

HFC-227-ea CLEAN AGENT SYSTEM W/ IMPULSE TECHNOLOGY EN CONTAINERS LPCB APPROVAL NFPA 2001 STANDARD

U.S. & Foreign Patents

P/N 06-439 (Rev. 3 / December, 2015)



Origina	Release Date:
Revisio	n / Description of Change Revision Date
REVISIO	N 1 March, 2011
1)	Remove all references to FM-200 $^{\circ}$ and replace with HFC-227ea in all sections of manual
2)	Changes to the Equipment Information / Component Sheets (p/n 06-439-1)
REVISIC	N 2September, 2015
1)	Changes to the Equipment Information / Component Sheets (p/n 06-439-1)
2)	Changes to the Design Information (p/n 06-439-2)
REVISIO	N 3 December, 2015
EQUI	PMENT SECTION
1)	Added Direct Impulse Valve Actuator (DIVA) Component Sheet (06-698-1-2 rev 0)
2)	Added Impulse Valve Operator Supervisor (IVOS) Component Spec (06-432-1-11 rev 0)
3)	Added Impulse Valve Pneumatic Operator (IVPO) Component Spec (06-698-1-3 rev 0)
4)	Added Mounting Bracket information for 5, 9 & 16 liter containers to Component Sheet (06-540-1-5 rev 1)
5)	Removed BS 1387 grade/type of pipe from Component Sheet (06-540-1-11 rev 1)
6)	Added Brass Nozzles Component Sheet (06-542-1-6 rev 0) and removed Aluminum Nozzle Component Sheet (06-542-1-4)
DESIG	IN SECTION

7) Added pages 23, 24 & 25 containing information on pre-engineered limitations for 5, 9 & 16 liter cylinders

#### Manual P/N 06-439 (Rev 3 / December, 2015)

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#### EQUIPMENT SECTION

Part Number	Revision Level	DESCRIPTION OF COMPONENT SHEET	Number of Pages		
06-542-1-1	1	Agent – HFC-227ea	2		
06-542-1-2	2	Agent Storage Container – HFC-227ea	6		
06-540-1-1	0	IMPULSE VALVE	2		
06-542-1-3	1	Pressure Gauge – HFC-227ea	2		
06-698-1-2	0	DIRECT IMPULSE VALVE ACTUATOR (DIVA)	6		
06-432-1-11	0	IMPULSE VALVE OPERATOR SUPERVISOR (IVOS)	2		
06-698-1-3	0	IMPULSE VALVE PNEUMATIC OPERATOR (IVPO)	2		
06-540-1-4	0	Low Pressure Switch	2		
06-540-1-5	1	Mounting Straps & Brackets			
06-540-1-11	1	Pipe and Fitting			
06-540-1-7	0		2		
06-542-1-6	1		1		
00-342-1-0	1				
00-340-1-6	0		2		
06-542-1-5	0	CAUTION / ADVISORY SIGNS – HFC-227EA	Z		
DESIGN SECTIO	DN				
HAZARD CLASS	IFICATION		1		
MINIMUM DES	SIGN CONCENTRATI	ON	1		
MAXIMUM DE	SIGN CONCENTRAT	ION	1		
ENCLOSURE VO	DLUME		2		
AGENT REQUIR	RED		2		
FLOODING FAC	TORS – AGENT VS	TEMPERATURE CHART (METRIC UNITS)			
TEE DESIGN FA	CTOR		4		
ALTITUDE COR	RECTION FACTORS.		5		
CONCENTRATIO	ον ατ Μαχιμυμ Τ	EMPERATURE	5		
System Desig	N CONCEPTS		6		
CONTAINER SIZ	e and Fill Range		6		
TEMPERATURE	LIMITATION		6		
System Disch	arge Time		7		
NOZZLE FLOW	RATE LIMITATION .		7		
NOZZLE AREA	Nozzle Area Coverage				
NOZZLE PLACE	MENT				
CEILING HEIGH	T VS. LEVELS OF NO	DZZLES	9		
MAXIMUM ELE	EVATION DIFFERENCE	CES IN PIPE RUNS LIMITATION	9		
NOZZLE DISCH	ARGE OBSTRUCTIO	NS			

Manual P/N 06-439 (Rev 3 / December, 2015)

TEE CONFIGURATION – BULHEAD TEE CONFIGURATION – BULHEAD TEE ORIENTATION TEE ORIENTATION TEE ORIENTATION TEE ORIENTATION TEE ORIENTATION TEE ORIENTATION PIPING DISTANCE EGURALENT LENGTH VALUES PIPE NET OR GENTL DUCATION OF 1 <sup>st</sup> TEE. LIQUE ORRIVAL TIME LIQUE ORRIVAL TIME LIQUE ORRIVAL TIME LIQUE ORRIVAL TIME NOZZLE ORIECE ARA LIMITATION MAINFOLD OPTIONS SAMPLE PROBLEM – ENGINEERED HAZARO INFORMATION PROFINATION PROGRAM OUTPUTS – FILE FLOW CALCULATION PROGRAM OUTPUTS – FILE FLOW CALCULATION PROGRAM PROFINES – PRE-ENGINEERED PIPING NETWORK LIMITATIONS – SINGLE NOZZLE SYSTEMS PIPING NETWORK LIMITATIONS – TWO NOZZLE SYSTEMS SERVICE SECTION SYSTEM CHECKOUT MAINTENANCE DISCHARCE DISCH	TEE SPLIT RATIOS	
TEE CONFIGURATION – SIDE-THRU	TEE CONFIGURATION – BULLHEAD	
TEE ORIENTATION	TEE CONFIGURATION – SIDE-THRU	
ESTIMATING PIPE SIZE	TEE ORIENTATION	
MINIMUM PIPING DISTANCE	ESTIMATING PIPE SIZE	
EQUIVALENT LENGTH VALUES	MINIMUM PIPING DISTANCE	
PIPE NETWORK LIMITATIONS	Equivalent Length Values	
PERCENT OF AGENT IN PIPE	PIPE NETWORK LIMITATIONS	
Location of 1 <sup>st</sup> Tee Liquid Arrival Time Liquid Rarival Time	Percent of Agent in Pipe	
LIQUID ARRIVAL TIME	LOCATION OF 1 <sup>ST</sup> TEE	
LIQUID RUNOUT TIME	LIQUID ARRIVAL TIME	14
NOZZLE ORIFICE AREA LIMITATION	LIQUID RUNOUT TIME	
MANIFOLD OPTIONS	Nozzle Orifice Area Limitation	15
SAMPLE PROBLEM – ENGINEERED	MANIFOLD OPTIONS	15
HAZARD INFORMATION INPUTS – FIKE FLOW CALCULATION PROGRAM OUTPUTS – FIKE FLOW CALCULATION PROGRAM PRE-ENGINEERED PIPING LIMITATIONS NOZZLE TYPES – PRE-ENGINEERED PIPING NETWORK LIMITATIONS – SINGLE NOZZLE SYSTEMS PIPING NETWORK LIMITATIONS – TWO NOZZLE SYSTEMS PIPING NETWORK LIMITATIONS – TWO NOZZLE SYSTEMS SERVICE SECTION	SAMPLE PROBLEM – ENGINEERED	
INPUTS – FIKE FLOW CALCULATION PROGRAM	HAZARD INFORMATION	16
OUTPUTS – FIKE FLOW CALCULATION PROGRAM         PRE-ENGINEERED PIPING LIMITATIONS         NOZZLE TYPES – PRE-ENGINEERED         PIPING NETWORK LIMITATIONS – SINGLE NOZZLE SYSTEMS         PIPING NETWORK LIMITATIONS – TWO NOZZLE SYSTEMS         SERVICE SECTION       4 PAC         HAZARD ENCLOSURE         SYSTEM CHECKOUT         MAINTENANCE         SYSTEM COMPONENTS         AGENT STORAGE CONTAINER & ACCESSORIES         SYSTEM CHECKOUT         MAINTENANCE         PIPE & FITTINGS         SYSTEM CHECKOUT         MAINTENANCE         PIPE & FITTINGS         SYSTEM CHECKOUT         MAINTENANCE         DISCHARGE NOZZLE	INPUTS – FIKE FLOW CALCULATION PROGRAM	
PRE-ENGINEERED PIPING LIMITATIONS         NOZZLE TYPES – PRE-ENGINEERED         PIPING NETWORK LIMITATIONS – SINGLE NOZZLE SYSTEMS         PIPING NETWORK LIMITATIONS – TWO NOZZLE SYSTEMS         SERVICE SECTION       .4 PAC         HAZARD ENCLOSURE         System CHECKOUT         MAINTENANCE         SYSTEM COMPONENTS         AGENT STORAGE CONTAINER & ACCESSORIES         System CHECKOUT         MAINTENANCE         PIPE & FITTINGS         System CHECKOUT         MAINTENANCE         PIPE & FITTINGS         System CHECKOUT         MAINTENANCE         DISCHARGE NOZZLE         System CHECKOUT         MAINTENANCE	OUTPUTS – FIKE FLOW CALCULATION PROGRAM	
NOZZLE TYPES – PRE-ENGINEERED PIPING NETWORK LIMITATIONS – SINGLE NOZZLE SYSTEMS	Pre-Engineered Piping Limitations	
PIPING NETWORK LIMITATIONS – SINGLE NOZZLE SYSTEMS	Nozzle Types – Pre-Engineered	
PIPING NETWORK LIMITATIONS – TWO NOZZLE SYSTEMS	PIPING NETWORK LIMITATIONS – SINGLE NOZZLE SYSTEMS	
SERVICE SECTION	PIPING NETWORK LIMITATIONS – TWO NOZZLE SYSTEMS	
HAZARD ENCLOSURE	SERVICE SECTION	4 Pages
SYSTEM CHECKOUT	HAZARD ENCLOSURE	1
MAINTENANCE	System Checkout	
SYSTEM COMPONENTS Agent Storage Container & Accessories System Checkout Maintenance Pipe & Fittings System Checkout Maintenance Discharge Nozzle System Checkout Maintenance Discharge Nozzle System Checkout Maintenance Detection & Control System	Maintenance	2
Agent Storage Container & Accessories	SYSTEM COMPONENTS	2
System Checkout Maintenance Pipe & Fittings System Checkout Maintenance Discharge Nozzle System Checkout Maintenance Detection & Control System	Agent Storage Container & Accessories	2
Maintenance	System Checkout	2
Pipe & Fittings System Checkout Maintenance Discharge Nozzle System Checkout Maintenance Detection & Control System	MAINTENANCE	
System Checkout	PIPE & FITTINGS	
Maintenance Discharge Nozzle System Checkout Maintenance Detection & Control System	System Снескоит	
DISCHARGE NOZZLE	MAINTENANCE	4
System Checkout Maintenance Detection & Control System	DISCHARGE NOZZLE	4
Maintenance	System Checkout	
DETECTION & CONTROL SYSTEM	MAINTENANCE	4
	DETECTION & CONTROL SYSTEM	

#### ANNEX MATERIAL

SAFETY DATA SHEETS	
HFC-227ea Agent	11 Pages
NITROGEN	

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#### INTRODUCTION

Fike's Equipment, Design and Service Manuals for Clean Agent Fire Suppression Systems incorporates the latest design requirements found in NFPA Standard 2001, as well as the most up-to-date information available for our products.

This manual has been provides the information necessary for the design, installation, and service / maintenance of Fike hardware and systems.

Fike utilizes two types of systems:

"Pre-Engineered System" concept – minimizes the engineering effort required to design an effective system. As long as nozzle selection, pipe size and pipe length limitations are adhered to, hydraulic flow calculations are not required.

"Engineered System" concept – These systems are designed within the basic parameters outlined in this manual, and their performance is evaluated with the assistance of the Fike Flow Calculation Program.

Tests have shown that the Fike Flow Calculation Program can accurately determine the expected performance of the system when it is discharged. This provides the system designer with the maximum degree of flexibility possible as it pertains to flow imbalance, tee splits, piping configurations, etc.

Fike Clean Agent Fire Suppression systems must be installed and maintained in accordance with the limitations established by the appropriate Code or Standard (e.g. ISO 14520, NFPA Standard 2001, etc.), as well as the limitations set forth by Underwriters Laboratories Inc. and FM Approvals. The information contained within this manual defines these limitations in detail.

Enough information is incorporated into this manual to allow those responsible for designing Fike Clean Agent Fire Suppression systems to properly do so, and for the parties responsible for verifying the system design to determine if the design parameters have in deed been met.

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



704 South 10<sup>th</sup> Street P.O. Box 610 Blue Springs, Missouri 64013 (U.S.A.) Phone: (816) 229-3405 Fax: (816) 229-5082 Webpage: www.fike.com

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#### DISCLAIMERS

The information contained in this manual is as accurate as possible. Fike does not guarantee that this manual is technically correct, complete, or free from writing problems or that this product is free from minor flaws.

In accordance with our policy of continuing product and system improvement, Fike reserves the right to change designs or specifications without obligation and without further notice.

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#### **READER RESPONSES**

Fike encourages input from our distributors and end users on how we can improve this manual and even the product itself. Please direct all calls of this nature to Fike's Systems Sales Department at (800)-979-FIKE (3453), option 22.

Any communication received becomes the property of Fike.

#### WARRANTIES

Fike provides a one-year limited manufacturer's warranty on this product. The standard warranty is printed in each Marketing Price List. All warranty returns must be returned from an authorized Fike Distributor. Contact Fike's Marketing Department for further warranty information. Fike maintains a repair department that is available to repair and return existing electronic components or exchange/purchase previously repaired inventory component (advance replacement). All returns must be approved prior to return. A Material Return Authorization (MRA) number should be indicated on the box of the item being returned. Contact the appropriate Regional Sales Manager for further information regarding Return Material Procedures.

#### LIMITATION OF LIABILITY

Fike cannot be held liable for any damages resulting from the use or misuse of this product.

#### QUALITY NOTICE

Fike has maintained ISO 9001 certification since 1996. Prior to shipment, we thoroughly test our products and review our documentation to assure the highest quality in all respects.

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# FIKE CLEAN AGENT SYSTEM W/IMPULSE TECHNOLOGY HFC-227EA AGENT EN CONTAINERS



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#### **CLEAN AGENT**

Chemical Name	Heptafluoropropane		
ASHRAE Designation	HFC-227ea		
APPROVALS	UL Ex4623 / FM 3024180 / LPCB		
	Colorless, odorless, liquefied compressed gas		
	Stored as a liquid		
	Electrically-nonconductive		
FEATURES AND BENEFITS	Discharges as a gaseous vapor (due to its relatively low boiling point)		
	Zero ozone depleting potential		
	Low global warming potential		
	Included on the U.S. EPA Significant New Alternative Policy (SNAP) rules		

#### **EXTINGUISHING METHOD**

HFC-227ea extinguishes a fire primarily through Heat Absorption that occurs as the agent changes from a liquid to a vapor during discharge. In addition, HFC-227ea also disrupts the combustion reaction which aids in the extinguishment of a fire. It is important to note, HFC-227ea does not use the depletion of oxygen to extinguish a fire.

#### USE AND LIMITATIONS

HFC-227ea system shall be used on the following Class of Hazards:	HFC-227ea systems shall "NOT" be used on fires involving the following materials:
Class A & C: Electrical and Electronic Hazards Telecommunications Facilities	Chemicals or mixtures of chemicals that are capable of rapid oxidation in the absence of air. (Examples include: Cellulose Nitrate and Gunpowder)
High value assets, where the associated down-time would be costly	Reactive metals such as Lithium, Sodium, Potassium, Magnesium, Titanium, Zirconium, Uranium, and Plutonium
Class B.	Metal hydrides such as Sodium Hydride and Lithium Aluminum Hydride
Flammable liquids and gases	Chemicals capable of undergoing auto-thermal decomposition. (Examples: Organic Peroxides and Hydrazine)

#### **EXPOSURE LIMITATIONS**

Hazard Type	Design Concentration	Maximum Human Expose Time
Normally Occupied Space	6.25% to 10.5%	5 minutes
Not Normally Occupied Space	11.0% to 12.0%	30 seconds

**NOTE:** Fike does not recommend HFC-227ea systems to be used in any normally occupied spaces where the design concentration required is above **10.5%**.

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**WARNING:** The discharge of clean agent systems to extinguish a fire can result in potential hazard to personnel from the natural form of the clean agent or from the products of combustion that result from exposure of the agent to the fire or hot surfaces. Unnecessary exposure of personnel either to the natural agent or to the products of decomposition shall be avoided.

PHYSICAL	<b>PROPERTIES</b>	OF HFC-227ea
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Chemical Name	1,1,1,2,3,3,3-Heptafluoropropane
Chemical Formula	CF <sub>3</sub> CHFCF <sub>3</sub>
CAS No.	431-89-0
Molecular Wt.	170.03
Boiling Point, 1 atm	-15.6 °C
Freezing Point	-133 °C
Critical Temperature	101.7 °C
Critical Pressure	2930.6 kPa
Critical Density	621 kg/m <sup>3</sup>
Liquid Density @ 25 °C	1386 kg/m <sup>3</sup>
Vapor Density @ 25 °C and 1atm	7.148 kg/m <sup>3</sup>
Specific Heat, Liquid (Cp) @ 25°C	1.247 kJ/kg-℃
Specific Heat, Vapor (Cp) @ 25°C and 1 ATM	0.8136 kJ/kg- ⁰C
Vapor Pressure, Saturated @ 25°C	453.3 kPa
Heat of Vaporization @ B.P.	132.6 kJ/kg-°C
Thermal Conductivity, Liquid @ 25°C	0.0533 W/m- °C
Thermal Conductivity, Vapor @ 25°C	0.0127 (0.0073) W/m- °C
Viscosity, Liquid (lb/ft-hr) @ @ 25°C	0.2442 cP
Relative dielectric strength @ 1atm, 25 $^{\circ}$ C (N <sub>2</sub> =1)	2.00
Solubility of Water in HFC-227ea @ 20 °C	600 ppm
Ozone Depletion Potential	0.0
Global Warming Potential, GWP (100 yr. ITH. For CO2, GWP = 1)	2900

#### **AGENT STORAGE CONTAINER – HFC-227EA** COMPONENT SHEET

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#### **CONTAINER DATA / SPECIFICATIONS**

Purpose	Pressure Vessel to hold agent until activated			
Approvals	l	_CPB		
Container Super – Pressurization Level	24.8 bar at 21°C after filling with dry nitrogen			
Container Storage Temperature Limitation	-20°C (minimum) +50°C (maximum)			
Container Rating	Designed to EN13322-1			
Container Actuation Methods	Electric / Pneumatic / Manual			
<b>NOTE:</b> If container temperatures exceeding 54.4°C, valve will open automatically, this also fulfills the pressure relief valve requirements in accordance with DOT regulations.				
Container Color Red		Red		
Fill Increments	0.5 kg			
Fill Range	481 kg/m <sup>3</sup> (minimum) 1080 kg/m <sup>3</sup> (maximum)			



Container		Fill Range		Valve Tare		Dimensions (approximate)		Mounting
Size (L)	P/N	Minimum	Maximum	Size	Weight	Diameter	Height	Position
012e (L)	17/1	(kg)	(kg)	in. (mm)	(kg)	(mm)	(mm)	
5	70-348	5	5	1 (25)	11	178	414	Upright (Valve Up)
9	70-349	4.5	9.5	1 (25)	13	178	609	Upright (Valve Up)
16	70-350	8.0	17.0	1 (25)	16	229	635	Upright (Valve Up)
26	70-278	12.5	28.0	1 (25)	23	229	876	Upright (Valve Up)
45	70-255	22.0	48.5	1 (25)	35	324	816	Upright (Valve Up)
83	70-256	40.0	89.5	3 (75)	62	324	1316	Upright (Valve Up)
150	70-257	72.5	162.0	3 (75)	82	406	1483	Upright (Valve Up)

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#### ITEMS SUPPLIED WITH CONTAINER ASSEMBLY

Item Number	Description	Component Sheet
1	Shroud	
2	Victaulic Coupling & Nipple	06- 540-1-11
3	Impulse Valve	06-540 -1-9
4	Pressure Gauge with Low Pressure Switch	06-439 -1-2
5	Nameplate (see note 1)	n/a
6	Siphon Tube (see note 2)	n/a
7	Mounting Straps & Brackets (not shown)	06-540-1-5

#### NOTES:

1) Fike nameplate provides the information that is specific to each container:

Assembly and serial number of the container, Weight information: tare, gross and agent and Installation, operation and safety information.

All containers filled either by the factory or by an Approved Initial Fill Station are provided with a nameplate bearing the approval agency markings.

2) All containers have straight siphon tubes and must be mounted upright (valve up).



#### **OPTIONAL ITEMS FOR CONTAINER**

The following container accessory items must be ordered separately.

#### **ACTUATION COMPONENTS**

 Electric / Manual Actuation – Impulse Valve Operator (IVO) (For detailed information, refer to the IVO Component Sheet p/n 06-540-1-10)



 Pneumatic Actuation – Impulse Valve Pneumatic Operator (IVPO) (For detailed information, refer to the IVPO Component Sheet p/n 06-540-1-3)



#### **ACTUATION METHODS**

Clean Agent containers with an Impulse Valve can be actuated by the following methods:

- Method 1 Electric Actuation Single Container System w/ IVO & IRI
- Method 2 Electric Actuation Multi-Containers System w / IVO's & IRI's
- Method 3 Electric & Pneumatic Actuation Two Container System w/ IVO & IVPO
- Method 4 Electric & Pneumatic Actuation Multi Container System w/ IVO & IVPO's

For detailed information on actuation methods, refer to the Impulse Valve Operator (IVO) Component Sheet (p/n 06-540-1-10).

These devices provide the force required to extend a pin that will open the rupture disc, allowing the agent to be released from the container.

#### INSTALLATION

The system installation must comply with the requirements of this manual; ISO 14520 or EN 15004, latest editions; all applicable local codes, regulations, and standards and the authority having jurisdiction (AHJ).

- **WARNING: DO NOT** start system installation until the final design of the total system has been verified using Fike's Engineered Flow Calculation.
- **WARNING:** The Actuator shall **always** be the last component installed on a Fike Clean Agent Fire Suppression system to avoid accidental discharge.

#### FACTORS TO CONSIDER – CONTAINER LOCATION

FACTOR	CONSIDERATION			
MOUNTING SURFACE	Container brackets must be mounted securely to solid load-bearing surfaces that will support the container load. Some installations may require additional mounting support not supplied by Fike.			
ENVIRONMENTAL EFFECTS	Container(s) should be located in clean, dry, and relatively vibration-free areas. Avoid aisle ways and other high traffic areas where physical damage or tampering is more likely. Container(s) should never be mounted where the container could potentially be splashed with, or submerged in any liquid. Do not locate containers where they would be subject to physical damage, exposure to corrosive chemicals, or harsh weather conditions.			
TEMPERATURE RANGE	Container locations must be between -20°C to +50°C Temperatures outside of this range may result in the system not supplying the desired quantity of agent or accidental discharge.			
SERVICEABILITY	In general, the larger the container, the more difficult it will be to remove it from the system for maintenance and service. However, smaller containers that are located in a sub-floor space, under a computer bank, or above the ceiling over the same computer bank can be difficult as well.			
FLOOR SPACE	Consideration should be given to the space available to install the container(s).			

FACTOR	CONSIDERATION			
FACTOR	<ul> <li>CONSIDERATION</li> <li>Floor loading must be considered when selecting a container location.</li> <li>The floor must be able to support the total weight of the Fike container(s) as they are moved into position. Consult raised floor manufacturer for floor loading limitation.</li> <li>The following guidelines are recommended: <ul> <li>Raised floor loading is a function of the manufacturer's load specification and the positioning of the container(s) on the raised floor grid.</li> </ul> </li> <li>NOTE: Fike cannot assume responsibility for determining the suitability of a particular raised floor system; the following does provide information to help determine installation requirements.</li> <li>When clean agent containers are located on a raised floor support can handle the increased load. If necessary additional floor supports can be added.</li> </ul> <li>Option: <ul> <li>To help distribute the container weight over a greater area, a 6.4 mm steel plate can be placed under the container(s), sized to span multiple floor supports. If container spans multiple floor tiles, add additional floor supports (Minimum of 4 floor supports, 1 per corner, must be used). Excessive floor loading may require relocating the container(s) to a more suitable location.</li> </ul></li>			
	For floor loading information refer to Table 1 or to Fike's Flow Calculation program for container size and actual fill weight being supplied.			

TABLE 1 – FLOOR LOADING / AREA BY CONTAINER SIZE						
Container Size (L) Total Container Weight (kg) (See Note 1)		Container Floor Area (m²)	Container Floor Loading (kg/m <sup>2</sup> )	Container Floor Area w/ Plate 6.4mm x 0.6m x 0.6m plate (m <sup>2</sup> )	Container w/ Plate Floor Loading (kg/m <sup>2</sup> ) (See Note 2)	
150	244	0.129	1891	0.36	688	
83	151.5	0.082	1848	0.36	431	
45	83.5	0.082	1018	0.36	242	
26	51	0.041	1244	0.36	152	
16	33	0.041	805	0.36	102	
9	22.5	0.025	900	0.36	73	
5	16	0.025	640	0.36	55	

#### NOTES:

- 1) Total container weight is based on container tare weight + maximum fill weight.
- Total container weight + 10.2 kg / m<sup>2</sup>) added for 6.4mm x 0.6m x 0.6m plate used to calculate container w/ plate floor loading.

#### RECHARGE ITEMS - 1" (25) & 3" (80) VALVE (Must Order Separate)

After a system has been discharged, the following items must be replaced before a container can be recharged. For a detailed procedure on recharging a Fike container w/ an Impulse Valve refer to Fike's Recharge Manual (p/n 06-540-3).

ltem	Description	<b>1" (25mm) Recharge Kit</b> (p/n 85-047) includes the following:	3" (80mm) Recharge Kit (p/n 85-048) includes the following: Part Number	
		Part Number		
1	Friction Ring	70-2060	70-2063	
2	Disc Assembly	70-247	70-248	
3	O-Ring	02-11987	02-11989	
4	Valve Core-Fill Port (not shown)	02-4161	02-4161	

NOTE: 1" (25 mm) Recharge Kit is used on 26 & 45 L containers. 3" (80 mm) Recharge Kit is used on 83 & 150 L containers.







The 1" (25 mm) & 3" (80 mm) Impulse Valves are a rupture disc (metal diaphragm), pressure operated device that allows the agent to be released from the container and into the protected enclosure via the associated piping network and discharge nozzle(s).

The valves have a free flow cross sectional area of:

- 1" = 506 mm<sup>2</sup>
- 3" =3445 mm<sup>2</sup>

Fike Impulse Valves are equipped with following ports:

- Agent Discharge Port allows agent release from container and also fulfills the pressure relief valve requirements in accordance with DOT regulations.
- Agent Fill Port used to fill (refill) and pressurize the container and also used for the Pressure Gauge with Low Pressure Switch that will monitor internal container pressure. The Agent Fill Port has a valve core to allow the Pressure Gauge / LPS to be removed safely when the container is pressurized.



- Actuator Port used to connect an Impulse Valve Operator (IVO) with Manual Strike Button for electric and manual actuation of the container or an Impulse Valve Pneumatic Operator (IVPO) for pneumatic operation.
- Pressure Gauge Port is plugged and is not used.

COMPONENT	MATERIAL	
Valve Body	Brass	
Rupture Disc Assembly	Hastelloy C276/ 316SST	
APPROVALS	LPCB	



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Internal View - 1" (25 mm) Impulse Valve



Internal View – 3" (80 mm) Impulse Valve

PRESSURE GAUGE W/ LOW PRESSURE SWITCH - HFC-227EA COMPONENT SHEET

All Fike Clean Agent Fire Suppression containers with HFC-227ea agent are provided with a pressure gauge and low pressure switch to indicate the internal container pressure.

The pressure gauge scale is calibrated to show the actual pressure and is color-coded to show operating range, under-pressure range, and over-pressure range.

The low pressure switch is continuously monitoring the container pressure for a low-pressure condition. If the pressure inside the container drops below 18 bar, the switch contacts will transfer and invoke a "supervisory" indication on the control panel.

The pressure gauge / low pressure switch assembly can be installed, removed/replaced on a charged container without removing the agent first.



SPECIFICATIONS			
Assembly Part Number	02-12391		
Temperature Limits	-20°C to +50°C		
Protection Rating	IP65		
Contact Rating	Single pole, 4.5 to 24VDC/VAC, 5 to 100 mA; 3 W		
Pressure Connection	M10 x 1		
Electrical Connection	Hirschman L-Plug		
Wire Leads	(2) 18 gauge x 1 m long		
Pressure Setting	Contacts open @ 18 bar (decrease)		
APPROVALS	VdS		

#### **INSTALLATION / REPLACEMENT PROCEDURE**

The following procedure is used to install and/or replace the pressure gauge with low pressure switch on a charged container. This device can be installed in the fill port on a container that is charged by using the following steps:

- Step 1: Prior to installation; lubricate the Pressure Gauge O-Ring with Molykote 55 or equal. Use care not to get lubricant into pressure port.
- **NOTES:** DO NOT apply Teflon Tape to LPS threads. DO NOT cross thread during installation.
- Step 2: Remove and retain Plug from Fill Port. (See Figure 1)
- Step 3: Screw in the Pressure Gauge w/ LPS (Hand Tight) until the threads bottoms out. Screwing this device in to this point will open an internal check valve and applies pressure to the gauge.
- **NOTE:** The gauge can be unscrewed by a maximum of 1 turn to attain correct orientation.

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- NOTE: "NO TOOLS" are required to install Pressure Gauge w/ LPS.
- Step 4: Leak check around the pressure gauge port using Snoop leak test fluid or equivalent.

If a leak is detected; remove the Pressure Gauge from the fill port and remove the lubricant and contaminants from the O-Ring, threads and valve port using isopropyl alcohol and a soft clean cloth. Lubricate the O-Ring with Molykote 55 or equal and reinstall. Leak test around the fill port.

If a leak is detected; remove the Pressure Gauge from the fill port, remove the O-Ring, install a new O-Ring, lubricate the O-ring with Molykote 55 or equal, install the Pressure Gauge in the fill port, and leak test around the fill port.



**FIGURE 1** 

#### WIRING DIAGRAM – LOW PRESSURE SWITCH

The Pressure Gauge w/ LPS should be wired into a supervised circuit in the control panel used to provide a supervisory signal if the container pressure drops below 18 bar. The switch is wired as a normally open contact (closed under pressure). (see Figure 2)

**NOTE:** Refer to the Installation, Operation & Maintenance for the control panel being used for specific wiring criteria.



The container pressure needs to be checked as a part of the installation procedure. They should read 24.8 bar at  $21^{\circ}$ C. For temperatures other than  $21^{\circ}$ C, reference Figure 1 – Temperature vs. Pressure Chart.

Figure 1 – Temperature vs. Pressure Chart (Metric Units)				
Temperature (°C)	Pressure (bar)			
0	19.9			
4	20.9			
10	22.1			
16	23.4			
21	24.8			
27	26.2			
32	27.7			
38	29.3			
43	31.0			
49	32.8			
54	34.6			



# **COMPONENT SPEC**

#### DIRECT IMPULSE VALVE ACTUATOR (DIVA) KIT

#### DESCRIPTION

The Direct Impulse Actuator (DIVA) provides means to electrically or manually activate the Fike Clean Agent Containers with the Impulse Valve by providing the force required to extend a piston that will open the rupture disc, allowing the agent to be released from the container.

The DIVA can be activated electrically via a signal from a Fike control panel or manually by depressing the red strike button.

Fike Clean Agent Containers with Impulse Valve / DIVA are designed to be connected directly to the extinguishant releasing circuit of control panels.



#### **SPECIFICATIONS**

P/N 70-332		DIRECT IMPULSE VALVE ACTUATOR (DIVA) KIT	
NOTE: The follow	ving items are furnished w	vith the DIVA Kit:	
ltem No.	Part Number	Description	
1	02-14231	Direct Impulse Valve Actuator (DIVA)	
2	70-286	Reset Tool (Designed especially for the <b>DIVA only</b> and not any other Fike Actuator)	
3	02-10219	DIN (4 pin) Connector	
Normal Supply	/ Voltage	24 VDC (minimum)/ 30 VDC (maximum)	
Minimum Duration of Firing Signal		2 seconds	
Current Consumption (for Battery Calculation)		Supervision max. 10 mA Minimum current during activation at 24 VDC of 0.36 A. Rated for continuous duty at 24 VDC	
Electrical Conr	nection	IP65 – DIN Connector w/ Cable	
DIVA Material		Stainless Steel (Body) / Brass (End Cap)	
Temperature Range		-20°C to +50°C	
LISTINGS & APPROVALS		LPCB	



#### Part of Manuals: P/N 06-439

#### P/N 06-698-1-2 (Rev. 0 / December, 2013)

#### INSTALLATION

After the electrical / control system has been checked and no trouble / ground faults are present; proceed with the Actuation System installation.

**NOTE:** This should be the last items completed before the system is placed into operation.

**IMPORTANT NOTE:** Check to ensure DIVA is armed (Firing Pin retracted) and Safety Pin is in place before installing to the Impulse Valve on the container.



Install the wire lead w/ connector (Item no. 3) to the DIVA (Item no. 1) connector and secure with set screw.

Install DIVA; remove Retaining Clip and Plastic Plug from Impulse Valve Actuation Port.

Insert DIVA into Impulse Valve Actuation Port and re-insert Retaining Clip.



WARNING: Do not attempt to install the DIVA with the firing pin in the activated (extended) position.

CAUTION: The container is "NOW ARMED".

For wiring installation details between Control Panel, and the DIVA, reference page 5.

 Part of Manuals: P/N 06-439
 P/N 06-698-1-2 (Rev. 0 / December, 2013)

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#### **DIVA WIRING**

The DIVA coil is not polarity sensitive and can be wired to a compatible control panel releasing circuit. Final termination is through the DIN connector supplied with the unit, connections are to be made to pins 2 & 3 of the plug.



Refer to the manual & wiring requirements for the specific control panel being used to ensure proper operation.

#### **METHODS OF ACTUATION**

The Impulse Valve actuation system can be setup in a number of different arrangements; the following examples illustrate these methods and call up the actuation components required.

ITEM	PART NUMBER	DESCRIPTION
1	02-10797	Adaptor – ½" BSPT x ¼" BSPP (supplied with Discharge Pressure Switch 02-9635)
2	02-9751	Hose – ¼″ BSPP x ¼″ BSPP x 0.7m lg. (supplied with Discharge Pressure Switch 02-9635)
3	02-10801	Actuation Hose – ¼" JIC x ¼" BSPP 1.0m lg. (must be ordered separately)
4	C02-1278	Elbow – $\mathcal{V}_{s}$ " NPT x $\mathcal{V}_{s}$ " JIC Adaptor (must be ordered separately)
5	02-13191	Run Tee – ¼" NPT x ¼" JIC x ¼" JIC (must be ordered separately)
6	02-4977	Actuation Hose – $\frac{3}{2}$ JIC x 3.0' lg. (must be ordered separately)

#### EXAMPLE 1: ELECTRIC ACTUATION - SINGLE CONTAINER SYSTEM W/ DIVA



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#### EXAMPLE 2: ELECTRIC & PNEUMATIC ACTUATION - TWO CONTAINER SYSTEM W/ DIVA & IVPO



1<sup>st</sup> remove the ½" NPT Plug from Adaptor Nipple, then install Actuation System as shown above. Secure Actuation tubing to a solid surface. Anchoring into plaster, sheetrock wall or any other facing material is NOT acceptable. For additional information regarding the installation and resetting of the IVPO, refer to the IVPO Component Spec (p/n 06-698-1-3).

# Adaptor Nipple w/ 1/8" Port

#### EXAMPLE 3: ELECTRIC & PNEUMATIC ACTUATION - MULTI CONTAINER SYSTEM W/ DIVA & IVPO

#### EXAMPLE 4: ELECTRIC & PNEUMATIC ACTUATION - MULTI CONTAINER SYSTEM W/ DIVA & IVPO w/ ACTUATION TUBING

The illustration above shows the items required to make the proper connection between the Container equipped w/ a DIVA and the other Container(s) equipped w/ a IVPO's. The maximum length of pneumatic actuation line (including Hoses) cannot exceed 50 ft. (15.2 m) and up to 6 containers equipped w/ IVPO's.

Refer back to Fike for details.

For additional information regarding the installation and resetting of the IVPO, refer to the IVPO Component Spec (p/n06-698-1-3).

 Part of Manuals: P/N 06-439
 P/N 06-698-1-2 (Rev. 0 / December, 2013)

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#### **RESET INSTRUCTIONS**

Part of Manuals: P/N 06-439



#### P/N 06-698-1-2 (Rev. 0 / December, 2013)



#### IMPULSE VALVE OPERATOR SUPERVISOR

#### DESCRIPTION

The Impulse Valve Operator Supervisor (IVOS) is used to monitor the presence of the Impulse Valve Operator (IVO). When installed between the Impulse Valve on the container and the IVO, this supervises the position of the actuation device; when the IVO is removed from the container this will cause a "trouble" at the system control panel.



**COMPONENT SPEC** 

This can also be used to monitor the position of the Impulse Valve Pneumatic Operator (IVPO).

SPECIFCATIONS – IMPULSE VAVLE OPERATOR SUPERVISOR (IVOS)			
Item Description			
Part Number	02-14263		
Switch	Normally Closed (Black) / Normally Open Contacts (White) / Common (Red)		
Conduit	0.25"ID SST Flexible Conduit 34.75" lg. with 1/2" Knockout Connector		
Wire Leads	22 AWG, 44″ lg.		
Temperature Range	32°F to 130°F (0°C to 54.4°C)		
Listings & Approvals	UL / ULC Listed & FM Approved		

#### INSTALLATION

After the electrical / control system has been checked out and no trouble / ground faults are present; proceed with the Actuation System installation.

NOTE: This should be the last items completed before the system is placed into operation.

IMPORTANT NOTES: Check to ensure IVO is armed (Firing Pin retracted) and Safety Pin is place before installing to the Impulse Valve on the container.

Install the wire leads from the IVOS to the control unit. (Refer to typical wiring diagrams for details)

Install IVO; remove Retaining Clip and Plastic Plug from Impulse Valve Actuation Port.

Insert IVO into Impulse Valve Actuation Port and insert IVOS Retaining Clip.

#### Part of Manuals: P/N 06-431, 06-431-DF, 06-433, 06-433-DF

#### P/N 06-432-1-11 (Rev. 0 / November, 2015)





The container is "NOW ARMED".

#### TYPICAL WIRING DETAIL FOR SHP PRO TO IVOS

(See SHP Pro Control Unit manual for specific wiring requirements)



#### TYPICAL WIRING DETAIL FOR MONITOR MODULE TO IVOS

(See Cheetah Xi Control Unit manual for specific wiring requirements)



Part of Manuals: P/N 06-431, 06-431-DF, 06-433, 06-433-DF

P/N 06-432-1-11 (Rev. 0 / November, 2015)



# **COMPONENT SPEC**

#### **IMPULSE VALVE PNEUMATIC OPERATOR (IVPO) KIT**

#### DESCRIPTION

The Impulse Valve Pneumatic Operator (IVPO) provides the means to pneumatically activate the Fike Impulse Valve clean agent container by providing the force required to extend a piston that will open the rupture disc, allowing the agent to be released from the container.

The IVPO is installed in systems utilizing multiple clean agent containers.

Fike Clean Agent Containers with IVPO are operated by pneumatic pressure from Container with Direct Impulse Valve Actuator (DIVA). For detailed information, refer to the Direct Impulse Valve Actuator Component Spec (p/n 06-698-1-2).



SPECIFICATIONS – IMPULSE VALVE PNEUMATIC OPERATOR (IVPO) KIT					
ltem No.	No. Part Number Description				
1	02-12729	Impulse Valve Pneumatic Operator (IVPO)			
2	02-4543	1/8" x ¼" JIC Adaptor			
3	02-4977	¼" JIC x 3.0' lg. Actuation Hose			
4	70-286	Reset Tool			
IVPO Material		Stainless Steel (Body) / Brass (End Cap)			
Pneumatic Connection		1/8" NPT			
Operating Pressure		6.9 bar (minimum) / 17.2 bar (nominal) / 69 bar (maximum)			
Triggering Pressure Duration		2 seconds (minimum)			
Temperature Range		-20°C to 50°C)			
Approvals		LPCB			

#### INSTALLATION

After the electrical / control system has been checked out and not trouble / ground faults are present; proceed with the IVO and IVPO installation.

NOTE: The DIVA should be the last items completed before the system is placed into operation.

- Remove the Retaining Clip p/n (02-11986) from the actuation port of the Impulse Valve. (see Figure 1)
- Remove the Plastic Plug from the actuation port of the Impulse Valve. Retain the plug for future use when the container has to be re-filled/serviced.
- Insert the IVPO into the actuation port of the Impulse Valve and secure by inserting the Retaining Clip provided. (see Figure 1)

#### **IMPORTANT NOTE:** Check IVPO to ensure device is armed before inserting on Impulse Valve.

#### Part of Manuals: P/N 06-439

#### P/N 06-698-1-3 (Rev. 0 / December, 2013)



#### **RESET INSTRUCTIONS**

Remove IVPO from Impulse Valve by removing Retaining Clip.



IVPO – Fired Position

Insert IVPO into Reset Tool and secure with Retaining Clip



Push Reset Tool button (firmly) against a hard surface until IVPO Pin resets (clicks into place)



Remove Retaining Clip, IVPO is reset and ready to be installed on Impulse Valve.

IMPORTANT NOTE: Check IVPO to ensure device is armed before inserting on Impulse Valve.



Part of Manuals: P/N 06-439

P/N 06-698-1-3 (Rev. 0 / December, 2013)



### MOUNTING STRAPS & BRACKETS COMPONENT SHEET



Mounting Straps / Brackets are used to secure containers to a wall or other suitable mounting surface. These devices are supplied with each container purchased in accordance with the information shown below.

Mounting hardware (nuts, bolts, etc.) is supplied by system installer.

**CAUTION:** Anchoring into plaster, sheetrock wall or any other facing material is **NOT** acceptable.

CONTAINER	STRAP PART	NO. OF STRAPS	MOUNTING POSITION	DIMENSION (mm)		
SIZE (L)	NUMBER	REQ'D		А	В	H₁
5	74-1013-109	1	Upright (Valve Up)	89	115	150
9	74-1013-109	1	Upright (Valve Up)	89	115	300
16	74-1013-106	1	Upright (Valve Up)	115	141	300
26	74-1013-106	1	Upright (Valve Up)	115	141	350
45	74-1013-101	1	Upright (Valve Up)	162	188	631
83	74-1013-101	1	Upright (Valve Up)	162	188	867
150	74-1013-102	1	Upright (Valve Up)	206	239	1137
NOTE		All dimensions are approximate				
MATERIAL		Carbon Steel				
BRACKET COLOR		White				



Front View – Container & Mounting Strap



Top & Side View – Mounting Strap



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#### **PIPING MATERIALS**

Piping materials must conform to the requirements as outlined in NFPA 2001, latest edition. The thickness of the piping wall shall be calculated in accordance with ASME B31.1 Power Piping Code. For Fike Clean Agent System, w/ 24.8 bar working pressure, use a minimum piping design pressure of 34.4 bar at 21°C.

CAUTION: Cast iron pipe, steel pipe conforming to ASTM A120, or nonmetallic pipe shall not be used.

The following piping materials and configurations are acceptable:

Schedule 80 Threaded & Welded

Schedule 40 Threaded, Welded & Grooved

The following piping types and grades are acceptable for pipe configurations utilizing threaded, welded or grooved end connections:

	Pipe Size (mm)	Grade / Type					
Pipe Schedule		A-106C	A-53B A-106B	A-53B	A-53A A-106A	A-53A	A-53F
		Seamless	Seamless	ERW	Seamless	ERW	Furnace
40 or 80	10	~	~	~	~	~	~
	15	~	~	~	~	~	~
	20	~	~	~	~	✓	~
	25	~	~	~	~	~	~
	32	~	~	✓	~	~	~
	40	~	~	~	~	~	~
	50	~	~	~	~	~	~
	65	~	~	~	~	~	~
	80	~	~	~	~	~	~
	100	~	~	~	~	~	~
	150	~	~	$\checkmark$	~	$\checkmark$	~





#### FITTING MATERIALS

Fitting materials **MUST** conform to one of the following requirements NFPA 2001, EN 10241 or EN 10242:

#### NFPA 2001, latest edition.

FITTINGS SIZE	FITTING CLASS
Up to 80 mm	Class 300 malleable or ductile iron
Over 80 mm	1000 lb. ductile or forged steel
All pipe sizes	Class 300 flanged

**NOTE:** All grooved fittings must conform to the pressure requirements outlined in NFPA 2001 and/or ISO 14520, latest edition. Cast Iron fittings are **NOT** acceptable.

#### EN 10241

Screwed Fittings Steel th	hreaded	Seamless with a test pressure of 150 bar
5		·

#### EN 10242

Screwed Fittings	Malleable cast iron threaded	Special order with a test pressure of 150 bar
------------------	------------------------------	---

#### PIPE SIZE CHANGE

Pipe size changes, to increase or decrease the size, can be done at three different locations in the piping network:

Pipe Size Change at a Tee	When the change in pipe size is done at a tee, this is accomplished by using either a reducing tee or a standard tee and reducing fittings. All reducers must be concentric bell reducers or concentric reducing couplings.
Pipe Size Change at an Elbow	When the change in pipe size is done at an elbow, this is accomplished by using either reducing elbows or a standard elbow with concentric bell reducers or concentric reducing couplings.
Pipe Size Change at a Coupling	When the change in pipe size accomplished at a coupling, only concentric bell reducers or concentric reducing couplings can be used.

**NOTE:** Reducing bushings, weld-o-let, and hole-cut fittings "**ARE NOT**" acceptable.

#### INSTALLATION

The piping system should be securely supported with due allowance for agent thrust forces, thermal expansion, and contraction, and should not be subject to mechanical, chemical, vibration, or other type of damage. The maximum horizontal spacing for screwed, welded or grooved pipe are as indicated on the following table:

Pipe Size (mm)	Distance Between Supports (m)	Rod Diameter (mm)	<ul> <li>NOTE:</li> <li>Each pipe section shall be cleaned internally before installation with a nonflammable cleaner such as Perchlorethylene in accordance with</li> </ul>		
10	2.2	10	• Teflon tape or joint compound shall be used on all threaded joints. All		
15	2.2	10	grooved coupling gaskets shall be lubricated per the manufacturer's		
20	2.1	10	<ul> <li>"C" Clamps are not acceptable to support rod hangers.</li> </ul>		
25	2.2	10	• Rigid pipe supports are required to support the "live load" of the pip		
32	2.2	10	system during discharge. Rigid bracing is required at each directiona change, fitting, tee and nozzle. All drops to 180° nozzles require back		
40	2.8	10	bracing in the opposite direction of the discharge. Earthquake bracing <b>shall</b> be used where required by local code. (Refer to ANSI B31.1		
50	3.1	10	Power Piping Code for additional information)		
65	3.4	15	• For additional information on pressure rating of pipe and fittings, plus recommended pipe supports and hangers, refer to FSSA's Pipe Design		
80	3.7	15	Handbook, FSSA PDH-01.		
100	4.3	20	<ul> <li>All system piping shall be installed in strict accordance to system plans. If piping changes are necessary, they must be recalculated on Fike's Flow Calculation Program.</li> </ul>		
150	5.2	25			
#### **CONNECTION – CONTAINER TO PIPING NETWORK**

Discharge Valve Size	Fittings Required	Comments	
25 mm	25 mm Victaulic Coupling (p/n 02-9964)		
25 1111	25 mm Adapter Nipple (p/n 70-1870) Supplied w/ Contain		
90 mm	80 mm Victaulic Coupling (p/n 02-1987)	Supplied w/ Container (82,8450)	
	80 mm Adapter Nipple (p/n 70-1350)		

The container discharge valve outlet is connected to the piping network using the following items:

- **NOTES:** 1) It is not necessary to supply a pipe union after the grooved coupling to facilitate removal of the container for service or maintenance purposes. The container can be removed by removing the grooved coupling provided with each container.
  - 2) Adapter Nipple is supplied with 1/8 NPT female threads to connect to:
    - Discharge Pressure Switch
    - Used to provide pressure to activate slave container(s)
- **IMPORTANT NOTE:** Remove the Baffle Plug that is threaded into the discharge outlet of the Adapter Nipple before connecting the discharge piping to the container. The Baffle Plug is an anti-recoil device that must be installed whenever transporting or handling pressurized containers that are not connected to the discharge piping.



**Front View** 

An ISO 9001:2008 Company



## DISCHARGE PRESSURE SWITCH ASSEMBLY COMPONENT SHEET



Discharge Pressure Switch Assembly (DPS) is used to provide a positive pneumatic confirmation to the control system that the Fike Fire Suppression system has been discharged.

When a system is discharged manually (by Impulse Valve Operator (IVO) with Strike Button), the discharge pressure switch is required to provide the input to the control system needed to activate various audio/visual warning devices and auxiliary relays.

The switch is operated pneumatically using the agent pressure in the discharge piping network







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#### INSTALLATION

The Discharge Pressure Switch has a SPST switch that can be wired for a normally open or normally closed discharge input to the system control panel.

The pressure connection to the Discharge Pressure Switch is accomplished using the flex hose supplied with the unit. Connect the 1/8" NPT end to the Adapter Nipple; which has a 1/8" NPT port machined in the side as shown in the illustration below. (see Figure 1)

- Step 1: Mount the Discharge Pressure Switch next to the container(s) using the mounting bracket supplied with (2) 6mm fasteners.
- Step 2: Apply Teflon Tape to the male 1/8" NPT threads of the 1/8" Adaptor, install the 1/8" NPT x 1/4" BSPM Adaptor into the Adaptor Nipple (Wrench tight).
- Step 3: Connect the Flex Hose to the 1/8" Adaptor (Wrench tight).



#### WIRING DIAGRAM

Following is a typical wiring diagram showing how the discharge pressure switch is wired to the manual release input of a control panel (See Figure 2) (Refer to the Control Panel Manufacturer's manual for wiring details).



# DISCHARGE NOZZLES - HFC-227EA COMPONENT SHEET



The function of the Fike discharge nozzle is to control the agent flow and distribute the agent throughout the protected enclosure in a uniform, predetermined pattern and concentration.

The discharge nozzle size refers to the size of schedule 40 or 80 pipe that it can be connected to.

The discharge nozzle is mounted to allow the agent to be discharge on a horizontal axis.

The nozzle orifice area is determined be performing a hydraulic calculation using the Fike Engineered Flow Calculation program.

Nozzle should not be ordered until the clean agent system pipe network is installed and an "As Built" hydraulic calculation is performed.

Nozzle orifice drilling must be done at Fike factory or at a UL listed Nozzle Drill Station.







360° Enginee		ed Nozzles (12 Orifices)		180° Engineered Nozzles (11 Orifices)			Nozzle
Size	Part Number	Drill Dia. (mm)		Dent Number	Drill Dia. (mm)		Length
(mm)		Minimum	Maximum	Part Number	Minimum	Maximum	(mm)
10	84-045-XXXX	1.5	3.2	84-052-XXXX	1.5	3.3	46
15	84-046-XXXX	1.5	4.1	84-053-XXXX	1.5	4.3	48
20	84-047-XXXX	2.0	5.4	84-054-XXXX	2.3	5.7	56
25	84-048-XXXX	2.7	6.7	84-055-XXXX	2.9	7.2	64
32	84-049-XXXX	3.5	8.9	84-056-XXXX	3.8	9.4	79
40	84-050-XXXX	4.3	10.5	84-057-XXXX	4.4	10.8	86
50	84-051-XXXX	5.4	13.5	84-058-XXXX	5.6	13.9	95
Thread Type		BSP					
Material		Brass					
Listing & Approvals			UL / ULC Listed & FM Approved				

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#### INSTALLATION

Always verify the nozzle identification number (stamped on the closed end of the nozzle) matches the nozzle part number listed on the system installation plans. All nozzle locations should be within 0.3m of their intended locations on the system plans. Discharge Nozzles must be mounted in the vertical position and can face either up or down.

**CAUTION:** The piping should be blown clear to remove chips, mill scale, or metal shavings before the nozzles are installed.



#### 360° NOZZLES

360° 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.



#### **180° NOZZLES**

 $180^{\circ}$  Nozzles should be located in a symmetrical, or near symmetrical, pattern within the protected area.  $180^{\circ}$  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 0.3 m out from the wall.

180° Nozzles generate a reactive force in the opposite direction from the nozzle discharge orifices. Rigid pipe bracing must be attached to the nozzle drop to counteract the expected movement.



#### 180° NOZZLES – BACK to BACK APPLICATION

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

- Maximum distance between nozzles = 0.3 m
- Agent supplied and flow rate from both nozzles are the same.
- Pipe size from tee to both nozzles is the same.
- Pipe lengths from tee to each nozzle are within 10% of each other.



#### NOZZLE AREA COVERAGE

Nozzle Size – 10 – 50 mm					
Nozzle Type		Radius "R" Dimension (m)		Ceiling Height Range (m)	
180°		14		0.3 to 4.9	
360°		9		0.3 to 4.9	
Maximum Distance	180° Nozzle	360° Nozzle		Note	

	()	()	
Below Ceiling	0.3	0.3	Maximum distance above highest point of protection when
Away from Sidewall	0.3		stacking nozzles.







Check Valves are used prevent agent loss from the open end of a manifold and/or piping system in the event that one or more containers are removed for servicing / maintenance.

Check Valves are required for multiple containers connected in a manifold arrangement and for containers used in a main / reserve system, without the need for redundant piping systems, to prevent agent loss and to ensure personnel safety if the system is operated when any containers are removed for maintenance. All containers must be the same size & same weight.



CHECK VALVE DATA		DIMENSIONS		APPROXIMATE	EQUIVALENT	
PART NO.	DESCRIPTION	HEIGHT (mm)	LENGTH (mm)	(kg)	(m)	
02-2980	1" (25 mm) Check Valve	95 (maximum)	108	4.1	0.61	
02-4158	2" (50 mm) Check Valve	144 (maximum)	152	5.4	1.22	
02-4157	3" (80 mm) Check Valve	152	203	14.1	1.37	
MATERIAL		Carbon Steel				
WORKING PRESSURE		50 bar				
THREAD TYPE		Female NPT (Both Ends)				
APPROVALS		UL Ex4623 / FM 3034180				

**NOTE**: Check Valves have threaded female connections on both ends; therefore piping leading into and exiting from must be threaded.

**IMPORTANT NOTE:** The Check Valves **must** be installed with the flow arrow pointing in the direction of discharge. If reversed, the system will not discharge.

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Part of Manuals: 06-439, 06-541 & 06-542

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#### INSTALLATION

Once the pipe / manifold is assembled and the containers connected, the pipe / manifold should not be supported by the containers. The piping should be secured with pipe hangers or brackets to support the manifold when the containers are removed for service.

If grooved couplings are used, the gaskets must be lubricated with a non-petroleum base lubricant as recommended by the fitting manufacturer.

Manifolds are commonly assembled using grooved fittings, however threaded; welded or flanged fittings can also be used. Teflon tape or joint compound shall be used on all threaded joints.

#### EXAMPLE – CENTER EXIT MANIFOLD / MAIN & RESERVE SYSTEM







Caution / Advisory Signs are provided to comply with NFPA 2001 and ISO requirements, and to provide the necessary information to personnel in the area. The signs are made from flame retardant, Lexan<sup>™</sup> polycarbonate material.

Optional Item - Caution / Advisory signs must be ordered separately.

#### CAUTION SIGN (P/N 02-4694)



This sign is provided to alert personnel that the room is protected with an HFC-227ea system and to evacuate the area when the alarms sound. The sign measures 160mm x 160mm.

The Caution Sign should be placed on the outside of each door entering the protected space.

#### MANUAL DISCHARGE STATION (P/N 02-4695)



This sign is provided to identify each manual release station associated with the HFC-227ea system. This reduces the risk of a manual discharge station being mistaken for a fire alarm pull station. This sign measures 195mm x 70mm.

The Manual Discharge Station Sign should be placed at each manual release station location for positive identification.

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## CAUTION – AREA PROTECTED BY HFC-227ea SIGN – p/n 02-10139



THIS AREA IS PROTECTED BY A HFC-227ea EXTINGUISHING SYSTEM

DO NOT ENTER AREA DURING OR AFTER DISCHARGE

KEEP DOOR CLOSED AT ALL TIMES

Provided to alert personnel that the room is protected with an HFC-227ea system and that they should not enter the area during or after discharge.

The sign also indicates the requirement that all doors serving the protected area must be kept closed at all times.

The sign is 330 mm x 254 mm, with black lettering on a yellow background for Caution and black lettering on a white background for Sign text.

#### CAUTION - SYSTEM DISCHARGE ALARM SIGN - p/n 02-10138



Provided to alert personnel that the room is protected with an HFC-227ea system and to evacuate the area when the alarms sound.

This sign is provided to alert personnel that the room is protected with an HFC-227ea system and that they should not enter the area when the alarm sounds.

The sign is 229 mm x 154 mm, with black lettering on a yellow background for Caution and black lettering on a white background for Sign text.

#### CAUTION - EXIT AREA SIGN - p/n 02-10105



HFC-227ea EXTINGUISHING SYSTEM ALARM

IF ACTIVE EXIT AREA IMMEDIATELY Provided to explain the presence of notification devices that are located inside the protected space.

This sign explains that the HFC-227ea system will soon be discharged if the strobe light is flashing, and appropriate actions should be taken.

This sign should be placed at each strobe light location.

The sign is 229 mm x 154 mm, with black lettering on a yellow background for Caution and black lettering on a white background for Sign text.

#### SYSTEM RELEASE SIGN – p/n 02-10137

HFC-227ea EXTINGUISHING SYSTEM RELEASE Provided to identify each system release station associated with the HFC-227ea system.

This reduces the risk of a manual discharge station being mistaken for a fire alarm pull station.

This sign should be placed at each manual release station location for positive identification. This sign is 102 mm x 57 mm, with black lettering on a white background.

#### MAIN / RESERVE SIGN – p/n 02-10107

HFC-227ea EXTINGUISHING SYSTEM MAIN / RESERVE Provided to identify each system main/reserve station associated with the HFC-227ea system.

This sign clearly identifies the purpose of the switch.

This sign should be placed at each main/reserve station location for positive identification.

This sign is 102 mm x 57 mm, with black lettering on a white background.

#### SYSTEM ABORT SIGN – p/n 02-10106

HFC-227ea EXTINGUISHING SYSTEM ABORT PUSH AND HOLD Provided to identify each system abort station associated with the HFC-227ea system.

This reduces the risk of an abort station being mistaken for a manual release or fire alarm pull station.

This sign should be placed at each abort station location for positive identification.

The sign is 102 mm x 57 mm.

# FIKE CLEAN AGENT SYSTEM W/ **IMPULSE TECHNOLOGY HFC-227EA AGENT**

#### Fike DESIGN INFORMATION - HFC-227EA

An 190 9001:2008 Company 

(Metric Units)

The following information details the steps necessary to design a Fike Clean Agent Fire Suppression System w/ HFC-227ea agent within the limitations established by Fike's UL listing (UL Ex4623), FM approval (FM 3014476) and in compliance with RFPA 2010 and/or ISO Standard 14520-1.

#### HAZARD CLASSIFICATION

Class of Hazard	Definitions of Fire Class (definitions per NFPA 2001)
Class A	A fire in ordinary combustible materials, such as wood, cloth, paper, rubber and many plastics (anything that leaves an ash residue after combustion).
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.

#### MINIMUM DESIGN CONCENTRATION

Hazard Classification (Type)	Minimum Design Concentration (Per NFPA 2001)	Minimum Design Concentration (Per ISO-14520-1)	NOTES
Class A & C	6.25%	7.9%	Clean Agent System incorporates Detection & Control System to automatically discharge agent.
Class A & C	6.4%	8.1%	Recommendation, when protecting multiple hazards w/single agent supply.
Class B (Heptane)	8.7%	8.7%	For design concentrations of other Class B (flammable liquids), consult Fike's Product Support group.

#### MAXIMUM DESIGN CONCENTRATION

Part of Manual: 06-542

Space Туре	Maximum Concentration Allowed
Occupiable (See Note below)	10.5%
Not Occupiable	No Limit

Occupiable space is defined as a space that can be "Normally Occupied" or that can be "Not Normally Occupied. NOTE: Maximum human exposure time shall not exceed 5 minutes for HFC-227ea systems utilized in any occupiable spaces.

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here k<sub>1</sub> = 0,126.9

10%	11%	12%	13%	14%	15%
0.9147	1.0174	1.1225	1.2301	1.3401	1.4527
0.8951	0.9957	1.0985	1.2038	1.3114	1,4216
0.8763	0.9748	1.0755	1.1785	1.2839	1.3918
0.8586	0.9550	1.0537	1.1548	1.2579	1.3636
0.8414	0.9360	1.0327	1.1316	1.2328	1.3364
0.8251	0.9178	1.0126	1.1096	1.2089	1.3105
.8094	0.9004	0.9934	1.0886	1.1859	1.2856
0.7944	0.8837	0.9750	1.0664	1.1640	1.2618
0.7800	0.8676	0.9573	1.0490	1.1428	1.2388
0.7861	0.8522	0.9402	1.0303	1.1224	1,2168
0.7528	0.8374	0.9239	1.0124	1.1029	1.1956
0.7399	0.8230	0.9080	0.9950	1.0840	1.1751
0.7276	0.8093	0.8929	0.9784	1.0680	1.1555
0.7156	0.7960	0.8782	0.9623	1.0484	1.1365
0.7041	0.7832	0.8641	0.9469	1.0316	1.1183
0.6929	0.7707	0.8504	0.9318	1.0152	1.1005
0.6821	0.7588	0.8371	0.9173	0.9994	1.0834
0.6717	0.7471	0.8243	0.9033	0.9841	1.0668
0.6617	0.7360	0.8120	0.8898	0.9694	1.0509
0.6519	0.7251	0.8000	0.8767	0.9551	1.0354
0.6423	0.7145	0.7883	0.6638	0.9411	1.0202
0.6332	0.7044	0.7771	0.8516	0.9277	1.0057
0.6243	0.6945	0.7662	0.8396	0.9147	0.9916

er unit volume of protected space, m/V (kg/m<sup>2</sup>) acentration (% by volume)





Maximum 10 seconds

Notes

aximum distance above highest point of protection when acking nozzles.

13.4 m

- 0,000 513 (%); i.e. the vol n of HFC 227ea in air at the t of 1.013 bar abs



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#### Manual P/N 06-439 (Rev 3 / December, 2015)

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## HAZARD CLASSIFICATION

Class of Hazard	Definitions of Fire Class (definitions per NFPA 2001)		
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Class C	A fire that involves energized electrical equipment.		

#### MINIMUM DESIGN CONCENTRATION

Hazard Classification (Type)	Minimum Design Concentration (Per NFPA 2001)	Minimum Design Concentration (Per ISO-14520-1)	NOTES
Class A & C	6.25%	7.9%	Clean Agent System incorporates Detection & Control System to automatically discharge agent.
Class A & C	6.4%	8.1%	Recommendation, when protecting multiple hazards w/ single agent supply.
Class B (Heptane)	8.7%	8.7%	For design concentrations of other Class B (flammable liquids), consult Fike's Product Support group.

#### MAXIMUM DESIGN CONCENTRATION

Space Type	Maximum Concentration Allowed
Occupiable (See Note below)	10.5%
Not Occupiable	No Limit

NOTE: Occupiable space is defined as a space that can be "Normally Occupied" or that can be "Not Normally Occupied.

> Maximum human exposure time shall not exceed 5 minutes for HFC-227ea systems utilized in any occupiable spaces.

#### **ENCLOSURE VOLUME**

FORMULA	NOTES
Protected Volume =	As a general rule, Hazard Volume should be based on the empty (gross) volume.
Base Volume	Length x Width x Height
+ Added Volume	Volume that is open to the space being protected (i.e. non-dampered ductwork, uncloseable openings, etc.)
- Removed Volume	Volume for items that are solid, non-permeable, and non-removable objects can be deducted from the protected volume
IMPORTANT NOTE:	Any object that can be removed from the protected space <b>CANNOT</b> be deducted from the volume

#### AGENT REQUIRED

Calculation Based on:	Lowest Expected Ambient Temperature	Minimum Design Concentration Required (to protect this type of hazard)
-----------------------	-------------------------------------	--

The agent quantity needed can be determined by the following formula:

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

Where: W = Agent Weight in kg

V = Hazard Volume / m<sup>3</sup>

C = Design Concentration, % by volume

S = Specific Vapor in m<sup>3</sup>/kg

$$S = k1 + k2 (t)$$

Where: k1 = 0.1269, k2 = 0.0005(t), t = temperature (°C)

**NOTE**: The equation to calculate S is an approximation.

#### FLOODING FACTORS – Agent vs. Temperature Charts (Metric Units)

Temp. T	Specific Vapor Volume S	HF	C 227ea r	nass requ	uirements Design C	s per unit Concentra	volume c tion (% b	of protect y volume)	ed space	, m/V (kg/	′m³)
(°C)	(m³/kg)	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%
-10	0.1215	0.5254	0.6196	0.7158	0.8142	0.9147	1.0174	1.1225	1.2301	1.3401	1.4527
-5	0.1241	0.5142	0.6064	0.7005	0.7967	0.8951	0.9957	1.0985	1.2038	1.3114	1.4216
0	0.1268	0.5034	0.5936	0.6858	0.7800	0.8763	0.9748	1.0755	1.1785	1.2839	1.3918
5	0.1294	0.4932	0.5816	0.6719	0.7642	0.8586	0.9550	1.0537	1.1546	1.2579	1.3636
10	0.1320	0.4834	0.5700	0.6585	0.7490	0.8414	0.9360	1.0327	1.1316	1.2328	1.3364
15	0.1347	0.4740	0.5589	0.6457	0.7344	0.8251	0.9178	1.0126	1.1096	1.2089	1.3105
20	0.1373	0.4650	0.5483	0.6335	0.7205	0.8094	0.9004	0.9934	1.0886	1.1859	1.2856
25	0.1399	0.4564	0.5382	0.6217	0.7071	0.7944	0.8837	0.9750	1.0684	1.1640	1.2618
30	0.1425	0.4481	0.5284	0.6104	0.6943	0.7800	0.8676	0.9573	1.0490	1.1428	1.2388
35	0.1450	0.4401	0.5190	0.5996	0.6819	0.7661	0.8522	0.9402	1.0303	1.1224	1.2168
40	0.1476	0.4324	0.5099	0.5891	0.6701	0.7528	0.8374	0.9239	1.0124	1.1029	1.1956
45	0.1502	0.4250	0.5012	0.5790	0.6586	0.7399	0.8230	0.9080	0.9950	1.0840	1.1751
50	0.1527	0.4180	0.4929	0.5694	0.6476	0.7276	0.8093	0.8929	0.9784	1.0660	1.1555
55	0.1553	0.4111	0.4847	0.5600	0.6369	0.7156	0.7960	0.8782	0.9623	1.0484	1.1365
60	0.1578	0.4045	0.4770	0.5510	0.6267	0.7041	0.7832	0.8641	0.9469	1.0316	1.1183
65	0.1604	0.3980	0.4694	0.5423	0.6167	0.6929	0.7707	0.8504	0.9318	1.0152	1.1005
70	0.1629	0.3919	0.4621	0.5338	0.6072	0.6821	0.7588	0.8371	0.9173	0.9994	1.0834
75	0.1654	0.3859	0.4550	0.5257	0.5979	0.6717	0.7471	0.8243	0.9033	0.9841	1.0668
80	0.1679	0.3801	0.4482	0.5178	0.5890	0.6617	0.7360	0.8120	0.8898	0.9694	1.0509
85	0.1704	0.3745	0.4416	0.5102	0.5803	0.6519	0.7251	0.8000	0.8767	0.9551	1.0354
90	0.1730	0.3690	0.4351	0.5027	0.5717	0.6423	0.7145	0.7883	0.8638	0.9411	1.0202
95	0.1755	0.3638	0.4290	0.4956	0.5636	0.6332	0.7044	0.7771	0.8516	0.9277	1.0057
100	0.1780	0.3587	0.4229	0.4886	0.5557	0.6243	0.6945	0.7662	0.8396	0.9147	0.9916

Symbols:

m/V is the agent mass requirements (kg/m<sup>3</sup>); 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;

is the net volume of hazard (m<sup>3</sup>); i.e. the enclosed volume minus the fixed structures impervious to extinguishment v  $m = (c / (100 - c))^* (V / S)$ 

is the temperature (°C); i.e. the design temperature in the hazard area; Т

is the specific volume (m<sup>3</sup>/kg); the specific volume of superheated HFC 227ea vapor at a pressure of 1,013 bar may be S approximated by the formula:

 $S = k_1 + k_2 T$ 

where

 $k_1 = 0,126.9$ 

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

Manual P/N 06-439 (Rev 3 / December, 2015)

#### **TEE DESIGN FACTOR**

Definition:When a single agent supply is being used to protect multiple hazards, a tee design fact applied when more than 4 tees are used in multiple hazard applications.					
Steps:			Tee Count	Design Factor	
				0.00	
	Starting from	n the point where the piping enters the hazard that is located traulically) from the agent container(s), count the number of tees in	5 0.01		
1	the direct flo	by path as it returns to the agent container(s), could the number of tees in the weather the agent container(s).	6	0.02	
	DO NOT INCI	de the tees that are used in the manifold (if applicable).	7	0.03	
			8	0.04	
2	Any tee with	in the hazard that supplies agent to another hazard shall be	9	0.05	
included in		the tee count.		0.06	
			11 - 12	0.07	
3	After counting the Tee Des	ng the tees, compare that number to the chart above to determine sion Factor	13	0.08	
		C C C C C C C C C C C C C C C C C C C	14 - 15	0.09	
		Pe Design Eactor to the Agent Quantity calculations by multiplying	16	0.10	
4	the Tee Des	the Tee Design Factor by the amount of agent previously determined in the volumetric calculations		0.11	
vo	volumetric c			0.12	

#### EXAMPLE:

This example shows a multi-hazard area arrangement. Starting at the point where the piping enters the hazard farthest away, count the number of tees leading back to the agent container. With a tee count of five (5), an additional 1% (0.01) of agent is required. Therefore, the base quantity of agent is multiplied by 1.01 (1%) to determine the adjusted quantity of agent required



**NOTE:** Fike recommends increasing the design concentration to 6.4% when protecting multiple hazards w/ single agent supply. This will satisfy the tee design factor requirement.

#### **ALTITUDE CORRECTION FACTORS**

Definition	Where compensation is made when pressure varies from standard sea level pressure due to elevation change.
Altitude (m)	Correction Factor
-1,000	1.11
0	1.00
1,000	0.89
1,500	0.82
2,000	0.78
2,500	0.72
3,000	0.70
3,500	0.65
4,000	0.61
4,500	0.57

NOTE: The Fike flow calculation program will automatically calculate the agent required based altitude correction factor entered

#### **CONCENTRATION AT MAXIMUM TEMPERATURE**

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

Where: Agent Weight in kg W =

> V = Hazard Volume / m<sup>3</sup>

C = Design Concentration, % by volume

S = Specific Vapor in m<sup>3</sup>/kg

Refer to Flooding Factor Table on page 3 to determine the S value

NOTE: This is a necessary step to properly evaluate the exposure and egress time limitations discussed in the beginning of this section.

The Fike flow calculation program will automatically calculate concentration at the maximum temperature entered.

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## SYSTEM DESIGN CONCEPTS

Systems can be designed with the containers arranged in modular, central storage or manifolded arrangements as described below:

Modular System	Where the containers are located throughout or around the protected area(s) to keep the discharge piping requirements down to a minimum, but increases the electrical materials necessary to reach each individual container location.
Central Storage System	Where the containers are located in one location, and piped to the protected space(s) from this location. This concept often requires more discharge piping, but it decreases the electrical materials necessary to reach the singular container(s) location. This concept may be more difficult to design due to the increased piping runs involved, and the installation labor will tend to be more costly.

#### CONTAINER SIZE AND FILL RANGE

Refer the Equipment Section Agent Storage Container – HFC-227ea Component Sheet (p/n 06-542-1-2) for details.

#### **TEMPERATURE LIMITATION**

Description	Minimum	Maximum	Note
Container Storage / Location	0°C	54.4°C	At temperatures outside of this range, the system may not supply the desired quantity of agent or
Flow Calculation Program	16°C	27°C	discharge due to over-pressure.

## SYSTEM DISCHARGE TIME

Discharge Time Limits			
Minimum Maximum			
6 seconds	10 seconds		

## **NOZZLE FLOW RATE LIMITATION**

Nominal Pipe Size (mm)	Minimum Design Flow Rate (System Limitation) (kg/sec)	Maximum Design Flow Rate (Estimate Only) (kg/sec)	Notes
10	0.3	0.9	A maximum nozzle flow rate of 7.7 kg/sec.
15	0.5	1.5	is recommended for all areas with false
20	0.9	2.7	higher flow rate may dislodge objects or
25	1.5	3.9	affect a process.
32	2.6	5.9	This information is provided for estimation
40	3.8	8.9	purposes only. The final system design
50	5.9	15.0	Calculation Program.

## **NOZZLE AREA COVERAGE**

Nozzle Size – 10 – 50 mm			
Nozzle Type	Radius "R" Dimension (m)	Ceiling Height Range (m)	
180°	14	0.3 to 4.9	
360°	9	0.3 to 4.9	

Maximum Distance	180° Nozzle (m)	360° Nozzle (m)	Note
Below Ceiling	0.3	0.3	Maximum distance above highest point of protection when
Away from Sidewall	0.3		stacking nozzles.



#### Manual P/N 06-439 (Rev 3 / December, 2015)

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#### NOZZLE PLACEMENT

TYPE OF NOZZLE	PLACEMENT RECOMMENDATION	NOTES
360° Nozzle(s)	Located on, or near, the centerline of the protected area, discharging toward the perimeter of the area being covered.	Nozzle patterns need to overlap, to adequately cover the area without any "blind spots" due to nozzle locations. Apply to all Nozzle types. Refer to Figure 1



180° Nozzle(s)	Located along the perimeter of the area, discharging toward the opposite side.	Refer to Figure 2
----------------	--	-------------------



180° Nozzles – Back to Back ApplicationMaximum distance between nozzles is 1'-0" (0.3 m)Refer to Figure 3	180° Nozzles – Back to Back Application
--	--

## **IMPORTANT NOTE:**

The Minimum Piping Distance Rule outlined on page 12 **does not** apply when using back-to-back 180° nozzles as long as:

- 1) Agent supplied and flow rate from both nozzles are the same.
- 2) Pipe size from tee to both nozzles is the same.
- 2) Dina longths from too to ageh nozzla ara



## **CEILING HEIGHT vs. LEVELS OF NOZZLES**

Ceiling Height	Levels of Nozzles Required
0.3 m to 4.9 m	1
Over 4.9 m to 9.75 m	2 (See Maximum Elevation Differences in Pipe Runs Limitation)



#### MAXIMUM ELEVATION DIFFERENCES IN PIPE RUNS LIMITATION

Nozzle(s) Location	Maximum Elevation Difference
Nozzle(s) "Only" above Container Outlet	9.1 m (See Examples 1 & 2)
Nozzle(s) "Only" below Container Outlet	9.1 m (See Examples 3)
Nozzle(s) above & below Container Outlet	9.1 m (See Examples 4)



Manual P/N 06-439 (Rev 3 / December, 2015)

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## NOZZLE DISCHARGE OBSTRUCTIONS

When solid obstructions (walls, partitions, equipment racks, and tall equipment) interfere with the nozzle discharge path, they should be treated as separate areas. All nozzles should be located in a manner that will provide a clear discharge path that reaches all of the outer extremes for the protected space.





(Side View)

#### **TEE SPLIT RATIOS**

	Major-Flo	ow Outlet	Minor-Flow Outlet	
Type of Tee	Minimum	Maximum	Minimum	Maximum
Bullhead	50%	75%	25%	50%
Side-Thru	65%	90%	10%	35%

## **TEE CONFIGURATION – BULLHEAD**

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



## **TEE CONFIGURATION – SIDE-THRU**

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



Manual P/N 06-439 (Rev 3 / December, 2015)

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Page: 10 of 30

#### **TEE ORIENTATION**

**IMPORTANT NOTE:** 

EVERY OUTLET of every tee MUST be orientated in the horizontal plane.



 Manual P/N 06-439 (Rev 3 / December, 2015)
 Page: 11 of 30

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#### **ESTIMATING PIPE SIZE**

Factor	Definition		
Minimum Flow Rate	A two phase flow (liquid and vapor) that creates a turbulent flow effect forming a homogenous mixture of liquid and vapor. If the pipe size is too large, phase separation will occur and the flow cannot be predicted.		
Pipe Size (mm)	Minimum Design Flow Rate (kg/sec) (System Limitation)Maximum Design Flow Rate (kg/sec) 		
10	0.3	0.9	
15	0.5	1.5	
20	0.9	2.7	
25	1.5	3.9	
32	2.6	5.9	
40	3.8	8.9	
50	5.9	15.0	
65	8.9	26.3	
80	15.0	43.1	
100	26.3	57.6	
150	57.6	144.2	

NOTE: To determine the flow rate of a pipe section, divide the amount of agent flowing through that section by the discharge time (10 seconds).

#### MINIMUM PIPING DISTANCE

A minimum of ten (10) pipe diameters must be maintained between fittings to stabilize the flow and maintain the accuracy of the splits occurring at the tees.

The (10) pipe diameter rule applies to the following configurations:

Configuration 1: Distance from a Tee to an Elbow or Tee

Configuration 2: Distance from an Elbow to a Tee



#### Manual P/N 06-439 (Rev 3 / December, 2015)

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10 PIPE DIAMETERS VS. PIPE SIZE			
Pipe Size	Minimum Length		
10 mm	102 mm		
15 mm	127 mm		
20 mm	204 mm		
25 mm	254 mm		
32 mm	305 mm		
40 mm	381 mm		
50 mm	508 mm		
65 mm	635 mm		
80 mm	762 mm		
100 mm	1016 mm		
150 mm	1524 mm		

NOTE: The ten (10) pipe diameter rule does not apply:

- between an Elbow and another Elbow.
- when using back-to-back 180° nozzles as long as:
  - 1) Agent supplied and flow rate from both nozzles are the same.
  - 2) Pipe size from tee to both nozzles is the same.
  - 3) Pipe lengths from tee to each nozzle are within 10% of each other.

#### EQUIVALENT LENGTH VALUES (Schedule 40 pipe)

Pipe Size (mm)	Union (m)	45° Elbow (m)	90° Elbow (m)	Thru (n	I <b>Tee</b> n)	Side Tee (m)	Check Valve (m)
10	0.09	0.18	0.40	0.2	24	0.82	
15	0.12	0.24	0.52	0.3	30	1.04	
20	0.15	0.30	0.67	0.4	43	1.37	
25	0.18	0.40	0.85	0.9	55	1.74	0.61
32	0.24	0.52	1.13	0.7	70	2.29	
40	0.27	0.61	1.31	0.8	82	2.65	
50	0.37	0.79	1.68	1.0	07	3.41	1.22
65	0.43	0.94	2.01	1.2	25	4.08	
80	0.55	1.16	2.50	1.	55	5.06	1.37
100	0.73	1.52	3.26	2.0	04	6.64	
150	1.07	2.32	4.94	3.0	08	10.0	
Impulse Valve Size		1"			3"		
Equivalent Length1.84 m9.42 m							

Manual P/N 06-439 (Rev 3 / December, 2015)

Page: 13 of 30

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## PIPE NETWORK LIMITATIONS (Verified by the Fike Flow Calculation Program)

Description of Limit	Definition	Limitation	
Percent of Agent in Pipe	The total agent weight (liquid) that may reside in the piping network during discharge.	70% maximum	
	The distance from the cylinder to	1 – Percent of agent in pipe network = 39% or less: No Restriction applies to the location of the $1^{st}$ tee.	
Location of 1 Tee	the first tee of the piping system.	2 – Percent of agent in pipe network = 40% or higher: 1 <sup>st</sup> tee must be located a minimum of 10% to 30% away from the container	
		See Figure 1 for details	



**Total Percent of Agent in Pipe Network** 



#### Example 5:

If liquid agent takes 2.0 seconds to arrive at the 1<sup>st</sup> nozzle, (the closest nozzle to the container); liquid arrival time for remaining nozzles cannot exceed 1 second.

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Liquid Runout Time	The time necessary for the liqui agent to discharge (runout) of each nozzle.	d Each nozzle must "Runout" within <b>2.1 seconds</b> of each other. (See Example 6)
7.0	seconds 7.9 seconds If the seconds 9.1 seconds	<b>xample 6:</b> liquid runout time for the 1 <sup>st</sup> nozzle takes 7.0 seconds, le runout time for remaining nozzles must not exceed 9.1 econds <b>.</b>

## NOZZLE ORIFICE AREA LIMITATION - 180° & 360°

Minimum Orifice Area	Maximum Orifice Area	Minimum Pressure	
20% – Pipe cross sectional area	80% – Pipe cross sectional area	3.8 bar	

CAUTION: It is important to use pipe & fittings that are approved (for details, refer to the Pipe and Fittings component sheet (p/n 06-495) and not to exceed system limitations in a clean agent fire suppression system design, failure to do so may cause the system not to supply the quantity of extinguishing agent required to suppress the fire.

#### **MANIFOLD OPTIONS**

Configurations	Notes				
Center Exit Manifold	Used for multiple container applications.				
End Exit Manifold	Check Valves are required for <b>EACH</b> container being connected to a manifold				
Center Exit Manifold / Main and Reserve	Every container must be the same type, same size, and identical fill weight. Refer to Check Valve Component sheet (p/p.06-497) for installation				
End Exit Manifold / Main and Reserve	information.				



**Typical End Exit Manifold** 

Manual P/N 06-439 (Rev 3 / December, 2015)

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#### SAMPLE PROBLEM

The following is a Fike Clear Agent Fire Suppression system designed within the limitations established by Fike's UL listing and FM approval, and in compliance with NFPA 2001 using Fike Flow Calculation Program reflecting the inputs required and showing the computer program output information.

#### HAZARD INFORMATION

Design Concentration:	6.25% (Minimum)
Temperature Range:	20° C. to 29° C.
Enclosure Elevation:	0 Feet (Sea Level)
Room Height:	2.5 m
Unclosable Openings:	None
No. of Nozzles:	
- Control Room:	2 - 360° Nozzles

- Office / Storage Room: 1 - 180° Nozzles



FIGURE 1 – Floor Plan

## **INPUTS – FIKE FLOW CALCULATION PROGRAM**

Setup Project
Setup for the CURRENT project. Unit of Measure Metric
Default Pipe Type
40T - Schedule 40, Threaded
Default Nozzle Type
1 - 360 Degree
Agent
HFC-227ea / Propellant N2
<pre>&lt; Back Next &gt; OK Cancel Help</pre>

Customer And Project Information							
Customer Information Company Name:	Phone:						
Kolten Corporation							
Address:	Contact Name:						
2000 4th Street / KAF Avenue							
Blue Springs, MO 64015	Contact Title:						
Project Information Name: KAF Building							
Designer:	Location:						
EDN							
Number:	Account:						
2010-03-23	2000-04-07						
Description:							
Control Room and Office/Storage Room	×						
< <u>B</u> ack <u>N</u> ext >	<u> </u>						

Enclosure Selection		
Elevation above sea level: Atmospheric Correction Factor:	0 <b>(≑</b> m 1.00 <b>≑ ⊡</b> Manu	ial Override
Add Edit	<u>D</u> elete	
Total Agent Required:	0 kg	
< <u>B</u> ack <u>N</u> ext⇒	<u>0</u> K	<u>H</u> elp

#### Manual P/N 06-439 (Rev 3 / December, 2015)

Page: 17 of 30 While every precaution has been taken during the preparation of this document to ensure the accuracy of its content, Fike assumes no responsibility for errors or omissions. Fike reserves the right to make changes to the product or this document without notice.

Enclosure Information					
Enclosure Number:	1	Elevatio	n above sea	level:	0 m
		Atmospheric	Correction F	actor: 1	.00
Name:	Control Roon	n			
Enclosure Temperature Minimum:	20.0 <b>\$</b> C		Max	imum: 29.0	<b>¢</b> C
		Maxim	ium Concent	ration: 6.6	510 %
- Design Concentration					
Adjusted:	6.413 🗢 %	:	Mi	nimum: 6.250	\$ %
		Minim	um Agent Re	quired: 8	7.7 kg
Enclosure Width:	6.00 🗢	m		Number of No	zzles: 2 🗢
Enclosure Length:	12.00 🗢	m			
Enclosure Height:	2.50 🖨	m	∆diusted	agent required	(rounding up to
Enclosure Volume:	180.00 🗢	cubic m	the neare	st tenth of a kg	) )
Non-permeable Volume:	¢.00 <b>\$</b>	cubic m	Thi	s Enclosure:	<mark>90.1</mark> kg
Total Volume:	180.00 🗢	cubic m	All	108.0 kg	
	<u>N</u> ozzl	e Table	<u>0</u> K	<u>C</u> ancel	Help

Noz	zle Table							
	Enclosure	Nozzle	Name	Age	nt Required			
	· 1	1	E1-N1		45.1			
	1	2	E1-N2		45.0			
	Agent re	equired for this	enclosure		90.1 kg			
	Agent amount entered: 90.1 kg							
	Balance: 0.0 kg							
	<u>Auto</u>	<u> </u>		<u>C</u> ancel	<u>H</u> elp			

Enclosure Information					
Enclosure Number:	2	Elevatio	on above sea	level:	0 m
		Atmospheric	: Correction F	actor: 1	.00
Name:	Office/Stora	je Room			_
Enclosure Temperature					_
Minimum:	20.0 <b>¢</b> C		Мах	imum: 29.0	¢ C
		Maxin	num Concent	ration: 6.6	29 %
Design Concentration					
Adjusted:	6.431 🖨 🕺	:	Mi	nimum: 6.250	\$ %
		Minim	um Agent Re	quired: 17	7.4 kg
·					
Enclosure Width:	4.60 🖨	m		Number of No:	zzles: 1 🗢
Enclosure Length:	3.10 🗢	m			
Enclosure Height:	2.50 🗢	m			· • •
Enclosure Volume:	35.65 ♠	cubic m	<ul> <li>Adjusted</li> <li>the neare</li> </ul>	agent required ( st tenth of a kg	rounding up to )
Non-nermeable Volume:	0.00¢	cubic m			·
	4.00 <b>-</b>		Thi	s Enclosure:	<b>17.9</b> kg
Total Volume:	35.65 🖨	cubic m	All	Enclosures:	108.0 kg
	<u>N</u> ozzl	e Table	<u>0</u> K	<u>C</u> ancel	<u>H</u> elp

Nozz	zle Table					
	Enclosure	Nozzle	Name	Ag	ent Red	quired
	2	1	E2-N1			17.9
<u> </u>					47.0	
	Agent re	quired for this	enclosure	:	17.9	kg
_		Agent amou	int entered	:	17.9	kg
			Balance	:	0.0	kg
	Auto	<u> </u>		<u>C</u> ancel		<u>H</u> elp

A	dju	st Ag	gent Requi	red							
	Enclosure Information Nozzle Information										
		#	Total Volume	Minimum Temperature	Adjusted Concentration		#	Nozzle Name	Agent Required		
ľ	Þ	1	180	20	6.413	90.1		1	E1-N1	45.1	
l		2	35.65	20	6.431	17.9		1	E1-N2	45.0	
								2	E2-N1	17.9	
				New Aa	ent Amount:	108.0 k	a	_Sh	iow:		
		9	Set to New ->	Original Age	ent Amount:	108.0	- -		All Nozzles	<b>F</b>	
		_	-		Channan	0.0	.g	$\square$	Nozzles by	Enclosure	
					Change:	0.0 8	g				
			Elevation abo	ove sea level:	0 m						
		Atm	ospheric Corr	ection Factor:	1.00	Manual Ov	erride				
				Number of	Cylinders: 1		Total		Per Cylinder		
	Adjusted Agent Amount 108.0 kg										
			Ag	gent amount wł	nen filled (roundir	ng up):	108.0	D	108.0	kg	
					Diffe	rence:	0.0	D	0.0	kg	
			<u>R</u> eset	< <u>B</u> ack	<u>N</u> ext>		<		<u>C</u> ancel	<u>H</u> elp	



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Manual P/N 06-439 (Rev 3 / December, 2015)



FIGURE 2 – Pipe and Nozzle Layout

Fike HFC-22	7ea Flo	wCal	c FIK3.	.02 - Sa	ampleProble	m-Metric.F	LC - [Pipe	e Network	(]											
File Edit In	nput Ca	alculati	e Repo	orts Ta	bles Window	w Help														
[Def. D.] Dup. <u>T</u> .	Dyp. D.			<b>1</b> 1	• 1	<u>T</u> est	< <u>B</u> ac	k <u>o</u> k												
🔽 Desc. 🔽	PipeTy	pe 🖪	<b>7</b> 45	U 🗹	nion 🔽 Ot	her 🔽 E	L. 🔽	Flow,Noz	zle											
Description	Start	End	Туре		Diameter	Lock Pipe	Length	Elev.	- 90	45	Thru	Side	Union	Others	EL Added	EL Total	Flow	Nozzle	Nozzle Type	Nozzle Area
▶ Main Cyl. X 1	0	1			80 mm	Yes	1.54	1.54							0.00	9.42	108.0			
Pipe	1	2	40T		32 mm	No	1.30	1.30							0.00	1.31	108.0			
Pipe	2	3	40T		32 mm	No	1.00	0.00	1						0.00	2.13	108.0			
Pipe	3	4	40T		32 mm	No	4.00	0.00			1				0.00	4.69	90.1			
Pipe	4	5	40T		32 mm	No	0.60	0.00	1						0.00	1.74	90.1			
Pipe	5	6	40T		32 mm	No	5.00	0.00				1			0.00	7.28	45.0			
Pipe/E1-N2	6	7	40T		32 mm	No	0.20	-0.20	1						0.00	1.34	45.0	E1-N2	360 Degree	380.00
Pipe	5	8	40T		32 mm	No	1.00	0.00				1			0.00	3.29	45.1			
Pipe/E1-N1	8	9	40T		32 mm	No	0.20	-0.20	1						0.00	1.34	45.1	E1-N1	360 Degree	367.94
Pipe	3	10	40T		20 mm	No	1.00	0.00				1			0.00	2.38	17.9			
Pipe/E2-N1	10	11	40T		20 mm	No	0.20	-0.20	1						0.00	0.88	17.9	E2-N1	180 Degree	136.00

#### **OUTPUTS – FIKE FLOW CALCULATION PROGRAM**



Fike Corporation Phone: 816-655-4743 Fike HFC-227ea FlowCalc FIK3.02 UL: EX4623 FM: OY4A8.AF Project: KAF Building File Name: SampleProblem-Metric.FLC

#### **Consolidated Report**

#### **Customer Information**

Company Name: Kolten Corporation Address: 2000 4th Street / KAF Avenue Blue Springs, MO 64015

Phone:

Contact: Title:

#### Project Data

Project Name: KAF Building Designer: EDN Number: 2010-03-23 Account: 2000-04-07 Location: Description: Control Room and Office/Storage Room

Page: 1 of 7 Calculation Date/Time: Tuesday, March 23, 2010, 3:25:43 PM Copyright (c) Hughes Associates, Inc. Licensed to: Fike Protection Systems

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# Fike

## **Consolidated Report Enclosure Information**

Elevation:	0 m (relative to sea level)
Atmospheric Correction Factor:	1
Enclosure Number: Name: Enclosure Temperature	1 Control Room
Minimum:	20.0 C
Maximum:	29.0 C
Maximum Concentration:	5.510 %
Design Concentration Adjusted: Minimum Minimum Agent Pequired:	6.413 % 6.250 %
Width:	6.00 m
Length:	12.00 m
Height:	2.50 m
Volume:	180.00 cubic m
Non-permeable:	0.00 cubic m
Total Volume:	180.00 cubic m
Adjusted Agent Required:	90.1 kg
Number of Nozzles:	2

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# Fike

## **Consolidated Report Enclosure Information**

Elevation: Atmospheric Correction Factor:	0 m (relative to sea level) 1
Enclosure Number: Name: Enclosure Temperature	2 Office/Storage Room
Minimum: Maximum: Maximum:	20.0 C 29.0 C
Design Concentration Adjusted: Minimum:	6.431 % 6.250 %
Winnmum Agent Required. Width: Length: Height:	4.60 m 3.10 m 2.50 m
Volume: Non-permeable:	35.65 cubic m 0.00 cubic m
Total Volume: Adjusted Agent Required: Number of Nozzles:	35.65 cubic m 17.9 kg 1
Humber of Hozzles.	

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### **Fike**

### **Consolidated Report** Agent Information

Agent: HFC-227ea / Propellant N2

Adjusted Agent Required:	108.0 kg
Cylinder Name:	150 L Cylinder, Upright
Cylinder Part Number:	70-257
Number of Main Cylinders:	1
Number of Reserve Cylinders:	0
Manifold:	No Manifold
Pipe Take Off Direction:	Up
Agent Per Cylinder:	108.0 kg
Fill Density:	0.720 kg / I
Cylinder Empty Weight:	101.1 kg
Weight, All Cylinders + Agent:	209.1 kg
Floor Area Per Cylinder:	0.11 square m
Floor Loading Per Cylinder:	1834 kg /square m

### Pipe Network

Part 1 - Pipe						
Description	Start	End	Туре	Diameter	Length	Elevation
Main Cyl. X 1	0	1		80 mm	1.54 m	1.54 m
Pipe	1	2	40T	32 mm	1.30 m	1.30 m
Pipe	2	3	40T	32 mm	1.00 m	0.00 m
Pipe	3	4	40T	32 mm	4.00 m	0.00 m
Pipe	4	5	40T	32 mm	0.60 m	0.00 m
Pipe	5	6	40T	32 mm	5.00 m	0.00 m
Pipe/E1-N2	6	7	40T	32 mm	0.20 m	-0.20 m
Pipe	5	8	40T	32 mm	1.00 m	0.00 m
Pipe/E1-N1	8	9	40T	32 mm	0.20 m	-0.20 m
Pipe	3	10	40T	20 mm	1.00 m	0.00 m
Pipe/E2-N1	10	11	40T	20 mm	0.20 m	-0.20 m

Page: 4 of 7

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### Fike

### **Consolidated Report**

### Part 2 - Equivalent Length

Start	End	9	0 45	Thru	Side	Union	Other	Added	Total
0	1	(	0 0	0	0	0		0.00 m	9.42 m
1	2	(	0 0	0	0	0		0.00 m	1.31 m
2	3	,	1 0	0	0	0		0.00 m	2.13 m
3	4	(	0 0	1	0	0		0.00 m	4.69 m
4	5		1 0	0	0	0		0.00 m	1.74 m
5	6	(	) (	0	1	0		0.00 m	7.28 m
6	7	,	1 0	0	0	0		0.00 m	1.34 m
5	8	(	0 0	0	1	0		0.00 m	3.29 m
8	9		1 0	0	0	0		0.00 m	1.34 m
3	10	(	0 0	0	1	0		0.00 m	2.38 m
10	11	,	1 0	0	0	0		0.00 m	0.88 m

### Part 3 - Nozzles

Start	End	Flow	Name	Size	Туре	Nozzle Area
0	1	108.0 kg				
1	2	108.0 kg				
2	3	108.0 kg				
3	4	90.1 kg				
4	5	90.1 kg				
5	6	45.0 kg				
6	7	45.0 kg	E1-N2	32 mm	360 Degree	380.00 square mm
5	8	45.1 kg				
8	9	45.1 kg	E1-N1	32 mm	360 Degree	367.94 square mm
3	10	17.9 kg				
10	11	17.9 kg	E2-N1	20 mm	180 Degree	136.00 square mm

#### Parts Information

Total Agent Required: 108.0 kg Cylinder Name: 150 L Cylinder, Upright (Part: 70-257) Number Of Cylinders: 1 Field1

> Page: 5 of 7 Calculation Date/Time: Tuesday, March 23, 2010, 3:25:43 PM Copyright (c) Hughes Associates, Inc. Licensed to: Fike Protection Systems

<b>Fike</b>	Consolidated Report						
Nozzle	Туре	Diameter	Nozzle Area	Part Number			
E1-N1	360 Degree	32 mm	367.94 square mm	80-056-2460			
E1-N2	360 Degree	32 mm	380.00 square mm	80-056-2500			
E2-N1	180 Degree	20 mm	136.00 square mm	80-062-1562			
Nozzle	Drill Diamete	r	Drill Size				
E1-N1	6.2484 mm		D				
E1-N2	6.3500 mm		1/4				
E2-N1	3.9675 mm		5/32				
Pipe:	Туре	Diameter	Length				
	40T	20 mm	1.20 m				
	40T	32 mm	13.30 m				

List of 90 degree elbows: 1 - 20 mm 4 - 32 mm

List of Tees: 2 - 32 mm

### System Acceptance

System Discharge Time:	8.7 seconds
Percent Agent In Pipe:	17.2%
Percent Agent Before First Tee:	2.9%
Enclosure Number:	1
Enclosure Name:	Control Room
Minimum Design Concentration:	6.250%
Adjusted Design Concentration:	6.413%
Predicted Concentration:	6.437%
Maximum Expected Agent Concentration:	6.635% (At 29.0 C)
maximum Exposice rigent obneentration.	0.000 /0 (/ 11 20.0 0)

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Manual P/N 06-439 (Rev 3 / December, 2015)

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### Fike

### **Consolidated Report**

	Minimum	Adjusted	Predicted	Nozzle	
	Agent	Agent	Agent	Pressure	
Nozzle	Required	Required	Delivered	(Average)	_
E1-N1	43.9 kg	45.1 kg	45.2 kg	9.092 bar	
E1-N2	43.8 kg	45.0 kg	45.3 kg	8.489 bar	

Minimum	Adjusted Predicted
Maximum Expected Agent Concentration	: 6.504% (At 29.0 C)
Predicted Concentration	6.310%
Adjusted Design Concentration	: 6.431%
Minimum Design Concentration	6.250%
Enclosure Name	: Office/Storage Room
Enclosure Number	: 2

Nozzle	Minimum Agent Required	Adjusted Agent Required	Predicted Agent Delivered	Nozzle Pressure (Average)	
E2-N1	17.4 kg	17.9 kg	17.5 kg	11.791 bar	



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#### Manual P/N 06-439 (Rev 3 / December, 2015)

Page: 27 of 30 While every precaution has been taken during the preparation of this document to ensure the accuracy of its content, Fike assumes no responsibility for errors or omissions. Fike reserves the right to make changes to the product or this document without notice.

#### PRE-ENGINEERED PIPING LIMITATIONS

The following information details the steps necessary to design a pre-engineered piping network for a Fike HFC-227ea Clean Agent Fire Suppression System within the limitations established by Fike's UL / ULC listing (UL Ex4623) and FM approval (FM 3014476).

Pipe sizes have been pre-determined based on container size and the number of nozzles needed. Refer to one of the following tables:

- Table 1 HFC-227ea Pre-Engineered Pipe Network Limitations 1 Nozzle Systems
- Table 2 HFC-227ea Pre-Engineered Pipe Network Limitations 2 Nozzle Systems

The Pre-Engineered concept minimizes the engineering effort required to design an effective system. As long as nozzle selection, pipe size and pipe length limitations are adhered to, hydraulic flow calculations are not required.

The designer will need to perform a simple hand calculation to determine the following:

#### For 1 Nozzle Systems:

Determine the length of pipe and the number of elbows from the container to the nozzle, if pipe length and number of elbows is equal to or less than values for the container and pipe size being used, the pipe network is acceptable.

#### For 2 Nozzle Systems:

When designing a two nozzle Pre-Engineered System, the nozzle and piping layout **MUST** be installed in a balanced configuration. To accomplish this, the flow path from the container to each nozzle must be the same length, using the same pipe sizes, the same quantity and type of fittings, and the nozzles must discharge the same amount of agent from each nozzle. A piping network is considered to be balanced if the total length from the container to each nozzle is within 10% of each other.

In addition, all tee splits **MUST** be made using a Bullhead Tee configuration, and each outlet must be oriented in the horizontal plane.

### **NOZZLE TYPES – PRE-ENGINEERED**

The  $180^{\circ}$  and  $360^{\circ}$  nozzles can be used on a pre-engineered Fike HFC-227ea Clean Agent Fire Suppression System: For design limitations for the  $180^{\circ}$  and  $360^{\circ}$  Nozzles, refer to pages 7 and 8.

#### PIPING NETWORK LIMITATIONS – SINGLE NOZZLE SYSTEMS

	TABLE 1 – HFC-227ea Pre-Engineered Pipe Network Limitations – Single Nozzle Systems							
		Maximum Pipe	Elbows included	Deduct for each	Nozzle	е Туре		
Container Size	Pipe Size	Meters	in Maximum Pipe Length	n Maximum additional Pipe Length Elbow over 8		180° Nozzle		
5L	10	13.7	8	0.4	84-045-030	84-052-032		
9L	15	10.6	8	0.5	84-046-040	84-053-042		
16L	20	13.7	8	0.7	84-047-053	84-054-056		
26L	25	13.7	8	0.8	84-048-067	84-055-071		
45L	40	18.3	8	1.3	84-050-076	84-057-080		



(Pipe Network is "Acceptable")

### **PIPING NETWORK LIMITATIONS – TWO NOZZLE SYSTEMS**

TABLE 2 – HFC227ea Pre-Engineered Pipe Network Limitations – Two Nozzle Systems							
	Total	Section A		Section B (see Note 1)		Nozzle Type	
Container Size	Pressure Drop (TPD)	Pipe Size	Deduct for each Elbow over 6	Pipe Size	Deduct for each Elbow over 4	360° Nozzle	180° Nozzle
5L	7	10	0.4	10	0.4	84-045-017	84-052-017
9L	11	15	0.5	10	0.4	84-045-031	84-052-032
16L	14	20	0.7	15	0.5	84-046-040	84-053-042
26L	14	25	0.8	20	0.7	84-047-053	84-054-056
45L	18.3	40	1.3	25	0.8	84-048-067	84-055-071

1) Maximum actual pipe length of **each** Section B branch line is as follows: 9, 16, 26 & 45L systems = 9.75 5L system = 4.87

### EXAMPLE:

16L. Container w/ 20 m Pipe (Section A) & 15 m Pipe (Section B w/ 2 Nozzles)

Actual Pipe Lengths + (No. of Elbows x Equivalent Length) = TPD per Section

(Section A) (1.2 + 3.0 + 0.6 + 3.9) 8.7 + (3 elbows <sup>1</sup> ) 0		= 8.7
(Section B) (4.4 + 0.2) 4.6 ft. + (1 elbow <sup>2</sup> ) 0		<u>= 4.6</u>
	Total TPD	= 13.3 (less thar

n 14 maximum TPD) (Pipe network is "Acceptable")

<sup>1</sup> The 3 elbows in Section A is less than 6 therefore no pressure drop compensation required

<sup>2</sup> The 1 elbow in Section B is less than 4 therefore no pressure drop compensation required



#### Manual P/N 06-439 (Rev 3 / December, 2015)



# CLEAN AGENT FIRE SUPPRESSION SYSTEM



# SYSTEM CHECKOUT / MAINTENANCE

Manual P/N 06-439 (Rev 3 / December, 2015)

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The following information details the steps necessary to perform system checkout and periodic maintenance on a Fike Clean Agent Fire Suppression System within the limitations established by Fike's UL listing, FM approval and in compliance with NFPA 2001, ISO 14520 and/or EN 15004.

The checkout procedures outlined are intended to represent the minimum requirement for the extinguishing portion of the system. Additional procedures may be required by the Authority having Jurisdiction (AHJ)

**IMPORTANT NOTE:** This information **does not** cover service and maintenance procedures for the electrical and control portions of the system. The control portion of the system should be thoroughly checked out according to the manufacturer's recommendations and the requirements of the AHJ.

#### HAZARD ENCLOSURE

#### System Checkout

A good review of the hazard area is just as important as the proper operation of system components. The following item shall be checked.

Factors to Consider	Recommendation	
Area Configuration	The area dimensions should be checked against those shown on the system plan(s). If the area volume has changed, the agent weight should be recalculated and compared with the agent weight supplied. The area should also be checked for walls or movable partitions, which have been added or changed. If walls or partitions have been added, check to see that all areas within the hazard still receive adequate nozzle coverage and agent distribution.	
Doors	All perimeter doors should have drop seals on the bottom, weather-stripping around the jambs, latching mechanisms and door closure hardware. Double doors should have a weather-stripped astragal to prevent leakage between the doors, and a coordinator to assure the proper sequence of closure. Normally open doors shall be equipped with door closure hardware and magnetic door holders that will release the door(s) upon a system alarm.	
Ductwork	All ductwork leading into, or out of, the protected space(s) should be isolated with sealed, "low smoke" dampers. Dampers should be spring-loaded or motor-operated to provide 100% air shutoff upon activation.	
Air Handling/Ventilation	Unit(s) should be shutdown upon alarm, if unit(s) cannot be shutdown volume of ductwork must be protected.	
Penetrations	All holes, cracks, gaps or penetrations in perimeter walls must be sealed and floor drains with traps be filled with a non-evaporating liquid. Sub-floor drains must have "P"- traps and be sealed with a non-evaporating liquid, such as anti-freeze or mineral oil. Wall switch and receptacle boxes should be sealed.	
Walls	All perimeter walls should extend slab-to-slab, and each should be sealed top and bottom on the interior side. Where walls do not extend slab-to-slab, bulkheads will have to be installed to achieve the desired sealing characteristics. Porous block walls must be sealed.	
Openings	Cable and duct penetrations into the area, joints where walls contact floors, or other walls should be permanently sealed.	

Enclosure Integrity	An Enclosure Integrity Test shall be performed on all protected enclosures. A Door Fan Test is the accepted method to estimate worst-case room leakage and agent (concentration) hold time. The door fan calculation method makes it possible to predict the timeline for a descending interface to fall to a given height and estimate how long an extinguishing concentration will be maintained within the protected space. Refer to NFPA Standard 2001, latest edition for additional information and door fan test procedures.
Auxiliary Functions	Operation of auxiliary functions such as door closures, damper closures, air handling shutdown, etc. should be verified when the control system is activated, both manually and automatically.
Caution/ Advisory Signs	Check to ensure that all signs are legible and free of damage.

### Maintenance

Certain aspects about the hazard may have changed, or been overlooked, which could affect overall system performance.

Interval	Factor	Recommendation	
1 Year	The items described in System Checkout need to be re-checked during system maintenance. If hazard conditions indicate the inability to maintain agent concentration, a Door Fan Test needs to be performed:		
	Check Hazard Enclosure	The volume of the hazard enclosure(s) must be checked to determine if agent being supplied will protect the hazard properly. If changes are found, the system needs to be recalculated.	

### SYSTEM COMPONENTS

**IMPORTANT NOTE:** Before starting system checkout or system maintenance, disable the system control panel releasing circuit.

### AGENT STORAGE CONTAINER & ACCESSORIES

### System Checkout

Factors to Consider	Recommendation	
The items described in System Installation, covered in the Equipment Information Section, need to be re-checked during system checkout.		
Container Pressure	Pressure should read 24.8 bar at 21°C. For temperatures other than 21°C, reference Temperature vs. Pressure Chart on the Pressure Gauge Component Sheet in the Equipment Section of this manual.	
Agent Weight	Amount of agent in the Container(s) must be verified by either weighing the container or by using Liquid Level Indictor (LLi). This information should be recorded and affixed to the container so it can be used during container maintenance.	
Low Pressure Switch	If used, check to ensure device is installed properly to container and wired properly to control panel.	
Direct Impulse Valve Actuator (DIVA)	Check to ensure the DIVA circuit is free of trouble and ground fault conditions before installing the DIVA to the container.	

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Page: 2 of 4

### Maintenance

These procedures do not preclude those required by NFPA 2001 and the authority having **IMPORTANT NOTE:** jurisdiction (AHJ).

Interval	Factor	Recommendation
3 Months	Check Container Pressure	The nominal pressure should be 24.8 bar @ 21°C; however, the pressure will vary with temperature. In the range of 10°C to 27°C the difference is approximately 15 kPa per degree. For temperatures other than 21°C, reference Temperature vs. Pressure Chart on the Pressure Gauge Component Sheet in the Equipment Section of this manual. If the pressure loss indicated exceeds 10% of the nominal pressure, check the container for leaks and repair as necessary.
6 Months	Verify Agent Weight	Verify the weight of the agent in each container matches the agent weight stamped on the label. If the weight indicates a shortage exceeding five percent of required weight, the container must be removed from service for repair and/or recharge. If the container has a liquid level indicator installed, weight verification can be made without the need for cylinder removal.
12 Months	Check DIVA	Check the operation of the DIVA for both electrical and manual function. IMPORTANT NOTE: Ensure the DIVA is removed from impulse valve prior to conducting function tests. Reset DIVA and secure cotter pin with security tie on DIVA prior to re-arming the system. (refer to DIVA CompSpec for instructions).
10 Years	Container Inspection	Containers shall be retest if more than ten years have elapsed since the last test. The retest shall be in accordance with instructions P200 in the ADR (International Carriage of Dangerous Goods by Road). Cylinders continuously in service without discharging shall receive a complete external [visual] inspection every ten years. The cylinder does not need to be emptied for this inspection. All visual inspections must be performed in accordance with instructions P200 in the ADR (International Carriage of Dangerous Goods by Road)

### **PIPE NETWORK**

### System Checkout

Factors to Consider	nsider Recommendation	
Discharge Piping	Check to ensure Piping is installed according to the system design drawings. If not, system needs to be recalculated.	
	Checked piping to see that it is securely supported and free from any lateral movement. All joints should be checked for mechanical tightness. Discharge piping shall be pressure tested in accordance with NFPA 2001, latest edition.	
Discharge Pressure Switch	Check to ensure the Discharge Pressure Switch is installed and wired correctly.	

Manual P/N 06-439 (Rev 3 / December, 2015)

Page: 3 of 4 While every precaution has been taken during the preparation of this document to ensure the accuracy of its content, Fike assumes no responsibility for errors or omissions. Fike reserves the right to make changes to the product or this document without notice.

Check Valves	If used, check to ensure the "Flow Arrow" is pointing in the correct direction.	
Check Valves	If used, check to ensure the "Flow Arrow" is pointing in the correct direction.	

### Maintenance

Interval	Factor	Recommendation
6 Months	Condition of Pipe	Check the system discharge piping for corrosion and damage.
	Pipe Supports	Check all piping supports to make sure they are tight and all piping is securely supported.

### **DISCHARGE NOZZLES**

#### System Checkout

Factors to Consider	Recommendation	
Nozzle Part Number vs Location	Verify that the correct nozzle part number is installed at the proper location in accordance with the system plans. If the piping system was changed from the original system plans, make sure the nozzles were calculated using the "as installed" piping configuration.	
	Check to ensure the nozzle(s) is aimed / positioned correctly.	
Set Screws	Make sure all nozzle set screws are in place.	
Nozzle Orifices	Check to see that nozzle orifices are clear and unobstructed.	

#### Maintenance

Interval	Factor	Recommendation	
6 Months	The items described in System Checkout need to be re-checked during system maintenance.		
	Corrosion	Verify that the orifices are not showing signs of corrosion.	
	Obstructions	Check all nozzle orifices for obstructions and make sure large objects have not been placed in front of the nozzles that would block the discharge.	

#### **DETECTION AND CONTROL SYSTEM**

The information contained in this document **does not** cover service and maintenance procedures for the Detection and Control System (electrical portion). The electrical portion of the system must be thoroughly checked out according to the manufacturer's recommendations and the requirements of the AHJ.

**IMPORTANT NOTE:** Do not arm the Fike Clean Agent Fire Suppression system before the Detection and Control System has been checked out and all circuits are free of trouble and ground fault conditions. If control panel checks out, install the Impulse Valve Operator (IVO) to the container(s).

Page: 4 of 4

## **SAFETY DATA SHEETS**

Safety Data Sheet	QIPIN:
FM-200 <sup>®</sup>	
Version 2.2	
Revision Date 05/09/2015	Ref. 130000036866
This SDS adheres to the stand requirements in other countries	lards and regulatory requirements of the United States and may not meet the regulatory 5.
SECTION 1. PRODUCT AND	COMPANY IDENTIFICATION
Product name Tradename/Synonym	: FM-200 <sup>®</sup> : FE-227 2-Hydroperfluoropropane Propane, 1.1.1.2,3,3.3-Heptafluoro- HFC-227eaHP 2-Hydroheptafluoropropane Heptafluoropropane 2-H-heptafluoropropane 1.1.1.2,3,3.3-Heptafluoropropane R-227 R227 HFC-227ea
Product Use	: Fire extinguishing agent, For professional users only.
Restrictions on use Manufacturer/Supplier	Do not use product for anything outside of the above specified uses     DuPont     1007 Market Street     Wilmington, DE 19898     United States of America
Product Information	: +1-800-441-7515 (outside the U.S. +1-302-774-1000)
Medical Emergency Transport Emergency	: 1-800-441-3637 (outside the U.S. 1-302-774-1139) : CHEMTREC: +1-800-424-9300 (outside the U.S. +1-703-527-3887)
SECTION 2. HAZARDS IDENTIFICATION Product hazard category Gases under pressure Liquefied gas	
	1/11

Manual P/N 06-439 (Rev 3 / December, 2015)

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### Safety Data Sheet

### **FM-200<sup>®</sup>**

Version 2.2

Revision Date 05/09/2015

Ref. 13000036866

This SDS adheres to the standards and regulatory requirements of the United States and may not meet the regulatory requirements in other countries.

### SECTION 1. PRODUCT AND COMPANY IDENTIFICATION

Product name Tradename/Synonym	:	FM-200 <sup>®</sup> FE-227 2-Hydroperfluoropropane Propane, 1,1,1,2,3,3,3-Heptafluoro- HFC-227eaHP 2-Hydroheptafluoropropane Heptafluoropropane 2-H-heptafluoropropane 1,1,1,2,3,3,3-Heptafluoropropane R-227 R227 HFC-227ea
Product Use	:	Fire extinguishing agent, For professional users only.
Restrictions on use Manufacturer/Supplier	:	Do not use product for anything outside of the above specified uses DuPont 1007 Market Street Wilmington, DE 19898 United States of America
Product Information Medical Emergency Transport Emergency	:	+1-800-441-7515 (outside the U.S. +1-302-774-1000) 1-800-441-3637 (outside the U.S. 1-302-774-1139) CHEMTREC: +1-800-424-9300 (outside the U.S. +1-703-527-3887)

### **SECTION 2. HAZARDS IDENTIFICATION**

Product hazard category Gases under pressure

Liquefied gas

1/11

Safety Data Sheet		<b>OUPOND</b> <sub>®</sub>
FM-200 <sup>®</sup>		
Version 2.2		
Revision Date 05/09/2015	Ref. 13000036866	
Label content Pictogram		
Signal word	: Warning	
Hazardous warnings	: Contains gas under pressure; may explode if heated.	
Hazardous prevention measures	: Protect from sunlight. Store in a well-ventilated place.	
<b>Other hazards</b> Misuse or intentional inha Vapours are heavier than Rapid evaporation of the l	lation abuse may lead to death without warning. air and can cause suffocation by reducing oxygen available for breath liquid may cause frostbite.	ing.

### SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

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

### SECTION 4. FIRST AID MEASURES

### *FM-200*<sup>®</sup>

Version 2.2



Revision Date 05/09/2015	Ref. 13000036866
General advice	: Never give anything by mouth to an unconscious person. When symptoms persist or in all cases of doubt seek medical advice.
Inhalation	: Remove from exposure, lie down. Move to fresh air. Keep patient warm and at rest. Artificial respiration and/or oxygen may be necessary. Consult a physician.
Skin contact	<ul> <li>In case of contact, immediately flush skin with plenty of water for at least 15 minutes. Take off all contaminated clothing immediately. Consult a physician. Wash contaminated clothing before re-use. Treat for frostbite if necessary by gently warming affected area.</li> </ul>
Eye contact	: In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Consult a physician if necessary.
Ingestion	: Is not considered a potential route of exposure.
Most important symptoms/effects, acute	: No applicable data available.
Protection of first-aiders	: If potential for exposure exists refer to Section 8 for specific personal protective equipment.
Notes to physician	<ul> <li>Because of possible disturbances of cardiac rhythm, catecholamine drugs, such as epinephrine, that may be used in situations of emergency life support should be used with special caution.</li> </ul>

### SECTION 5. FIREFIGHTING MEASURES

Suitable extinguishing media	: This material is a fire extinguishing agent.
Unsuitable extinguishing media	: No applicable data available.
Specific hazards	: The product is not flammable.
Special protective equipment for firefighters	: No applicable data available.
Further information	: No applicable data available.
	3 / 11

Safety Data Sheet

# **OUPOND**®

### **FM-200<sup>®</sup>**

Version 2.2

Revision Date 05/09/2015

Ref. 130000036866

### SECTION 6. ACCIDENTAL RELEASE MEASURES

NOTE: Review FIRE FIGHTING MEASURES and HANDLING (PERSONNEL) sections before proceeding with clean-up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean-up.

Safeguards (Personnel)	Evacuate personnel, thoroughly ventilate area, use self-contained breathing apparatus. Keep upwind of leak - evacuate until gas has dispersed.	
Environmental precautions	Should not be released into the environment. In accordance with local and national regulations.	
Spill Cleanup	Evaporates. Ventilate area using forced ventilation, especially low or enclosed places where heavy vapors might collect.	
Accidental Release Measures	No applicable data available.	

### SECTION 7. HANDLING AND STORAGE

Handling (Personnel)	<ul> <li>Do not breathe gas. Avoid contact with skin, eyes and clothing. Provide sufficient air exchange and/or exhaust in work rooms. For personal protection see section 8. Wash hands thoroughly after handling. Wash clothing after use. Decomposition will occur when product comes in contact with open flame or electrical heating elements. Handle in accordance with good industrial hygiene and safety practice.</li> </ul>
Handling (Physical Aspects) Dust explosion class Storage	<ul> <li>No applicable data available.</li> <li>No applicable data available.</li> <li>Valve protection caps and valve outlet threaded plugs must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Never attempt to lift cylinder by its cap. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder. Cylinders should be stored upright and firmly secured to prevent falling or being knocked over.</li> <li>Separate full containers from empty containers. Keep at temperature not exceeding 52°C. Do not store near combustible materials. Keep container tightly closed in a dry and well-ventilated place.</li> </ul>
	4 / 11

Safety Data Sheet	QU POND.
<i>FM-200<sup>®</sup></i>	
Version 2.2	
Revision Date 05/09/2015	Ref. 13000036866
	Store in original container. Protect from contamination. Avoid area where salt or other corrosive materials are present. The product has an indefinite shelf life when stored properly.
Storage period	: > 10 yr
Storage temperature	: < 52 °C (< 126 °F)
SECTION 8. EXPOSURE CONTRO	LS/PERSONAL PROTECTION
Engineering controls	: Use only with adequate ventilation. Keep container tightly closed.
Personal protective equipment Respiratory protection	: Wear NIOSH approved respiratory protection as appropriate.
Hand protection	: Additional protection: Impervious gloves
Eye protection	: Safety glasses with side-shields Additionally wear a face shield where the possibility exists for face contact due to splashing, spraying or airborne contact with this material.
Skin and body protection	: Where there is potential for skin contact, have available and wear as appropriate, impervious gloves, apron, pants, jacket, hood and boots.
Protective measures	: Self-contained breathing apparatus (SCBA) is required if a large release occurs.
Exposure Guidelines Exposure Limit Values	
1,1,1,2,3,3,3-Heptafluoropr AEL * (	opane DUPONT) 1,000 ppm 8 & 12 hr. TWA
* AEL is DuPont's Acceptable lower than the AEL are in effe	Exposure Limit. Where governmentally imposed occupational exposure limits which are ct, such limits shall take precedence.
SECTION 9. PHYSICAL AND CHE	
	5 / 11

Revision Date 05/09/2015

### *FM-200*<sup>®</sup>

Version 2.2

**OUPOND**<sub>®</sub>

Appearance Physical state Form Color	:	gaseous Liquefied gas No applicable data available.
Odor	:	none
Odor threshold	:	No applicable data available.
рН	:	No applicable data available.
Melting point/freezing point	:	Melting point/range -131 °C (-204 °F)
Boiling point/boiling range	:	Boiling point -16.3 °C (2.7 °F)
Flash point	:	No applicable data available.
Evaporation rate	:	No applicable data available.
Flammability (solid, gas)	:	The product is not flammable.
Upper explosion limit	:	Method: None per ASTM E681-98
Lower explosion limit	:	Method: None per ASTM E681-98
Vapor pressure	:	4.547 hPa at 25 °C (77 °F)
Vapour density	:	No applicable data available.
Density	:	1.388 g/cm3 at 25 °C (77 °F) (as liquid)
Specific gravity (Relative density)	:	No applicable data available.
Water solubility	:	No applicable data available.
Solubility(ies)	:	No applicable data available.
Partition coefficient: n- octanol/water	:	No applicable data available.

Ref. 130000036866



### *FM-200*<sup>®</sup>

Version 2.2

Ref. 130000036866
: No applicable data available.

SE	SECTION 10. STABILITY AND REACTIVITY					
	Reactivity	:	Decomposes on heating.			
	Chemical stability	:	Stable at normal temperatures and storage conditions.			
	Possibility of hazardous reactions	:	Polymerization will not occur.			
	Conditions to avoid	:	The product is not flammable in air under ambient conditions of temperature and pressure. When pressurised with air or oxygen, the mixture may become flammable. Certain mixtures of HCFCs or HFCs with chlorine may become flammable or reactive under certain conditions. To avoid thermal decomposition, do not overheat.			
	Incompatible materials	:	Alkali metals Alkaline earth metals, Powdered metals, Powdered metal salts			
	Hazardous decomposition products	:	Hazardous decomposition products formed under fire conditions.: Hazardous thermal decomposition products may include: Hydrogen halides, Carbon oxides, Fluorocarbons, Carbonyl halides			

### SECTION 11. TOXICOLOGICAL INFORMATION

FM-200 <sup>®</sup>			
	Inhalation 4 h LC50	:	> 788698 ppm , Rat
	Inhalation	:	Dog Cardiac sensitization
	Dermal	:	Not applicable
	Oral	:	Not applicable
	Skin irritation	:	No skin irritation, Not tested on animals Not expected to cause skin irritation based on expert review of the
			7 / 11

<b>OUPONT</b>	
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FM-200 <sup>®</sup>	
Version 2.2	
Revision Date 05/09/2015	Ref. 13000036866
	properties of the substance.
Eye irritation	<ul> <li>No eye irritation, Not tested on animals Not expected to cause eye irritation based on expert review of the properties of the substance.</li> </ul>
Sensitisation	<ul> <li>Does not cause skin sensitisation., Not tested on animals Not expected to cause sensitization based on expert review of the properties of the substance.</li> </ul>
	Did not cause sensitisation on laboratory animals. There are no reports of human respiratory sensitization.
Repeated dose toxicity	: Inhalation Rat
	- No toxicologically significant effects were found.
Further information	: Cardiac sensitisation threshold limit : 730190 mg/m3
1,1,1,2,3,3,3-Heptafluoropropane Carcinogenicity	: Not classifiable as a human carcinogen. Animal testing did not show any carcinogenic effects.
Mutagenicity	<ul> <li>Animal testing did not show any mutagenic effects.</li> <li>Tests on bacterial or mammalian cell cultures did not show mutagenic effects.</li> </ul>
Reproductive toxicity	: No toxicity to reproduction Animal testing showed no reproductive toxicity.
Teratogenicity	: Animal testing showed no developmental toxicity.
Carcinogenicity The carcinogenicity classif to HazCom 2012, Append Program (NTP) Report on International Agency for R	ications for this product and/or its ingredients have been determined according ix A.6. The classifications may differ from those listed in the National Toxicology Carcinogens (latest edition) or those found to be a potential carcinogen in the esearch on Cancer (IARC) Monographs (latest edition).

None of the components present in this material at concentrations equal to or greater than 0.1% are listed by IARC, NTP, or OSHA, as a carcinogen.

8 / 11

Safety Data Sheet		OU POND <sub>®</sub>
FM-200 <sup>®</sup>		
Version 2.2		
Revision Date 05/09/2015		Ref. 13000036866
Aquatic Toxicity 1,1,1,2,3,3,3-Heptafluoropro 96 h LC50	opane : Danio Inforr	io rerio (zebra fish) > 200 mg/l OECD Test Guideline 203 mation given is based on data obtained from similar substances.
72 h ErC50	: Pseu Guide Inforr	udokirchneriella subcapitata (green algae) > 114 mg/I_OECD Test leline 201 mation given is based on data obtained from similar substances.
72 h NOEC	: Pseu Guide Inforr	udokirchneriella subcapitata (green algae) 13.2 mg/I_OECD Test Jeline 201 mation given is based on data obtained from similar substances.
48 h EC50	: Daph Inforr	hnia magna (Water flea) > 200 mg/I OECD Test Guideline 202 mation given is based on data obtained from similar substances.
SECTION 13. DISPOSAL C Waste disposal method Product Contaminated packagin	SONSIDERATIONS s - : Can be used permitted wa State/Provin	d after re-conditioning. Recover by distillation or remove to a aste disposal facility. Comply with applicable Federal, ncial and Local Regulations. sure vessels should be returned to the supplier.
SECTION 14. TRANSPOR	T INFORMATION	
DOT UN r Prop Clas Labe	number ber shipping name s elling No.	: 3296 : Heptafluoropropane : 2.2 : 2.2
IATA_C UN r	number	: 3296
		9 / 11



### **FM-200<sup>®</sup>**

Version 2.2

Revision Date 05/09/2015 Ref. 130000036866 Proper shipping name : Heptafluoropropane : 2.2 Class Labelling No. : 2.2 UN number IMDG : 3296 Proper shipping name : HEPTAFLUOROPROPANE : 2.2 Class Labelling No. : 2.2 SECTION 15. REGULATORY INFORMATION

TSCA	:	On the inventory, or in compliance with the inventory
SARA 313 Regulated Chemical(s)	:	This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.
California Prop. 65	:	Chemicals known to the State of California to cause cancer, birth defects or any other harm: none known
	TSCA SARA 313 Regulated Chemical(s) California Prop. 65	TSCA : SARA 313 Regulated : Chemical(s) California Prop. 65 :

### **SECTION 16. OTHER INFORMATION**

<sup>®</sup> DuPont's registered trademark Before use read DuPont's safety information. For further information contact the local DuPont office or DuPont's nominated distributors.

Revision Date : 05/09/2015

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.

Significant change from previous version is denoted with a double bar.

10 / 11

Safety Data Sheet



### *FM-200*<sup>®</sup>

Version 2.2

Revision Date 05/09/2015

Ref. 130000036866



Safety Data Sheet P-4631

 $e^{*}$  according to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Date of issue: 01/01/1980 Revision date: 06/24/2015 Supersedes: 04/23/2015

SECTION: 1. Product and company ide	entification
1.1. Product identifier	
Product form :	Substance
Name :	Nitrogen, compressed
CAS No :	7727-37-9
Formula :	N2
Other means of identification :	Dinitrogen, Refrigerant R728, Nitrogen, Medipure Nitrogen, Extendapak Nitrogen, Nitrogen - Diving Grade
1.2. Relevant identified uses of the substant	nce or mixture and uses advised against
Use of the substance/mixture :	Industrial use Medical applications. Food applications. Diving Gas (Underwater Breathing)
1.3. Details of the supplier of the safety dat	a sheet
Praxair, Inc. 39 Old Ridgebury Road Danbury, CT 06810-5113 - USA T 1-800-772-9247 (1-800-PRAXAIR) - F 1-716-879 www.praxair.com	2146
1.4. Emergency telephone number	
Emergency number :	Onsite Emergency: 1-800-645-4633
	CHEMTREC, 24hr/day 7days/week — Within USA: 1-800-424-9300, Outside USA: 001-703- 527-3887 (collect calls accepted, Contract 17729)
SECTION 2: Hazards identification	
2.1. Classification of the substance or mixt	ure
Classification (GHS-US)	
Compressed gas	H280
2.2. Label elements	
GHS-US labeling	
Hazard pictograms (GHS-US) :	GHS04
Signal word (GHS-US) :	WARNING
Hazard statements (GHS-US) :	H280 - CONTAINS GAS UNDER PRESSURE; MAY EXPLODE IF HEATED OSHA-H01 - MAY DISPLACE OXYGEN AND CAUSE RAPID SUFFOCATION.
Precautionary statements (GHS-US) :	<ul> <li>P202 - Do not handle until all safety precautions have been read and understood</li> <li>P271+P403 - Use and store only outdoors or in a well-ventilated place.</li> <li>CGA-PG05 - Use a back flow preventive device in the piping.</li> <li>CGA-PG10 - Use only with equipment rated for cylinder pressure.</li> <li>CGA-PG06 - Close valve after each use and when empty.</li> <li>CGA-PG02 - Protect from sunlight when ambient temperature exceeds 52°C (125°F).</li> </ul>
2.3. Other hazards	
	No additional information available
EN (English US)	SDS ID: P-4631 1/8

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Safety Data Sheet P-4631

tive" according to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Date of issue: 01/01/1980 Revision date: 06/24/2015 Supersedes: 04/23/2015

24	Unknown acute toxicity (GHS-US)			
A		No data available		
SECTI	ON 3: Composition/information	on ingradiants		
3.1	Substance	on ingreatents		
Name	Substance	Nitrogen compressed		
CAS No		: 7727-37-9		
Name		Product identifier	%	
Nitroger	1	(CAS No) 7727-37-9	99.5 - 100	
3.2.	Mixture			-
Not appl	icable			
SECTI	ON 4: First aid measures			
4.1.	Description of first aid measures			
First-aid	measures after inhalation	<ul> <li>Immediately remove to fresh difficult, qualified personnel n</li> </ul>	air. If not breathing, g nay give oxygen. Call	give artificial respiration. If breathing is a physician.
First-aid	measures after skin contact	Adverse effects not expected	from this product.	
First-aid	measures after eye contact	: Adverse effects not expected plenty of water. Consult an op	from this product. In ohthalmologist if irritat	case of eye irritation: Rinse immediately with ion persists.
First-aid	measures after ingestion	Ingestion is not considered a	potential route of exp	osure.
4.2.	Most important symptoms and effects	s, both acute and delayed		
		No additional information ava	ilable	
4.3.	Indication of any immediate medical a	ttention and special treatmer	nt needed	
None.				
SECTI	ON 5: Firefighting measures			
5.1.	Extinguishing media			
Suitable	extinguishing media	: Use extinguishing media app	ropriate for surroundir	ng fire.
5.2.	Special hazards arising from the subs	stance or mixture		
Reactivit	у	: Under certain conditions, nitro 1472°F/800°C), and magnesi oxygen and hydrogen.	ogen can react violen um to form nitrides. A	tly with lithium, neodymium, titanium (above At high temperature, it can also combine with
5.3.	Advice for firefighters			
Firefighti	ng instructions	<ul> <li>Evacuate all personnel from t and protective clothing. Imme flow of gas if safe to do so, w safe to do so. Remove contai comply with OSHA 29 CFR 1 L—Fire Protection.</li> </ul>	he danger area. Use ediately cool containe hile continuing cooling ners from area of fire 910.156 and applicab	self-contained breathing apparatus (SCBA) rs with water from maximum distance. Stop g water spray. Remove ignition sources if if safe to do so. On-site fire brigades must ole standards under 29 CFR 1910 Subpart
Protectio	on during firefighting	: Compressed gas: asphyxiant	. Suffocation hazard b	by lack of oxygen.
Special p	protective equipment for fire fighters	: Standard protective clothing a fighters.	and equipment (Self C	Contained Breathing Apparatus) for fire
Specific	methods	: Use fire control measures ap radiation may cause gas cont from a protected position. Pre drainage systems.	propriate for the surro tainers to rupture. Coo event water used in er	unding fire. Exposure to fire and heat ol endangered containers with water spray jet mergency cases from entering sewers and
		Stop flow of product if safe to	do so.	
		Use water spray or fog to kno	ock down fire fumes if	possible.

6.1.	Personal precautions, prot	tective equipment and emergency procedures	
General	measures	: Evacuate area. Ensure adequate air ventilation. Wear self-contained breathing apparatus we entering area unless atmosphere is proven to be safe. Stop leak if safe to do so.	hen
EN (Engl	lish US)	SDS ID: P-4631	2/8

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See also sections 8 and 13.

Safety Data Sheet P-4631

according to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Making our planet more productive" Date of issue: 01/01/1980 Revision date: 06/24/2015 Supersedes: 04/23/2015 6.1.1. For non-emergency personnel No additional information available 6.1.2. For emergency responders No additional information available 6.2. **Environmental precautions** No additional information available 6.3. Methods and material for containment and cleaning up No additional information available 6.4. **Reference to other sections** 

SECT	ION 7: Handling and storage	
7.1.	Precautions for safe handling	
Precaut	ions for safe handling :	Wear leather safety gloves and safety shoes when handling cylinders. Protect cylinders from physical damage; do not drag, roll, slide or drop. While moving cylinder, always keep in place removable valve cover. Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve. When moving cylinders, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport cylinders. Never insert an object (e.g., wrench, screwdriver, pry bar) into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to remove over-tight or rusted caps. Slowly open the valve. If the valve is hard to open, discontinue use and contact your supplier. Close the container valve after each use; keep closed even when empty. Never apply flame or localized heat directly to any part of the container. High temperatures may damage the container and could cause the pressure relief device to fail prematurely, venting the container contents. For other precautions in using this product, see section 16.
Safe us	e of the product :	The suitability of this product as a component in underwater breathing gas mixtures is to be determined by or under the supervision of personnel experienced in the use of underwater breathing gas mixtures and familiar with the physiological effects, methods employed, frequency and duration of use, hazards, side effects, and precautions to be taken.
7.2.	Conditions for safe storage, including	any incompatibilities
Storage conditions :		Store in a cool, well-ventilated place. Store and use with adequate ventilation. Store only where temperature will not exceed 125°F (52°C). Firmly secure containers upright to keep them from falling or being knocked over. Install valve protection cap, if provided, firmly in place by hand. Store full and empty containers separately. Use a first-in, first-out inventory system to prevent storing full containers for long periods.
		OTHER PRECAUTIONS FOR HANDLING, STORAGE, AND USE: When handling product under pressure, use piping and equipment adequately designed to withstand the pressures to be encountered. Never work on a pressurized system. Use a back flow preventive device in the piping. Gases can cause rapid suffocation because of oxygen deficiency; store and use with adequate ventilation. If a leak occurs, close the container valve and blow down the system in a safe and environmentally correct manner in compliance with all international, federal/national, state/provincial, and local laws; then repair the leak. Never place a container where it may become part of an electrical circuit.
7.3.	Specific end use(s)	

None.

#### SECTION 8: Exposure controls/personal protection **Control parameters** 8.1. Nitrogen, compressed (7727-37-9) ACGIH Not established USA OSHA Not established Nitrogen (7727-37-9) ACGIH Not established USA OSHA Not established

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Safety Data Sheet P-4631

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		Date of issue: 01/01/1980	Revision date: 06/24/2015	Supersedes: 04/23/2015
8.2.	Exposure controls			
Appro	priate engineering controls	: Use a local exh the worker's br acceptable if it	naust system with sufficient flow eathing zone. Mechanical (ger can maintain an adequate supp	velocity to maintain an adequate supply of air in neral): General exhaust ventilation may be ly of air.
Eye pr	otection	: Wear safety gla	asses with side shields.	
Skin a	nd body protection	: Wear metatars needed. Wear product is poss	al shoes and work gloves for cy appropriate chemical gloves du ible. Select per OSHA 29 CFR	linder handling, and protective clothing where uring cylinder changeout or wherever contact with 1910.132, 1910.136, and 1910.138.
Respir	atory protection	: When workplac meets OSHA 2	ce conditions warrant respirator 9 CFR 1910.134, ANSI Z88.2, i blied er ein purfiking partridag if	use, follow a respiratory protection program that or MSHA 30 CFR 72.710 (where applicable).

Use an air-supplied or air-purifying cartridge if the action level is exceeded. Ensure that the respirator has the appropriate protection factor for the exposure level. If cartridge type respirators are used, the cartridge must be appropriate for the chemical exposure (e.g., an organic vapor cartridge). For emergencies or instances with unknown exposure levels, use a self-contained breathing apparatus (SCBA).

SECTION 9: Physical and chemical	properties	
9.1. Information on basic physical and c	hemical properties	
Physical state	: Gas	
Appearance	: Colorless gas.	
Molecular mass	: 28 g/mol	
Color	: Colorless.	
Odor	: No odor warning properties.	
Odor threshold	: No data available	
рН	: Not applicable.	
Relative evaporation rate (butyl acetate=1)	: No data available	
Relative evaporation rate (ether=1)	: Not applicable.	
Melting point	: -210 °C	
Freezing point	: No data available	
Boiling point	: -195.8 °C	
Flash point	: No data available	
Critical temperature	: -149.9 °C	
Auto-ignition temperature	: Not applicable.	
Decomposition temperature	: No data available	
Flammability (solid, gas)	: No data available	
Vapor pressure	: Not applicable.	
Critical pressure	: 3390 kPa	
Relative vapor density at 20 °C	: No data available	
Relative density	: No data available	
Density	: 1.16 kg/m³	
Relative gas density	: 0.97	
Solubility	: Water: 20 mg/l	
Log Pow	: Not applicable.	
Log Kow	: Not applicable.	
Viscosity, kinematic	: Not applicable.	
Viscosity, dynamic	: Not applicable.	
Explosive properties	: Not applicable.	
Oxidizing properties	: None.	
Explosion limits	: No data available	
9.2. Other information		
Gas group	: Compressed gas	
Additional information	: None.	
EN (English US)	SDS ID: P-4631	4/8

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Safety Data Sheet P-4631

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Date of issue: 01/01/1980 Revision date: 06/24/2015 Supersedes: 04/23/2015

SECT	ON 10: Stability and reactivity	
10.1.	Reactivity	
		Under certain conditions, nitrogen can react violently with lithium, neodymium, titanium (above 1472°F/800°C), and magnesium to form nitrides. At high temperature, it can also combine with oxygen and hydrogen.
10.2.	Chemical stability	
		Stable under normal conditions.
10.3	Possibility of bazardous reactions	
10.5.	rossibility of hazardous reactions	May occur
10.4.	Conditions to avoid	
		None under recommended storage and handling conditions (see section 7).
10.5.	Incompatible materials	
		None.
10.6	Hazardous decomposition products	
		None
0.5.0.5		
SECT	ON 11: Toxicological informati	on
11.1.	Information on toxicological effects	
Acute to	xicity	: Not classified
Skin corro	osion/irritation	Not classified
		pH <sup>.</sup> Not applicable
Serious e	ve damage/irritation	Not classified
Ochous c	ye damage/imation	nH: Not applicable
Poenirato	ny or skin consitization	Not elessified
		Not classified
Gerninger		Not classified
Carcinogo	enicity	Not classified
Reprodu	ictive toxicity	: Not classified
Specific	target organ toxicity (single exposure)	: Not classified
Specific exposur	target organ toxicity (repeated e)	: Not classified
Aspiratio	on hazard	: Not classified
SECT	ON 12: Ecological information	
12.1.	Toxicity	
Ecology	- general	: No ecological damage caused by this product.
12.2.	Persistence and degradability	
Nitrog	en, compressed (7727-37-9)	
Persis	ence and degradability	No ecological damage caused by this product.
Nitroa	en (7727-37-9)	
Persis	ence and degradability	No ecological damage caused by this product.
12.3.	Bioaccumulative potential	
Nitrog	en, compressed (7727-37-9)	
Log Po	W	Not applicable.
Loa Ka	W	Not applicable.
Bioacc	umulative potential	No ecological damage caused by this product.

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Safety Data Sheet P-4631

according to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication. Making our planet more productive"

Date of issue: 01/01/1980 Revision date: 06/24/2015 Supersedes: 04/23/2015

Nitrogen (7727-37-9)	
Log Pow	Not applicable for inorganic gases.
Log Kow	Not applicable.
Bioaccumulative potential	No ecological damage caused by this product.
12.4. Mobility in soil	
Nitrogen, compressed (7727-37-9)	
Mobility in soil	No data available.
Ecology - soil	No ecological damage caused by this product.
Nitrogen (7727-37-9)	
Mobility in soil	No data available.
Ecology - soil	No ecological damage caused by this product.
12.5. Other adverse effects	
Effect on ozone layer	: None.
Effect on the global warming	: None.
SECTION 13: Disposal consideration	ons
13.1. Waste treatment methods	
Waste disposal recommendations	: Dispose of contents/container in accordance with local/regional/national/international regulations. Contact supplier for any special requirements.

### SECTION 14: Transport information In accordance with DOT Transport document description : UN1066 Nitrogen, compressed, 2.2 UN-No.(DOT) : UN1066 Proper Shipping Name (DOT) : Nitrogen, compressed Transport hazard class(es) (DOT) : 2.2 - Class 2.2 - Non-flammable compressed gas 49 CFR 173.115 Hazard labels (DOT) : 2.2 - Non-flammable gas

Additional information		
Emergency Response Guide (ERG) Number	: 121 (UN1066);120 (UN1977)	
Other information	: No supplementary information available.	
Special transport precautions	: Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency. Before transporting product contai - Ensure there is adequate ventilation Ensure that containers are firmly secured Ensure cylinder valve is closed and not leaking Ensure valve outlet cap nut or plug (where provide is correctly fitted Ensure valve protection device (where provided) is correctly fitted.	s ners: e Jed)
Transport by sea		
UN-No. (IMDG)	: 1066	
Proper Shipping Name (IMDG)	: NITROGEN, COMPRESSED	
Class (IMDG)	: 2 - Gases	
MFAG-No	: 121	
Air transport		
UN-No.(IATA)	: 1066	
Proper Shipping Name (IATA)	: Nitrogen, compressed	
EN (English US)	SDS ID: P-4631	6/8

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Safety Data Sheet P-4631

Date of issue: 01/01/1980

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according to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication. Revision date: 06/24/2015

**Civil Aeronautics Law** 

Class (IATA)

: 2 : Gases under pressure/Gases nonflammable nontoxic under pressure

Supersedes: 04/23/2015

SECTION 15: Regulatory information				
15.1 US Endoral regulations				
Nitrogen, compressed (7727-37-9)				
Listed on the United States TSCA (Toxic Substances Control Act) inventory				
SARA Section 311/312 Hazard Classes	Sudden release of pressure hazard			
15.2 International regulations				
15.2. International regulations				

#### CANADA

Nitrogen, compressed (7727-37-9)
Listed on the Canadian DSL (Domestic Substances List)
Nitrogen (7727-37-9)
Listed on the Canadian DSL (Domestic Substances List)

#### **EU-Regulations**

#### Nitrogen, compressed (7727-37-9)

Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances)

#### 15.2.2. **National regulations**

#### Nitrogen, compressed (7727-37-9)

Listed on the AICS (Australian Inventory of Chemical Substances)

Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China)

Listed on the Korean ECL (Existing Chemicals List) Listed on NZIoC (New Zealand Inventory of Chemicals)

Listed on PICCS (Philippines Inventory of Chemicals and Chemical Substances)

15.3. US State regulations				
Nitrogen, compressed(7727-37-9)				
U.S California - Proposition 65 - Carcinogens List	No			
U.S California - Proposition 65 - Developmental Toxicity	No			
U.S California - Proposition 65 - Reproductive Toxicity - Female	No			
U.S California - Proposition 65 - Reproductive Toxicity - Male	No			
State or local regulations	U.S Massachusetts - Right To Know List U.S New Jersey - Right to Know Hazardous Substance List U.S Pennsylvania - RTK (Right to Know) List			

Nitrogen (7727-37-9)						
U.S California -	U.S California -	U.S California -	U.S California -	No significance risk level		
Proposition 65 -	Proposition 65 -	Proposition 65 -	Proposition 65 -	(NSRL)		
Carcinogens List	Developmental Toxicity	Reproductive Toxicity -	Reproductive Toxicity - Male			
		Female				
No	No	No	No			
Nitrogen (7727-37-9)						
U.S Massachusetts - Right To Know List						
U.S New Jersey - Right to Know Hazardous Substance List						
U.S Pennsylvania - RTK (Right to Know) List						

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Date of issue: 01/01/1980 Revision date: 06/24/2015 Supersedes: 04/23/2015

SECTION 16: Other information		
Revision date Other information	:	6/24/2015 12:00:00 AM When you mix two or more chemicals, you can create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an industrial hygienist or other trained person when you evaluate the end product. Before using any plastics, confirm their compatibility with this product.
		Praxair asks users of this product to study this SDS and become aware of the product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents, and contractors of the information in this SDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information.
		The opinions expressed herein are those of qualified experts within Praxair, Inc. We believe that the information contained herein is current as of the date of this Safety Data Sheet. Since the use of this information and the conditions of use are not within the control of Praxair, Inc., it is the user's obligation to determine the conditions of safe use of the product.
		Praxair SDSs are furnished on sale or delivery by Praxair or the independent distributors and suppliers who package and sell our products. To obtain current SDSs for these products, contact your Praxair sales representative, local distributor, or supplier, or download from www.praxair.com. If you have questions regarding Praxair SDSs, would like the document number and date of the latest SDS, or would like the names of the Praxair suppliers in your area, phone or write the Praxair Call Center (Phone: 1-800-PRAXAIR/1-800-772-9247; Address: Praxair Call Center, Praxair, Inc., P.O. Box 44, Tonawanda, NY 14151-0044).
		PRAXAIR and the Flowing Airstream design are trademarks or registered trademarks of Praxair Technology, Inc. in the United States and/or other countries.
NFPA health hazard	:	0 - Exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials.
NFPA fire hazard	:	0 - Materials that will not burn.
NFPA reactivity	:	0 - Normally stable, even under fire exposure conditions, and are not reactive with water.
NFPA specific hazard	:	SA - This denotes gases which are simple asphyxiants.

HMIS III Rating	
Health	: 0 Minimal Hazard - No significant risk to health
Flammability	: 0 Minimal Hazard
Physical	: 3 Serious Hazard

SDS US (GHS HazCom 2012) - Praxair

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