INSTRUCTION MANUAL
IND-21 & IND-45
VEHICULAR
FIRE CONTROL SYSTEMS

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IND-21 and IND-45 Vehicular Fire Control Systems

Instruction Manual

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Chapter 1
Introduction

1-1 INTRODUCTION

Heavy duty vehicles, used in both on-road and off road applications require fire protection to save:

- Costly vehicle replacement
- Costly down time

The Kidde IND-21 and IND-45 Fire Control Systems provide this protection.

These systems are pre-engineered systems and consist of a pressurized container to store the dry-chemical extinguishing agent, an actuation device to expel the dry chemical and a delivery system consisting of flexible hoses and fixed nozzles to transport the dry chemical to the fire hazard.

Actuation may be manual or automatic, at the user's option. Also, at the user's option, automatic detection may be included.

The following sections describe the components, the nozzle coverage, piping limitations, system design, controls, typical applications, installation and maintenance. Figure 1-1 shows a complete system.

1-2 SYSTEM TESTING

The Kidde IND dry-chemical fire control systems have been thoroughly tested, as follows:

- **Fire Tests:** In each test, a fire was allowed to progress to maximum intensity before the system was actuated. In these tests, the time allowed before the system was actuated was far in excess of the time an actual detector would require to detect a fire and actuate the system.
- These tests were conducted with maximum hose lengths and simulated cylinder pressure for a -65° F temperature environment. They were also conducted with minimum hose length and simulated cylinder pressure for a +200° F temperature environment.
- **Splash Tests:** Fuel in depth splash tests, using minimum hose lengths, maximum temperature and minimum clearances, were made to ensure that the nozzles did not cause fuel to splash.
- **Flow Rate Tests:** Operational flow rate tests were conducted at the two temperature extremes, cited under fire tests, and with maximum and minimum hose lengths.

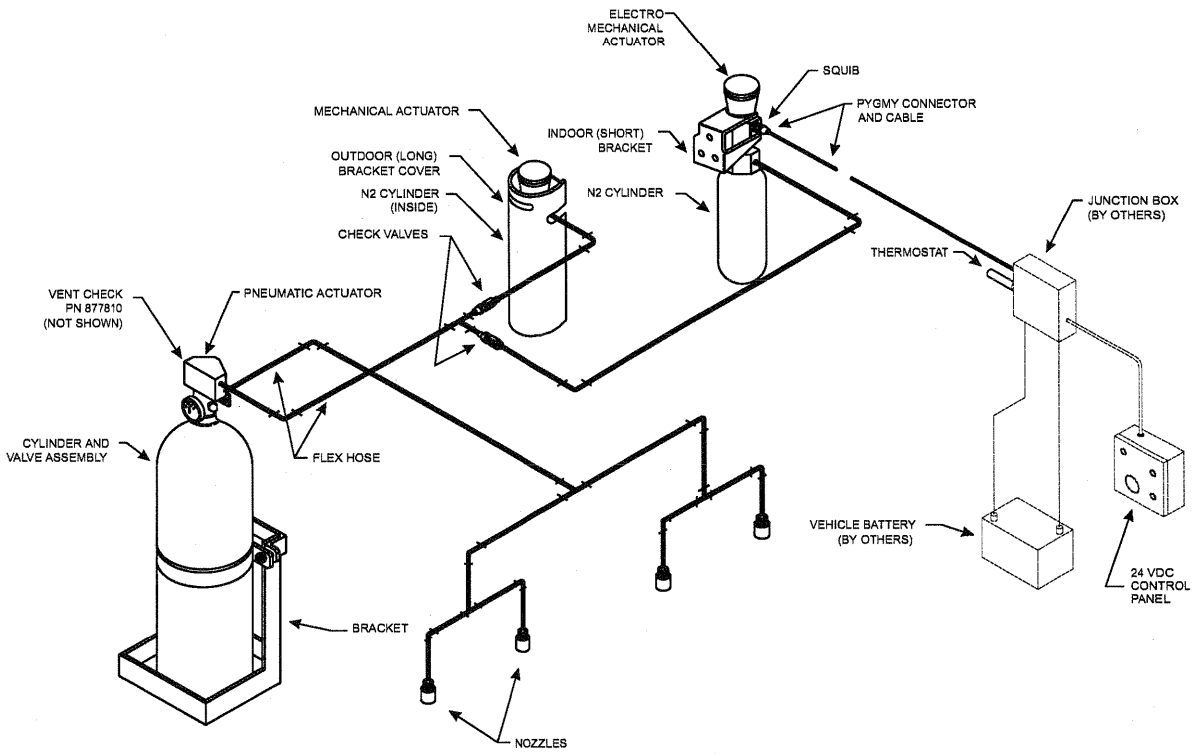

Figure 1-1. Typical Kidde Off-Road Fire Control System

- **Vibrational Tests:** Cyclical Vibrational testing of all mechanical and electrical components was performed to ensure structural integrity.
- **Functional Tests:** All mechanical components were functionally tested at -65° F and 200° F. The electrical control boxes were functionally tested at -65° F and 145° F.

Chapter 2
Component Descriptions

The Kidde IND dry-chemical fire control systems come in two sizes. The number in the designation indicates the weight, in pounds, of the dry-chemical charge.

2-1 FIRE SUPPRESSION COMPONENTS

2-1.1 Cylinder, Valve and Bracket

The pressurized dry-chemical cylinder and valve is supplied as a unit and is attached to the vehicle with an appropriately sized steel bracket. Both cylinders are made of steel and meet DOT specifications. Both cylinders are fitted with a spring loaded check in a nickel-plated brass valve, equipped with a fusible pressure relief plug and pressure gauge.

Table 2-1 outlines the specific information for each cylinder-and-valve assembly model. Each cylinder-and-valve assembly must be installed in an upright position using the mounting bracket specified in Table 2-2.

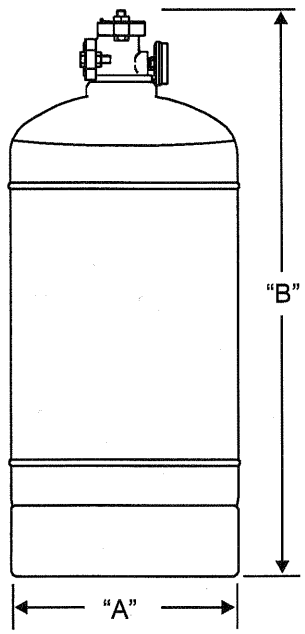

Figure 2-1. IND Cylinder and Valve Assembly

The IND-21 cylinder has a capacity of 750 cubic inches and holds 21 pounds of ABC dry chemical. The IND-45 cylinder has a capacity of 1550 cubic inches and holds 45 pounds of ABC dry chemical.

Both cylinders are pressurized with nitrogen plus 5% helium to 360 psig at 70° F.

Table 2-1. Cylinder and Valve Assemblies

Cylinder/ Valve Model	Part Number (P/N)	Type of Powder	Charge or Fill Weight of Powder (lbs.)	Nominal Diameter "A" (in.)	Overall Assembly Height "B" (in.)	Mounting Bracket P/N
IND-21	486573	ABC	21	9	17.6	296189
IND-45	486574	ABC	45	9	30.8	296188

2-1.2 Mounting Bracket Kits

A mounting bracket kit is used for mounting all cylinder-and-valve assemblies. The kit consists of a steel bracket with a shelf to hold the cylinder bottom. A cylinder strap is used to secure the cylinder to the bracket. Prior to installation, ensure that the wall or other mounting surface will support the recommended load specified in Table 2-2. Mount the bracket to the surface using three (3) 3/8-in. bolts or screws.

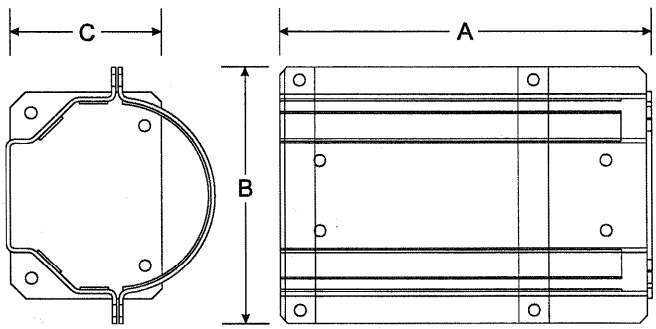

Figure 2-2. Mounting Bracket(s)

Table 2-2. Mounting Bracket Kits

Mounting Bracket P/N	For Cylinder/ Valve Model	Dimension A (in.)	Dimension B (in.)	Dimension C (in.)
296189	IND-21	11.75	12.38	7.19
296188	IND-45	18.5	12.38	7.19

2-1.3 Extinguishing Agent

The extinguishing agent is a dry-chemical powder suitable for extinguishing Class A, B and C fires. The powder is nonconductive, physiologically inert and nonabrasive. It will not harm most materials and may be brushed, blown, vacuumed or washed from vehicles.

2-2 ACTUATION COMPONENTS

2-2.1 Manual Mechanical Operator

The manual mechanical operator (P/N 876992), is a single lever operated plunger which mounts directly to the cylinder and valve assembly. The mechanical operator is covered with a rubber boot to prevent dirt and moisture from entering the operator or cylinder valve. The manual operator is shown in Figure 2-3.

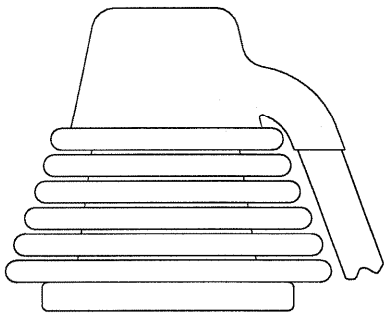

Figure 2-3. Manual Mechanical Operator (P/N 876992)

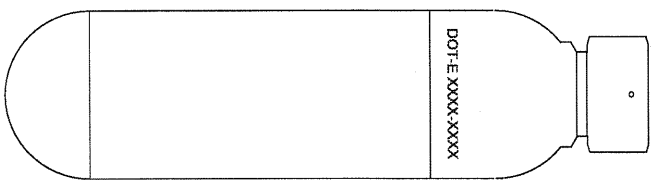

Figure 2-4. Nitrogen Cylinder (P/N 878508)

2-2.2 Nitrogen Cylinder

The nitrogen cylinder (P/N 878508) supplies the pressure charge for the pressure-operated actuator. This is a 15 cubic inch steel cylinder with a gold-plated disc bushing to contain the nitrogen at a pressure of 1800 psig at 70° F.

The cylinder is six inches long by two inches in diameter. The neck is threaded to mate with the actuators. Figure 2-4 shows the nitrogen cylinder.

The nitrogen cylinder has a protective cap which should be in place at all times except when an actuator is installed on the cylinder.

2-2.3 Check Valve

The check valve (P/N 259404), is a ball valve with a brass body. One end of the valve has a male thread. If more than one remote mechanical, or electromechanical, actuator is used, there can be no more than 125 feet of 1/4-inch hose from the nitrogen cartridge to each actuator, inclusive. Check valves must be inserted in the 1/4-inch line just before the tee connecting the two actuators to the dry-chemical cylinder (See Section 5, System Design). Figure 2-5 shows the check valve.

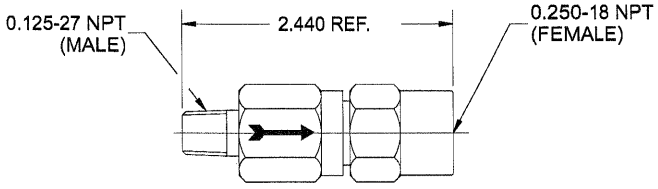

Figure 2-5. Check Valve (P/N 259404)

2-2.4 Pneumatic Actuator

The pneumatic actuator (P/N 877806) is also mounted on the valve of the dry-chemical cylinder. It also contains a piston which is pneumatically depressed. See Figure 2-6.

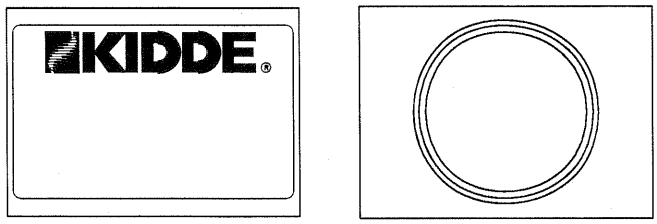

Figure 2-6. Pneumatic Actuator (P/N 877806)

2-2.5 Vent Check (Optional)

The vent check (P/N 877810) has an aluminum body and a spring loaded nylon ball to act as the vent check. The vent check screws into the pneumatic actuator (P/N 877806, mounted on the cylinder valve. It is used as a safety device to bleed off pressure, to the pneumatic actuator, if pressure should leak from the nitrogen supply cylinder. It can also be used to relieve the pressure in the 1/4-inch hose, after a dry-chemical discharge. If several pneumatic actuators are used, install the vent check in the last actuator in the series. Figure 2-27 shows the vent check.

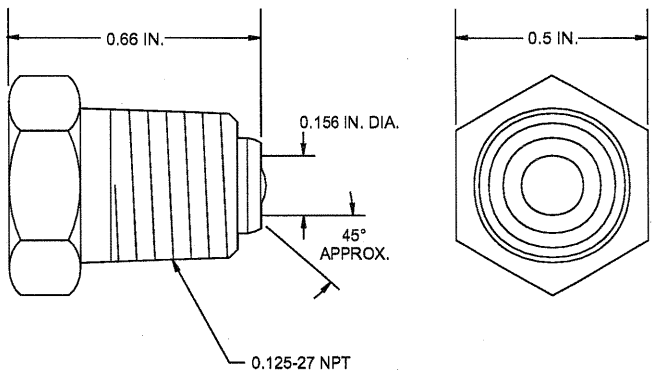

Figure 2-7. Vent Check (P/N 877810)

2-2.6 Brackets—Nitrogen Cylinder

There are two different brackets used to mount the actuator and nitrogen cylinder assembly. One is a short bracket used to mount the cylinder inside the vehicle. The other is a long bracket and cover used to mount the cylinder on the outside of the vehicle.

2-2.6.1 INDOOR NITROGEN BRACKET (SHORT)

This short bracket is used to hold the actuator with the nitrogen cylinder screwed onto the actuator. This provides easy access to the cylinder for removal and replacement.

The short Nitrogen cylinder mounting bracket (P/N 844726) is made of stainless steel, and coated with a rust-preventative oil. The bracket may be bolted or welded to the vehicle. Figure 2-8 shows the short Nitrogen bracket. This bracket should be painted by the end user.

This bracket may be used to mount either the electromechanical actuator (P/N 897391) or the mechanical actuator (P/N 897392) if the mechanical actuator is mounted inside the vehicle.

The mechanical actuator is frequently mounted outside the vehicle, using the outdoor bracket and cover.

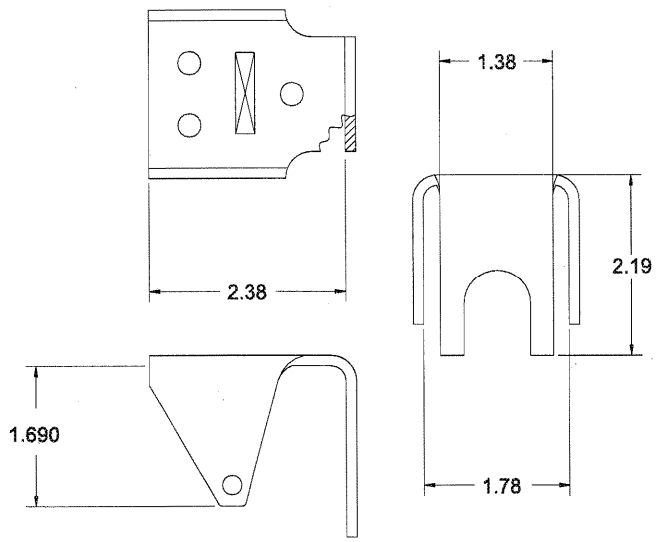

Figure 2-8. Indoor (Short) Nitrogen Cylinder Bracket (P/N 844726)

2-2.6.2 OUTDOOR NITROGEN BRACKET AND COVER (LONG)

The long Nitrogen cylinder mounting bracket and cover (P/N 844725) are used only with the mechanical actuator (P/N 897392) and is for outdoor use. Figure 2-9 shows the long Nitrogen bracket and cover.

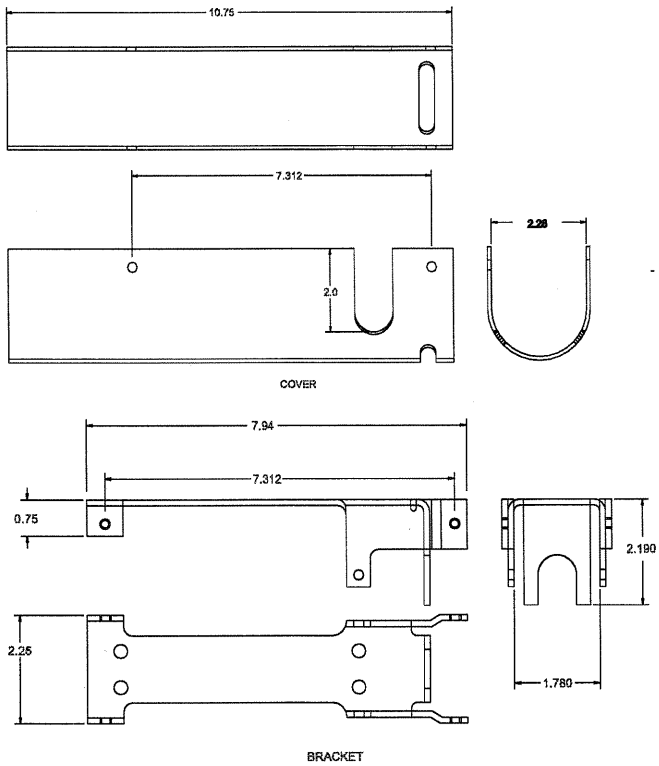

Figure 2-9. Outdoor (long) Nitrogen Cylinder Bracket And Cover (P/N 844725)

The bracket and cover are made of steel and coated with a rust preventative oil. The cover has a slot to facilitate the removal of the locking pin. The bracket and cover should be painted by the end user. The bracket may be bolted or welded to the vehicle. The cover is bolted to the bracket.

2-2.7 Mechanical Actuator

The mechanical actuator (P/N 897392) has a brass body and contains a stainless steel cutter pin assembly attached to a stainless steel stem which has a knob on the end. The cutter pin can be moved up and down manually by moving the stem knob up or down. Figure 2-10 shows the mechanical actuator. It can be mounted indoors using bracket (P/N 844726), or outdoors using bracket (P/N 844725).

The actuator bottom opening is threaded to mate with the nitrogen cylinder (P/N 878508). The knob and stem are enclosed in a rubber boot to prevent debris from entering the actuator. To operate the actuator, remove the locking pin and strike the knob toward the cylinder.

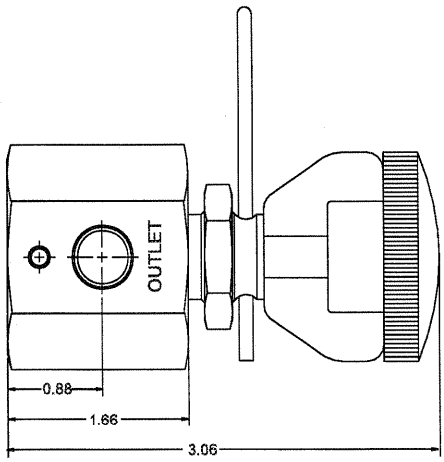

Figure 2-10. Mechanical Actuator (P/N 897392)

2-2.8 Electromechanical Actuator

The electromechanical actuator (P/N 897391) is similar to the mechanical actuator except the knob and stem are spring loaded. Also, an activating squib cartridge screws into the actuator body. This actuator can be operated automatically if an electrical signal from a detection device detonates the cartridge releasing pressure to depress the cutter pin pneumatically. This actuator can also be operated manually by pulling the locking pin and striking the knob forcefully downward. Figure 2-11 shows the electromechanical actuator.

This actuator body also is threaded to mate with the nitrogen cylinder. It must always be mounted indoors, using indoor bracket (P/N 844726).

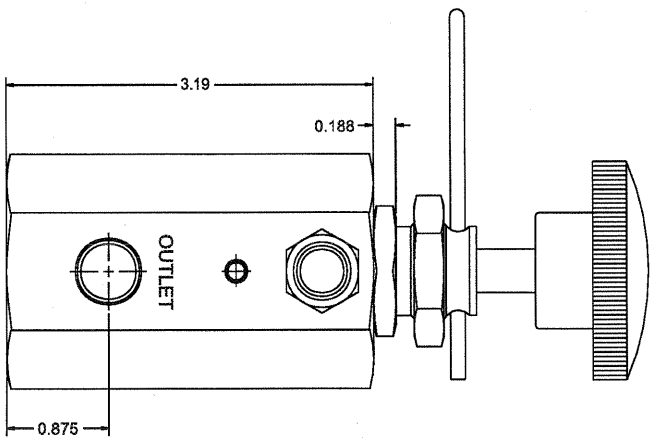

Figure 2-11. Electromechanical Actuator (P/N 897391)

2-2.9 Cartridge and Pygmy Connector

The cartridge (P/N 844712) is made of Cadmium-plated steel (See Figure 2-12). One end is threaded to screw into the electromechanical actuator. The other end mates with a Pygmy connector and cable (P/N 844710).

The cartridge is equipped with a safety shunt wire in the electrical connector end. This wire must be removed before the Pygmy connector is attached. The cartridge has an operating range of -65° to 200° F. The cartridge momentarily drains 7 Amperes of current when actuated.

The cartridge has a shelf life of 10 years when stored at 70° F and 5 years when stored at 200° F. The cartridge should be stored at 70° F in a dry environment. Figure 2-12 shows the cartridge and Figure 2-13 shows the pygmy connector cable.

NOTE: Cartridge must be replaced after system is fired.

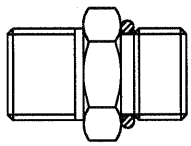

Figure 2-12. Cartridge (P/N 844712)

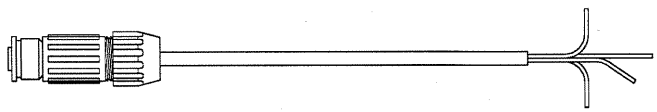

Figure 2-13. Pygmy Connector And Cable (P/N 844710)

2-2.10 Delivery Components

Delivery components consist of nozzles, flexible piping, or hose, support brackets and a specially designed distributor.

2-2.10.1 NOZZLES

There are two types of nozzles available for use with the IND Off-Road Fire Extinguishing System. One is a cone type nozzle, the other is a tankside nozzle.

2-2.10.2 CONE NOZZLE

The cone nozzle (P/N 844714) is made of steel and contains a 45° steel cone, causing the nozzle to disperse a cone-shaped spray of dry chemical. This nozzle has a polyethylene protective cap that is blown off by the dry-chemical discharge. Figure 2-14 shows the cone nozzle and cap. Figure 2-15 shows the nozzle and spray pattern.

This nozzle may be used in two ways. One way is for total flooding applications for an enclosed volume. The other way is for overhead local application for an unenclosed area.

Nozzle coverage and placement is detailed in Section 3 of this manual.

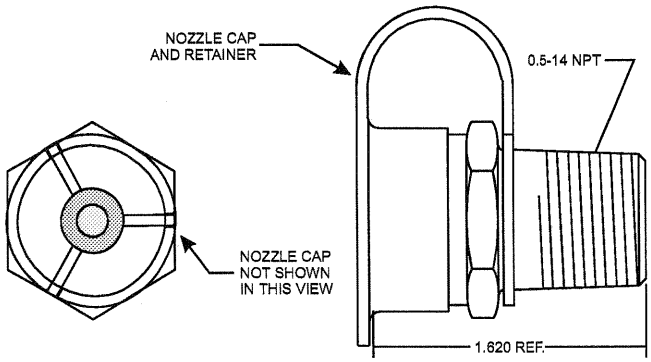

Figure 2-14. Cone Nozzle (P/N 844714)

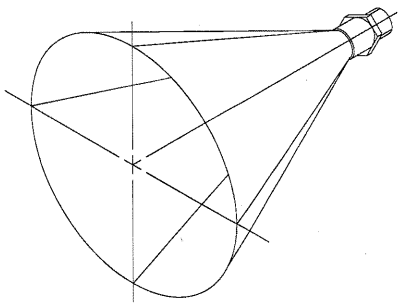

Figure 2-15. Cone Nozzle Spray Pattern

2-2.10.3 TANKSIDE NOZZLE

The tankside nozzle (P/N WK-259072-001) is a brass nozzle with a semicircular slot which delivers a 180° fan-shaped stream of dry chemical. This nozzle can be used for tankside local applications and can cover a larger area than the cone nozzle. This nozzle rests on the side of the tank. Figure 2-16 shows the tankside nozzle. Figure 2-17 shows the nozzle and spray pattern.

This nozzle has a polyethylene protective cap that is blown off by the dry-chemical discharge.

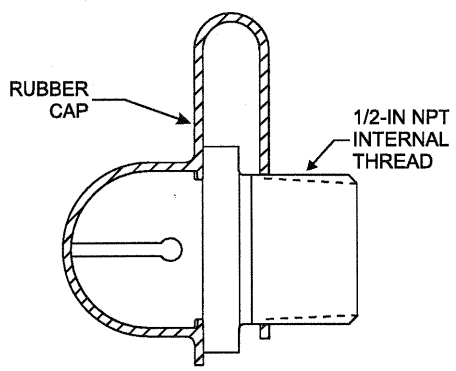

Figure 2-16. Tankside Nozzle
(P/N WK-259072-001)

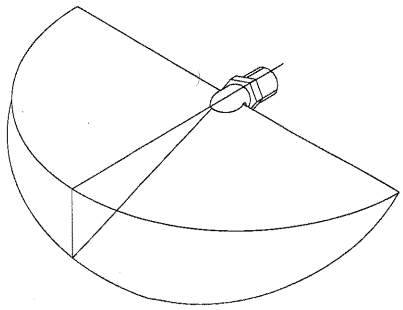

Figure 2-17. Tankside Nozzle Spray Pattern

2-2.10.4 FLEXIBLE PIPING

Flexible piping for the IND Fire Extinguishing Systems will be customer supplied hose. All hoses must meet the SAE 100 R5 (minimum) specification. In addition, any hose used in underground mining applications must also meet USBM flame resistance requirements as specified in MSHA 2G-11C and all other SAE requirements including an operating range of -65° F (-54° C) to +200° F (+93° C).

The following SAE standards should be used for reference:

- SAE J5162 Hydraulic Hose Fitting Standard
- SAE J517A Hydraulic Hose Standard
- SAE J343 Standard

Fittings shall be used, as necessary, where hose is connected to nozzles, cylinders, tees or distributors. Swivel hose couplings may be used at any location.

Fittings may be reusable type or hydraulically crimped type.

For convenience the following manufacturer's hose meets these specifications is given here.

NOTE: This list is not meant to be all-inclusive. Any hose meeting the above specifications may be used.

Aeroquip Company Example Hoses

Wire Braid					Rubber Covered
Hose ID (in.)	**100 R1A**	**100 R1T**	**100 R5**	**MIL Spec**	**100 R5**
1/4	2681-4	2663-4	1503-5	2665-4	2651-5
1/2	2681-8	2663-8	1503-10	2665-8	2651-10
3/4	2681-12	2663-12	-	2665-12	-
7/8	2681-14	-	1503-16	2665-14	2651-16

2-2.10.5 NOZZLE BRACKETS

There are two specially designed brackets used to mount the nozzles and direct the discharge. One is a 90° bracket and coupling. The other is a bracket and 45° elbow. These brackets may be bolted or welded to the vehicle. Brackets are not painted as supplied.

2-2.10.5.1 Bracket and Coupling

This bracket (P/N 263363) consists of a 2" x 2" x 1/8" steel 90° angle bracket with a Schedule 40 black iron coupling welded to it. The coupling has a 1/2" NPT female thread. Figure 2-19 shows the bracket and coupling. The bracket should be painted by the user, before installation, to prevent rusting.

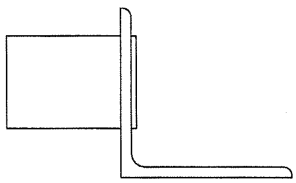

Figure 2-18. 90°-Bracket and Coupling (P/N 263363)

2-2.10.5.2 45° Bracket and Elbow

This bracket (P/N 263362) is also a 2" x 2" x 1/8" steel 90° angle bracket welded to a Schedule 40 black iron 45° elbow. The 45° elbow has a female thread. Figure 2-20 shows the 45° bracket and elbow. The bracket should be painted by the user, before installation, to prevent rusting.

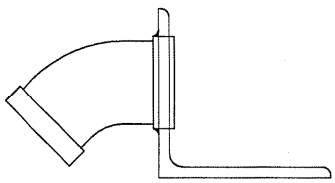

Figure 2-19. 45°-Bracket and Elbow (P/N 263362)

2-2.10.6 DISTRIBUTOR

Some means must be provided to distribute the dry-chemical powder to the 4, 6 or 8 nozzles. This can be done by means of ordinary tee fittings or by means of a specially designed distributor (P/N 283067).

This steel distributor has four 1/2-inch NPT female thread outlet ports at right angles to each other. The distributor also has a 3/4-inch NPT female thread inlet port. The distributor should be painted by the user, before installation, to prevent rusting.

One or more distributors may be used alone or in combination with tees, as explained in Section 4 of this manual. Figure 2-21 shows the distributor.

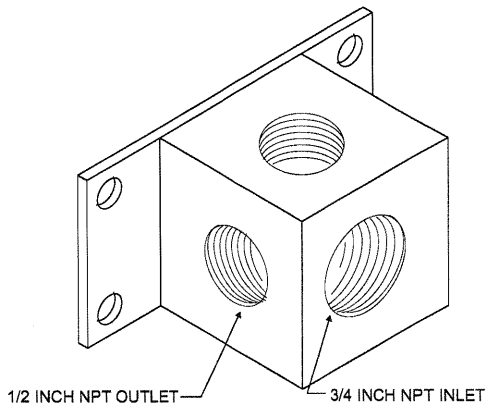

Figure 2-20. Distributor (P/N 283067)

When protecting a vehicle with an IND system, there will be hidden or "shadow" areas, i.e., areas that are hard to reach or partially obstructed by some part of the vehicle. When planning hazard protection, examine all possible hazard areas to determine if planned coverage of dry chemical will reach all of these hidden areas. If there is any doubt, include extra nozzles to be sure of reaching all shadow areas.

2-3 DETECTION COMPONENTS

Thermostatic spot detection or continuous detection, or some combination of both may be used. These detectors are used with certain controls, as discussed in this subsection.

2-3.1 Thermostats

There are three thermostats available with temperature ratings of 325° F, 450° F and 600° F. (See Figure 2-21). The sensing element is an explosion-proof stainless steel tube with a color coded tip and band to indicate the temperature rating.

The thermostat sensing elements have normally open (NO) contacts set to close at the designated temperature.

Table 2-3 lists the available thermostat part numbers, color codes and temperature designations. Table 2-4 lists the electrical ratings for the thermostats.

Table 2-3. Thermostat Designations

Part Number	Color Code	Temperature Designation, °F
12-F27121-000-06	RED	325
12-G27121-000-07	GREEN	450
12-G27121-000-08	ORANGE	600

Table 2-4. Thermostat Ratings

Voltage	Maximum Current
125 VAC	5.0 A
24 VDC	2.0 A
48 VDC	1.0 A
125 VDC	0.5 A

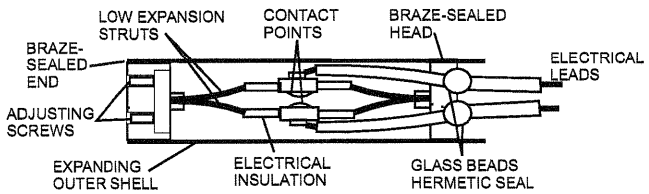

Figure 2-21. Typical Thermostat

2-4 ACCESSORIES

2-4.1 Cylinder Discharge Adapter Kit

The cylinder discharge adapter kit (P/N 844908) consists of a threaded discharge adapter, mounting flange, O-ring and related hardware. The adapter is used to connect the dry-chemical valve discharge port to the discharge piping leading to the nozzles. See Figure 2-29.

The discharge adapter provides a means to connect 3/4" discharge pipe (or 1" pipe with a concentric reducer or reducing bushing) to any IND cylinder-and-valve assembly.

The discharge-adapter kit consists of a male, 3/4" NPT, brass, discharge-valve-outlet adapter and a steel flange plate for securing the discharge adapter to the valve outlet.

NOTE: Nuts and bolts used to secure the anti-recoil plate to the discharge valve should be retained and used for mounting the discharge adapter to the valve outlet.

NOTE: The discharge adapter can also be used as a recharge adapter to pressurize the cylinder with nitrogen after filling with dry chemical.

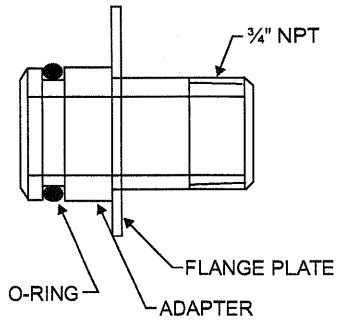

Figure 2-22. Discharge Adapter Kit (P/N 844908)

2-4.2 Recharging Adapter

The recharging adapter (P/N 279262) is screwed into the discharge port of the dry-chemical cylinder valve to allow the cylinder to be re-pressurized after being refilled with dry chemical from the recharge pail (P/N 806411). Figure 2-30 shows the recharge adapter.

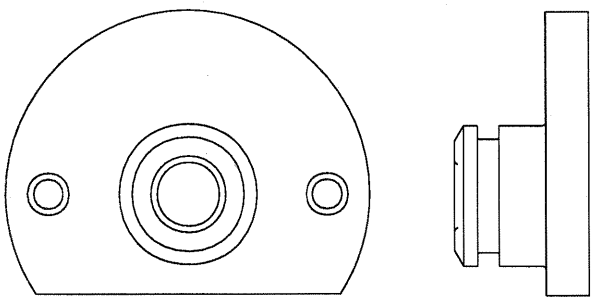

Figure 2-23. Recharge Adapter (P/N 279262)

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Chapter 3
Nozzle Coverage

3-1 NOZZLE TYPES

There are two types of nozzles:

- Cone Nozzle (Figure 2-14)
- Tankside Nozzle (Figure 2-16)

NOTE: Nozzle types MUST NOT be mixed on any one system.

System	Number of Nozzles	
	Maximum	Minimum
IND-21	4	4
IND-45	8	6

3-1.1 Nozzle Application

There are two methods of application:

- **Total flooding** for enclosed areas
- **Local application** for unenclosed areas
- **Local application** may be overhead or tankside

3-1.2 Nozzle Coverage

Each nozzle provides a module of protection, either a volume or an area:

- **Total Flooding**
  Volume: 216 cubic feet (6' x 6' x 6')
- **Local Application**
  Overhead
  Area: 900 square inches (30" x 30")
- **Tankside**
  Area: 1764 square inches (42" x 42")

3-1.3 Nozzle Placement

- **Total Flooding**
  Center of top plane of volume
- **Local Application**
  overhead: 25-45 inches above center of area
- **Tankside**
  On rim of tank - center of one side of area

NOTE: Slit must be over area and parallel to surface.

Figure 3-1 shows nozzle placement and volume coverage for total flooding.

Figure 3-2 shows nozzle placement and area coverage for local overhead application.

Figure 3-3 shows nozzle placement and area coverage for local tankside application.

Table 3-4 gives total area coverage for local overhead, and local tankside, four, six and eight nozzle systems.

Table 3-3 gives total volume coverage for four, six and eight nozzle systems.

Figure 3-4 shows an example of multi-nozzle coverage where the volumes are adjacent.

Figure 3-5 shows an example of multi-nozzle coverage of nonadjacent volumes.

Volumes and areas may be arranged in any configuration as long as total coverage and hose lengths are not exceeded.

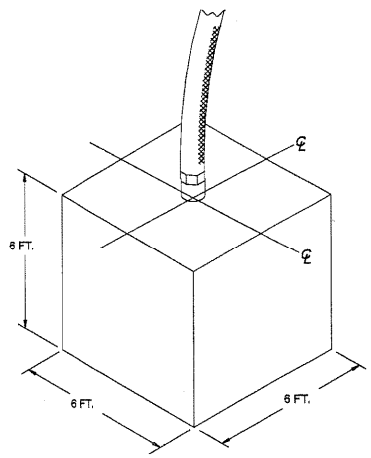

Figure 3-1. Volume Coverage Per Nozzle, IND Total Flooding Application

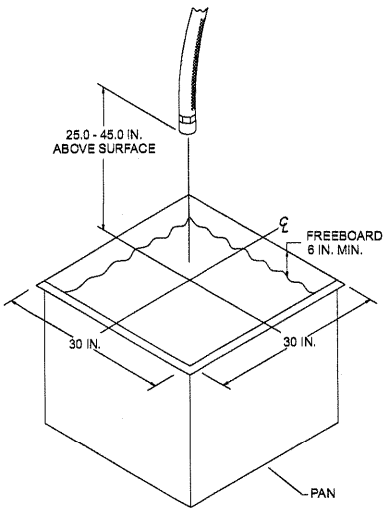

Figure 3-2. Area Coverage Per Nozzle, IND Local Overhead Application

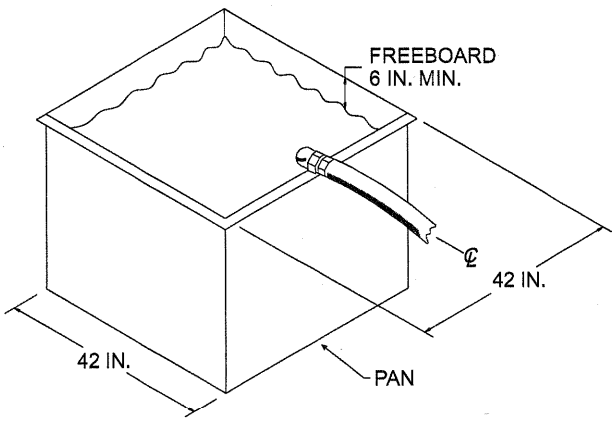

Figure 3-3. Area Coverage Per Nozzle, IND Local Tankside Application

Table 3-1. Total Flooding Application Volume Coverage

Cylinder Size and Number of Nozzles	Total Volume (Cu. Ft.)
IND-21	
4 Nozzles	864
IND-45	
6 Nozzles	1296
8 Nozzles	1728

Table 3-2. Local Application Area Coverage

Cylinder Size and Number of Nozzles	Total Area			
	Overhead		Tankside	
IND-21				
4 Nozzles	3600	25.0	7056	49.0
IND-45				
6 Nozzles	5400	37.5	10,584	73.5
8 Nozzles	7200	50.0	14,112	98.0

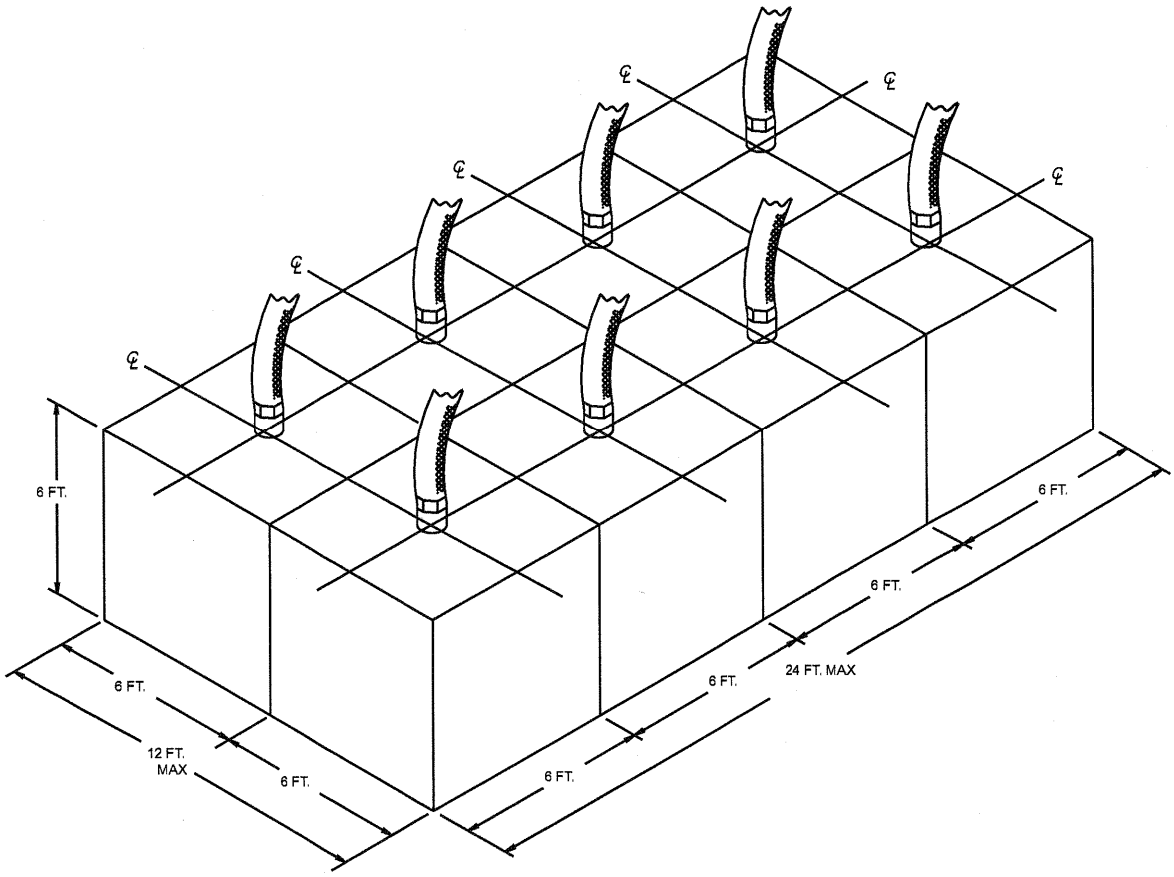

Figure 3-4. Multi-Nozzle, Total Flooding of Adjacent Volumes

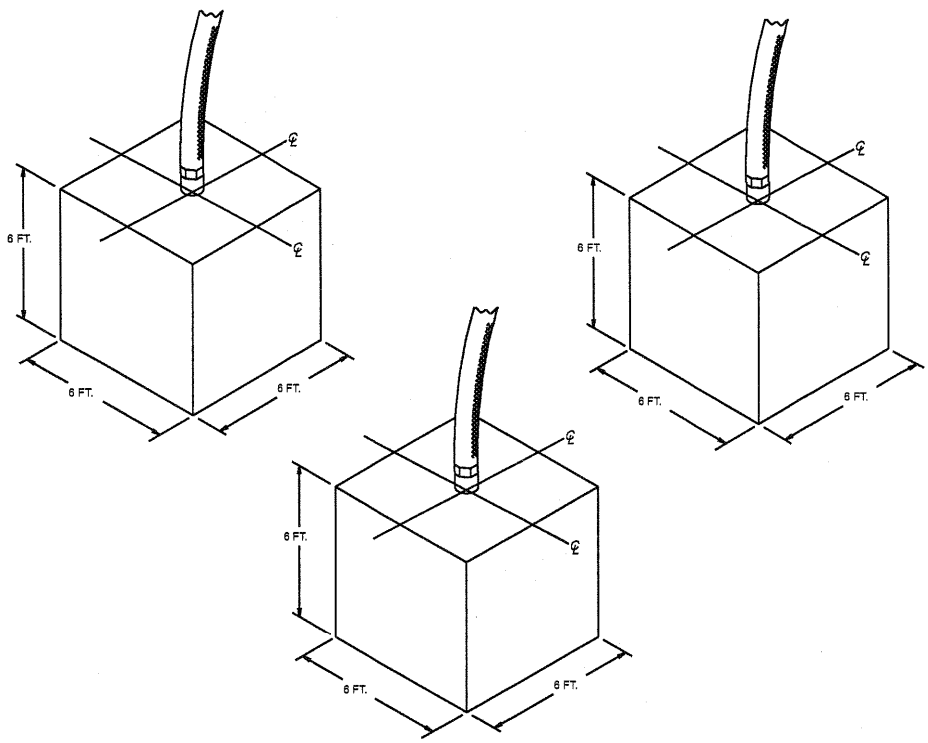

Figure 3-5. Multi-Nozzle, Total Flooding of Non-Adjacent Nozzles

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Chapter 4
Hose Limitations

4-1 INTRODUCTION

As noted in Chapter 2 the dry-chemical cylinder comes in two sizes. One has a capacity of 21 pounds and the other 45 pounds of dry chemical powder.

It was pointed out, in Chapter 3 that the IND-21 system must use four nozzles, while the IND-45 system may use either six or eight nozzles.

The flexible hose routes the dry-chemical powder to the nozzles; however, each nozzle must receive an adequate quantity of dry-chemical powder. This can be accomplished by using a system of tees, or by using one, or more, specially designed Kidde distributors (See Chapter 2), or by some combination of these distributors and tees.

In each of these systems, there is a maximum system total hose length between the cylinder and all nozzles. There is also a system minimum total hose length between the cylinder and any one nozzle.

The system maximum total hose length will vary from system to system. However, the system minimum hose length for all systems is 10 feet.

It is important to remember this when using the tables. Each branch of a system may have a zero minimum but the total minimum hose between the cylinder and any one nozzle must be 10 feet. Therefore, all branches cannot be zero at once.

These system maximums and minimums must be strictly observed. If the system maximum hose length is exceeded, the pressure will be reduced too much to allow the nozzles to receive adequate dry-chemical powder. If the minimum total hose length between cylinder and one nozzle is not adhered to, splashing will result.

NOTE: All hose can be run with any number of bends at any direction.

Each system will be discussed in detail.

4-2 IND-21

4-2.1 Four-Nozzle Systems

The four nozzle system can be piped with either all tees or with one distributor. Figure 4-1 shows a maximum IND-21, four nozzle system, using all tees. Table 4-1 gives the hose size at each location, plus the maximum and minimum hose length and quantity of elbows at each location. It also gives the maximum and minimum total hose between the cylinder an each nozzle. Figure 4-2 shows a maximum IND-21 system using a distributor. Table 4-2 gives the hose size at each location, plus the maximum and minimum hose length and quantity of elbows at each location. It also gives the maximum and minimum total hose between the cylinder and each nozzle.

4-3 IND-45

4-3.1 Six-Nozzle Systems

The six nozzle system can only be piped using one distributor and three tees. In this configuration, one of the outlet ports of the distributor is blocked with a 1/2-inch plug. Figure 4-3 shows the six-nozzle balanced system

NOTE: All 7/8-inch hose utilizes 3/4-inch fittings.

Table 4-3 gives the hose size at each location and the maximum and minimum hose length and quantity, of elbows at each location. It also gives the maximum and minimum hose between the cylinder and an one nozzle.

4-3.2 Eight-Nozzle Systems

The eight nozzle system is piped, using two distributors. Figure 4-4 shows a maximum IND-45, eight-nozzle system, using two distributors. Table 4-4 gives the hose size at each location an the maximum and minimum hose length and quantity and minimum hose between the cylinder and any one nozzle.

NOTE: All 7/8-inch hose utilizes 3/4-inch fittings.

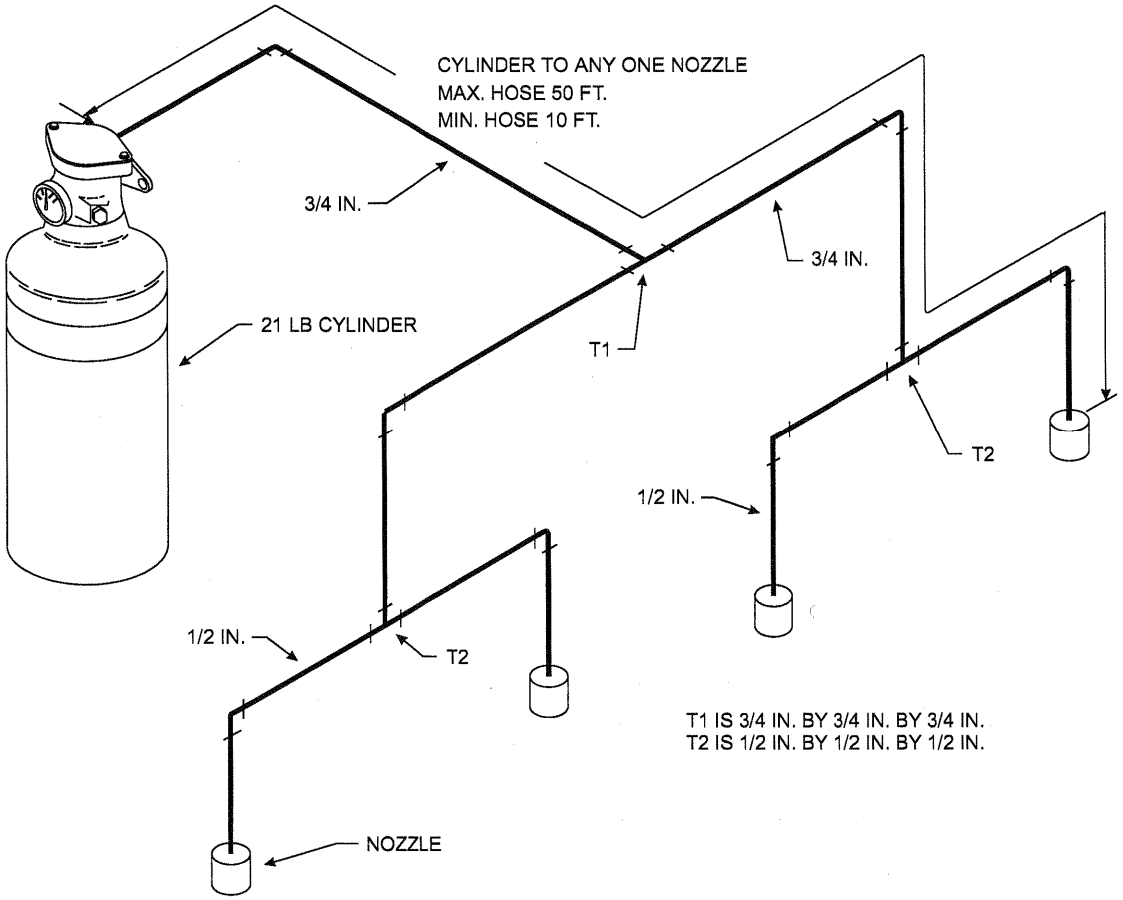

Figure 4-1. IND-21, Four-Nozzle System, Using All Tees.

Table 4-1. Hose and Elbow Limitations, IND-21, Four-Nozzle System, Using Tees

Location	Hose ID (IN.)	Hose Length (FT.)		Number of Elbows/Hose Length	
		Maximum	Minimum	Maximum	Minimum
Cylinder to T1	3/4	45	0	1	0
T1 to T2	3/4	20	0	1	0
T2 To Each Nozzle	1/2	15	0	1	0
Cylinder to Each Nozzle	-	50	10	-	-
All 3/4-in. Hose	-	45	5	-	-
All 1/2-in. Hose	-	60	0	-	-

This system may be unbalanced in a maximum ratio of 3:1 at any one tee.

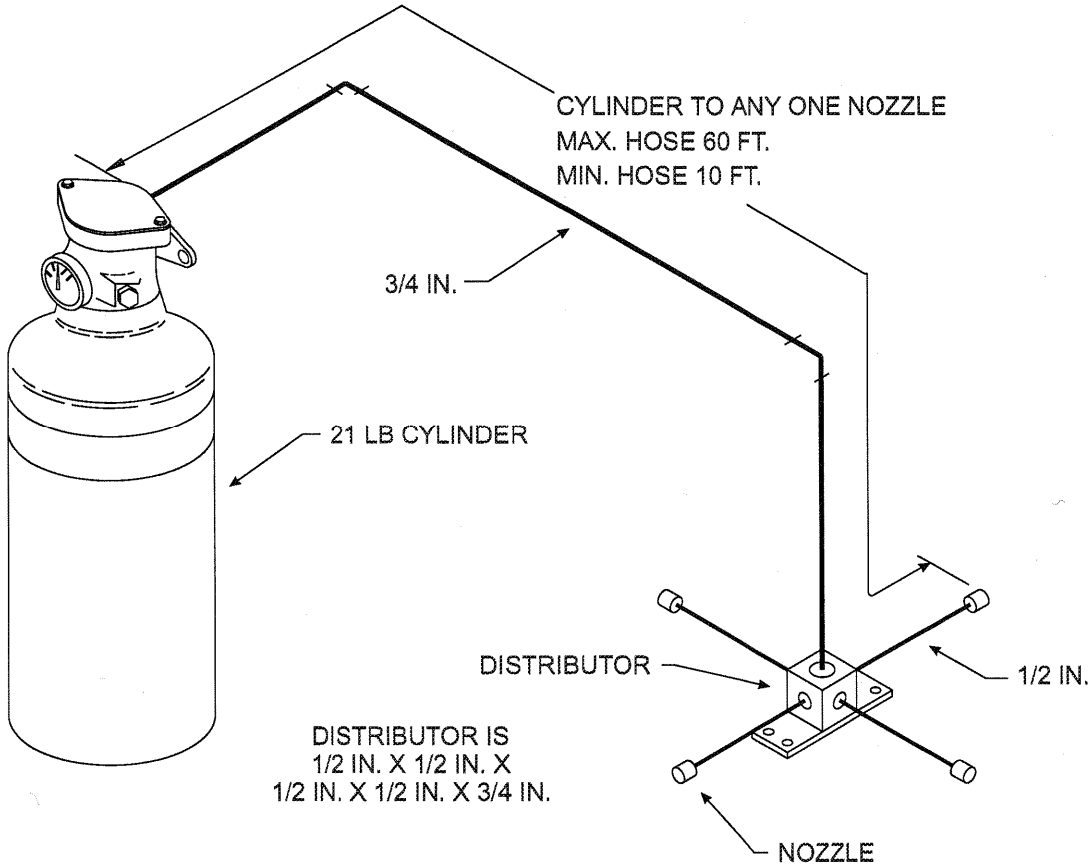

Figure 4-2. IND-21, Four-Nozzle System, Using a Distributor

Table 4-2. Hose and Elbow Limitations, IND-21, Four-Nozzle System, Using a Distributor

Location	Hose ID (IN.)	Hose Length (FT.)		Number of Elbows/Hose Length	
		Maximum	Minimum	Maximum	Minimum
Cylinder to Distributor	3/4	45	0	1	0
Distributor to Each Nozzle	1/2	15*	5	1	0
Cylinder To Each Nozzle	-	60	10	-	-
All 3/4-in. Hose	-	45	5	-	-
All 1/2-in. Hose	-	60	0	-	-

***This system can be unbalanced in a maximum ratio of 3:1 at the distributors or T1.**

These maximums pertain to the maximum limits for a balanced system. These values can be exceeded for the unbalanced system provided that all other limits are not exceeded. See Figure 4-6 for an example of a maximally unbalanced configuration.

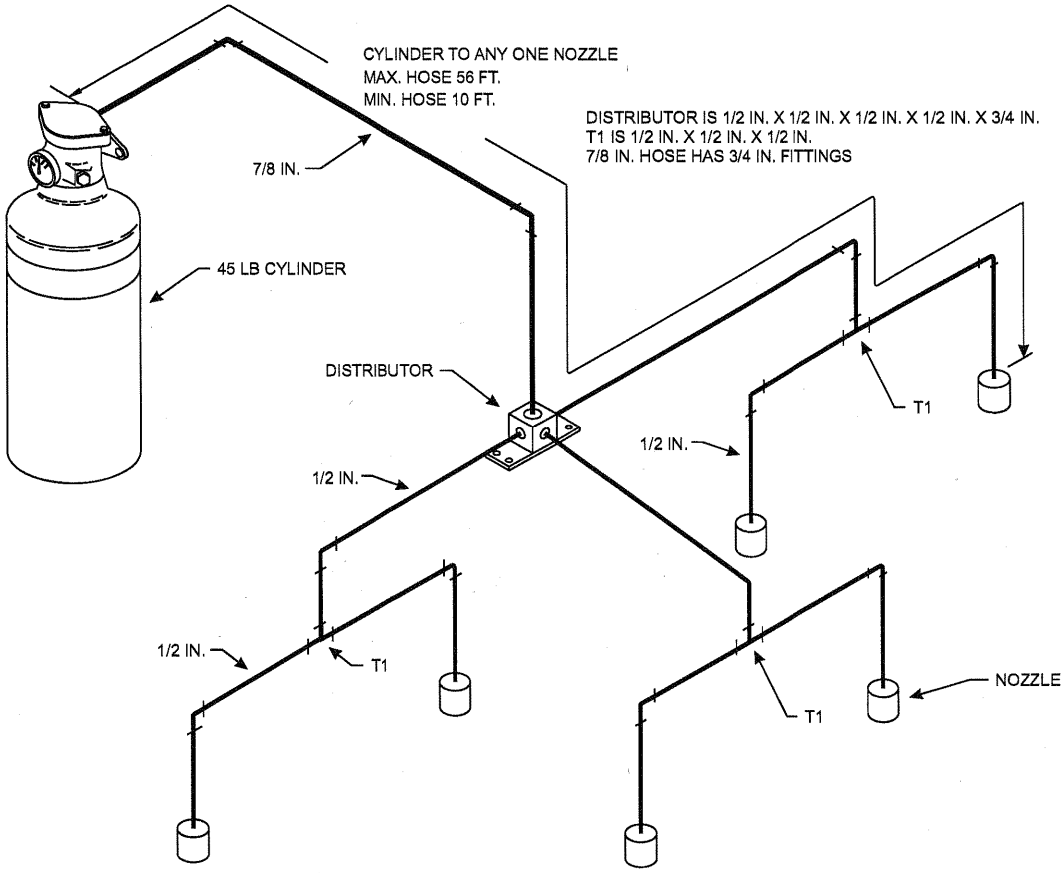

Figure 4-3. IND-45, Six-Nozzle System, Using a Distributor

Table 4-3. Hose Limitations, IND-45, Six-Nozzle System

Location	Hose ID (IN.)	Hose Length (FT.)		Number of Elbows/Hose Length	
		Maximum	Minimum	Maximum	Minimum
Cylinder to Distributor	7/8	45	5	2	0
Distributor to T1	1/2	15*	0	1	0
T1 To Each Nozzle	1/2	11*	0	1	0
Cylinder to Each Nozzle	-	56	10		
All 7/8-in. Hose	-	45	5	-	-
All 1/2-in. Hose	-	66	0	-	-

***This system can be unbalanced in a maximum ratio of 3:1 at the distributors or T1.**

These maximums pertain to the maximum limits for a balanced system. These values can be exceeded for the unbalanced system provided that all other limits are not exceeded. See Figure 4-6 for an example of a maximally unbalanced configuration.

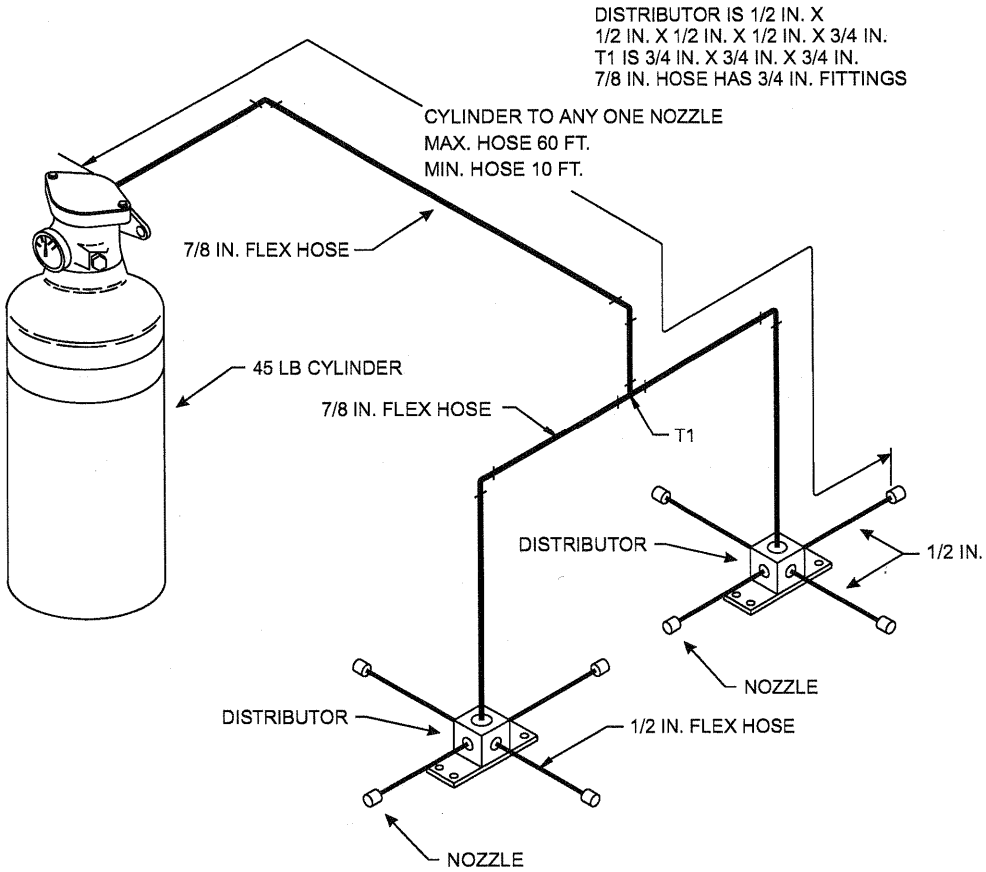

Figure 4-4. IND-45, Eight-Nozzle System, Using Two Distributors

Table 4-4. Hose Limitations, IND-45, Eight-Nozzle System

Location	Hose ID (IN.)	Hose Length (FT.)		Number of Elbows/Hose Length	
		Maximum	Minimum	Maximum	Minimum
Cylinder to T1	7/8	40	0	2	0
T1 to Each Distributor	1/2	20*	0	1	0
Distributor To Each Nozzle	1/2	11*	0	1	0
Cylinder to Each Nozzle	-	60	10		
All 7/8-in. Hose	-	45	5	-	-
All 1/2-in. Hose	-	88	0	-	-

***This system can be unbalanced in a maximum ratio of 3:1 at the distributors or T1.**

These maximums pertain to the maximum limits for a balanced system. These values can be exceeded for the unbalanced system provided that all other limits are not exceeded. See Figure 4-6 for an example of a maximally unbalanced configuration.

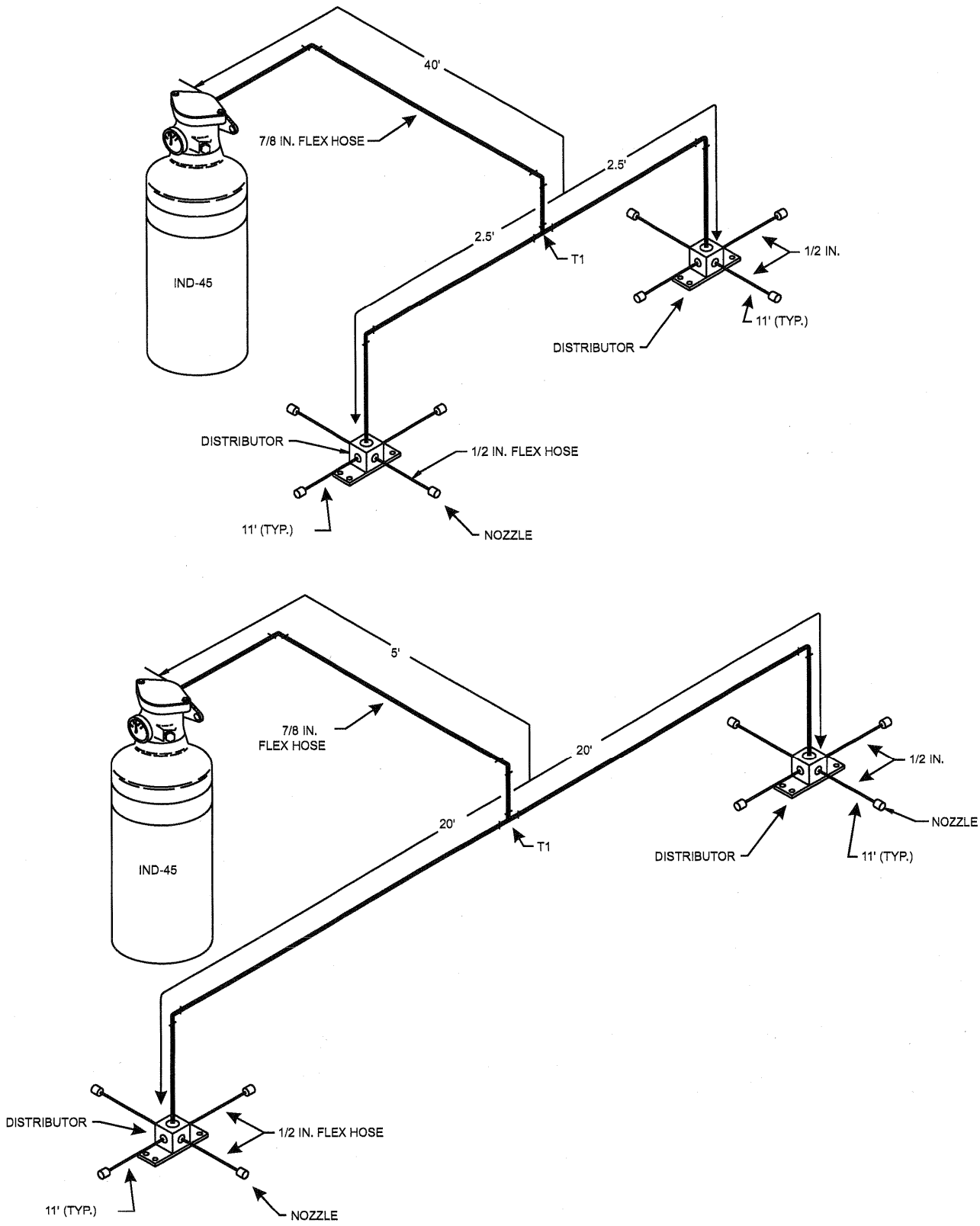

Figure 4-5. Examples of Maximum Balanced IND-45 Systems, Eight Nozzles

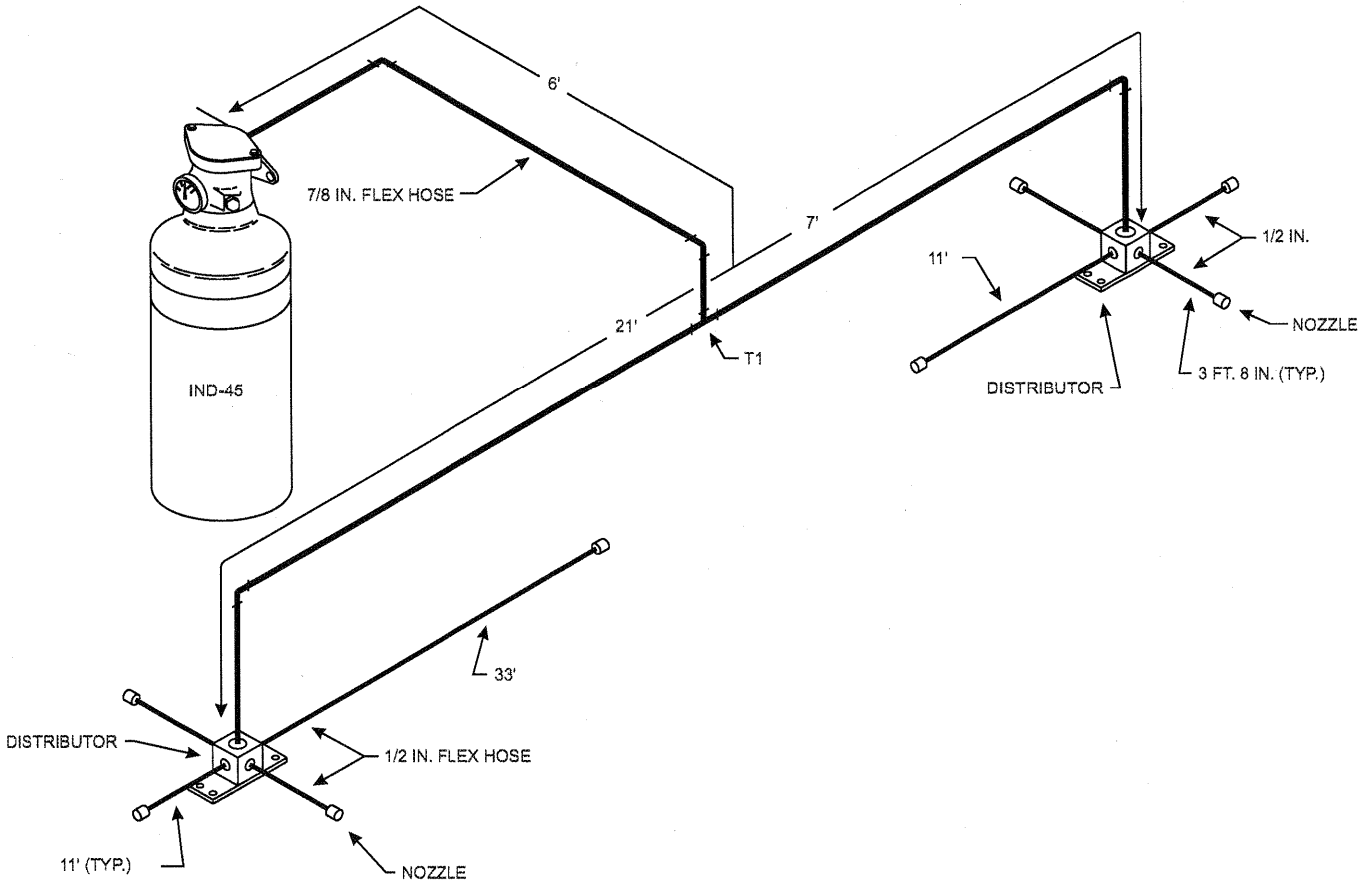

Figure 4-6. Example of an IND-45 Maximum Unbalanced System, Eight Nozzles (Maximum Unbalance Ratio 3:1)

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Chapter 5
System Design

To design a fire-protection system properly, for a given vehicle, it is necessary to do two things:

1. Perform a vehicle hazard analysis.
2. Pick the proper system in terms of nozzle coverage and detection.

5-1 HAZARD ANALYSIS

The following should be carefully analyzed:

- Fuel areas and heat sources are hazards, particularly where they overlap.
- The environment in which the vehicle is used adds hazards.
- Modifications to the vehicle to adapt it for different applications may alter hazards. For example, a bulldozer used for landfill may present different hazards from an identical bulldozer used in a forestry application.
- Typical fuel hazards are gasoline, diesel fuel, engine oil, lubricating oil and hydraulic fluid. Wood, cloth and plastic are other fuel hazards. Leaves, coal dust, and other foreign objects represent hazards caused by the environment.
- Typical sources of heat are areas containing brakes, bearings, gears, and transmissions. Auxiliary equipment such as pumps, turbochargers, belly pans, electric motors and equipment are other sources of heat, or sparks.
- Areas where fuel hazards and heat sources both exist, are prime hazard areas.
- Vehicle fire history. Very important. The equipment installer should discuss this with the end user.
- The installer should document the hazard areas requiring protection.

5-2 FIRE PROTECTION

Having identified the hazard areas, several points should be considered in planning fire protection.

Examine each hazard area and answer the following questions:

1. What is the hazard? Is it an essentially open or an essentially closed area? This determines the type of coverage. Total flooding is used in essentially enclosed areas, local application in essentially open areas.
2. What are the dimensions of the hazard area? This determines the basic nozzle coverage.
3. Could a liquid fuel leak spread fire to other areas? If so, additional nozzles may be required.
4. Are there "shadow" areas, i.e., areas blocked by vehicle components that would prevent the dry chemical from reaching that area? If so, additional nozzles may be required. Also, care must be taken to aim the nozzle so that the dry chemical will reach the shadow area.
5. Will the normal air flow from fans, etc. affect the chemical discharge? This will affect the nozzle placement and discharge direction. Place the nozzle to take advantage of the air stream. The airflow should be used to assist the dry-chemical coverage of the hazard area.

There are several system options available. There are several methods of system actuation available and two types of detection available. Each will be presented starting with the simplest and progressing to the most complex.

5-3 SYSTEM OPTIONS

5-3.1 Local Manual Actuation

The simplest system uses a lever operated, manual, mechanical actuator mounted directly on the dry-chemical cylinder and valve assembly. See Figure 5-1. This system must be discharged manually at the cylinder and thus is best suited to small (vehicle) installations.

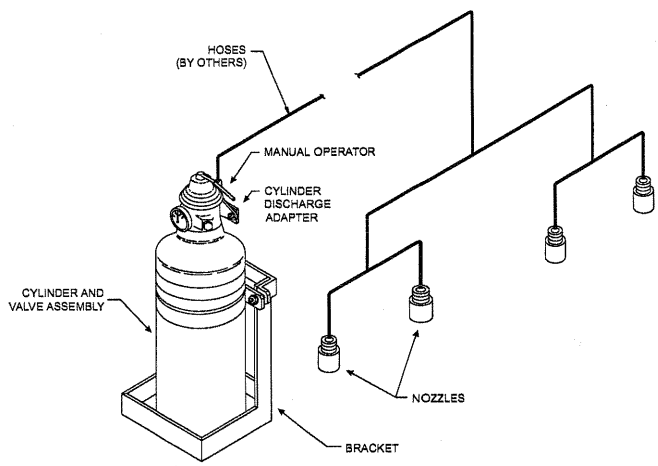

Figure 5-1. Off-road Fire Protection System With Dry-chemical Cylinder and Valve Assembly and Local Manual, Mechanical Actuation

5-3.2 Remote Manual Actuation

The next step is to add a remote mechanical actuator. See Figure 5-2. This system also has to be discharged manually, however, it can be discharged from a distance. The actuator can be located outside the vehicle.

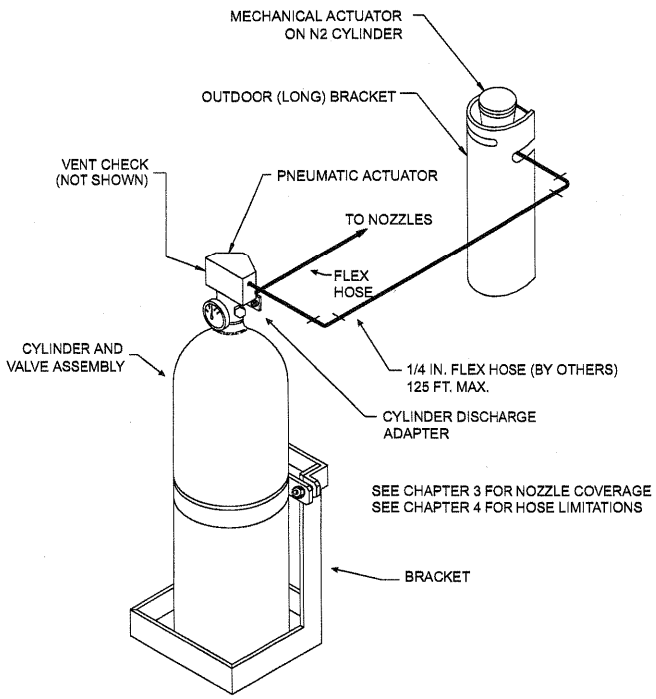

Figure 5-2. Off-Road Fire Protection System Cylinder And Valve Assembly and Remote Manual, Mechanical Actuator.

5-3.3 Detection and Automatic Actuation

The next step is to add detection and a remote, electromechanical actuator. The electromechanical actuator contains a squib cartridge (See Chapter 2 for description).

5-3.4 Thermostat Detection

The simplest detection system uses thermostat spot detectors connected directly to the squib cartridge in the actuator. The thermostat fires the squib automatically when a fire is detected. Figure 5-8 is the wiring diagram for the back of switch cover, as required in the field for use with the 24 VDC control box.

The next step upward in system sophistication is to add a 24 VDC control box. Figure 5-5 shows the system with thermostats, manual switch and 24 VDC control box.

5-4 SUMMARY OF SYSTEM DESIGN

1. Perform hazard analysis, including related factors.
2. Decide on:
   a) Number of nozzles
   b) Type of nozzles
   c) Size of cylinders
   d) No. of cylinders
   e) Type of detection, if any
   f) Number of actuators
   g) Type and number of controls

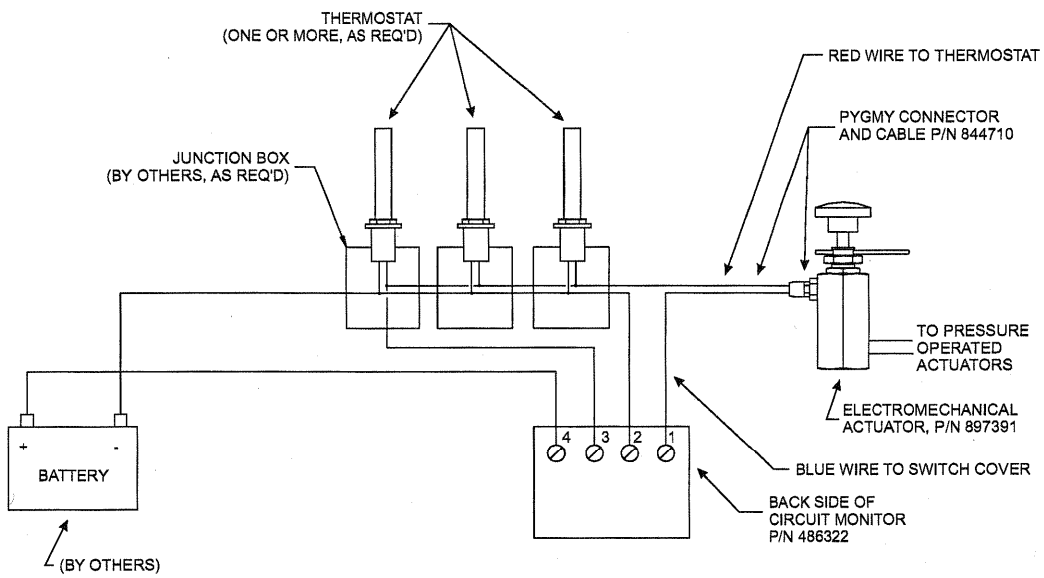

Figure 5-3. Field Wiring Diagram; Off-Road System With Thermostat and Circuit Monitor

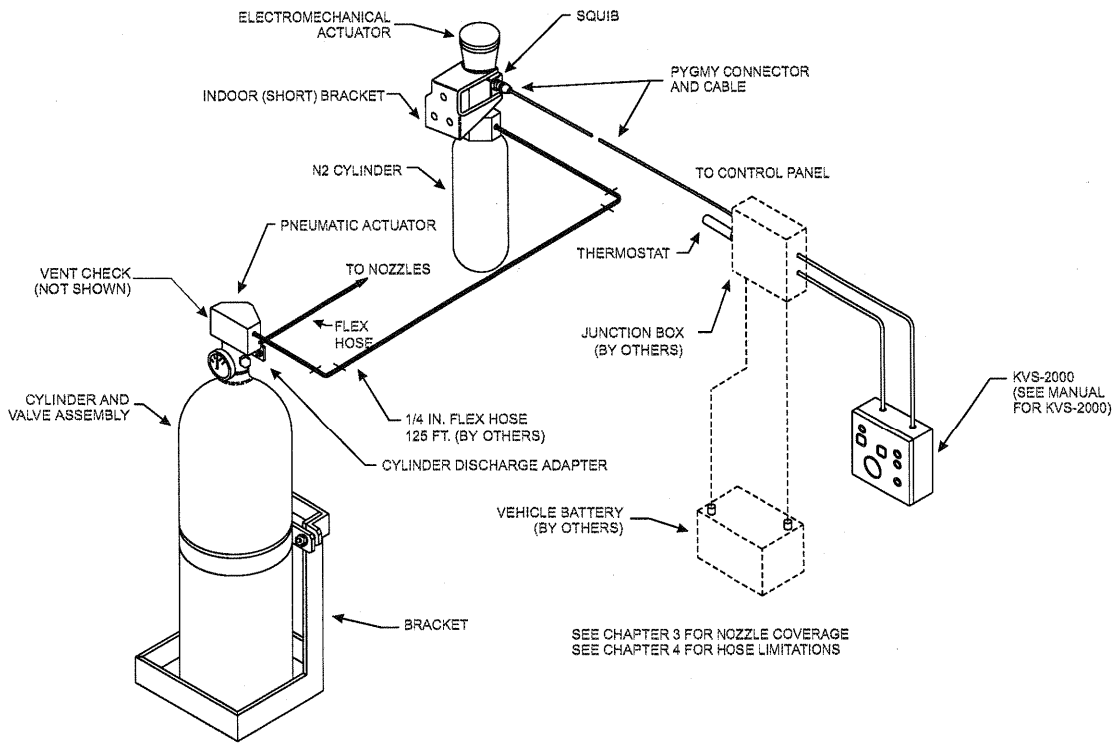

Figure 5-4. Typical Off-Road Fire Protection System With Control Panel

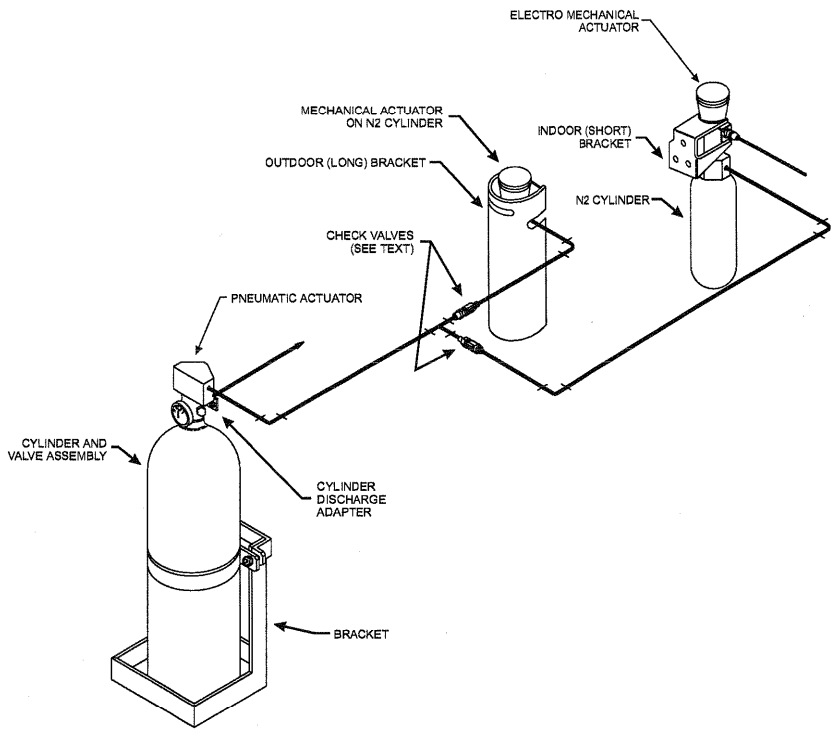

Figure 5-5. Use Of Check Valves with Multiple Actuators.

3. Plan system layout, as follows. Decide on:
   a) Position of nozzles
   b) Aiming of nozzles
   c) Location of actuators
   d) Location of dry-chemical cylinders
   e) Hose lengths
4. Lay system out on paper.

NOTE: In planning the layout, make sure there is enough room to mount each component at the desired spot and that it is readily accessible. Also, make sure that there is enough flat surface available to mount the component securely.

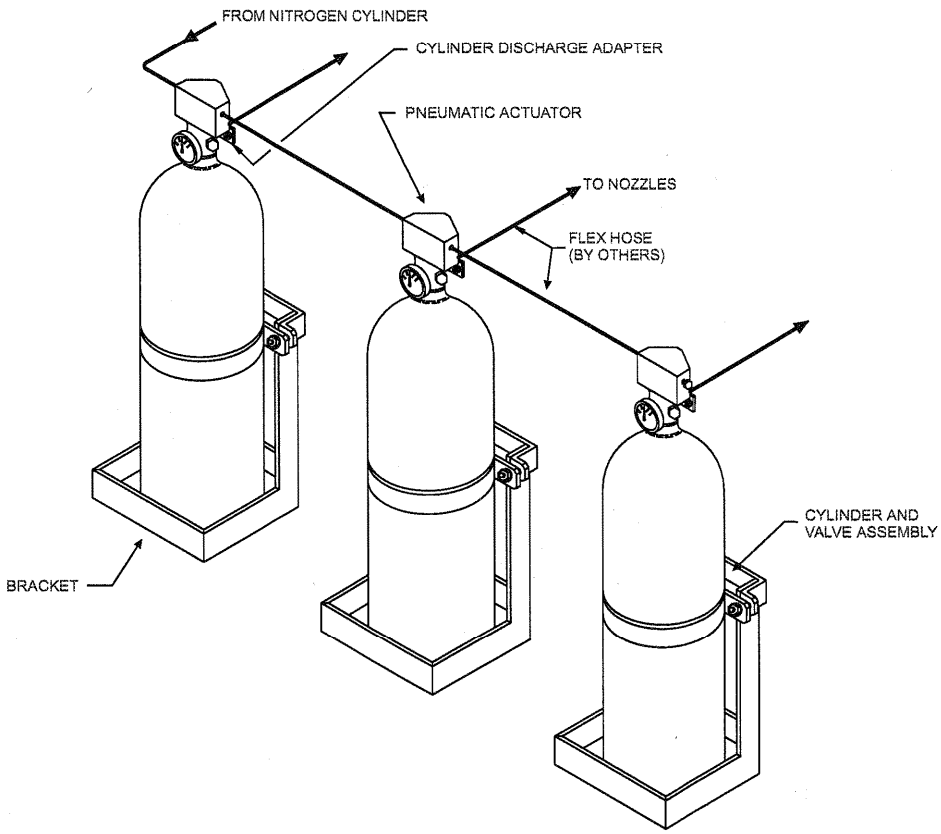

Figure 5-6. Use of Vent Check with Multiple Dry-Chemical Cylinders

Chapter 6
Installation, Assembly, and Maintenance

IMPORTANT

It is the responsibility of the company or individual installing the system to present the Owner/Operator Manual to the person responsible for the operation of the vehicle or machine.

6-1 EQUIPMENT LOCATION

6-1.1 Dry Chemical Container

The dry-chemical container must be located in a clean, dry protected area away from the hazard area.

6-1.2 Switch Box, Control Boxes

Locate the boxes in accessible convenient locations away from the hazard areas.

6-1.3 Actuators

The mechanical actuator (P/N 897392) can be located either inside or outside the vehicle in any accessible, convenient location away from hazards. The electromechanical actuator (P/N 897391) must be located inside the vehicle in a protected location.

6-2 INSTALLATION PROCEDURE

A summary of the installation procedures is given below. Detailed installation procedures for each section of the system follows.

6-2.1 Summary of Installation

1. Install brackets by bolting or welding to vehicle.
2. Assemble dry-chemical cylinders and Nitrogen actuators to their respective brackets.
3. Install distributors, connectors, and clamps.
4. Install flexible hose.
5. Blow dry air or Nitrogen through hose.
6. Install nozzles.
7. Install switch boxes and control boxes.
8. Install thermostat detectors and strip detectors (See Section 5).
9. Make electrical connections (See Section 5) except for the pygmy connector (Figure 2-1 3) to the actuating cartridge (Figure 2-1 2). This procedure is covered in Steps 10 through 13 of assembly procedures.

6-3 ATTACHMENT OF COMPONENTS TO VEHICLE

- IND cylinder brackets (Figures 2-1 and 2-2). These brackets are furnished with mounting holes. Bolt or weld brackets in place.
- Nitrogen cylinder actuator brackets (Figures 2-8 and 2-9). These brackets are furnished with mounting holes. Bolt or weld brackets in place.
- Nozzle bracket and coupling and nozzle bracket and elbow (Figures 2-19 and 2-20). These brackets are furnished with mounting holes. Bolt or weld distributor in place.
- Distributor (Figure 2-21). The distributor is furnished with mounting holes. Bolt or weld distributor in place.
- Switch box (Figure 2-25). Attach switch box to desired location with screws using mounting holes in box. Attach switch cover to junction box (See Figure 2-24).
- 24 VDC control box and thermistor strip control box (Figures 2-26 and 2-27). Attach control box to desired location with screws using mounting holes in box.
- Bracket connector and plate connector (Figures 2-39 and 2-40). These connectors are furnished with mounting holes. Bolt or weld in place.
- Hinged clamps (Figure 2-36). Weld in place.

6-4 ASSEMBLY

6-4.1 Procedure

1. Assemble IND cylinder to bracket (Figures 2-1 and 2-2).
2. Remove anti-recoil shipping plate. Assemble discharge adapter (Figure 2-29) to cylinder valve assembly (P/N 877488) using mounting screws.
3. Remove valve actuator plate. Assemble manual operator (Figure 2-3) or pneumatic actuator (Figure 2-6) to IND cylinder valve.
4. Blow hoses out to clear any obstructions.
5. Assemble hose to hose couplings or tees, elbows, couplings and distributors (Figure 2-21).
6. Screw in nozzles to hose couplings to brackets (Figures 2-19 and 2-20); cap cone nozzles (Figure 2-14) with polyethylene caps. Orient tankside nozzle (Figure 2-16) with slit over area and parallel to surface.
7. Weigh Nitrogen cartridge (Figure 2-4) with its anti-recoil cap in place. If the weight is 1/4 ounce less than the full weight stamped on the cartridge, replace cartridge.

NOTE: Remove anti-recoil cap and remove the rubber gasket from the anti-recoil cap and install it in the mechanical or electromechanical actuator and hand tighten the Nitrogen cylinder into the actuator.

8. Assemble Nitrogen cylinder to mechanical actuator (Figure 2-10) or electromechanical actuator (Figure 2-11). Remove safety cap. Insert gasket ((P/N 263413) and screw on actuator. Hand tighten.

NOTE: Nitrogen cylinder cannot be reused. Discard after operation.

8. Assemble Nitrogen cylinder and actuator assembly to bracket (Figure 2-8 or 2-9).
9. Attach vent check (Figure 2-7) to pneumatic actuator (Figure 2-6). If several pneumatic actuators are used, connect with 1/4-inch hose and install vent check in the last actuator in the series.

NOTE: Make certain the shunt wire on the electromechanical actuator cartridge (Figure 2-1 2) is installed at all times until the system pygmy connector and cable (Figure 2-13) is attached to the cartridge.

10. When pygmy connector is to be assembled, remove the protection cap from the squib cartridge on the electromechanical actuator (Figure 2-11).

⚠ WARNING

Do not remove squib cartridge from the actuator.

11. Remove the coiled safety shunt wire from inside the electrical connector end of the squib cartridge.

⚠ CAUTION

The shunt wire prevents accidental actuation of the squib. The wire is meant to carry the current from the hot pin to the ground pin rather than to energize the squib.

- **Make sure the electrical power is off before attaching the pygmy connector to the cartridge.**
- **Be careful not to damage the electrical pins of the cartridge when removing the shunt wire.**

12. Attach the pygmy connector (Figure 2-12) finger tight.

NOTE: In an electrically actuated automatic system consisting of thermostat detectors and cartridge only, no current flows through the systems for supervision. Automatic actuation, in this instance, is by one or more thermostats closing when heated to their closure temperature. The thermostats are all connected in parallel. The systems may, of course, also be manually actuated by mechanical means. In a system actuated by thermostats and electrical switches only, the thermostat wiring and squib wiring is supervised.

6-4.2 Recharging Cylinders

⚠ CAUTION

Do not attempt to recharge any cylinder with out first checking for last hydrostatic test date. The U.S. Department of Transportation (DOT) has ruled that any pressurized container of the type used in dry-chemical systems shall not be recharged or transported with out first being inspected internally and externally and hydrostatically tested if more than five (5) years have elapsed since the date of the last hydrostatic test. Regardless of previous inspection dates, it is illegal to refill any pressurized container that leaks, which bulges, has defective safety devices, bears evidence of physical abuse, fire or heat damage, or detrimental rusting or corrosion, until it is properly repaired and requalified as specified in dot regulations. Remove the valve and siphon tube assembly from the discharged cylinder.

2. Invert the cylinder and tap the threaded neck end on a wooden block to remove any residual dry chemical.
3. Blow any dry-chemical residual from the valve, siphon tube and cylinder threads.
4. Visually inspect the entire inside and outside surface of the cylinder per CGA Pamphlet C-6.

Replace the valve stem (P/N 877343), the valve spring (P/N 217768), the spring retainer (P/N 253299), the retaining ring check (P/N 1849-0004), and the valve stem O-ring (P/N 6435-0006). Put a light coating of Dow Corning No. 55M grease, or equivalent, on the valve stem O-ring. Do not grease the bonded seal on valve check. Refer to Figure 6-1 .

5. Replace the valve-to-cylinder O-ring, P/N 5661-0327.
6. Use a funnel to fill the cylinder. Fill the cylinder with the appropriate weight of either regular BC powder or multipurpose ABC powder as indicated on the cylinder nameplate. Use Kidde P/N 804904 for BC dry chemical and Kidde P/N 806411 for ABC dry chemical.

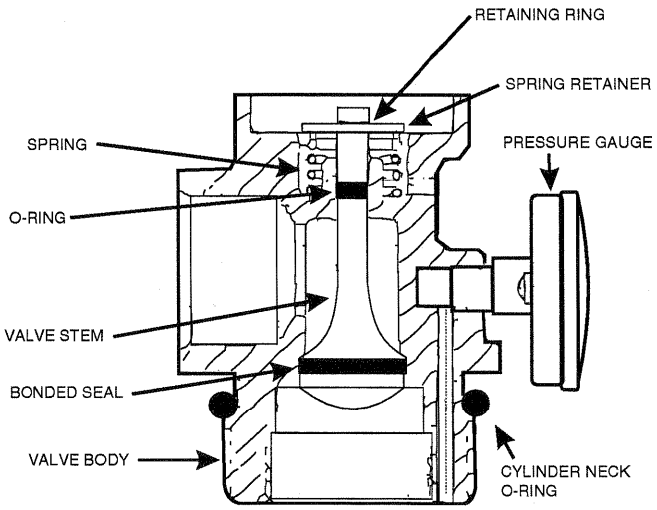

Figure 6-1. Valve Assembly

⚠ WARNING

Do not mix ABC (monoammonium phosphate base) agent with BC (sodium bicarbonate base) agent in the cylinder as excessive pressure buildup can result in the presence of moisture.

7. Reinstall the siphon tube and valve. Screw down hand-tight.
8. Install an O-ring (P/N 1080-1900) on a spare discharge adapter (P/N 844908).
9. Unbolt the anti-recoil plate and bolt the spare discharge adapter to the outlet port of the valve. Securely clamp the cylinder to a rigid structure.

⚠ WARNING

Under no circumstances while performing cylinder recharge should a charged cylinder be allowed to "free stand" without either the charging apparatus attached or the anti-recoil plate installed. Whenever these devices are not installed, a charged cylinder must be securely clamped to a rigid structure capable of withstanding the full thrust that would result should the valve inadvertently open.

10. Use nitrogen to pressurize the cylinder to 360 pounds per square inch (psig) at 70 degrees F. Use an accurate gauge.

    Do not rely on the pressure regulator or the cylinder pressure gauge to determine the container pressure.

    Refer to Figure 6-2 for a suggested recharging arrangement.
11. Remove the spare discharge adapter and check for leakage using a soap solution.
12. Bolt the anti-recoil plate, P/N 255681, to the valve outlet. Leave the protection plates in place until the cylinder is ready to be reinstalled.

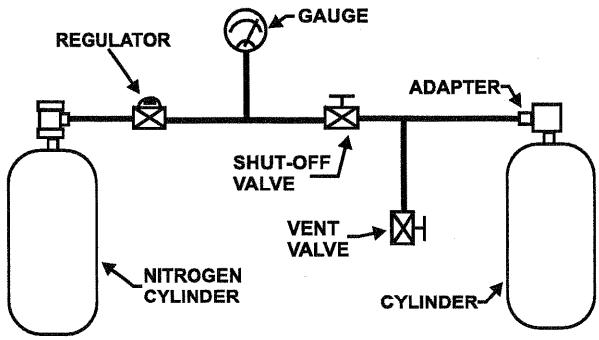

Figure 6-2. Recharge Hookup

6-5 SERVICING SYSTEM AFTER A FIRE

⚠ WARNING

Do not disturb the equipment until the system has cooled sufficiently.

6-5.1 General

1. Blow out piping system with dry air or Nitrogen.
2. Inspect all piping. Replace any hose or fitting that was exposed to direct flame or subjected to excessive heating. The heat may have melted the galvanized coating which may have clogged the pipe restricting the flow of the dry chemical.
3. Remove discharged dry chemical with water as soon as possible after discharge. Dry chemical may cause corrosion if not removed immediately.
4. Inspect all nozzles. Replace any damaged nozzles and protective caps.
5. Install cylinder following recharging procedure outlined above.

6-6 MAINTENANCE

Refer to cylinder nameplate for maintenance instructions

6-6.1 Inspection

6-6.1.1 MONTHLY

1. Check all parts of system for physical damage, rust, corrosion, e.g., piping, nozzles, cylinder(s), elbows, auxiliary equipment.
2. Check continuous strip detectors or thermostats. If they are coated with mud, grease or dirt, wipe in place with a clean dry cloth. If grease cannot be removed, the strip detectors or thermostats must be replaced with

strip or thermostats of the same rating. Check for corrosion or mechanical damage.

3. Check seal wires on the pull rings of the manual release lever and remote cable pull handle. If seal wires have been broken, check carefully to make certain that the system has not been tampered with.

Make monthly inspections to make certain that the system has not been tampered with, and that nothing has been placed where it would interfere with the operation of the system.

Any service (other than that on electric control boxes) that is required as result of monthly inspections or semi-annual inspections must be done only by a qualified factory-trained representative.

6-6.1.2 SEMI-ANNUAL

1. Check the flexible piping or hose for obstructions. Remove cylinder and valve. Blow piping out with clean dry air or Nitrogen.

⚠ WARNING

Never use water or oxygen to blow piping out. Moisture could cause corrosion, resulting in a blockage. The use of oxygen is extremely dangerous. Even a minute quantity of oil could cause an explosion if contacted by oxygen.

2. Check the cylinder for leakage. Check pressure gauge. If pressure has dropped, leakage is indicated.
3. Examine the Nitrogen cylinder (P/N 878508) for knicks and corrosion. Replace if cylinder is knicked or corroded. Unscrew the Nitrogen cylinder from actuator assembly. Install the anti-recoil cap with gasket onto the cylinder and weigh. Replace if the weight is not within 1/4 ounce of the weight stamped on the cartridge.

6-7 HYDROSTATIC TESTING

NFPA-17 states that "dry-chemical systems of less than 150 pounds normal capacity shall be hydrostatically tested at an interval not to exceed twelve years." Use test adapter (P/N 878453).

TECHNICAL MANUAL USER FEEDBACK FORM

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