolated during occupation. This may be achieved either by an electrically contacted lock assembly or by a clearly marked key switch at a suitable location outside the risk area.

## 5.3. Actions Following a Fire

These notes are only applicable to the hazard area(s) protected by HFC-227ea clean agent fire extinguishing system. Where such a system may form part of or combine with other forms of fire protection systems, then composite instructions for all systems are necessary to ensure the safety of personnel and property following a fire.

### 5.3.1. Actions Immediately Following a Fire

These actions should, at a minimum, include the following:

1. Advise the emergency services, Fire or Police if appropriate.
2. Organize a 'rollcall' of employees and any visitors.
3. Prevent unauthorized personnel from entering the hazard area.
4. In the case of deep-seated fires, the hazard space should be kept tightly closed for at least 60 minutes after discharge of the HFC-227ea clean agent extinguishing agent. It is essential that the fire be completely extinguished before ventilating the space. Before permitting anyone to enter space, ventilate thoroughly or ensure self-contained breathing equipment is used.
5. Do not enter the hazard area in which fire has been extinguished with an open flame or lighted cigarettes, the possible presence of flammable vapors may cause re-ignition or explosion. Should it be necessary to enter a space containing HFC-227ea clean agent or decomposition products the following precautions should be taken;

1. Use a fresh air mask or self-contained breathing equipment.
2. Do not use a filter mask or canister type mask.
3. Do not enter space unless you are under observation from outside the space or tethered by a lifeline.
4. Ensure that all pressurized equipment is isolated or safe from release.

# 6. Maintenance

## 6.1. Introduction

This chapter contains maintenance instructions for HFC-227ea clean agent fire suppression system.

## 6.2. Maintenance Procedure

***IMPORTANT NOTICE:*** HFC-227ea clean agent fire suppression system cylinder must be handled, installed and inspected by a qualified and trained by a personnel in accordance with the manual.

### 6.2.1. General

1. A well planned and approved schedule is essential for the inspection and testing of the system, keeping in view, the following.
2. At least once a year, all systems shall be thoroughly inspected and tested for proper operation by competent personnel. Discharge tests are not necessary.
3. The inspection report along with recommendations shall be filed and always available with the owner and the same shall be produced to the authorities concerned when demanded.
4. At least once in six months, the agent's quantity and pressure of the cylinders shall be checked and details logged in a register.
5. For HFC-227ea clean agent cylinder shows a loss in agent quantity of more than 5 percent or a loss in pressure (adjusted for room temperature) of more than 10 percent, it shall be refilled or replaced.
6. Date of inspection, gross weight of cylinder plus agent or net weight of agent, type of agent, person performing the inspection, and, where applicable, the pressure at a recorded temperature shall be recorded on a tag attached to the cylinder.

## 6.3. Agent Storage Cylinders

Agent storage cylinders, approved by Transportable Pressurized Equipment Directive (TPED), are pressurized vessels containing HFC-227ea clean agent super-pressurized with nitrogen to 42 Bar gauge at 21°C (610 psi at 70°F). This pressure causes considerable thrust if the discharge valve is actuated, thus, the safety cap supplied with the cylinder must be installed when handling or storing the cylinder, or whenever it is not securely fastened down. The safety cap prevents objects from striking the burst disc valve and reduces and redirects the thrust if the cylinder is accidentally discharged.

Handle the cylinder carefully to prevent damaging the gauge and other attached fixtures. The cylinder must not be subjected to temperatures above 50 °C (122 °F), or the pressure relief device may operate, releasing the agent.

### 6.3.1. Cylinder test

1. Clean agent cylinders shall not be recharged without retesting if more than 5 years have elapsed since the date of the last test and inspection.
2. Transporting charged cylinders that have not been tested within 5 years shall not be allowed
3. Cylinders continuously in service without discharging shall be given a complete external visual inspection every 5 years or more frequently if required. The visual inspection shall be in accordance with the guidelines of TPED, so that the cylinders need not be emptied or stamped while under pressure. Inspections shall be made only by competent personnel and the results recorded on both of the following:
a) A record tag permanently attached to each cylinder,
b) A suitable inspection report.
4. A completed copy of the inspection report shall be furnished to the owner of the system or an authorized representative. These records shall be retained by the owner for the life of the system.

## 6.4. Hose Test

### 6.4.1. General

All system hoses shall be examined annually for damage. If visual examination shows any deficiency, hose shall be immediately replaced or tested as specified below.

### 6.4.2. Testing

a) All hoses shall be tested every 5 years.
b) All hoses shall be tested at 1½ times the maximum cylinder pressure at 50 ºC. The testing procedure shall be as follows:
1. The hose is removed from any attachment.
2. The hose assembly is then placed in a protective enclosure designed to permit visual observation of the test.
3. The hose must be filled with water before testing.
4. Pressure then is applied at a rate-of-pressure rise to reach test pressure within a minimum of 1 min. The test pressure is maintained for 1 full min. Observations are then made to note any distortion or leakage.
5. If the test pressure has not dropped or if the couplings have not moved, the pressure is released. The hose assembly is then considered to have passed the hydrostatic test if no permanent distortion has taken place.
6. Hose assembly passing the test must be completely dried internally. If heat is used for drying, the temperature must not exceed the manufacturer's specifications.
7. Hose assemblies failing a hydrostatic test must be marked and destroyed and replaced with new assemblies.

8. Each hose assembly passing the hydrostatic test is marked to show the date of test.

## 6.5. Enclosure Inspection

At least every 12 months, the enclosure protected by these agents shall be thoroughly inspected to determine if penetrations or other changes have occurred that could adversely affect agent leakage or change volume of hazard or both. Where the inspection indicates conditions that could result in inability to maintain the clean agent's concentration, they shall be corrected. If uncertainty still exists, the enclosures shall be retested for integrity.

## 6.6. Training

All people who could be expected to inspect, test, maintain, or operate fire extinguishing systems shall be thoroughly trained and kept thoroughly trained in the functions they are expected to perform. Personnel working in an enclosure protected by these agents shall receive training regarding agent safety issues.

## 6.7. Maintenance Procedures

**Table 6.1. Maintenance Procedures by Time Schedule**

| Schedule | Requirement | Section |
|---|---|---|
| Daily | Check cylinder pressure | Paragraph 6.7.1 |
| Monthly | Inspect hazard area system components | Paragraph 6.7.2 |
| Check cylinder pressure | 42 Bar gauge at 21°C (610 psi at 70°F) | Paragraph 6.3 |
| Semi-Annually | Test pressure switches | Paragraph 6.7.3 |
| | Check Agent qty. and cylinder pressure | |
| | Actuation functional test | |
| Every 2 Years | Blow out distribution piping with nitrogen | Paragraph 6.7.4 |
| Every 5 Years | Agent cylinder pressure test or inspection | Paragraph 6.3 |
| | Flexible hose pressure test | Paragraph 6.4 |

### 6.7.1. Daily

#### 6.7.1.1. Check agent cylinder pressure

Check the cylinder pressure gauges for proper operating pressure (refer to Table 2.2.). If the pressure gauge indicates a pressure loss (adjusted for temperature) of more than 10 %, it shall be refilled. Remove and recharge the cylinder. For other requirement related to periodic maintenance of HFC-227ea clean agent unit please refer manual clause 6.2.1.

## 6.7.2. Monthly

### 6.7.2.1. General inspection

Make a general inspection survey of all cylinders and equipment for damaged or missing parts. If the equipment requires replacement.

### 6.7.2.2. Hazard access

Ensure access to hazard areas, manual pull stations, discharge nozzles, and cylinders are unobstructed and that nothing obstructs the operation of the equipment or distribution of HFC-227ea clean agent.

### 6.7.2.3. Inspect hoses

Inspect flexible actuation hoses for loose fittings, damaged threads, cracks, distortion, cuts and dirt. Tighten loose fittings and replace hoses with striped threads or other damage. If necessary, clean the parts. Inspect the adapters, couplings and tees at the cylinder pilot outlets and tighten couplings if necessary. Replace any damaged parts.

### 6.7.2.4. Inspect pneumatic actuators

Inspect the pressure actuators for physical damage, deterioration, corrosion, distortion, cracks, dirt and loose couplings. Tighten loose couplings. Replace damaged caps. Replace the control head if damaged. If necessary.

### 6.7.2.5. Inspect solenoid actuators

Inspect the solenoid actuators for damage, corrosion, and dirt. Check the solenoid actuators flexible electrical line for wear and damage. Check the solenoid actuator for loose coupling and tighten if necessary. Check that the indicator is in the SET position, the pull pin is installed in the manual lever, and the seal wire is intact. Replace the solenoid actuator if damaged.

### 6.7.2.6. Inspect cylinder and valve assembly

Inspect the Cylinder and Valve assembly for leakage and physical damage such as cracks, dents, distortion and worn parts. Check the burst disc and pressure gauges for damage. Replace damaged gauges or burst disc. If the gauge pressure is not 42 Bar gauge at 21°C (610 psi at 70°F) remove and recharge the cylinder.

### 6.7.2.7. Inspect brackets and mounting hardware

Inspect the cylinder brackets, cradles and mounting hardware for loose, damaged or broken parts. Check the cylinder brackets and associated parts for corrosion, oil, grease and grime. Tighten any loose hardware. Replace damaged parts. If necessary.

#### 6.7.2.8. Inspect discharge hoses

Inspect the flexible discharge hoses for loose fittings, damaged threads, cracks, rust, kinks, distortion, dirt and frayed wire braid. Tighten loose fittings and replace hoses with stripped threads. If necessary.

#### 6.7.2.9. Inspect discharge nozzles

Inspect discharge nozzles for dirt and physical damage. Replace damaged nozzles. If nozzles are dirty or clogged.

### 6.7.3. Inspection procedures, semi-annual

#### 6.7.3.1. Discharge pressure switch test

1. Contact the appropriate personnel and obtain authorization for a shutdown.
2. Ensure that the hazard area operations controlled by the pressure switch are operative.
3. Manually operate the manifold switch by pulling up on the plunger and verify that the hazard area operations controlled by the pressure switch shut down.
4. Return the manifold pressure switch to the SET position.
5. Reactivate all systems that were shut down by the pressure switch (such as power, ventilation systems and compressors)

#### 6.7.3.2. Solenoid actuator test

Solenoid actuator must be tested semiannually for proper operation. This test can be performed without discharging the cylinders. Test one hazard area at a time before proceeding to the next, as follows:

1. Remove all solenoid actuators from all cylinders serving the hazard area being tested. Let the solenoid actuators hang freely from the flexible electric conduit connections. Leave all pneumatic actuators and pilot actuation hoses attached to the cylinders.
2. Operate the System electrically. This can be accomplished by actuation of the control panel or by manual operation of an electric pull station.
3. If the manual actuator has not operated. Replace all damaged actuators.
4. Observe the instructions on the caution label attached to the manual actuator. Replace any damaged heads which fail to reset properly before reconnecting to cylinders. Reattach all actuators to the threaded port on the cylinder valve or pressure operated control head. Tighten the swivel nut securely. Make certain each actuator is in SET position before reconnecting to cylinders. Failure to follow this procedure will result in accidental system discharge.

#### 6.7.3.3. Check cylinder weight

The cylinder weight shall be checked and compared to the gross weight marked on the cylinder. If the scale indicates a loss in agent quantity of more than 5 %, it shall be refilled. Remove and

recharge the cylinder. For other requirements related to periodic maintenance of the Clean Agent Unit please refer manual clause 6.2.1.

### 6.7.4. Inspection procedures - 2 year

1. Remove any nozzles from the piping to allow foreign matter to blow clear.
2. Remove all pneumatic actuators from the cylinders.
3. Blow out all distribution piping with air or nitrogen to ensure it is not obstructed.
4. Reconnect all control heads.

### 6.7.5. Inspection procedures - 5 year

#### 6.7.5.1. Clean agent cylinders

HFC-227ea clean agent system is using TPED specification for their cylinders. Clean agent cylinders continuously in service for more than five years without discharge shall be removed from rack and given a complete external inspection incompliance with Authority Having Jurisdiction. Where external inspection indicates that the cylinder has been damaged, the same shall be sent for hydraulic testing. However, a hydraulic test shall be carried out after discharge of cylinder.

#### 6.7.5.2. Flexible hose

All system hoses shall be visually inspected annually for damage. If visual examination shows any deficiency, hose shall be replaced or tested. As per the NFPA2001 hydrostatic test to be conducted at interval of every 5 years.

#### 6.7.5.3. Record

All inspection and test records are to be maintained by end user. This record should be made available to the auditor during safety audit.

## 6.8. Check List

| Table 6.2. Check List for Maintenance | | | | |
|---|---|---|---|---|
| **Features of the installation** | | | | |
| Installation Date | | Type of the system | | |
| Authorized Installer | | Country of Installation | | |
| **Maintenance** | | | | |
| Maintenance date | | Last maintenance date | | |
| Authorized company | | Authorized person | | |
| Maintenance type | ***Semi-annual*** *Visual inspection Control pressure of the cylinders* ☐ | ***Annual*** *Functionality* ☐ | ***Every 2 years*** *Revision of wear and tear parts* ☐ | ***Every 5 years*** *Cylinder and valve testing or/and refilling* ☐ |
| System working pressure | ..... bar | Cylinder capacity | | ..... L |
| Cylinders storage pressures verified | ☐ | Cylinders and labels are fine | | ☐ |
| Safety valve in good state | ☐ | Electrical connections checked | | ☐ |
| Revision of nozzles and internal discs satisfactory | ☐ | Operation test of the solenoid actuator satisfactory | | ☐ |
| Extinguishing panel functional test is ok | ☐ | General visual inspection OK | | ☐ |
| Blow out test with nitrogen to cleaning of the dirty and dusty ambient (each 2 years) | | | | ☐ |
| General maintenance (each 5 years) | | | | ☐ |

# 7. Refilling Process

## 7.1. Introduction

The general situations that may require refilling are explained as follows;

1. A cylinder is going to discharge after system activation in case of fire.

2. A cylinder should be refilled when it shows a loss in agent quantity of more than 5 % or loss in pressure of more than 10 %.

3. Recovering the gas in the cylinder whose hydrostatic test inspection period has expired and refilling it after the hydrostatic test process.

These situations occur, the cylinders should be sent to an authorized filling station for refilling process.

***IMPORTANT NOTICE:***

The initial filling or refilling of cylinders must be carried out by trained and authorized personnel in UL approved filling facility. Unauthorized and/or untrained personnel must never attempt to fill cylinders. Even if the field has suitable conditions, the refilling process must be done at an authorized filling station. Transportation process shall be completed according to TPED Directive 2010/35/EU.

## 7.2. Clean Agent Filling Procedure

### 7.2.1. Authorized and Certified Filling Facility

Honeywell has a filling facility at the address below; refills must be done at this address and/or at one of the alternative filling facilities authorized by Honeywell and certified by UL and FM. Contact with Honeywell Technical Team to learn about the authorized filling facility closest to you.

**Honeywell Nexus Filling Facility:**

Ovacik Mah. Ali İslam Cad. No:23/B, Basiskele, Kocaeli, Turkey, 41140

## 7.2.2. Filling Equipment

Filling equipment to be used in filling operations shall be supplied and/or existed equipment checked and approved by Honeywell. Filling operations cannot be performed with devices not supplied and/or approved by Honeywell.

***IMPORTANT NOTICE:***

All measuring devices shall be calibrated in ISO 17025 accredited laboratories within the relevant periods.

Clean agent charging equipment consists of following equipment;

1. Agent storage cylinder
2. Flexible hoses
3. Piping adapter
4. Control valves, strainer & pressure gauge
5. Filling adaptor set
6. Weighing scale
7. Nitrogen supply with pressure regulator
8. Agent filling pump station
9. Agent and nitrogen mixing station
10. Leakage control device

***IMPORTANT NOTICE:***

After an operation of the system, the cylinders shall be refilled with the correct amount of gas. All the information needed for the correct refilling (clean agent quantity, pressure etc.) appears in the labels of the cylinders. In case of doubt, please contact Honeywell Technical Team.

## 7.3. Performing the Refilling Process

Before refilling, must be checked that the cylinders meet the necessary conditions for refilling.

### 7.3.1. Refill Process Steps

General guidelines should be followed being careful while working with high pressures, chemical agents, heavy cylinders, etc. Be sure to follow any company training practices and other local code requirements when working with extinguishing system units and refill equipment.

If cylinder can be refill, follow the next steps correctly;

1. Check the cylinder for the last hydrostatic test date prior to charging.

2. Check the cylinder valve assembly for physical defects which are unacceptable.

3. With the cylinder ready for filling a check is made to the filling instruction sheet and the cylinder fill weight, time, date and fill details record. (for sample see the Table 7.5. Sample Record Book for HFC-227ea Clean Agent)

4. Connect the HFC-227ea agent supply lines to the cylinder valve.

5. Cylinder valve and filling adaptors connected each other and scale tare is arranged zero (after that every kg on the scale screen will show you net filled agent quantity).

6. Switch on the HFC-227ea agent pump and fill cylinder to required weight. When the fill is reached switch off pump.

7. Slowly increase the nitrogen pressure on the approved pressure regulator to the stated pressure on the filling instruction sheet, making the relevant allowances in pressure to compensate for the current room temperature (see the Table 7.6. Filling Pressure vs Temperature Chart). Calibrated pressure gauge or sensor attached to the extinguishing system to determine when the intended charging pressure has been reached. Read off the calibrated external fill pressure gauge to determine when the intended charging pressure has been reached. (Check that the cylinder pressure gauge reads within +/- 0.5bar of the fill gauge, replace cylinder gauge if outside this tolerance).

8. Shake the cylinder to accelerate nitrogen absorption into the agent and top up the pressure accordingly. Switch off nitrogen supply once absorption has stopped.

9. Turn off the nitrogen supply and open the vent valve to release remaining gas from filling adaptor.

10. At this time push the valve lock button which is located on the cylinder valve minimum 5 seconds. After that check the filling adaptor inside pressure, to be sure valve is closed and there

is no continues gas flow. If there is no gas flow, the valve is closed. Assemble the protection cap to valve outlet line. (to more detail see the Figure 7.3.: Valve locking after filling process)

11. Place cylinder in waiting area for leak monitoring for at least 24 hours prior to shipment.

12. After 24 hours a leak test on the cylinder is conducted. Move the leak test device probe back and forth slowly approximately 5 mm away from all potential leak points. (See the Figure 7.4.: Sample leak detector for final leaking control)

13. After leak test is complete, assemble all protection cap. (See the Figure 7.2.: Valve protection cap assemble to valve outlet line)

14. Insert fill information on to cylinder label.

15. Record the all data to filling station record book.

***IMPORTANT NOTICE:***

Record cylinder acceptance date, any comments or remarks, and initial filling or refill types in the filling station record book (See Table 7.5. Sample Record Book for HFC-227ea Clean Agent).

***IMPORTANT NOTICE:***

After the cylinder has been filled with the required quantity of agent and super-pressurized with nitrogen, it must be carefully checked for leaks. All potential leak points must be carefully inspected with a leak detector. The leak detector must be checked against a leak standard before each use, and after every five units tested or every half-hour, whichever comes first. For calibration purposes, the leak standard shall be set to the minimum leakage rate for the specific cylinder being filled. See Table 7.4. HFC-227ea Clean Agent Approximate Leak Rate by Cylinder Volume for details on approximate leak rates per cylinder.

## 7.3.2. Essential Points to Consider

1. Damaged or leaking valves have to be replaced immediately. Non-conformity report shall be prepared such kind of cases and take necessary actions according to related international regulations.
2. Shall take necessary actions when exceeding the permissible filling pressure or filling weight. To more information contact with Honeywell Technical Team.
3. Never tighten the release devices unless the cylinder is secured and fixed and unless the pipe work is connected to the cylinder valve outlet. (for more detail see the Figure 7.1.: Valve position during the filling process without release devices).
4. Sure about valve outlet protection cap is assembled on the valve after every filling process. An unintended actuation of the release device will release the system and could cause risk of injury and damage. (for more detail see the Figure 7.2.: Valve protection cap assemble to valve outlet line)

### 7.3.3. Instructions and Guidelines

The cylinder filling is only permitted without mounted release devices (solenoid, pneumatic or manual type).

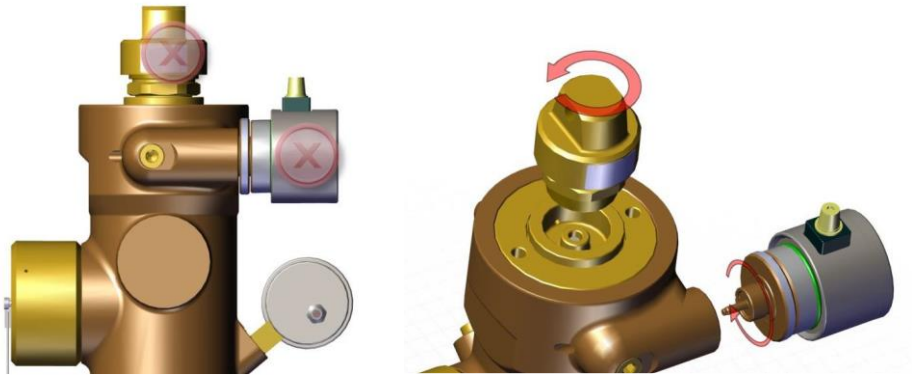


Figure 7.1.: Valve position during the filling process without release devices

Sure about valve outlet protection cap is assembled on the valve after every filling process.



Figure 7.2.: Valve protection cap assemble to valve outlet line

The cylinder valve is closing by a short actuation of the filling valve. (just pushing with the finger force, for over 4 seconds, all the way to the stop – no additional tools are allowed). The cylinder valve closes automatically.

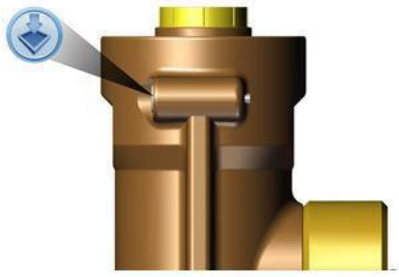


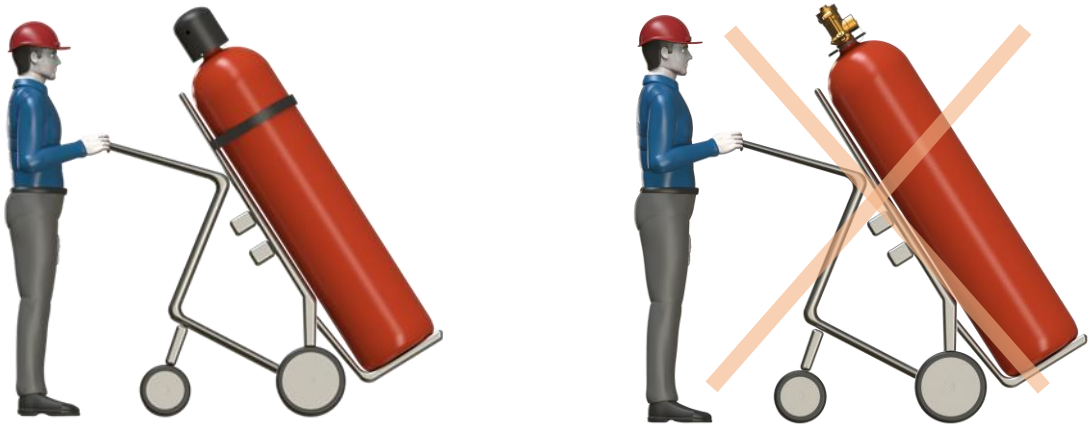
Figure 7.3.: Valve locking after filling process

After the filling process is completed, the cylinder is put on hold for 24 hours and then subjected to a leakage control test. The leakage control test is performed with a probe type special leak detector.



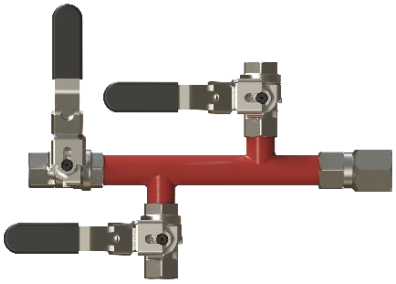
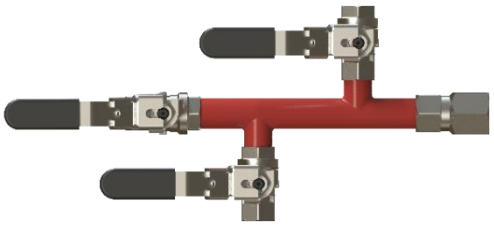
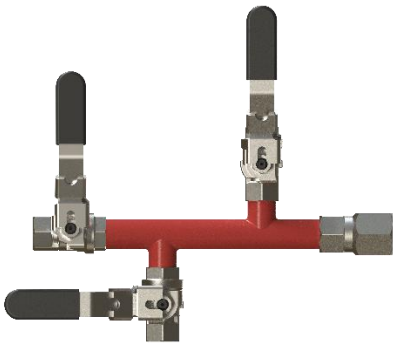
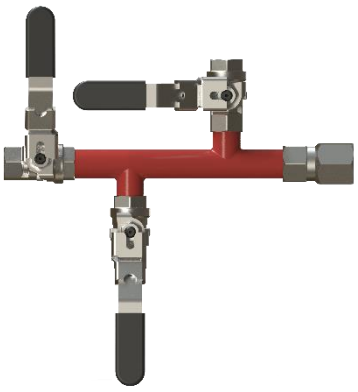
Figure 7.4.: Sample leak detector for final leaking control

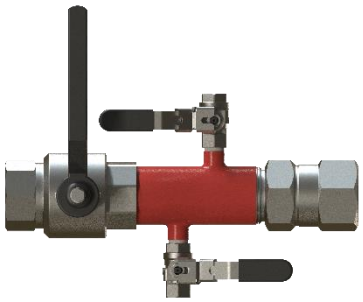
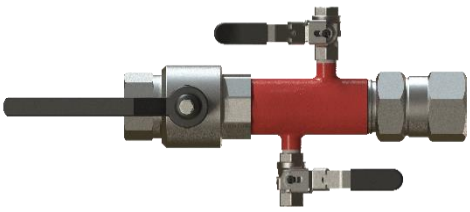
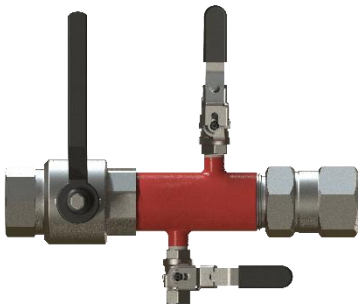
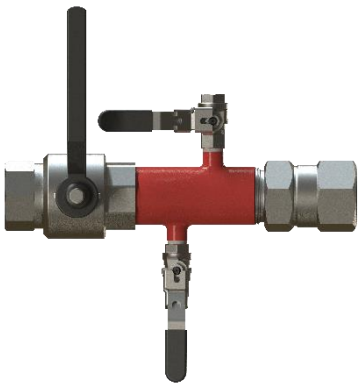
When moving a cylinder from one point to another, a protective cover must be installed on the cylinder valve.

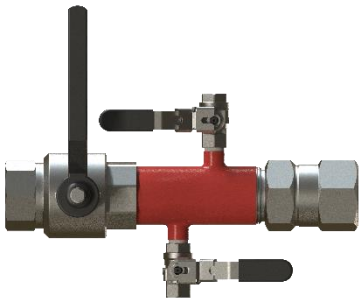
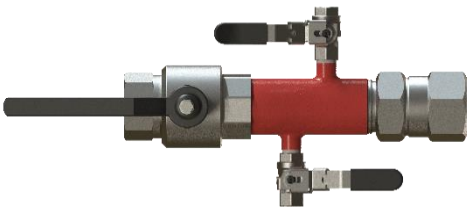
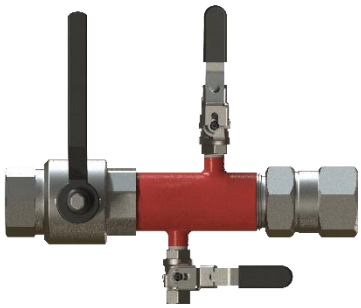
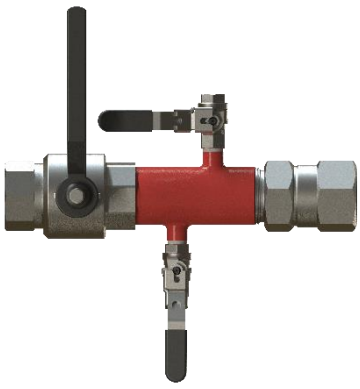


**Correct application** **Inccorrect application**

Figure 7.5.: Correct and incorrect practices in cylinder handling operations

| Table 7.1. DN12 Valve Filling Adaptor Positions During Filling Process | |
|---|---|
| **Step-1** | **Step-2** |
| Appropriate type of filling adapter is selected and aligned with the cylinder valve to be filled. | Filling adapter is tightened to the cylinder valve without any leakage from the filling port. |
|  |  |
| **Step-3** | **Step-4** |
| It is checked that all lines are closed. | Only agent supply line valve is open and pump start to filling process |
|  |  |
| **Step-5** | **Step-6** |
| Nitrogen supply line valve is open until to reach necessary storage pressure. | Remaining gas in the adapter is vented to the atmosphere. |
|  |  |
| For more information check the 2.2.18.1.Filling adaptor set for DN12 valve (P/N: HSN-FLA-12-01) and Section 7.3.1.Refill Process Steps. | |

| Table 7.2. DN33 Valve Filling Adaptor Positions During Filling Process | |
|---|---|
| **Step-1** | **Step-2** |
| Appropriate type of filling adapter is selected and aligned with the cylinder valve to be filled. | Filling adapter is tightened to the cylinder valve without any leakage from the filling port. |
|  |  |
| **Step-3** | **Step-4** |
| It is checked that all lines are closed. | Only agent supply line valve is open and pump start to filling process |
|  |  |
| **Step-5** | **Step-6** |
| Nitrogen supply line valve is open until to reach necessary storage pressure. | Remaining gas in the adapter is vented to the atmosphere. |
|  |  |
| For more information check the 2.2.18.2.Filling adaptor set for DN33 valve (P/N: HSN-FLA-33-01) and Section 7.3.1.Refill Process Steps. | |

| Table 7.3. DN50 Valve Filling Adaptor Positions During Filling Process | |
|---|---|
| **Step-1** | **Step-2** |
| Appropriate type of filling adapter is selected and aligned with the cylinder valve to be filled. | Filling adapter is tightened to the cylinder valve without any leakage from the filling port. |
|  |  |
| **Step-3** | **Step-4** |
| It is checked that all lines are closed. | Only agent supply line valve is open and pump start to filling process |
|  |  |
| **Step-5** | **Step-6** |
| Nitrogen supply line valve is open until to reach necessary storage pressure. | Remaining gas in the adapter is vented to the atmosphere. |
|  |  |
| For more information check the 2.2.18.3.Filling adaptor set for DN50 valve (P/N: HSN-FLA-50-01) and Section 7.3.1.Refill Process Steps. | |

| Table 7.4. HFC-227ea Clean Agent Approximate Leak Rate by Cylinder Volume | | |
|---|---|---|
| **Part Number** | **Cylinder Volume** (L) | **Leak Rate** (g/year) |
| HSN-EU-SM-008-12 | 8.0 | 2.5 |
| HSN-EU-SM-013-12 | 13.4 | 5.0 |
| HSN-EU-SM-026-33 | 26.8 | |
| HSN-EU-SM-040-33 | 40 | 7.5 |
| HSN-EU-SM-067-33 | 67.5 | |
| HSN-EU-SM-080-33 | 80 | 10.0 |
| HSN-EU-SM-120-33 | 120 | |
| HSN-EU-SM-180-50 | 180 | 15.0 |
| HSN-EU-SM-220-50 | 220 | |

| Table 7.5. Sample Record Book for HFC-227ea Clean Agent | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PO No** | **Date** | **Cylinder Serial Number** | **Cylinder Vol. (L)** | **Initial or Refill** | **Filled Agent Weight (kg)** | **Storage Pressure (bar)** | **Leak Test Result** |
| 24111 | 21.09.24 | UN120F001 | 120 | Refill | 118.7 | 42 | Passed |
| 24112 | 12.10.24 | UN080L001 | 80 | Initial | 76.4 | 42 | Passed |
| 24113 | 28.10.24 | UN040Y001 | 40 | Refill | 39.1 | 42 | Failed |

***IMPORTANT NOTICE:***

Gas filling record book must be filled by authorized persons. Information of the persons who perform filling process, quality control and final approval must be recorded in the filling record book. Filling record book must be kept in secure environments as hard copy and soft copy. Filling certificates must be issued for cylinders that have completed the entire process correctly.

| Table 7.6. Filling Pressure vs Temperature Chart | | | |
|---|---|---|---|
| Temperature | | Nominal Pressure | |
| °C | °F | bar | psi |
| 5 | 41.0 | 37.8 | 548 |
| 6 | 42.8 | 38.1 | 552 |
| 8 | 46.4 | 38.6 | 560 |
| 10 | 50.0 | 39.1 | 567 |
| 12 | 53.6 | 39.6 | 574 |
| 14 | 57.2 | 40.1 | 581 |
| 16 | 60.8 | 40.6 | 589 |
| 18 | 64.4 | 41.2 | 597 |
| 20 | 68.0 | 41.8 | 606 |
| **21** | **69.8** | **42.1** | **610** |
| 22 | 71.6 | 42.4 | 615 |
| 24 | 75.2 | 43.2 | 626 |
| 26 | 78.8 | 44.0 | 638 |
| 28 | 82.4 | 44.8 | 650 |
| 30 | 86.0 | 45.6 | 661 |
| 32 | 89.6 | 46.4 | 673 |
| 34 | 93.2 | 47.2 | 684 |
| 36 | 96.8 | 48.0 | 696 |
| 38 | 100.4 | 48.8 | 708 |
| 40 | 104.0 | 49.6 | 719 |
| 42 | 107.6 | 50.4 | 731 |
| 44 | 111.2 | 51.2 | 742 |
| 46 | 114.8 | 52.0 | 754 |
| 48 | 118.4 | 53.0 | 769 |
| 50 | 122.0 | 54.0 | 783 |

***IMPORTANT NOTICE:***

For intermediate values not shown in this table, the required intermediate value can be found by calculating with the interpolation method. When specifying the minimum or maximum gas filling quantities of cylinders, "Table 2.3. 42 Bar HFC-227ea Clean Agent Seamless Cylinders" criteria must be taken into account during the filling process.

# 8. Typical System Layout

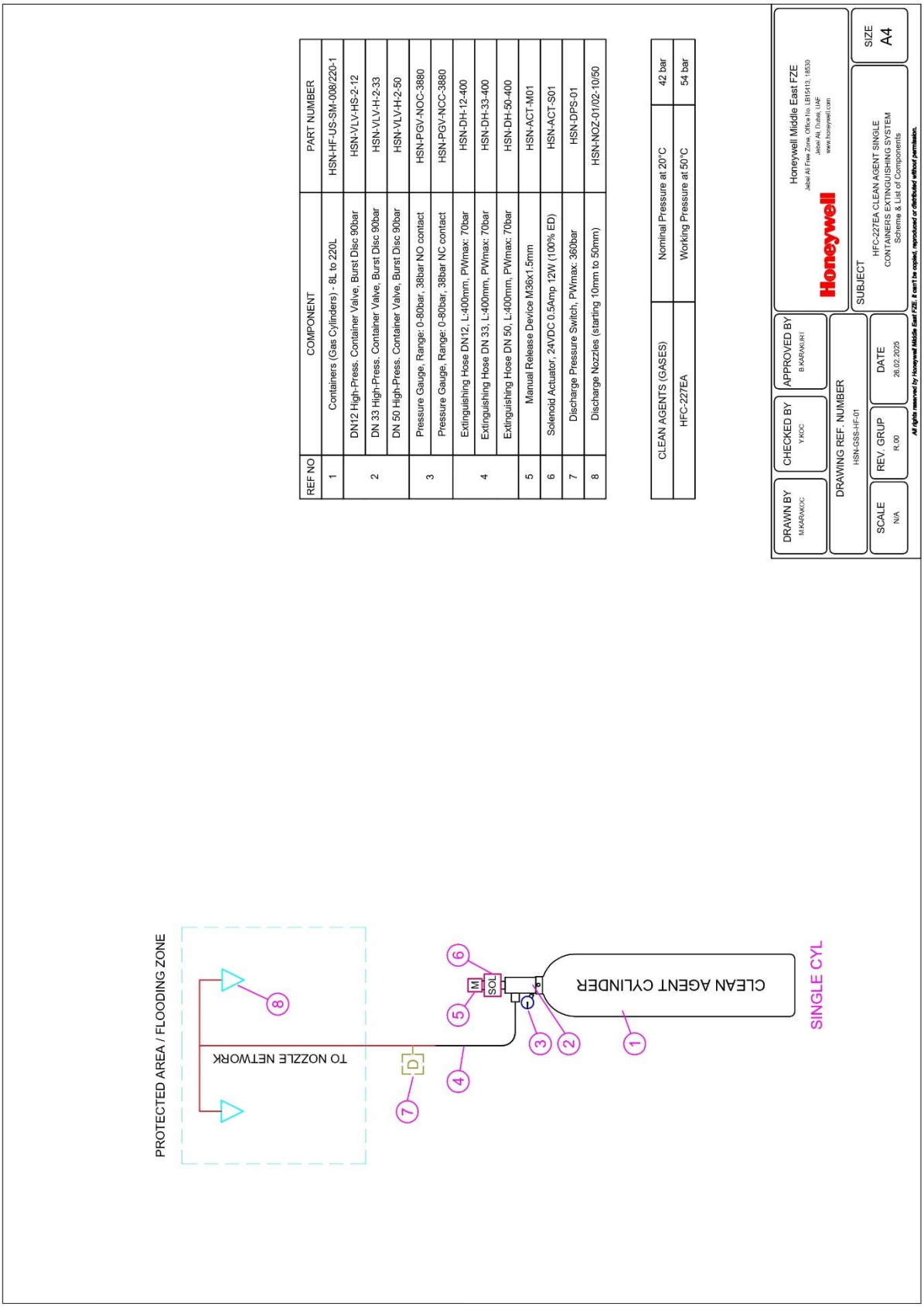
## 8.1. General

There are two main arrangements for a typical system layout.

- Single cylinder system arrangement
- Multiple cylinders system arrangement

The sections are intended to illustrate typical system drawings.

## 8.1.1. Single Cylinder System Arrangement



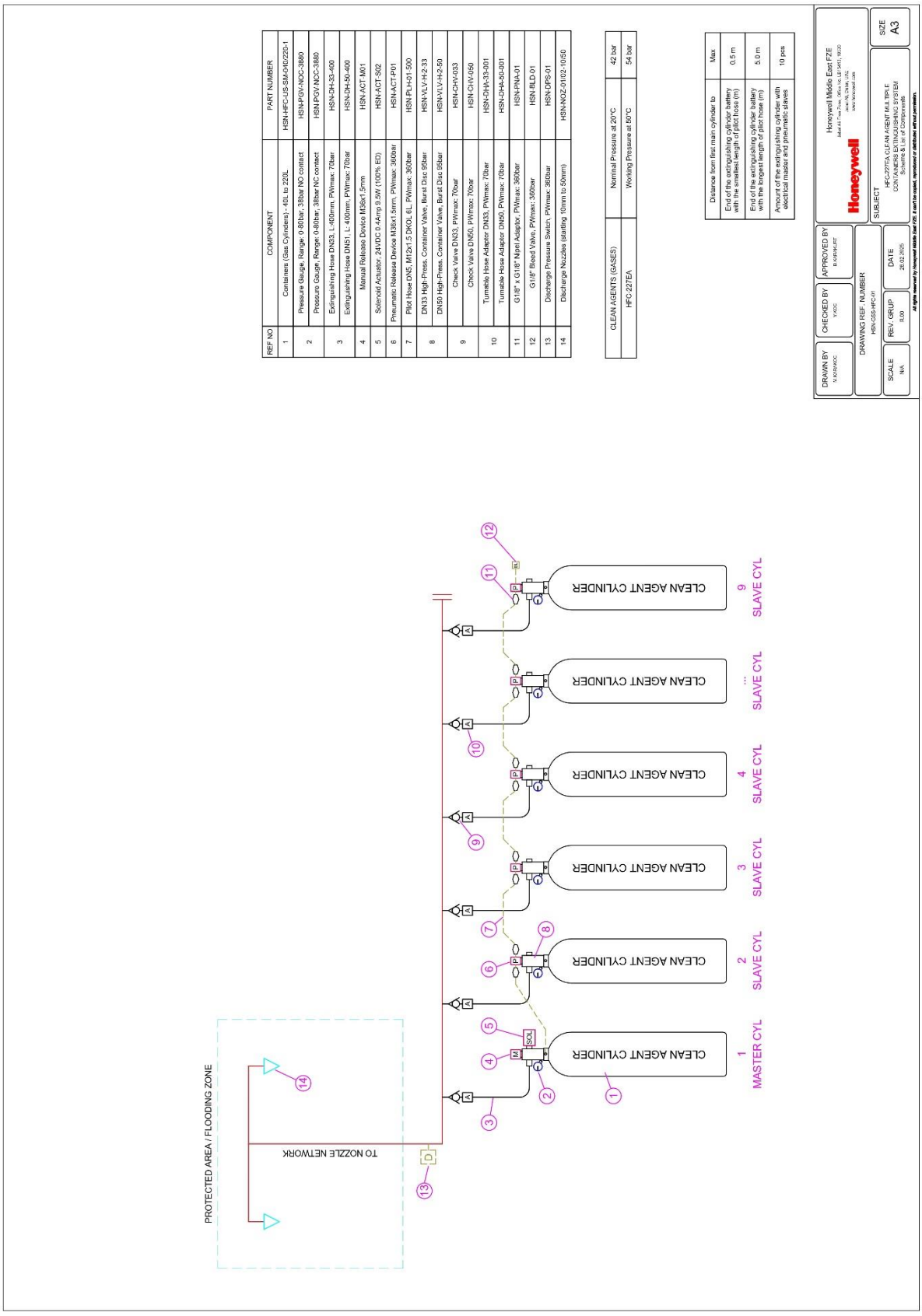

| REF NO | COMPONENT | PART NUMBER |
|---|---|---|
| 1 | Containers (Gas Cylinders) - 8L to 220L | HSN-HF-US-SM-008/220-1 |
| 2 | DN12 High-Press. Container Valve, Burst Disc 90bar | HSN-VLV-HS-2-12 |
| | DN 33 High-Press. Container Valve, Burst Disc 90bar | HSN-VLV-H-2-33 |
| | DN 50 High-Press. Container Valve, Burst Disc 90bar | HSN-VLV-H-2-50 |
| 3 | Pressure Gauge, Range: 0-80bar, 38bar NO contact | HSN-PGV-NOC-3880 |
| | Pressure Gauge, Range: 0-80bar, 38bar NC contact | HSN-PGV-NCC-3880 |
| 4 | Extinguishing Hose DN12, L:400mm, PWmax: 70bar | HSN-DH-12-400 |
| | Extinguishing Hose DN 33, L:400mm, PWmax: 70bar | HSN-DH-33-400 |
| | Extinguishing Hose DN 50, L:400mm, PWmax: 70bar | HSN-DH-50-400 |
| 5 | Manual Release Device M36x1.5mm | HSN-ACT-M01 |
| 6 | Solenoid Actuator, 24VDC 0.5Amp 12W (100% ED) | HSN-ACT-S01 |
| 7 | Discharge Pressure Switch, PWmax: 360bar | HSN-DPS-01 |
| 8 | Discharge Nozzles (starting 10mm to 50mm) | HSN-NOZ-01/02-10/50 |

| CLEAN AGENTS (GASES) | Nominal Pressure at 20°C | 42 bar |
|---|---|---|
| HFC-227EA | Working Pressure at 50°C | 54 bar |

| | | | |
|---|---|---|---|
| DRAWN BY MKARAKOC | CHECKED BY YKOC | APPROVED BY BKARAKURT | Honeywell Middle East FZE Jabel Ali Free Zone, Office No. LB15413, 18530 Jabel Ali, Dubai, UAE www.honeywell.com |
| SCALE N/A | REV. GRUP R.00 | DATE 26.02.2025 | SUBJECT HFC-227EA CLEAN AGENT SINGLE CONTAINERS EXTINGUISHING SYSTEM Scheme & List of Components |
| DRAWING REF. NUMBER HSN-GSS-HF-01 | | | SIZE A4 |

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## 8.1.2. Multiple Cylinders System Arrangement



**Appendix A** / Material Safety Data sheet for HFC-227ea

**SAFETY DATA SHEET**
**Regulation (EC) No 1907/2006 (REACH), Annex II**
**(COMMISSION REGULATION (EU) No 453/2010**
Fire Suppression Clean Agent HFC-227ea

**SECTION 1:** Identification of the substance/mixture and of the company/undertaking

### 1.1 Product identifier

**Product name:** HFC-227ea
**Chemical name:** 1,1,1,2,3,3,3-heptafluoropropane
**CAS-No.:** 431-89-0
**EC No:** 207-079-2
**REACH Registration No.:** No information available

### 1.2 Relevant identified uses of the substance or mixture and uses advised against

**Recommended use:** Used as refrigerants, medical propellant; extinguishing agent, explosion-proof, flame retardants.
**Uses advised against:** No information available.

### 1.3 Details of the supplier of the safety data sheet

**Supplier**
Honeywell Middle East FZE
Jebel Ali Free Zone, Office No. LB15413
18530, Jebel Ali, Dubai, UAE
**Telephone:** +971 4 450 5800
**Fax:** +971 4 450 5900

### 1.4 Emergency telephone number: +86-532-83889090

**SECTION 2:** Hazards identification

### 2.1 Classification of the substance or mixture

**Classification according to Regulation (EC) No. 1272/2008 [CLP]**
Gases under pressure Liquefied gas - (H280)

### 2.2. Label elements

**Appendix A** / Material Safety Data sheet for HFC-227ea

**Symbols/Pictograms:**



**Signal word:** Warning

**Hazard statements**: H280 - Contains gas under pressure; may explode if heated.
**Precautionary Statements:** P410 + P403 - Protect from sunlight. Store in a well-ventilated place.

**2.3. Other hazards:** No information available.

**SECTION 3:** Composition/information on ingredients

**Description**: Substance

| Chemical Name | EC No | CAS No | Weight-% | Classification according to Regulation (EC) No. 1272/2008 [CLP] |
|---|---|---|---|---|
| Propane, 1,1,1,2,3,3,3-heptafluoro- | 207-079-2 | 431-89-0 | >= 99.90 | Liquefied gas H280 |

**SECTION 4:** First aid measures

**4.1 Description of first aid measures**

**General advice:** Do not get in eyes, on skin, or on clothing. Do not breathe dust/fume/gas/mist/vapors/spray. In case of accident or unwellness, seek medical advice immediately (show directions for use or safety data sheet if possible).

**Inhalation:** IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Vapors are heavier than air and can cause suffocation by reducing oxygen available for breathing. Administer oxygen if breathing is difficult. Get medical advice/attention if you feel unwell.

**Skin contact:** Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Wash contaminated clothing before

reuse. If skin irritation persists, call a physician.

**Eye contact:** IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention.

**Ingestion:** Not an expected route of exposure. If swallowed, do not induce vomiting: seek medical advice immediately and show this container or label. Never give anything by mouth to an unconscious person.

**4.2 Most important symptoms and effects, both acute and delayed**

No information available.

**4.3 Indication of any immediate medical attention and special treatment needed**

Treat symptomatically.

## **SECTION 5:** Firefighting measures

**5.1 Extinguishing media**

**Suitable extinguishing:** Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

**Unsuitable extinguishing media:** No information available.

**5.2 Specific hazards arising from the chemical:** Thermal decomposition can lead to release of irritating and toxic gases and vapors, such as carbon monoxide, carbon dioxide, hydrogen fluoride and fluorophosgene.

**5.3. Advice for firefighters**

Evacuate personnel to safe areas. Move containers from fire area if you can do it without risk. Cool drums with water spray. Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Stay upwind. Ensure adequate ventilation, especially in confined areas.

**SECTION 6:** Accidental release measures

**6.1 Personal precautions, protective equipment and emergency procedures:**

Evacuate personnel to safe areas. Remove all sources of ignition. Ensure adequate ventilation, especially in confined areas. Remove all sources of ignition. Do not touch or walk through spilled material. Avoid contact with skin, eyes or clothing. Avoid breathing dust/fume/gas/mist/vapors/spray. Use personal protection recommended in Section 8.

**6.2 Environmental precautions:**

Local authorities should be advised if significant spillages cannot be contained. Prevent entry into waterways, sewers, basements or confined areas.

**Appendix A** / Material Safety Data sheet for HFC-227ea

**6.3 Methods and material for containment and cleaning up:**

Allow substance to evaporate. Avoid breathing dust/fume/gas/mist/vapors/spray. Avoid release to the environment.

**6.4. Reference to other sections:**

See Section 7 for more information
See section 8 for more information
See section 13 for more information

**SECTION 7:** Handling and storage

**7.1 Precautions for safe handling:**

Handle in accordance with good industrial hygiene and safety practice. Ensure adequate ventilation, especially in confined areas. Avoid contact with skin, eyes and clothing. Wash contaminated clothing before reuse. Do not breathe dust/fume/gas/mist/vapors/spray. Do not eat, drink or smoke when using this product. Wash thoroughly after handling. Use personal protection recommended in Section 8.

**7.2 Conditions for safe storage, including any incompatibilities:**

Keep container tightly closed in a dry and well-ventilated place. Keep

away from heat, sparks, flame and other sources of ignition. Storage temperature: <52 °C. Keep locked up and out of reach of children. Keep only in original container. Keep away from food, drink and animal feeding stuffs. Store in accordance with local regulations.

### 7.3. Specific end use(s)

Apart from the uses mentioned in SECTION 1.2 no other specific uses are stipulated.

## **SECTION 8:** Exposure controls/personal protection

### 8.1 Control parameters

| Chemical Name | Latvia | France | Finland | Germany | Italy |
|---|---|---|---|---|---|
| Propane, 1,1,1,2,3,3,3-heptafluoro- (CAS #: 431-89-0) | TWA: 2 ppm<br>TWA: 20 mg/m$^3$ | - | - | - | - |

**Derived No Effect Level (DNEL)**

| | Route | Type of effects | DNEL |
|---|---|---|---|
| For the worker | Inhalation | Systemic effects - Long-term | 61279 mg/m³ |
| For the general population | Inhalation | Systemic effects - Long-term | 6355 mg/m³ |

**Predicted No Effect Concentration (PNEC)**

| Compartment | PNEC |
|---|---|
| **Water** | Freshwater: 0.1 mg/L<br>Intermittent release: 1 mg/L |
| **Sediment** | Freshwater: 1.3 mg/kg sediment dw |
| **STP** | 1.73 mg/L |

### 8.2 Exposure controls

**Engineering controls:**

Ensure adequate ventilation, especially in confined areas. Showers. Eyewash stations. Remove all sources of ignition.

**Personal protective equipment**

Eye/face protection Wear safety glasses with side shields (or goggles).

| | |
|---|---|
| Hand Protection | Wear protective gloves. |
| Skin and body protection | Suitable protective clothing. |
| Respiratory protection | In case of insufficient ventilation, wear suitable respiratory equipment. |

**Environmental exposure controls**

Do not allow into any sewer, on the ground or into any body of water

## **SECTION 9:** Physical and chemical properties

**9.1 Information on basic physical and chemical properties:**

| | |
|---|---|
| **Appearance:** | Gas |
| **Color:** | Colorless |
| **Odor:** | Odorless |
| **Odor threshold:** | Not determined |
| **pH:** | Neutral |
| **Melting point/freezing point:** | -131.0 °C |
| **Boiling point/boiling range:** | -17 °C |
| **Flash point:** | Not determined |
| **Evaporation rate:** | Not determined |
| **Flammability (gas):** | Not flammable |

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| | |
|---|---|
| **Flammability limit in air:** | Not determined |
| **Vapor pressure:** | 457.7 kPa (25 °C) |
| **Vapor density:** | 6.04 |
| **Density:** | 1.46 g/cm$^3$ |
| **Relative density**: | 1.46 |
| **Bulk density:** | Not determined |
| **Specific gravity:** | Not determined |
| **Water solubility:** | 260 mg/L (25 °C) |
| **Partition coefficient (LogPow):** | 2.11 |
| **Autoignition temperature:** | 532°C |
| **Decomposition temperature:** | Not determined |
| **Kinematic viscosity:** | Not determined |
| **Dynamic viscosity:** | Not determined |

**Explosive properties:** Not an explosive
**Oxidizing properties:** Not determined

**9.2 Other information**: No information available

## **SECTION 10:** Stability and reactivity

**10.1 Reactivity**: Contact with strong oxidizers, alkali metals and alkaline earth, metals may cause fires or explosions.
**10.2 Chemical stability:** Stable under recommended storage conditions.
**10.3 Possibility of hazardous reactions:** Hazardous polymerization does not occur.
**10.4 Conditions to avoid:** Heat, flames and sparks**.** Strong heating. Incompatible materials. Compressed air, oxygen, chlorine.
**10.5 Incompatible materials:** Light and/or alkaline metals, alkaline earth metals, powdered metals, oxidizing agents
**10.6. Hazardous decomposition products:** Gaseous hydrogen fluoride (HF). Fluorophosgene.

## **SECTION 11:** Toxicological information

**Acute toxicity:**

| Chemical name | Oral LD50 | Dermal LD50 | Inhalation LC50 |
|---|---|---|---|
| Propane, 1,1,1,2,3,3,3-heptafluoro- (CAS #: 431-89-0) | - | - | > 788696 ppm 4h (Rat) |

**Skin corrosion/irritation**
Non-irritating to the skin.
**Serious eye damage/eye irritation**
No eye irritation.
**Sensitization**
No sensitization responses were observed.
**Germ cell mutagenicity**
Genotoxicity: negative.
**Carcinogenicity**
No information available.

**Reproductive toxicity**

No information available.

**STOT - single exposure**

No information available.

**STOT - repeated exposure**

No information available.

**Aspiration hazard**

No information available.

## **SECTION 12:** Ecological information

**12.1. Toxicity:**

| Chemical name | Algae/aquatic plants EC50 | Fish LC50 | Crustacea EC50 |
|---|---|---|---|
| Propane, 1,1,1,2,3,3,3-heptafluoro- (CAS #: 431-89-0) | > 114 mg/L 72h Pseudokirchnerella subcapitata | - | > 200 mg/L 48h Daphnia magna |

**12.2. Persistence and degradability**

The test substance was not biodegradable by micro-organisms under the present test conditions.

**12.3. Bioaccumulative potential**

LogPow = 2.11

**12.4. Mobility in soil**

No information available

**12.5. Results of PBT and vPvB assessment**

PBT/vPvB assessment information is not available as chemical safety assessment not conducted.

**12.6. Other adverse effects**

No information available.

## **SECTION 13:** Disposal considerations

**Waste treatment methods:**

| | |
|---|---|
| Waste from residues/unused products: | Disposal should be in accordance with applicable regional, national and local laws and regulations. |
| Contaminated packaging: | Disposal should be in accordance with applicable regional, |

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**SECTION 14:** Transport information

**14.1 UN number:** 3296
**14.2 Proper shipping name**: HEPTAFLUOROPROPANE (REFRIGERANT GAS R 227)
**14.3 Hazard class:** 2.2
**14.4 Packing group:** Not regulated
**14.5 Environmental hazards:** Non-marine pollutant
**14.6 Special precautions:** No information available
**14.7 Transport in bulk according to Annex II of MARPOL and the IBC Code**: Not applicable

**SECTION 15:** Regulatory information

**15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture European Union**

| Component | EINECS/ELINCS | SVHC candidates | RESTRICTIONS – REACH TITLE |
|---|---|---|---|
| Propane, 1,1,1,2,3,3,3-heptafluoro- 431-89-0 (>=99.0%) | X | X | - |

Take note of Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work
Take note of Directive 94/33/EC on the protection of young people at work
Take note of Directive 92/85/EC on the protection of pregnant and breastfeeding women at work

**International inventories:**

| Component | TSCA | DSL/NDSL | ENCS | IECSC | KECL | PICCS | AICS |
|---|---|---|---|---|---|---|---|
| Propane, 1,1,1,2,3,3,3-heptafluoro- 431-89-0 >=99.0% ) | X | X | X | X | X | - | X |

***"-" Not Listed***
***"X" Listed***

**15.2. Chemical safety assessment**
No information available

**SECTION 16:** Other information

**This material safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006**

**Key or legend to abbreviations and acronyms used in the safety data sheet**

**TWA -** TWA (Time Weighted Average)

**STEL -** STEL (Short Term Exposure Limit)

**Ceiling -** Maximum limit value

**TSCA -** Toxic Substances Control Act Section 8(b) Inventory

**DSL/NDSL -** Canadian Domestic Substances List/Non-Domestic Substances List

**IECSC -** Chinese Inventory of Existing Chemical Substances

**EINECS/ELINCS -** European INventory of Existing Commercial chemical Substances/ European LIst of Notified Chemical Substances

**ENCS -** Japanese Existing and New Chemical Substances

**KECL -** Korea Existing Chemicals List

**NZIoC -** New Zealand Inventory of Chemicals

**PICCS -** The Philippine Inventory of Chemicals and Chemical Substances

**AICS -** The Australian Inventory of Chemical Substances

**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.

**Note:** The SDS document in this section is a sample reference only. Technically, SDS information is country and language specific.

**-------- End of Safety Data Sheet --------**