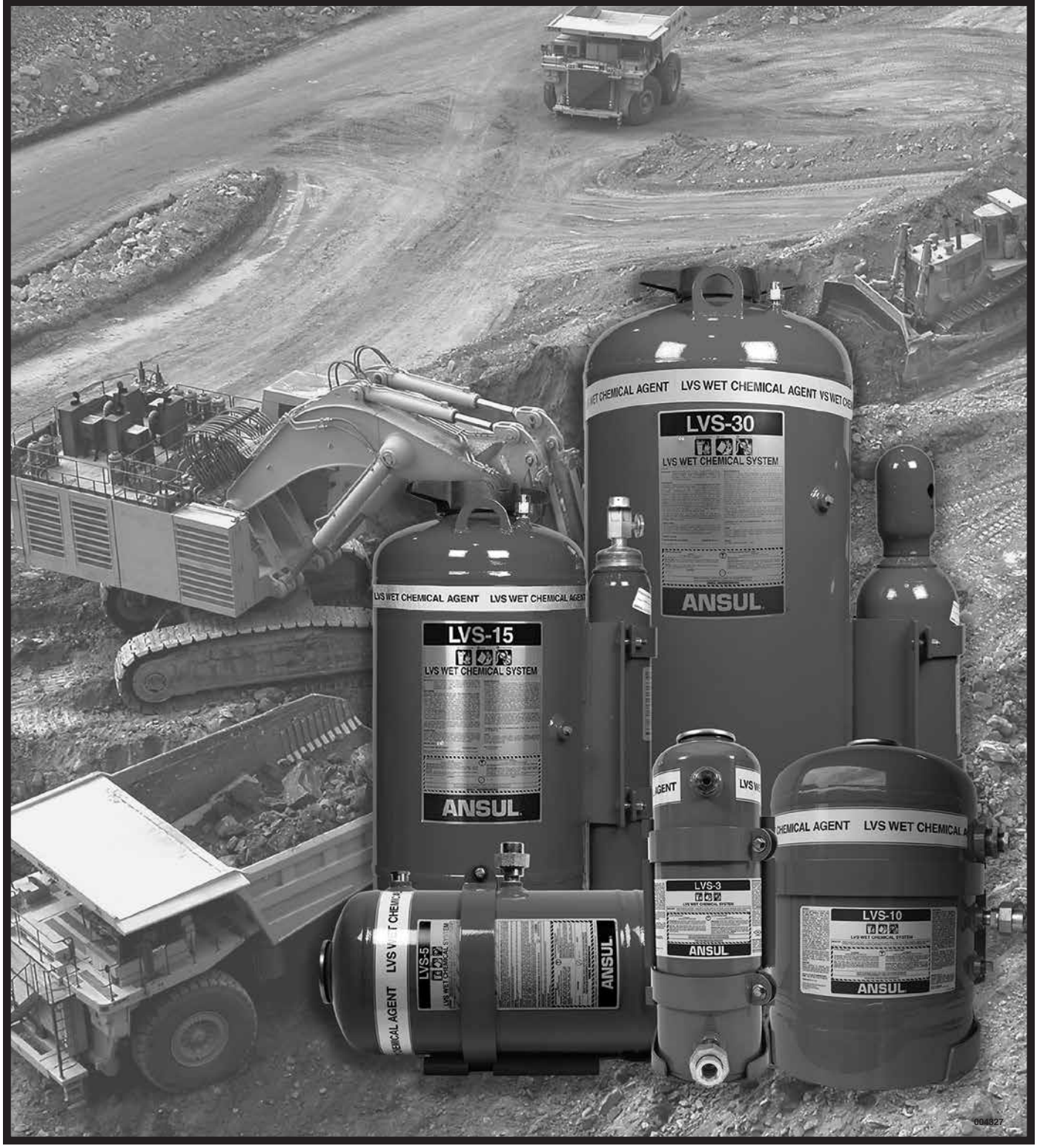
LVS LIQUID AGENT SYSTEM

ANSUL®

INSTALLATION, RECHARGE, INSPECTION, AND MAINTENANCE MANUAL



tyco Fire Protection Products

One Stanton Street / Marinette, WI 54143-2542, USA / +1-715-735-7411 / www.ansul.com

This manual is intended for use with the LVS Liquid Agent Fire Suppression System.

Those who install, operate, recharge, or maintain these fire suppression systems should read this entire manual. Specific sections will be of particular interest depending on one's responsibilities.

Design, installation, recharge, and maintenance of the system must conform to the limitations detailed in this manual and performed by an individual who attended an ANSUL training program and became trained to design, install, recharge, and maintain the ANSUL system(s).

Fire suppression systems are mechanical devices. They need periodic care to provide maximum assurance that they will operate effectively and safely. Inspection frequency shall be performed monthly, or sooner, depending on operating and/or environmental conditions. Maintenance shall be performed semi-annually or sooner, depending on operating and/or environmental conditions.

This ANSUL systems manual is limited to the uses herein described. For other applications, contact your local Authorized ANSUL Distributor, Domestic District Manager, International Area Manager, or Tyco Fire Protection Products – Technical Services Department, Marinette, Wisconsin 54143-2542.

Note: The converted metric values in this manual are provided for dimensional reference only and do not reflect an actual measurement.

Part Number: 427109-09

Date: 2015-JAN-30

⚠ DANGER

Indicates a hazardous situation in which a person ***will*** **experience serious personal injury or death** if the situation is not avoided.

⚠ WARNING

Indicates a hazardous situation in which a person ***could*** **experience serious personal injury or death** if the situation is not avoided.

⚠ CAUTION

Indicates a hazardous situation in which a person **could experience minor or moderate personal injury** if the situation is not avoided.

CAUTION

Addresses practices not related to personal injury, such as a system part malfunctioning, property damage, or system failure.

NOTICE

Addresses general practices or observations related to system function that are not related to personal injury.

DATE	PAGE	REV. NO.
2015-JAN-30	Style changes to the manual caused some technical information to be re-written, re-located or placed in bulleted lists while maintaining the same information. Only new or removed technical information is marked with a revision indicator (▸).	
2015-JAN-30	1-1	09
2015-JAN-30	2-1	09
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2015-JAN-30	3-2	09
2015-JAN-30	3-3	09
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LEGEND FOR MANUAL PAGE REVISION INDICATORS:

▸ Indicates revised information.

■ Indicates change in page sequence.

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NOTES:

INTRODUCTION

The ANSUL LVS Liquid Agent fire suppression system is a pre-engineered, fixed nozzle system for protection of on-road and off-road vehicles and equipment. The basic system includes an agent storage tank(s) containing wet chemical solution with a limited number of nozzles for each tank. The LVS system can be a stand-alone primary fire suppression system with cooling, or serve as supplemental cooling for a twin-agent design while the ANSUL A-101/LT-A-101 or LT-A-101-50/125/250 dry chemical system provides the primary fire suppression system.

LVS FIRE SUPPRESSION SYSTEM

The ANSUL LVS Liquid Agent stand-alone fire suppression system can protect the following types of equipment:

On-Road Vehicles	Off-Road Vehicles/Equipment
Public transportation	Landfill equipment
Waste management	Forestry vehicles
Over-the-road trucking	Construction equipment
Cargo transport	Mining equipment- above ground and sub-surface
Intermodal	

Specialty Vehicles

Slag carriers	Iron/steel slab carriers
Pot carriers	Tunnel boring machines

Four liquid agent actions occur to help suppress fires and secure hazard areas:

1. The wet chemical agent formulation interrupts the chemical reaction that supports combustion.
2. Because agent formulation is liquid, it flows into areas where flammable liquids also flow.
3. The agent formulation forms a film over flammable fuels, which minimizes reflash potential.
4. LVS wet chemical solution cools fuel and surrounding super-heated surface areas reducing the possibility of fire re-ignition.

TWIN-AGENT SYSTEM

The LVS twin-agent fire suppression system can protect all types of vehicles, and is recommended any time dry chemical is protecting a vehicle with one or more turbochargers. Recommended types of large equipment:

Off-road Vehicles/Equipment

Large excavators/shovels

Draglines

Haul trucks

Wheeled loaders

Specialty and Underground Mining

Slag, pot, and/or slab carriers

Tunnel boring machines

Waste management equipment

Forestry vehicles

This larger class of equipment generally incorporates greater volumes of oils, fuels, and hydraulic fluids under pressure. With a break in a large pressurized hydraulic line, fuel can spray onto many surfaces, some possibly hot enough to cause ignition. The LVS wet chemical solution may flow into areas where flammable fuels may also flow.

When the ANSUL LVS Liquid Agent fire suppression system is part of a twin-agent system, the dry chemical portion of the system is primarily responsible for quick fire knock-down and suppression. Even though the LVS wet chemical system has similar fire suppression capabilities, the wet chemical solution is primarily intended for cooling.

TESTING AND SYSTEM APPROVALS

The ANSUL LVS-3, LVS-5, LVS-10, LVS-15, and LVS-30 Liquid Agent fire suppression systems have been tested and approved by Factory Mutual Research Corporation (FM), as a pre-engineered system. FM testing incorporates the fire test apparatus and fire test requirements as outlined in the Australian Fire Test Standard, AS5062, including the extinguishment of flammable liquid pan fires with obstructions, as well as pressurized impinging flammable liquids.

Testing to verify cooling capabilities for hot surfaces is also performed. These tests require the cooling of super-heated surfaces (approximately 1100-1200 °F (593-649 °C)) below the temperature which will cause re-ignition of hydraulic and diesel fuels (approximately 850 °F (454 °C)). FM testing incorporates a time delay period prior to system actuation to simulate a time lag considered well beyond the time a detector would take to detect the fire and actuate the system. The resulting test procedures result in a more severe than expected heating of components.

System operational flow rate tests at the minimum, the average, and the maximum temperatures, with maximum and minimum hose lengths, are also required. In addition, individual component testing, such as cycle tests on all mechanical and electrical components to determine their structural integrity, corrosion testing, and shock and vibration testing is performed in accordance with UL 1254. Additional in-house fire and agent discharge tests were performed to verify application design requirements.

NOTES:

SYSTEM DESCRIPTION

The ANSUL LVS Liquid Agent Fire Suppression System is either a stand-alone fire suppression system, or a Twin-Agent System when combined with the ANSUL A-101/LT-A-101 or LT-A-101-50/125/250 Dry Chemical System. The design of the LVS Liquid Agent Fire Suppression System is for first line fire suppression and/or surface area cooling (twin-agent application) in the protected hazard areas. However, due to extreme environmental conditions (e.g. high winds, dust, build-up of environmental debris, and insufficient vehicle maintenance procedures or schedules) and/or continued contact between combustible materials and an ignition source, or due to flammable liquids flowing to unknown areas within and/or outside the vehicle, this system may not fully extinguish all fires. The system will not suppress fires that result from re-ignition once the system has been completely discharged. Alternative fire-fighting equipment will need to be available to supplement the system if re-ignition occurs or when total extinguishment is not possible.

Operating Temperature Limits

The LVS Liquid Agent Fire Suppression and Twin-Agent (LVS and Dry Chemical) System use nitrogen as the expellant gas with a temperature range of -40 °F to +140 °F (-40 °C to 60 °C)

▸ System installations requiring a “CE” marking have a tempera-
▸ ture rating of -22 °F to +140 °F (-30 °C to 60 °C)

ANSUL LVS LIQUID AGENT FIRE SUPPRESSION SYSTEM

The liquid agent is a pre-mixed proprietary solution of LVS wet chemical. The agent discharges through hydraulic
▸ hose or stainless steel tube arranged in certain straight-line configurations, depending on tank size.

▸ **LVS System Parameters* per Tank Size**

Tank	Agent Qty. gal	(L)	Max. Noz.	Avg. Noz. Discharge Time-Sec.	Single Nozzle Coverage Area ft^2	(m^2)
LVS-3	3	(11.4)	6	20	3	(0.28)
LVS-5	5	(18.9)	4	30	7	(0.65)
LVS-10	10	(37.9)	8	40	7	(0.65)
LVS-15	15	(56.8)	10	60	7	(0.65)
LVS-30	30	(113.6)	20	60	7	(0.65)

▸ *See Section 4 - System Design to review all system parameters.

TWIN-AGENT SYSTEM

The twin-agent system consists of both dry chemical and liquid agents. The dry chemical portion of the system is the ANSUL A-101/LT-A-101 or LT-A-101-50/125/250 system. The liquid
▸ agent portion of the system includes an LVS tank(s) containing a premixed solution of LVS wet chemical.

▸ The LVS system average discharge time ranges from 20 to 60 seconds determined by size of tank and number of nozzles.

▸ The dry chemical portion of the system can be a standard discharge or an extended discharge system per the requirements of the A-101/LT-A-101 Vehicle Fire Suppression Installation, Recharge, Inspection, and Maintenance Manual.

Both systems are designed to discharge simultaneously when actuated either manually or automatically.

PIPING ARRANGEMENT

DRY CHEMICAL SYSTEM – The dry chemical portion of a twin-agent system follows the guidelines as stated in the A-101/LT-A-101 Vehicle Fire Suppression Systems Installation, Recharge, Inspection, and Maintenance Manual (Part No. 24327 or Part No. 427865 (50/125/250)), with the following exceptions for an extended discharge system:

- When utilizing an LT-A-101-30 tank in a twin-agent concept
▸ for the protection of larger equipment, the piping arrangement is limited to a maximum of 4 nozzles per tank.
- A six nozzle dry chemical system with LVS could be used
▸ on small equipment.

LVS SYSTEM – The LVS system must follow the guidelines stated within this manual.

DETECTION OPTIONS

Any approved ANSUL CHECKFIRE Electric Detection and Actuation System is acceptable for use with the LVS system. Refer to appropriate CHECKFIRE Installation, Recharge, Inspection, and Maintenance Manual for detailed information.

NOTES:

LVS-3 TANK ASSEMBLY
Part No. 441774

Holds 3 gal (11.4 L) of LVS wet chemical solution.
See Figure 3-1.

- Carbon steel tank
- Tank bracket
- Vertical or horizontal mounting positions
- Expellant gas pressurizes tank and expels agent
- Separately order expellant gas components:
  - LT-30-R Nitrogen cartridge with electric-pneumatic actuator and bracket assembly (TC/DOT) Part No. 442586
  - LT-30-R Nitrogen cartridge with electric-pneumatic actuator and bracket assembly (CE version) Part No. 442587

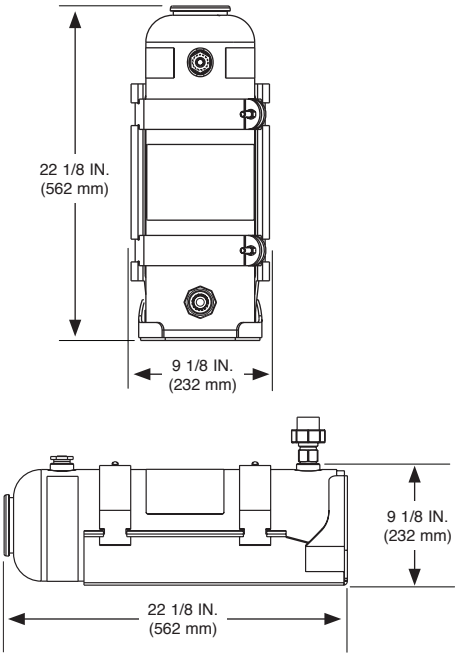


FIGURE 3-1
LVS-3 TANK ASSEMBLY
009524

LVS-5 TANK ASSEMBLY
Part No. 435876

Holds 5 gal (18.9 L) of LVS wet chemical solution.
See Figure 3-2.

- Carbon steel tank
- Tank bracket
- Vertical or horizontal mounting positions
- Expellant gas pressurizes tank and expels agent
- Separately order expellant gas components:
  - LT-A-101-30 Nitrogen cartridge with electric-pneumatic actuator and bracket assembly (TC/DOT) Part No. 24883
  - LT-A-101-30 Nitrogen cartridge with electric-pneumatic actuator and bracket assembly (CE version) Part No. 431735
- Red, corrosion-resistant paint for tank and components

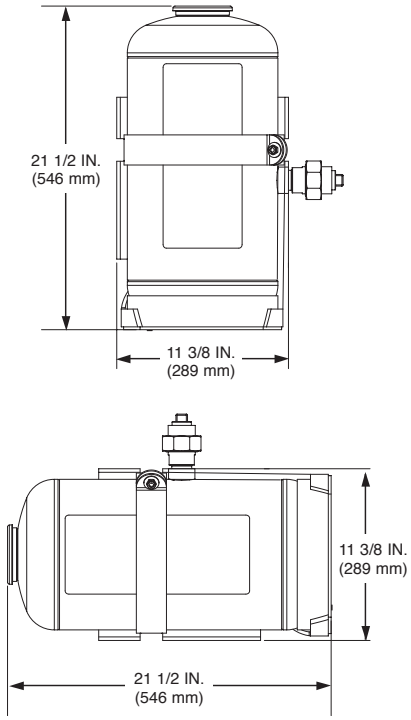


FIGURE 3-2
LVS-5 TANK ASSEMBLY
007277

LVS-10 TANK ASSEMBLY
Part No. 439361

Holds 10 gal (37.9 L) of LVS wet chemical solution. See Figure 3-3.

- Carbon steel tank
- Tank bracket
- Vertical or horizontal mounting positions
- Separate discharge outlets for vertical or horizontal position
  - Tank ships with outlets prepared for vertical mounting
  - Vertical discharge outlet includes sealed burst disk (labeled with “V” and a pictorial)
  - Horizontal discharge outlet includes 3/4 in. NPT pipe plug (labeled with “H” and a pictorial) **Note**: Switch burst disk and pipe plug when tank is horizontal.
- In horizontal position, removable expellant gas port may be used for inspection or filling
- Expellant gas pressurizes tank and expels agent
- Separately order expellant gas components:
  - LT-A-101-30 nitrogen cartridge with electric-pneumatic actuator and bracket assembly — Part No. 24883
- Red, corrosion-resistant paint for tank and components

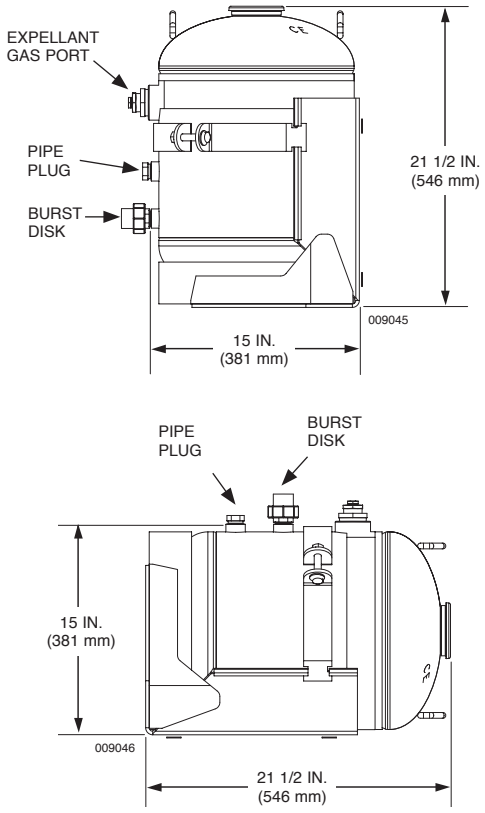


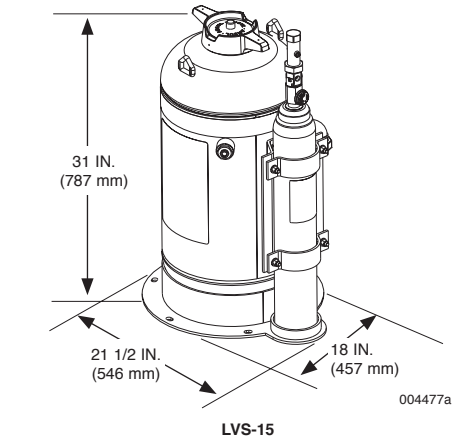
FIGURE 3-3
LVS-10 TANK ASSEMBLY

LVS-15 AND LVS-30 TANK ASSEMBLIES
Part No. See table

Holds 15 gal (56.8 L) or 30 gal (113.6 L) of LVS wet chemical solution. See Figure 3-4.

- Carbon steel tank
- Expellant gas pressurizes tank and expels agent
- Includes integral nitrogen cartridge with electric-pneumatic actuator for expellant gas
- Red, corrosion-resistant paint for tank and components

Part Number	LVS Tank	Quantity gal	(L)
438775	LVS-15	15	(56.8)
438838	LVS-15 (CE version)	15	(56.8)
438821	LVS-30	30	(113.6)
438839	LVS-30 (CE version)	30	(113.6)



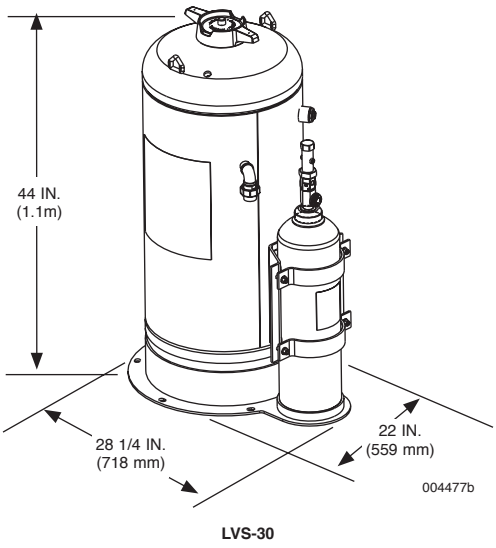


FIGURE 3-4
LVS-15 AND LVS-30 TANK ASSEMBLIES

LT-A-101-125/250 DRY CHEMICAL TANK ASSEMBLY
Part No. See table

Factory filled with FORAY dry chemical for use with the twin-agent system. See Figure 3-5.

All sizes of ANSUL dry chemical tanks can be used with the twin-agent system; refer to specific manuals (latest revision) for detailed guidelines on tank sizes and design requirements.

LT-A-101-10/20/30 Manual (Part No. 24327)

LT-A-101-50/125/250 Manual (Part No. 427865)

- Nameplate with recharge and maintenance information
- Manufactured with seismic mounting ring - bolt or weld to surface
- Optional mounting ring
- Includes proper size nitrogen cartridge for expellant gas
- Expellant gas pressurizes tank and expels agent
- Red, corrosion-resistant paint for tank and components

Part No.	LVS Tank	Quantity lb (kg)
427745	LT-A-101-125	112 (50.8)
434378	LT-A-101-125 (CE version)	112 (50.8)
427746	LT-A-101-250	225 (102.1)
434379	LT-A-101-250 (CE version)	225 (102.1)

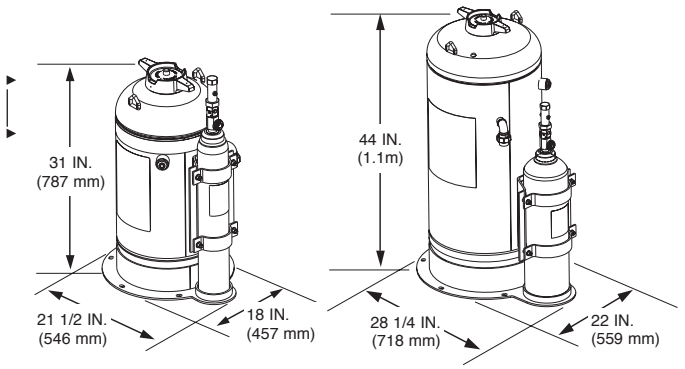


FIGURE 3-5
LT-A-101-125/250 TANK ASSEMBLY
004477a/b

LVS-3 TANK BRACKET
Part No. 442056

Retains agent tank from movement or damage. See Figure 3-6.

- Heavy gauge steel back/bottom plate, and clamp arms
- Rubber pads minimize shock and vibration effect on tank
- Red, corrosion-resistant paint

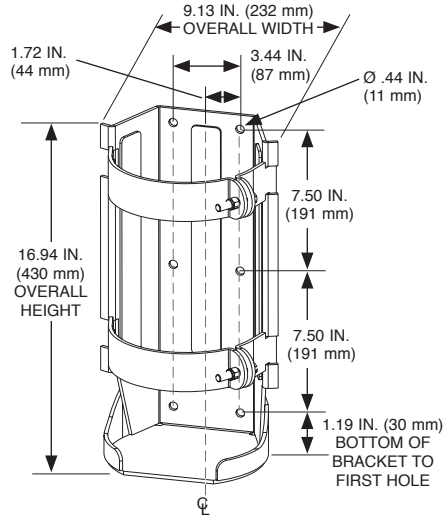


FIGURE 3-6
LVS-3 TANK BRACKET
009525

LT-A-101-50 / LVS-5 TANK BRACKET
Part No. 433685

Retains agent tank from movement or damage. See Figure 3-7.

- Heavy gauge steel back/bottom plate, and clamp arms
- Rubber pads minimize shock and vibration effect on tank
- Red, corrosion-resistant paint

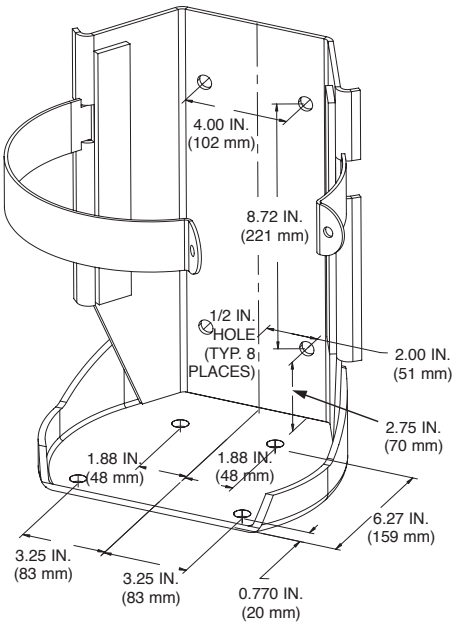


FIGURE 3-7
LT-A-101-50 / LVS-5 TANK BRACKET
007278

LVS-10 TANK BRACKET
Part No. 439710

Retains agent tank from movement or damage. See Figure 3-8.

- Heavy gauge steel back/bottom plate, and clamp arms
- Rubber pads minimize shock and vibration effect on tank
- Red, corrosion-resistant paint

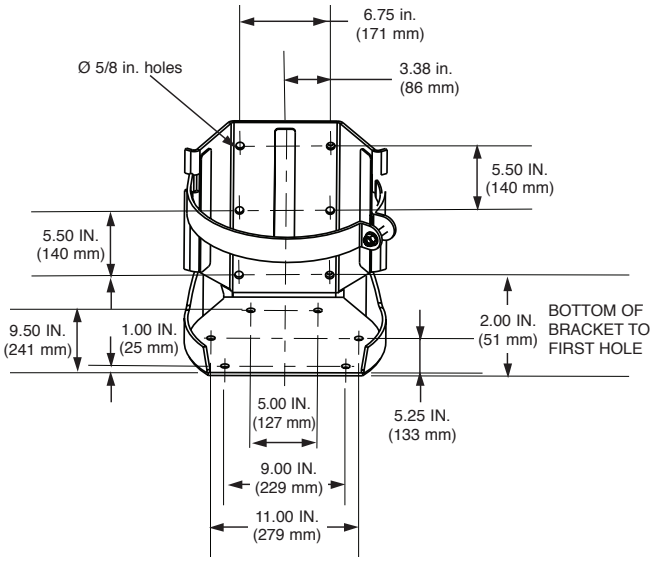


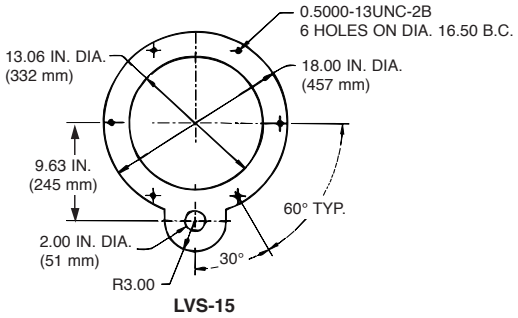
FIGURE 3-8
LVS-10 TANK BRACKET
009047

MOUNTING RING (LVS-15 or LVS-30)
Part No. See table

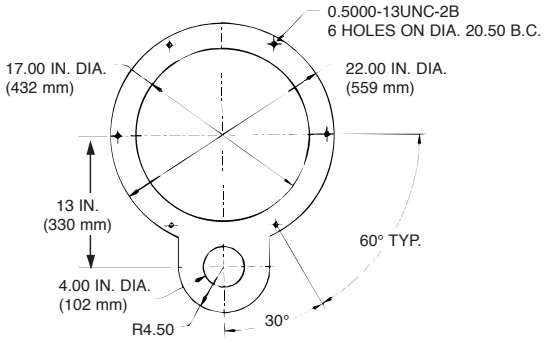
Facilitates tank mounting. See Figure 3-9.

- Threaded holes match holes on tank seismic ring base
- Constructed of 1/2 in. (13 mm) steel
- Can be pre-welded to mounting surface and tank bolted to ring during installation
- Bolts and washers supplied by others
- Use six 1/2 in. x 1 in. (25 mm) long bolts with flat washer and lock washer on each bolt

Part No.	Tank Mounting Ring
428404	LVS-15
428405	LVS-30



LVS-15



LVS-30

FIGURE 3-9
MOUNTING RINGS
004698

LVS WET CHEMICAL
Part No. See table

Provides fire suppression for LVS system. See Figure 3-10.

- Unique blend of organic and inorganic salts, coupled with surface active agents
- Provides a strong measure of freeze protection along with foaming properties similar to conventional Class A and B liquid agents
- Store in original containers within temperature range of –60 °F to 140 °F (–51 ° to 60 °C)
- ▸ Shelf life may exceed 20 years when stored in original plastic container

Part No.	Quantity gal	(L)
▸441775	3	(11.4)
426961	5	(18.9)

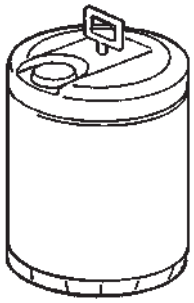


FIGURE 3-10
LVS WET CHEMICAL
004330

EXPELLANT GAS NITROGEN CARTRIDGE
Part No. See table

Provides expellant gas for LVS wet chemical. See Figure 3-11.

- ▸ Electric-pneumatic actuator mounts on top of cartridge
- Securely bracket to agent tanks

Part No.	Nitrogen (N_2) Cartridges and Assemblies	N_2 Quantity ft^3	(m^3)
▸442586	LT-30-R N_2 Cartridge (TC/DOT) Bracket, and Electric-Pneumatic Actuator - For LVS-3, order separately	3	(0.9)
442587	LT-30-R N_2 Cartridge (CE version) Bracket, and Electric-Pneumatic Actuator - For LVS-3, order separately	3	(0.9)
423435	LT-30-R N_2 Cartridge (TC/DOT) Replacement: LVS-3	3	(0.9)
428441	LT-30-R N_2 Cartridge (CE version) Replacement: LVS-3	3	(0.9)
24883	LT-A-101-30 N_2 Cartridge (TC/DOT) Brkt. and Elec.-Pneumatic Actuator For LVS-5 and LVS-10, order separately	8	(0.23)
431735	LT-A-101-30 N_2 Cartridge (CE version) Brkt. and Elec.-Pneumatic Actuator For LVS-5 and LVS-10, order separately	8	(0.23)
423491	LT-A-101-30 N_2 Cartridge (TC/DOT) Replacement: LVS-5 or LVS-10	8	(0.23)
▸428442	LT-A-101-30 N_2 Cartridge (CE version) Replacement: LVS-5 or LVS-10	8	(0.23)
428060	LT-A-101-125/LVS-15 N_2 Cartridge (TC/DOT/CE) Replacement: LVS-15	23	(0.7)
428061	LT-A-101-250/LVS-30 N_2 Cartridge (TC/DOT/CE) Replacement: LVS-30	55	(1.6)

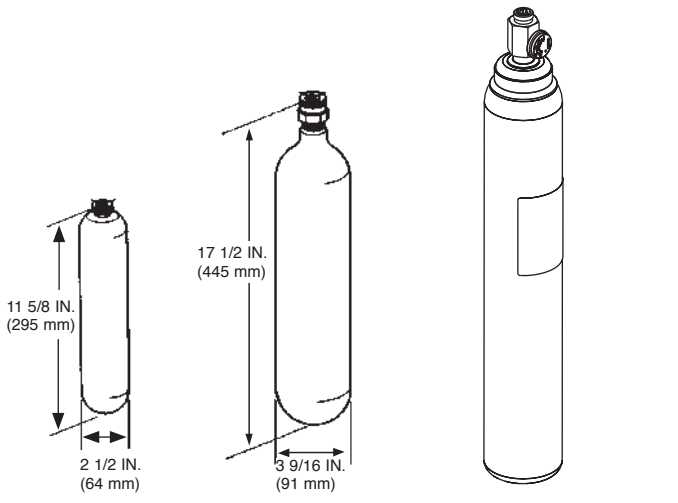


FIGURE 3-11
NITROGEN CARTRIDGES

LT-30-R CARTRIDGE BRACKET
Part No. 24325

Secures nitrogen expellant gas cartridge for LVS-3 agent storage tanks - order separately. See Figure 3-12

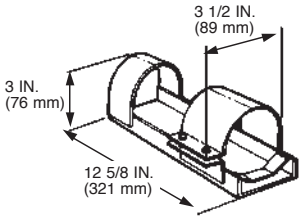


FIGURE 3-12
LT-30-R CARTRIDGE BRACKET
003470

LT-A-101-30 CARTRIDGE BRACKET ASSEMBLY
Part No. 24883

Secures nitrogen expellant gas cartridge for LVS-5 and LVS-10 agent storage tanks - order separately.

- Cartridge bracket assembly includes the following parts:
  - Cartridge bracket Part No. 29193
  - LT-A-101-30 cartridge Part No. 423491
  - Electric-pneumatic actuator Part No. 439569

LT-A-101-30 CARTRIDGE BRACKET
Part No. 29193

Protects and secures LT-A-101-30 cartridge (Part No. 423491) and electric-pneumatic actuator (Part No. 439569). See Figure 3-13.

- Heavy gauge steel plate, and clamp arm
- Red, corrosion-resistant (CR) paint
- Included with LT-A-101-30 cartridge bracket assembly (Part No. 24883)

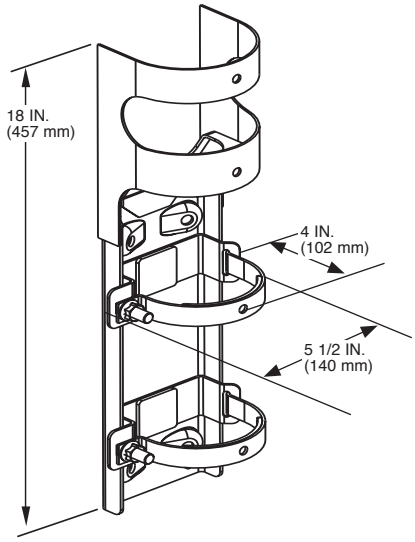


FIGURE 3-13
LT-A-101-30 CARTRIDGE BRACKET
009527

ELECTRIC-PNEUMATIC ACTUATOR
Part No. 439569

Installs on agent tank expellant gas cartridge and provides release of gas into agent tank. See Figure 3-14.

- Brass and stainless steel construction
- Includes preventor to reduce possibility of installing actuator with puncture pin not completely retracted

NOTICE

Do not bend or remove the preventor; it is required for correct operation of the actuator.

- Activate with electric and/or pneumatic connections
- Punctures seal in cartridge allowing expellant gas to flow into agent tank
- 1/4 in. rubber hose connects expellant gas side of the actuator to pressure inlet port of the LVS tank

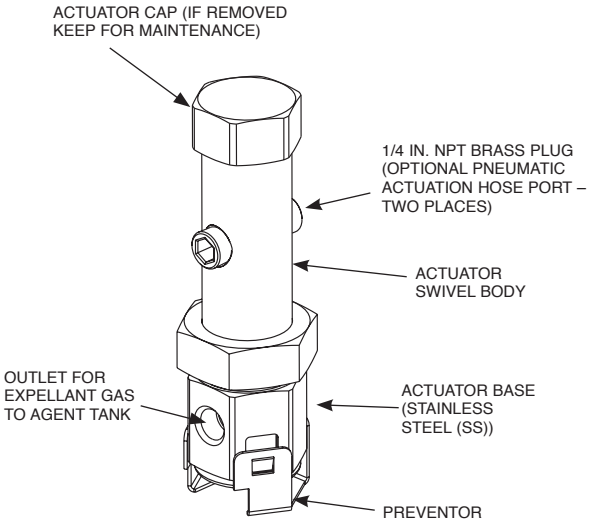


FIGURE 3-14
ELECTRIC-PNEUMATIC ACTUATOR
009528

MANUAL ACTUATORS AND BRACKETS
Part No. See table and Section 9 - Component Index for actuator packages

Provides activation of fire suppression system; typically accessible from ground level and/or in a path of operator egress. See Figure 3-15.

Note: If system design includes an Electric Manual Actuator (Part No. 439400) and Electric Manual Actuator Bracket (Part No. 440537), refer to the following manuals (latest revision) for detailed information on these components.

CHECKFIRE 110 System Manual (Part No. 440391)

CHECKFIRE 210 System Manual (Part No. 440392)

- Select either right or left hand cartridges
- Two styles available:
  - Standard with either “S” type or “L” type bracket
  - Cartridge guard type

Part No.	Description
57452	Actuator for right-hand cartridges
70581	Actuator for left-hand cartridges
70580	“L” Bracket
57661	“S” Bracket

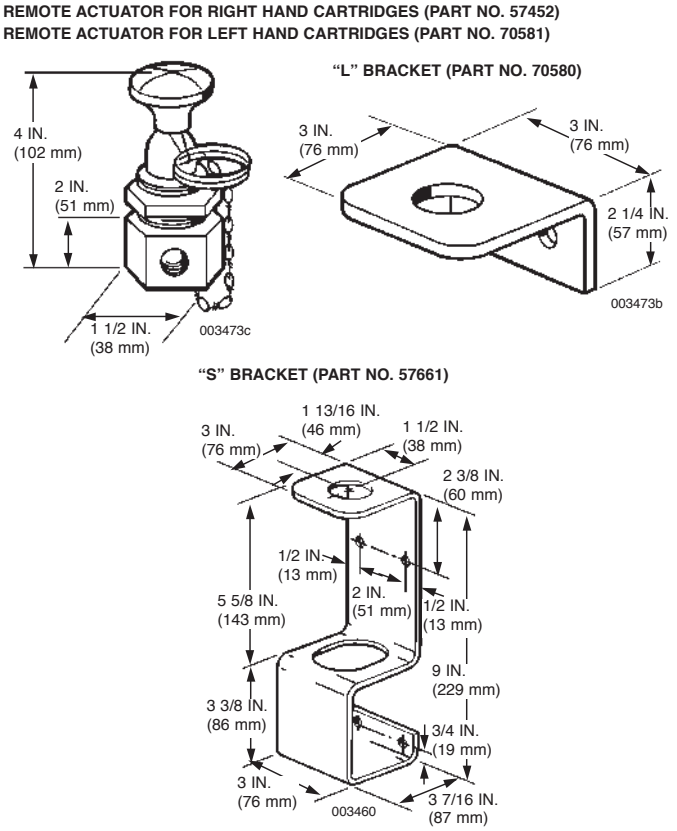


FIGURE 3-15
MANUAL ACTUATORS

LT-10 CARTRIDGE – ACTUATION GAS
Part No. See table

Contains nitrogen as the actuation gas to open the expellant gas cartridges for the LVS fire suppression system. See Figure 3-16.

When the cartridge seal is punctured by the pin in the remote manual or electric-pneumatic actuator, gas flows to the actuator on the expellant gas cartridge, causing that actuator to puncture the seal in the expellant gas cartridge.

- Sealed pressure vessel containing gas under pressure
- Meets requirements of DOT 3E-1800

Part No.	Description
13193	LT-10-R, Right-hand thread (DOT)
423423	LT-10-R, Right-hand thread (TC/DOT)
13177	LT-10-L, Left-hand thread (DOT)
423425	LT-10-L, Left-hand thread (TC/DOT)

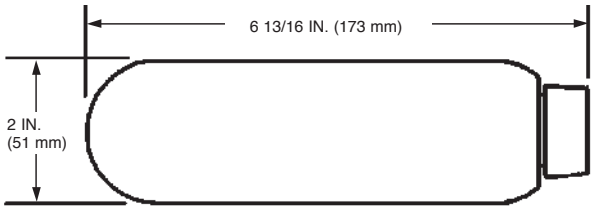


FIGURE 3-16
LT-10 CARTRIDGE
000439

▸ **1/4 IN. ACTUATION LINE CHECK VALVE**
Part No. 25627

Use at branch lines to each actuation device (whether manual or automatic). See Figure 3-17.

- Blocks flow of actuation gas from the actuator that was actuated to the actuator(s) that was not actuated.
- Prevents actuation gas from escaping from an open actuator which may have had the cartridge removed.
- Keeps gas from pressurizing all branch actuation lines thus allowing main line to be of maximum length

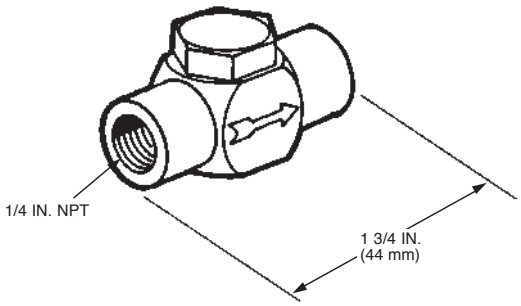


FIGURE 3-17
1/4 IN. CHECK VALVE
000899

▸ **SAFETY VENT RELIEF VALVE**
Part No. 15677

Prevents excessive pressure from building up in actuation line. See Figure 3-18.

- Spring-loaded valve
- Set to relieve at 265 psi (18.3 bar)
- Pull ring on safety relief valve after system discharge to relieve pressure in actuation line

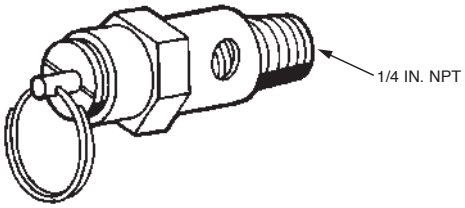


FIGURE 3-18
SAFETY RELIEF VALVE
000437

▸ **LABEL**
Part No. 440802

Instructs vehicle/equipment operators and service personnel on system operation. See Figure 3-24.

Install this label next to every actuator.

FIGURE 3-24
INSTRUCTION LABEL
009324

▸

REDUCING TEE - DISTRIBUTION LINE
Part No. 4655

Splits distribution network at end of the 3/4 in. supply line connected to LVS-15 outlet, or use after 3/4 in. tee to split both secondary supply lines when using LVS-30 tank. See Figure 3-19.

- 1/2 in. x 1/2 in. x 3/4 in. NPT
- Available as a two-pack (Part No. 53040)

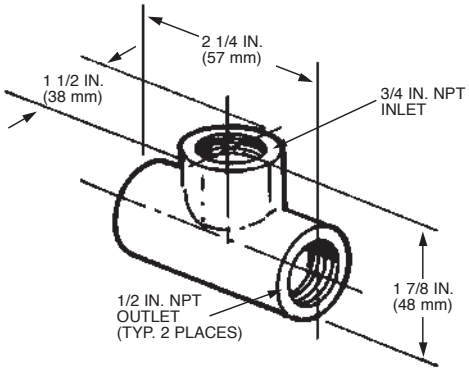


FIGURE 3-19
REDUCING TEE
003456

"QUIK-SEAL" ADAPTOR
Part No. See table

The "Quik-Seal" adaptor is a listed mechanical bulkhead fitting that produces a liquid-tight seal around both distribution and actuation piping. See Figure 3-20. The "Quik-Seal" adaptor accepts threaded pipe. The adaptor is available in packages of 24. When using with EMT conduit, a conduit connector must be installed in each end of the adaptor. Use the listed part numbers to order the "Quik-Seal" Adaptor Shipping Assembly:

Shipping Assembly Part No.	Size	Qty.	Hole Size Required
78196	1/4 in.	24	3/4 in.
77285	3/8 in.	24	1 1/8 in.
77287	1/2 in.	24	1 1/8 in.
77289	3/4 in.	24	1 3/8 in.

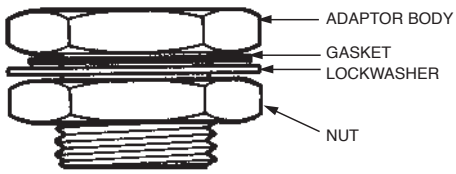


FIGURE 3-20
"QUIK-SEAL" ADAPTOR
000154

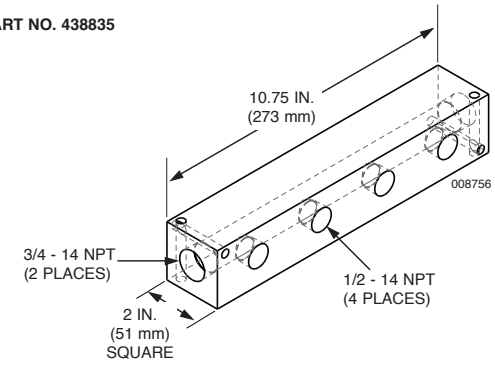
DISTRIBUTION MANIFOLD BLOCK
Part No. See table

Simplifies agent distribution hose installation. See Figure 3-20.

- Use with LVS-3, LVS-5, LVS-10, LVS-15, and LVS-30 systems
- Constructed of mild steel and painted with red corrosion-resistant (CR) paint
- Female 3/4 in. NPT supply line inlet at each end of block and four female 1/2 in. NPT distribution outlets
- Install by welding or bolting
- Bolts and washers supplied by others
- Use two 5/16 in. bolts with a flat washer and a lock washer on each bolt

Part No.	Description
438835	Four female 1/2 in. NPT distribution outlets on one side of block
438834	Two female 1/2 in. NPT distribution outlets on each side of block

PART NO. 438835



PART NO. 438834

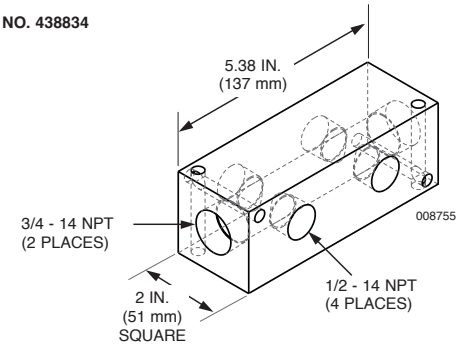


FIGURE 3-20
DISTRIBUTION MANIFOLD BLOCKS

LVS-9.5 NOZZLE
Part No. See table

Provides discharge of fire suppression agent into the hazard area. See Figure 3-21.

- Non-aspirating full cone agent discharge nozzle
- Brass with a 1/2 in. NPT male thread
- 45° angled discharge coverage is 3 ft^2 (0.27 m^2) (20 3/4 in. x 20 3/4 in.) at a range of 2 ft to 4 ft (0.3 m to 1.2 m) for LVS-3
- 45° angled discharge coverage is 7 ft^2 (0.65 m^2) (31 3/4 in. x 31 3/4 in.) at a range of 2 ft to 4 ft (0.3 m to 1.2 m) for LVS-5, LVS-10, LVS-15, and LVS-30

LVS System Parameters* per Tank Size

Tank	Agent Qty. gal (L)	Max. No. Noz.	Avg. Noz. Discharge Time-Sec.	Single Nozzle Coverage Area ft^2 (m^2)
LVS-3	3 (11.4)	6	20	3 (0.28)
LVS-5	5 (18.9)	4	30	7 (0.65)
LVS-10	10 (37.9)	8	40	7 (0.65)
LVS-15	15 (56.8)	10	60	7 (0.65)
LVS-30	30 (113.6)	20	60	7 (0.65)

*See Section 4 - System Design to review all system parameters.

Part No.	Description
433294	Single nozzle with blow-off cap
433325	Shipping assembly with 1 nozzle, 2 lock-washers, 1 “L” shaped bracket, and 1 rubber blow-off cap
439049	Shipping assembly with 4 nozzles, 8 lock-washers, 4 “L” shaped brackets, and 4 rubber blow-off caps

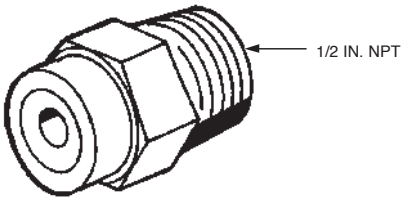


FIGURE 3-21
LVS-9.5 NOZZLE
004333

BLOW-OFF CAP (PACK OF 50)
Part No. 433303

The Nozzle Blow-Off Cap, Shipping Assembly (Part No. 434403) consists of 50 blow-off caps (Part No. 433303).

NOZZLE BRACKETS
Part No. See table

Secures nozzle to approved mounting location. See Figure 3-22.

- Unpainted 1/4 in. (6.4 mm) steel
- Contain pre-punched mounting holes for nozzle

Part No.	Description
427149	“L”-shaped bracket shipping assembly, 2 in. x 3 in. (51 mm x 76 mm)
427228	Straight bracket (in packs of 4), 5 in. x 2 in. (127 mm x 51 mm)

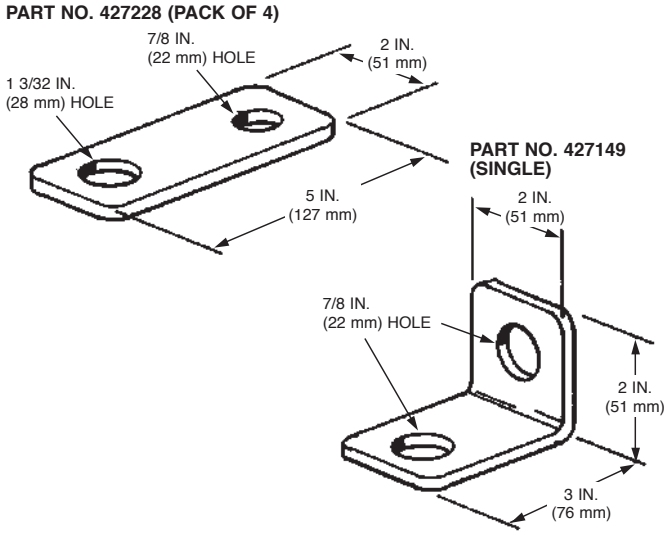


FIGURE 3-22
NOZZLE BRACKETS
004334

HOSE AND TUBING (SUPPLIED BY OTHERS)

To help assure proper performance of the LVS system, the hose used must meet SAE 100 R5 or 100 R1 (minimum) hose specification. Stainless steel tube shall meet Seemless Tube ATM A213 or ASME SA 213, 316L tubing specification. Refer to Section 4 - System Design for detailed specifications.

Alternate color jacketed hose, meeting the above specifications, is available from various hose manufacturers. It may be desirable to use this hose to distinguish dry chemical and wet chemical discharge hoses from other vehicle hoses.

SEALED BURST DISC ASSEMBLY
Part No. 428271

Ruptures when proper expellant gas pressure is built up within agent tank allowing agent into the distribution lines. See Figure 3-23.

- Machined brass housing containing an integral stainless steel burst disc
- Male 3/4 in. NPT threads at tank end and 1.7-11 NS threads at exit end
- Included with agent tank shipping assembly
- After tank discharge, complete burst disc assembly must be removed, discarded, and replaced with a new assembly
- Available in a 15 pack (Part No. 428363)

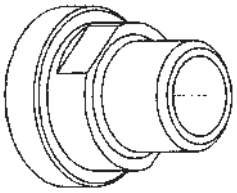


FIGURE 3-23
SEALED BURST DISC ASSEMBLY
004793

PRESSURE SWITCH

If using a pressure switch, refer to the following manuals (latest revision) for detailed instructions.

CHECKFIRE 110 System Manual	(Part No. 440391)
CHECKFIRE 210 System Manual	(Part No. 440392)
CHECKFIRE SC-N Electric System	(Part No. 423522)

VEHICLE SYSTEM PRESSURE SWITCH
FOR USE WITH ALL SYSTEMS
Part No. 440090

Provides auxiliary functions (i.e., equipment shutdown, turning on notification appliances, or providing "Pressure Switch Feedback" to a vehicle control panel). See Figure 3-24.

- One integral cable, sealed to switch housing
- Manually resettable 3-conductor (NO/C/NC) SPDT switch
- Rated for 6A with 12/36 VDC nominal
- Includes Pressure Switch Connector Kit (Part No. 440086) to ensure adequate weatherproofing of all electrical connections
- Includes 1/4 in. brass tee and nipple

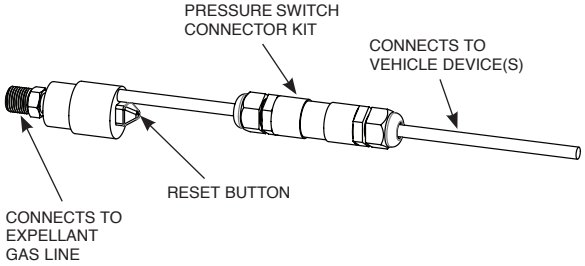


FIGURE 3-24
PRESSURE SWITCH CONNECTIONS
009536

Install switch in expellant gas actuation line using a 1/4 in. tee at the inlet port on the agent tank. Make certain to protect switch and connections from potential damage.

⚠ CAUTION

The location of the Discharge Pressure Switch must be at the expellant gas inlet port of the agent tank. Failure to comply may result in damage to the switch and cause the switch to not function properly.

DISCHARGE PRESSURE SWITCH ASSEMBLY
ONLY FOR USE WITH CHECKFIRE 210 SYSTEM
PART NO. 440389

Provides pressure switch feedback to the ICM through Detection Circuit #2. See Figure 3-25.

- One integral cable, sealed to switch housing
- Manually resettable SPDT switch
- Rated for 6A with 12/36 VDC nominal
- Temperature range: – 40 °F to 175 °F (– 40 °C to 79 °C)
- Includes 1/4 in. brass tee and nipple

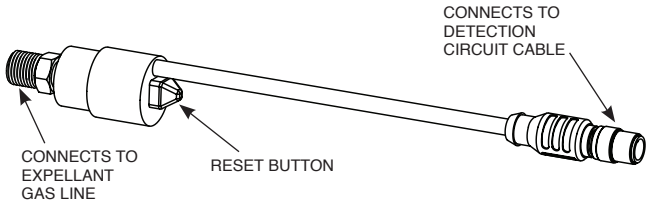


FIGURE 3-25
DISCHARGE PRESSURE SWITCH CONNECTIONS
009537

Install switch in expellant gas line next to agent tank inlet port. Make certain to protect switch and connections from potential damage.

⚠ CAUTION

Locate pressure switch next to agent tank at end of expellant gas line. Failure to comply will cause pressure switch to not function properly.

CHECKFIRE ELECTRIC DETECTION AND ACTUATION SYSTEM

CHECKFIRE 110 and 210 Detection and Actuation Systems offer supervised electronic detection and actuation. The detection circuit incorporates electronic manual activation and the release circuit provides supervised actuation to the expellant gas cartridge. Both systems have an internal reserve power feature along with external power capabilities. Refer to the following manuals (latest revision) for detailed instructions.

CHECKFIRE 110 System Manual (Part No. 440391)

CHECKFIRE 210 System Manual (Part No. 440392)

CHECKFIRE Electric SC-N, and CHECKFIRE Electric MP-N offer electric/pneumatic systems consisting of detection wiring, control module, actuator with nitrogen cartridge, mounting bracket, and squib (SC-N) or gas motor (MP-N). The CHECKFIRE SC-N and MP-N contain internal Lithium batteries as the power source.

Shutdown and auxiliary alarm functions can also be accomplished using internal relays within the CHECKFIRE SC-N or MP-N controller. Relays are available with a normally open/normally closed set of contacts rated for 3A 30VDC resistive.

System Temperature Ratings:

CHECKFIRE 110 System:	–40 °F	to	140 °F
(Manual Part No. 440391)	(–40 °C	to	60 °C)
CHECKFIRE 210 System:	–40 °F	to	185 °F
(Manual Part No. 440392)	(–40 °C	to	85 °C)
CHECKFIRE Series SC-N:	–40 °F	to	140 °F
(Manual Part No. 423522)	(–40 °C	to	60 °C)
CHECKFIRE Series MP-N:	32 °F	to	120 °F
(Manual Part No. 427310)	(0 °C	to	49 °C)

NOTES:

HAZARD ANALYSIS

Individuals responsible for the design of an ANSUL LVS Liquid Agent fire suppression system must be trained and hold a current ANSUL certificate in an A-101/LVS training program. Knowledge of potential fire hazard areas that can exist in the equipment to be protected is also required. In addition, understanding federal and/or local fire protection codes and standards is necessary. **No one should begin designing an LVS Liquid Agent fire suppression system without a thorough understanding of the system, its operation, and its capabilities, as well as becoming familiar with the equipment to be protected, and its operation and service procedures, as well as any applicable code requirements.**

The first phase of any design process requires an in-depth hazard analysis and risk assessment of the equipment to be protected. A properly completed hazard analysis should result in the identification of all potential fire hazards on or within the equipment to be protected, as well as the level of risk for each. The level of risk will impact the choice of fire suppression system options, as well as detection options. In addition, consider any heated vehicle components that may require cooling below temperatures having the potential for flammable fuel fire reflash.

Assessing the level of risk for each potential hazard may vary from vehicle to vehicle. A typical process generally includes:

1. Identifying the facets of the fire potential (e.g. What may happen and why? When, where, and how can it happen?) (Refer to “Hazards” in this section)
2. Determining the likelihood of a fire and its consequences
3. Prioritizing the risk levels of each identified potential fire hazard

Every foreseeable hazard should be identified now while the design is flexible; once the system is installed, adding protection for another hazard becomes more difficult. Note that the LVS system is designed to cool and/or protect vehicle equipment and/or hazard areas that are identified at the time of hazard analysis. This includes vehicle equipment and/or fire hazard areas specified by the designer as foreseeable hazards that are particular to the equipment and its operation, as well as the general environmental conditions it is intended to operate in. The protected areas are fixed at installation and are limited in number.

NOTICE

An LVS wet chemical system used as a stand-alone system or in combination with an A-101/LT-A-101 dry chemical system as a twin-agent system, does not remove the need for one or more hand portable extinguishers on the equipment.

Fuel leaks or spills, or contact with high heat or flammable environmental debris, welding (repair), heat or other unforeseeable causes may result in fires not having LVS or twin-agent protection. An LVS system or twin-agent system protects areas with high likelihood of fire and potential for damage; seldom would an LVS or twin-agent system protect every square inch of the equipment to be protected.

The final system design must consider all potential ignition and fuel source areas, as well as super-heated surfaces that exceed temperatures which can cause re-ignition of hydraulic and diesel fuels (approximately 850 °F (454 °C)). This means a pre-installation in-depth analysis of all likely areas of probable fire incident must be performed, as well as a thorough identification of all vehicle component areas that can become heated to highly elevated temperatures under normal operational conditions.

Hazards (Fire Suppression)

An effective LVS system design is based on a thorough hazard analysis. A hazard analysis of the equipment to be protected should determine which components and/or fire hazard areas would require protection. A hazard analysis should also determine any other areas not commonly considered hazardous that potentially could be considered hazard areas requiring protection. Fire hazard areas exist when a fuel source can directly or indirectly come in contact with an ignition source. This may be due to the close proximity of the fuel source to the ignition source or due to the configuration of the machine that may allow running or spraying fuel to come in contact with an ignition source.

Operator safety is a primary concern when designing a fire suppression system. In many cases operator egress may be difficult due to machine size and configuration, as well as the location and severity of a fire. Operator egress time and operator safety must be considered when designing the final system. Safe operator egress options in the event of a fire should be identified by the safety manager, owner, or operator and discussed between them and the LVS system designer. In some situations, an LVS only system may need to use a larger tank size(s) or fewer nozzles per tank(s) to extend the wet chemical discharge time, providing longer hazard area protection, and minimizing potential harm due to fire during operator egress. When designing for a twin-agent system, refer to the LT-A-101-10/20/30 Installation, Recharge, and Maintenance manual (Part No. 24327, latest revision) for instruction regarding dry chemical extended discharge and twin-agent design information.

Fire is a chemical chain reaction that is made up of heat, fuel, and oxygen. A fire hazard area can be any place where these three elements of fire can be combined to support combustion. Because oxygen is always present in off-road vehicle fire protection applications, identifying fuel and heat sources is most critical during the hazard analysis to assist in determining potential fire hazard areas.

HAZARD ANALYSIS (Continued)

Hazards (Fire Suppression) (Continued)

Fuel Sources. Some common fuel sources found in vehicles may include, but are not limited to: flammable liquids, such as various oils, gasoline or diesel fuel, hydraulic fluid, braking fluid, coolants and lubricants. And in certain vehicles, combustible gases, such as, LPG, methane, propane, and hydrogen may be utilized. In addition, rubber, plastics, upholstery, and environmental debris such as wood chips, bark, coal dust, and refuse may serve as fuel sources.

Where there is dripping or leaking fuel, or accumulations of flammable material debris, the hazard(s) may become even more dangerous than initially considered. In addition, spraying atomized fuels from high pressure sources such as, hoses, tube connections, or fittings not only present an immediate hazard area where the breach is located, but can also encompass other hazard areas, or even previously considered non-hazard areas, that may not be in the immediate location of the breach.

Heat Sources. Common vehicle heat sources include, but are not limited to: engine turbo-chargers, engine blocks, exhaust manifolds, exhaust systems including, mufflers and connecting components, heat exchangers, brakes, pumps, transmissions and transfer cases, torque converters, bearings, gears, and electrical equipment. A potential fire hazard exists when a flammable fuel source comes in contact with any heat source.

Identifying all potential fire hazard areas and determining their risks may be too complex to be fully understood by the designer alone. Consulting with authorized machine dealers, experienced operators, vehicle maintenance personnel, or the owner of the equipment or similar equipment can help in determining locations that may not be readily identified as hazardous or not normally considered as common fire hazards. In addition, details and locations of previous fire scenarios(s) should also be discussed. When possible, contact the insurance underwriter for additional details.

The following are typical vehicle fire hazard areas and conditions that require consideration:

Engine Compartment – The engine compartment contains an assortment of flammable fluids, fuels, oils, and greases, as well as congested wires, hoses, and accumulated debris, all generally in close proximity to high heat components that can be sources of ignition. In addition, the engine is generally tightly packed with various equipment and machine options that may result in obstructions that need to be considered in the fire suppression system design phase.

Battery Compartments – Battery compartments are a potential fire hazard, especially when debris can build up on the top of the battery and become wet, which can result in a direct short circuit of the battery(s). Open battery compartment should always be considered as needing protection. In some underground mining applications, enclosed battery compartments are required by code to be protected.

Brakes, Travel Clutches – Excessive friction due to overuse of braking mechanisms or a parking brake inadvertently left engaged, can become an ignition source. Brake fluids or flammable debris that can come in contact with over-heated braking materials or enclosures, or over-heated clutching mechanisms may have the potential for fire ignition.

Transmissions, Torque Converters, Transfer Cases – All these components are a possible high heat source, especially after continuous usage and wear, that could cause ignition to combustible material(s).

Generators, Alternators, Motors, and other Electrical Equipment – Electrical generating equipment, switching mechanisms, retarders, transformers, electrical contact and connecting devices, and electrical motors can all be sources of heat generation, especially when worn insulating materials, corroded or oxidized contacts, or moisture is present.

Pumps (Hydraulic, Fuel, Power Steering, Braking, and others) – Pumps can become over-heated and can be a source of ignition of some fuels. In addition, high pressure generation, especially from hydraulic pumps, can result in severe fire hazard conditions, when a hose or line leak or a ruptured connection, allows high pressurized and atomized fuel to spray onto heated component surfaces or into fire hazard areas,

High Pressure Hoses, Tubing, Connections – Hot atomized fluid or fuel spraying from a ruptured high pressure hose, tube, or fitting, or leaking form a loose flange or fitting could find its way to a source of ignition. If this occurs, fire can result in that location, as well as any other locations where the burning and spraying fuel may also be discharging into or impinging on including the source of the rupture.

Hydraulic, Fuel, Brake, or Steering Control Valves, Manifolds, Storage tanks, and others – Protection of these devices/components also need consideration. Flammable liquid storage tanks contain fill ports and distribution connections that could leak and provide a fuel source that could come into contact with a high heated surface, or result in fatigue during a fire that could contribute additional fuel to the fire. Control valves and hydraulic hose banks or manifolds may have several high pressurized connections that could become weakened during normal usage or become compromised in a fire, adding to its severity.

Vehicle Belly Pans or Horizontal Surfaces in Fire Hazard Areas – Belly pans are generally utilized to protect the engine and/or drive train from damage. However, they also present areas that can accumulate flammable debris and dripping and leaking flammable fuels that can contribute to a fire. Horizontal plating or other surfaces can also be areas of accumulated debris. Areas that accumulate materials that can result in Class A fires may need additional LVS wet chemical to soak and penetrate the debris when deep seated fire conditions are possible.

Simultaneous Fire Protection vs. Zoned Fire Protection – Most off-road vehicle construction designs/configurations do not lend themselves to zoned (separate) fire suppression systems, especially with high pressurized flammable liquids utilized. A fire originating in one hazard area requires the fire suppression system to be discharged simultaneously throughout all other areas that the fire can propagate to (either directly or indirectly). In some vehicles, there may be separately confined areas that will not allow fire propagation from one area to another. In those areas, separate protection zones may be considered.

HAZARD ANALYSIS (Continued)

Hazards (Fire Suppression) (Continued)

Material Properties – Consideration should be made regarding properties of fuels and material(s) utilized for various components in off-road vehicles. Flammability, quantity, storage, and distribution of flammable fuels need to be considered. In addition, properties of materials used in the various components and equipment on vehicles must also be considered. Material properties can change over time, due to continual usage, or due to the vehicles operating environment, with the potential of causing deterioration, resulting in an increased fire risk.

Air Movement – Air movement and thermal draft in the event of a fire can impact fire detection as well as fire suppression effectiveness and should be discussed with maintenance personnel and considered in the design process. Air handling equipment, cooling fans, blowers, etc. should be shutdown once a fire is detected. Some flammable fuel cooling fans may take several seconds before air movement is controlled. Air movement throughout the vehicle must be considered when choosing fire suppression options, locations for agent discharge nozzles and their aiming directions, and detection choices and placement. Air movement under normal vehicle operation can compliment a fire detection system by reducing detection lag time with properly positioned detectors. But, it can also negatively impact detection time if detection is not positioned properly.

Operational Conditions – Operational conditions can impact both the fire suppression system and the detection system, and can also increase fire risk. The following include, but are not limited to, conditions that may impact fire risk or fire suppression and detection:

1. Inadequate vehicle cleaning and/or maintenance procedures or frequencies
2. Maintenance practices (e.g. welding, cutting torches, grinding, use of incorrect or non-approved materials, and inappropriate modifications)
3. Impact on operating environment (e.g. forestry, landfill, and underground mining)

   Note: Potential for property damage outside the vehicle may warrant additional protection and/or delayed or non-allowed vehicle shutdown options.
4. Operating environmental conditions (e.g. temperatures, corrosivity, moisture, ground conditions, and flammable debris buildup)
5. Operator misuse/human error (e.g. service braking instead of dynamic braking, parking brakes left on, vehicle wear, leakage, or damage not reported, operator inexperience, and inappropriate vehicle operation)
6. Refueling and lubrication systems or procedures
7. Continuous component usage, wear, and deterioration

Hazards (Cooling)

The following super-heated equipment surface areas should be considered when designing for cooling vehicle equipment below re-ignition temperatures for flammable fuels. Super-heated equipment surface areas exist when a flammable liquid or other fuel source can come in contact with an equipment surface area that remains at or above flammable liquid or other fuel source ignition temperatures (approximately 850 °F (454 °C) for hydraulic fluid and diesel oil) at the end of a fire suppression system discharge. This may be due to the close proximity of the flammable liquid or other fuel source to the super-heated equipment surface(s) or due to the configuration of the machine that may allow running, dripping, or spraying flammable liquids to come in contact with a super-heated equipment surface(s).

A hazard analysis of the equipment is required to determine which vehicle equipment components would require cooling to minimize reflash potential. A hazard analysis should also determine any other areas not listed below that potentially could be considered super-heated equipment surface areas requiring design consideration for cooling.

1. Engine – The engine consists of various components that contain or transfer fuels, components involved with lubrication, and electrical contacts and controls as well as several components that generate heat. Surface cooling may include but is not limited to the following components:
   - Exhaust manifolds
   - Exhaust systems including mufflers
   - Turbochargers
   - Heat exchangers
   - Engine block
   - Electrical equipment, such as starters, generators, alternators, etc. (de-energized)
2. Hydraulic pump(s)
3. Brakes
4. Bearings
5. Travel clutches
6. Large electrical generators and motors (de-energized)
7. Class A collection area hazards

Note: All areas that can become superheated during machine operation, to temperatures close to or in excess of 850 °F (454 °C), should be considered for cooling. These areas may include, but are not limited to, the areas or components specified above.

Hand Portable Fire Extinguishers

Depending on the size and configuration of the vehicle, the protection designed must also include at least two 20 lb ABC ▸ RED LINE Cartridge-Operated hand portable fire extinguishers; located on board the vehicle for manually suppressing residual fire(s) or to help provide an escape route.

HAZARD ANALYSIS (Continued)

Other Design Considerations

- Tank size should be considered when designing. Tank size can impact location due to a number of factors:
  - Weight may impact vehicle structural integrity. Mounting plates or fabricated support structures may be needed to minimize weight impact, or several smaller tanks may be needed to distribute the weight over a larger area or several areas.
  - Height may impact potential locations where a shorter tank can fit, or it may be an obstruction to machine operation or the operator's vision.
  - Tank diameter may also impact machine access for the operator or maintenance personnel. An adequate tank location that cannot accommodate a larger diameter tank may allow multiple tanks with a lesser diameter.
  - Tank bracket mounting may allow tanks to be installed to a vertical surface, while the larger LVS-15 and LVS-30 tanks require a horizontal mounting surface.
  - The LVS-3, LVS-5 and LVS-10 can be mounted horizontally, which may allow for areas not available with other tank models.
  - Nozzle groupings and distribution tee choices and locations should also be considered when designing. This will minimize hose/tube required in the distribution system without compromising protection.
  - The number of nozzles in a hazard area may be difficult to balance, especially in a dry chemical portion of a system if they do not correspond to the distribution tee choices in that area.
  - Additional nozzles, changes in nozzle types, and/or nozzle relocation may be needed.
- An automatic detection and actuation system utilizing a CHECKFIRE Detection and Actuation system is strongly recommended (required when providing protection for mid-size and large hydraulic excavators). See "Section 10 – Hydraulic Excavator Fire Protection – Additional Protection Schemes" for additional information.
- Consideration should also be made when designing an LVS or twin-agent system to provide for the following automatic functions (required when providing protection for mid-size and large hydraulic excavators):
  - Engine and/or electrical power shutdown
  - Pressurized hydraulic tank and fuel tank venting, if possible
  - Fuel shutoff
- An LVS or twin-agent system should consider utilizing a Remote High Level Alarm (Part No. 79559) as well as an Alarm Strobe (Part No. 419208). Both are required with mid-size and large hydraulic excavators. See "Section 10 – Hydraulic Excavator Fire Protection – Additional Protection Schemes" for additional information.
- As part of the total fire suppression system package, training for personnel and machine operators should be conducted and documented.
- A maintenance contract allowing periodic service and maintenance at scheduled intervals should be included.
- When the LVS wet agent system is used in conjunction with a dry chemical system (twin-agent concept), the dry chemical system can be designed as either a standard discharge system or an extended discharge system. See appropriate A-101 manual for twin-agent design information.

WET CHEMICAL NOZZLE COVERAGE

The LVS system allows a maximum number of LVS-9.5 nozzles for each tank, depending on the application.

Tank	Agent Qty. gal	(L)	Max. Noz.	Avg. Noz. Discharge Time-Sec.	Single Nozzle Coverage Area ft²	(m²)
LVS-3	3	(11.4)	6	20	3	(0.28)
LVS-5	5	(18.9)	4	30	7	(0.65)
LVS-10	10	(37.9)	8	40	7	(0.65)
LVS-15	15	(56.8)	10	60	7	(0.65)
LVS-30	30	(113.6)	20	60	7	(0.65)

LVS-9.5 Nozzle Coverage of Hazard Surface Area — Fire Suppression

The 9.5 Nozzle discharges agent in an approximate 45° discharge pattern. Nozzles must be positioned to discharge agent directly onto the hazard surface area, with little or no obstructions to interfere with the discharge of the agent.

In-house nozzle application testing has shown that the following areas require direct agent discharge:

1. Areas that can result in discharge, collection, or pooling of flammable liquids, or areas that will allow flammable liquids to flow down, through, or across.
2. Areas or surfaces to be cooled below temperatures that could result in ignition of flammable liquid fuels (e.g. diesel and hydraulic fuel).
3. Areas or surfaces that can collect debris, which could result in Class A surface or deep seated fires.

Foamy LVS liquid, discharged from one or more nozzles, flowing over flammable liquids or across hazard areas or surfaces, also has fire suppression characteristics.

Performance testing under severe fire conditions, utilizing a test apparatus in accordance with Fire Test Standard AS5062, resulted in repeatable fire extinguishment with the following test results.

WET CHEMICAL NOZZLE COVERAGE (Continued)

LVS-9.5 Nozzle Coverage of Hazard Surface Area — Fire Suppression (Continued)

SQUARE COVERAGE

When the hazard surface area is within the allowable area constraints of the square (square to slightly rectangular), a single 9.5 nozzle can be placed anywhere within the shaded area and aimed at the center of the hazard surface area. See Figure 4-1. Make sure the nozzle is within the range of 2 ft to 4 ft. (0.6 m to 1.2 m) from the center of the hazard surface area.

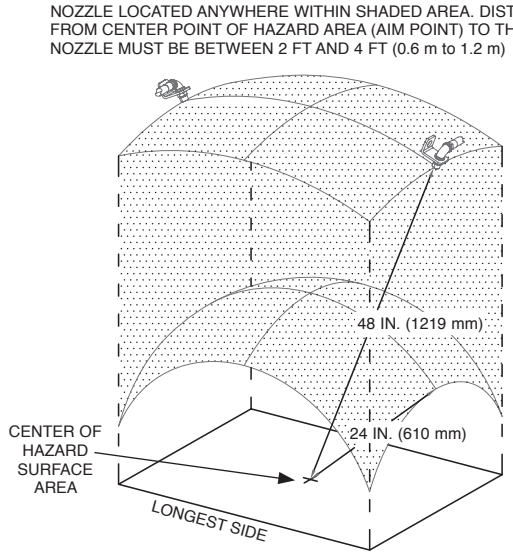


FIGURE 4-1
SQUARE COVERAGE
009551

For the LVS-3 tank, the 9.5 nozzle can protect a square to slightly rectangular area of 3 ft^2 (0.28 m^2) with the longest side not to exceed 24 in. (610 mm). See Table 4-1.

For the LVS-5, LVS-10, LVS-15, or LVS-30 tanks, the 9.5 nozzle can protect a square to slightly rectangular area of 7 ft^2 (0.65 m^2) with the longest side not to exceed 36 in. (914 mm). See Table 4-1.

TABLE 4-1:
SQUARE COVERAGE PER NOZZLE

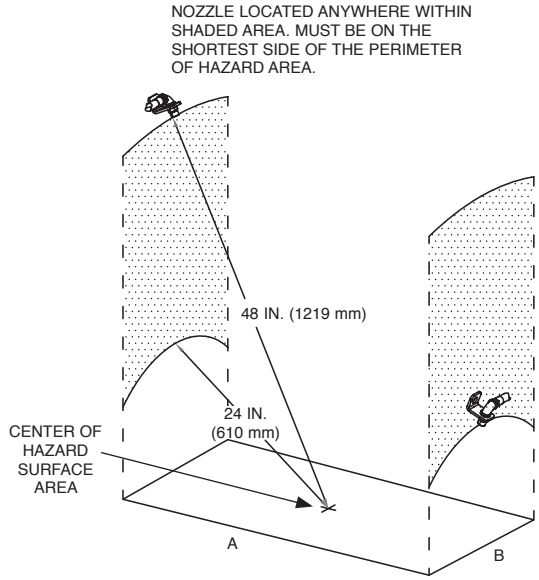
Tank	Hazard Surface Area	Nozzle Range*
LVS-3	3.0 ft^2 (0.28 m^2) From a 20 3/4 in. x 20 3/4 in. (527 mm x 527 mm) square to a 18 in. x 24 in. (457 mm x 609 mm) rectangle.	2 ft to 4 ft (0.6 m to 1.2 m)
LVS-5 LVS-10 LVS-15 LVS-30	7.0 ft^2 (0.65 m^2) From a 31 3/4 in. x 31 3/4 in. (806 mm x 806 mm) square to a 28 in. x 36 in. (711 mm x 914 mm) rectangle.	2 ft to 4 ft (0.6 m to 1.2 m)

*Range is measured from center of coverage area to nozzle.

RECTANGULAR COVERAGE

When a longer side coverage is required, apply the hazard surface area coverage limits of the rectangular coverage for a single 9.5 nozzle. Make sure the nozzle is within the range of 2 ft to 4 ft. (0.6 m to 1.2 m) from the center of the hazard surface area.

The 9.5 nozzle must be placed along either short side of the rectangular single nozzle area, anywhere within the shaded area and aimed at the center of the hazard surface area. See Figure 4-2.



Tank	Dimension A Longest Side – (Min. / Max. Values)	Dimension B (Matching Short Side)
LVS-3	> 24 in. (610 mm) 28 in. (711 mm)	18 in. (457 mm) 15.5 in. (394 mm)
LVS-5, LVS-10 LVS-15, LVS-30	> 36 in. (914 mm) 42 in (1067 mm)	28 in. (711 mm) 24 in. (610 mm)

FIGURE 4-2
RECTANGULAR COVERAGE
009553

WET CHEMICAL NOZZLE COVERAGE (Continued)

LVS-9.5 Nozzle Coverage of Hazard Surface Area — Fire Suppression (Continued)

RECTANGULAR COVERAGE (Continued)

For the LVS-3 tank, the 9.5 nozzle can protect a rectangular area of 3 ft^2 (0.28 m^2) with the longest side greater than 24 in. (609 mm) up to a maximum of 28 in. (711 mm). See Table 4-2.

For the LVS-5, LVS-10, LVS-15, or LVS-30 tanks, the 9.5 nozzle can protect a rectangular area of 7 ft^2 (0.65 m^2) with the longest side greater than 36 in. (914 mm) up to a maximum of 42 in. (1067 mm). See Table 4-2.

TABLE 4-2:
RECTANGULAR COVERAGE PER NOZZLE

Tank	Hazard Surface Area	Nozzle Range*
LVS-3	3.0 ft^2 (0.28 m^2) Longest side greater than 24 in. to 28 in. (610 mm to 711 mm)	2 ft to 4 ft (0.6 m to 1.2 m)
LVS-5 LVS-10 LVS-15 LVS-30	7.0 ft^2 (0.65 m^2) Longest side greater than 36 in. to 42 in. (914 mm to 1067 mm)	2 ft to 4 ft (0.6 m to 1.2 m)

*Range is measured from center of coverage area to nozzle.

SPLIT COVERAGE

The 9.5 nozzle can also split the Rectangular Coverage (see Table 4-2) across two adjoining hazard surface areas that are within 270º from each other. The nozzle must be positioned to discharge at the corner of the adjoining surfaces, and aimed from a point that is close to an equal split of the angle between the two adjoining surfaces (maximum of 135º angle from nozzle to each surface). Make sure the nozzle is within the range of 2 ft to 4 ft. (0.6 m to 1.2 m) from the corner of the hazard surface area. See Figure 4-3.

When using the LVS-3 tank, the 9.5 nozzle can protect a total combined surface area of 3 ft^2 (0.28 m^2) within the limits specified in Table 4-2: Rectangular Coverage. The longest side limit is evenly split at the corner edge (closest point to the nozzle), with each half of the discharge covering each adjoining side. For example, a longest side of 28 in. (711 mm) is split to 14 in. (355 mm) for each surface area and the “width” is 15.5 in. (394 mm). See Figure 4-3.

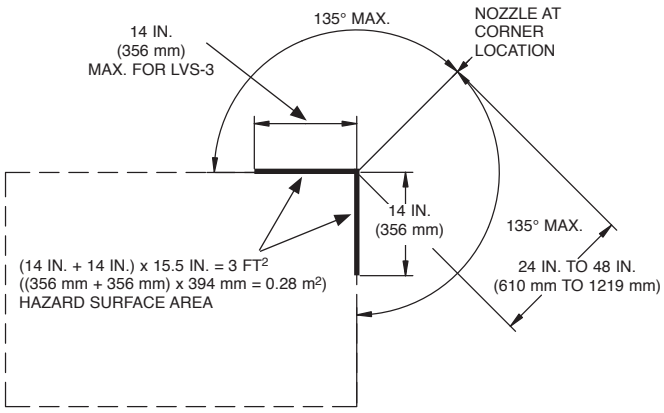


FIGURE 4-3
LVS-3 SPLIT COVERAGE
009554

When using the LVS-5, LVS-10, LVS-15, or LVS-30 tanks, the 9.5 nozzle can protect a total combined surface area of 7 ft^2 (0.65 m^2) within the limits specified in Table 4-2: Rectangular Coverage. The longest side limit is evenly split at the corner edge (closest point to the nozzle), with each half of the discharge covering each adjoining side. For example, a longest side of 42 in. (1067 mm) is split to 21 in. (533 mm) for each surface area and the “width” is 24 in. (610 mm). See Figure 4-4.

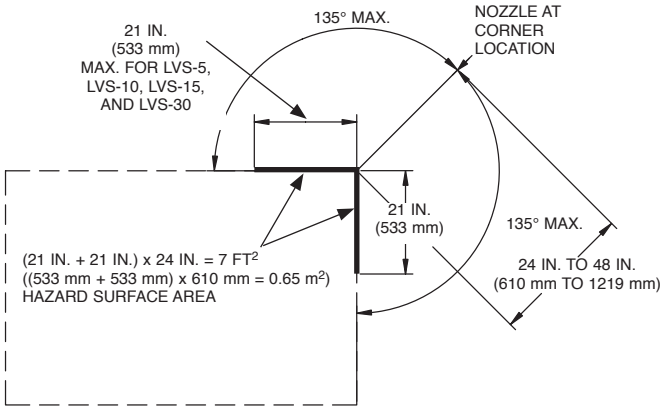


FIGURE 4-4
LVS-5, -10, -15, OR -30 SPLIT COVERAGE
009554

WET CHEMICAL NOZZLE COVERAGE (Continued)

LVS-9.5 Nozzle Coverage of Hazard Surface Area — Cooling

Regardless of whether the LVS system will be used as a stand-alone system or in combination with dry chemical in a twin-agent configuration, all equipment surface areas that can become superheated to temperatures close to or in excess of 850 °F (454 °C) must also be considered and designed for cooling, such as turbochargers.

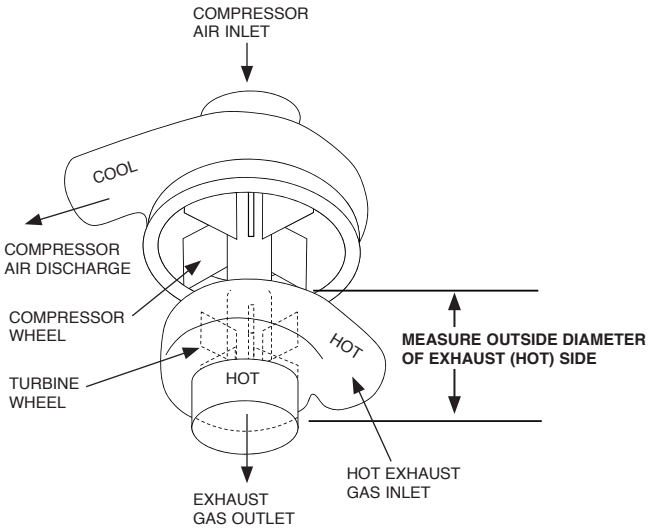
Turbochargers are used on most diesel operated off-road mobile equipment to increase engine horsepower. A turbo-charger is made up of two sections; a turbine which operates from exhaust flow from the engine, and a connected compressor which draws in, pressurizes, and injects air into the engine pistons. The turbine enclosure side of the turbo-charger (generally smaller in diameter than the compressor) becomes extremely hot (usually has paint burned off) and requires cooling to reduce the chance of fire reflash. Measure the outside diameter of the turbine enclosure to determine proper nozzle coverage. See Figure 4-5.

When cooling a turbocharger, the nozzle(s) must be positioned to discharge agent directly onto the hazard surface area, with little or no obstructions to interfere with the discharge of the agent.

TABLE 4-3: TURBOCHARGER COOLING REQUIREMENTS

	Diameter (hot side)	Required
LVS-3	Less than 6.5 in. (165 mm)	2 Nozzles
LVS-5 LVS-10 LVS-15 LVS-30	Up to 6.5 in. (165 mm)	1 Nozzle
	Up to 10 in. (254 mm)	2 Nozzles
	Maximum two turbo-chargers up to 10 in. (254 mm) within a cube of 11.4 ft^3 (0.32 m^3) length of each side is 27 in. (686 mm). See Figure 4-5.	2 Nozzles (1 nozzle for each turbo-charger)

Note: For turbochargers larger than 10 in. (254 mm) additional 9.5 nozzles are required.



Nominal Turbocharger Measurements			
Compressor Side		Exhaust Side (Hot)	
in.	(mm)	in.	(mm)
12	(305)	10	(254)
10	(254)	8	(203)
8	(203)	6.5	(165)

FIGURE 4-5
SINGLE TURBO COVERAGE
009529a

When using two or more nozzles to cool super-heated surfaces, such as turbocharger exhaust, if possible mount nozzles anywhere within 135° of each other and aimed at the center of the hazard surface area. Make sure the nozzle is within the range of 2 ft to 4 ft (0.6 m to 1.2 m) from the center of the hazard surface area. See Figure 4-6.

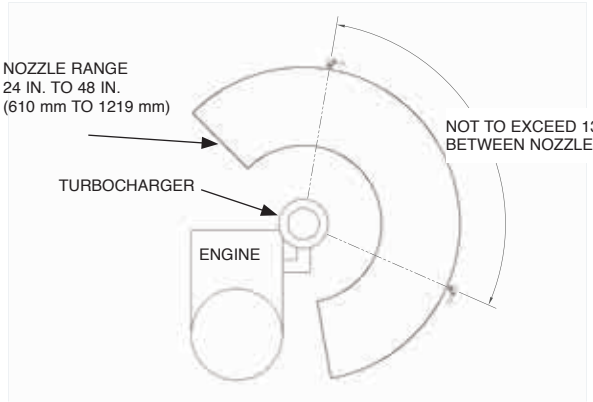


FIGURE 4-6
TWO-NOZZLE COOLING
009555

When possible, position nozzles at the maximum allowable distance (4 ft (1.2 m)) from turbochargers for maximum cooling efficiency.

WET CHEMICAL NOZZLE COVERAGE (Continued)

LVS-9.5 Nozzle Coverage of Hazard Surface Area — Cooling (Continued)

TWO TURBO COVERAGE LIMITS

For situations involving two closely installed turbochargers with exit turbines greater than 6.5 in. up to 10 in (165 mm up to 254 mm), each turbo-charger may be protected with 1 nozzle instead of two. The turbochargers must be close enough to fit within a 27 in. (686 mm) cube (11.4 ft^3 (0.32 m^3). When installed within 135° of each other, the discharge from each nozzle provides an additional cooling affect for the adjoining turbocharger. Make sure each nozzle is within the range of 2 ft to 4 ft (0.6 m to 1.2 m) from the nearest surface point on the exhaust turbine (hot side). See Figure 4-7.

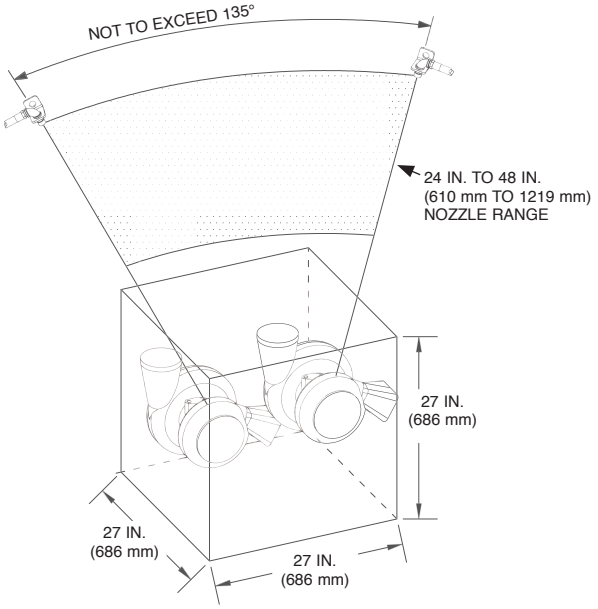


FIGURE 4-7
TWO TURBO COVERAGE LIMITS
009556

Other super-heated equipment surfaces (exhaust manifolds, other exhaust related equipment, etc.) that could reach elevated temperatures at or above 850 °F (454 °C) utilize similar conservative design considerations.

TANK QUANTITY REQUIREMENTS

If system design includes a CHECKFIRE 110 or CHECKFIRE 210 Detection and Actuation System refer to specific manuals for detailed guidelines on tank quantity requirements (latest revision).

CHECKFIRE 110 System Manual (Part No. 440391)

CHECKFIRE 210 System Manual (Part No. 440392)

If system design includes a CHECKFIRE SC-N Detection and Actuation System or manual pneumatic actuation, up to ten LVS wet chemical and LT-A-101 dry chemical tanks can be actuated from the primary actuation line.

Important: The maximum number of electric-pneumatic actuators for any combination of LT-A-101-10/20/30, LT-A-101-50/125/250, LVS-3, LVS-5, LVS-10, LVS-15, and LVS-30 tanks that can be actuated from one remote manual/automatic actuator is ten with a maximum length actuation line of 150 ft (45.7 m). See Figure 4-8.

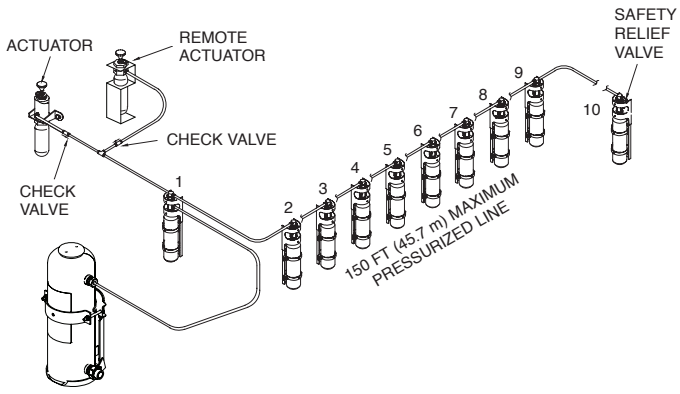


FIGURE 4-8
PNEUMATIC ONLY SYSTEM
008758

DISTRIBUTION SYSTEM REQUIREMENTS

After the tank(s) and nozzle(s) location(s) have been selected, it is necessary to accurately determine the distribution system routings to each nozzle to make certain they can be run without interfering with vehicle components and the maximum lengths of distribution hose/tube per tank model are not exceeded. Distribution system may use hydraulic hose or stainless steel tube or a combination of both.

Hose and Fittings Specifications

To ensure proper performance of the ANSUL LVS Liquid Agent system, the hose used must meet either SAE 100 R5 or 100 R1 hose specifications as a **minimum.** The hose must have an operating temperature of –40 °F to +200 °F (–40 °C to +93 °C). The following list of appropriate standards is for reference.

SAE Selection, Installation, and Maintenance of Hose and Hose Assemblies	J1273 (latest revision)
SAE Hydraulic Hose Fitting Standard	J516 (latest revision)
SAE Hydraulic Hose Standard	J517 (latest revision)
SAE Test and Procedures For SAE 100R Series Hydraulic Hose and Hose Assembly Standard	J343 (latest revision)

For underground mining applications, hose must comply with MSHA specified flame resistance acceptance and all applicable SAE requirements.

Stainless Steel Tube and Fittings Specifications

To ensure proper performance of the ANSUL LVS Liquid Agent System, the stainless steel tubing must meet Seamless Tube ASTM A213 or ASME SA213, 316L tubing specifications as a minimum. For reference review the following appropriate standards.

ASTM – A789 / A789M-13ae1, Standard specification for Seamless and Welded Ferritic / Austenitic Stainless Steel Tubing for General Service

ASTM – A1016/A1016M, Specifications for General Requirements for Ferritic Alloy Steel, Austenitic Stainless Steel and Stainless Steel Tubing.

Stainless Steel Tube

Stainless steel tube and fittings shall be installed in accordance with manufacturer's tubing / fitting installation instructions. Compression type fittings shall be of compatible material of 316 stainless steel.

Tube manufacturers recommend that only fittings manufactured by the tube manufacturer be used with their tubing.

Note: When using stainless steel tubing, adaptors (supplied by others) are required for transitions from NPT threaded components.

Hydraulic Hose Couplings

Before connecting a hydraulic hose to the LVS fire suppression system, it must first be assembled utilizing a hose coupling attached to each end of the hose. Hose couplings installed on hydraulic hose can be the permanent crimp-on type or the reusable type. Female or male swivel hose couplings of either the crimp-on type or the reusable type are also acceptable. All couplings used with SAE 100R1 or SAE 100R5 hydraulic hose must be suitable for the hose chosen and must comply with Hydraulic Hose Fitting Standard J516 as a minimum.

When attaching a hose coupling to a hose, it is very important to follow all manufacturer's installation instructions. SAE J1273, Selection, Installation, and Maintenance of Hose and Hose Assemblies, paragraph 3.2, requires that the manufacturer's assembly instructions be followed. SAE J1273, paragraph 2.10, Proper End Fitting, states that, "Care must be taken to insure proper compatibility exists between the hose and coupling selected based on the manufacturer's recommendations substantiated by testing to industry standards such as SAE J517."

Many hose manufacturers require only the couplings that they supply to be used with their hose. One manufacturer warns that they "will not be responsible when interchanging their hose and/or couplings with hose and/or couplings of any other manufacturer." Another states that "Under no circumstances should hose and couplings from different suppliers be interchanged."

Permanent Crimp-on Hose Couplings

A permanent crimp-on hose coupling is installed as a one-piece assembly attached to the hose end and crimped on. The crimp is made using a machine that will hydraulically or electrically crimp the coupling permanently to the hose end.

When using permanent crimp-on type couplings, lubricate the hose end, if necessary, and push the hose end all the way into the fitting in accordance with hose and hose coupling assembly instructions. Then place the hose end in the appropriate crimping machine and crimp the coupling. Follow all hose crimping machine operating instructions.

Reusable Hose Couplings

Reusable hose couplings can be attached to new hose in the field with no other tools than a wrench and a vise (or two wrenches). When reusable hose couplings are used, make certain the corresponding couplings and the assembly procedures used are in accordance with the manufacturer's specifications. **Failure to follow the manufacturer's instructions in their entirety may result in plugged nozzle orifices at system discharge due to chips and pieces of rubber cut from the inside of the hose during improper assembly.**

Reusable hose couplings include a coupling shell that fits over the end of the hydraulic hose and a coupling insert that installs inside the end of the hose and mates with the coupling shell threads. A mandrel tool may be required when using 1/4 in. through 1/2 in. SAE 100R5 hose to facilitate installation of the coupling insert.

DISTRIBUTION SYSTEM REQUIREMENTS (Continued)

Reusable Hose Couplings (Continued)

To attach a reusable coupling to the hose, clamp the coupling shell in a vise and turn the end of the hydraulic hose counter-clockwise into the coupling shell until the end is seated against the bottom of the shell. Then, back off 1/4 to 1/2 turn to allow for expansion.

Note: Some-rubber covered hydraulic hose ends must be skived (stripped of the rubber cover) before attaching the coupling. Refer to the appropriate manufacturer's instructions.

Lubricate the hose, coupling insert, and mandrel tool (when required) in accordance with manufacturer's instructions and screw the insert clockwise into the coupling shell and hose. Wrench tighten the insert until the hex on the insert contacts the shell. If a female swivel end is being used, use the appropriate assembly tool and leave approximately 1/32 in. to 1/16 in. (0.8 mm to 1.6 mm) clearance between the nut and the shell to allow the nut to swivel.

Note: It is important to lubricate only those surfaces specified by the manufacturer of the hose and coupling used. The lubricant will minimize the risk of cutting or shaving the inside of the hose. **Failure to use the proper lubricant or follow the appropriate lubrication instructions may result in pieces of hose plugging the gas tube in the agent storage tank or plugging a discharge nozzle orifice. Improper lubricant or lubrication procedures may also result in contamination of the hose due to the use of an incompatible lubricant.**

After attaching hose couplings to the hose, make certain that the hose is clean, dry and oil free. Use a solvent that is compatible with the hose, such as Stoddard Fluid or Varsol, to dissolve any oil remaining in the hose. Using dry air or nitrogen, blow out each hose length until dry and clear of metal or rubber shavings and any foreign matter before making any connections to the system.

JIC Hose Fittings and 150 lb Fittings

JIC hose fittings meeting Hydraulic Hose Fitting Standard J516 can be used in most applications. When using JIC hose fittings as elbows, use only elbows that have a long radiused bend. 150 lb NPT elbows and tees can also be used to assemble hose or pipe and attach hose or pipe to the discharge nozzles. Make certain that all elbows used in the agent distribution line, are of the same type (i.e., either all JIC or all 150 lb NPT elbows). Refer to LVS Tank Size Charts, pages 4-12 to 4-17, and General Distribution Network Guidelines for maximum elbows allowed.

Note: When figuring the maximum and minimum amount of elbows in the LVS system, two (2) 45° fittings can be counted as one 90° fitting.

Heat Resistant Fire Jacket for Hydraulic Hose

Note: It is recommended to install stainless steel tube in areas with temperatures exceeding 200 °F (93 °C).

All hose assemblies, including actuation lines, expellant gas lines, and agent distribution hose that will be normally exposed to or located in areas with temperatures exceeding 200 °F (93 °C), should be sleeved with an extreme temperature heat-resistant fire jacket. (Do not route actuation or expellant gas hose through fire hazard areas. If this cannot be avoided, the hose must be fire jacketed.) Information concerning fire jacketing should be available through your local hose supplier. If not, Bentley Harris manufacturers a fire jacket that will withstand continuous operating temperatures from –65 °F to 500 °F (–54 °C to 260 °C) and short term exposures up to 2000 °F (1093 °C).

General LVS Distribution Hose/Tube Requirements

The LVS-3, LVS-5, LVS-10, LVS-15, and LVS-30 utilize various distribution configurations that have been tested and approved with certain tank sizes.

LVS-3 – A system using the LVS-3 tank incorporates a distribution network in a straight line configuration, using 3/4 in. and/or 1/2 in. supply line hose/tube and a maximum of six 9.5 nozzles.

LVS-5 – A system using the LVS-5 tank incorporates a distribution network in a straight-line configuration, using 3/4 in. and/or 1/2 in. supply line hose/tube and a maximum of four 9.5 nozzles.

LVS-10, LVS-15, and LVS-30 – A system utilizing the LVS-10, LVS-15 or LVS-30 tank requires the distribution line to be split before any nozzle or nozzle drop can be installed.

- LVS-10 can utilize up to a maximum of eight 9.5 nozzles with a distribution network incorporating a 3/4 in. supply line with a 1/2 in. x 1/2 in. x 3/4 in. reducing tee to split the distribution to two 1/2 in. hose/tube runs supporting the nozzles.
- LVS-15 can utilize up to a maximum of ten 9.5 nozzles, with a distribution network incorporating a 3/4 in. supply line with a 1/2 in. x 1/2 in. x 3/4 in. reducing tee to split the distribution to two 1/2 in. hose/tube runs supporting the nozzles.
- LVS-30 can utilize up to a maximum of twenty 9.5 nozzles, with a distribution network incorporating a 3/4 in. primary supply line with a 3/4 in. x 3/4 in. x 3/4 in. tee to split the supply into two 3/4 in. secondary supply line hose/tube runs. Each 3/4 in. secondary supply line is connected to a 1/2 in. x 1/2 in. x 3/4 in. reducing tee, creating a secondary supply line split into two 1/2 in. hose/tube runs (for a total of four) supporting the nozzles.

Hydraulic hose and/or stainless steel tubing of appropriate size may be used alone or in combination as necessary.

Note: When utilizing the LVS-10, LVS-15 or LVS-30, nozzles cannot be installed from the supply line or secondary supply line hose/tube runs. They must not be installed until after the split(s) or until a Distribution Manifold Block is utilized.

DISTRIBUTION SYSTEM REQUIREMENTS (Continued)

Distribution Manifold Blocks

Instead of using conventional tees to split the primary supply line and secondary supply lines, the LVS system can utilize a Distribution Manifold Block. Two styles of Distribution Manifold Blocks are available for the LVS-3, LVS-5, LVS-10, LVS-15, and the LVS-30 systems. Both Distribution Manifold Block styles contain a 3/4 in. NPT female inlet on either end of the block.

- Distribution Manifold Block (Part No. 438835) contains four female 1/2 in. NPT distribution outlets on one side of the block.
- Distribution Manifold Block (Part No. 438834) contains two female 1/2 in. NPT distribution outlets on two opposite sides of the block for a total of four outlets.

If the Distribution Manifold Block is used with the LVS-3 or LVS-5 and only uses 1/2 in. hose/tube, the line must be reduced at the tank to 1/2 in. hose/tube and a 1/2 in. x 3/4 in. bushing must be used at the block.

When using the block with the LVS-10, LVS-15 or LVS-30, 3/4 in. supply line hose/tube will be used between the tank and the block, with four 1/2 in. outlet hose/tube lines to connect nozzles.

Note 1: When using a Distribution Manifold Block, any port not utilized will have to be plugged by the appropriate sized pipe plug (supplied by others).

Note 2: The Distribution Manifold Block can be used in a number of distribution configurations. The distribution manifold block can be used as a “splitting tee” or it can be used after a splitting tee to facilitate nozzle installation. The maximum number of nozzles the distribution manifold block can support is dependent upon where it is used, and with which tank size it is used:

1. When a distribution manifold block is used for a primary supply line split, the block can supply a maximum of twenty nozzles (LVS-30), ten nozzles (LVS-15), or eight nozzles (LVS-10) with a maximum of six nozzles from any 1/2 in. NPT distribution manifold block outlet.
2. When the LVS-30 uses a standard 3/4 in. x 3/4 in. x 3/4 in. tee for a primary supply line split, up to ten nozzles can be used with a distribution manifold block downstream from the tee, with a maximum of six nozzles from any 1/2 in. NPT distribution manifold block outlet.
3. When a distribution manifold block is used to connect to either another distribution manifold block or standard tee using the 3/4 in. NPT end outlet, a maximum of six nozzles may be used with the manifold block(s) and/or standard tee(s).

DISTRIBUTION SYSTEM REQUIREMENTS (Continued)

LVS Tank Size Charts

The following LVS Tank Size Charts and associated distribution system details provide additional distribution network design and installation guidelines.

LVS-3 (See Figure 4-9)

Max. No. of Nozzles	6
Type of Nozzle	9.5 nozzle
Total Combined Length of Hose/Tube	50 ft (15.2 m) of 3/4 in. and /or 1/2 in.hose/tube
Max. No. of Elbows	8
Avg. Agent Discharge Time	20 seconds
Max. Nozzles per Split	Split not required with LVS-3

Note: CE Applications require a minimum 2 ft (0.60 m) of hose/tube prior to any fitting.

LVS-3 Distribution to 6 Nozzles Maximum

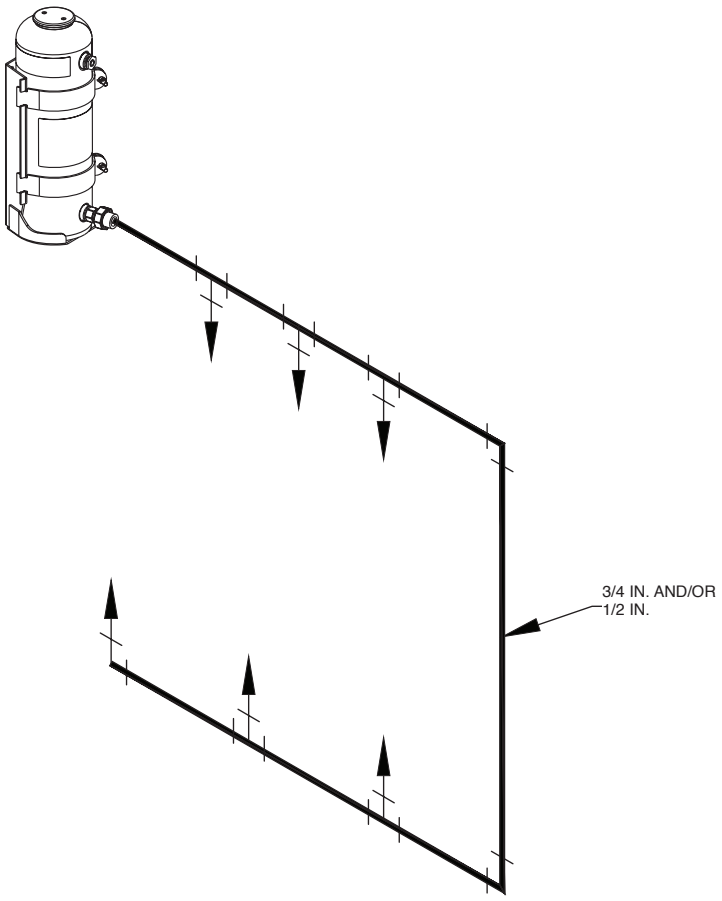


FIGURE 4-9
008694

DISTRIBUTION SYSTEM REQUIREMENTS (Continued)

LVS Tank Size Charts (Continued)

LVS-5 (See Figure 4-10)

Max. No. of Nozzles	4
Type of Nozzle	9.5 nozzle
Total Combined Length of Hose/Tube	75 ft (22.9 m) of 3/4 in. and /or 1/2 in.hose/tube
Max. No. of Elbows	8
Avg. Agent Discharge Time	30 seconds
Max. Nozzles per Split	Split not required with LVS-5

LVS-5 Distribution to 4 Nozzles Maximum

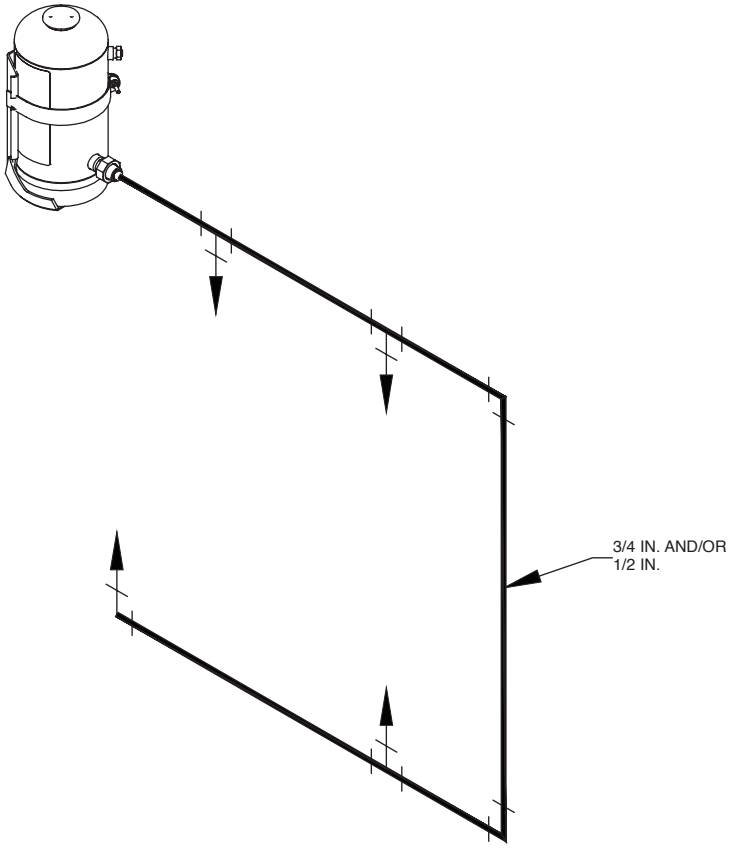


FIGURE 4-10
008694

DISTRIBUTION SYSTEM REQUIREMENTS (Continued)

LVS Tank Size Charts (Continued)

LVS-10 (See Figure 4-11)

Max. No. of Nozzles	8
Type of Nozzle	9.5 nozzle
▸ Total Combined Length of Hose/Tube	100 ft (30.5 m) of 3/4 in. and 1/2 in. hose/tube
Max. No. of Elbows	8
▸ Avg. Agent Discharge Time	40 seconds
Max. Nozzles per Split	6 (or a max. of 6 per 1/2 in. NPT Distribution Manifold Block outlet, if utilized)

LVS-10 Distribution to 8 Nozzles Maximum

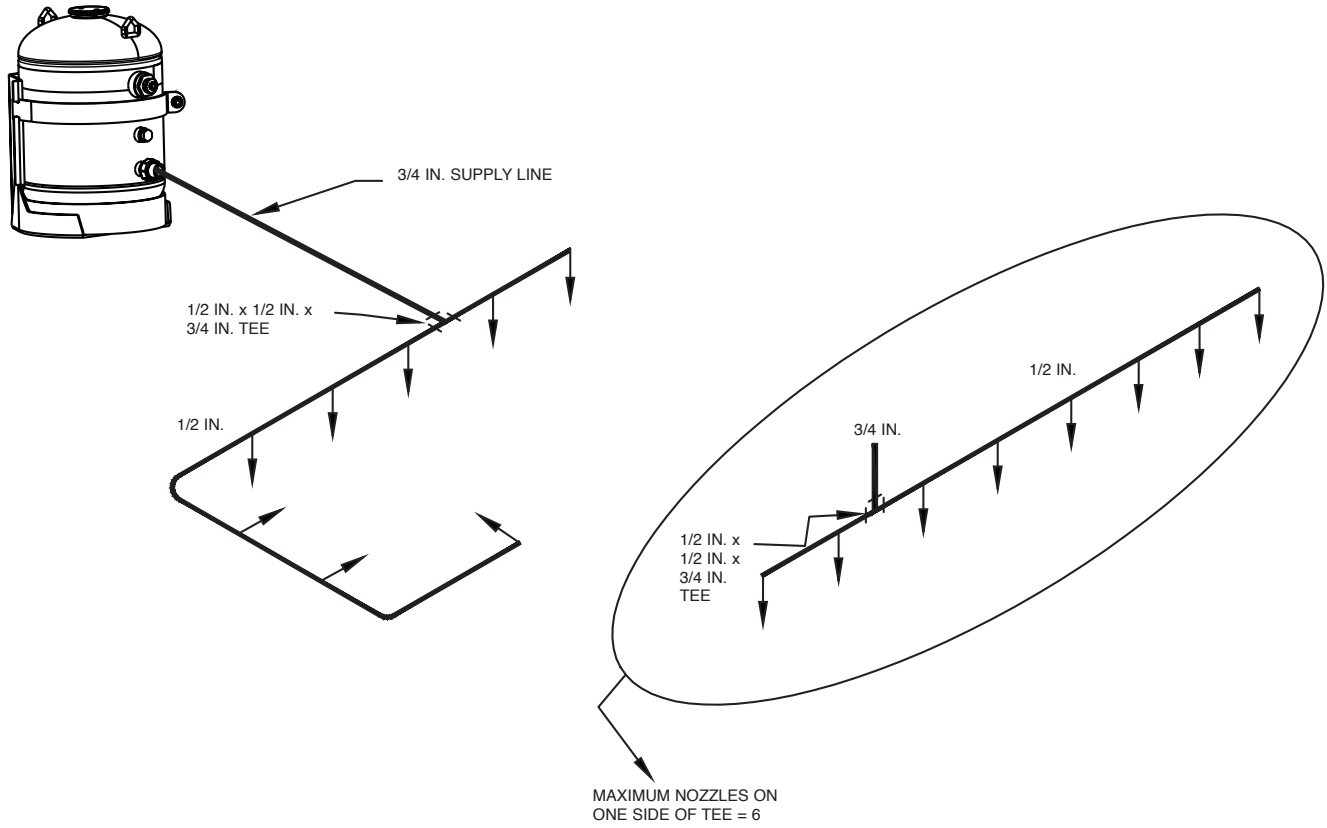


FIGURE 4-11
009048

DISTRIBUTION SYSTEM REQUIREMENTS (Continued)

LVS Tank Size Charts (Continued)

LVS-15 (See Figure 4-12)

Max. No. of Nozzles	10
Type of Nozzle	9.5 nozzle
Total Combined Length of Hose/Tube	150 ft (45.7 m) of 3/4 in. and 1/2 in. hose/tube
Max. No. of Elbows	8
Avg. Agent Discharge Time	60 seconds
Max. Nozzles per Split	6 (or a max. of 6 per 1/2 in. NPT Distribution Manifold Block outlet, if utilized)

LVS-15 Distribution to 10 Nozzles Maximum

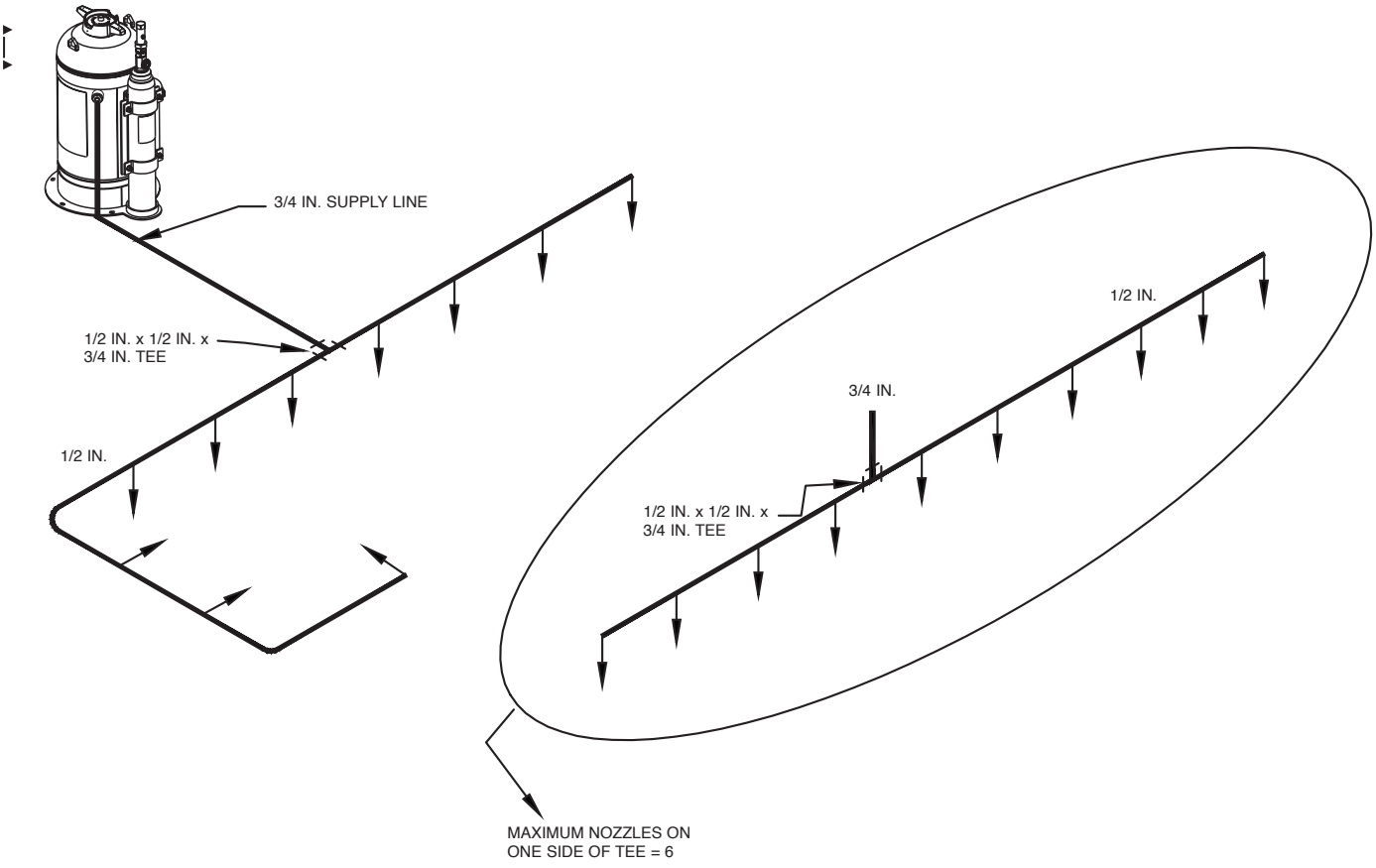


FIGURE 4-12
008695

DISTRIBUTION SYSTEM REQUIREMENTS (Continued)

LVS Tank Size Charts (Continued)

LVS-30 (See Figure 4-13)

Max. No. of Nozzles	20
Type of Nozzle	9.5 nozzle
Total Combined Length of Hose/Tube	225 ft (68.6 m) of 3/4 in. and 1/2 in. hose/tube
Max. No. of Elbows	16
Avg. Agent Discharge Time	60 seconds
Max. Nozzles per Primary Supply Line Split	10 (See Nozzle Unbalance Matrix, page 4-16)
Max. Nozzles per Secondary Supply Line Split	6 (or a max. of 6 per 1/2 in. NPT Distribution Manifold Block outlet, if utilized)

LVS-30 Distribution to 20 Nozzles Maximum (Balanced)

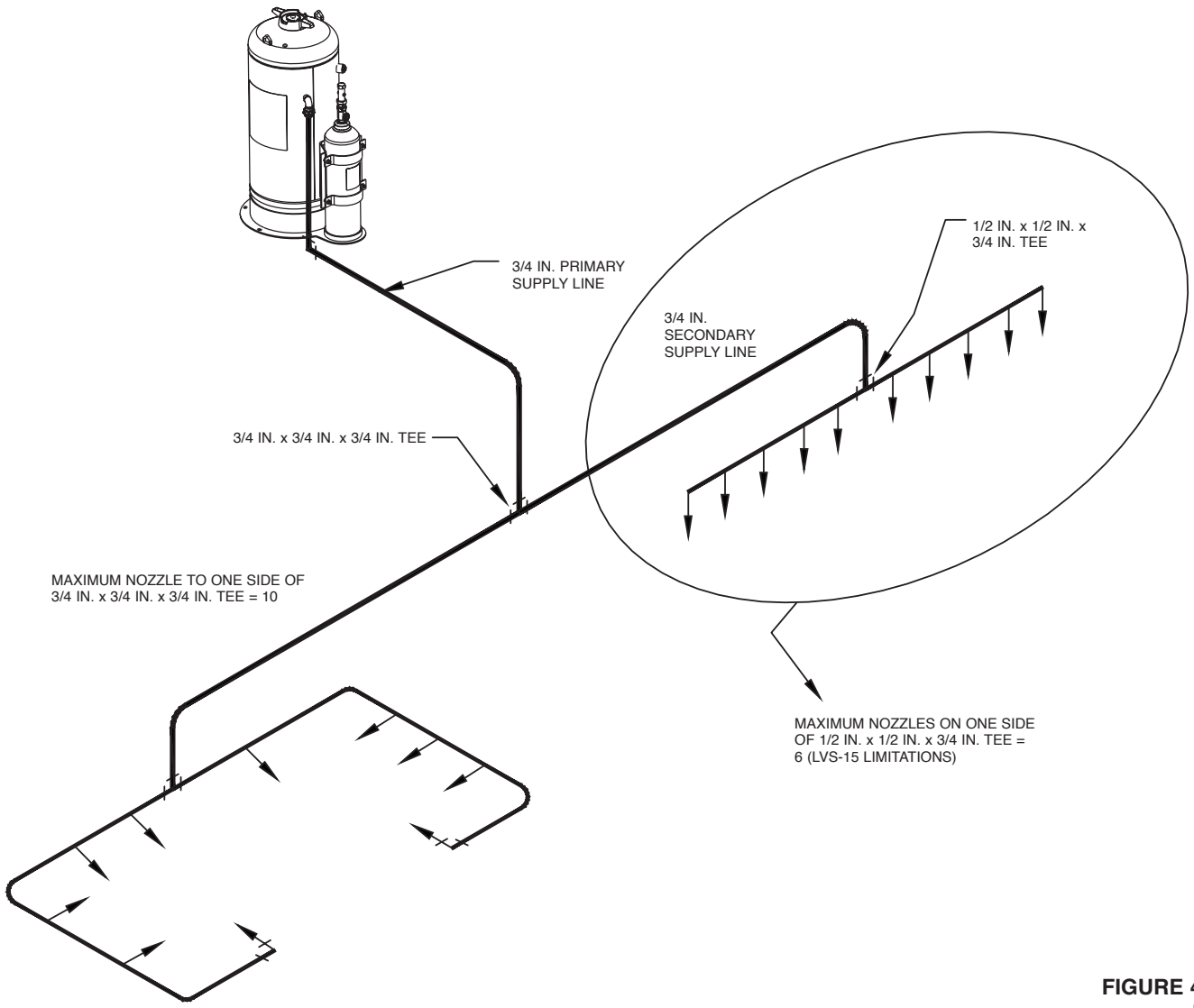


FIGURE 4-13
008696

DISTRIBUTION SYSTEM REQUIREMENTS (Continued)

LVS Tank Size Charts (Continued)

LVS-30 (See Figure 4-14)

Max. No. of Nozzles	20
Type of Nozzle	9.5 nozzle
Total Combined Length of Hose/Tube	225 ft (68.6 m) of 3/4 in. and 1/2 in. hose/tube
Max. No. of Elbows	16
Avg. Agent Discharge Time	60 seconds
Max. Nozzles per Outlet	6

LVS-30 Distribution to 20 Nozzles Maximum (Manifold Block)

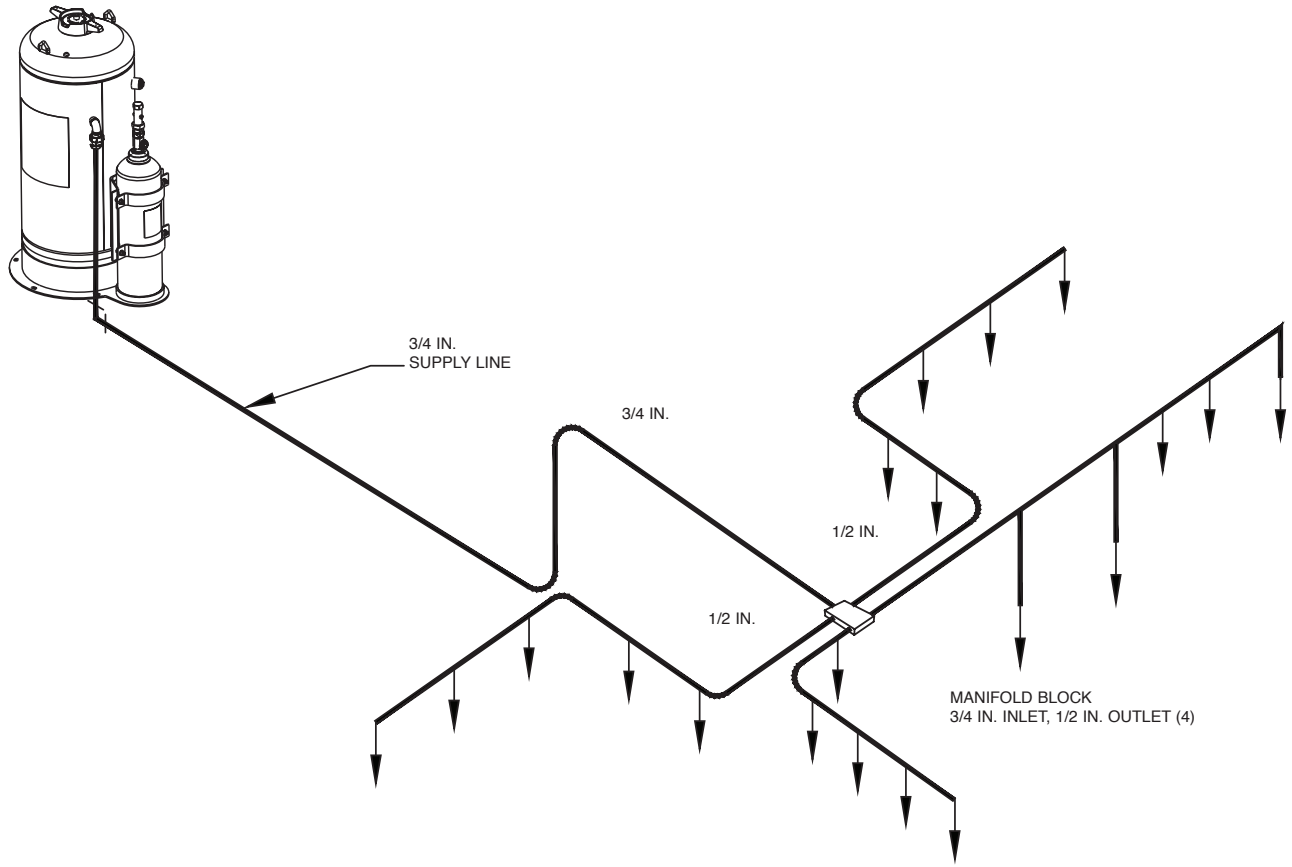


FIGURE 4-14
008697

DISTRIBUTION SYSTEM REQUIREMENTS (Continued)

LVS Tank Size Charts (Continued)

LVS-30 Distribution to 20 Nozzles Maximum (Unbalanced) (See Figure 4-15)

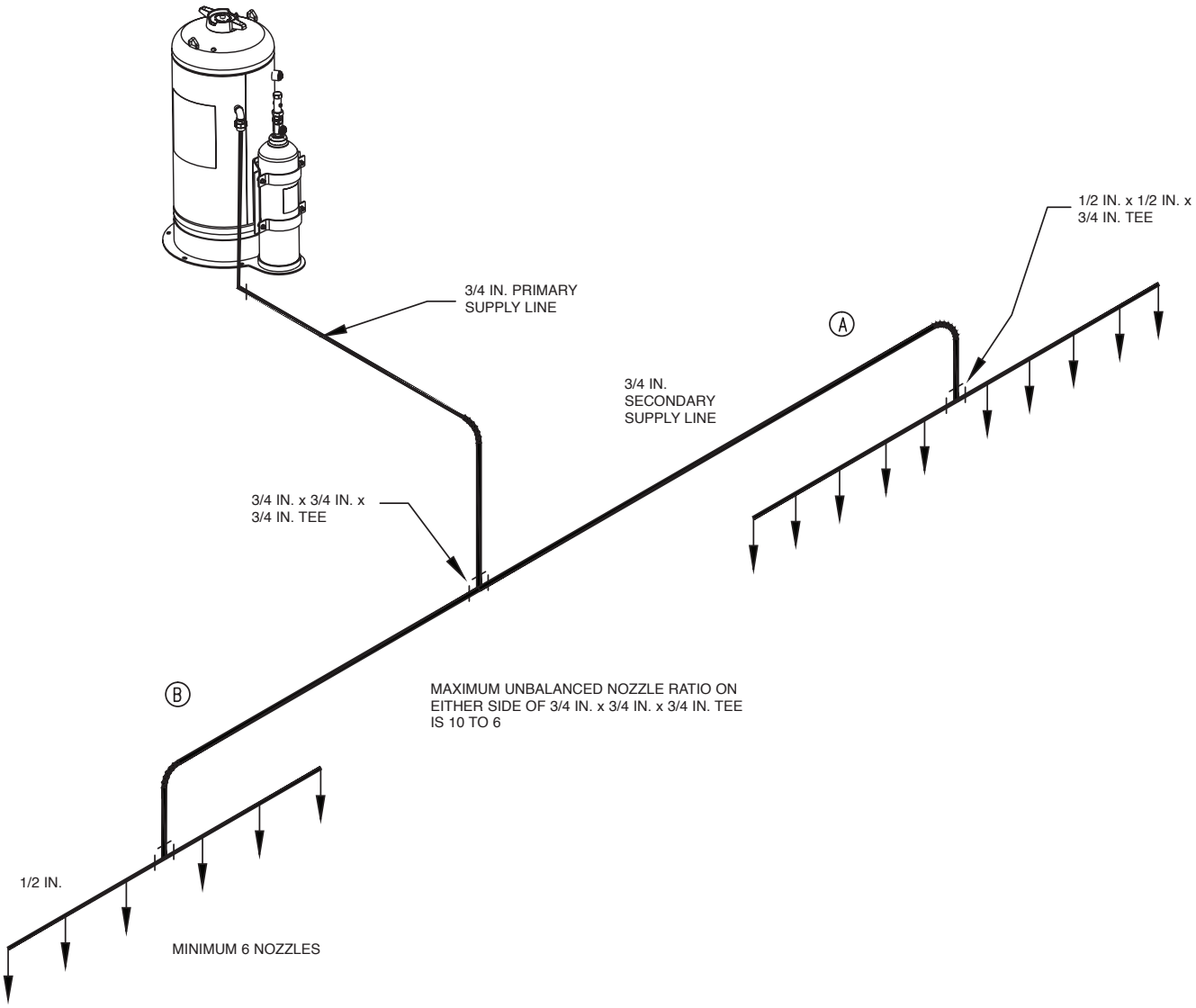


FIGURE 4-15
008698

LVS-30 Split Nozzle Unbalance Matrix

Total Number Nozzles	3/4 in. NPT Tee Side A	3/4 in. NPT Tee Side B	Total Number Nozzles	3/4 in. NPT Tee Side A	3/4 in. NPT Tee Side B
20	10	10	15	8	7
19	10	9	14	8	6
18	10	8	14	7	7
18	9	9	13	8	5
17	10	7	13	7	6
17	9	8	12	7	5
16	10	6	12	6	6
16	9	7	11	6	5
16	8	8			
15	9	6			

GENERAL DISTRIBUTION NETWORK GUIDELINES

1. Because the LVS system distribution network does not have the same flow characteristics as dry chemical, no consideration need be made for critical length; and the need for hose/tube-line balancing is minimized.
2. Hose/tube lengths are measured from center of fitting to center of fitting. See Figure 4-16.

FIGURE 4-16
000778

3. A maximum of two nozzles are allowed per drop when the drop occurs before any nozzle in a hose/tube run. See Figure 4-17.

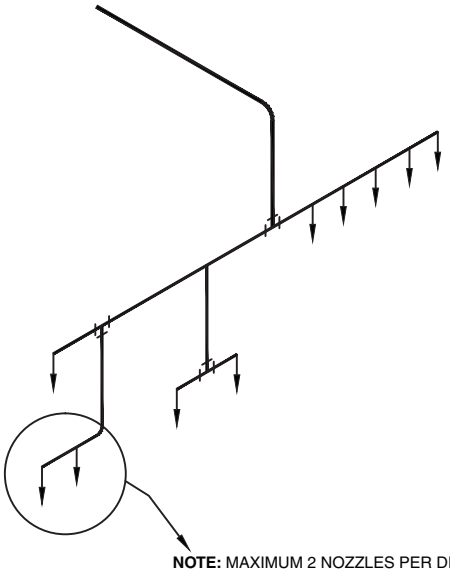


FIGURE 4-17
008699

4. A bull tee can be used at the end of a hose/tube run to connect to one, two, or more nozzles installed from either tee outlet with other nozzles installed prior to the tee. This may be done as long as the total nozzle limitations are not exceeded. See Figure 4-18.
5. A maximum of five elbows can be used between a nozzle and a preceding tee.
6. Two elbows, allowed at each nozzle for aiming, do not need to be counted in the maximum allowed. However, they will be counted as elbows between a nozzle and a preceding tee. (See Step number 5).
7. Reducing bushings are allowed when reducing to a smaller hose/tube size.

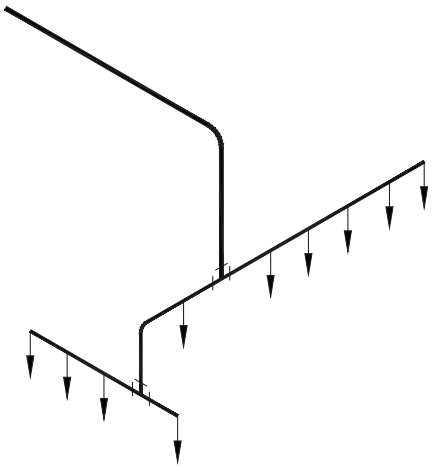


FIGURE 4-18
009049

8. The maximum height elevation difference between a tank and any nozzle used with the tank equals 10 ft (3.0 m).
9. No nozzles are allowed before the primary split in the LVS-10 or LVS-15, or the secondary splits in the LVS-30.
10. A secondary split is not needed with the LVS-30 when the Distribution Manifold Block is used to create the primary supply line split. **Note**: If using stainless steel tubing, NPT adaptor is required for manifold block.
11. When using a Distribution Manifold Block, maximum nozzles from each 1/2 in. outlet equals six, not to exceed the maximum allowed per tank size. **Note**: If using stainless steel tubing, NPT adaptor is required for manifold block.
12. Turbocharger Cooling:

Turbocharger Cooling Requirements

	Diameter (hot side)	Required
LVS-3	Less than 6.5 in. (165 mm)	2 Nozzles
LVS-5 LVS-10	Up to 6.5 in. (165 mm)	1 Nozzle
LVS-15 LVS-30	Up to 10 in. (254 mm)	2 Nozzles
	Maximum two turbochargers up to 10 in. (254 mm) within a cube of 11.4 ft^3 (0.32 m^3) length of each side is 27 in. (686 mm). See Figure 4-5, page 4-7.	2 Nozzles (1 nozzle for each turbo-charger)

Note: For turbochargers larger than 10 in. (254 mm) additional 9.5 nozzles are required.

ACTUATION SYSTEM REQUIREMENTS

To help assure proper performance of the actuation system, the hose must meet SAE 100 R5 or 100 R1 (minimum) hose specification.

If system design includes a CHECKFIRE 110 or CHECKFIRE 210 Detection and Actuation System refer to specific manuals for detailed actuation instructions (latest revision).

CHECKFIRE 110 System Manual (Part No. 440391)

CHECKFIRE 210 System Manual (Part No. 440392)

If system design includes a CHECKFIRE SC-N Detection and Actuation System or manual pneumatic actuation (e.g. redundant 110 or 210 systems), apply the following limits:

1. Any combination of LT-A-101-10/20/30, LT-A-101-50/125/250, and/or LVS-3, LVS-5, LVS-10, LVS-15 and LVS-30 actuators, the maximum number of electric-pneumatic actuators allowed is ten. See Figure 4-19.
2. All remote manual/automatic actuators must use the LT-10-R cartridge (Part No. 423423 – Right Hand Threads, or Part No. 423425 – Left Hand Threads).
3. When using more than one manual pneumatic actuator, keep the common actuation joint as close as possible to electric-pneumatic actuator on first expellant gas cartridge. The branch for each pneumatic actuator must include a check valve (Part No. 25627) as near as possible to common actuation joint. This preserves redundancy and minimizes length of pressurized line. See Figure 4-19.
4. The maximum length of 1/4 in. actuation hose that may become pressurized from any manual/automatic actuator must not exceed 150 ft (45.7 m), including pressurized line lengths connecting to pneumatically operated auxiliary devices, such as pressure switches.

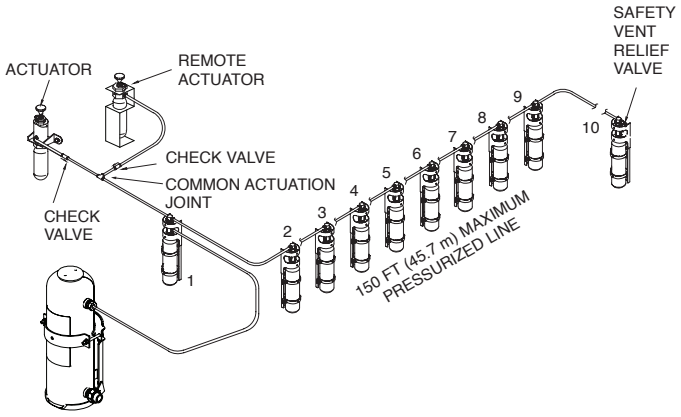


FIGURE 4-19
008758

DETECTION SYSTEM REQUIREMENTS

A properly designed LVS Liquid Agent fire suppression system should include automatic detection and actuation that is designed to automatically detect and suppress a fire that may not be noticed by the vehicle operator until it may be too late.

The CHECKFIRE Electric Detection and Actuation Systems are used for automatic operation in most applications. The detection design and layout must follow the guidelines stated in the CHECKFIRE Manuals, latest revision:

CHECKFIRE 110 System Manual (Part No. 440391)

CHECKFIRE 210 System Manual (Part No. 440392)

CHECKFIRE SC-N System Manual (Part No. 423522)

For certain underground mining vehicle applications, the CHECKFIRE MP-N Electric Detection and Actuation System is required. The CHECKFIRE MP-N is utilized in applications where a vehicle may be operating in an explosive methane/air atmosphere. Refer to guidelines stated in the CHECKFIRE MP-N Installation, Recharge, Inspection, and Maintenance Manual (Part No. 427310, latest revision).

SHUTDOWN REQUIREMENTS

When protecting any vehicle, especially vehicles with large amounts of hydraulic fluid and other flammable fuels on board, the engine, electric motor(s), and/or equipment power must be shut down, hydraulic pumps shut off, and if possible, hydraulic or fuel storage tanks vented. To accomplish this, it may be necessary to wire the shutdown of these devices into the CHECKFIRE shutdown or relay contacts, or vehicle system pressure switch contacts.

CAUTION

Before designing for any shutdown or venting method, consult the vehicle manufacturer or dealer, the owner, or the vehicle service department manager for specific instructions on vehicle shutdown options and acceptable method(s) for vehicle shutdown.

If system design includes a CHECKFIRE 110 or CHECKFIRE 210 Detection and Actuation System, refer to specific manuals for detailed shutdown requirement instructions (latest revision).

CHECKFIRE 110 System Manual (Part No. 440391)
CHECKFIRE 210 System Manual (Part No. 440392)

The LVS fire suppression system can incorporate several methods that may be used to provide shutdown for the vehicle engine or other equipment requiring shutdown or electrical de-activation. See Figure 4-20.

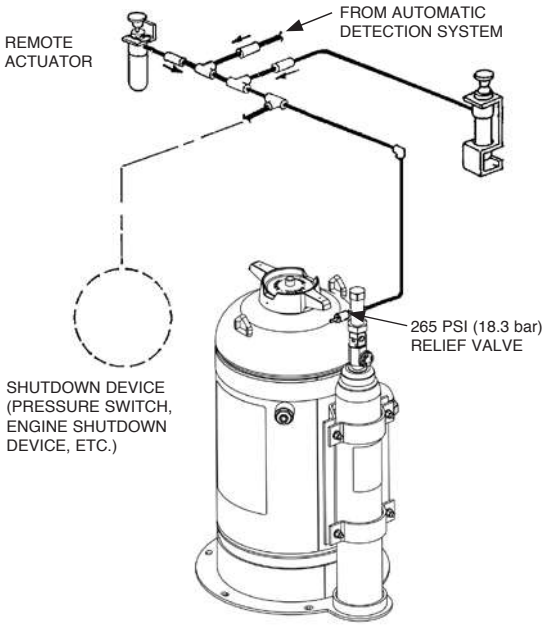


FIGURE 4-20
007061

Engine Shutdown (Shutdown Relay or Pressure Switch) – Engine shutdown may be accomplished electrically by one of two means – a CHECKFIRE control module, using an integral "Shutdown Relay," or a pressure switch. In many applications, a continuous duty normally energized fuel solenoid (supplied by others) may be used, which is wired in series with the Normally Closed "Shutdown" relay contacts of the CHECKFIRE control module or the pressure switch. The "Shutdown" relay contacts will transfer (open) after the first time delay cycle is completed in the CHECKFIRE control module, or when the LVS fire suppression system has operated (when the pressure switch is utilized for shutdown). Any shutdown wiring or connections to the vehicle or vehicle operating systems, or fuel solenoid installation and associated connections, should be performed either by vehicle maintenance personnel, or with their supervision.

Normally Open and Normally Closed contacts in the CHECKFIRE control module relays or one or more pneumatically operated vehicle pressure switches can be used for various electrical functions to energize or de-energize optional equipment, or operate high level audio alarm and visual strobe devices. Refer to the appropriate CHECKFIRE System Manual for relay use and associated wiring instructions.

Hydraulic Fluid Tank Venting – It may be possible in some applications to vent pressure in the hydraulic oil tank. Solenoid valves (supplied by others) may be utilized with relay contacts in the CHECKFIRE control module or switch contacts in the optional vehicle pressure switch assembly. **Note:** This option may not be suitable for certain off-road vehicle applications. Consult with the vehicle manufacturer or authorized dealer, owner, and/or vehicle maintenance personnel before considering this option. Solenoid installation and/or final wiring connections for hydraulic tank venting should be authorized by the owner or service department manager. If possible, installation and connections should be performed by the vehicle maintenance personnel or (with proper instruction and supervision provided by the manufacturer or owner) by qualified vehicle fire suppression system installation personnel.

NOTES:

MOUNTING COMPONENT BRACKETS

When considering locations for mounting agent tanks, expellant gas cartridges, and manual and automatic actuators, choose areas where the components are easily accessible for operation and service, and where components will not be abused or will not interfere with vehicle operation or maintenance procedures, or obstruct operator vision or vehicle egress. Keep in mind not only requirements for each individual component, but also how components are connected, and maximum lengths between each component. Discuss potential mounting locations with the vehicle owner, and/or vehicle maintenance personnel before installing components.

NOTICE

When mounting brackets for fire suppression and detection system components, make certain the mounting surface is a rigid surface capable of supporting the total weight of the equipment. The heaviest components for bracket mounting are tank assemblies:

Tank Assembly	Weight	
LVS-3	70 lb	(22.7 kg)
LVS-5	100 lb	(45.4 kg)
LVS-10	195 lb	(88.5 kg)
LVS-15	400 lb	(181.4 kg)
LVS-30	600 lb	(272.2 kg)

Before securing brackets, verify acceptance by the vehicle manufacturer to bolt (weld if necessary) onto that surface.

Nozzle Bracket

Based on the specifications determined in Section 4 – System Design, locate a secure mounting location for each nozzle bracket that will allow the nozzle to be positioned within its effective discharge range. The nozzle is to be properly aimed at the furthest portion of the area to be protected, without obstruction to agent discharge.

1. Bolt or weld bracket to mounting surface. When welding bracket, make certain there is enough weld to keep bracket properly in place.
2. Bracket can be drilled and bolted to the mounting surface with appropriate fasteners. Make certain the bolting method does not allow mounting bracket to rotate out of position or interfere with nozzle discharge.

Note: A minimum of two bolts is required for proper mounting.

Distribution Fittings or Manifold Blocks

Based on hose/tube routing determined in Section 4 - Design, choose locations for supply line tee and secondary supply line tees (if applicable), or Distribution Manifold Blocks that will not exceed corresponding tank size maximums, cause interference for vehicle maintenance access, or hinder service.

Note: When using stainless steel tubing, adaptors (supplied by others) are required for transitions from NPT threaded components.

1. When locating agent distribution tees or manifold blocks, make certain locations do not cause hose/tube to be exposed to extreme heat or physical abuse.

   Note: If areas with normally high operating temperatures are unavoidable, stainless steel tubing is preferred. Make certain hoses routed in those areas are protected with properly installed extreme temperature fire jacketing.
2. All distribution fittings must be secured to the mounting surface with suitable clamping devices or to a mounting bracket that can be welded to the mounting surface. See Figure 5-1. If Distribution Manifold Block is to be used, install either by bolting or welding. When bolting the block, use two 5/16 in. bolts with a flat washer and a lock washer on each. Bolts and washers are supplied by others. Make certain mounting location allows for easy hose/tube installation and a 3/4 in. NPT pipe plug is installed at the end of the block.
3. All welds must be made before any hose/tube has been installed to avoid damage to hose/tube due to high welding temperatures.

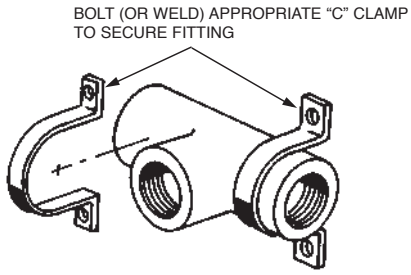


FIGURE 5-1
SECURE ALL FITTINGS
003513

Agent Storage Tanks and Brackets

NOTICE

The location of LVS tank must not cause hose/tube length limitations to be exceeded.

Proper mounting is very important because the weights of fully charged LVS tanks are in **excess** of the following:

Tank Assembly	Weight	
LVS-3	70 lb	(22.7 kg)
LVS-5	100 lb	(45.4 kg)
LVS-10	195 lb	(88.5 kg)
LVS-15	400 lb	(181.4 kg)
LVS-30	600 lb	(272.2 kg)

The tank should be bolted (weld if necessary) in place.

MOUNTING COMPONENT BRACKETS (Continued)

Tank Bracket and Tank – LVS-3 and LVS-5

1. Position LVS-3 or LVS-5 tank on a rigid area capable of supporting weight of the full tank assembly, making sure there is no interference with any vehicle components, access panels, or doors. The tank can be mounted in either a vertical or horizontal position or at any position between 0° and 90°. When mounted in horizontal position, tank outlet must point in the up position, parallel to the vertical plane. If tank is installed at an angle between 0° and 90°, make certain tank outlet is opposite lowest corner of the tank. See Figure 5-2.

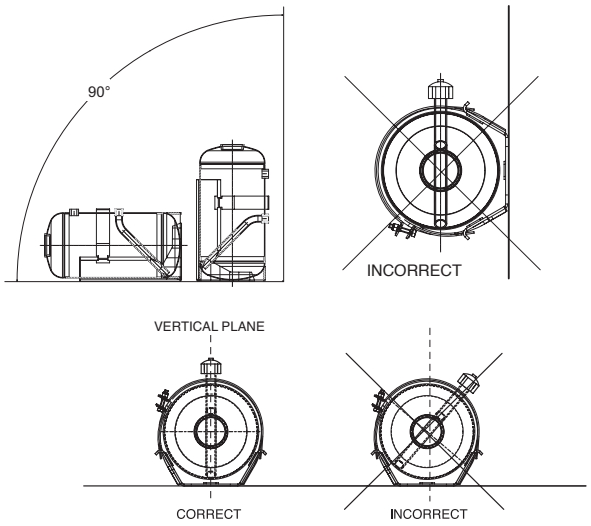


FIGURE 5-2
HORIZONTAL: OUTLET MUST POINT UP
008198 / 008198a

Note: When mounting LVS-3, LVS-5 or LVS-10 tank in a horizontal position, bracket back plate must be secured to a horizontal surface, such as a deck. When tank is in a horizontal position, bracket cannot be mounted to a vertical surface, such as a wall. See Figure 5-2.

2. Remove agent tank from bracket and bolt (or weld if necessary) bracket to mounting surface. The bracket can be secured at the base, at the back, or both, depending on the mounting surface. (If bracket cannot be bolted, welding is acceptable.) Use the 7/16 in. (11 mm) mounting holes provided in bracket for 3/8 in. fasteners. When mounting bracket make sure there is access to bolts holding clamp arm in place.

   When utilizing back frame for mounting, use all four mounting holes. When utilizing the bottom for mounting, use all four mounting holes. If conditions require, use all eight holes. Use Grade 5 bolts (supplied by others) as a minimum.

Tank Bracket and Tank – LVS-10

1. Position LVS-10 tank on a rigid area capable of supporting weight of full tank assembly, making sure there is no interference with any vehicle components, access panels, or doors. The tank can be mounted in either a vertical or horizontal position or at any position between 0° and 90°. When mounted in horizontal position, tank outlet must point up, parallel to the vertical plane. See Figure 5-3.

   In horizontal position, sealed burst disc assembly, union ring and tail piece must be removed from factory-installed position in vertical tank outlet port and re-installed in horizontal tank outlet port. To do so, remove 3/4 in. NPT pipe plug from horizontal tank outlet port and set aside for reinstallation. Remove sealed burst disc assembly, union ring, and tail piece from vertical tank outlet port. Clean burst disc threads and carefully apply thread tape to threads, and reinstall in horizontal tank outlet port. Wrench tighten. Clean threads on 3/4 in. pipe plug and carefully apply thread tape to threads, and reinstall in vertical tank outlet port. Wrench tighten. See Figure 5-3 (next page).

NOTICE

When applying pipe tape, start at second male thread and wrap tape (two turns maximum) clockwise around threads, away from threaded opening. Do not allow tape to overlap male threaded opening as distribution hose/tube and/or nozzles could become plugged.

MOUNTING COMPONENT BRACKETS (Continued)

Tank Bracket and Tank – LVS-10 (Continued)

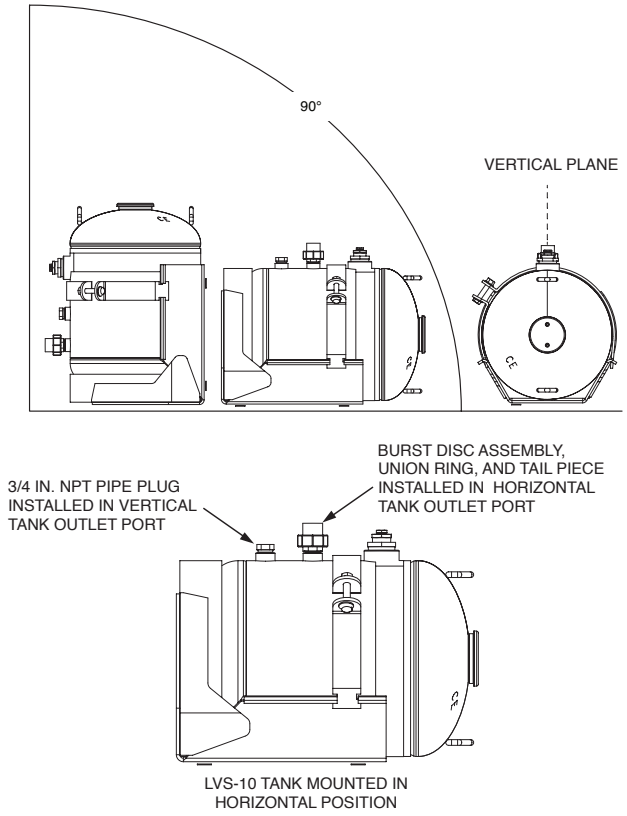


FIGURE 5-3
HORIZONTAL: OUTLET MUST POINT UP AND CHANGE OUTLET PORTS
009050

2. Remove agent tank from bracket and bolt bracket to mounting surface. The bracket can be secured at the base, at the back, or both depending on the mounting surface. Mounting holes 1/2 in. (13 mm) in diameter are provided in the bracket to accommodate 1/2 in. fasteners. Make sure when mounting bracket there is access to bolts holding clamp arm in place. When utilizing back frame for mounting, use all six mounting holes. When utilizing the bottom for mounting, use all six mounting holes. If conditions require, use all twelve holes. Use Grade 5 bolts (supplied by others) as a minimum. If the bracket cannot be bolted, welding is acceptable.

LT-A-101-30 Cartridge Bracket

1. Remove cartridge from bracket.
2. Locate a rigid, protected surface that will not hinder normal vehicle operation or service, and bolt or weld cartridge bracket securely. When bolting bracket, use 5/16 in. fasteners.
3. Make certain mounting location allows for easy removal of cartridge for service or recharge, and for easy installation of actuation and expellant gas hoses and safety vent relief valve.

Tank Mounting Ring and Tank – LVS-15 and LVS-30

1. To properly secure LVS-15 or LVS-30 tank, base of tank must be bolted to surface on which tank is to be located, or to mounting ring (preferred).
2. Position LVS-15 or LVS-30 tank and mounting ring on a rigid surface capable of supporting weight of full tank assembly, making sure there is no interference with any vehicle components, service access panels or doors, or operator egress. Verify tank can be easily filled and serviced from that position. See Figure 5-4.

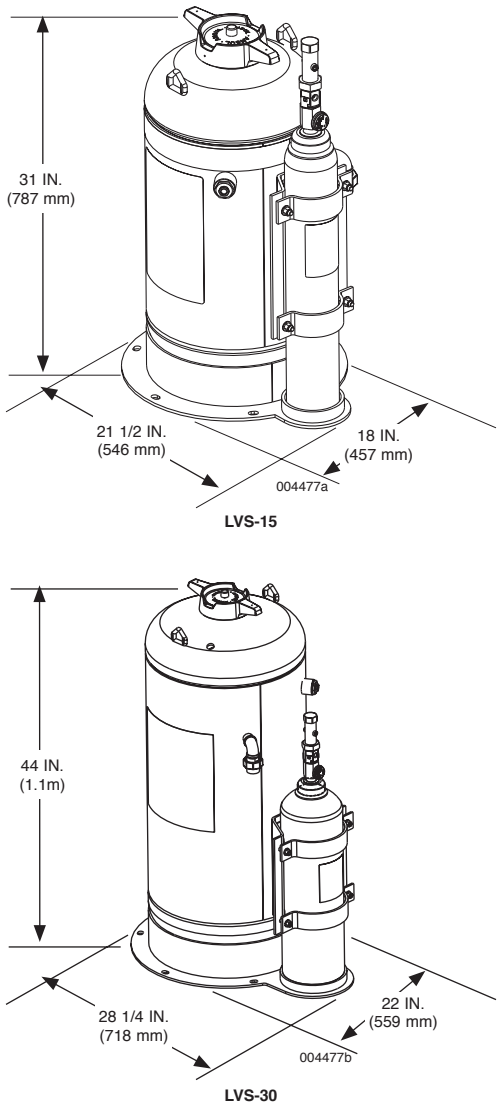


FIGURE 5-4
LVS-15 AND LVS-30 MOUNTING DIMENSIONS

Note: If chosen location is not structurally suited for filled tank weight, a suitable support structure may need to be fabricated. Verify support and tank location with vehicle service personnel before installing.

MOUNTING COMPONENT BRACKETS (Continued)

Tank Mounting Ring and Tank – LVS-15 and LVS-30 (Continued)

3. If the location is suitable, remove tank from tank mounting ring (Part No. 428404 (LVS-15) or Part No. 428405 (LVS-30)), and bolt the tank mounting ring in position. See Figure 5-5.

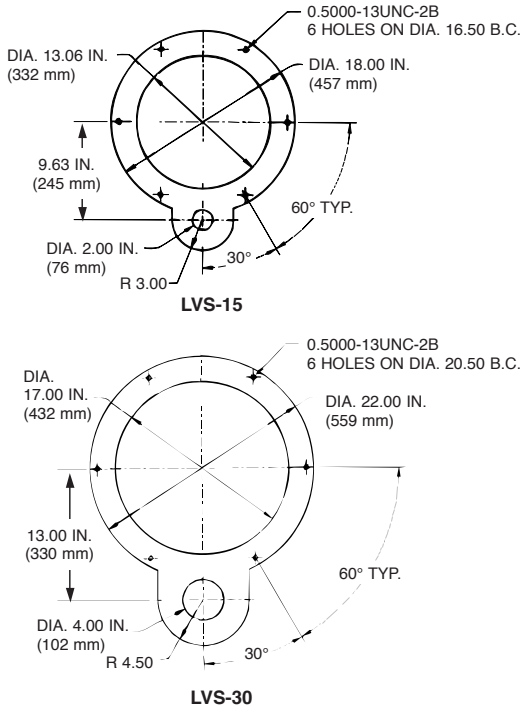


FIGURE 5-5
BOLT TANK MOUNTING RING
004792

4. With tank mounting ring securely in place, position tank on ring and bolt tank flange to mounting ring using six hardened steel 1/2 in. x 1 in. (13 mm x 25 mm) long bolts with washers and lock washers (supplied by others).

Remote Manual/Automatic Actuator Bracket

If system design includes a CHECKFIRE 110 or CHECKFIRE 210 Detection and Actuation System refer to specific manuals for detailed remote electric manual actuator installation instructions (latest revision).

CHECKFIRE 110 System Manual (Part No. 440391)

CHECKFIRE 210 System Manual (Part No. 440392)

CHECKFIRE SC-N AND MANUAL PNEUMATIC SYSTEM

A remote manual or CHECKFIRE manual/automatic actuator must be located in the operator's compartment within easy reach of the operator. In addition, at least one remote manual actuator should be located in general path of operator egress, at a point on vehicle within access of ground level, if possible. **Note:** The actuator must be located in an area that will not exceed temperature limitations or be subject to fire or damage. Try to avoid mounting actuator near engine compartment.

1. Choose a location that will provide protection for red manual actuator push knob, if possible. The red push knob must be easily accessible and have enough room for knob to be hit with sufficient force to puncture the actuation cartridge. Also, make certain there will be enough room for removal of the LT-10-R cartridge for service and recharge.
2. When choosing a mounting location for any actuator, make certain total length of actuation hose from actuator to all tank pneumatic actuators and any auxiliary accessories does not exceed 150 ft (45.7 m).
3. Bolt or weld remote manual or manual/automatic actuator bracket in place. If bolting bracket(s), use 3/8 in. fasteners (supplied by others). If welding, paint welded surface(s) to avoid corrosion. See Figure 5-6.
4. If mounting remote manual actuator in dashboard of a vehicle or through a bulkhead, the actuator can be mounted by drilling a 1 5/16 in. (33 mm) diameter hole as shown in Figure 5-6. Make certain there is enough room for actuator body, cartridge, and 1/4 in. actuation line connection under dash or behind bulkhead. Make certain high pressure cartridge is protected from damage. If cartridge will be exposed to possible damage, the "S" bracket assembly will be required.

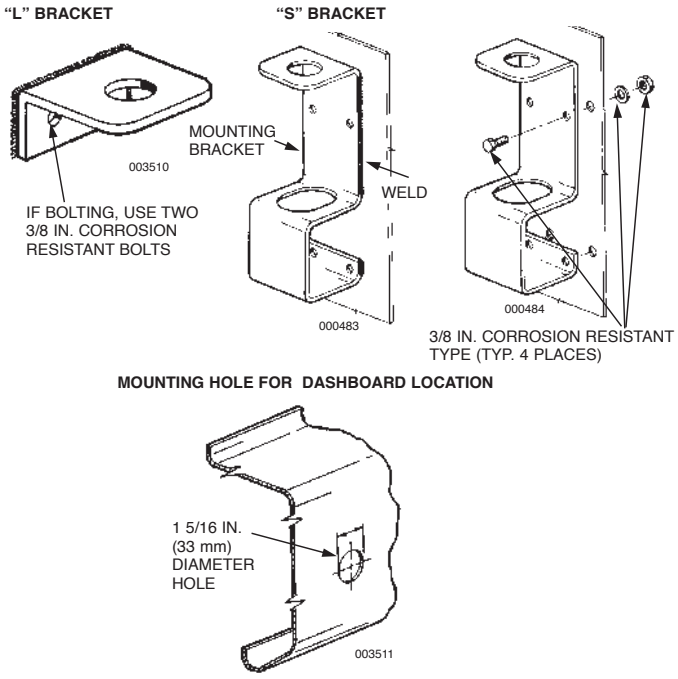


FIGURE 5-6
BRACKETS FOR ACTUATOR

INSTALLING COMPONENTS

Installing Nozzles

1. Refer to system specifications determined in Section 4 – System Design for information regarding intended nozzle protection and aiming.
2. With nozzle brackets firmly secured in place, install nozzles into brackets using two internal tooth lockwashers, one on each side of the bracket, and tighten nozzles into 1/2 in. NPT elbows or couplings. The position of bracket must allow nozzle to aim correctly. If bracket does not allow for proper aiming of nozzle, two elbows will be needed to aim correctly. See Figure 5-7.

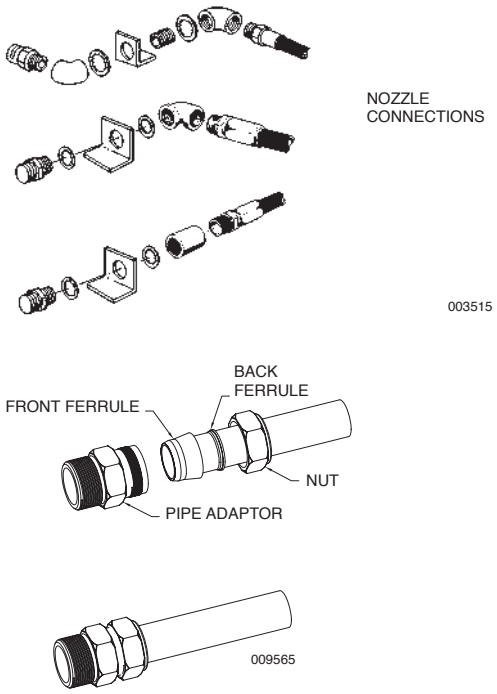


FIGURE 5-7
NOZZLE AND TUBE ADAPTOR INSTALLATION

Note: For stainless steel tubing, adaptors (supplied by others) are required for transitions from NPT threaded components.

Installing Manual Actuators

Three types of manual actuator brackets are available for the LVS/A-101/LT-A-101 systems: “S” bracket, “L” bracket, and cartridge guard. Location of all actuators must not expose actuator to excessive heat, physical abuse, or damage. Actuators using the “S” bracket and the cartridge guard type bracket are suitable for both internal and external mounting. The “L” type bracket is not suitable for external mounting and must be installed in a way that will provide protection for the exposed cartridge.

For CHECKFIRE manual/automatic actuator installation instructions, refer to the following manuals (latest revision) for detailed instructions.

CHECKFIRE 110 System Manual (Part No. 440391)
CHECKFIRE 210 System Manual (Part No. 440392)
CHECKFIRE SC-N Electric System (Part No. 423522)

REMOTE MANUAL ACTUATOR WITH “S” BRACKET

1. If not already done, bolt or weld mounting bracket to selected surface. If welding, to avoid corrosion, paint welded surface. See Figure 5-6, page 5-4.

> ***NOTICE***
>
> When bolting the mounting bracket, use 3/8 in. (corrosion-resistant) bolts of appropriate length with lockwashers and nuts.

2. Unscrew RED actuator button from actuator stem, remove locknut, and slide actuator body through mounting hole on bracket. See Figure 5-8.
3. Rotate actuator body for desired location of actuation hose outlet connection. Screw locknut firmly onto actuator body and insert ring pin. Apply a non-permanent thread adhesive, such as Locktite 242 or equal, to RED actuator button threads and then screw button onto stem. See Figure 5-8.

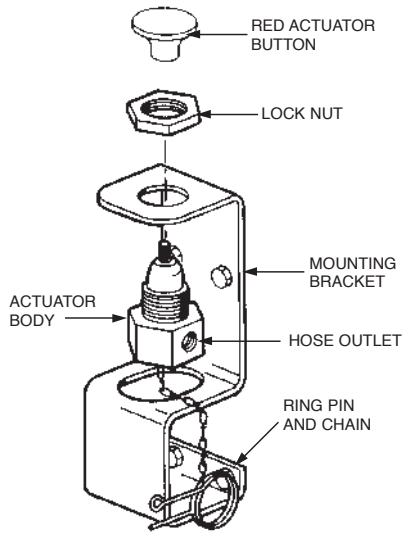


FIGURE 5-8
ASSEMBLE ACTUATOR

INSTALLING COMPONENTS (Continued)

Installing Manual Actuators (Continued)

4. Affix appropriate operating nameplate adjacent to manual actuator so it is visible to attending personnel. See Figure 5-9.

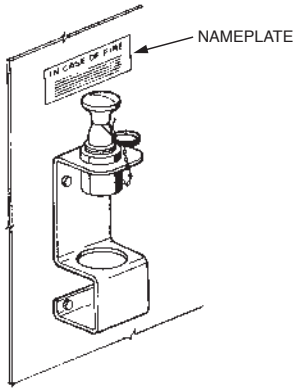


FIGURE 5-9
NAMEPLATE LOCATION
000486

5. Make certain ring pin is inserted through RED actuator button to ensure safe cartridge installation. See Figure 5-10.
6. Seal ring pin to actuator stem with visual seal (Part No. 197). Make certain visual seal is looped through ring pin and around actuator stem. Do not wrap seal around boot cover. See Figure 5-10. DO NOT INSTALL CARTRIDGE AT THIS TIME.

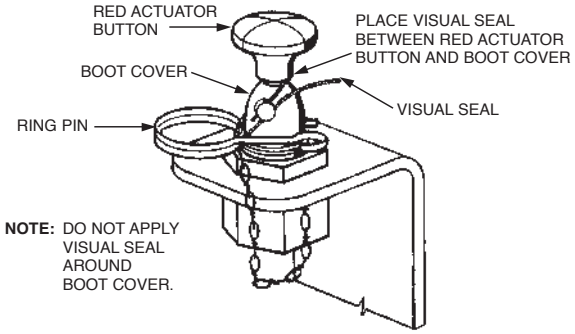


FIGURE 5-10
INSTALL VISUAL SEAL
000487

REMOTE MANUAL ACTUATOR MOUNTED IN DASHBOARD

1. Punch or drill a 1 5/16 in. (33 mm) diameter hole for mounting actuator body. See Figure 5-11. Make certain there is enough room under dash for actuator body, cartridge, and 1/4 in. actuation hose connection.

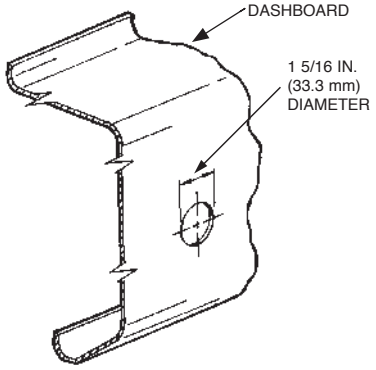


FIGURE 5-11
MOUNTING HOLE FOR ACTUATOR BODY
003511

2. Unscrew RED actuator button from actuator stem, remove locknut, and slide actuator body through mounting hole. See Figure 5-12, pg. 5-7.
3. Rotate actuator body for desired location of actuation hose outlet connection. Screw locknut firmly onto actuator body and insert ring pin. Apply a non-permanent thread adhesive, such as Locktite 242 or equal, to RED actuator button threads and then screw button onto stem. See Figure 5-12, page 5-7.

NOTICE

The ring pin chain may not be long enough in certain dashboard mounted locations. When this occurs, remove chain from drive pin in actuator body and attach it to an appropriate location using either a pop rivet or a sheet metal screw. See Figure 5-12, pg. 5-7.

INSTALLING COMPONENTS (Continued)

Installing Manual Actuators (Continued)

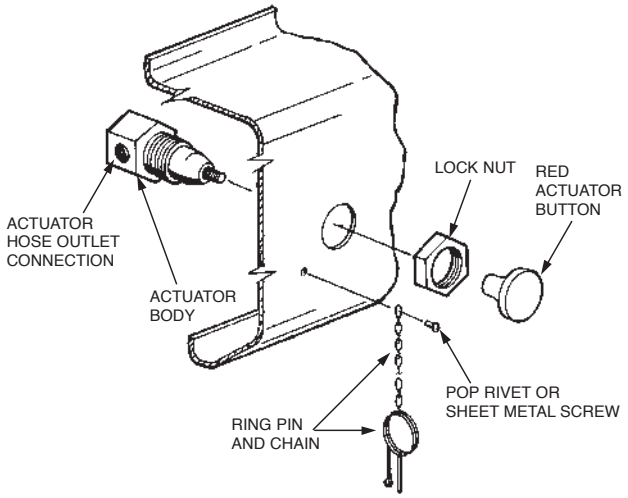


FIGURE 5-12
POSITION HOSE OUTLET
003517

4. Affix appropriate operating nameplate adjacent to manual actuator so that it is visible to attending operator. See Figure 5-13.
5. Make certain ring pin is inserted through RED actuator button to ensure safe cartridge installation. See Figure 5-13.
6. Seal ring pin to actuator stem with visual seal (Part No. 197). Make certain visual seal is looped through ring pin and around actuator stem. Do not wrap seal around the boot cover. See Figure 5-13. DO NOT INSTALL CARTRIDGE AT THIS TIME.

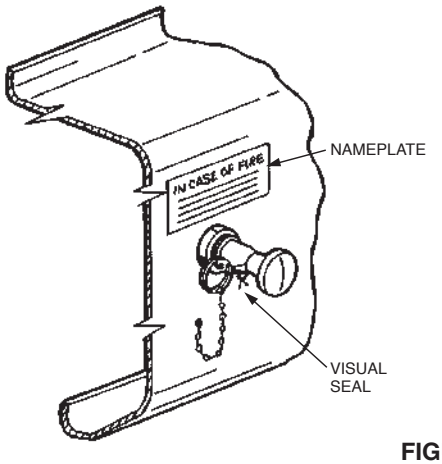


FIGURE 5-13
NAMEPLATE LOCATION
003518

REMOTE MANUAL ACTUATOR WITH “L” BRACKET

NOTICE

Actuator must be installed in a way that will provide protection for the exposed cartridge from physical damage.

1. If not already done, bolt or weld mounting bracket to selected surface. If welding, to avoid corrosion, paint welded surface. See Figure 5-6.

NOTICE

When bolting mounting bracket, use 3/8 in. (corrosion-resistant) bolts of appropriate length with lockwashers and nuts.

2. Unscrew RED actuator button from actuator stem and slide actuator body through mounting hole on bracket.
3. Rotate actuator body for desired location of actuation hose outlet connection. Screw locknut firmly onto actuator body and insert ring pin. Apply a non-permanent thread adhesive, such as Locktite 242 or equal, to RED actuator button threads and then screw button onto stem.
4. Affix appropriate operating nameplate adjacent to manual actuator so that it is visible to attending personnel.
5. Make certain ring pin is inserted through RED actuator button to ensure safe cartridge installation.
6. Seal ring pin to actuator stem with visual seal (Part No. 197). Make certain visual seal is looped through ring pin and around actuator stem. Do not wrap seal around boot cover. See Figure 5-10, page 5-6. DO NOT INSTALL CARTRIDGE AT THIS TIME.

INSTALLING AGENT DISTRIBUTION HOSE/TUBE

General Requirements

Refer to hose/tube routing determined in Section 4 – System Design. Make certain maximum total hose/tube lengths allowed per tank size are not exceeded. Ensure all fittings are tight according to manufacturer recommendations.

Note: When using stainless steel tubing, adaptors (supplied by others) are required for transitions from NPT threaded components.

When installing hose/tube, complete the following steps:

1. Make certain proper type and size of hose/tube is used. The 3/4 in. or 7/8 in. hydraulic hose or 3/4 in. stainless steel tube is used for the supply line (LVS-10, LVS-15 and LVS-30) and secondary supply lines (LVS-30), and 1/2 in. hose/tube is used after the split in the LVS-10 and LVS-15 distribution system or after secondary supply line split in LVS-30, or from outlets in a Distribution Manifold Block. The 1/2 in. hose/tube can also be used for the entire LVS-3 or LVS-5 agent distribution network.
2. Refer to appropriate LVS Tank Size Charts in Section 4 – System Design for tank sizes intended to be used. Remember the LVS-10, LVS-15 and LVS-30 either have to be split using standard tees, or they must utilize one of two styles of Distribution Manifold Blocks.
3. Per SAE J1273, “Care must be taken to insure that fluid and ambient temperatures, both static and transient, do not exceed the hose/tube limitations. Special care must be taken when routing near hot manifolds.”
4. The 150 lb class NPT elbows and tees meeting Hydraulic Hose Fitting Standard J516 can be used with hose or pipe nipples of 6 in. (152 mm) or less, and also with discharge nozzles. Standard NPT elbows and tees must be plated malleable steel or stainless steel.
5. JIC hose fittings meeting Hydraulic Hose Fitting Standard J516 can also be used.
6. When figuring maximum number of elbows in the LVS system, two 45° fittings can be counted as one 90° fitting. Refer to LVS Tank Size Charts, pages 4-12 to 4-17, and General Distribution Network in Section 4 – System Design for maximum elbows allowed.
7. When bends are formed in the distribution system, the following minimum bend radius must not be exceeded:

Hydraulic Hose Size	100R1	100R5	Stainless Steel Tube
1/4 in.	4 in.	3 in.	--
1/2 in.	3 in.	3 in.	3 in.
3/4 in.	3 in.	3 in.	5 in
7/8 in.	—	7 3/8 in.	--

Note: Minimum bend radius is measured to the inside of the hose/tube radius.

8. Use pipe tape to seal threaded hose/tube adaptor connections to pipe threaded fittings, and nozzles. When applying pipe tape, start at the second male thread and wrap tape (two turns maximum) clockwise around threads, away from the open end of hose, fitting, or nozzle.

CAUTION

Do not allow pipe tape to overlap the end of threads. If a piece of tape breaks off and lodges within the fitting, hose/tube, or nozzle, agent discharge could be compromised. Thread sealant or compound must not be used.

Distribution Hose/Tube Installation

1. Follow hose/tube routing determined in Section 4 – System Design; begin installing agent distribution system, starting at LVS tank outlet. Route supply line hose/tube (3/4 in. and/or 1/2 in. with LVS-3 and LVS-5; 3/4 in. with LVS-10, LVS-15 and LVS-30) through protected areas away from high heat. **Note:** It is recommended to install stainless steel tube in areas with temperatures exceeding 200 °F (93 °C). Connect supply line hose/tube to tank outlet and installed supply line tee or Distribution Manifold Block.
   - If LVS-3 or LVS-5 routing only uses 1/2 in. hose/tube, distribution line will need to be reduced at tank using either a 3/4 in. x 1/2 in. bushing or reducing coupling.
   - If Distribution Manifold Block is not installed, either a 1/2 in. x 1/2 in. x 3/4 in. reducing tee is needed to split the LVS-10 or LVS-15 distribution network, or a 3/4 in x 3/4 in. x 3/4 in. primary supply line tee is needed to split the LVS-30 supply line into two 3/4 in. secondary supply lines. The secondary supply lines will be routed between the primary supply line tee and the 1/2 in. x 1/2 in. x 3/4 in. reducing tees.
2. Continue installing 1/2 in. hose/tube from reducing bushing or coupling (LVS-3, LVS-5) or reducing tee(s) (LVS-10, LVS-15, LVS-30), or Distribution Manifold Block to all of the 9.5 agent discharge nozzles.
3. Make certain all hose/tube is routed in an orderly manner and if possible avoid routing hose/tube through fire hazard areas. Tighten all hose/tube and pipe connections securely, and make certain bursting disc union or tank is connected and tightened.
4. Clamp discharge hose/tube securely at least every 5 ft (1.5 m) using industrial duty cable ties or conduit clamps.
5. When connecting hose/tube to nozzles, make certain the aiming angle of each nozzle is not disturbed.
6. When routing hose/tube through bulkheads, take precautions to protect hose/tube from excessive wear due to constant vehicle vibration. Do not pinch hose/tube.
7. When passing through bulkheads or grates, Schedule 40 threaded pipe nipples up to 6 in. (152 mm) in length may be used in the distribution line. ANSUL Approved Quik-Seal Adaptors (Part No. see list) may also be used when hose/tube penetrates bulkheads.

Part No.	Description
78196	1/4 in. (pkg. of 24)
77285	3/8 in. (pkg. of 24)
77287	1/2 in. (pkg. of 24)
77289	3/4 in. (pkg. of 24)

INSTALLING CABLE, ACTUATION, AND EXPELLANT GAS LINE HOSE

If system design includes a CHECKFIRE 110 or CHECKFIRE 210 Detection and Actuation System refer to specific manuals for information regarding release circuit installation (latest revision).

CHECKFIRE 110 System Manual (Part No. 440391)

CHECKFIRE 210 System Manual (Part No. 440392)

CHECKFIRE SC-N and Manual Pneumatic System — General Requirements

1. Use only 1/4 in. hose for actuation and expellant gas lines that meet specifications noted in Section 4 – System Design, page 4-20. Pipe nipples of 6 in. (152 mm) or less in length may also be used.
2. Use pipe tape to seal all actuation and expellant gas line threaded pipe and hose adaptor connections to threaded fittings, and components. When applying pipe tape, start at the second male thread and wrap the tape (two turns maximum) clockwise around the threads, away from open end of hose, fitting, or nozzle.

> ***NOTICE***
>
> Do not allow pipe tape to overlap the end of threads. Pipe tape that lodges within a fitting, hose, or actuation component could block gas pressure. Thread sealant or compound must not be used.

3. When routing hose through bulkheads, take precautions to protect hose from excessive wear due to constant vehicle vibration. Do not pinch hose.
4. When passing through bulkheads or grates, Schedule 40 threaded pipe nipples up to 6 in. (152 mm) in length may be used in the actuation or expellant gas line. ANSUL Approved 1/4 in. HPT Quik-Seal Adaptors (Part No. see list) can also be used when hose penetrates a bulkhead.

Part No.	Description
78196	1/4 in. (pkg. of 24)
77285	3/8 in. (pkg. of 24)
77287	1/2 in. (pkg. of 24)
77289	3/4 in. (pkg. of 24)

5. Cast iron pipe and fittings are not allowed.
6. Per SAE J1273, “Care must be taken to insure that fluid and ambient temperatures, both static and transient, do not exceed limitations of hose.”

Installing the Actuation Gas Line(s) – LVS-3, LVS-5, LVS-10, LVS-15, and LVS-30

When using CHECKFIRE SC-N or manual pneumatic actuation the LVS actuation gas line is the 1/4 in. hose installed from remote actuator(s) to electric-pneumatic actuator(s) located on each LT-A-101 and/or LVS expellant gas cartridge. See Figure 5-14.

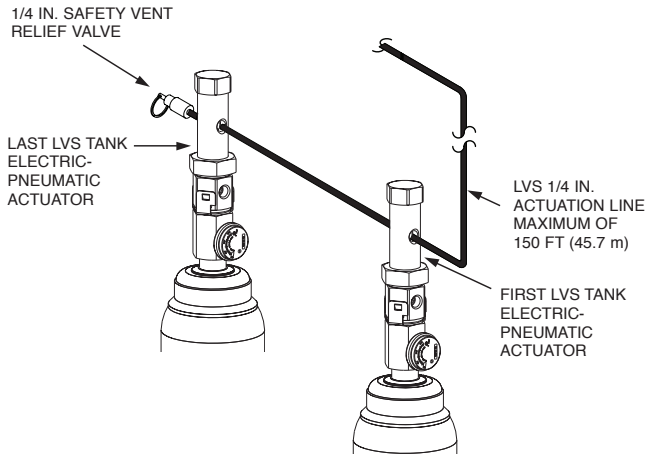


FIGURE 5-14
ACTUATION GAS LINE
009530

1. The maximum length of 1/4 in. actuation hose that may become pressurized from any manual/automatic actuator must not exceed 150 ft (45.7 m), including pressurized line lengths connecting to pneumatically operated auxiliary devices, such as pressure switches and shut down valves.
2. All remote manual/automatic actuators must use the LT-10-R cartridge (Part No. 423423 – Right Hand Threads; or Part No. 423425 – Left Hand Threads).
3. If more than one remote actuator is used in the system, total length of actuation line allowed to be pressurized from any one actuator must also include any amount of hose in other actuation line branches up to the check valves located in those lines.

INSTALLING CABLE, ACTUATION, AND EXPELLANT GAS LINE HOSE (Continued)

Installing the Actuation Gas Line(s) – LVS-3, LVS-5, LVS-10, LVS-15, and LVS-30 (Continued)

ELECTRIC-PNEUMATIC ACTUATOR INSTALLATION

The Electric-Pneumatic Actuator (Part No. 439569) installs on an expellant gas cartridge and can be used as an electronic and/or pneumatic actuation device, see Figure 5-15. The actuator includes a preventor to reduce the possibility of installing actuator with the puncture pin not completely retracted, see Figure 5-16. Do not bend or remove the preventor; it is required for correct operation of the actuator.

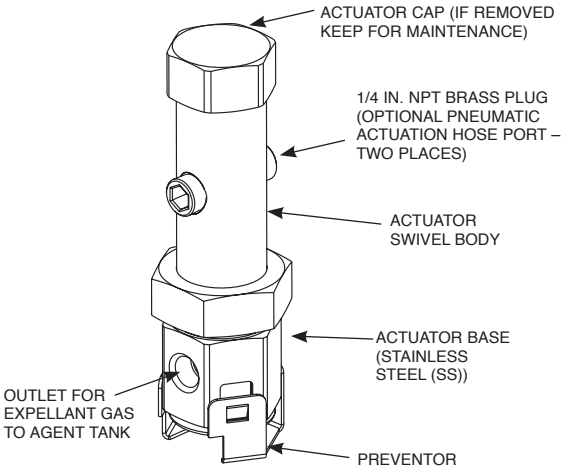


FIGURE 5-15
ELECTRIC-PNEUMATIC ACTUATOR
009528

⚠ WARNING

Before attaching Electric-Pneumatic Actuator to expellant gas cartridge, verify the cartridge is properly secured and confirm puncture pin is in the completely retracted position. See Figure 5-16. If puncture pin is not completely retracted, the seal can become damaged or pierced, which can result in system actuation or serious personal injury or death.

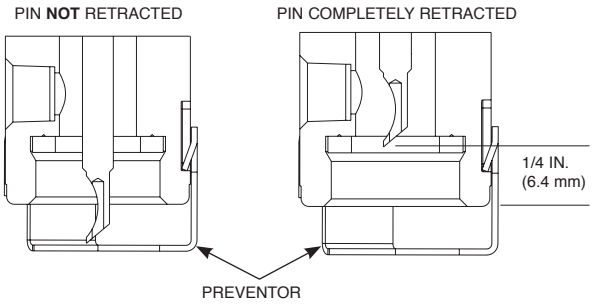


FIGURE 5-16
RETRACT ACTUATOR PUNCTURE PIN
009531/009532

1. To install the actuator, slide the unit onto the expellant gas cartridge from the side. (Cartridge must be properly secured.) Slide Preventor underneath cartridge threads and thread actuator on cartridge. See Figure 5-17.

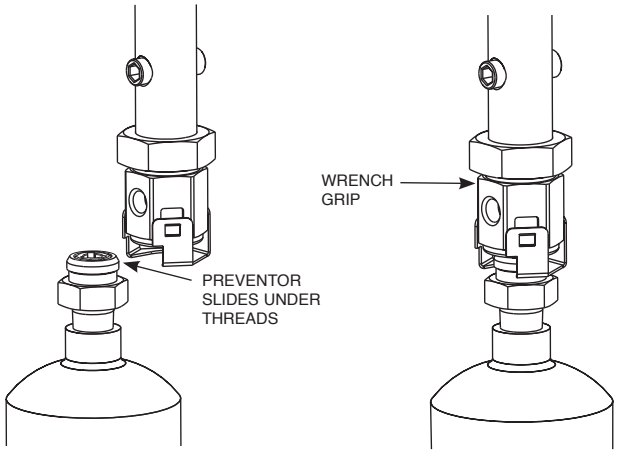


FIGURE 5-17
SLIDE ACTUATOR ONTO CARTRIDGE
009533

2. Wrench-tighten actuator base (SS) to cartridge. **Note:** Wrench grip is above Preventor. See Figure 5-17.
3. Turn cartridge in cartridge bracket (loosen as needed) so expellant gas outlet is in desired orientation, then re-secure cartridge in bracket.
4. Position actuator swivel body in desired orientation and wrench-tighten to actuator base until Preventor is held tight in place. See Figure 5-18.

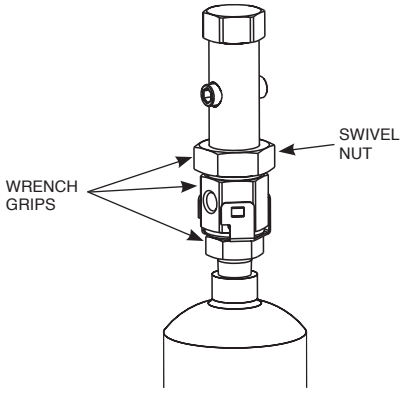


FIGURE 5-18
ACTUATOR INSTALLED ON CARTRIDGE
009534

Once electric-pneumatic actuator is installed, if system design includes a CHECKFIRE 110 or CHECKFIRE 210 Detection and Actuation System refer to specific manual for detailed information regarding release circuit installation (latest revision).

CHECKFIRE 110 System Manual (Part No. 440391)

CHECKFIRE 210 System Manual (Part No. 440392)

CAUTION

Each electric-pneumatic actuator contains two 1/4 in. NPT actuation line ports. If both ports are not utilized, the open ports must be plugged with a 1/4 in. NPT pipe plug. Failure to plug the port will cause loss of actuation gas pressure upon system actuation, causing the system to fail.

INSTALLING CABLE, ACTUATION, AND EXPELLANT GAS LINE HOSE (Continued)

Installing the Actuation Gas Line(s) – LVS-3, LVS-5, LVS-10, LVS-15, and LVS-30 (Continued)

CHECKFIRE SC-N OR MANUAL PNEUMATIC SYSTEM

1. Leave brass actuator cap on electric-pneumatic actuator in place.
2. Install required 1/4 in. actuation lines from the manual actuators to all actuation ports on the upper portion of each electric-pneumatic actuator. **Note:** A check valve is required in the actuation line branch from each manual/automatic actuator used. See Figure 5-19.

CAUTION

Do not route actuation hose through fire hazard areas. Fire could damage hose, causing the system to not operate properly or fail. If routing through the fire hazard area cannot be avoided, make certain properly installed extreme temperature, fire jacket is used to protect hose from the heat.

3. Once all lines are securely installed, wrench tighten swivel nut on upper portion of each electric-pneumatic actuator.

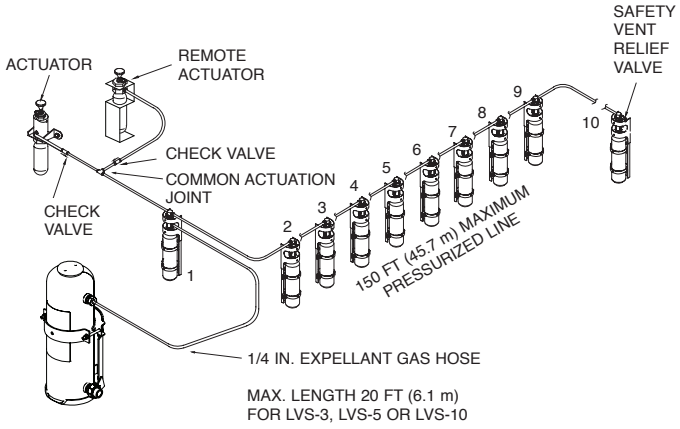


FIGURE 5-19
ACTUATION LINE
008758

4. Install safety vent relief valve on last electric-pneumatic actuator.

Installing Expellant Gas Line(s) – LVS-3, LVS-5, LVS-10, LVS-15, and LVS-30

The expellant gas line is the 1/4 in. hose located between the pneumatic actuator on nitrogen cartridge and the pressure inlet on agent tank.

LVS-3 – Requires an LT-30-R nitrogen cartridge, electric-pneumatic actuator, and bracket assembly (Part No. 442586 or 442587 (CE)) to pressurize the LVS liquid agent storage tank and expel agent from tank. A 1/4 in. hose, meeting the specifications noted in Section 4 – System Design, page 4-20, must be used. The maximum length of 1/4 in. expellant gas line is 20 ft (6.1 m).

LVS-5, LVS-10 – Require an LT-A-101-30 nitrogen cartridge, electric-pneumatic actuator, and bracket assembly (Part No. 24883 or 431735 (CE)) to pressurize the LVS liquid agent storage tank and expel agent from tank. A 1/4 in. hose, meeting the specifications noted in Section 4 – System Design, page 4-20, must be used. The maximum length of 1/4 in. expellant gas line is 20 ft (6.1 m).

LVS-15, LVS-30 – The expellant gas line for the LVS-15 and LVS-30 tank assemblies is a 24 in. (610 mm), 1/4 in. rubber hose (included with the shipping assemblies). This expellant gas line is to be installed between the bottom outlet port of each electric-pneumatic actuator and the pressure inlet port on the side of each corresponding LVS tank.

1. Before installing expellant gas hose, install a 1/4 in. street elbow (included) into the inlet coupling on side of LVS tank and install a second 1/4 in. street elbow (included) into the bottom port of pneumatic actuator. See Figure 5-20. Use Teflon tape on male elbow threads. Position elbows to insure a smooth transition into 1/4 in. hose when attached.
2. Securely attach hose as shown in Figure 5-20.

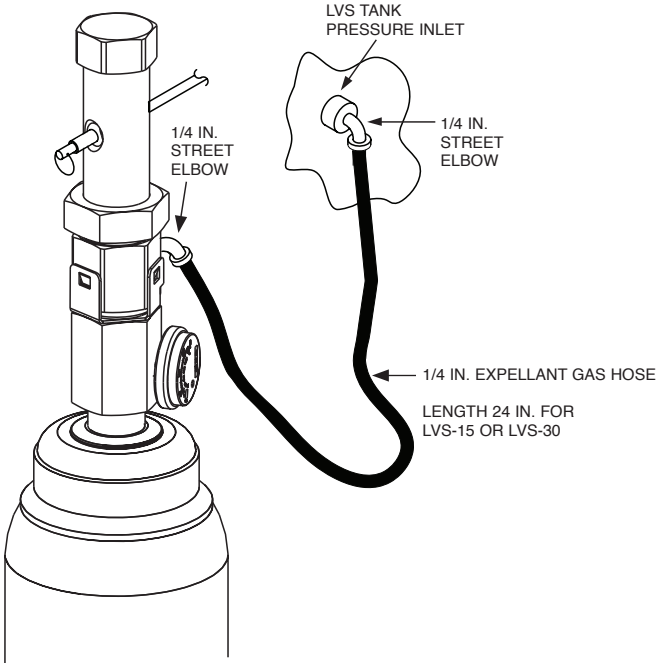


FIGURE 5-20
EXPELLANT GAS HOSE
009535

FILLING THE LVS TANK

After all components are installed, LVS tanks must be filled with LVS wet chemical agent (see list). Confirm the tank is securely mounted in place.

- 3 gal (11.4 L) Pail Part No. 441775
  5 gal (18.9 L) Pail Part No. 426961

If provided, pull ring pin on safety vent relief valve located on top of LVS tank to relieve residual pressure. After pressure is relieved, confirm saftey relief valve returns to set position.

Remove fill cap and carefully pour appropriate amount of agent into tank (see table). Use a funnel with strainer and an approximately 3 ft (0.9 m) long hose to help reduce agent foaming for easier filling of tank (keep hose-end near bottom of tank). Mixing or stirring is not required.

NOTICE

Make certain LVS-15 and LVS-30 fill cap indicator stem is in the down position.

Once filled, securely hand-tighten fill cap and confirm tank is securely mounted in place.

Tank Assembly	Qty. LVS Agent	Approximate Fill Level*
LVS-3	3 gal (11.4 L)	3 in. ± 0.5 in. (76 mm ± 13 mm)
LVS-5	5 gal (18.9 L)	5 in. ± 0.5 in. (127 mm ± 13 mm)
LVS-10	10 gal (37.9 L)	4 in. ± 0.5 in. (102 mm ± 13 mm)
LVS-15	15 gal (56.8 L)	4 in. ± 0.5 in.) (102 mm ± 13 mm)
LVS-30	30 gal (113.6 L)	12 in. ± 0.5 in. (305 mm ± 13 mm)

* From top of fill opening, tank in vertical position.

When LVS-3 and LV-5 tanks are not vertical, remove tank from bracket and fill in a vertical position (confirm tank is in a stable location). Replace tank in bracket, verify outlet is in the correct position, (refer to page 5-2, step 1), and tighten securely.

When LVS-10 tanks are in the horizontal position, pour agent through expellant gas check valve port by removing the 1 1/2 in. adapter and following the above LVS agent filling procedure. Level of agent will be approximately 3.5 in. ± 0.5 in. (89 mm ± 13 mm) from top of the opening. Once filled, carefully apply thread tape to adaptor threads and re-install adapter. Wrench tighten.

INSTALLING DETECTION SYSTEM

The detection system can be any approved ANSUL CHECKFIRE Electric Detection and Actuation System. Follow guidelines stated in the appropriate CHECKFIRE manual (latest revision).

- CHECKFIRE 110 System Manual (Part No. 440391)
- CHECKFIRE 210 System Manual (Part No. 440392)
  CHECKFIRE SC-N System Manual (Part No. 423522)
  CHECKFIRE MP-N System Manual (Part No. 427310)

INSPECTION

Inspection is a "quick check" verifying that the fire suppression system does not have any noticeable conditions that could render the system inoperable. It is intended to give a level of assurance that the system is charged and will likely operate. It is important to verify that the system has not been tampered with and there is no obvious physical damage or condition to prevent operation. The value of an inspection lies in the frequency and the thoroughness with which it is conducted. The Vehicle Fire Protection Owner's Manual (Part No. 53081) addresses some of the basic vehicle fire preventative maintenance procedures that should be considered, which may be in addition to those outlined by the vehicle manufacturer. The manual also outlines basic fire suppression and detection inspection requirements by the owner, vehicle service personnel, or vehicle operator.

Inspection frequency shall be performed monthly, or sooner, depending on operating and/or environmental conditions (by competent personnel following an approved schedule necessitated by conditions as determined by the owner, maintenance supervisor, or operator). The following steps include, but are not limited to, inspection procedures that should be followed to provide reasonable assurance that your ANSUL LVS, or LVS/LT-A-101 Twin-Agent System is charged and operable:

1. Note general appearance of system components (e.g. document and/or report any noticeable mechanical damage, corrosion, or missing fire system/detection components).
2. Make sure all connections are tight, securely fastened and not cut or showing signs of pinching, collapse, or abrasion.
3. Report all loosened or unconnected fittings. Make certain they are tight.
4. Check to make certain all cartridges are in place. Ensure that all manual and manual/automatic actuators are ring pinned and sealed with visual seals, and that the seals are intact.
5. Make certain the nozzles are tightly secured in their brackets and aimed at the hazard area(s). Check to make certain the blow-off caps are properly installed.
6. Check nameplate(s) and additional remote labels for readability and make certain they are properly attached.
7. Make certain the indicator stem on the LVS-15 or LVS-30 agent tank (and the LT-A-101-125/250 dry chemical tank(s) in a twin-agent system configuration) fill cap is in the down position. **Note:** When utilizing the LVS in a twin-agent configuration, the LT-A-101-125/250 tanks will also require similar inspection.
8. For the LVS-15 and LVS-30 tanks (and the LT-A-101-125/250 dry chemical tank(s) in a twin-agent system configuration), check the pressure gauge on the nitrogen cartridge. Make certain the arrow is pointing within the correct pressure range.
9. The automatic detection system should be inspected per appropriate detection system manual (latest revision). Verify the GREEN Power LED is green, displaying correctly and no other LEDs are flashing.

   CHECKFIRE 110 System Manual (Part No. 440391)
   CHECKFIRE 210 System Manual (Part No. 440392)
   CHECKFIRE SC-N System Manual (Part No. 423522)
10. Check to make certain the hazard size or components being protected have not changed since the original installation.
11. Check any hand portable fire extinguishers onboard the vehicle to make certain they are securely mounted and not damaged, corroded, or have excessive wear. If the extinguisher is a stored pressure model, make certain the pressure gauge arrow is pointing within the correct pressure range. Verify a visual seal is in place and that the distributor certification tag is attached and current.
12. If there are any broken or missing visual seals on any fire system manual or manual/automatic actuators, any hand portable fire extinguishers on board, or any other deficiency is noted, immediately contact an authorized ANSUL vehicle system distributor to evaluate and correct any problem or deficiency. **Note:** It is recommended that noted deficiencies that could render the fire suppression system inoperable or ineffective, be resolved before the vehicle is returned to service.
13. Keep a permanent record of each inspection.

NOTES:

MAINTENANCE

Maintenance is a "thorough check" of the system. It is intended to give maximum assurance that the system will operate effectively and safely. It includes a thorough examination and any necessary repair or replacement. It will normally reveal if there is a need for hydrostatic testing of the tank.

Maintenance shall be performed semi-annually or sooner, depending on operating and/or environmental conditions. The fire suppression system, including alarms, shutdown and associated equipment shall be thoroughly examined and checked for proper operation by an authorized ANSUL vehicle system distributor or their trained and responsible designee in accordance with this manual.

SEMI-ANNUAL MAINTENANCE

To provide maximum assurance the ANSUL LVS (or LVS/LT-A-101 twin-agent) system will operate effectively and safely:

1. General – Check to see the hazard(s) has not changed, or additional vehicle equipment has not been added since the original fire suppression system design.
2. For a CHECKFIRE SC-N or manual pneumatic actuation, safely disarm the fire suppression/detection system for service; remove LT-10-R system actuation cartridges from each manual and manual/automatic actuator.
   - Install a safety shipping cap on each removed cartridge and set aside in a safe location.
   - CHECKFIRE System – Follow maintenance instructions for appropriate CHECKFIRE system; refer to specific manual (latest revision):

CHECKFIRE 110 System Manual	(Part No. 440391)
CHECKFIRE 210 System Manual	(Part No. 440392)
CHECKFIRE SC-N System Manual	(Part No. 423522)
CHECKFIRE MP-N System Manual	(Part No. 427310)

CAUTION

The cartridge must be removed and squib, PAD, or gas motor disconnected before continuing with the following steps or accidental actuation and subsequent system discharge will take place when either squib, PAD, or gas motor is activated.

3. Note general appearance of the fire suppression/detection system components, checking for mechanical damage or corrosion, and check that components are securely fastened and all hose fittings are tight. Replace if necessary.
4. Check nameplates and additional remote labels to make certain they are clean, readable, and properly attached. Replace if necessary.
5. LVS Agent Storage Tanks – If provided, pull ring on safety relief valve on top of tank to relieve any possible pressure build-up; remove tank fill cap and check the wet chemical level **from top of the fill opening.**

   If LVS-3 and LVS-5 tanks are not in a vertical position, remove from bracket and set upright to confirm agent level. Return to same postion and securely tighten bracket.

Tank Assembly	Approximate Fill Level*	
LVS-3	3 in. ± 0.5 in.	(76 mm ± 13 mm)
LVS-5	5 in. ± 0.5 in.	(127 mm ± 13 mm)
LVS-10	4 in. ± 0.5 in.	(102 mm ± 13 mm)
LVS-15	4 in. ± 0.5 in.)	(102 mm ± 13 mm)
LVS-30	12 in. ± 0.5 in.	(305 mm ± 13 mm)

   * From top of fill opening, tank in vertical position.

   When LVS-10 tanks are installed in the horizontal position, the approximate level is 3.5 in. ± 0.5 in. (89 mm ± 13 mm) from top of opening when measured through the expellant gas port.
6. Inspect and clean threads on fill cap and tank fill opening. Ensure threads are in good condition with no nicks, burrs, or cross-threading.
7. Check fill cap quad ring and/or flat gasket for elasticity, cuts, checking, or other irregularities and replace, if necessary. Lightly coat quad ring and/or flat gasket with an extreme temperature silicone grease, such as Dow Corning No. 4 or equal. Make certain indicator stem is in DOWN position for the LVS-15 and LVS-30 tanks. Reinstall fill cap and hand tighten.
8. Disconnect the discharge union assembly from sealed burst disc assembly and examine burst disc for any dents or damage. Replace if damaged. **Note**: Removing disk, drains tank. See Section 8 - Recharge.
9. Agent Distribution Hose/Nozzles – With discharge hose disconnected from the tank burst disc assembly, blow dry air or nitrogen gas through the agent discharge hose lines at approximately 100 psi (6.9 bar) to make certain hoses are not plugged with debris or contain moisture. **Note:** Before performing this procedure, ensure all nozzle blow-off caps are properly installed.
   - Disassemble any hose segments that do not have pressure discharging from the nozzles, or that show signs of debris at the nozzles. Make certain any blockage or debris buildup is located and cleaned out of hose and nozzles. Replace if necessary.
   - Inspect hose and hose fittings for damage. Replace if necessary.
10. Reinstall all disconnected hoses.
11. Apply a thin coat of extreme temperature silicone grease, such as Dow Corning No. 4 or equal, to male threads of the discharge union assembly and reconnect to sealed burst disc assembly.
12. Confirm nozzles are tightly secured in brackets, nozzle openings are not obstructed, and nozzles are properly aimed and have not rotated out of position.

SEMI-ANNUAL MAINTENANCE (Continued)

13. Make certain each nozzle has a blow-off cap properly installed, confirm caps are clean, pliable, and undamaged. Caps must be securely in place with enough room to easily blow off in the event of a discharge. Replace if damaged or missing. **Note: Blow-off caps must be replaced annually.**

▸ 14. Pneumatic Actuator (Part No. 430221) – Unscrew pneumatic actuator(s) from nitrogen cartridge(s) and inspect all threaded areas for nicks, burrs, and cross-threads.

▸ 15. Clean actuator(s):

▸ PNEUMATIC ACTUATOR (PART NO. 430221)
See Figure 7-1

- Using two wrenches, one positioned on swivel nut, and one positioned on the bottom portion of the actuator, loosen swivel nut and remove top portion of the actuator.
- Using a wooden dowel, push pin assembly and spring out of the actuator body.
- ▸ Remove cartridge receiver flat gasket (Part No. 181) from inside cartridge thread port. Inspect, clean, apply a good grade of low temperature grease, such as Dow Corning No. 4, and reinstall gasket. Replace at least
- ▸ semi-annually.
- Remove the o-rings from pin assembly and swivel adaptor. Inspect, clean, apply a good grade of low temperature grease, such as Dow Corning No. 4, and reinstall the o-rings. Replace as necessary.
- Apply a small amount of grease to puncture pin shaft. There is a U-Cup guide inside the actuator body and when pin is reinstalled into body, grease on the shaft will lubricate U-Cup.
- Clean inner surface of the actuator body and, using a small diameter wire, clean the vent hole. **Make certain not to scratch the inner surface.**
- Reinstall spring onto puncture pin shaft and insert into actuator body. Push pin down several times to allow grease to coat U-Cup. When positioned back in body, make certain tip of pin is above gasket in bottom of actuator.
- To minimize potential of moisture or dirt entering actuator, apply a thin coat of a good grade of extreme temperature silicone grease, such as Dow Corning No. 4 or equal, over the vent hole.

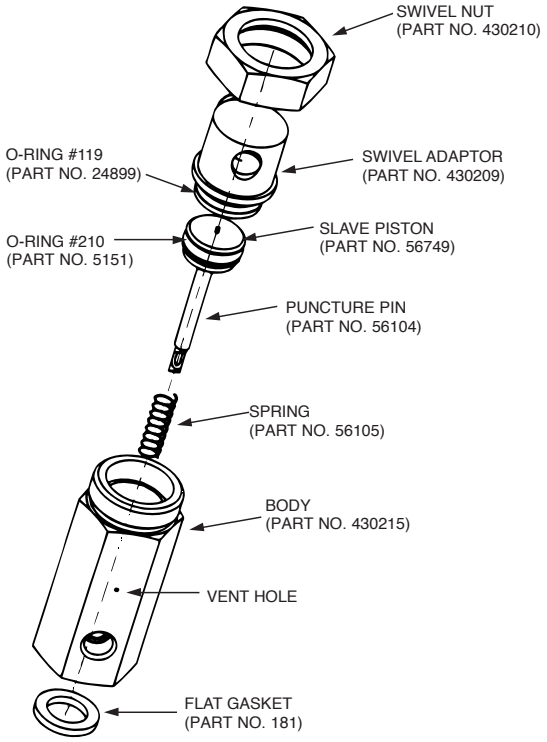


FIGURE 7-1
PNEUMATIC ACTUATOR
006195

Note: It may be necessary to remove actuation and/or expellant gas line hose from the pneumatic actuator to service actuator.

ELECTRIC-PNEUMATIC ACTUATOR (PART NO. 439569)
See Figure 7-2

- If a release circuit drop cable is attached, refer to specific CHECKFIRE manual, see step 2, page 7-1, to complete maintenance on actuator.
- If needed, remove 1/4 in. gas actuation hose(s).
- Loosen and slide base of Electric-Pneumatic Actuator sideways to remove from each expellant gas cartridge.

CAUTION

If Electric-Pneumatic Actuator is difficult to remove, puncture pin is not fully retracted. Do not force.

SEMI-ANNUAL MAINTENANCE (Continued)

15. Clean actuator(s): (Continued)

    ELECTRIC-PNEUMATIC ACTUATOR (PART NO. 439569) See Figure 7-2 (Continued)

    • Disassemble actuator and inspect for damage. Remove puncture pin spring and pull puncture pin out of body being careful not to bend puncture pin. Retain all parts for re-assembly. See Figure 7-2.

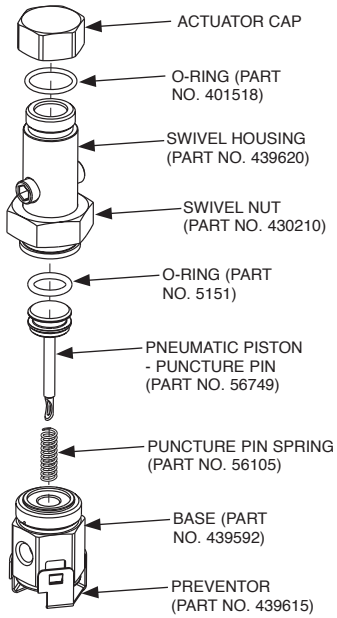


FIGURE 7-2
ELECTRIC-PNEUMATIC ACTUATOR
009538

    • Inspect and replace all damaged components (i.e. o-rings, flat gaskets, etc.).
    • Lubricate all o-rings with Dow Corning #4 (or equal) and reinstall.
    • Replace flat gasket semi-annually and lubricate.
    • Install spring on puncture pin and insert into body. Push down several times to confirm ease of movement.
    • Reassemble actuator.
    • Install actuator cap. (Ensure cap is tight for testing the actuation lines.) Pressure test actuator using dry air or nitrogen.

⚠ WARNING

Actuator must be removed from expellant gas cartridge and be fully assembled before pressure testing. Failure to do so could result in serious personal injury or death.

16. Reinstall swivel adaptor in correct position for actuation lines and wrench tighten the swivel nut. Make certain all actuation and expellant lines are properly tightened into actuator(s) and safety vent relief valve is installed.

17. Actuation Hose Line – With pneumatic actuators completely reassembled and in actuation line, disconnect 1/4 in. actuation line from manual or manual/automatic actuator and pressurize the actuation line with dry air or nitrogen gas to 300 psi (20.7 bar). Confirm integrity of the following components.

CAUTION

Make certain pneumatic actuators are not connected to expellant gas cartridges or accidental actuation and subsequent system discharge will take place when actuation line is pressurized.

    • Check Valve – Verify proper check valve installation and operation. The check valve installed in actuation branch being tested must allow flow of actuation pressure through it to activate all pneumatically operated devices in the line. All other check valves NOT located in actuation branch being tested, must hold actuation line pressure and not allow pressure to escape through valve.
    • Pressure Switches/Pressure Operated Auxiliary Devices – Verify proper operation of all approved pneumatically operated devices.
    • Pneumatic Actuator(s) – Examine operation of each pneumatic actuator, verifying each actuator pin is extended, simulating puncturing the expellant gas cartridge seal.
    • Hose/Hose Connections – Check to make certain pressure does not leak from hose and hose connections. If hose bubbles or leaks pressure through hose section, replace hose. If leaks occur at fittings, make certain they are sealed with pipe tape and are tightened. Replace if needed.
    • Safety Relief Valve – Verify safety relief valve operation. The relief valve should release excess pressure and retain approximately 26.5 psi (18.3 bar) to actuate and hold pneumatic actuators in the actuated position. After successful operation of all devices has been verified, manually relieve residual actuation line pressure by pulling the ring on the safety relief valve. After pressure is released, ensure safety relief valve properly resets and all pneumatic actuator puncture pins fully retract at least 1/4 in. (6 mm) from the bottom edge of the actuator cartridge receiver threads. If an actuator pin does not fully retract smoothly, disassemble and visually recheck inside of actuator body and confirm plunger is properly lubricated and not damaged. Re-verify operation manually and re-assemble.

    Reset all auxiliary equipment and repeat procedure for each manual and manual/automatic actuator.

18. Check all gauges on the 23 ft^3 (0.7 m^3) nitrogen cartridge (LVS-15) or the 55 ft^3 (1.6 m^3) nitrogen cartridge (LVS-30). The needle must be in the black “normal” operating range.

19. Weigh the LT-30-R cartridge for LVS-3 and LT-A-101-30 cartridge, for LVS-5 and LVS-10. Cartridges must weigh ± 1/2 oz (14.2 g) from the weight stamped on the cartridge. Weigh cartridge with the shipping cap removed.

SEMI-ANNUAL MAINTENANCE (Continued)

20. Reinstall pneumatic actuator onto the cartridge. Hand ▸ tighten. If servicing LVS-3, LVS-5 or LVS-10, it is necessary to loosely install LT-30-R, and LT-A-101-30 cartridge in the bracket first. Then re-install the electric-pneumatic actuator assembly.
21. Secure assembly into the bracket.
22. Remote Manual, Manual/Automatic Actuators – Carefully remove cartridge receiver flat gasket from remote manual actuator(s) and CHECKFIRE manual/automatic actuator, if used. Examine flat gasket for elasticity, cuts, and checking; and lubricate it with a light coat of extreme temperature silicone grease, such as Dow Corning No. 4 or equal. ▸ Re-install gasket. Replace flat gasket semi-annually.

    Note: Over time the flat gasket may experience a "set" condition where the cartridge seals against the gasket. If flat gasket can no longer provide a seal for cartridge, or if there is damage to the gasket, replace.
23. Inspect threaded areas of the actuator for nicks, burrs, or cross-threading and clean them with a stiff bristle (non-metal) brush.
24. With cartridge removed, pull ring pin and manually operate actuator to test puncture mechanism for free movement.
25. Next, remove puncture pin by disassembling actuator and examine pin to ensure it is sharp, straight, and free of corrosion.
    - With ring pin installed, remove red push knob at the top of actuator by unscrewing knob from puncture pin assembly.
    - Push down on puncture pin to remove pin from actuator body.
26. Without removing the o-ring from puncture pin, examine o-ring. If it is not damaged, lubricate o-ring while in place and reassemble the actuator, reversing the previous steps.
27. ▸ With ring pin properly installed, attach a visual seal (Part No. 197) to each actuator stem so that when the ring pin is ▸ pulled, visual seal will break.
28. Weigh each LT-10-R actuator cartridge. Weight must be within ± 1/4 oz (7.1 g) from weight stamped on cartridge. Weigh cartridge with safety shipping cap removed.
29. For dry chemical and automatic detection systems, refer to the appropriate A-101/LT-A-101 Installation, Recharge, Inspection, and Maintenance Manual and the appropriate CHECKFIRE Electric Detection and Actuation System Manual for detailed maintenance steps.
30. After all actuation devices are re-armed and CHECKFIRE system is fully operable and reset, record date of maintenance and inform personnel the system is back in operation.

1-YEAR MAINTENANCE EXAMINATION

Along with the required semi-annual maintenance steps, at 1-year intervals the LVS Wet Chemical agent must be checked. A sample of the agent must be taken from the tank and accurately tested to determine agent properties are in compliance with ANSUL Quality Control Standards. See Field Inspection Instructions, page 7-5.

12-YEAR MAINTENANCE EXAMINATION

Along with the required semi-annual maintenance steps, at 12-year intervals the following steps are required:

1. The LVS tank must be hydro-tested. See ANSUL Technical Bulletin No. 50, "Hydrostatic Retest Requirements For ANSUL Portables, Wheeled Units, and Pre-Engineered Vessels" (Form No. F-81301, latest revision), for detailed hydrostatic test requirements.
2. The wet chemical agent must be removed from the tank and discarded. Replace with clean, new agent.
3. All actuation hoses must be hydrostatic tested to 1000 psi (68.9 bar) or replaced.
4. All cartridges, except for LT-10-R or LT-10-L nitrogen cartridges require hydrostatic testing in accordance with CFR 49, Code of Federal Regulations, or NFPA requirements. If the cartridge is pressurized and NOT installed in a vehicle fire suppression system, a 5 or 10-year Department of Transportation (DOT) hydrostatic test interval may be required, depending on whether the cartridge is carbon dioxide (CO_2) – 5 years, or nitrogen (N_2) – star stamped 10 years. If the cartridge is installed in a vehicle fire suppression system and is NOT being shipped or transported, a 12-year NFPA hydrostatic test interval may be utilized.
5. All outdated cartridges must be removed from the system, discharged, and returned to Tyco Fire Protection Products for hydrotesting. Refer to ANSUL Technical Bulletin No. 50, "Hydrostatic Retest Requirements For ANSUL Portables, Wheeled Units, and Pre-Engineered Vessels" (Form No. F-81301, latest revision), for detailed hydrostatic test requirements.

FIELD INSPECTION INSTRUCTIONS FOR LVS WET CHEMICAL

LVS wet chemical should be field inspected annually. These results should be documented and filed with other LVS system maintenance records.

The agent should be checked for three parameters: appearance (color and clarity), pH, and freeze point. To measure these parameters, a small sample of agent should be removed from each tank. This should be done when performing the annual maintenance examination.

Appearance

Remove approximately 1 quart (0.94 L) of agent from tank. In a clean, clear plastic container, note the color and clarity of agent. The agent should have a clear, water-white appearance.

pH

Using a portable pH meter (Cole-Parmer Cat. #P-59000-70 or equivalent), measure the pH of agent. The pH reading should be a minimum of 9 s.u.

Freeze Point

Use a hydrometer calibrated for measuring the freeze point of antifreeze solution. Draw a sample of the LVS agent into hydrometer. The reading on the hydrometer should read a temperature of –50 °F (–46 °C) or lower. (A device similar to the E-Z Red Battery Hydrometer, purchased from www.batterystuff.com, may be used.)

At the conclusion of these tests, return sample of agent back into the tank. If one or more of the test results is unsatisfactory, contact Distributor Technical Services, 715-735-7411 or (800) 862-6785.

Tyco Fire Protection Products recommends that a 1 quart (0.94 L) sample of LVS agent be sent back to Tyco Fire Protection Products every two years for a complete analysis. Ship sample in a clean, plastic sealable container suitable for shipping.

NOTES:

RECHARGE

The first concern in Recharge is to determine the cause of the system discharge and to have the problem corrected before rearming the fire suppression system.

In the event of system discharge, the vehicle must not be returned to service until the system has been recharged and repaired, if necessary.

The system must be recharged immediately after use. A fire condition can result in damage to fire suppression system and detection system components, as well as hose/tube, nozzles, and possibly other mounting hardware and supports. Check all components for possible damage, including hose/tube supports, hose/tube, and all fitting connections. Remove all nozzles and inspect for damage, corrosion, or obstructions. Clean and re-install, making certain they are aimed correctly. All nozzle blow-off caps (Part No. 434403, pkg. of 50) must be replaced after a fire.

In addition to the semi-annual maintenance steps, after a system discharge, complete the following steps:

1. If provided, pull the ring pin on the safety relief valve located on the actuation line to relieve the pressure in the lines. After pressure is released, confirm safety relief valve returns to set position.
2. If available, pull ring pin on safety relief valve(s) located on LVS tank(s) that incorporate the device, to relieve any residual pressure in the tank. After pressure is released, confirm safety relief valve returns to set position.
3. Remove all empty nitrogen cartridge(s) on the LVS tank(s) and attach a safety shipping cap to each cartridge removed.
4. The LVS tanks and discharge hoses/tubes must be flushed with water after a discharge. To accomplish this:
   a. Remove the fill cap from the LVS tank and fill tank with clean water, see table for per tank quantity. Reinstall fill cap, hand tight.

Tank	Minimum Water Qty. gal	(L)
LVS-3, LVS-5	2	(7.6)
LVS-10	5	(18.9)
LVS-15, LVS-30	10	(37.9)

   Note: If recharge is occurring where conditions are below 32 °F (0 °C), the flushing solution is to be a mixture of 50% antifreeze (automotive antifreeze) and 50% water.

   b. Attach the blow down adaptor (Part No. 427560) to the electric-pneumatic actuator. See Figure 8-1.

   Note: If LVS tank utilizes a burst disc assembly, the 1/4 in. port in the blow down adaptor is not used and must be plugged with a 1/4 in. pipe plug (included with adaptor).

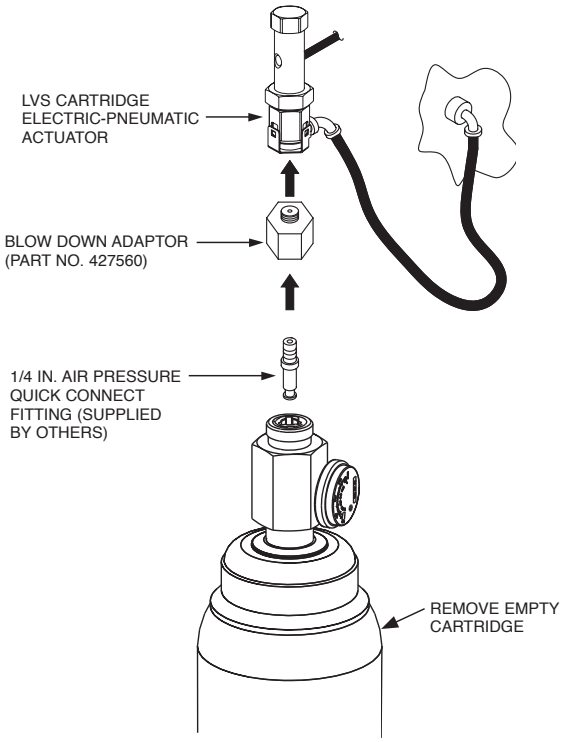


FIGURE 8-1
009539

   c. Attach a regulated supply of dry air or nitrogen to the blow down adaptor. Regulator should be set to approximately 100 psi (6.9 bar).
   d. Apply pressure and allow all the water to discharge through the system. Continue to allow the pressure to blow through the tank and hose for at least 30 seconds after all water has been discharged.
   e. Once completed, disconnect nitrogen or air supply, disconnect adaptor, and install NEW blow-off caps on all nozzles.
5. Replace ruptured sealed burst disc assembly (Part No. 428363, pkg. of 15). Remove used disc assembly from tank outlet. Clean tank threads. Apply Teflon tape to male threads on new burst disc assembly and install to tank outlet. Wrench tighten.

6. LVS tanks must be filled with LVS wet chemical agent (confirm the tank is securely mounted in place).
   3 gal (11.4 L) Pail Part No. 441775
   5 gal (18.9 L) Pail Part No. 426961

   If provided, pull ring pin on safety relief valve located on top of LVS tank to relieve residual pressure. After pressure is relieved, confirm saftey relief value returns to set position.

   Remove fill cap and carefully pour appropriate amount of agent into tank (see table). Use a funnel with strainer and approximately 3 ft (0.9 m) long hose to help reduce agent foaming allowing easier filling of tank (keep hose-end near bottom of tank). Mixing or stirring is not required.

> ***NOTICE***
>
> Make certain LVS-15 and LVS-30 fill cap indicator stem is in the down position.

   Once filled, securely hand-tighten fill cap and confirm tank is securely mounted in place.

Tank Assembly	Qty. LVS Agent	Approximate Fill Level*
LVS-3	3 gal (11.4 L)	3 in. ± 0.5 in. (76 mm ± 13 mm)
LVS-5	5 gal (18.9 L)	5 in. ± 0.5 in. (127 mm ± 13 mm)
LVS-10	10 gal (37.9 L)	4 in. ± 0.5 in. (102 mm ± 13 mm)
LVS-15	15 gal (56.8 L)	4 in. ± 0.5 in.) (102 mm ± 13 mm)
LVS-30	30 gal (113.6 L)	12 in. ± 0.5 in. (305 mm ± 13 mm)

   * From top of fill opening, tank in vertical position.

   When LVS-3 and LV-5 tanks are not vertical, remove tank from bracket and fill in a vertical position (confirm tank is in a stable location). Replace tank in bracket, verify outlet is in the correct position, (refer to page 5-2, step 1), and tighten securely.

   Note: When tightening bolt in bracket clamp arm(s), tighten until contact is made between both arm surfaces.

   When LVS-10 tanks are in the horizontal position, pour agent through expellant gas check valve port by removing the 1 1/2 in. adapter and following the above LVS agent filling procedure. Level of agent will be approximately 3.5 in. ± 0.5 in. (89 mm ± 13 mm) from top of fill opening. Once filled, carefully apply thread tape to adaptor threads and re-install adapter. Wrench tighten.

7. Disassemble and clean the electric-pneumatic actuator by following the instructions in Step No. 15, Section 7 – Maintenance.

8. Make certain electric-pneumatic actuator puncture pin is in the fully retracted position. See Figure 8-2.

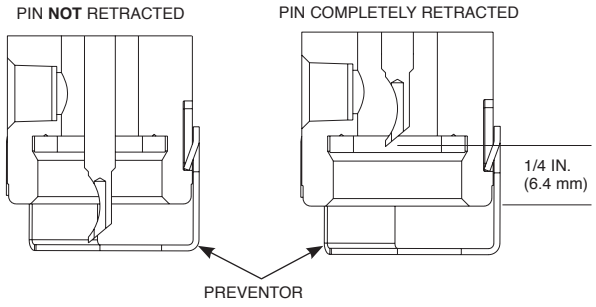


FIGURE 8-2
009531/009532

9. Install the electric-pneumatic actuator to a fully charged nitrogen cartridge.

Tank	Nitrogen Cartridge
LVS-3	LT-30-R
LVS-5, LVS-10	LT-A-101-30
LVS-15	23 ft^3 (0.7 m^3)
LVS-30	55 ft^3 (1.6 m^3)

   Make certain all actuation and expellant gas hoses are not damaged and all connections are tight. See Figure 8-3.

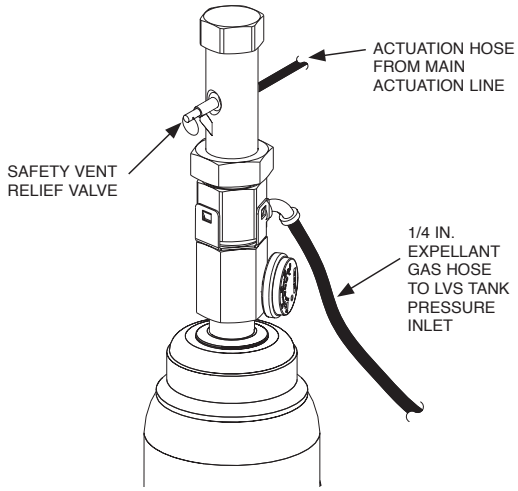


FIGURE 8-3
009540

10. To recharge the A-101/LT-A-101 Dry Chemical System (if protection includes a twin-agent system) and reset the CHECKFIRE Detection Systems, refer to the appropriate system manuals for detailed maintenance and recharge steps.
11. Make certain maintenance has been completed on the LVS system, detection system and the dry chemical portion of the system (if included).
12. After fully recharging the system and completing all service requirements, notify operating personnel that the fire suppression system is back in service. Record date of recharge and repairs made during recharge.

Part No.	Description
	LVS Tanks and Accessories
▸ 441774	LVS-3 Tank Shipping Assembly, Includes: LVS-3 Tank Mounting Bracket Order separately: LT-30-R Nitrogen Cartridge, Bracket or (CE) Bracket, Electric-Pneumatic Actuator ◂
435876	LVS-5 Tank Shipping Assembly, Includes: LVS-5 Tank Tank Bracket Order separately: LT-A-101-30 Cartridge Bracket Assembly (PN 24883)
439361	LVS-10 Tank Shipping Assembly, Includes: LVS-10 Tank Tank Bracket Order separately: LT-A-101-30 Cartridge Bracket Assembly (PN 24883)
438775 or 438838 (CE)	LVS-15 Tank Shipping Assembly, Includes: LVS-15 Tank 23 ft^3 (0.7 m^3) Nitrogen Cartridge with Electric-Pneumatic Actuator Expellant Gas Hose 1/4 in. Street Elbows (2)
438821 or 438839 (CE)	LVS-30 Tank Ship. Assembly, Includes: LVS-30 Tank 55 ft^3 (1.6 m^3) Nitrogen Cartridge with Electric-Pneumatic Actuator Expellant Gas Hose 1/4 in. Street Elbows (2)
▸ 442056	LVS-3 Tank Bracket
433685	LT-A-101-50/LVS-5 Tank Bracket
439710	LVS-10 Tank Bracket
428404	Mounting Ring, LVS-15
428405	Mounting Ring, LVS-30
▸ 441775	LVS Wet Chemical, 3 gal (11.4 L) Pail
426961	LVS Wet Chemical, 5 gal (18.9 L) Pail
▸ 442586 or 442587 (CE)	LT-30-R N_2 Cartridge, Bracket, and Electric-Pneumatic Actuator Shipping Assembly (LVS-3)
423435 or 428441 (CE)	LT-30-R N_2 Cartridge (LVS-3)
▸ 24325	LT-30-R Cartridge Bracket
24883 or ▸ 431735 (CE)	LT-A-101-30 N_2 Cartridge, Bracket, and Electric-Pneumatic Actuator Shipping Assembly (LVS-5 and LVS-10)
423491 or ▸ 428442 (CE)	LT-A-101-30 N_2 Cartridge (LVS 5 and LVS-10)
29193	LT-A-101-30 Cartridge Bracket
428060	LT-A-101-125/LVS-15 23 ft^3 (0.7 m^3) N_2 Cartridge (LVS-15)
428061	LT-A-101-250/LVS-30 55 ft^3 (1.6 m^3) N_2 Cartridge (LVS-30)
▸ 439569	Electric-Pneumatic Actuator

Part No.	Description
	Actuators and Accessories
70584	Remote Manual Actuator Package Includes: LT-10-L (Left Hand) Cartridge, "S" Bracket, Elbow, Check Valve, Seal Operating Instruction Labels Installation Instructions
71699	Remote Manual Actuator Package Includes: LT-10-L (Left Hand) Cartridge "L" Bracket, Elbow Check Valve, Seal Operating Instruction Labels Installation Instructions
57484	Remote Manual Actuator Package Includes: LT-10-R (Right Hand) Cartridge "S" Bracket, Elbow, Check Valve, Seal Operating Instruction Labels Installation Instructions
71804	Remote Manual Actuator Package Includes: LT-10-R (Right Hand) Cartridge "L" Bracket, Elbow, Check Valve, Seal Operating Instruction Labels Installation Instructions
70581	Remote Manual Actuator for LT-10-L (Left Hand) Cartridge Only
57452	Remote Manual Actuator for LT-10-R (Right Hand) Cartridge Only
57661	"S" Type Mounting Bracket for Dashboard Actuator, Part No. 70581 and 57452
70580	"L" Type Mounting Bracket for Remote Manual Actuator, Part No. 70581 and 57452
13193	LT-10-R Cartridge (DOT)
423423	LT-10-R Cartridge (TC/DOT)
13177	LT-10-L Cartridge (DOT)
423425	LT-10-L Cartridge (TC/DOT)
25627	1/4 in. Check Valve
53051	1/4 in. Check Valve (Package of 2)
15677	Safety Vent Relief Valve
53050	Safety Vent Relief Valve Package Includes: 2 Safety Vent Relief Valves
▸ 440802	Operating Instruction Label for Actuators
	Distribution Line
438835	Distribution Manifold Block (4 outlets)
438834	Distribution Manifold Block (2 outlets on two opposing sides)
53040	Reducing Tee Package Includes: 2 Reducing Tees (1/2 in. x 1/2 in. x 3/4 in.)
4655	Reducing Tee (1/2 in. x 1/2 in. x 3/4 in.)
▸ 78196	Quick-Seal Adaptor, 1/4 in. NPT, (Package of 24)
77285	Quick-Seal Adaptor, 3/8 in. NPT, (Package of 24)
77287	Quick-Seal Adaptor, 1/2 in. NPT, (Package of 24)
77289	Quick-Seal Adaptor, 3/4 in. NPT, (Package of 24) ◂

Part No.	Description
	Nozzles
433325	LVS-9.5 Nozzle Assembly, 1/2 in. NPT, Includes: Nozzle with Blow-Off Cap "L" Mounting Bracket Lockwashers (2)
433294	LVS-9.5 Nozzle, 1/2 in. NPT, with Blow-Off Cap (Single)
439049	LVS-9.5 Nozzle, 1/2 in. NPT, Package of 4 Includes: 4 Nozzles 8 Lockwashers 4 "L" Brackets 4 Blow-Off Caps
434403	LVS-9.5 Nozzle Blow-Off Cap (Package of 50)
73871	Nozzle Bracket Package: Includes: 12 Brackets, 2 in. x 2 in. Angle
427149	Nozzle Bracket, 2 in. x 3 in. Angle
427228	Nozzle Bracket, Straight 5 in. x 2 in., 4 Brackets
73872	Nozzle Lockwasher Package: Includes: 50 Lockwashers (Part No. 25581)

Part No.	Description
	System Supplies
428363	Sealed Burst Disc Assembly Package, Includes: 15 Burst Disc Assemblies (Part No. 428271)
75382	Cartridge Scale and Hook Assembly (LT-A-101-30)
3923	Cartridge Scale and Hook Assembly
197	Visual Seal
16511	Fill Cap Spanner Wrench (LVS-5)
3461	Fill Cap Gasket
427560	System Blow Down Kit (Adaptor and 1/4 in. pipe plug)
▸ 79559	Remote High Level Alarm
▸ 419208	Alarm Strobe
427109	LVS Manual, Installation, Operation, Design, Maintenance, and Recharge
53081	Owners Manual
	CHECKFIRE Automatic Detection and Actuation Systems - Component Indexes available in the following manuals:
▸ 440391	CHECKFIRE 110 Detection and Actuation System
440392 ▸	CHECKFIRE 210 Detection and Actuation System
427310	CHECKFIRE MP-N Electric System
423522	CHECKFIRE SC-N Electric System

▸ GENERAL DISCUSSION - HYDRAULIC EXCAVATORS

Of the various methods utilized for surface mining, haul-truck/shovel mining is commonly preferred, with hydraulic excavators (shovels) often used to satisfy their excavating, digging, and haul-truck loading needs. However, due to their size, construction, operational characteristics, and the vast amount of flammable liquids and lubricants stored and utilized onboard, hydraulic excavators can also have fire risk levels that may exceed risk levels found on other off-road vehicles.

Many of the large classes of hydraulic excavators are in operation 24 hours a day, 7 days a week. They often utilize dual engines, some incorporating up to eight double stacked turbochargers per engine, to produce a combined horsepower of up to 4000 hp, fueled with up to 5000 gal (18,927 L) of diesel fuel stored onboard the machine. Hydraulic excavators that primarily use hydraulics for operation, utilize large hydraulic oil storage tanks with multiple hydraulic pumps, control valves, and hundreds of feet of hydraulic tubing and/or hose runs, handling up to nearly 3500 gal (13,249 L) of hydraulic fluid. In addition, other flammable liquids, including lubricants are required. Many excavators have automatic lubrication systems, some using up to 264 gal (1000 L) of lubricating grease.

Special design consideration must be given when protecting large hydraulic excavators to reduce the potential for fire reflash and provide additional time for safe operator egress. ANSUL requires the following as a minimum:

1. Two large size dry chemical agent tanks are available: a 125 lb (56.7 kg) tank and a 250 lb (113.4 kg) tank. The LT-A-101-125 tank can utilize an 8-nozzle extended discharge or 12- or 16-nozzle standard discharge distribution system. The LT-A-101-250 tank can utilize either an 8, 12, or 16 nozzle extended discharge or a 24 nozzle standard discharge system. Both the 125 lb (56.7 kg) and 250 lb (113.4 kg) tanks can be used where an extended dry chemical discharge is required.
2. When utilizing the 30 lb (13.6 kg) or 50 lb (22.7 kg) agent containers, use a maximum of four nozzles (LT-A-101-30) or eight nozzles (LT-A-101-50) for standard dry chemical discharge, or a maximum of two nozzles (LT-A-101-30) or four nozzles (LT-A-101-50) for extended dry chemical discharge.

▸ **Note:** When protecting high-risk areas, such as the ▸ engine, or high pressure hydraulic equipment on large non-road mobile equipment used in surface mining, landfill equipment, or other large specialized machines, **do not** ▸ utilize more than 4 nozzles with a 30 lb (13.6 kg) dry ▸ chemical tank system, or use the larger capacity (50 lb (22.7 kg), 125 lb (56.7 kg), or 250 lb (113.4 kg)) dry chemical tank systems.

3. The fire suppression system must be a fully automatic system, including automatic detection and fire suppression system operation. The system must automatically perform the following functions:
   a. Diesel engine/electric motor shutdown
   b. Pressurized hydraulic tank and fuel tank venting, if possible
   c. Fuel shutoff
   d. Electrical disconnect (optional)
4. Remote high level alarm and flashing alarm strobe (recommended to be installed within the operator's compartment) to enhance machine operator warning.
5. A safe means of egress from the operator's compartment without having to exit past fire hazard areas.
6. In addition to the LT-A-101/LVS twin-agent system with CHECKFIRE Electric Detection and Control equipment, supplemental fire protection should be included when considering protection of large non-road mobile equipment:
   a. Cartridge operated hand portable fire extinguishers
   b. Secondary means of fire suppression
7. As part of the total fire package, training for mine personnel and the machine operator(s) must be conducted and documented. Training should include, but not be limited to:
   ▸ a. LVS, LT-A-101, and CHECKFIRE system description
   b. Fire suppression system operation
   c. Fire suppression system limitations and primary intent
   d. What to do in case of a fire
   e. Safe egress procedures
   f. Vehicle fire preventive maintenance, Owner/Operator inspection requirements, and fire suppression system maintenance requirements
8. ▸ An LVS/LT-A-101/CHECKFIRE Maintenance Contract, allowing periodic service and maintenance at scheduled intervals, should also be included.

PROTECTION CLASSES

Hydraulic excavators can be classified into three categories, depending on their size and the amount of flammable liquids stored, and/or in use on board. Tyco Fire Protection Products has researched hydraulic fluid capacities of excavators with regard to their size (operating weight) as a means to enable classifying risk levels, and is requiring a twin-agent configuration (dry chemical and LVS) on certain sizes of excavators.

PROTECTION CLASSES (Continued)

With the LVS Liquid Agent Suppression System, an enhanced protection scheme using a combination of wet chemical and dry chemical for large hydraulic excavators (twin-agent system), as well as other non-road mobile equipment can be offered. **The following protection schemes are required for hydraulic excavators of the specified sizes and risk levels. Refer to the table below.**

<table>
<tr><th></th><th colspan="2">Engine Compartment/ Area</th><th>Hydraulic Pump Compartment/ Area</th><th>Hydraulic Swing Motor/ Hydraulic Valve Bank/Oil and Hydraulic Cooling Areas and Other Hazardous Areas</th><th>With Engine/ Hydraulic Separation</th><th>Without Engine/ Hydraulic Separation</th></tr>
<tr><td>Small-Sized Excavators (99K to 200K lb)</td><td colspan="3">Standard discharge dry chemical with LVS for cooling
OR
LVS wet chemical for suppression and cooling</td><td>Standard Discharge Dry Chemical</td><td colspan="2">X</td></tr>
<tr><td rowspan="3">Mid-Sized Excavators (200K to 1M lb)</td><td colspan="3">Standard discharge dry chemical with LVS for cooling
OR
LVS wet chemical for suppression and cooling</td><td>Extended Discharge Dry Chemical</td><td>X</td><td></td></tr>
<tr><td colspan="3">Extended discharge dry chemical with LVS for cooling
OR
Both standard discharge dry chemical and LVS wet chemical for suppression, with LVS for cooling</td><td>Extended Discharge Dry Chemical with LVS on hydraulic control valves and valve banks (hose block connections) and ring gear area</td><td rowspan="2"></td><td rowspan="2">X</td></tr>
<tr><td colspan="4">AND
IR3 Detection Mandatory</td></tr>
<tr><td rowspan="3">Large-Sized Excavators (1M lb and greater)</td><td colspan="3">Extended discharge dry chemical with LVS for cooling
OR
Both standard discharge dry chemical and LVS wet chemical for suppression, with LVS for cooling</td><td>Extended Discharge Dry Chemical with LVS on hydraulic control valves and valve banks (hose block connections) and ring gear area</td><td rowspan="2">X</td><td rowspan="2"></td></tr>
<tr><td colspan="4">IR3 Detection Recommended</td></tr>
<tr><td colspan="3">Both extended discharge dry chemical and LVS wet chemical for suppression, with LVS cooling</td><td>Extended Discharge Dry Chemical with LVS on hydraulic control valves and valve banks (hose block connections) and ring gear area</td><td rowspan="2"></td><td rowspan="2">X</td></tr>
<tr><td colspan="4">AND
IR3 Detection Mandatory</td></tr>
</table>