

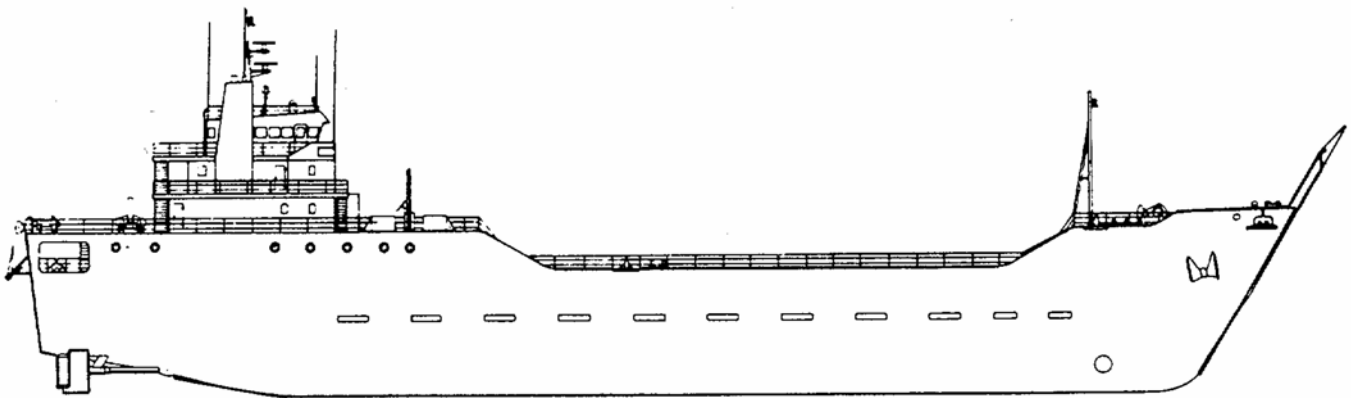
**TECHNICAL MANUAL**

**UNIT, DIRECT SUPPORT AND GENERAL SUPPORT**  
**MAINTENANCE MANUAL**  
**(INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST)**

**FOR**

**FM-200 FIREFIGHTING SYSTEM FOR**  
**LOGISTICS SUPPORT VESSEL (LSV)**

**NSN 1915-01-153-8801**



**Distribution Statement A:** Approved for public release. Distribution is unlimited.

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**HEADQUARTERS, DEPARTMENT OF THE ARMY**  
**15 May 2003**



**WARNINGS**

**MODIFICATION HAZARD**

Unauthorized modifications, alterations or installations of or to this equipment are prohibited and are in violation of AR 750-10. Any such unauthorized modifications, alterations or installations could result in death, injury or damage to the equipment.

**HIGH PRESSURE SYSTEM HAZARDS**

Pressurized liquid or gas systems can cause serious injuries if high pressure lines or equipment fail.

High pressure compressed air tanks, piping systems and air operated devices possess potential for serious injury to eyes and exposed areas of shin due to escaping air pressure.

**FIRE SUPPRESSANT HAZARDS**

Fire suppressant chemicals displace oxygen and can cause suffocation. Immediately evacuate areas when they are used.

After discharge, do not enter protected areas without breathing apparatus until areas are ventilated.

**ELECTRICAL HAZARDS**

Whenever possible, the power supply to the equipment must be shut off before beginning work on the equipment. Do not be misled by the term "low voltage". Potentials as low as 50 volts may cause death under adverse conditions.

Be careful not to contact 115-Vac input connections when installing or operating this equipment.

Whenever the nature of the operation permits, keep one hand away from the equipment to reduce the hazard of current flowing through the body.

**MOVING MACHINERY HAZARDS**

Be very careful when operating or working near moving machinery.

Running engines, rotating shafts, and other moving machinery parts could cause personal injury or death.

**FM-200 FIRE SUPPRESSANT HAZARDS**

In the event the FM-200 system electric horns/strobes or the warning lights (amber strobe) are activated, always leave the protected space immediately.

For Artificial Respiration, refer to FM 21-11.





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HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON D.C. 15 May 2003

TECHNICAL MANUAL  
UNIT, DIRECT SUPPORT  
AND GENERAL SUPPORT  
MAINTENANCE MANUAL (INCLUDING  
REPAIR PARTS AND SPECIAL TOOLS LIST)  
FOR  
FM-200 FIRE FIGHTING SYSTEM  
LOGISTICS SUPPORT VESSEL (LSV)  
NSN: 1915-01-153-8801

**REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS**

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## SUPPLEMENTARY INTRODUCTORY MATERIAL

- 1-1. **Maintenance Forms and Records.** Department of the Army forms and procedures used for equipment maintenance will be those described by DA PAM 738-750, The Army Maintenance Management System.
- 1-2. **Reporting Errors and Recommending Improvements.** You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) located in the back of this manual directly to: Technical Publication Information Office, TACOM-RI, 1 Rock Island Arsenal, IL 61299-7630. A reply will be furnished directly to you.
- 1-3. **Preparation for Storage and Shipment.** Refer to Maintenance Section of the Operation and Maintenance Manual for Fire Detection System (Pyrotronics System 3).
- 1-4. **Destruction of Army Materiel to Prevent Enemy Use.** Refer to TM 750-244-2 and TM 750-244-3 for instructions covering the destruction of Army Materiel to Prevent enemy use.

**SECTION I**

**GENERAL INFORMATION**





**1. GENERAL INFORMATION FOR FM-200 FIREFIGHTING SYSTEM**

**1.1 DESCRIPTION OF FM-200.** FM-200 (1,1,1,2,3,3,3 - Heptafluoropropane is a compound of Carbon, Fluorine, and Hydrogen (CF<sub>3</sub>CHF<sub>2</sub>CF<sub>3</sub>). It is colorless, odorless, and electrically non-conductive. It suppresses fire by a combination of chemical and physical mechanisms without affecting the available Oxygen. FM-200 is clean, leaves no residue, thereby eliminating costly after-fire clean-up, and keeping “down time” to a minimum. FM-200 is stored in steel containers, at 360 PSIG, 70°F (25 bars at 21°C), as a liquid, with Nitrogen added to improve the discharge characteristics. When discharged, the FM-200 liquid vaporizes at the discharge nozzles and is uniformly distributed as it enters the fire area. FM-200 is approved for total flooding fire extinguishing applications in occupied spaces by the Environmental Protection Agency (EPA) and appears on the Significant New Alternatives Policy (SNAP) list of acceptable substitutes for ozone depleting substances. FM-200 is also on the clean halocarbon fire extinguishing agents listed in the National Fire Protection Agency (NFPA) 2001 Standard, Clean Agent Fire Extinguishing Systems and is approved for marine application by the US Coast Guard (USCG).

**1.2 INSTALLATION REQUIREMENTS.** The FM-200 systems have been installed in accordance with the approved Technical Data Package (TDP) consisting of the Detailed Design/Installation Drawings.

**1.3 VESSEL SPECIFIC DESIGN CONFIGURATIONS.** Due to differences in vessel configuration within the LSV Design, minor configuration changes to the Detailed Design/Installation Drawings were made during each installation to accommodate the configuration of each vessel. The Detailed Design/Installation Drawings have been revised to fully disclose the as-built configuration of the FM-200 systems installed on your vessel. LSV-1-5553-1, US Army LSV-1 FM-200 System Piping Installation and Details; LSV-1-5553-2, US Army LSV-1 FM-200 System Miscellaneous Mods; LSV-1-5553-3, US Army LSV-1 FM-200 System Electrical Modifications; and LSV-1-5553-4, US Army LSV-1 FM-200 System Label Plates and Placards; are specific to your vessel and disclose the as-built configuration of the installed FM-200 systems. These drawings are provided as follows:

DRAWING TITLE	DRAWING NUMBER	LOCATION
US Army LSV-1 FM-200 System Piping Installation and Details	LSV-1-5553-1	Appendix E
US Army LSV-1 FM-200 System Miscellaneous Mods	LSV-1-5553-2	Appendix E
US Army LSV-1 FM-200 System Electrical Modifications	LSV-1-5553-3	Appendix E
US Army LSV-1 FM-200 System Label Plates and Placards	LSV-1-5553-4	Appendix E

**NOTE**

AS BUILT DIFFERENCES IN VESSEL CONFIGURATION EXIST WITHIN THE LSV DESIGN. ACTUAL LOCATION OF SOME COMPONENTS MAY VARY SLIGHTLY BETWEEN VESSELS.

**1.4 IDENTIFICATION OF PROTECTED SPACES.** The FM-200 Total Flooding Fire Extinguishing Systems on LSV consists of four (4) manually actuated systems.

**CAUTION**

**THE INSTALLED FM-200 SYSTEMS ARE MANUALLY ACTUATED.  
IT IS IMPERATIVE YOU BECOME TOTALLY VERSED IN THE OPERATION  
AND MAINTENANCE OF THESE SYSTEMS.**

**1.4.1 ENGINE ROOM.** This manually actuated system is designed and installed to protect the Engine Room and bilge (2-84-0-E), Frames 84 to 144. The physical location of this system, less FM-200 distribution piping and nozzles, Electric Horn/Strobe, and Warning Lights (Amber Strobe), is installed outside of the protected space (Engine Room). Three (3) each 600 pound cylinders and supporting components, installed on the forward bulkhead, Frame 115, Boatswain Storeroom (1-115-2-A), provide protection for the Engine Room and bilge. Three (3) each 600 pound cylinders and supporting components, installed on the forward bulkhead, Frame 111, Machinery Room (1-111-1-Q), provide protection for the starboard side of the Engine Room and bilge.

**1.4.2 PAINT LOCKER.** This manually actuated system is designed and installed to protect the Paint Locker (1-7-3-A), main deck level, Frames 7 to 14. The physical location of this system, less FM-200 distribution piping and nozzle and FM-200 Siren, is installed outside the protected space. One (1) each 125 pound FM-200 cylinder and supporting components, installed on the forward bulkhead of the Bow Thruster Compartment (2-10-0-E) at Frame 22, provide protection for the Paint Locker.

**1.4.3 BOW THRUSTER COMPARTMENT.** This manually actuated system is designed and installed to protect the Bow Thruster Compartment and bilge (2-10-0-E), Frames 10 to 22. The physical location of this system, less FM-200 distribution piping and nozzles, Electric Horn/Strobe, and Warning Light (Amber Strobe), is installed outside of the protected space. One (1) each 350 pound FM-200 cylinder and supporting components, installed in the Paint Locker (1-7-3-A), Frame 9, provides protection for Bow Thruster Compartment and bilge.

**1.4.4 EMERGENCY GENERATOR ROOM.** This manually activated system is designed and installed to protect the Emergency Generator Room (1-120-1-Q), Frames 120 to 128. The physical location of this system, less FM-200 distribution piping and nozzles, Electric Horn/Strobe, and Warning Light (Amber Strobe), is installed outside of the protected space. One (1) each 125 pound FM-200 cylinder and supporting components, installed in the Machinery Room (1-111-1-Q), Frame 9, provides protection for Emergency Generator Room.

**1.5 RELATED INSTALLATIONS.** The Engine Room and Bow Thruster Compartment FM-200 installations are supplemented by the installation of a Water Washdown System (WWS). This manually activated system serves to quickly reduce compartment temperature prior to discharge of FM-200 agent, minimizes production of Hydrogen Fluoride (HF) Gas generated as a result of FM-200 agent decomposition from contact with hot surfaces and flame at temperatures above 1300°F, aids in scrubbing of any HF Gas generated, and expedites ventilation of the compartment.

**1.6 FM-200 OPERATION INSTRUCTIONS.** Operation instructions for each protected space are located in TM 55-1915-200-10, paragraph 2-63.

## **2. GENERAL INFORMATION FOR WATERWASHDOWN SYSTEM (WWS)**

**2.1 DESCRIPTION OF WWS.** The WWS built of all stainless components are three (3) separate systems installed in the Engine Room and Bow Thruster Compartment. The WWS is a hydrogen fluoride (HF) gas mitigation, water washdown system (WWS) which provides general overhead coverage to the protected spaces. The WWS is a simple overhead sprinkler grid which is piped directly to the existing firemain. The Engine Room WWS receives seawater from the NO. 2 Emergency Fire Pump which is powered electrically from the emergency buss. The Bow Thruster Compartment WWS receives seawater from either Fire Pump.

**2.2 PURPOSE OF WWS.** The WWS, upon activation, serves to quickly reduce the temperature within the protected space, minimize production of Hydrogen Fluoride (HF) Gas which is produced as a result of FM-200 agent decomposition in contact with hot surfaces and flame at temperatures above 1300° F, aid in scrubbing of any HF Gas generated and expedite ventilation of the protected space.

### **WARNING**

**THE WWS IS NOT DESIGNED NOR INTENDED TO BE A STAND ALONE FIRE EXTINGUISHING SYSTEM. IT IS DESIGNED TO BE USED IN CONJUNCTION WITH THE INSTALLED FM-200 FIXED FIRE EXTINGUISHING SYSTEM. FAILURE TO DO SO COULD RESULT IN EQUIPMENT DAMAGE, DEATH OR SERIOUS INJURY.**

**2.3 INSTALLATION.** Each WWS has been installed in accordance with the approved Technical Data Package (TDP) which consists of the Detailed Design/Installation Drawings.

**2.4 VESSEL SPECIFIC DESIGN CONFIGURATIONS.** Due to the differences in vessel configuration within the LSV Design, minor configuration changes to the Detailed Design/Installation Drawings were made during each installation to accommodate the configuration of each vessel. The Detailed Design/Installation Drawings have been revised to fully disclose the configuration of each WWS installed on your vessel. Drawings LSV-5231-1, US Army LSV Water Washdown System Piping Installation and Details and LSV-5231-2, US Army LSV Water Washdown System Label Plates and Placards, which are specific to your vessel, disclose the as-built configuration of each WWS. Drawing LSV-5231-1 and drawing LSV-5231-2 are provided at Appendix E.

**2.5 OPERATION INSTRUCTIONS FOR WWS.** Operation instructions for the WWS are contained in TM 55-1915-200-10, paragraph 2-64.

### 3.0 PREPOSITION OR STORAGE OF VESSEL.

**3.1 PLACING VESSEL IN PREPOSITION OR STORAGE:** There are no required maintenance actions required on the FM-200 systems prior to placing vessel in preposition or storage. The FM-200 cylinders may require storage in an environmentally controlled external storage space. The FM-200 cylinders are required to be in an environment protected from the weather, where the ambient temperature does not exceed 130°F, nor fall below 32°F, at all times.

### 3.2 REMOVING VESSEL FROM PREPOSITION OR STORAGE:

**3.2.1 ENGINE ROOM FM-200 SYSTEM:** Perform Item No. 1 through Item No. 6 as identified in Preventative Maintenance Checks and Services for Engine Room FM-200 system.

**3.2.2 TUNNEL FM-200 SYSTEM:** Perform Item No. 1 through Item No. 6 as identified in Preventative Maintenance Checks and Services for Tunnel FM-200 system.

**3.2.3 BOW THRUSTER COMPARTMENT FM-200 SYSTEM:** Perform Item No. 1 through Item No. 6 as identified in Preventative Maintenance Checks and Services for Bow Thruster Compartment FM-200 system.

**3.2.4 PAINT LOCKER FM-200 SYSTEM:** Perform Item No. 1 through Item No. 5 as identified in Preventative Maintenance Checks and Services for Paint Locker FM-200 system.

**3.3 A/C AND EMERGENCY GENERATOR ROOM FM-200 SYSTEM:** Perform Item No. 1 through Item No. 5 as identified in Preventative Maintenance Checks and Services for Emergency Generator Room FM-200 system.

### 4.0 SERVICE AND WARRANTY INFORMATION

**4.1 SCOPE OF CONTRACTOR SERVICE.** The FM-200 Installation Contractor will provide three (3) years of manufacturer recommended inspection and routine preventive maintenance services and supplies from date of acceptance of installation. This includes annual recertification of FM-200 systems for three (3) years from date of acceptance of installations.

**4.2 ANNUAL RE-CERTIFICATION OF FM-200 SYSTEMS.** Installed FM-200 systems, installed on LSV, require annual re-certification. For annual recertification of FM-200 systems, contact Hiller Systems, Inc. directly to schedule (see Paragraph 4.5).

#### NOTE

THE INITIAL INSTALLATION CONTRACT COVERS THE FIRST THREE YEARS OF RE-CERTIFICATION SERVICES, EXCLUDING ANY REPAIR PARTS. THIS PRE-PAID RECERTIFICATION FOR LSV SHOULD HAVE TAKEN PLACE IN NOVEMBER 1999, NOVEMBER 2000 AND NOVEMBER 2001.

**4.3 WARRANTY.**

**4.4 SCOPE OF CONTRACTOR WARRANTY.** The FM-200 Installation Contractor will provide one (1) year warranty on FM-200 systems parts and installation from date of acceptance of installation.

**4.5 CONTRACTOR WARRANTY SERVICE.** To obtain FM-200 system warranty service, contact the FM-200 systems Installation Contractor (24 hours/day):

COMPANY	ADDRESS	TELEPHONE	FACSIMILE	E-MAIL
Hiller Systems Inc.	833 Principal Lane Chesapeake, VA 23320.	(757) 549-9123	(757) 549-1083	hiller@exis.net

**4.6 POST WARRANTY SERVICE.** To obtain service or repair of FM-200 systems after warranty expiration, contact a Kidde-Fenwal Inc. Manufacturer's Certified Technician/Distributor. A world-wide listing is provided at Section VIII.



## **SECTION II**

### **Installation, Operation and Maintenance Manual for Marine FM-200 Fire Suppression System**







**FM-200<sup>®</sup>**  
**ECS SERIES ENGINEERED**  
**FIRE SUPPRESSION SYSTEM**

**DESIGN, INSTALLATION,  
OPERATION AND MAINTENANCE MANUAL  
FOR MARINE FM-200 SYSTEMS**

*US Coast Guard Rules*

**KIDDE-FENWAL, INC.**

400 Main Street  
Ashland, MA 01721

Tel:(508) 881-2000  
Fax:(508) 881-8920

**P/N 90-FM200M-021**

Version 1.0  
May 1998



## FOREWORD

This manual is written for those who design, install, and maintain Kidde FM-200® Marine ECS Series Engineered Fire Suppression Systems. It contains design, installation, operation, and maintenance information for systems installed aboard US Coast Guard inspected vessels.

## IMPORTANT

Kidde assumes no responsibility for application of any systems other than those addressed in this manual. The technical data contained herein is limited strictly for information purposes only. Kidde believes this data to be accurate, but it is published and presented without any guarantee or warranty whatsoever. Kidde disclaims any liability for any use that may be made of the data and information contained herein by any and all other parties.

Kidde FM-200® ECS Series Engineered Fire Suppression Systems are to be designed, installed, inspected, maintained, tested, and recharged by qualified, trained personnel in accordance with the following:

- Standard of the National Fire Protection Association No. 2001, titled "Clean Agent Fire Extinguishing Systems."
- Applicable US Coast Guard Rules
- All instructions, limitations, etc. contained in this manual P/N 90-FM200M-021.
- All information contained on the system container nameplate(s).
- MSC Circular 776
- Storage, handling, transportation, service, maintenance, recharge, and test of agent storage containers shall be performed only by qualified and trained personnel in accordance with the information in this manual and Compressed Gas Association\* pamphlets C-1, C-6, and P-1:

C-1, "Methods for Hydrostatic Testing of Compressed Gas Cylinders"

C-6, "Standards for Visual Inspection of Compressed Gas Cylinders"

P-1, "Safe Handling of Compressed Gases In Containers."

\*CGA pamphlets are published by the Compressed Gas Association, Crystal Square Two, 1725 Jefferson Davis Highway, Arlington, VA 22202-4102.

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

Kidde- Fenwal, Inc.  
400 Main Street  
Ashland, MA 01721  
USA  
Phone: (508) 881-2000  
Fax: (508) 881-8920

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## 1. INTRODUCTION

### 1.1 General

This manual has been prepared for those who design, install, and maintain Kidde FM-200 Marine ECS Series Engineered Fire Suppression Systems. It contains design, installation, operation and maintenance information for systems installed aboard US Coast Guard (USCG) inspected vessels.

These systems are designed for total flooding in accordance with National Fire Protection Association (NFPA) 2001, Standard on *Clean Agent Fire Extinguishing Systems* and have been tested to established limits, including those established by the USCG and by the International Maritime Organization (IMO) and detailed in Maritime Safety Committee (MSC) Circular 776 annex entitled *Test Method for Fire Testing of Fixed Gas Fire-Extinguishing Systems as referred to in SOLAS 74 for Machinery Spaces and Cargo Pump-Rooms*.

In addition to this manual, the system designer must be familiar with NFPA 2001, USCG Navigation and Vessel Inspection Circular 6-72 (NVIC 6-72) and MSC Circular 776. In any situation not specifically covered by this manual, the application and installation of the system must meet the requirements of the standards as stated. In any case, all installations must meet the requirements of the USCG.

### 1.2 System Design

The complexity of two-phase flow does not allow for any simple method of manual FM-200 calculation. For this reason, the flow calculations and design criteria described in this manual have been incorporated into a computer software program. The calculations are based on conserving mass, energy, and momentum in the pipe network. The routine calculates the flow in quasi-steady state steps from the initiation of the discharge to the final gas blow down. This is a significantly more rigorous treatment than the traditional Halon NFPA 12A method.

The system designer must become thoroughly familiar with the software program user's manual (the manual accompanies the software) in order to determine the proper procedures for applying the input parameters to the FM-200 Flow Program. There are a number of limitations to these input parameters which must be observed if accurate results are to be obtained.

Kidde FM-200 Marine ECS Series Engineered Fire Suppression Systems combine an environmentally safe fire suppression agent and specially developed components for fast agent discharge. The resulting rapid suppression of a fire reduces property damage and products of combustion to the lowest possible level. These systems are electrically, pressure and/or cable operated, with a normal design discharge time of less than ten seconds.

### 1.3 Type Approval

Kidde FM-200 Marine ECS Series Engineered Fire Suppression Systems are type approved by the US Coast Guard (USCG). A copy of the USCG Certificate of Approval is located in Appendix D.

## **2. SYSTEM DESCRIPTION**

### **2.1 General**

Kidde Marine FM-200 systems are used to suppress fires in specific hazards or equipment located where an electrically non-conductive agent is required, where agent cleanup creates a problem, where extinguishing capability with low weight is a factor, and where the hazard is normally occupied. Kidde Marine FM-200 systems are intended to protect spaces containing the following hazards:

- Class A - surface type fires - wood or other cellulose-type material
- Class B - flammable liquids
- Class C - energized electrical equipment.

FM-200 systems are not suitable for the protection of a ship's cargo holds.

For hazards beyond the scope described above, the designer must consult with Kidde and NFPA 2001 on the suitability of FM-200 for the protection, necessary design concentration, and personnel exposure effects from that concentration.

FM-200 must not be specified where the following material may be present:

- Pyrotechnic chemicals containing their own oxygen supply
- Reactive metals - sodium, potassium, magnesium, titanium, zirconium, uranium, and plutonium
- Metal hydrides

**Operating Temperature Range Limitations:** The operating temperature range for all components used in Kidde FM-200 Engineered systems is +32°F to +130°F (0°C to +54°C).



## 2.2. Extinguishing Agent

FM-200 (1,1,1,2,3,3,3 - heptafluoropropane) is a compound of carbon, fluorine and hydrogen (CF<sub>3</sub>CHF<sub>2</sub>CF<sub>3</sub>). It is colorless, odorless and electrically non-conductive. It suppresses fire by a combination of chemical and physical mechanisms without affecting the available oxygen. This allows personnel to see and breathe, permitting them to leave the fire area safely. FM-200 has acceptable toxicity for use in occupied spaces when agent concentration is in accordance with NFPA 2001, USCG Rules and MSC Circular 776. Although FM-200 is considered non-toxic to humans in concentrations necessary to extinguish most fires, certain safety considerations should be observed when applying and handling the agent. The discharge of FM-200 may create a hazard to personnel from the undecomposed agent itself and from the decomposition products which result when the agent is exposed to fire or other hot surfaces. Exposure to the agent is generally of less concern than is exposure to the decomposition products. Unnecessary exposure to the agent or the decomposition products should be avoided.

**Toxicity:** In tests, the acute toxicity of FM-200 was shown to be equivalent to that of Halon 1301. FM-200 agent concentrations for marine systems must be designed in accordance with this manual, NFPA 2001, USCG NVIC 6-72 and MSC Circular 776.

**Decomposition:** When FM-200 is exposed to temperatures over approximately 1300°F (700° C), products of decomposition (halogen acids) are formed. If the FM-200 is discharged in 10 seconds or less, causing rapid extinguishment of flames, the amount of by-products formed is minimal. However, integrity must be maintained to prevent the migration of products of decomposition to adjacent areas outside of the protected space.

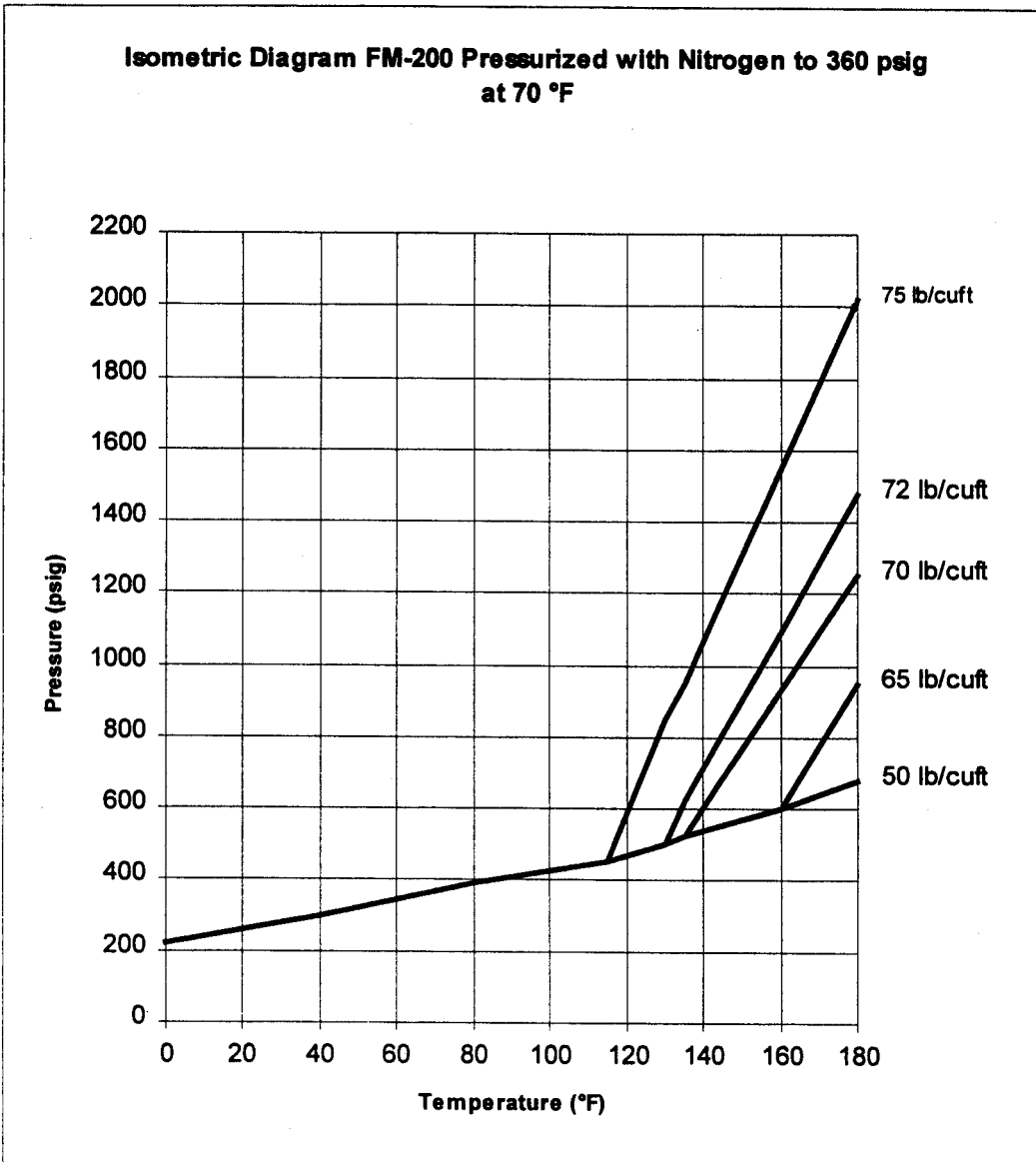
**Other Safety Considerations:** The high pressure discharge of FM-200 from the system nozzle(s) can create noise loud enough to be startling. The high velocity discharge can be significant enough to dislodge objects located directly in the discharge path. Enough turbulence may be created in the enclosure to move unsecured paper and other light objects. Direct contact with the vaporizing agent being discharged from the nozzle(s) will have a chilling effect on objects, and can cause frostbite burns to the skin. The liquid phase vaporizes rapidly when mixed with air, and limits the chilling hazard to the immediate vicinity of the nozzle(s).

FM-200 is colorless; discharge into humid atmospheres may cause a reduction of visibility for a short time, due to fogging.

**Storage:** FM-200 is stored in steel containers at 360 PSIG at 70°F (25 bars at 21°C), as a liquid with nitrogen added to improve the discharge characteristics. When discharged, the FM-200 liquid vaporizes at the discharge nozzles, and is uniformly distributed as it enters the fire area.

**Table 2.2-1. FM-200 Physical Properties**

Molecular weight	170.03
Freezing point	-204°F (-131°C)
Boiling point at 1 atm.	2.6°F (-16.4°C)
Vapor pressure	32.9 PSIA @ 40°F (2.26 bars absolute @ 4.4°C) 66.4 PSIA @ 77°F (4.57 bars absolute @ 25°C) 148.2 PSIA @ 130°F (10.2 bars absolute @ 54°C)
Critical temperature	215.1°F (101.7°C)
Critical density	38.76 lb/ft <sup>3</sup> (621 kg/m <sup>3</sup> )
Critical pressure	422 PSIA (29.0 bar absolute)
Critical volume	0.0258 cu. ft/lb. (1.61 L/kg)
Specific heat, saturated liquid at 77°F (25°C)	0.2633 Btu/lb °F (0.2633 kcal/kg °C)
Specific heat, saturated vapor at 77°F (25°C)	0.1856 Btu/lb °F (0.1856 kcal/kg °C)
Specific heat, saturated vapor at 1 atm., 77°F (25°C)	0.1734 Btu/lb °F (0.1734 kcal/kg °C)
Heat of vaporization at boiling point	57.0 Btu/lb (31.7 kcal/kg)
Thermal conductivity, liquid at 77°F (25°C)	0.040 Btu/hr ft °F (0.069 W/m °K)
Thermal conductivity, vapor at 77°F (25°C)	0.0068 Btu/hr ft °F (0.012 W/m °K)
Viscosity, liquid at 77°F (25°C)	0.000124 lbm/ft s (0.184 centipoise)
Viscosity, vapor at 77°F (25°C)	0.00000887 lbm/ft s (0.0132 centipoise)
Surface tension at 77°F (25°C)	7.00 dyn/cm (7.00 mN/m)



**Figure 2.2.1 - FM-200 Pressure/Temperature Curve Isometric Diagram**

## 2.3 Component Descriptions

**2.3.1 FM-200 Cylinder/Valve Assemblies.** FM-200 is stored in steel cylinders as a liquid superpressurized with nitrogen to 360 PSIG. The cylinder valve assembly is equipped with a supervisory pressure switch connection for monitoring cylinder pressure, a pressure gauge and a safety burst disc in compliance with DOT requirements. In addition, each cylinder/valve assembly is provided with a safety cap and a protection cap WHICH MUST BE INSTALLED ON THE DISCHARGE OUTLET AND ACTUATION PORT WHENEVER A CYLINDER IS NOT IN SERVICE. These caps are added safety features designed to prevent uncontrolled accidental discharge which may result in serious injury, death, or property damage.

Part Number	With LLI	Height		Diameter		Volume	
		In.	cm	In.	cm.	Ft <sup>3</sup>	m <sup>3</sup>
90-100010-001	No	17.30	44	7.07	18	.167	.0047
90-100020-001	No	24.97	64	7.07	18	.286	.0081
90-100040-001	No	26.76	68	9.00	23	.572	.0162
90-100070-001	No	38.83	99	9.00	23	1.000	.0283
90-100125-001	No	35.93	92	12.75	35	1.788	.0506
90-100200-101	No	52.75	134	12.75	32	2.859	.0810
90-100201-101	Yes	52.75	134	12.75	32	2.859	.0810
90-100350-001	No	58.36	149	16.00	41	5.000	.1416
90-100351-001	Yes	58.36	149	16.00	41	5.000	.1416
90-100600-001	No	56.72	145	22.00	56	8.572	.2427
90-100601-001	Yes	56.72	145	22.00	56	8.572	.2427

**Table 2.3.1.1 - Dimensions FM-200 Cylinder/Valve Assemblies for Vertical Installation Only**

Part No.	Fill Range		Empty Wt.	
	Lbs.	Kg.	Lbs.	Kg.
90-100010-001	5-10	3-5	25	11
90-100020-001	9-20	4-9	31	14
90-100040-001	17-40	8-18	38	17
90-100070-001	30-70	14-32	52	24
90-100125-001	54-125	25-57	96	44
90-100200-101	86-200	39-91	130	59
90-100201-101	86-200	39-91	131	59
90-100350-001	150-350	68-159	201	91
90-100351-001	150-350	68-159	203	92
90-100600-001	258-600	114-272	360	163
90-100601-001	258-600	114-272	362	164

**Table 2.3.1.1.2 - Fill Range FM-200 Cylinder/Valve Assemblies for Vertical Installation Only**

**2.3.1.2** Paragraph deleted.

**2.3.1.3** The Kidde FM-200 Marine ECS Series Engineered equipment listed herein is designed for an operating temperature range of +32°F to +130°F. See 3.4.3 for more details. Table 2.3.1.3.1 shows the cylinder gauge pressure-temperature relationship based on a maximum fill density of 70 lbs./ft<sup>3</sup>. All cylinder assemblies must be mounted in the vertical position. If desired, the 200, 350 and 600 lb. cylinders can be provided with an integral liquid level indicator.

GAUGE CALIBRATION	
°F	PSI
30	285
40	300
50	320
60	340
70	360
80	380
90	405
100	425
110	445
120	475
130	500

**Table 2.3.1.3.1 - Cylinder Pressure Gauge Calibration  
 (based on cylinder fill density of 70 lbs./ft<sup>3</sup>)**

**2.3.2 Liquid Level Indicators.** The optional liquid level indicator consists of a hollow metal tube inserted into a special fitting located in the top of the 200, 350 or 600 lb. FM-200 cylinder. The indicator is provided with a graduated tape designed to sense the position of a toroidal magnet encased within an internal float riding on the liquid surface. The graduations on the tape indicate the location of the liquid level within the cylinder.

**2.3.3 Cylinder Mounting Equipment.** Steel straps and cradles are used to mount the cylinders in a vertical position. Cylinder straps (P/Ns 283945, 283934, 235317, 292971, 281866 and 294651) are available for all sizes of cylinders. Cradles (P/Ns 235431, 292938, 281867 and 294652) and front clamps (P/Ns 235432, 293457, 281868 and 294653) are available for the 125 lb, 200 lb, 350 lb and 600 lb size cylinders. Note that for marine systems, each cylinder shall be secured with two strap & cradle bracket assemblies (see 4.11.1 & 4.11.2). If moisture is present, elevate cylinder(s) at least 2" (5.08 cm) off the deck.

### 2.3.4 Control Heads

2.3.4.1 Paragraph Deleted

2.3.4.2 Paragraph Deleted

**2.3.4.3 Cable Operated Control Head (P/N 979469).** This control head is used for systems designed for manual operation only. The cable operated control head mounts directly on top of the FM-200 cylinder valve. The control head is operated remotely from a cable manual pull station or locally using the manual lever on the control head. The cable operated control head is self-venting to prevent accidental system discharge in the event of a slow build up of pressure in a pilot line.

**2.3.4.4 Lever Operated Control Head (P/N 870652).** This type of control head is equipped with an operating lever, secured in the closed position by a safety pull pin. By removing the safety pin, the lever can be manually rotated to the open position, thereby activating the cylinder or valve on which it is installed. The lever operated control head is self-venting to prevent accidental system discharge in the event of a slow build up of pressure in a pilot line.

**2.3.4.5 Lever/Pressure Operated Control Head (P/N 878751).** The lever/pressure operated control head allows manual or pressure actuation of several system components, including FM-200 cylinder valves, and nitrogen actuators. The lever/pressure operated control head is self-venting to prevent accidental system discharge in the event of a slow build up of pressure in a pilot line.

**2.3.4.6 Pressure Operated Control Heads.** The pressure operated control head, P/N 878737 allows for pressure actuation of FM-200 cylinders, and are mounted directly on top of the FM-200 cylinder valve. Pressure operated control head, P/N 878750, offers a stackable design and is used where an electric/mechanical control head actuation is also required on the same cylinder. The pressure operated control heads are self venting to prevent accidental system discharge in the event of a slow build up of pressure in a pilot line.

## **2.3.5 Remote Pull Stations**

### **2.3.5.1 Paragraph Deleted**

**2.3.5.2 Cable Manual Pull Station, Surface (P/N 871403).** The surface type remote cable manual pull station is a cable operated device. To operate the FM-200 system, break the glass plate on the box using the attached hammer and pull the handle.

## **2.3.6 Actuation Accessories**

**2.3.6.1 Nitrogen Actuator and Mounting Bracket (P/N 877940 and P/N 877845).** Gas pressure from a nitrogen cylinder is routed to the pressure operated control head mounted on each FM-200 cylinder. When the control head on the remote nitrogen cylinder is actuated, the FM-200 cylinder will be activated, causing FM-200 to be discharged from the cylinder. The nitrogen cylinder is used in multiple cylinder and main/reserve systems.

**2.3.6.2 Flexible Actuation Hoses (P/N 264986 and P/N 264987).** The flexible actuation hose is used in multiple cylinder systems. Pilot pressure is directed to a pressure operated control head on each FM-200 cylinder valve using a 1/4-inch actuation hose.

**2.3.6.3 Master Cylinder Adapter Kit (P/N 844895).** The master cylinder adapter kit provides a means of connecting a flexible actuation hose to the master cylinder assembly. The adapter kit is provided with a cap intentionally chained to the adapter to prevent loss while in service and must not be removed from its chain. The kit also contains a pressure sensitive label which is placed on the cylinder valve after adapter installation.

**2.3.6.4 Tees, Elbows, and Adapters.** The tees, elbows and adapters are used for interconnection of actuation hoses to pressure operated control heads in multiple cylinder system installations.

## **2.3.7 Discharge Accessories**

**2.3.7.1 Flexible Discharge Hoses (P/N 283898, 283899, and 283900).** FM-200 agent is routed from the storage cylinders to the discharge piping by a flexible 1- 1/2", 2", or 2-1 1/2" rubber covered hose with wire braided reinforcements. The hose is connected to the discharge outlet of the FM-200 cylinder valve and terminates at the system piping or discharge manifold.

**2.3.7.2 Valve Outlet Adapters (P/N 283904, 283905, and 283906).** A valve outlet adapter is used to connect the cylinder valve outlet to the discharge piping when no flexible discharge hose is used.

**2.3.7.3 Check Valve (1/4 inch) (P/N 264985).** 1/4-inch check valves are installed in the pilot manifold to allow proper actuation of systems using multiple pilot cylinders.

**2.3.7.4 Manifold EL-Checks (P/N 877690 and P/N 878743).** Manifold EL-checks are installed at the discharge manifold in a multiple cylinder arrangement to allow installation and removal of any FM-200 cylinder from the manifold while still retaining a closed system. The 2-inch EL-check is used on the 10 through 350 lb. size cylinders; the 2-1/2 inch EL-check is used with the 600 lb. size cylinder.

### CAUTION

**Manifold EL-checks are not intended to be used as check valves in main/reserve systems.**

- 2.3.7.5 Check Valves.** Check valves are installed in sections of piping in main/reserve systems to prevent the actuation of the reserve system when the main system is discharged.
- 2.3.7.6** Paragraph deleted.
- 2.3.7.7 Pressure Operated Switches (P/N 486536 and P/N 981332).** Pressure switches operate from system pressure upon discharge to energize or de-energize electrically operated equipment. Pressure switches may be used to shut down machinery and ventilation or to enunciate system discharge.
- 2.3.7.8 Pressure Operated Trip (P/N 874290).** Pressure trips are used to close off the hazard space upon system discharge. The trips, operated by system pressure, are designed to release self-closing units for doors, windows and dampers. The maximum load to be attached to a pressure trip is 100 lbs. (this is based on a minimum pressure of 75 PSIG at the pressure trip).
- 2.3.7.9** Paragraph deleted.
- 2.3.7.10 Discharge Indicator (P/N 875553).** The discharge indicator may be installed in the discharge piping to visually indicate a system discharge. When in the SET position, the discharge indicator acts as a vent.
- 2.3.7.11** Paragraph deleted.
- 2.3.7.12 Corner Pulleys.** Corner pulleys are used to change direction of cable lines without binding to ensure smooth operation. P/N 803808 is used for all marine applications.
- 2.3.7.13 Supervisory Pressure Switch (P/N 878709).** The optional supervisory pressure switch is connected to the FM-200 cylinder valve to provide indication at the system control panel of a low cylinder pressure condition.
- 2.3.7.14 Main to Reserve Transfer Switch (P/N 802398).** The main to reserve switch is installed on systems having main and reserve cylinders. Placing the switch in either the "main" or "reserve" position provides uninterrupted fire protection capability during system maintenance or in the event of a system discharge.



**2.3.8 Discharge Nozzles.** The 180° and 360° discharge nozzles are designed to provide the proper flow rate and distribution of FM-200 to total flood a hazard area. The 180° nozzle is engineered to provide a 180° discharge pattern for sidewall applications. The 360° nozzle offers a full 360° discharge pattern for installations where nozzles are located in the center of the hazard.

### **2.3.9 Other Accessories**

**2.3.9.1 Hydrostatic Test Adapters.** The hydrostatic pressure test adapter is installed on the FM-200 cylinder in place of the cylinder valve when the cylinder is to be hydrostatically pressure tested. For cylinder test requirements, see Paragraph 6.4.3 of this manual.

**2.3.9.2 FM-200 Cylinder Recharge Adapters.** The FM-200 recharge adapter is installed on the cylinder discharge outlet during the cylinder charging procedure. This adapter is used for refilling the cylinder with FM-200 agent and super pressurizing the cylinder with nitrogen.

**2.3.9.3 FM-200 Cylinder Seating Adapter.** The FM-200 seating adapter is installed on the cylinder actuation port during the cylinder charging procedure. This adapter is used for seating the valve assembly after charging and super pressurization are complete.

**2.3.10 Paragraph Deleted**

**2.3.10.1 Paragraph Deleted**

**2.3.10.2 Paragraph Deleted**

### 3 SYSTEM DESIGN AND LIMITATIONS

#### 3.1 General.

System design is based on the requirements of NFPA 2001, the USCG NVIC 6-72 and MSC Circular 776 entitled *Guidelines for the Approval of Equivalent Fixed Gas Fire Extinguishing Systems as referred to in SOLAS 74 for Machinery Spaces and Cargo Pump-Rooms*.

**3.1.1 Agent Concentration.** FM-200 agent concentrations vary with the hazard being protected. Class A and Class C hazards must be designed with at least a 7% concentration. In no case shall the concentration for any Class A or Class C hazard be below 7% v/v.

Kidde FM-200 systems that are protecting marine Class B flammable liquid hazards should be designed with a design concentration of 30% above the minimum "cup burner" concentration. This exceeds the NFPA 2001 requirement for a concentration of at least 20% above the minimum "cup burner" extinguishing concentration for the hazard fuel. Refer to Appendix H for information on these concentrations.

**3.1.2 NOAEL/LOAEL Values.** The designer must be aware of two significant thresholds when designing an FM-200 system. These are the No Observed Adverse Effect Level (NOAEL) and the Lowest Observed Adverse Effect Level (LOAEL). The NOAEL is the highest concentration at which no adverse physiological or toxicological effect has been observed. The LOAEL is the lowest concentration at which adverse physiological or toxicological effect has been observed. The NOAEL value for FM-200 is 9.0% v/v and the LOAEL value is >10.5% v/v.

In normally occupied areas, agent concentration must not exceed the LOAEL, but may exceed the NOAEL where a pre-discharge alarm and time delay are provided. Since agent concentrations are based upon the gross volume of the space, the designer must be at all times mindful of the temperature range of the protected space and any other factors that may impact the actual concentration.

**3.2. Application.** The following steps must be taken to design a marine FM-200 system:

- Determine design concentration required for hazard. Refer to Table 3.2.1.
- Determine minimum and maximum ambient temperature for hazard.
- Determine volume of the hazard.
- Determine integrity of the hazard.
- Determine if additional agent will be required to offset leakage of agent from the hazard.

**3.2.1 Calculate the quantity of FM-200 required to provide the proper design concentration at the minimum expected hazard temperature.**

- Refer to Tables 3.2.1, and 3.2.2. This information is given for estimating purposes only. The computer program calculates this information for the designer.
- Calculate the corresponding concentration at the maximum expected design concentration.

**3.2.2 Determine what components are required. Review the following.**

- Cylinder size, quantity, and fill requirements (Refer to Table 3.2.1 and to Table 3.2.2.)
- Actuation method; manual (cable or pressure actuation) or automatic (pneumatic actuation)  
**Note that USCG rules require manual actuation of all systems protecting any space with a volume greater than 6,000 ft<sup>3</sup>. Automatic actuation is required for volumes less than or equal to 6,000 ft<sup>3</sup> where the system is located within the protected space.**
- Other system requirements, i.e., discharge delay, pre-discharge alarm, automatic ventilation shutdown, automatic engine shutdown, reserve supply, etc.
- Other required hardware, i.e., cylinder brackets, actuation stations, ship's spares, etc.

**3.2.3 Locate nozzles based on the following:**

- Overhead height (15'-6" (4.75 M) maximum, 1' (0.3 M) minimum).
- Nozzle area coverage.
- Special hazard area layout considerations.

**3.2.4 Locate cylinders based on the following:**

- Number of cylinders required.
- Storage temperature/environmental considerations, i.e., weather, area classification, corrosive environment.
- Accessibility.
- Deck loading.
- Requirements of the US Coast Guard.

**Note that for systems of greater than 6,000 ft<sup>3</sup> with cylinders stored within the protected space, the designer must receive special permission or project approval from the USCG.**

**3.2.5 Locate piping based on the following:**

- Nozzle location.
- Structural members for bracing pipe.
- Required overhead clearance, if any.

**3.2.6 Determine pipe size and layout.**

- Draw piping isometric.
- Dimension all pipe sections.
- Locate all fittings.
- Note all elevation changes.

This information will be needed for input into the computer program.

<u>Fuel</u>	<u>FM-200 Fire Suppression Design Concentration, %v/v</u>
Diesel	8.7
Gasoline	9.0
Hydraulic Fluid	8.5
Hydraulic Oil	7.7
JP4	9.0
JP5	9.0
Class A (Surface Fires)	7.0
Class C (Electrical Fires)	7.0

**Table 3.2.1 - FM-200 Fire Suppression Design Concentrations for Common Marine Hazards**  
 (see Appendix H for more design concentrations)

**3.2.7 Using the FM-200 Concentration Flooding Factors**

To find the total quantity of FM-200 required at a specific temperature and concentration, multiply the hazard area volume by the multiplier from Table 3.2.2 that corresponds to the design temperature and concentration desired.

<b>A</b>		<b>B</b>		<b>C</b>					
Temp °F	s	7	8	8.7	9	9.5	10	10.5	
10	1.9311	0.0390	0.0450	.0494	0.0512	0.0544	0.0575	0.0608	
20	1.9769	0.0381	0.0440	.0482	0.0500	0.0531	0.0562	0.0593	
30	2.0226	0.0372	0.0430	.0472	0.0489	0.0519	0.0549	0.0580	
40	2.0684	0.0364	0.0420	.0461	0.0478	0.0508	0.0537	0.0567	
50	2.1141	0.0356	0.0411	.0452	0.0468	0.0497	0.0526	0.9555	
60	2.1598	0.0348	0.0403	.0442	0.0458	0.0486	0.0514	0.0543	
70	2.2056	0.0341	0.0394	.0433	0.0448	0.0476	0.0504	0.0532	
80	2.2513	0.0334	0.0386	.0424	0.0439	0.0466	0.0494	0.0521	
90	2.2971	0.0328	0.0379	.0416	0.0431	0.0457	0.0484	0.0511	
100	2.3428	0.0321	0.0371	.0408	0.0422	0.0448	0.0474	0.0501	
110	2.3885	0.0315	0.0364	.0400	0.0414	0.0439	0.0465	0.0491	
120	2.4343	0.0309	0.0357	.0393	0.0406	0.0431	0.0456	0.0482	
130	2.4800	0.0304	0.0351	.0386	0.0399	0.0423	0.0448	0.0473	

**Table 3.2.2- FM-200 Total Flooding Concentration Factors (W/V)**  
 (continued on next page)

A	B	C				
Temp °F	s	11	12	13	14	15
10	1.9311	0.0640	0.0706	0.0774	0.0843	0.0914
20	1.9769	0.0625	0.0690	0.0756	9.0823	0.0893
30	2.0226	0.0611	0.0674	0.0739	0.0805	0.0872
40	2.0684	0.0598	0.0659	0.0722	0.0787	0.0853
50	2.1141	0.0585	0.0645	0.0707	0.0770	0.0835
60	2.1598	0.0572	0.0631	0.0692	0.0754	0.0817
70	2.2056	0.0560	0.0618	0.0677	0.0738	0.0800
80	2.2513	0.0549	0.0606	0.0664	0.0723	0.0784
90	2.2971	0.0538	0.0594	0.0650	0.0709	0.0768
100	2.3428	0.0528	0.0582	0.06389	0.0695	0.0753
110	2.3885	0.0517	0.0571	0.0626	0.0682	0.0739
120	2.4343	0.0508	0.0560	0.0614	0.0669	0.0725
130	2.4800	0.0498	0.0550	0.0603	0.0656	0.0712

**Table 3.2.2- FM-200 Total Flooding Concentration Factors (W/V)**

**Definitions for Table 3.2.2**

Column A = minimum design temperature in the flooded space.

Column B = specific volume of superheated FM-200 vapor at the temperature indicated.

Row C = design concentration, %v/v

Columns W/V = Flooding factor = lbs. of FM-200 agent per cubic foot of hazard volume.

To determine the weight of agent required at minimum use concentrations for situations not given in Table 3.2.2, use the following equation:

$$W = (V/s) \times [c/(100-c)]$$

where:

W = agent weight required (lbs.)

V = volume of space to be flooded (ft<sup>3</sup>)

s = specific volume of superheated FM-200 vapor (ft<sup>3</sup>/lb.)

c = desired concentration, %v/v, in air at the temperature indicated

The specific volume of superheated FM-200 vapor, s, may be approximated using the following equation:

$$s = 1.8854 + 0.004574t$$

where:

s = specific volume of superheated FM-200 vapor at temperature indicated (ft<sup>3</sup>/lb.)

t = minimum design temperature (°F) in flooded space.

**3.3 Design Criteria.** The complexity of two-phase flow formulas does not allow for any simple method of manual FM-200 calculation. For this reason, the flow calculations and design criteria described in this manual have been programmed into a computer flow calculation software.

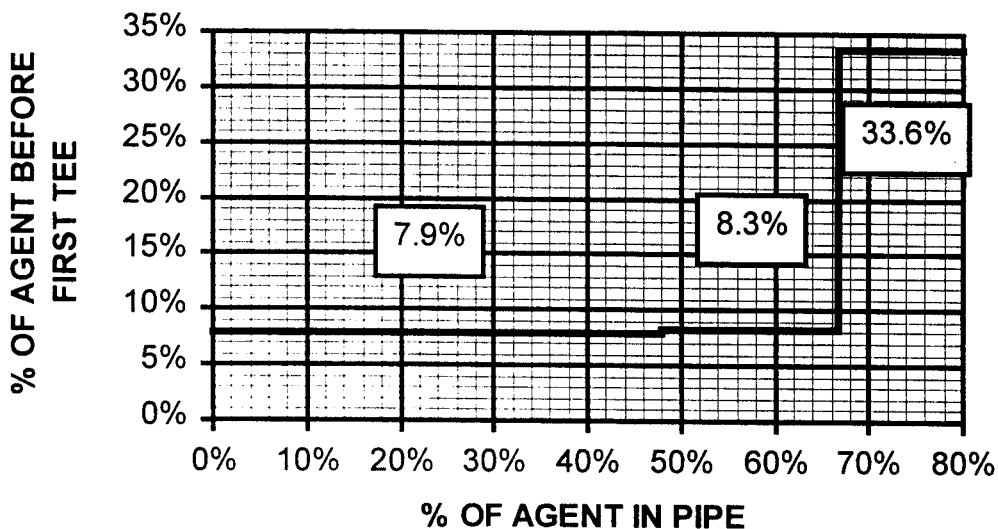
**CAUTION**

**Kidde FM-200 ECS Computer Design Software is the only calculation method to be used with Kidde FM-200 equipment. No other calculation method is acceptable to Kidde.**

The system designer must become thoroughly familiar with the "Kidde FM-200 ECS Flow Program User's Manual" (included with the software) to determine the proper procedures for applying the input parameters to the Kidde computer program. There are a number of limitations to these input parameters which must be observed if accurate results are to be obtained. Most of these limitations are in the program. However, there are certain restrictions that must be addressed by the system designer before applying his input data. The following sections describe the essential design parameters and design limitations which must be considered.

**3.3.1 First Branch Flow Split.** For accuracy of the flow calculations in unbalanced systems, any branch line must be covered by the liquid phase at the equilibrium design point (i.e., when one-half the liquid phase has been discharged through the nozzles). When this condition is not met, the computer output will display a warning. It is then up to the system designer to correct the piping volume preceding the first branch split to meet this design requirement (See Figure 3.3.1).

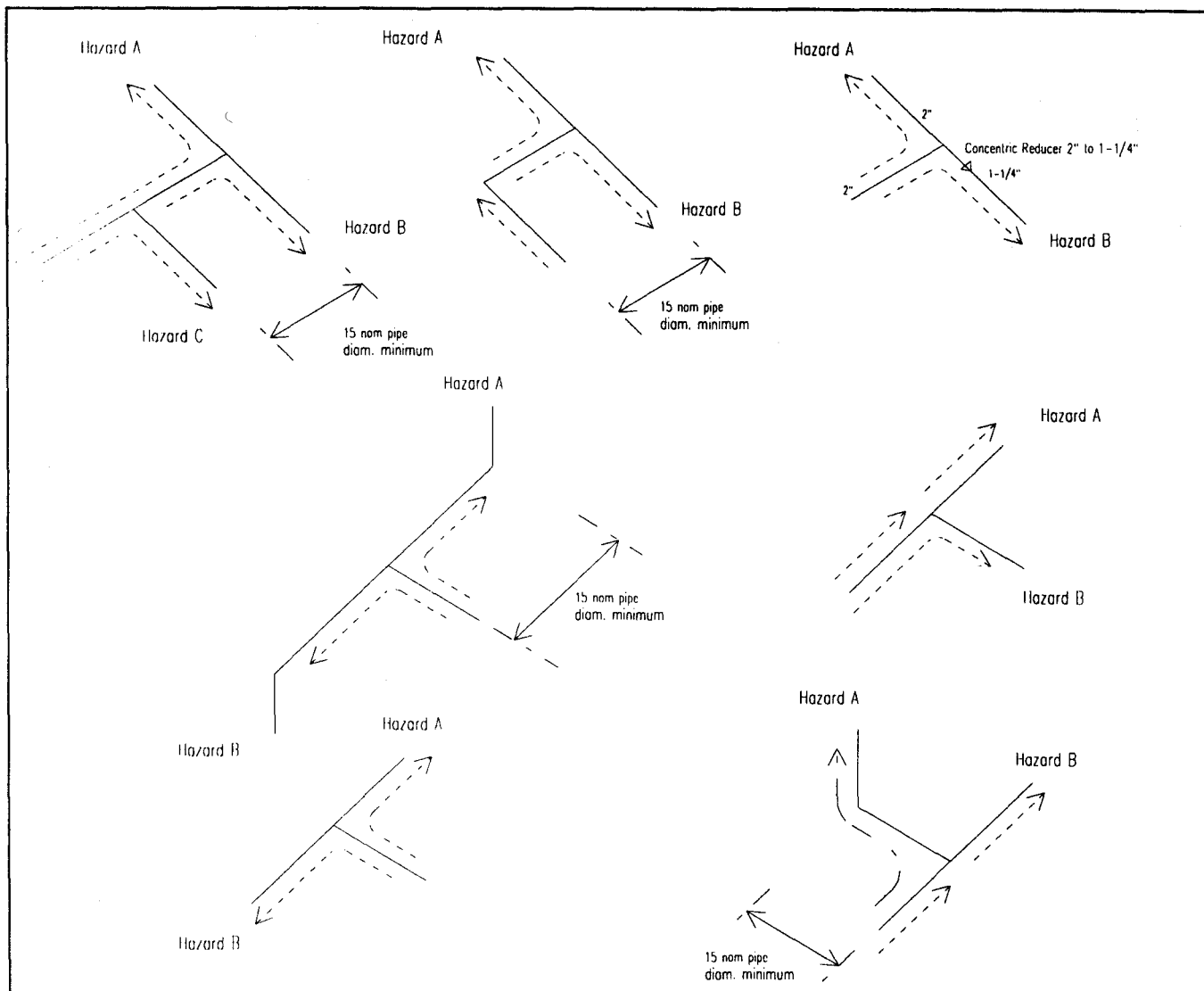
**Limits: % of agent in pipe and % of agent before first tee. (As computed by "FLOW", do not use for manual computation.)**



**Figure 3.3.1 Percent agent before First Tee as a function of Percent agent in Pipe**

**3.3.2 Tee Flow Splits.** Flow splits at tee junctions are sensitive to gravity. Even though turbulent flow exists, there is a tendency for the vapor phase to migrate to the upper portion of the pipe leaving a more dense medium at the bottom of the pipe. For this reason, the following limitations must be observed (also See Figure 3.3.2):

1. Bull head tees must have both outlets in the horizontal plane. The inlet to a bull head tee may approach in a horizontal, vertically up, or vertically down direction.
2. Side tees must have the inlet and both outlets all in the horizontal plane.
3. Elbows before and after tee splits going to separate hazards must be located a minimum distance of 15 pipe diameters (nominal) before the tee splits.
4. Tee splits going to separate hazards from a common supply line must be spaced a minimum of 15 pipe diameters (nominal) apart.
5. Pipe reducers before tee splits must be located a minimum of 15 pipe diameters (nominal) before the tee splits. Pipe reducers must be of the concentric reducer type.
6. Minimum flow out of a side tee branch is 10% of total flow at the tee.
7. For flow splits less than 30%, the split shall be done through a side tee with the smaller flow going through the side tee member. The minimum flow through the side tee member is 10%. The maximum flow through the tee is 90%.
8. For flow splits equal to or greater than 30%, the split shall be done through a bull head tee. The maximum flow split through a bull head tee is 70%.



**Figure 3.3.2 - Acceptable Tee Flow Splits for FM-200**

**3.3.3 Duration of Discharge.** Per NFPA 2001, the discharge shall be completed in a nominal 10 seconds or less. Discharge times shorter than 10 seconds are desirable to minimize production of decomposition products. Discharge times as short as 6 seconds should be considered when circumstances permit.

**3.3.4 Nozzle Selection and Placement.** There are two basic Kidde nozzle configurations:

1. The 360° nozzle which provides a full 360° discharge pattern is designed for placement in the central portion of the hazard. See Figure 3.3.5

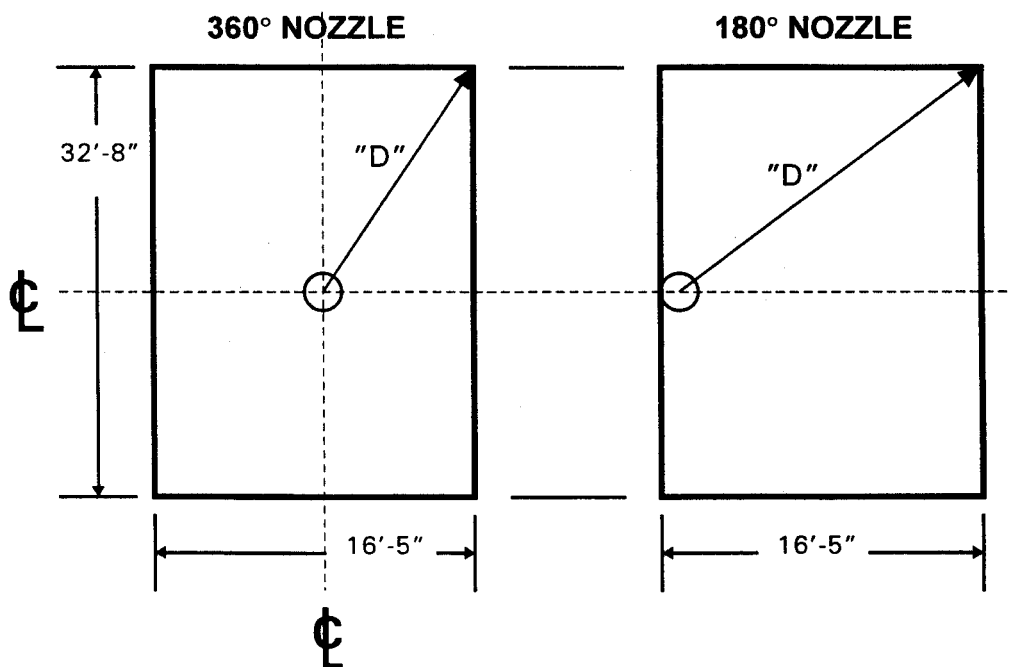


2. The 180° nozzle which provides a 180° discharge pattern is designed for placement adjacent to a side wall of the hazard. See Figure 3.3.5

Nozzles are available in nominal pipe sizes of 1/2", 3/4", 1", 1-1/4", 1 -1 /2" and 2".

**3.3.5 Nozzle Area Coverage.** To ensure proper agent distribution, nozzles must not exceed maximum area and height limitations described herein. The maximum height above deck level for a single row of nozzles is 15'-6". Nozzles must be located at 12" ± 2" away from sidewall. Nozzles must be pendant, with inlet (pipe threads) facing upward. For any space with an overhead higher than 15'-6", nozzles should be arranged in tiers each up to 15'-6" apart. The maximum area coverage for each nozzle is described as a straight-line distance from the nozzle to the farthest corner of the protected space (see Figure 3.3.5).

Where bilges are open (where openings allow free communication into the main protected space), they are part of the protected space and require no additional nozzles. Where bilges are closed, they must be protected with a dedicated nozzle network.



**Figure 3.3.5 - Nozzle Placement and Coverage**

The maximum distances ("D") are shown in Table 3.3.5.

Nozzle	Distance "D" (feet)
180°	23' - 4"
360°	18' - 5"

**Table 3.3.5 - Maximum Nozzle Straight Line Distances**

1. 180° Nozzles - 180° discharge pattern - 16'-5" x 32'-8" with the nozzle located in the center of a side wall for heights of up to 15'-6" maximum. Nozzles must be installed with orifices 6" ± 2" below the overhead. (SEE FOLLOWING NOTES) For heights below 2' high, the nozzle should be located no more than half the height below the overhead. 180° nozzles must be oriented with orifices radiating outward symmetrically.
2. 360° Nozzles - 360° discharge pattern - 16'-5" x 32'-8" with the nozzle located in the center of the enclosure for heights of up to 15'-6" maximum. Nozzles must be installed with orifices 6" ± 2 inches below the ceiling. (SEE FOLLOWING NOTES) For heights below 2' high, the nozzle should be located no more than half the height below the overhead.

**NOTE**

Nozzles are to be mounted perpendicular to overhead. They should not enter into the hazard at an angle.

**NOTE**

Nozzle spacing is based on open area. Consideration shall be given to reducing spacing when obstructions exist which would impede the uniform distribution of FM-200 throughout the area.

**3.3.6 Pipe Sizing.** The following table may be used as an estimating guide for sizing distribution piping.

Nom. Pipe Size (inches)	Flow Rate (lbs./sec)	
	Minimum Design	Max. Nom. Design
0.25	0.25	1.0
0.375	0.60	2.0
0.5	1.00	3.0
0.75	2.00	5.5
1.0	3.50	8.5
1.25	6.00	12.5
1.5	9.00	20.0
2.0	14.00	30.0
2.5	20.00	55.0
3.0	30.00	90.0
4.0	55.00	125.0
5.0	90.00	200.0
6.0	120.00	300.0

**Table 3.3.6 Kidde Pipe Size Estimating Table**

This table is intended for use as a guide only. The Kidde ECS Series flow calculation computer program must be used for the final design.

### 3.4 Other Conditions

**3.4.1 Discharge Time.** The maximum discharge time for a Kidde FM-200 system to reach the extinguishing concentration is 10 seconds, but not less than 6 seconds.

**3.4.2 Ventilation.** Any ventilation installed in the protected space must be shut down prior to agent discharge. Also, prior to agent discharge, any internal combustion engine which receives intake air from the protected space must be shut down.

**3.4.3 Operating/Storage Temperature Range.** The Kidde FM-200 ECS Series computer flow calculation software is intended for use in designs where the container operating/storage temperature is +60°F to +80°F. With the exception of the designs listed in Table 3.4.3, if the container operating/storage temperature is outside this range, an insufficient quantity of agent may be discharged from one or more discharge nozzles. Note: A system is considered balanced if each of the nozzles is designed to discharge the same quantity of agent. To accomplish this, the flow path from the flow split to each nozzle must contain the same length and size of pipe, (i.e. the length of pipe from the tee to each nozzle is no shorter than 90% of the longest leg), and the nozzle sizes must be identical. Also, the number of nozzles used must be in groups of 2 or 4. In addition, all splits are made with the flow entering the inlet branch of a bullhead tee, and exiting through the side branches of the tee. The exit branches must be horizontal to avoid an imbalance due to gravitational effects and liquid/vapor phase separation.

No. of Nozzles	No. of Hazards	System Design	Operating/Storage Temperature Range
single	single	-	32°F to 130°F
multiple	single	balanced	32°F to 130°F
multiple	single	unbalanced	32°F to 130°F
multiple	multiple	balanced	32°F to 130°F
multiple	multiple	unbalanced	60°F to 80°F

**Table 3.4.3 FM-200 Operating/Storage Temperature Range**

**3.4.4** Paragraph deleted.

#### **3.4.5 Cylinder Storage.**

**3.4.5.1 Outside the Protected Space.** Cylinders must be located as close to the protected space as possible. Cylinders must also be in an accessible location so as to permit manual actuation as a backup to the primary means of actuation (cable, etc.). Cylinders must be located such that the storage temperature range falls between +32°F and +130°F (see 3.4.3 for more detail). Additional heating or cooling for the space may be required to maintain this temperature range. All cylinders on a common manifold must be of the same size and must contain the same amount of agent.

**3.4.5.2 Inside the Protected Space.** In some cases, cylinders may be located inside the protected space. Cylinders must be located such that the storage temperature range falls between +32°F and +130°F. Additional heating or cooling for the space may be required to maintain this temperature range. All cylinders on a common manifold must be of the same size and must contain the same amount of agent.

**3.4.6 System Operating Pressure.** The normal system operating pressure for Kidde Marine FM-200 ECS Series Fire Suppression System equipment is 360 PSIG at 70°F.

**3.5 System Actuation Methods:** Kidde Marine FM-200 system actuation arrangements can vary, based upon system installation and operational requirements, etc. There are four (4) different ways to actuate a USCG marine FM-200 suppression system. These are via; cable, pressure, manual local and pneumatic operation. In addition to using one of the these ways as the primary means of actuation, systems must be capable of local actuation at the cylinder storage location. Any system protecting a space of greater than 6,000 ft<sup>3</sup> must be manually actuated. Automatic actuation is allowed only for systems protecting spaces of 6,000 ft<sup>3</sup> and under and is required when such a system is located within the protected space. Except for spaces of 6,000 ft<sup>3</sup> or less with a suitable horizontal escape, a marine FM-200 system should have a pre-discharge alarm and some means to shut down ventilation, machinery, etc.

**NOTE:** For systems of greater than 6,000 ft<sup>3</sup> to be located within the protected space, the designer must receive special permission or project approval from the USCG.

**3.5.1 Cable Actuation.** Cylinders can be remotely actuated via cable operated control head (P/N 979469). The cable operated control head is a mechanical device that enables the remote actuation of cylinder valves by pull cable. Depending upon system design, the control head may be attached directly to an FM-200 cylinder valve, or to either a CO<sub>2</sub> or nitrogen pilot actuation cylinder. The cable operated control head is fitted with a manual release lever to allow local actuation.

Cable actuation can also be used to operate stop valves.

**3.5.2 Pressure Actuation.** Cylinders can be remotely actuated via pressure operated control head (P/N 878737), stackable pressure operated control head (P/N 878750) and lever/pressure operated control head (P/N 878751). All three control heads are mechanical devices that enable the remote actuation of cylinder valves by pressurized gas (FM-200, nitrogen or CO<sub>2</sub>) pressure.

Pressure operated control head (P/N 878737) is **not** capable of local actuation and is used to actuate slave cylinders. Stackable pressure operated control head (P/N 878750) is used in cases where it is desired to actuate a cylinder via both pressure and another type of control head. Lever/pressure operated control head (P/N 878751) is used in cases where a pressure operated cylinder must also be capable of local actuation.

Pressure actuation can also be used to operate stop valves.

**3.5.3 Paragraph Deleted**

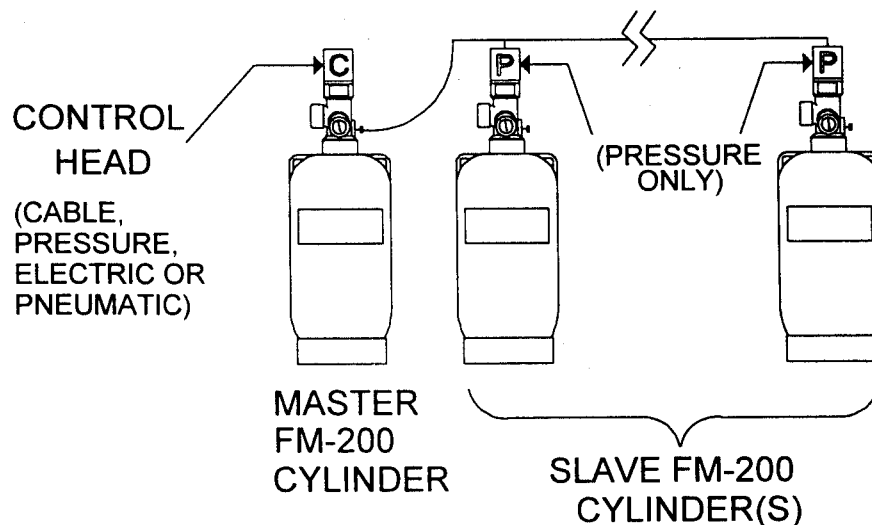
**3.5.4 Manual Local Actuation.** Cylinders can be manually operated locally (at the cylinder) with lever operated control head (P/N 870652). The lever operated control head is a mechanical device that can be used to locally operate FM-200 cylinder valves, CO<sub>2</sub> cylinder valves, time delay bypasses, stop valves, etc.

**3.5.5 Pneumatic Actuation.** Cylinders can be automatically actuated via pneumatic control heads (P/N 872318, 872335, 872365, 872362, 872310, 872330, 872360) when connected to pneumatic heat detector (P/N 841421). Air in the detector expands with increasing heat and the resultant pressure acts on an internal diaphragm, operating the control head. Automatic actuation is allowed only for systems protecting spaces of 6,000 ft<sup>3</sup> and under.

Pneumatic control heads are capable of both local control and remote cable actuation.

**3.6 Individual Cylinder Actuation.** An FM-200 cylinder assembly can only be actuated using a control head. These control heads can be operated in many different ways (see Section 3.5).

It is possible to operate several FM-200 cylinders from the FM-200 gas pressure of one FM-200 cylinder by using master cylinder adapter kit (P/N 844895). In such an arrangement, the cylinder assembly fitted with the master cylinder adapter kit is called a **master cylinder** and the cylinder assemblies (fitted with pressure operated control heads) operated via FM-200 gas pressure are called **slave cylinders**. Master and slave cylinder arrangements can be used in systems actuated by cable operated, lever operated, pressure operated, and pneumatic control heads. See Figure 3.6.



**Figure 3.6 - Master & slave cylinder arrangement**

When actuating FM-200 cylinders using either CO<sub>2</sub> or nitrogen pilot cylinders, FM-200 cylinder assemblies are fitted with pressure operated control heads. Where a pressure operated siren and time delay are required, it is necessary to actuate the FM-200 cylinders using CO<sub>2</sub> pressure. This pressure would be supplied by CO<sub>2</sub> cylinders, which can be actuated either via cable operated control head or pressure operated control head (using a nitrogen pilot cylinder).

**3.6.1 Master & Slave FM-200 Cylinder Actuation Limitations.** FM-200 cylinders are considered **close coupled** when cylinders are connected to each other using only actuation hoses (P/N 264986 or 264987). In any other case, FM-200 cylinders are considered **not close coupled**. When marine FM-200 ECS Series cylinders are configured in the master & slave arrangement, two modes of pressure actuation are available. Actuation of FM-200 cylinders by N<sub>2</sub>, CO<sub>2</sub> or pneumatically is covered in 3.6.2. The two modes are given below.

1. For cylinders close coupled using pressure from (1) master FM-200 cylinder:

One (1) master cylinder can actuate a maximum of fifteen (15) slave cylinders close coupled, using pressure operated control heads on the slave cylinders. The slave cylinder operation will be through actuation hoses (P/N 264986 or 264987).

2. For cylinders not close coupled using pressure from (1) master FM-200 cylinder

One (1) master cylinder can actuate a maximum of four (4) slave cylinders (maximum five cylinders in a group) using pressure operated control heads on the slave cylinders. The slave cylinder operation will be through a 5/16" O.D. x .032" wall copper tubing actuator line having a maximum total length of 100 feet (30.5m).

**3.6.2 Actuation System Limitations.** The purpose of the actuation system is to operate the FM-200 cylinders, either by actuating a master cylinder (in a master & slave arrangement) or by actuating all close coupled cylinders in a bank. Actuation systems often include equipment shut downs (via pressure switches & trips), alarms and time delays. Actuation system limitations are detailed in this section.

**3.6.2.1 Corner Pulley and Cable Limitations.** Cable and pneumatic control heads fitted with cable pulls are subject to certain limitations. The pull boxes are connected to the control heads via 1/16 inch stainless steel cable. Corner pulleys are used to change direction of the cable routing. The cable should be routed in 3/8 inch schedule 40 pipe. Refer to Table 3.6.2.1 below for corner pulley and cable length limitations. In addition, the maximum force required to operate a cable pull may not be greater than 40 pounds, nor require a movement greater than 14 inches. If any other combinations of corner pulleys and lengths of cable are required, the 40 lb. maximum force and 14 inch maximum travel requirements must not be exceeded.

Control Head Type	Control Head Part Number	Max. No. of P/N 803808	Max. Cable Length, Feet
Cable Operated	979469	15	100
Pneumatic	872318	6	100
Pneumatic	872335	6	100
Pneumatic	872365	6	100
Pneumatic	872362	6	100
Pneumatic	872310	6	100
Pneumatic	872360	6	100

**Table 3.6.2.1 - Corner Pulley and Cable Limitations**

**3.6.2.2 Actuation Limitations.** FM-200 systems can be actuated using CO<sub>2</sub> in situations where a CO<sub>2</sub> time delay and pressure operated siren are required and/or where it is desired to actuate up to 25 cylinders with one actuation system. The CO<sub>2</sub> actuation cylinders can be actuated either by cable operated control heads or by pressure operated control heads (actuated by a nitrogen pilot cylinder). CO<sub>2</sub> pressure can be used to operate one or more master FM-200 cylinders or can be used to operate close coupled FM-200 cylinders. Limitations are discussed below.

#### Cable Actuation

Cable actuated systems use pull boxes that operate pilot CO<sub>2</sub> cylinders which in turn actuate FM-200 cylinders. System limitations are as follows:

From actuation station to pilot CO<sub>2</sub> cylinders, see the cable limitations shown in 3.6.2.1.

From CO<sub>2</sub> pilot cylinders to FM-200 cylinders, a maximum of 20' of 3/8" schedule 40 pipe may be used. Total distance is measured from the CO<sub>2</sub> cylinders to the FM-200 cylinder pilot manifold.

FM-200 cylinder arrangements and limitations are as follows:

1. Using FM-200 cylinders actuated by (CO<sub>2</sub>) pressure operated control heads, up to 25 **close coupled** FM-200 cylinders can be actuated by CO<sub>2</sub> (using only K-F hose p/n's 264986 & 264987).
2. Using master & slave FM-200 cylinder arrangement(s) with master cylinders operated by (CO<sub>2</sub>) pressure operated control heads and slave cylinders actuated by (FM-200) pressure operated control heads, up to 25 close coupled master cylinders could be used to operate slave cylinders corresponding with the limitations in 3.6.1.

#### N<sub>2</sub> Pilot Actuation

These systems use nitrogen pilot cylinders that operate pilot CO<sub>2</sub> cylinders which in turn actuate FM-200 cylinders. System limitations are as follows:

From nitrogen pilot cylinder to pilot CO<sub>2</sub> cylinders, any of the following are allowed:

- 300' of 1/4" schedule 40 pipe OR
- 436' of 1/4" schedule 80 pipe OR
- 427' of 1/4" O.D. x .035 wall stainless steel tubing

From CO<sub>2</sub> pilot cylinders to FM-200 cylinders, a maximum of 20' of 3/8" schedule 40 pipe may be used. Total distance is measured from the CO<sub>2</sub> cylinders to the FM-200 cylinder pilot manifold.

FM-200 cylinder arrangements and limitations are the same as for cable actuated systems.

### Automatic Pneumatic Actuation

These systems use pneumatic heat detectors which operate the pneumatic control head on an FM-200 master cylinder which can then actuate slave FM-200 cylinders.

From pneumatic heat detector to pneumatic control head, 3/16 inch tubing is used (P/N 802366 802587, 802367, 802486). FM-200 cylinders are arranged per 3.6.1.

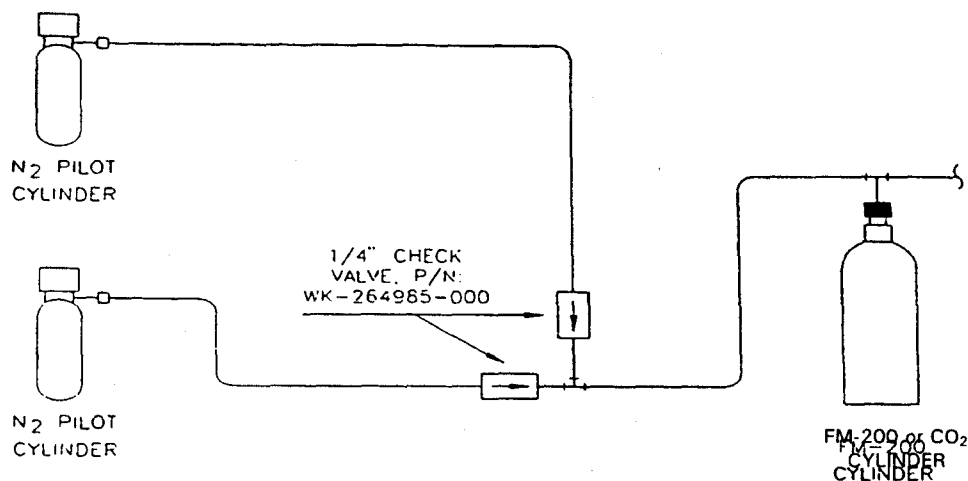
If time delay and siren are required, the pneumatic control head is instead connected to a CO<sub>2</sub> pilot cylinder which in turn operates FM-200 cylinders. FM-200 cylinder arrangements and limitations are the same as for cable actuated systems.

**3.6.2.3 CO<sub>2</sub> Pressure Operated Siren Limitations.** The pressure operated siren (P/N 981574) consumes approximately 20 lbs of CO<sub>2</sub> per minute. The maximum number of pressure operated sirens is two per 50 lb CO<sub>2</sub> cylinder (for a maximum of four sirens per two pilot CO<sub>2</sub> cylinders). Use 1/2 inch pipe to connect pilot cylinders and sirens. Length of 1/2 inch pipe shall not exceed 250 feet.

### **3.6.2.4 Use of Multiple Nitrogen Cylinders (See Figure 3.6.2.4).**

Two or more remotely located pilot nitrogen cylinders can be used to actuate the FM-200 systems described in Section 3.8, provided that the following conditions are met:

- 1/4" check valves (P/N 264985) shall be installed at the intersection of each pilot line to the main actuator line (see Figure 3.6.1.1).
- The total length of actuator line, from each nitrogen pilot cylinder to the FM-200 cylinders shall not exceed the limitation established in 3.6.2.2.



**Figure 3.6.2.4 - Multiple pilot nitrogen actuation cylinders**



### 3.7 System Actuation Details

**3.7.1 Discharge Delay and Pre-Discharge Alarm.** Any marine FM-200 system protecting a space of greater than 6,000 ft<sup>3</sup> must be equipped with a time delay and pre-discharge alarm to warn any occupants in the protected space and allow them sufficient time to exit as well as to let ventilation shut down prior to agent discharge. Systems protecting spaces of 6,000 ft<sup>3</sup> and under must be equipped with a time delay unless there is a suitable horizontal escape. Systems protecting spaces of 6,000 ft<sup>3</sup> and under must also be actuated automatically if located inside the protected space. Discharge delay is accomplished with mechanical 30 or 60 second discharge delays. Discharge delays should be used with a pre-discharge alarm.

**3.7.1.1 Mechanical Discharge Delay.** Discharge delay can be accomplished mechanically using either 30 second discharge delay (P/N 871071) or 60 second discharge delay (P/N 897636). **Note: these discharge delays operate only with CO<sub>2</sub> and must only be used in systems that use CO<sub>2</sub> pilot cylinders** (see Appendix I for system arrangements). When installed, this type of discharge delay must be installed in the actuation line piping down stream of any pressure operated equipment (including pre-discharge alarm). A lever operated control head (P/N 870652) should be fastened to each discharge delay to allow the discharge delay to be bypassed in the event of a failure.

**3.7.2 Pressure Trip Limitations.** The maximum load to be attached to pressure trip (P/N 874290) is 100 lbs. This is based on a minimum pressure of 75 PSIG at the pressure trip.

**3.7.3 Dual Pull Mechanism.** The dual pull mechanism (P/N 840058) is used to join three cables for dual operation of a single function (i.e.: the operation of one control head from two separate cable pull stations).

**3.7.4 Dual Pull Equalizer.** The dual pull equalizer (P/N 840051) is used to join three cables for single operation of two functions (i.e.: the operation of two separate control heads from one cable pull station).

**3.8 System Arrangements:** Kidde Marine FM-200 systems can be arranged in many different configurations using the system actuation methods and limitations detailed in this chapter. Cylinders can be stored in one central location (with close coupled cylinders) or spaced apart and stored in multiple locations (with not close coupled cylinders). FM-200 cylinders are typically located outside of the protected space, except for spaces up to 6,000 ft<sup>3</sup> and any spaces greater than 6,000 ft<sup>3</sup> that may be approved by the USCG on a case by case basis. In all cases, system arrangements must be designed to ensure uniform agent distribution and concentration.

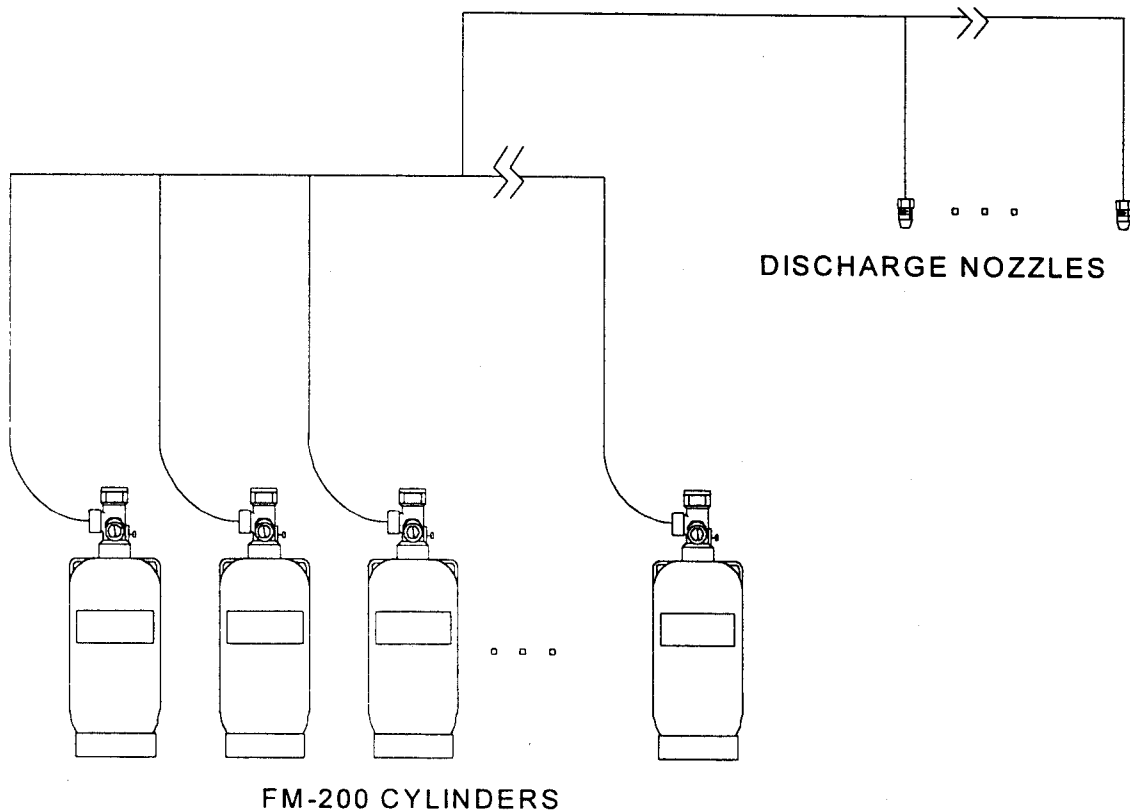
FM-200 cylinders should be located as close to the protected space as possible. Cylinders located outside of the protected space must be arranged to permit manual local actuation in the event of fire without the need to transit any space that they protect. In some cases, cylinders may be stored within the protected space. In any case, the cylinders must be located such that the storage temperature range falls between +32°F and +130°F. Additional heating or cooling for the space may be required to maintain this temperature range.

System arrangements must include all applicable requirements such as pre-discharge alarm, engine and ventilation shutdowns, etc.

**3.8.1 Central Storage.** Systems containing multiple cylinders with a common manifold and discharge piping (see Figure 3.8.1) must be of the same size and must contain the same amount of agent. In addition, manifold EL-checks must be installed on the discharge manifold of such a system to prevent agent discharge from the manifold in the event that any FM-200 cylinders are removed for servicing.

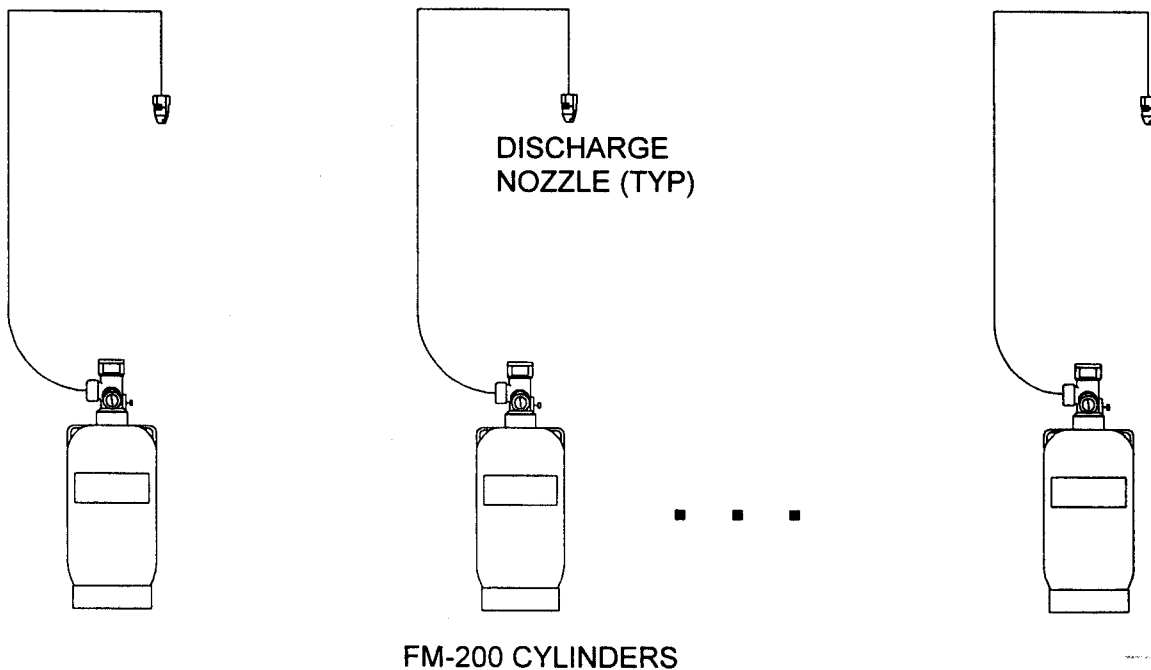
Cylinders may also be stored in a central location arranged with individual discharge manifolds & piping. Such a system may be desirable in certain situations. All cylinders discharging into the same space must be actuated by a common actuation system to ensure simultaneous discharge.

If a system is designed to protect more than one space, the agent quantity must be sufficient to protect the largest space. Actuation of different cylinder combinations is possible by using different combinations of control heads. Also, stop valves must be arranged in the discharge piping to route agent to the space indicated by the pull station. When actuating such a system, the stop valve for the space requiring agent must be opened prior to FM-200 cylinder actuation. All systems, except those of 6,000 ft<sup>3</sup> and under having a suitable horizontal escape, must have a pre-discharge alarm. Also, ventilation and dampers for the protected space must be secured prior to agent discharge.



**Figure 3.8.1 - Central storage system with common manifold and discharge piping (actuation components and EL-checks not shown).**

**3.8.2 Storage in Multiple Locations.** FM-200 cylinders may be located remotely from each other (see Figure 3.8.2). Instead of sharing a manifold, the cylinders in this type of system each have separate piping and nozzle(s).



**Figure 3.8.2 - Storage in multiple locations (actuation components not shown).**

**3.8.3 System Arrangement Schematics.** Appendix I contains schematics for three typical system arrangements using cable, pressure and pneumatic actuation methods. These methods and their corresponding schematics are detailed below.

**3.8.3.1 Cable Actuation.** Cable actuation is accomplished with cable pull stations, corner pulleys, cable and cable operated control heads. Cable operated control heads can be used to actuate stop valves, if required. See 3.8.3.1.1 for details on the system arrangement using cable actuation.

**3.8.3.1.1 BC-1CG Manual Cable Actuation.** This system uses cable actuation to operate CO<sub>2</sub> pilot cylinders which then actuate the FM-200 cylinders. The FM-200 cylinders that are actuated by CO<sub>2</sub> are close coupled and could also act as master cylinders for additional FM-200 cylinders. Although a common manifold and piping is shown, FM-200 cylinders in this system could have separate combinations of manifold and piping. This system provides a discharge delay (30 or 60 second) and siren(s) powered only by the suppression system. This system is configured with two pull boxes (one controlling the pilot cylinders and the other controlling a stop valve) to provide two separate and distinct actions for system actuation. Note that Kidde-Fenwal time delays operate only on CO<sub>2</sub>. When protecting more than one space with such a system, the designer must install stop valves that

route agent to the discharge piping of the individual protected spaces. *See corresponding sketch in Appendix I.*

**3.8.3.2 Pressure Actuation.** Pressure actuation is accomplished with pilot cylinders and pressure operated control heads. With pressure actuation, FM-200 cylinders are actuated with pressure operated control heads operating on either CO<sub>2</sub> or N<sub>2</sub> pressure. Pressure operated control heads can be used to actuate stop valves, if required. See 3.8.3.2.1 for details on the system arrangement using pressure actuation.

**3.8.3.2.1 BP-1CG Manual Pressure Actuation.** This system uses a nitrogen cylinder with a lever operated control head to operate CO<sub>2</sub> pilot cylinders which then actuate the FM-200 cylinders. The FM-200 cylinders that are actuated by CO<sub>2</sub> are close coupled and could also act as master cylinders for additional FM-200 cylinders. Although a common manifold and piping is shown, FM-200 cylinders in this system could have separate combinations of manifold and piping. This system provides a discharge delay (30 or 60 second) and siren(s) powered only by the suppression system. This system is configured with a nitrogen pilot cylinder and an in-line ball valve to provide two separate and distinct actions for system actuation. Note that Kidde-Fenwal time delays operate only on CO<sub>2</sub>. *See corresponding sketch in Appendix I.*

**3.8.3.3 Automatic Actuation.** Automatic actuation is accomplished with pneumatic heat detectors (P/N 841241) and pneumatic control heads. When more than one cylinder is required, pneumatically actuated cylinders can be arranged in the master and slave cylinder configuration. Automatic actuation is required when cylinders are stored within the protected space. Typically, cylinders can only be stored in a protected space when its volume is 6,000 ft<sup>3</sup> or less. Time delay and pre-discharge alarm are not required in protected spaces of 6,000 ft<sup>3</sup> and less when there is a suitable horizontal escape. See 3.8.3.3.1 for details on the system arrangement using automatic actuation.

The pneumatic heat detector uses the rate of rise principle in which a sudden increase in temperature will cause the system to actuate. The heat actuators are located in the protected space and are interconnected to pneumatic control heads via copper tubing. When the air within the heat detector heats up - due to a fire within the space - the air expands and builds up pressure in the actuator. The pressure is then transmitted through copper tubing to the pneumatic control heads. When sufficient pressure has built up (the amount of pressure ranges from one to six inches of water), the pneumatic control heads will operate and discharge the system. Pneumatic control heads are fitted with vents so that slight changes in pressure (due to normal changes in ambient temperature) can be vented to atmosphere. Heat detector spacing must not exceed 25 feet, center to center, or 625 square feet per detector. No more than four detectors should be located on a single system.

**3.8.3.3.1 AP-1CG Automatic Pneumatic Actuation** This arrangement uses a pneumatic heat detector (P/N 841241) and pneumatic control head with cable pull box. *See corresponding sketch in Appendix I.*

## 4. EQUIPMENT INSTALLATION

**4.1 General.** All Kidde FM-200 equipment must be installed to facilitate proper inspection, testing, manual operation, recharging and any other required maintenance as may be necessary. Equipment must not be subject to severe weather conditions or mechanical, chemical, or other damage which could render the equipment inoperative. Equipment must be installed in accordance with NFPA Standard 2001, current edition and USCG Rules.

### WARNING

**THE FM-200 CYLINDER/VALVE ASSEMBLIES MUST BE HANDLED, INSTALLED AND SERVICED IN ACCORDANCE WITH THE INSTRUCTIONS CONTAINED IN THIS SECTION AND COMPRESSED GAS ASSOCIATION (CGA) PAMPHLETS C-1, C-6, AND P-1. CGA PAMPHLETS MAY BE OBTAINED FROM: COMPRESSED GAS ASSOCIATION, 1235 JEFFERSON DAVIS HIGHWAY, ARLINGTON, VA 22202. FAILURE TO FOLLOW THESE INSTRUCTIONS CAN CAUSE FM-200 CYLINDERS TO VIOLENTLY DISCHARGE, RESULTING IN SEVERE INJURY, DEATH AND/OR PROPERTY DESTRUCTION.**

## 4.2 DISTRIBUTION PIPING AND FITTINGS

**4.2.1 Threads.** Threads on all pipe and fittings must be tapered threads conforming to ANSI Specification 8-20.1. Joint compound, tape or thread lubricant must be applied only to the male threads of the joint.

**4.2.2 Pipe.** Piping must be of non combustible material having physical and chemical characteristics, such that its integrity under stress can be predicted with reliability. The computer flow program is only capable of accurately predicting agent flow and nozzle pressure when utilizing commercial steel pipe (Schedule 40 or Schedule 80).

**4.2.2.1 Ferrous Piping.** Galvanized steel pipe conforming to ASTM A-53, Grade A or B, or ASTM A-106, Grade A, B or C, in accordance with ASME B-31.1 Power Piping Code shall be used. Schedule 40 pipe is acceptable for pipe up to 8 inch. The pressure rating shall be equal to or greater than 620 PSI.

### CAUTION

Pipe supplied as dual stenciled A-120/A-53 class F meets the requirements of Class F furnace welded pipe ASTM A-53 as listed above. Ordinary cast-iron pipe, steel pipe conforming to ASTM A-120, or nonmetallic pipe must not be used.

**4.2.2.2 Piping Joints.** The type of piping joint shall be suitable for the design conditions and shall be selected with consideration of joint tightness and mechanical strength.

**4.2.2.3 Fittings.** Class 150 and cast iron fittings must not be used. Fittings used must be a minimum 300 lb. class conforming to ASTM A-197 and have a minimum working pressure of 620 PSI. Flanged fittings must be 300 lb. class, American Standard, galvanized forged carbon steel. Pressure/temperature ratings of the fitting manufacturer must not be exceeded. Teflon tape must be applied on male threads for threaded fittings.

Concentric bell reducers are the only means for reducing pipe size. Reductions can be made after a tee or after a union. Where reducers are used at tees, the reducers must be downstream of each tee. Reductions made after a union are possible only if the next change in direction (tee split) is located a minimum of 15 nominal pipe diameters downstream of the concentric bell reducer

**4.3 Installation of Pipe and Fittings.** Pipe and fittings must be installed in strict accordance with the system drawings and good commercial practices. The piping between the cylinder and the nozzles must be the shortest route possible, with a minimum of fittings. Any deviations in the routing or number of fittings must be approved by the design engineer prior to installation.

Piping must be reamed free of burrs and ridges after cutting, welding or threading. All threaded joints must conform to ANSI B1-20-I. Joint compound or thread tape must be applied only to the male threads of the joint, excluding the first two threads. Welding must be in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. Each pipe section must be swabbed clean, using a non-flammable organic solvent.

All piping must be blown clear with dry nitrogen or compressed air prior to installing the discharge nozzles.

The piping must be securely braced to account for discharge reaction forces and thermal expansion/contraction. Care must be taken to insure the piping is not subjected to vibration, mechanical or chemical damage. All hangers must be UL Listed, must conform to general industry standards for pipe hangers and conform to ASME B-31.1 Power Piping Code. Refer to ASME B-31.1 for additional bracing requirements.

**4.4** Paragraph deleted.

**4.5 Installation of Check Valves.** Install the check valves as shown on the system drawings. Apply Teflon tape or pipe compound to male threads, excluding the first two threads. Valves greater than 2 inches in size are provided with flanged outlets. All valves must be installed with the arrow on the valve body pointing in the proper direction of the flow.

**4.6 Installation of Discharge Nozzles.** After the system piping has been blown free of debris, install the discharge nozzles in strict accordance with the system drawings. Orient the nozzles as shown on drawings. Make certain that the correct nozzle type(s), part number(s) and orifice size(s) are installed in the proper location(s). See Paragraph 3.3.5 for correct nozzle placement and orientation.

**4.7 Installation of Pressure Actuation Pipe.** The pressure actuation pipe must be 1/4 inch schedule 40 or 80 pipe. The pipe or tubing must be routed in the most direct manner with a minimum of fittings. Pipe and fittings must be in accordance with the requirements listed in Section 3. Fittings can be flared or compression type. The pressure-temperature ratings of the fitting manufacturer must not be exceeded. Piping must be reamed free of burrs and ridges after cutting, threading or flaring. Upon assembly, pipe must be blown out with dry nitrogen, carbon dioxide or compressed air. Piping should be securely braced, and isolated from vibration, mechanical, or chemical damage.

**4.8 Installation of Valve Outlet Adapter.** Install valve outlet adapter (P/Ns 283904, 283905 and 283906) in system piping. Tighten securely.

**WARNING**

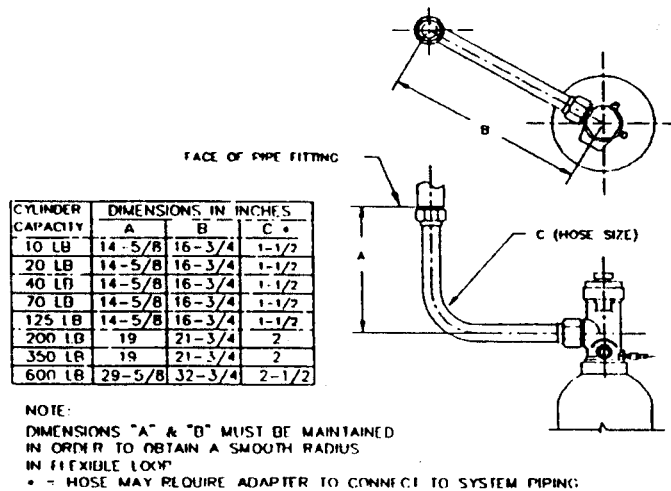
**ALWAYS CONNECT VALVE OUTLET ADAPTER INTO SYSTEM PIPING (UNION CONNECTION) BEFORE CONNECTING TO FM-200 CYLINDER.**

**4.9 Installation of Flexible Discharge Hose.** Attach flexible discharge hose from system piping or EL-check in discharge manifold to cylinder valve. Tighten securely. See Figure 4.9.1

**WARNING**

**ALWAYS CONNECT FLEXIBLE DISCHARGE HOSE INTO SYSTEM PIPING BEFORE CONNECTING TO FM-200 CYLINDER.**

*Equipment Installation*



**Figure 4.9.1 - Installation of the Flexible Hose Directly into System Piping**

#### 4.10 Installation of Master Cylinder Adapter Kit, Part Number 844895

##### NOTE

Master cylinder adapter installation can be accomplished safely with a pressurized cylinder

1. Remove 1/4 inch pipe plug from slave actuation port on master cylinder valve.
2. Prior to assembling the adapter to the cylinder valve, apply Permacel No. 412D Teflon tape male threads on adapter.
3. Ensure cap is screwed onto adapter outlet port before assembling to the cylinder valve.
4. Install adapter into slave actuation port on master cylinder valve.
5. Attach label to valve body (See Figure 4.10).

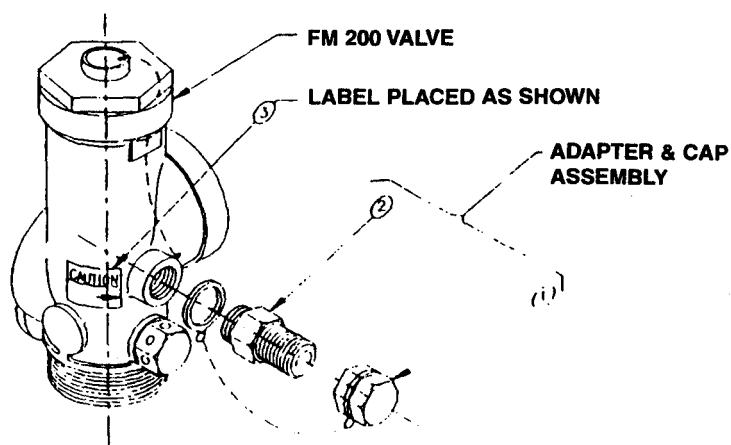


Figure 4.10 - Installation of Master Cylinder Adapter Kit



**4.11 Installation of FM-200 Cylinder/Valve Assemblies.** The FM-200 cylinders should be located as close to the protected hazard area as possible. The assemblies shall be located in a readily accessible location to allow for manual actuation and ease of inspection, service and maintenance. Operating instructions should be provided at the cylinder location (as well as any remote actuation locations). The cylinders shall be located in an environment protected from the weather, and where the ambient temperature does not exceed 130°F, nor fall below 32°F. External heating or cooling may be required to maintain this temperature range. The following installation instructions must be followed in the exact sequence outlined below to prevent accidental discharge, bodily injury, or property damage.

**4.11.1 Single Cylinder Systems.**

**WARNING**

**CYLINDER(S) MUST BE LOCATED AND MOUNTED WHERE THEY WILL NOT BE SUBJECT TO ACCIDENTAL DAMAGE OR MOVEMENT. SUITABLE PROTECTION TO PREVENT ACCIDENTAL CYLINDER DAMAGE OR MOVEMENT MUST BE INSTALLED WHEN NECESSARY.**

1. Position FM-200 cylinder in designated location. If moisture is likely to be present, locate cylinder(s) at least 2 inches off the deck and secure in place with two cylinder straps & cradles and attaching hardware (see Figure 4.11.1). Orient cylinder with valve outlet angled toward system piping. Cylinder must be mounted vertically.
2. Remove safety cap from cylinder valve outlet port.
3. Connect 1-1/2, 2 or 2-1/2 inch flexible discharge hose or valve outlet adapter to cylinder outlet port.

**NOTE**

If valve outlet adapter is used, a union must be installed in the discharge piping.

**WARNING**

**DISCHARGE HOSE MUST BE CONNECTED INTO SYSTEM PIPING BEFORE ATTACHING TO CYLINDER VALVE.**

**WARNING**

**VALVE OUTLET ADAPTER MUST BE CONNECTED INTO SYSTEM PIPING (UNION CONNECTION) BEFORE ATTACHING TO CYLINDER VALVE.**

4. Remove protection cap from cylinder valve actuation port.
5. Install control head to cylinder valve actuation port.

**WARNING**

**CONTROL HEAD MUST BE IN THE "SET" POSITION (ACTUATING PIN IS IN THE FULLY RETRACTED OR "SET" POSITION) BEFORE ATTACHING TO FM-200 CYLINDERS IN ORDER TO PREVENT ACCIDENTAL DISCHARGE.**

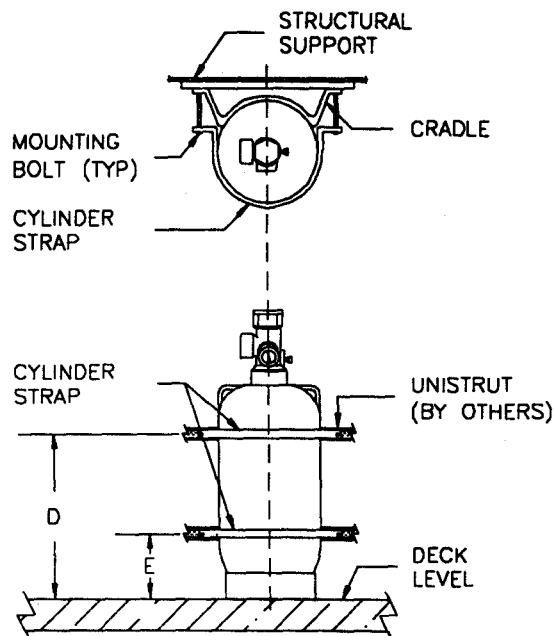


Figure 4.11.1 - Single Cylinder Installation (see Fig. 4.11.2 for "D" & "E" dimensions).

#### 4.11.2 Multiple Cylinder System.

##### WARNING

**CYLINDER(S) MUST BE LOCATED AND MOUNTED WHERE THEY WILL NOT BE SUBJECT TO ACCIDENTAL DAMAGE OR MOVEMENT. SUITABLE PROTECTION TO PREVENT ACCIDENTAL CYLINDER DAMAGE OR MOVEMENT MUST BE INSTALLED WHEN NECESSARY.**

1. Position cylinders in designated location. If moisture is likely to be present, locate cylinders at least 2 inches off the deck and secure each in place with two cylinder straps & cradles and attaching hardware. Orient cylinders so that valve outlet is angled towards the EL-check valve in manifold. Cylinders must be mounted vertically.
2. Remove safety cap from one cylinder outlet port and connect flexible discharge hose to cylinder outlet port. Repeat for each cylinder in system.

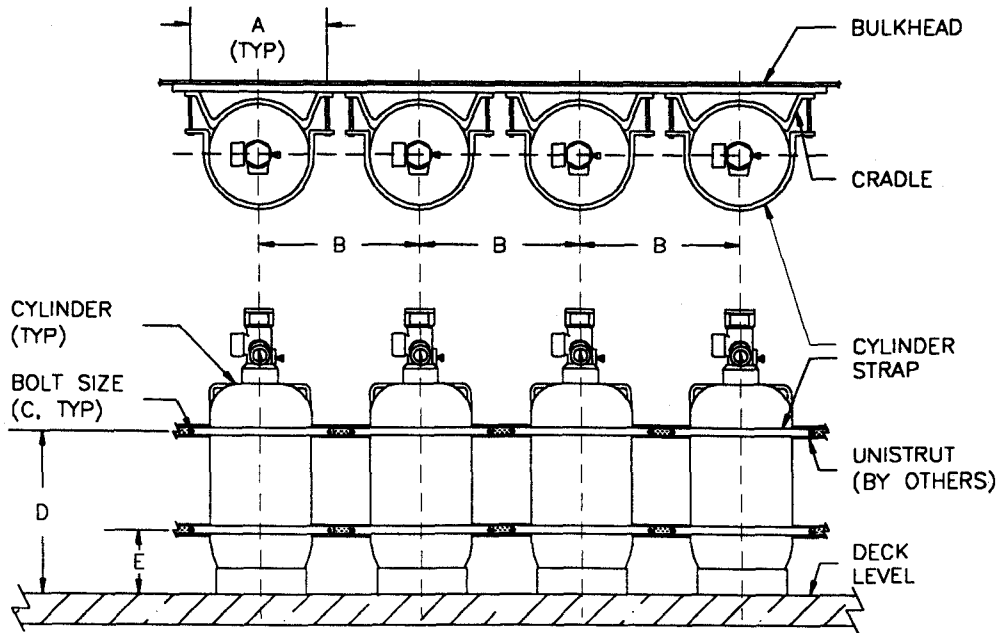
##### WARNING

**DISCHARGE HOSE MUST BE CONNECTED INTO SYSTEM PIPING BEFORE ATTACHING TO CYLINDER VALVE.**

3. Remove protection caps from cylinder actuation ports.
4. Install control heads to cylinder valve actuation ports.

##### WARNING

**CONTROL HEADS MUST BE IN THE "SET" POSITION (ACTUATING PIN IS IN THE FULLY RETRACTED OR "SET" POSITION) BEFORE ATTACHING TO FM-200 CYLINDERS IN ORDER TO PREVENT ACCIDENTAL DISCHARGE.**



CYLINDER SIZE	STRAP P/N	CRADLE P/N	"A"	"B"	"C"	"D"	"E"
10 lb	283945	N. A.	8.8	11.0	3/8	7.4	1.4
20 lb	283945	N. A.	8.8	11.0	3/8	12.5	1.4
40 lb	283934	N. A.	10.8	13.0	1/2	10.4	4.1
70 lb	283934	N. A.	10.8	13.0	1/2	21.9	8.3
125 lb	235317	235431	15.0	18.0	3/8	20.9	8.3
200 lb	292971	292938	15.5	18.0	3/8	29.6	12.0
350 lb	281866	281867	18.0	21.0	1/2	36.0	16.0
600 lb	294651	294652	24.0	27.0	1/2	36.0	16.0

(all dimensions are in inches)

**Figure 4.11.2- Multiple Cylinder Installation**

**4.11.3 Main and Reserve System.** Install main and reserve systems as instructed above.

**4.12 Installation of Cylinder Straps and Cradles.** Install cylinder straps and cradles as shown in applicable figures. Marine FM-200 cylinder installations must have two straps or brackets per cylinder. See Figure 4.11.2.

**WARNING**

**CYLINDER STRAPS AND CRADLES MUST BE PROPERLY ANCHORED TO STRUCTURAL SUPPORTS TO ADEQUATELY SECURE FM-200 CYLINDER(S).**

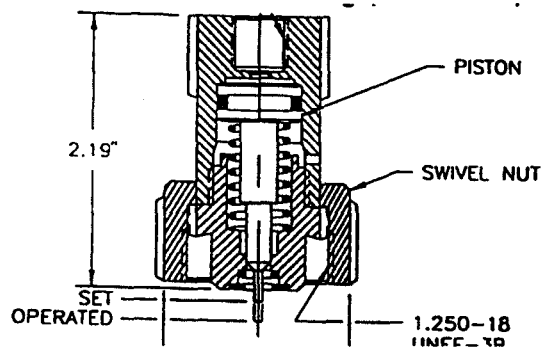
#### 4.13 Paragraph Deleted

#### 4.14 Installation of Pressure Operated Control Heads (P/N 878737). ( See Figure 4.14).

1. Remove protection cap from FM-200 cylinder actuation port.
2. Install pressure operated control head with flexible actuation hose attached to cylinder actuation port.

#### WARNING

**ENSURE THAT PILOT LINE IS NOT PRESSURIZED AND ACTUATING PINS ARE IN THE RETRACTED (SET) POSITION. FAILURE TO FOLLOW THIS PROCEDURE WILL RESULT IN ACCIDENTAL DISCHARGE OF THE FM-200 CYLINDER WHEN CONTROL HEAD IS INSTALLED ON CYLINDER VALVE.**



**Figure 4.14 - Pressure Operated Control Head**

#### 4.15 Paragraph Deleted

#### 4.16 Installation of Cable Operated Control Head (P/N 979469)

The following procedures are to be performed before attaching control head to cylinder valve.

1. Remove protection cap from cylinder actuation port.
2. Remove cover from control head and take out wheel assembly, cable pipe lock nut and closure disc.
3. Make sure plunger is below surface of control head body. Position control head at valve control port with arrow pointing in direction of pull.
4. Assemble cable pipe lock nut to cable pipe and place cable pipe in position in control head body.
5. Slide wheel assembly on control cable to proper "SET" position. Tighten set screws securely. Make sure wheel assembly is at start of stroke.
6. Cut off excess control cable close to wheel assembly.
7. Insert closure disc and replace cover on control head. Control head is now armed!

### **CAUTION**

**To ensure that manual lever does not snag or trap cable, make sure local manual release lever is in "SET" position with locking pin and seal wire installed before assembling control head cover to body.**

8. Assemble control head to cylinder valve actuation port. Tighten swivel nut securely.

### **WARNING**

**THE CABLE OPERATED CONTROL HEAD (P/N 979469) IS NOT TO BE USED IN CONJUNCTION WITH THE STACKABLE PRESSURE OPERATED CONTROL HEAD (P/N 878750). INSTALLATION OF THE CABLE OPERATED CONTROL HEAD ONTO THE ACTUATION PORT OF THE STACKABLE PRESSURE OPERATED CONTROL HEAD WILL RESULT IN FAILURE OF THE DEVICES TO OPERATE PROPERLY.**

#### **4.17 Actuation Arrangements, General Information.**

All controls and valves for the operation of the system shall be outside the space protected and shall not be located in any space that might be cut off or made inaccessible in the event of fire in any of the spaces protected. Controls shall be clearly identified and shall include instructions explaining system operation. A schematic diagram of the piping layout should be posted at each pull box or stop valve control, as well as at the FM-200 cylinder location.

When FM-200 cylinders are located in a protected space of 6,000 ft<sup>3</sup> or less, a system must have automatic actuation in addition to controls located outside the space.

#### **4.18 Installation of Lever Operated Control Head (P/N 870652).**

1. Ensure control head is in the "SET" position with safety pull pin and seal wire intact.
2. Remove protection cap from cylinder valve actuation port.
3. Using a suitable wrench, assemble control head to cylinder valve actuation port. Tighten swivel nut securely.

#### **4.19 Installation of Nitrogen Cylinder (P/N 877940)/Mounting Bracket (P/N 877845).**

1. Select an actuation station location in accordance with USCG rules.
2. Locate nitrogen cylinder mounting bracket in area where cylinder valve assembly and control head will be protected from inclement weather by a suitable total or partial enclosure, preferably adjacent to FM-200 storage cylinders.
3. Install mounting bracket clamps and hardware. Install nitrogen cylinder in position in mounting rack; tighten sufficiently to hold cylinder in place while allowing cylinder enough free play to be manually rotated.
4. Remove nitrogen cylinder valve protection cap.

5. Manually rotate cylinder until cylinder valve discharge outlet is in desired position.

#### **CAUTION**

**Nitrogen cylinder must be positioned so that control head, when installed, is readily accessible and cannot be obstructed during manual operation.**

5. Securely tighten mounting bracket clamps and hardware.
6. Attach adapter (P/N 6992-0501) and connect nitrogen pilot lines.
7. Remove protective cap from cylinder valve actuation port.
8. Install control head to cylinder valve actuation port; tightening securely.

#### **WARNING**

**ENSURE CONTROL HEAD IS IN THE "SET" POSITION (ACTUATING PIN IS IN THE FULLY RETRACTED OR "SET" POSITION) BEFORE ATTACHING TO CYLINDER VALVE. FAILURE OF CONTROL HEAD TO BE IN SET POSITION WILL RESULT IN ACCIDENTAL FM-200 SYSTEM DISCHARGE.**

**4.20 Installation of Pressure Switch (P/N 486536).** Pressure switches must be connected to the discharge manifold or piping in an upright position as shown on the system drawings. Both the standard and explosion-proof switches have 1/2 inch NPT pressure inlets to connect to the system piping. The electrical connections are either 1/2 inch conduit knockouts for the standard pressure switch and 1 inch NPT fittings for the explosion-proof pressure switch.

#### **WARNING**

**TO PREVENT PERSONNEL INJURY, DE-ENERGIZE ALL ELECTRICAL COMPONENTS PRIOR TO PRESSURE SWITCH INSTALLATION.**

**4.21 Installation of Pressure Trip (P/N 874290).** Install the pressure trip on the discharge manifold or piping in the horizontal position as shown on the system drawings. Connect the trip to the piping with 1/2 inch schedule 40 pipe. The minimum operating pressure required is 75 PSIG. The maximum allowable load to be attached to the retaining ring is 100 lbs.

#### **4.22 Installation of Manual Pull Station.**

1. Locate the remote pull boxes as shown on the system installation drawings and in accordance with USCG rules.
2. Connect pull boxes to the control heads using 3/8 inch, schedule 40 pipe. Do not run more than one cable in each pipe run.
3. Install a corner pulley at each change in pipe direction. Do not bend the pipe. A dual-pull equalizer (P/N 840051) should be installed where one pull box operates two controls. A dual pull mechanism (P/N 840058) should be installed where two pull boxes operate one control.
4. Beginning at the pull boxes, remove the covers of the first corner pulley. Feed the cable through the pulley into the 3/8 inch pipe. Connect one end of the cable to the cable fastener in the pull box, allowing short end to project at least 1/2 inch. Seat cable in groove by pulling on long end. Screw fastener and cable into handle. Route the other end to the control heads, taking up as much slack as possible. Attach the end of the cable to the fastener in the control head.

5. Reattach the corner pulley covers.
6. Check that control head is in "SET" position. Install the control head to the FM-200 cylinder valve.

**4.23 Installation of Discharge Indicator (P/N 875553).** The discharge indicator must be installed on the discharge manifold, either in a vertical or horizontal position. The indicator has a 3/4 inch NPT male connection. Make certain the indicator stem is in the normal position.

**4.24 Installation of Supervisory Pressure Switch (P/N 878709-01).**  
(See Figure 4.24 for details).

**WARNING**

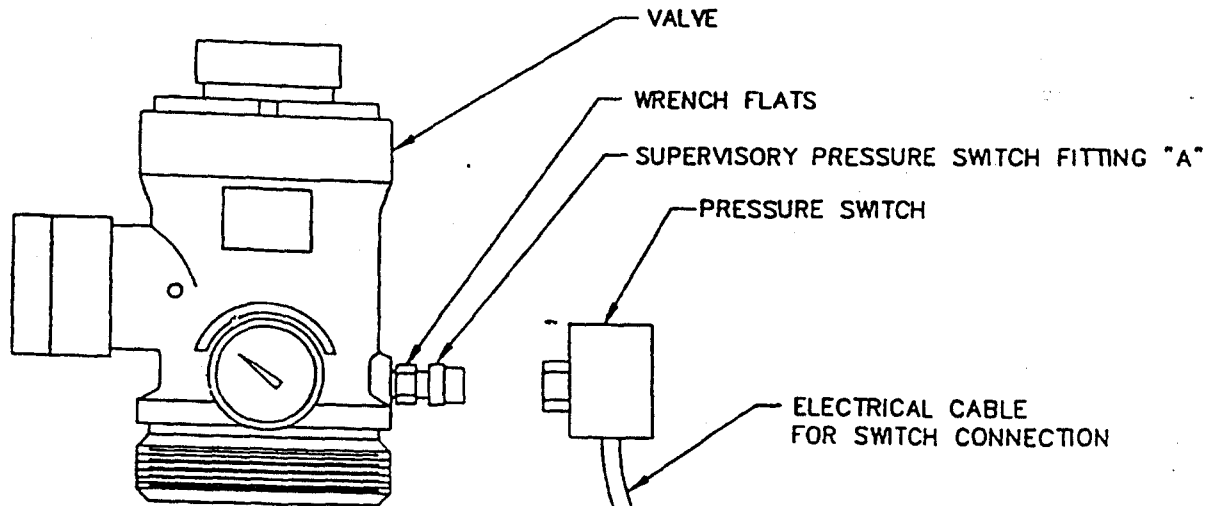
**PRIOR TO PRESSURE SWITCH INSTALLATION, DE-ENERGIZE ALL ELECTRICAL COMPONENTS TO PREVENT PERSONNEL INJURY.**

**NOTE**

Installation of the supervisory pressure switch can be accomplished safely on a pressurized cylinder.

**CAUTION**

When attaching or removing the supervisory pressure switch from the cylinder valve, attach a wrench to fitting and hold securely while tightening or loosening the pressure switch.



**Figure 4.24 - Installation of Supervisory Pressure Switch**

Install the supervisory pressure switch as follows:

1. Remove cap from switch connection port on FM-200 valve.
2. Screw on pressure switch securely using wrench.
3. Remove switch cover.
4. Make electrical connections.
5. Replace switch cover.

**4.25 Post Installation Checkout.** After FM-200 system installation has been completed, perform the following inspections and tests.

1. Verify that cylinders of correct weight and pressure are installed in accordance with installation drawings.
2. Verify that cylinder brackets and straps are properly installed and all fittings are tight.
3. The piping distribution system must be inspected for compliance with the system drawings, NFPA 2001, design limitations within this manual, and the computerized hydraulic calculations associated with each independent piping and nozzle configuration.
4. Check that discharge manifold, discharge piping and actuation piping are securely hung. Ensure all fittings are tight and securely fastened to prevent agent leakage and hazardous movement during discharge. Means of pipe size reduction and installation position of tees must be checked for conformance to the design requirements.
5. The piping distribution system must be cleaned, blown free of foreign material and inspected internally to prevent the possibility of any oil or particulate matter that may soil the hazard area or affect the agent distribution due to a reduction in the effective nozzle orifice area.
6. The system piping should be pressure tested in accordance with the requirements of NFPA 2001 and USCG rules.
7. Ensure that check valves are installed in the proper location as indicated on installation drawings and equipment is installed with the arrow pointing in the direction of flow.
8. Verify nozzles are installed in the correct location and have the correct part number and orifice size as indicated on installation drawings. Discharge nozzles must be oriented such that optimum agent dispersal can be achieved. Check nozzle orifices for obstructions.
9. The discharge nozzles, piping and mounting brackets must be installed such that they will not cause potential injury to personnel. Agent must not be discharged at head height or below, where personnel in the normal work area would be injured by the agent discharge. Agent must not directly impinge on any loose objects or shelves, cabinet tops or similar surfaces where loose objects could be propelled upon agent discharge.
10. For systems with a main/reserve capability, the main/reserve switch must be properly installed readily accessible and clearly identified.
11. Manual pull stations must be properly installed, readily accessible, and accurately identified. All manual stations used to activate FM-200 systems should be properly identified as to their purpose. Particular care should be taken where manual pull stations for more than one system are in close proximity and could be confused or the wrong system actuated. In this case, manual stations should be clearly identified as to which hazard area they affect.
12. Perform pressure switch test outlined in Section 6 for all pressure switches installed.

All acceptance testing shall be in accordance with NFPA 2001 current edition.



## 5 OPERATION

**5.1 General.** Compressed FM-200 liquid is held in the cylinder by a discharge valve. When the discharge valve is actuated by a control head, the valve piston is displaced, the compressed liquid escapes through the discharge port of the valve and is directed through the distribution piping to the nozzles. The nozzles provide the proper flow rate and distribution of FM-200.

### 5.2 Operating Procedures.

#### 5.2.1 Remote Manual Operation. Operate as follows:

1. Leave the hazard area quickly.
2. Proceed to appropriate remote manual pull station for hazard.
3. Operate manual pull station.
4. Allow no one to enter the hazard area.

#### NOTE

The above operating instructions must be posted on display in the protected area. These instructions should also indicate the cylinder storage location in the event that the cylinders need to be locally operated during an emergency condition.

#### 5.2.2 Local Manual Operation. Operate as follows:

1. Leave the hazard area quickly.
2. Proceed to appropriate FM-200 cylinder(s) for hazard.
3. Remove safety pull pin from cylinder control head.
4. Operate lever, following instructions on lever or control head nameplate.
5. Allow no one to enter the hazard area.

#### NOTE

The above operating instructions must be posted on display in the cylinder storage area.

**5.2.3 Automatic Operation.** When a system is operated automatically, personnel must evacuate the hazard area promptly upon hearing the alarm. Make sure no one enters the hazard area.

**5.3 Post Fire Operation.** After an FM-200 discharge, one must observe all warnings (see below), before entering the hazard area. Integrity must be maintained to prevent the migration of products of decomposition to adjacent areas outside of the protected space. After extinguishment, a minimum agent hold time of 15 minutes must be maintained. When ventilating the protected space of products of combustion, care should be taken to allow smoke, decomposition products, etc., to clear the vessel, away from personnel, muster stations, embarkation areas, etc. Upon arriving in port, qualified fire suppression system maintenance personnel must perform post fire maintenance as directed in Section 6 of this manual.

#### WARNING

**DO NOT ENTER A HAZARD AREA WITH AN OPEN FLAME OR LIGHTED CIGARETTE. THE POSSIBLE PRESENCE OF FLAMMABLE VAPORS MAY CAUSE RE-IGNITION OR EXPLOSION.**

### **WARNING**

**ENSURE FIRE IS COMPLETELY EXTINGUISHED BEFORE VENTILATING AREA. BEFORE PERMITTING ANYONE TO ENTER THE HAZARD AREA, VENTILATE AREA THOROUGHLY OR USE SELF-CONTAINED BREATHING APPARATUS.**

#### **5.4 Cylinder Recharge.**

1. Recharge all FM-200 and nitrogen pilot cylinders immediately after use.
2. Return all cylinders to Kidde distributor or other qualified refill agency.
3. Refill in accordance with procedures outlined in Section 6 of this manual.

#### **5.5 Special System Precautions.**

**5.5.1 Resetting Non-Pressure Operated Control Heads.** All electrically operated, cable operated, pneumatically operated and lever operated control heads must be reset prior to reinstallation on FM-200 cylinder valves.

**5.5.2 Resetting Pressure Operated Control Heads.** Pressure operated and lever/pressure operated control heads reset themselves **only** after actuation pressure (either from a pilot cylinder or master FM-200 cylinder) is released.

**5.5.2.1 Pressure Operated Control Heads Actuated by Pressure from a Master FM-200 Cylinder.** Pressure & lever/pressure operated control heads actuated by pressure from a master FM-200 cylinder will automatically reset themselves. The master/slave arrangement permits FM-200 pressure to back-bleed into the discharge manifold to release the pressure. As a precaution before re-attaching the pressure operated control head(s) to the FM-200 cylinder control port, ensure that the actuating pin(s) is/are in the retracted (SET) position.

**5.5.2.1 Pressure Operated Control Heads NOT Actuated by Pressure from a Master FM-200 Cylinder.** Pressure & lever/pressure operated control heads NOT actuated by pressure from a master FM-200 cylinder will **not** automatically reset themselves. In these arrangements, pilot pressure gets trapped in the pilot manifold upon system actuation which keeps the control head actuating pin(s) in the "OPERATED" position. Therefore, before re-attaching pressure operated control heads to the recharged FM-200 cylinders, the following procedure must be performed to ensure that the pilot manifold is vented and the control heads have returned to the "SET" position.

1. Remove and reset master control head from the nitrogen pilot cylinder(s). This will automatically vent the pilot manifold and reset the pressure operated control heads.
2. Recharge and reinstall nitrogen pilot cylinders to the correct charged pressure and reinstall master control head.
3. Before installing pressure operated control heads on the FM-200 cylinders, ensure that the actuator pin is in the retracted ("SET") position.
4. Follow all other procedures and cautions as detailed in Section 6 of this manual.

## 6. MAINTENANCE

### WARNING

**FM-200 CARBON DIOXIDE AND NITROGEN CYLINDER VALVE ASSEMBLIES MUST BE HANDLED, INSTALLED, INSPECTED AND SERVICED ONLY BY QUALIFIED AND TRAINED PERSONNEL IN ACCORDANCE WITH THE INSTRUCTIONS CONTAINED IN THIS MANUAL AND COMPRESSED GAS ASSOCIATION (CGA) PAMPHLETS C-1, C-6, G-6 AND P-1. CGA PAMPHLETS MAY BE OBTAINED FROM COMPRESSED GAS ASSOCIATION, CRYSTAL SQUARE TWO, 1725 JEFFERSON DAVIS HIGHWAY, ARLINGTON, VA 22202-4102.**

### WARNING

**BEFORE PERFORMING MAINTENANCE PROCEDURES, REFER TO THE MATERIAL SAFETY DATA SHEETS AND SAFETY BULLETINS IN THE APPENDIX AT THE BACK OF THIS MANUAL**

**6.1 General.** A regular program of systematic maintenance must be established for continuous, proper operation of all FM-200 systems. A periodic maintenance schedule must be followed and an inspection log maintained for ready reference. As a minimum, the log must record: (1) inspection interval, (2) inspection procedure performed, (3) maintenance performed, if any, as a result of inspection, and (4) name of inspector performing task.

If inspection indicates areas of rust or corrosion are present, immediately clean and repaint the area. Perform cylinder hydrostatic pressure testing in accordance with Paragraph 6.4 of this manual.

**6.2 Preventive Maintenance.** Perform preventive maintenance per Table 6.2.

Schedule	Requirement	Paragraph
Daily	Check FM-200 cylinder pressures	6.3.1
	Check nitrogen cylinder pressures	6.3.1
Monthly	Inspect hazard area system components	6.3.2
	Check FM-200 cylinder weights and pressures	6.3.3
Semi-Annually	Test pressure switch(es)	6.3.4
	Check CO <sub>2</sub> cylinder weight(s)	6.3.4
Every 2 Years	Blow out distribution piping	6.3.5
	Test pneumatic detection system	6.3.5
Every 5 Years	FM-200, CO <sub>2</sub> and nitrogen cylinder and flexible hose hydrostatic pressure test and/or inspection	6.4 and 6.10.1

**Table 6.2 - Preventive Maintenance Schedule**

## 6.3 Inspection Procedures

### 6.3.1 Daily

1. Check FM-200 cylinder pressure gauges for proper operating pressure (See Table 2.3.1.3). If pressure gauge indicates a pressure loss (adjusted for temperature) of more than 10% recharge with nitrogen to 360 PSIG at 70°F (24.8 bars gage at 21°C) . Remove and recharge cylinder as instructed in Paragraphs 6.6 and 6.9.
2. Check nitrogen cylinder for proper operating pressure. If pressure loss (adjusted for temperature) exceeds 10%, recharge with nitrogen to 1800 PSIG at 70°F (124 bars gage at 21°C) (See Figure 6.10).

### 6.3.2 Monthly

1. Make a general inspection survey of all cylinders and equipment for damaged or missing parts. If equipment requires replacement, refer to Paragraph 6.5.3.
2. Ensure access to hazard areas, manual pull stations, discharge nozzles, and cylinders are unobstructed and that there are no obstructions to the operation of the equipment or distribution of FM-200 agent.
3. Inspect 1/4-inch flexible actuation hoses for loose fittings, damaged threads, cracks, distortion, cuts, dirt, and frayed wire braid. Tighten loose fittings, replace hoses having stripped threads or other damage. If necessary, clean parts as directed in Paragraph 6.5.1. Inspect adapters, couplings and tees at FM-200 cylinder pilot outlets for tightness. Tighten couplings if necessary. Replace damaged parts.
4. Inspect FM-200 cylinder pressure operated control heads for physical damage, deterioration, corrosion, distortion, cracks, dirt and loose couplings. Tighten loose couplings. Replace damaged caps. Replace control head if damage is found. If necessary, clean as directed in Paragraph 6.5.1.
5. Paragraph deleted.
6. Inspect FM-200 cylinder and valve assembly for leakage, physical damage such as cracks, dents, distortion, and worn parts. Check burst disc and pressure gauges for damage. Replace damaged gauges or burst disc per Paragraph 6.8.4. If gauge pressure is not normal (360 PSIG at 70°F [24.8 bars gage at 21°C]), remove and recharge cylinder as instructed in Paragraphs 6.6 and 6.9. If damaged parts are found on FM-200 cylinder or cylinder valve, replace FM-200 cylinder. If necessary, clean cylinder and associated parts as directed in Paragraph 6.5.1.
7. Inspect FM-200, CO<sub>2</sub> and nitrogen cylinder brackets, straps, cradles and mounting hardware for loose, damaged, or broken parts. Check cylinder brackets, straps, and associated parts for corrosion, oil, grease, grime, etc. Tighten loose hardware. Replace damaged parts. If necessary, clean as directed in Paragraph 6.5.1.

8. Inspect flexible discharge hoses for loose fittings, damaged threads, cracks, rust, kinks, distortion, dirt and frayed wire braid. Tighten loose fittings and replace hoses with stripped threads. If necessary, clean as directed in Paragraph 6.5.1.
9. Inspect CO<sub>2</sub> and nitrogen actuation lines and support brackets for continuity, physical damage, loose fittings, distortion, cracks or cuts. Tighten loose fittings. Replace damaged parts. If necessary, clean as directed in Paragraph 6.5.1.
10. Inspect discharge nozzles for dirt and physical damage. Replace damaged nozzles. If nozzles are dirty or clogged, refer to Paragraph 6.5.2.

#### **CAUTION**

**Nozzles must never be painted. A part number is located on each nozzle. Nozzles must be replaced by nozzles of the same part number. Nozzles must never be interchanged since random interchanging of nozzles could adversely affect proper FM-200 distribution and concentration level within a hazard area.**

11. Inspect all manual pull stations for cracks, broken or cracked glass plate, dirt or distortion. Inspect station for signs of physical damage. Replace damaged glass. Replace station if damage is found. If necessary, clean as directed in Paragraph 6.5.1.
12. Inspect pressure switches for deformations, cracks, dirt or other damage. Replace switch if damage is found. If necessary, clean switch as directed in Paragraph 6.5.1.

**6.3.3 Weighing FM-200 Cylinders.** Weigh 10 through 600 lb. FM-200 cylinders as follows:

#### **WARNING**

**INSTALL PROTECTION CAP ON FM-200 CYLINDER VALVE ACTUATION PORT AND SAFETY CAP ON CYLINDER VALVE OUTLET PORT.**

#### **WARNING**

**DISCONNECT ALL CYLINDER CONTROL HEADS, DISCHARGE HOSES, AND FLEXIBLE PILOT HOSES TO PREVENT ACCIDENTAL SYSTEM DISCHARGE.**

1. Remove cylinder(s) as instructed in Paragraph 6.6.
2. Place cylinder(s) on scale.
3. Record weight and date on record card and attach to FM-200 cylinder. The gross weight and tare (empty) weight are metal stamped on the FM-200 cylinder valve label. Therefore, subtract tare weight from the gross weight to determine net weight of original charge. Then, subtract tare weight from scale reading to determine net weight of FM-200 agent remaining in FM-200 cylinder. If recorded agent net weight is less than 95% of original charge net weight, replace cylinder with fully charged FM-200 cylinder (refer to Paragraph 6.6).
4. If cylinder weight meets requirements, reinstall cylinder (see Paragraph 6.7).

**6.3.3.1 Cylinders Equipped with Flexible Tape Liquid Level Indicator.** Determine FM-200 weight of 200, 350 and 600 lb. cylinders equipped with flexible tape liquid level indicator as follows. This procedure can be performed without removing the FM-200 cylinders from the system. See Component description sheet K-2110 for more detail.

1. Remove the protective cap to expose the tape.
2. Raise the flexible tape slowly until it latches.
3. Note the reading at the point where the tape emerges from the fitting .
4. To determine the final, more precise reading, repeat the above procedure except when a point is reached approximately two inches before the tape is expected to latch, raise the tape very slowly until it latches.
5. While supporting the weight of the tape, record the liquid level measurement.

#### **CAUTION**

**Take care not to pull the flexible tape upwards after it latches.**

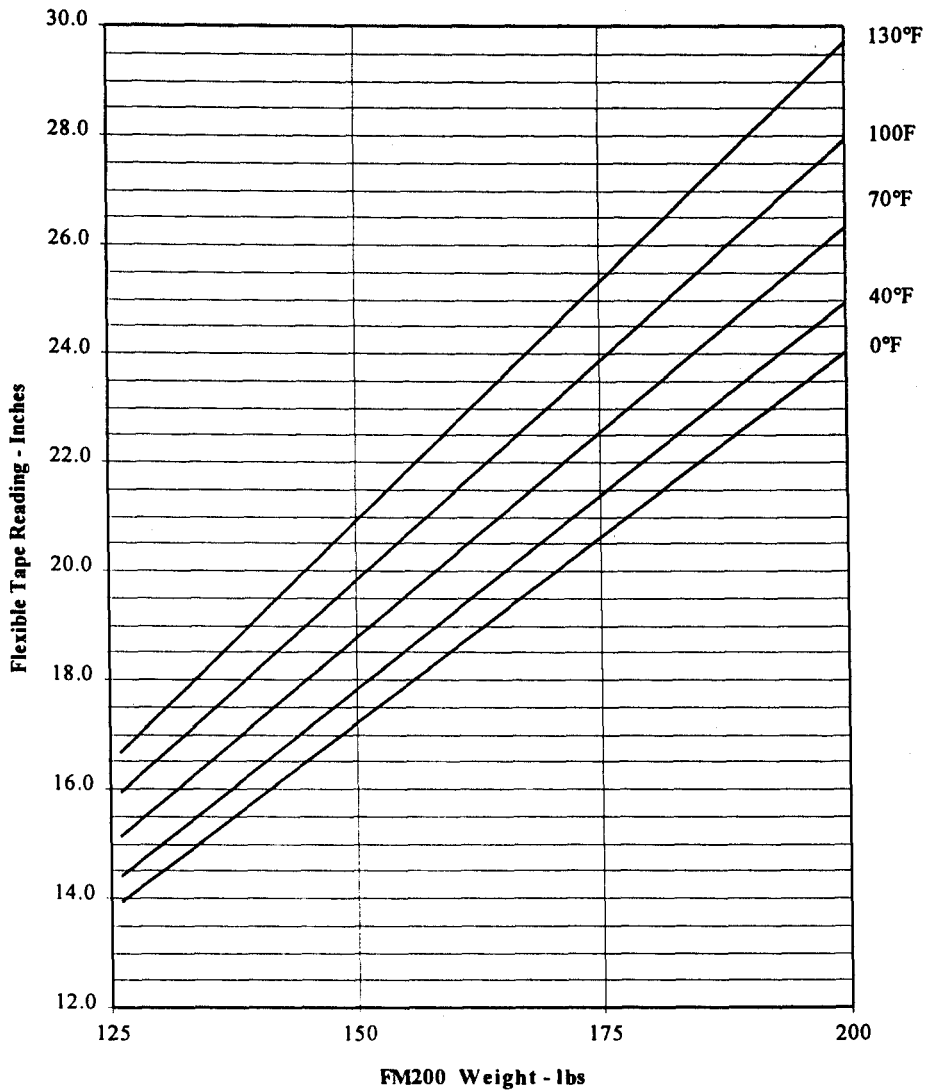
6. Check the ambient temperature where the FM-200 cylinders are stored, record temperature.
7. Refer to the appropriate calibration charts (Figures 6.3.1, 6.3.2 and 6.3.3) and locate the level reading on the flexible tape scale. Trace horizontally to the right to the appropriate temperature plot. Read the weight of FM-200 from the scale at the bottom of the chart. Record the weight and date on the record tag attached to the cylinder.
8. After the reading is taken, carefully push the tape down into the liquid level housing. Replace protective cap.

#### **NOTE**

**If the weight measured using the liquid level indicator signifies that the cylinder should be recharged, it is recommended that the cylinder first be removed from service and the weight loss verified by using a weigh scale prior to recharging.**

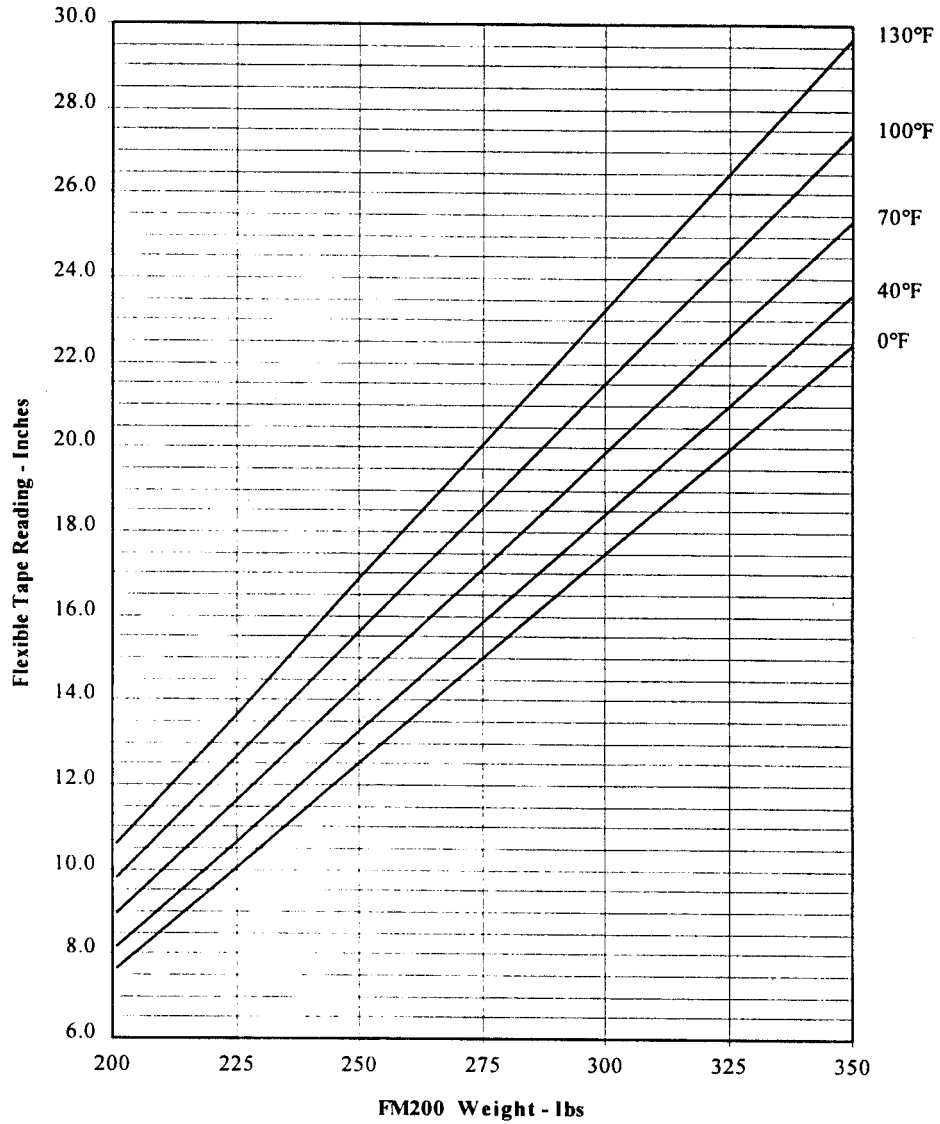
All FM-200 cylinders must be filled or recharged by weight using a platform scale or equivalent. If weight loss is more than 5% of the FM-200 charge, the unit must be recharged.

**FLEXIBLE TAPE READING VS. TOTAL FM200 WEIGHT**  
**200 lb Cylinder**  
**CHARGE PRESSURE: 360 PSI AT 70°F**



**Figure 6.3.1 Calibration Chart, 200lb. Cylinder**  
**Flexible Tape**

**FLEXIBLE TAPE READING VS. TOTAL FM200 WEIGHT**  
**350 lb Cylinder**  
**CHARGE PRESSURE: 360 PSI AT 70°F**



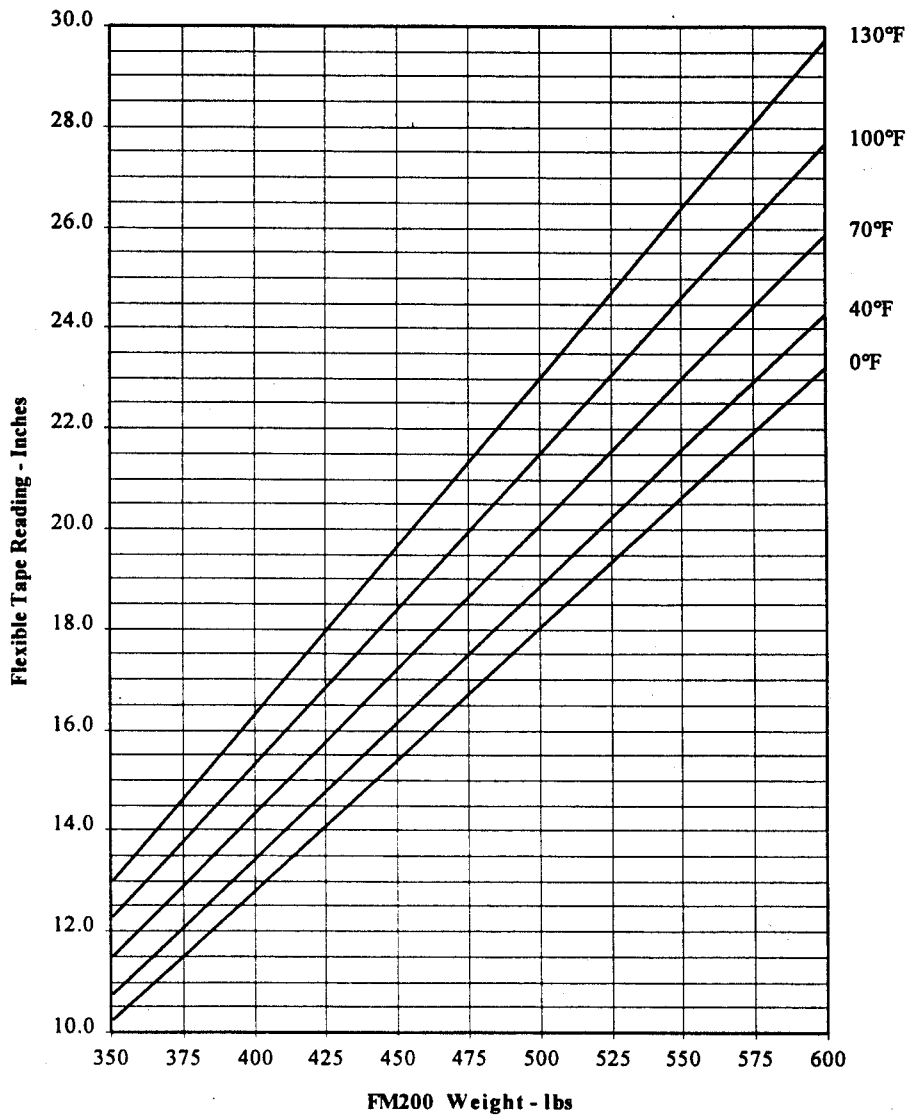
**Figure 6.3.2 Calibration Chart, 350lb. Cylinder**  
**Flexible Tape**



**FLEXIBLE TAPE READING VS. TOTAL FM200 WEIGHT**

**600 lb Cylinder**

**CHARGE PRESSURE: 360 PSI AT 70°F**



**Figure 6.3.3 Calibration Chart, 600 lb. Cylinder  
Flexible Tape**

### **6.3.4 Inspection Procedures, Semi-Annual**

#### **6.3.4.1 Pressure Switch Test.** Perform pressure switch test as follows:

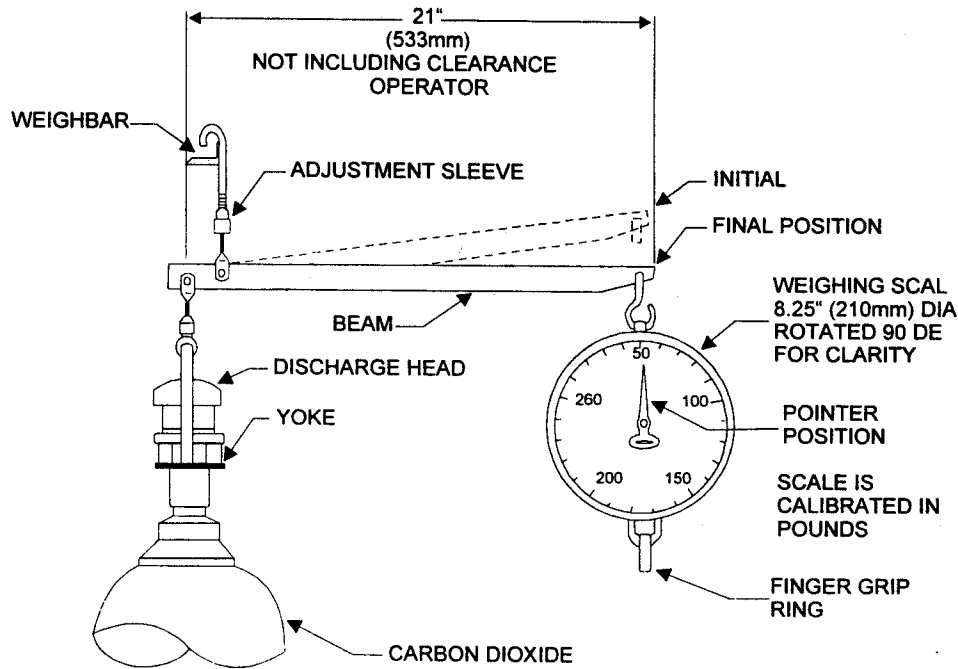
1. Contact appropriate personnel and obtain authorization for shutdown.
2. Ensure that hazard area operations controlled by pressure switch are operative.
3. Manually operate switch by pulling up on plunger and verify that hazard area operations controlled by pressure switch shut down.
4. Return pressure switch to "SET" position.
5. Re-activate all systems shut down by pressure switch (power and ventilation systems, compressors, etc.).

#### **6.3.4.2 Weighing CO<sub>2</sub> Cylinders**

##### **WARNING**

**THE CARBON DIOXIDE CYLINDERS ARE EQUIPPED WITH A HIGH RATE DISCHARGE VALVE, WHICH WHEN ACTUATED, WILL OPEN, REMAIN OPEN AND CANNOT BE CLOSED. ACCIDENTAL ACTUATION OF THE DISCHARGE VALVE ON AN UNSECURED, DISCONNECTED CYLINDER WILL RESULT IN A DISCHARGE THRUST CAPABLE OF PROPELLING THE CYLINDER TO VELOCITIES THAT WILL CAUSE SEVERE PROPERTY DAMAGE AND BODILY INJURY. IT IS, THEREFORE, EXTREMELY IMPORTANT THAT THE EXACT SEQUENCE OF CYLINDER REMOVAL ALWAYS BE FOLLOWED. FURTHER CYLINDER REMOVAL OR CYLINDER REPLACEMENT MUST ALWAYS BE SUPERVISED TO ASSURE FULL COMPLIANCE WITH THE INSTRUCTIONS IN THIS MANUAL.**

1. Remove control heads at the coupling nut only.
2. Disconnect flexible hose from discharge head.
3. Loosen cylinder framing so cylinders are free.
4. Hook scale on weighing angle and slip yoke under discharge head. Adjust lever as shown in Figure 6.3.4.2.



**Figure 6.3.4.2 Weighing Carbon Dioxide Cylinder Using Scale P/N 982505**

5. Pull down until cylinder is just clear of floor and lever is horizontal.
6. Read weight directly off scale (scale is calibrated to take care of leverage). Empty cylinder weight is stamped on the cylinder valve body; therefore, deduct empty weight from scale reading. Also, deduct 3.75 lbs. for weight of discharge head. The result is the amount (charge weight) of liquid carbon dioxide in the cylinder.
7. If charge weight loss exceeds 10%, forward charged cylinder WITH DISCHARGE AND CONTROL HEADS REMOVED AND SAFETY CAP AND PROTECTION CAP INSTALLED to a recognized Kidde-Fenwal, Inc. distributor.
8. After all carbon dioxide cylinders have been weighed, tighten clamps, reconnect flexible hose from discharge head, and reinstall control heads on cylinders. Tighten control head coupling nuts securely.

**CAUTION**

**All control heads must be removed from FM-200 cylinders and nitrogen pilot cylinders prior to testing to prevent accidental cylinder discharge.**

### 6.3.5 Inspection Procedures - 2 Year

#### 6.3.5.1 Blow Out All Distribution Piping

##### WARNING

**DO NOT USE WATER OR OXYGEN TO BLOW OUT PIPE LINES. THE USE OF OXYGEN IS ESPECIALLY DANGEROUS AS THE POSSIBLE PRESENCE OF EVEN A MINUTE QUANTITY OF OIL MAY CAUSE AN EXPLOSION.**

1. Remove any nozzles from piping to allow any foreign matter to blow clear.
2. Remove all pressure operated control heads from FM-200 cylinders.

##### WARNING

**DO NOT DISCONNECT PRESSURE OPERATED CONTROL HEAD FROM FLEXIBLE HOSE. ACCIDENTAL DISCHARGE OF FM-200 SYSTEM WILL CAUSE FLEXIBLE HOSE WITHOUT CONTROL HEAD ATTACHED TO WHIP AROUND, RESULTING IN POSSIBLE EQUIPMENT DAMAGE AND SEVERE BODILY INJURY TO PERSONNEL.**

3. Open distributing valves and keep open long enough to ensure cleanliness of pipe.
4. Blow out all distribution piping with air or nitrogen to ensure that it is not obstructed.
5. Reconnect all control heads.

#### 6.3.5.2 Pneumatic Detection System Tests

##### CAUTION

Before conducting any of the tests outlined below, remove the pneumatic control heads from the cylinders.

##### WARNING

**WHEN DISCONNECTING CONTROL HEADS (TANDEM MOUNTED) DO NOT LET THE HEADS TURN (IF INTERCONNECTING CABLE HOUSING IS A LOOSE FIT), THIS WILL PREVENT ACCIDENTAL DISCHARGE.**

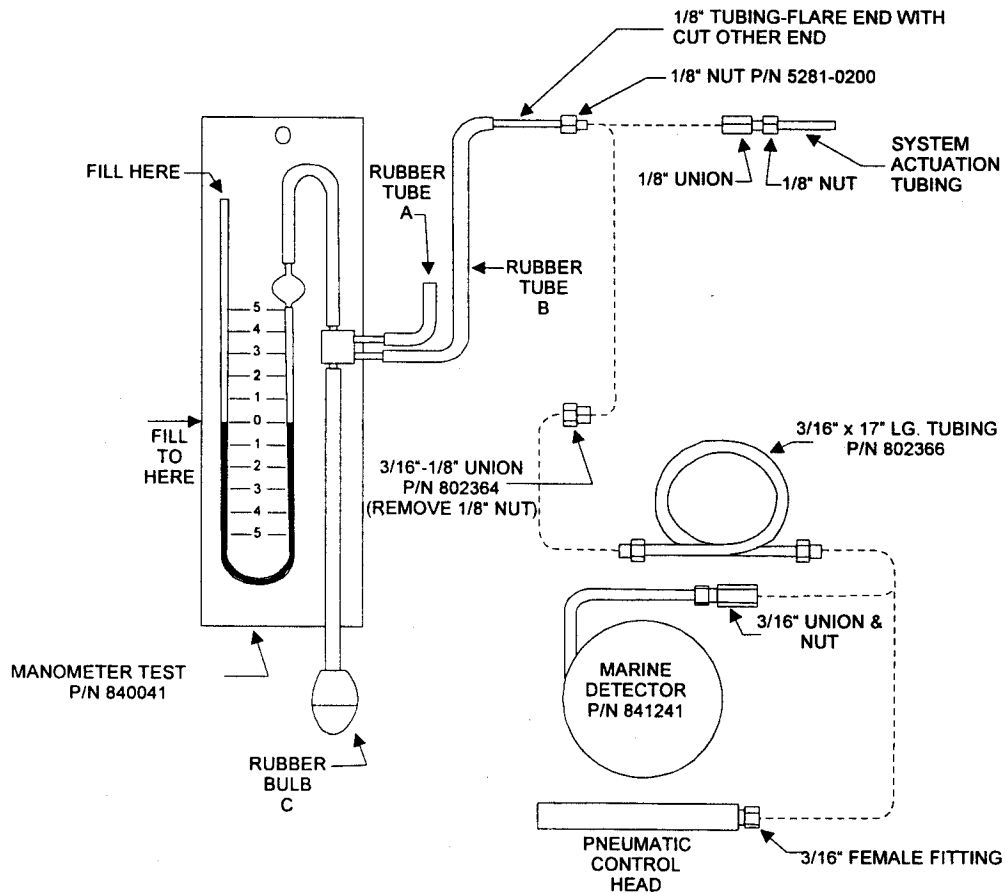
##### 6.3.5.2.1 Pneumatic Control Head Test (pressure setting - see Figure 6.3.5.2.1)

1. Connect the test fitting of the manometer test set to the diaphragm chamber of the control head.
2. Make certain sufficient clearance is provided at mounting unit so control head will not be damaged upon operation.
3. If control head has been operated, reset by placing screwdriver in reset stem and, turning clockwise until stem locks in position (with arrow on reset stem lined up with "SET" arrow on nameplate).
4. NOTE: Slight resistance will be met just before stem locks.

5. Use manometer test set P/N 840041 (see Figure 7-4) and pour water into the open tube until the water level in both tubes is exactly at the zero mark. (The test set is not furnished as part of the system).
6. Close off the rubber "A" by squeezing tightly with the fingers or use a crimp clamp, and then apply pressure by gradually squeezing the rubber bulb "C." The control head must operate at the factory pressure setting plus or minus the 10% tolerance allowed. The pressure required to operate the control head is the difference, in inches, between the water levels in the two tubes, and is equal to twice the reading of either tube, i.e., 3 inches both tubes or 1-1/2 inches on one tube.

**CAUTION**

After the control head has operated, be sure to release rubber tube "A" first before allowing the rubber bulb "C" to expand to normal; otherwise water may be sucked into the tubing and control head, causing serious problems.



**Figure 6.3.5.2.1 Manometer Test Set, P/N 840041**

### 6.3.5.2.2 Control Head Vent Test (see Figure 6.3.5.2.2)

Before disconnecting manometer from the control head, the vent must be tested. To test the vent for correct calibration, perform the following steps:

1. Squeeze rubber bulb "C" about halfway or enough to achieve sufficient vacuum for test, then close tube "A" by pinching with fingers or crimp clamp.
2. Let bulb expand gradually to its normal shape. This creates a partial vacuum, causing the water level to change, indicating inches of vacuum applied to the control head (the vacuum must be more than a minimum of 3 inches in order to observe drop from 3 inches to 1 inch).
3. The water column will recede to "0" level as air passes through the vent. The time required (number of seconds) for the water column to recede 2 inches reading from 3 inches to 1 inch on both legs or 1 1/2 inch to 1/2 inch on either leg is the number of the vent (the calibrated rate of flow), i.e., if the time required to pass the above amount of water is 5 seconds the control head vent is "No. 5." When vents are tested, the time will vary due to the added volume in the control head diaphragm chamber. A No. 5 vent may test at 5-7 seconds, which is acceptable. If a vent time reads much higher, it will increase system sensitivity and may not be acceptable. Table 6.3.5.2.2 shows the acceptable times allowed when testing for vent sensitivity using manometer method with vent installed in the control head.

Control Head Vent Setting	Allowable Time (Seconds)
40 seconds	40 - 60
20 seconds	20 - 27
10 seconds	10 - 15
5 seconds	5 - 7

**Table 6.3.5.2.2 Pneumatic Control Head Calibration Chart**

Repeat above procedure for testing tandem control head if installed. Since there is no vent in the tandem control head, the vacuum must hold (same as tubing tightness test).

4. Disconnect manometer test set from the control head (test fitting "A"). Reset the control head by turning the reset stem to its "SET" position.

Note: For accuracy, Kidde-Fenwal, Inc. manometer test set, P/N 840041, must be used.

### 6.3.5.2.3 Test for Leakage of System Tubing and Detectors

1. Connect the test fitting of the manometer to the pneumatic detector tubing (at the control head connection nut).

2. Squeeze the rubber bulb "C" fully and then close off the open rubber tube "A." Very gradually, release the rubber bulb to its normal shape. This will cause the water level in the two tubes to change, at which time a maximum vacuum will develop. Hold a minimum 8 inch vacuum (difference between two sides of "U" tube, or 4 inches on each side of "U" tube).
3. If all connections are absolutely tight, the water level will remain in the position taken in Paragraph 2 above and will not change as long as the rubber tube "A" is held closed. Observe the level of the water for at least one minute and then release the rubber tube "A." It is absolutely essential that the water level remain the same as long as the rubber tube is held closed. Even a slow, steady fall of the water level is serious, for it indicates a leak which may prevent automatic operation of the system. Disconnect the test set from the detector tubing. After tests have been completed, reset the control heads.

**WARNING**

**WHEN USING HOT OR BOILING WATER, EXERCISE CARE WHEN IMMERSING THE ACTUATING CHAMBER. DO NOT STAND DIRECTLY BENEATH THE CONTAINER.**

4. Functional Test of System. Hold a container of hot or boiling water under the heat detector, immersing the actuating chamber in the water. At least 50% of the detector must be immersed. The water must be at least 100°F above the ambient temperature. Note the time between the application of the hot water to the detector and the operation of the control head. The control head must operate in approximately 15 seconds. Do not apply heat for more than 15 seconds. The detector is not functioning if the control head has not operated within this time.

When testing two control heads connected in tandem, both may not operate simultaneously. Both control heads must operate within 15 seconds if the heat is sustained.

5. The heat test must be performed on each heat detector. Between each test, wait about five minutes for the system to return to normal, and then reset the control head. To reset, insert screwdriver in the reset stem and turn clockwise until the stem locks in position with the arrow or reset stem lining up with the "SET" arrow on the nameplate (slight resistance will be met just before the stem locks).
6. If the application of heat does not cause the control head to operate within 15 seconds, remove the container of water and investigate cause:
  - a. Heat differential was inadequate.
  - b. Leakage in the tubing system (tubing connections not tight).
  - c. Obstruction in the tubing.

#### **6.3.5.2.4 Troubleshooting of Pneumatic Detection System**

Failure of system to operate pneumatic detection system testing when applying heat to the detectors may be caused by: insufficient heat applied, obstructions in tubing, or leaks in system. The manometer can be used to assist in troubleshooting the system as follows:

1. Install manometer in system tubing at pneumatic control head connection. Replace union connection with a control head "T." Close open tube "A" of the manometer (see Figure 7-8) with crimp clamp. The manometer is now an integral part of the system and provides a visual record of pressure to which system is subjected by heat or cold at the detector.
2. The installation of the manometer as described above provides a visual indication of the pressure buildup within the system and will assist in determining if there is sufficient or insufficient pressure buildup during test of the system.

**6.4 Inspection and Re-test Procedures for FM-200 Cylinders.** FM-200 cylinders shall be inspected and tested in accordance with the requirements of Enclosure (1) of USCG Navigation and Inspection Circular (NVIC) 3-95. Enclosure 1, *Guidelines for Periodic Inspection and Testing of Steel Halon Storage Cylinders*, shall be used with the with the following modifications: Substitute "FM-200" for "halon" and "NFPA 2001" for "NFPA 12A."

#### **CAUTION**

**These guidelines do not apply to cylinders containing commodities other than FM-200.**

All Kidde FM-200 cylinders are designed, fabricated, and factory tested at 1000 PSIG (68.9 bars gage) in compliance with DOT CFR 49 4BA-500 or 4BW-500 as stamped on each cylinder.

**6.4.1 Annual Inspections.** Cylinders weights or liquid levels shall be checked annually as described in NVIC 3-95, Enclosure (1).

**6.4.2 Five Year Inspections.** FM-200 cylinders continuously in service without discharging shall be removed from mounting racks and given a complete external inspection every five years. This shall be effective 12 years after commissioning of the system or five years after the latest hydrostatic test, whichever is later. See table 6.4.2. The visual external inspection shall be made in accordance with the Compressed Gas Association (CGA) pamphlet C-6, Section 3 except that the cylinders need not be emptied (tare weight need not be measured) and cylinders shall not be stamped while under pressure. Cylinders weights or liquid levels shall be checked at this time. Cylinders that have been become discharged, damaged, rejected or condemned shall be removed from service. Before cylinders may be placed back in service, they must be inspected, tested or reconditioned in accordance with the provisions of 49 CFR 173 as if they were being used as shipping containers. See NVIC 3-95, Enclosure (1) for more details.



Re-test Method	First Re-test Due (Yrs)	Subsequent Re-test Due (Yrs)	Special Marking
Full hydrostatic test including determination of cylinder expansion	12	5	Re-test Date Month/Year
External visual inspection per Paragraph 173.34(e) (10) and CGA Pamphlet C-6, Section 3	12	5	Re-test Date Followed by "E"

**Table 6.4.2 - Test table**

**6.4.3 Flexible Hoses.** In accordance with NVIC 3-95, Enclosure (1), flex hoses shall be visually examined annually for damage. If visual examination shows any deficiency, the hose shall be replaced or tested. Flex hoses shall be inspected and tested in accordance with NFPA 2001, paragraph 4-3.1 except that hydrostatic testing shall be performed every 12 years in lieu of every 5 years.

**6.4.4 Records.** In accordance with NVIC 3-95, Enclosure (1), records of all inspections and tests shall be maintained on the vessel and shall be available for inspection. See NVIC 3-95 for more details.

**6.5 Service**

**6.5.1 Cleaning.** Remove dirt from metallic parts using a lint-free cloth moistened with dry cleaning solvent. Dry parts with clean, dry, lint-free cloth or air blow dry. Wipe non-metallic parts with clean, dry lint-free cloth. Remove corrosion with crocus cloth.

**6.5.2 Nozzle Service.** Service nozzles after use as follows:

1. Clean outside of nozzles with rag or soft brush.
2. Examine discharge orifices for damage or blockage. If nozzles appear to be obstructed, unscrew nozzles and clean by immersing in cleaning solvent and drying thoroughly with lint-free cloth. Replace damaged nozzles. Nozzles must be replaced with same part number in same location. See Paragraph 3.3.5 for correct nozzle placement and orientation.

**6.5.3 Repairs.** Replace all damaged parts found during inspection. Replacement procedures for FM-200 cylinders are provided below. Since replacement for other system components are similar, refer to installation drawings and FM-200 system assembly drawings for guidance.

FM-200 cylinders must be recharged when cylinder pressure gauge indicates pressure is below normal (360 PSIG at 70°F [24.8 bars gage at 21°C]), immediately after use, or a loss in weight in excess of 5% of the original charged net weight or loss of pressure (adjusted for temperature) of more than 10%

**6.6 Removing FM-200 Cylinder.** Remove FM-200 cylinder as follows:

**WARNING**

**DO NOT DISCONNECT FLEXIBLE DISCHARGE HOSE OR VALVE OUTLET ADAPTER PRIOR TO REMOVING PRESSURE AND ELECTRIC CONTROL HEADS FROM FM-200 CYLINDERS. BEFORE REPLACING A FM-200 CYLINDER IN A HAZARD AREA GROUP, ENSURE PILOT LINE IS COMPLETELY VENTED OF ALL PRESSURE.**

**6.6.1 Single Cylinder System**

1. Remove supervisory pressure switch (where installed) by removing switch cover and disconnecting electrical connection at switch. Unscrew switch from cylinder valve and install protection cap on switch connection port.
2. Disconnect swivel nut on control head from cylinder valve actuation port. Remove control head from FM-200 cylinder.
3. Install protection cap on FM-200 cylinder valve actuation port.
4. Remove valve outlet adapter or loosen swivel nut and remove flexible discharge hose from discharge outlet port adapter.
5. Immediately install safety cap on cylinder valve outlet port.
6. Remove cylinder strap. Remove FM-200 cylinder from bracket. Weigh cylinder using platform scale.

**6.6.2 Multiple Cylinder System.**

**WARNING**

**REMOVE ALL CONTROL HEADS FROM FM-200 CYLINDERS.**

1. Remove supervisory pressure switches (where installed) by removing switch cover and disconnecting electrical connection at switch. Unscrew switch from cylinder valve and install protection cap on switch connection port.
2. Disconnect swivel nut on pressure operated control heads from cylinder valve actuation port. Remove control heads from all FM-200 cylinder valves leaving flexible actuation hose or tubing attached to the pressure operated control heads.
3. Immediately install protection cap on FM-200 cylinder valve actuation port(s).
4. Remove tubing from master cylinder adapter on master cylinder (if used).

**WARNING**

**TO PREVENT INJURY IN THE EVENT OF DISCHARGE, MASTER CYLINDER ADAPTER CAP MUST BE INSTALLED ON ADAPTER WHENEVER TUBING IS NOT CONNECTED TO MASTER CYLINDER VALVE. UNDER NO CIRCUMSTANCES IS THE PROTECTION CAP TO BE REMOVED FROM ITS CHAIN.**

5. Immediately install protection cap on master cylinder adapter port.
6. Loosen swivel nut and remove flexible discharge hose from discharge outlet port.

**WARNING**

**TO PREVENT POSSIBLE INJURY TO PERSONNEL, ALL CYLINDERS MUST HAVE SAFETY CAPS INSTALLED IMMEDIATELY IN OUTLET PORTS WHEN DISCHARGE HOSES OR VALVE OUTLET ADAPTER IS DISCONNECTED.**

7. Immediately install safety cap in cylinder valve outlet port.
8. Remove attaching hardware or cylinder straps. Remove FM-200 cylinder from bracket. Weigh cylinders using platform scale.

**6.7 Installing FM-200 Cylinder.** Install FM-200 cylinders as follows:

**6.7.1 Single Cylinder System.**

1. Position FM-200 cylinder in designated location. Secure in place with cylinder strap or wall bracket and mounting hardware. Orient cylinder with valve outlet angled toward cylinder discharge piping (refer to installation drawings).

**WARNING**

**DISCHARGE HOSES OR VALVE OUTLET ADAPTERS MUST BE CONNECTED INTO SYSTEM PIPING (UNION CONNECTION) BEFORE ATTACHING TO CYLINDER VALVES.**

2. Remove safety cap from cylinder valve outlet port.
3. Immediately reconnect valve outlet adapter or flexible discharge hose to cylinder outlet port.
4. Remove protection cap from FM-200 cylinder actuation port.

**WARNING**

**CONTROL HEAD MUST BE IN "SET" POSITION (ACTUATING PIN IS IN THE FULLY RETRACTED OR "SET" POSITION) BEFORE ATTACHING TO CYLINDER VALVE TO PREVENT ACCIDENTAL DISCHARGE. OBSERVE THAT THE ACTUATING PIN HAS MOVED TO ITS FULLY RETRACTED POSITION.**

5. Install control head.
6. If required, install supervisory pressure switch as instructed in Paragraph 4.19.

**6.7.2 Multiple Cylinder System.**

1. Position FM-200 cylinders in designated location. Secure in place with cylinder straps or wall brackets and mounting hardware. Orient cylinders with valve outlets angled towards cylinder discharge piping (refer to system installation drawings).

**WARNING**

**DISCHARGE HOSES OR VALVE OUTLET ADAPTERS MUST BE CONNECTED INTO SYSTEM PIPING (UNION CONNECTION) BEFORE ATTACHING TO CYLINDER VALVES.**

2. Remove safety caps from cylinder valve outlet ports.
3. Immediately reconnect flexible discharge hoses or valve outlet adapters to cylinder valve outlet ports.
4. Remove protection cap from master cylinder adapter port (if used) and reconnect tubing to slave port on master cylinder. Tighten swivel nut.
5. Remove protection caps from FM-200 cylinder valve actuation ports.

**WARNING**

**CONTROL HEADS MUST BE IN "SET" POSITION BEFORE ATTACHING TO CYLINDER VALVE. CONTROL HEAD IN RELEASED POSITION WILL CAUSE DISCHARGE OF FM-200 CYLINDER UPON INSTALLATION TO CYLINDER VALVE.**

6. Reinstall pressure operated control heads with flexible actuation hoses or tubing on cylinder valve actuation ports. Tighten swivel nuts.
7. If required, install supervisory pressure switches as instructed in Paragraph 4.19.

**6.8 Post Fire Maintenance.**

**6.8.1 FM-200 Valve Inspection and Service.** Inspect and service the FM-200 valve as follows:

**IMPORTANT**

Because of the tendency of FM-200 to dissolve and wash out lubricant, it is necessary to inspect and service certain components in the FM-200 valve assembly prior to recharging the cylinder/valve assembly. Part numbers for items which may require replacement are listed below.

**6.8.2 Valve Disassembly** (Refer to Figure 6.8.1, Table 6.8.1).

**WARNING**

**PRIOR TO VALVE REMOVAL, MAKE CERTAIN THAT ALL PRESSURE HAS BEEN RELIEVED FROM THE CYLINDER. TO RELIEVE ANY REMAINING PRESSURE, DEPRESS THE PRESSURE SWITCH SCHRAEDER VALVE UNTIL ALL PRESSURE IS RELIEVED.**

1. Remove valve with siphon tube from cylinder.
2. Remove O-ring (Item 4). Examine O-ring for cuts or nicks; replace if necessary. Prior to reinstalling O-ring, apply lubricant.
3. Remove valve cap (Item 5), spring (Item 7), and piston assembly (Item 6).

**NOTE**

All internal components of FM-200 valves are removed from the top of the assembly. However, if there is excessive piston O-ring friction, it may be necessary to remove the siphon tube and press the piston assembly out from the bottom.

4. Remove O-rings (Item 1) and (Item 2) and examine for cuts or nicks; replace if necessary. Examine O-ring grooves for foreign matter. Prior to reinstalling the O-rings, apply lubricant.
5. Examine the exposed surface of O-ring (Item 3) for nicks or cuts. Also, ensure that the O-ring protrudes a minimum of .020 in. (0.5 mm) above the conical seating surface of the piston assembly. Replace this O-ring if necessary by removing the seat retainer (Item 8). Before re-assembly, apply lubricant to the O-ring.
6. Examine the valve core pin (Item 9) for any evidence of bending or other damage. Depress the pin and make certain it snaps back freely. Replace valve core if necessary using standard Schraeder core wrench. When reinstalling a new Schraeder core element, torque to 1-1/2 to 3 in. lbs.

**CAUTION**

After reinstalling a Schraeder core, the distance from the top of the core pin to the control head seating surface must fall between the dimensions of 0.515" to 0.565" (13 mm to 14 mm) when in the "shut" or non-actuated position (See Figure 6.8.1).

Figure Item Number	Description	10-125 lb. Cylinders	200-350 lb. Cylinders	600 lb. Cylinders
1	"O"-Ring, Cap	5661-0225	5661-0230	5661-0234
2	"O"-Ring, Piston	5661-0325	5661-0330	5661-0334
3	"O"-Ring, Seat	5661-0215	5661-0326	5661-0331
4	"O"-Ring, Neck	5661-0932	5661-0335	5661-0339
9	Schraeder Core	220278	220278	220278
11	Back-Up Ring	554003-250	554003-300	554003-340

Other Materials	
Lubricant	Parker Seal Co. Super-O-Lube or equivalent
Loctite Sealant	Loctite Corp. Sealant, Grade CV or equivalent
Locquic Primer	Loctite Corp. Primer, Grade N or equivalent

**Table 6.8.1 - Valve Components**

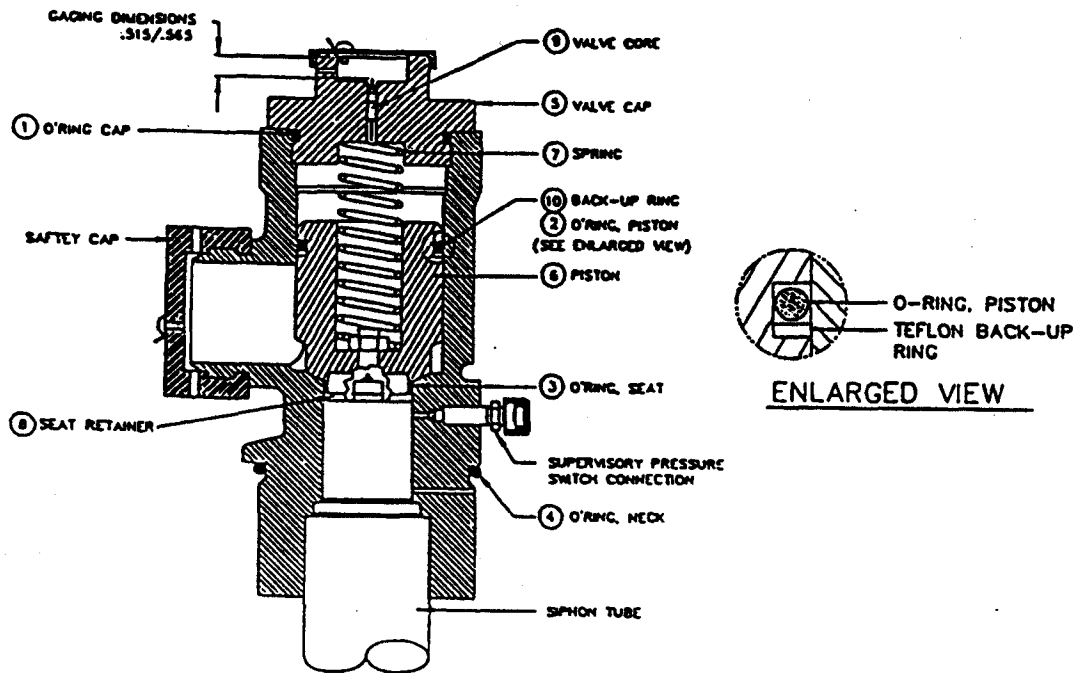


Figure 6.8.1 - Valve Assembly

**6.8.3 Valve Assembly** (Refer to Figure 6.8.1).

1. Install O-ring (Item 2) in piston groove.

**CAUTION**

**Make certain that the Teflon backup ring is below this o-ring as shown in Figure 6.8.1.**

2. Press piston (Item 6) back into valve body.
3. Install spring (Item 7).
4. Install o-ring (Item 1) onto groove in valve cap, screw cap onto valve body and torque to 250 in. lbs. (288 kg).
5. If it was necessary to remove siphon tube for valve disassembly, wire brush the siphon tube threads to remove the old Loctite residue.
6. Apply a film of Loctite primer to the siphon tube threads and allow 3 to 5 minutes to dry.
7. Apply a film of Loctite sealant to threads and reinstall siphon tube.

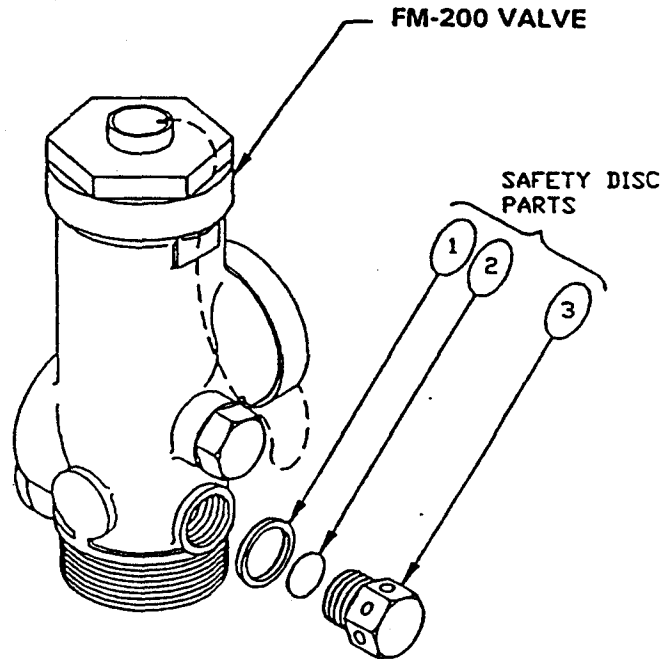
**6.8.4 Safety Disc Replacement** (Refer to Figure 6.8.2).

1. Remove safety disc retainer (Item 3) with safety disc (Item 2) and safety disc washer (Item 1) from valve body. Discard safety disc and washer.

2. Assemble safety disc retainer (Item 3) with new safety disc (Item 2) and safety disc washer (Item 1) to valve body. Torque to appropriate value listed below .

**WARNING**

**NEVER INSTALL ANY TYPE DISC OTHER THAN SPECIFIED ABOVE FOR THE APPROPRIATE CYLINDER. THE INSTALLATION OF THE INCORRECT DISC COULD RESULT IN VIOLENT RUPTURE OF THE CYLINDER AND SERIOUS INJURY TO Personnel.**



**Figure 6.8.2 - Safety Disc Replacement**

**CAUTION**

FM-200 cylinders may require re-test before recharge (see Paragraph 6.4 for details regarding cylinder re-test).

Cylinder Size	Safety Disc Part Number	Safety Disc Washer Part Number	Torque Value
10-125 lbs.	242461	294500	33 ft. lbs.
200-350 lbs.	264925	220360	38 ft. lbs.
600 lbs.	264929	220362	48 ft. lbs.

## 6.9 Recharging FM-200 Cylinders

### CAUTION

FM-200 cylinders may require re-test before recharge (see Paragraph 6.4 for details regarding cylinder re-test).

### DANGER

UNDER NO CIRCUMSTANCES WHILE PERFORMING EITHER CYLINDER RECHARGE OR LEAK TEST SHOULD A CHARGED CYLINDER BE ALLOWED TO FREE STAND WITHOUT EITHER THE CHARGING APPARATUS ATTACHED OR THE SAFETY CAP INSTALLED. WHENEVER THESE DEVICES ARE NOT INSTALLED, A CHARGED CYLINDER MUST BE SECURELY CLAMPED TO A RIGID STRUCTURE CAPABLE OF SUSTAINING THE FULL THRUST THAT WOULD RESULT SHOULD THE VALVE INADVERTENTLY OPEN. THE CLAMPING DEVICE AND SUPPORTS MUST BE CAPABLE OF WITHSTANDING A THRUST FORCE OF 1800 LBS. (816.5 KG.). THIS APPROXIMATES THE THRUST FORCE GENERATED OUT OF THE FM-200 CYLINDER VALVE OUTLET ON A FULL, WIDE OPEN DISCHARGE.

FM-200 charging equipment consists of an FM-200 storage container, piping adapter, control valves, strainer, pressure gauge, flexible hoses, seating adapter, recharge adapter, pump, regulated nitrogen supply, scale and interconnecting plumbing. Recharge equipment must be suitable for the purpose intended and must be compatible with FM-200. A typical FM-200 charging system schematic is shown in Figure 6.9.1.

### NOTE

During recharge, cylinder pressure gauge is not to be used to determine charging pressure.

Locate the charging equipment in a clean, well-ventilated area near the FM-200 supply and cylinder storage. There should be sufficient room for handling the cylinders to and from the charging equipment.

1	Recharge Adapter	16	Ball Valve
2	Seating Adapter	17	Regulator
3	Scale	18	Nitrogen Cylinder
4	Vent Valve - Recharge	19	FM-200 Shipping Container - Liquid
5	Vent Valve - Seating	20	Vent Valve
6	Ball Valve	21	Ball Valve
7	Ball Valve	22	FM-200 Shipping Container - Vapor
8	Ball Valve	23	Vent Valve
9	3- Way Valve	24	Ball Valve
10	Ball Valve	25	FM-200 Shipping Container - Vapor
11	Ball Valve	26	FM-200 Agent Storage Container
12	Safety Relief - Liquid	27	Ball Valve - Gauge
13	Safety Relief - Vapor	28	Master Pressure Gauge
14	Pump	29	Ball Valve
15	Check Valve	30	Vent Valve



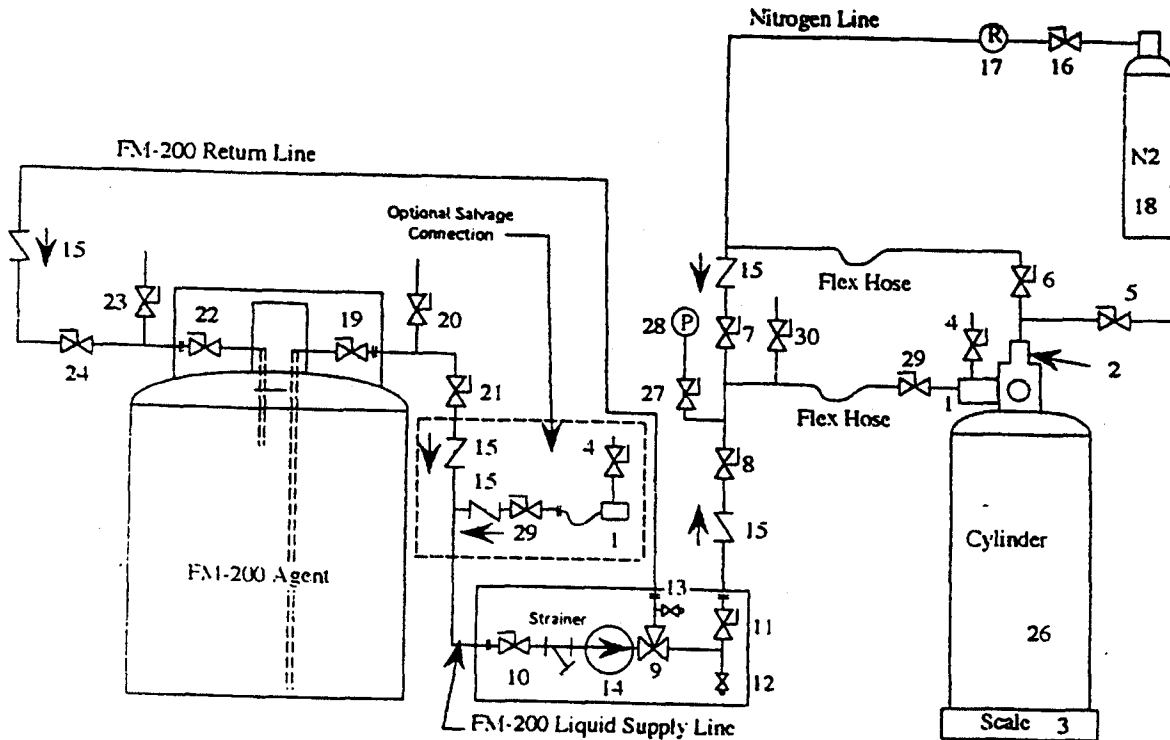


Figure 6.9.1 - Typical FM-200 Charging System Schematic

**6.9.1 Charging Equipment Installation.** Prior to assembling the charging equipment, apply Pemacel No. 412D Teflon tape to all pipe threads.

**6.9.2 Charging FM-200 Cylinder and Valve Assembly.** Recharge FM-200 cylinder and valve assembly as follows (see Figure 6.9.1):

**WARNING**

**ONLY QUALIFIED, DESIGNATED PERSONNEL SHOULD OPERATE CHARGING EQUIPMENT. EXERCISE EXTREME CARE WHEN WORKING WITH PRESSURE EQUIPMENT TO PREVENT INJURY TO PERSONNEL AND DAMAGE TO PROPERTY, RESULTING FROM CARELESS HANDLING OR POSSIBLE EQUIPMENT FAILURE. PERFORM ALL OPERATIONS IN AN ASSIGNED AREA CLEARED OF ALL UNAUTHORIZED PERSONNEL. MAKE SURE ALL EQUIPMENT IS PROPERLY SECURED. NEVER ATTEMPT TO ADJUST OR DISASSEMBLE PRESSURIZED EQUIPMENT.**

1. Check cylinder for last hydrostatic test date prior to charging. Perform any required DOT hydrostatic tests (see Paragraph 6.4).
2. Check cylinder valve assembly for any unacceptable physical defects (i.e., cracks of any kind, elongated pits of any length, inclusions of any size, pitting, bulging, dents, corrosion, fire damage, mechanical defects, scratches, nicks, or gouges if more than superficial in nature). These defects shall be cause for rejection.

#### **WARNING**

**DANGEROUSLY HIGH PRESSURES MAY BE GENERATED IF FM-200 IS INTRODUCED INTO A CYLINDER CONTAINING NITROGEN AT A PRESSURE ABOVE 10 PSIG (0.7 BARS GAGE).**

3. Weigh cylinder/valve assembly to verify quantity of agent in cylinder. Ensure that no more than 10 PSIG (0.7 bars gage) of nitrogen is in cylinder before beginning fill procedures.

#### **CAUTION**

**FM-200 is a colorless, odorless gas, low in toxicity, and is an extremely effective fire suppression agent. FM-200 can be liquefied by compression, and is normally shipped and stored in this condition. Being a liquefied and compressed gas, FM-200 is stored and handled under "Saturated" conditions (the liquid and vapor coexist in equilibrium). A reduction in pressure, without a corresponding reduction in temperature, will cause the liquid to flash into vapor with accompanying refrigeration effects. By understanding the physical properties of FM-200 and its safe handling techniques, the agent may be transferred from shipping cylinders to the desired end use container safely.**

4. Connect FM-200 supply and return lines to the FM-200 shipping container valves (Items 19 and 22). Close all valves in the charging system.
5. Open FM-200 supply valves (Items 19, 21, 10, 9, 11, 8, and 27). DO NOT open valve (Item 22) at this time. Pressure gauge (Item 28) should indicate supply pressure. Crack vent valve (Item 30) until FM-200 liquid is present. Close Valve (Item 30).
6. Turn 3-way valve (Item 9) to the return line position. Open valve (Item 24). Crack vent valve (Item 23) until FM-200 liquid is present. Close valve (Item 23). Open valve (Item 22). Charging system is now ready for use.
7. Position ECS Series FM-200 cylinder/valve assembly (Item 26) (with safety cap and pilot actuation port protection cap in place and properly connected) on weigh scale (Item 3). Monitor scale. Empty weight of cylinder assembly must be stamped on cylinder valve nameplate.
8. Remove safety cap and immediately connect cylinder assembly into the charging system by assembling the recharge adapter with O-ring packing (Item 1) to the cylinder assembly outlet port.

#### **NOTE**

**The main piston in the cylinder valve assembly will unseat, permitting flow into the assembly when a 10 PSIG (0.7 bars guage) differential (approximate) exists at the outlet port. Initial valve assembly seating occurs with pressure equalization. Final valve assembly seating occurs with removal of pressure from valve assembly outlet port and subsequent momentary application of 450 to 600 PSIG (31 to 41 bars guage) of nitrogen discussed below.**

9. Monitor scale, record empty cylinder assembly weight as A. Determine charge weight  $C=A+B+N_2$ , where B is weight of FM-200 agent indicated on valve nameplate.
10. Open valve (Item 29) and start pump (Item 14). Monitor the weigh scale (Item 3). When scale indicates charge weight C, shut off pump and close FM-200 supply valves (Items 29 and 8).

**NOTE**

The 360 PSIG (24.8 bars gage) pressure applies to the filling procedure with nitrogen and FM-200 at 70°F +/- 10°F. When the temperature is other than 70°F, refer to Table 6.9.1 for required total pressure. Do not fill FM-200 cylinders at temperatures below 60°F or above 90°F.

Temperature °F (°C)	Pressure	
	PSIG	Bars Gage
60 (15.6)	340	23.4
70 (21.1)	360	24.8
80 (26.7)	380	26.2
90 (32.2)	405	27.9

**Table 6.9.1 - Pressure vs. Temperature**

360 PSIG + 25, - 0 PSIG, at 70°F (24.8 bars gage +1.7, -0 bars gage at 21°C) is the final pressure required after the charged container has had sufficient time to stabilize. Nitrogen topping may be required to attain the 360 PSIG (24.8 bars gage) after the stabilization period has elapsed.

Nitrogen charge weight for Kidde FM-200 Marine ECS Series cylinders at 70 lbs./ ft<sup>3</sup> fill density is based on 1.88 lbs. (0.85 kg) of nitrogen per 100 lbs (45.3 kg) of FM-200.

11. If nitrogen is required, open hand wheel valve on nitrogen supply valve (Item 16) and nitrogen valve (Item 7). Adjust the regulator (Item 17) until the master gauge shows a pressure indication of 360 PSIG + 25, -0 PSIG (24.4 bars gage + 1.7, -0 bars gage).
12. Open the hose control valve (Item 29) and let nitrogen flow into the cylinder until the master gauge indicates 360 PSIG (24.8 bars gage). Cylinder agitation will assist with the equilibrium of nitrogen and FM-200. Additional nitrogen may be necessary as the cylinder equilibrates.
13. Close hose control valve (Item 29). Remove pilot actuation port protection cap and assemble seating adapter (Item 2) with flexible hose to the cylinder valve actuation port. Open valve (Item 6), then adjust regulator to momentarily apply 450 to 600 PSIG (31 to 41 bars gage) nitrogen pressure to the actuation port to firmly seat the cylinder valve piston .
14. While momentarily maintaining pressure on the actuation port, open vent valve (Item 4) on the recharge adapter (Item 1) to rapidly vent FM-200 from the valve assembly outlet port. The sudden pressure decrease at the valve outlet will ensure the valve seat stays in the closed position.

15. Leave vent valve (Item 4) open. Close valve (Item 6) and open valve (Item 5) to vent nitrogen from the seating adapter.

#### CAUTION

**ANY HISsing OR DISCHARGE COMING FROM VENT VALVE (ITEM 4) INDICATES THAT THE PISTON IS NOT SEATED PROPERLY OR HAS OPENED. IF THIS OCCURS, REPEAT STEP #16. VERIFY THAT THE CYLINDER VALVE PISTON REMAINS CLOSED.**

16. Keep vent valve (item 4) open. Close valve (Item 5), and once again open valve (Item 6) to reapply Nitrogen pressure to the actuation port. While momentarily maintaining pressure on the actuation port, remove the recharge adapter (Item 1) from the cylinder valve outlet port and immediately install the safety cap. Close vent valve (Item 4).

#### WARNING

**NITROGEN PRESSURE MUST BE MAINTAINED ON THE ACTUATION PORT DURING REMOVAL OF THE CHARGING ADAPTER AND INSTALLATION OF THE SAFETY CAP TO ASSURE THAT THE CYLINDER VALVE DOES NOT INADVERTENTLY ACTUATE WHILE THE VALVE OUTLET PORT IS WIDE OPEN. FAILURE TO FOLLOW THIS PROCEDURE COULD RESULT IN INJURY TO PERSONNEL AND DAMAGE TO PROPERTY.**

17. Close the nitrogen supply valve (Item 16) and open vent valve (Item 5) to vent nitrogen from the supply line.
18. Remove seating adapter (Item 2) from the cylinder valve and reinstall the actuation port protection cap. Close valves (Items 5 and 6).
19. Weigh the fully charged cylinder. The weight must agree with weight stamped on cylinder valve nameplate. Record date of recharge on cylinder record tag.
20. Monitor cylinder valve gauge. Gauge indicator must read 360 PSIG + 25 -0 PSIG at 70°F (24.8 bars +1.7, -0 bars gage at 21°C) (after the stabilization period).
21. Cylinder is now ready for leak test (refer to Paragraph 6.9.3).

#### CAUTION

**THE KIDDE FM-200 MARINE ECS SERIES AGENT CONTAINERS HAVE BEEN DESIGNED FOR A MAXIMUM FILL DENSITY OF 70 LBS./CU. FT. (4.37 KG/M<sup>3</sup>) AND SUPER PRESSURIZED WITH NITROGEN TO 360 PSIG + 25 PSIG AT 70° F (24.8 BARS GAGE +1.7, -0 BARS GAGE) AT 21°C. IT IS IMPORTANT THAT THESE VALUES NOT BE EXCEEDED.**

The pressure in the agent container is significantly affected by fill density and temperature. At elevated temperatures the rate of increase in pressure is very sensitive to fill density (see Figure 2.2-1). If the maximum fill density is exceeded, the pressure will increase rapidly with temperature increase so as to present a hazard to personnel and property. Adherence to the limits on fill density and pressurization levels will prevent excessively high pressures from occurring if the agent container is exposed to elevated temperature; minimizing the possibility of an inadvertent discharge of agent through the pressure relief device.

**NOTE:**

When charging more than one FM-200 cylinder, it may be advantageous to leave the pump (Item 14) running. In this case, when a cylinder is full, rotate 3-way valve (Item 9) to direct the flow back to the supply tank through the FM-200 return line. To resume charging operations, return the 3-way valve (Item 9) back to the "Filling" position.

To change FM-200 shipping container (Item 25) close cylinder valves (Items 19 and 22), close valves (Items 21 and 24). Carefully open vent valves (Items 20 and 23) to bleed pressure. Disconnect charging lines from FM-200 supply cylinder. Position new FM-200 supply cylinder in place. Connect charging lines to new FM-200 supply cylinder, ensuring vapor and liquid lines are connected to proper valves. Close vent valves (Items 20 and 23). Open valves (Items 21 and 24).

**6.9.3 FM-200 Cylinder Leak Test**

**WARNING**

CLAMP FM-200 CYLINDER SECURELY IN PLACE. THE CLAMPING DEVICE AND SUPPORTS MUST BE CAPABLE OF WITHSTANDING A THRUST FORCE OF 1800 LBS. (816.5 KG). THIS APPROXIMATES THE THRUST FORCE GENERATED OUT OF THE FM-200 CYLINDER VALVE OUTLET ON A FULL, WIDE OPEN DISCHARGE.

**CAUTION**

FM-200 cylinder leak tests must be conducted in a well-ventilated area, away from the charging station so as not to be influenced by extraneous FM-200 vapors released during the filling operations. Kidde recommends the Yokogawa Type H25C leak detector for FM-200, with the Yokogawa Type LS-20 leak standard for FM-200 for calibrating the leak detector.

1. Warm up leak detector for 30 minutes before proceeding with Step 2.
2. Calibrate the detector against the LS-20 leak standard by holding the probe about 1/8" (3 mm) away, and noting the meter deflection for the leakage allowance of the standard. Maximum allowable leak rates are shown in table 6.9.2.
3. Remove safety cap from discharge outlet. Blow nitrogen on the surface where plug is removed.
4. Move probe back and forth slowly approximately 1/8" (3 mm) away from all potential leak points (discharge outlet area, pilot check, valve bonnet, supervisory pressure switch connection, safety outlet, liquid level indicator, valve-to-cylinder connections, gauge, and container welds).
5. Meter deflections greater than indicated during calibration are considered excessive and will be cause for rejection.
6. Replace safety cap immediately after test.

Part No.	Cylinder Size (Lbs.)	Cylinder Fill Weight (Lbs)	Maximum Allowable Leakage (Oz./Yr.)
90-100010-001	10	5 - 10	.11
90-100020-001	20	9 - 20	.20
90-100040-001	40	17 - 40	.37
90-100070-001	70	30 - 70	.67
90-100125-001	125	54 - 125	1.20
90-100200-101	200	86 - 200	1.81
90-100201-101*	200	86 - 200	1.81
90-100350-001	350	150 - 350	3.34
90-100351-001*	350	150 - 350	3.34
90-100600-001	600	258 - 600	5.74
90-100601-001*	600	258 - 600	5.74

**Table 6.9.2 - Maximum Permitted Leakage Rates**

\* Includes liquid level indicator

7. If excess leakage is detected, salvage FM-200 agent, perform the required maintenance on the container, and recharge.
8. After leak test is complete, reassemble protection cap to actuation port of valve assembly  
Unclamp cylinder.

**6.9.4 Salvaging FM-200 from Leaking Cylinder Assembly (See Figure 6.9.1).**

**WARNING**

**TARGET CONTAINER MUST BE SIGNIFICANTLY LARGER THAN THE SOURCE CONTAINER TO PREVENT DANGEROUS PRESSURE BUILDUP.**

1. Close FM-200 supply valve (Item 19), close valve (Item 21). Open valve (Item 20) to vent pressure. Disconnect charging flexible hose from FM-200 supply valve (Item 19).
2. Connect the salvage discharge assembly to the flexible hose coupling; then assemble the discharge assembly to the outlet port of the leaking cylinder assembly (not shown).
3. Position an empty cylinder assembly of suitable size for FM-200 storage on the scale. Record empty weight.
4. Connect the recharge adapter (Item 1) to the empty cylinder outlet port.
5. Assemble manually operated control head onto the cylinder valve actuation port of the leaking cylinder assembly.
6. Check that all charging system valves are closed. Open valves (Items 21, 10, 9, 11, 8, and 27). Set the manually operated control head to the "OPEN" position. Pressure gauge (Item 28) should indicate supply pressure. Crack vent valve (Item 30) until FM-200 liquid is present. Shut valve (Item 30).

7. If cylinder assembly on scale is of sufficient size and is being used to store FM-200, monitor the scale, open valve (Item 29), and start the pump. Continue pumping until a maximum of FM-200 is transferred from the leaking cylinder assembly as indicated by a pressure drop on pressure gauge.
8. If cylinder assembly on scale is being charged, fill with the required weight of FM-200 by adding the required pounds to the empty cylinder weight. Follow charging procedure outlined in steps 9 through 21 of Paragraph 6.9.2. Conduct cylinder leak test as described in Paragraph 6.9.3.
9. Continue transfer of FM-200 agent until the leaking cylinder assembly is empty as indicated by pressure drop in pressure gauge. Shut off pump and close hose control valve (Item 29), and valve (Item 21).
10. Open valve (Item 20) to vent pressure, then disassemble adapter from outlet port of the leaking cylinder assembly and from the flexible hose hookup. Reassemble flexible hose to FM-200 supply valve (Item 19).
11. If cylinder assembly being recharged is not charged sufficiently, continue charging procedure as indicated in paragraph 6.9.2 using the FM-200 supply.

#### **6.10 Nitrogen Pilot Cylinder Service and Maintenance**

##### **WARNING**

**ANY AREA IN WHICH NITROGEN IS USED OR STORED MUST BE PROPERLY VENTILATED. A PERSON WORKING IN AN AREA WHERE AIR HAS BECOME ENRICHED WITH NITROGEN CAN BECOME UNCONSCIOUS WITHOUT SENSING THE LACK OF OXYGEN. REMOVE VICTIM TO FRESH AIR. ADMINISTER ARTIFICIAL RESPIRATION IF NECESSARY AND SUMMON A PHYSICIAN. NEVER DISPOSE OF LIQUEFIED NITROGEN IN AN INDOOR WORK OR STORAGE AREA.**

##### **6.10.1 Nitrogen Pilot Cylinder Hydrostatic Pressure Test**

Hydrostatic test must be performed in accordance with DOT regulations CFR Title 49, paragraph 173.34.

Nitrogen cylinders shall not be recharged and shipped without hydrostatic test if more than 5 years has elapsed from the date of the last test.

Nitrogen cylinders continuously in service without discharging can be retained in service for a maximum of 12 years from the date of the last hydrostatic test. At the end of 12 years the cylinder (s) shall be discharged and re-tested, before being recharged and returned to service.

Cylinders must also be hydrostatic pressure tested **immediately** if the cylinder shows evidence of distortion, cracking, corrosion, or mechanical and/or fire damage.

### 6.10.2 Nitrogen Cylinder Replacement.

#### WARNING

**WHEN REMOVING PRESSURIZED CYLINDER DUE TO PRESSURE LOSS, CONTROL HEAD LEVER MUST BE IN THE CLOSED POSITION WITH SAFETY PULL PIN INSTALLED. CONTROL HEAD LEVER IN THE OPEN POSITION WILL RESULT IN DISCHARGE OF REMAINING CONTENTS OF CYLINDER, RESULTING IN SYSTEM ACTIVATION, PROPERTY DAMAGE, OR POSSIBLE BODILY INJURY.**

When expended or when loss of pressure occurs, replace the nitrogen cylinder as follows:

1. Remove control head from nitrogen cylinder valve.
2. Immediately install protection cap on nitrogen cylinder actuation port.
3. Remove flexible actuation hose or tubing and adapter (P/N 6992-0501) from cylinder valve outlet.
4. Remove clamps and hardware securing nitrogen cylinder to mounting bracket.

**6.10.3 Nitrogen Cylinder Recharge.** Nitrogen cylinders must be recharged when cylinder pressure gauge indicates pressure is below normal (1800 PSIG at 70°F [124 bars gage at 21°C] or as adjusted for temperature as shown on Figure 6.10.1) or immediately after discharge. Nitrogen used for charging must comply with Federal Specification BB-N-411C, Grade A, Type 1. Copies of this specification may be obtained from: Global Engineering Documents, 2625 S. Hickory St., Santa Ana, CA 92707.

#### WARNING

**BEFORE RECHARGING, CYLINDER MUST BE FIRMLY SECURED BY CHAINS, CLAMPS OR OTHER DEVICES TO AN IMMOVABLE OBJECT SUCH AS A WALL, STRUCTURAL I-BEAM OR PERMANENTLY MOUNTED HOLDING RACK.**

Recharge nitrogen cylinders as follows:

1. Remove protection cap from cylinder valve actuation port.
2. Install nitrogen cylinder recharge adapter (P/N 933537) to cylinder valve actuation port and plug valve outlet port with 1/8" NPT pipe plug.
3. Connect nitrogen recharging supply hose to adapter. Tighten securely.
4. Open nitrogen recharging control valve slowly until full nitrogen flow is obtained.
5. Monitor recharging supply pressure gauge. Close charging control valve when gauge indicates the proper cylinder pressure (1800 PSIG at 70°F [124 bars gage at 21°C]).
6. Allow cylinder to cool to ambient temperature and recheck nitrogen cylinder indicated pressure.
7. Open valve and add additional nitrogen as necessary to obtain full cylinder charge at ambient temperature (1800 PSIG at 70°F [124 bars gage at 21°C]). Refer to Figure 6.10.1.
8. Close valve and remove supply hose and charging adapter from nitrogen cylinder.
9. Using a soap solution, thoroughly check nitrogen cylinder valve for leakage. Bubbles appearing in soap solution indicate leakage and shall be cause for rejection of cylinder.
10. At completion of leak test, thoroughly clean and dry cylinder valve.
11. Ensure cylinder valve control head port is clean and dry.
12. Immediately install protective cap to actuation port of cylinder valve.
13. Install charged cylinder as described below.



### 6.10.4 Nitrogen Cylinder Installation

1. Install nitrogen cylinder in position in mounting bracket.
2. Tighten sufficiently to hold cylinder in place while allowing cylinder enough free play to be manually rotated.
3. Manually rotate cylinder until cylinder valve discharge outlet is in desired position.

**CAUTION**

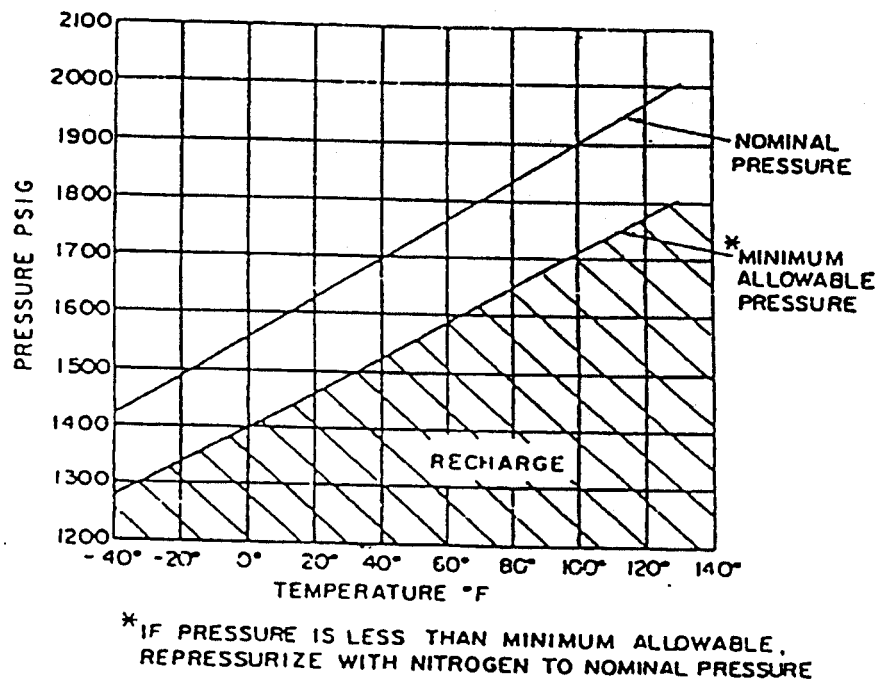
**Nitrogen cylinder must be positioned so that control head, when installed, is readily accessible and cannot be obstructed during manual operation.**

4. Securely tighten mounting bracket clamps and hardware.
5. Remove pipe plug, reconnect adapter (P/N 6992-0501) and flexible actuation hose or tubing to cylinder valve outlet port.
6. Remove protective cap from cylinder valve actuation port.

**WARNING**

**ENSURE CONTROL HEAD IS IN THE "SET" POSITION (ACTUATING PIN IS IN THE FULLY RETRACTED OR "SET" POSITION). FAILURE TO POSITION CONTROL HEAD IN "SET" POSITION WILL CAUSE DISCHARGE OF NITROGEN CYLINDER UPON CONTROL HEAD INSTALLATION.**

7. Install control head to cylinder valve and tighten securely.



**Figure 6.10.1 . Nitrogen Temperature vs. Pressure Data**

## 6.11 Inspection and Test of CO<sub>2</sub> Cylinders

### CAUTION

**These guidelines do not apply to cylinders containing commodities other than CO<sub>2</sub>.**

All Kidde-Fenwal, Inc. CO<sub>2</sub> cylinders are designed, fabricated and factory tested to comply with DOT CFR 49 Regulations 2A-2015, 3AA-1800 or 3AA-2300 as stamped on each cylinder.

CO<sub>2</sub> cylinders must be hydrostatically tested and marked in accordance with DOT 49 CFR 173.301 through 173.308 and 49 CFR 173.34, Ref. 46 CFR 147.65.

1. Any cylinder which has been discharged or removed from the vessel subsequent to five (5) years from the date of the last hydrostatic test, as indicated by the marking on the cylinder shoulder, must be emptied, retested and remarked.
2. A cylinder continuously in place onboard a vessel for a period of time exceeding five (5) years must, after twelve (12) years have elapsed from the date of the previous test and marking, be removed from the vessel, its contents discharged, and the cylinder retested and remarked.
3. A cylinder must also be hydrostatic tested and remarked immediately if the cylinder shows evidence of distortion, damage, cracks, corrosion, or mechanical damage. Any cylinder failing the hydrostatic pressure test must be destroyed.

## 6.12 Recharging CO<sub>2</sub> Cylinders

### CAUTION

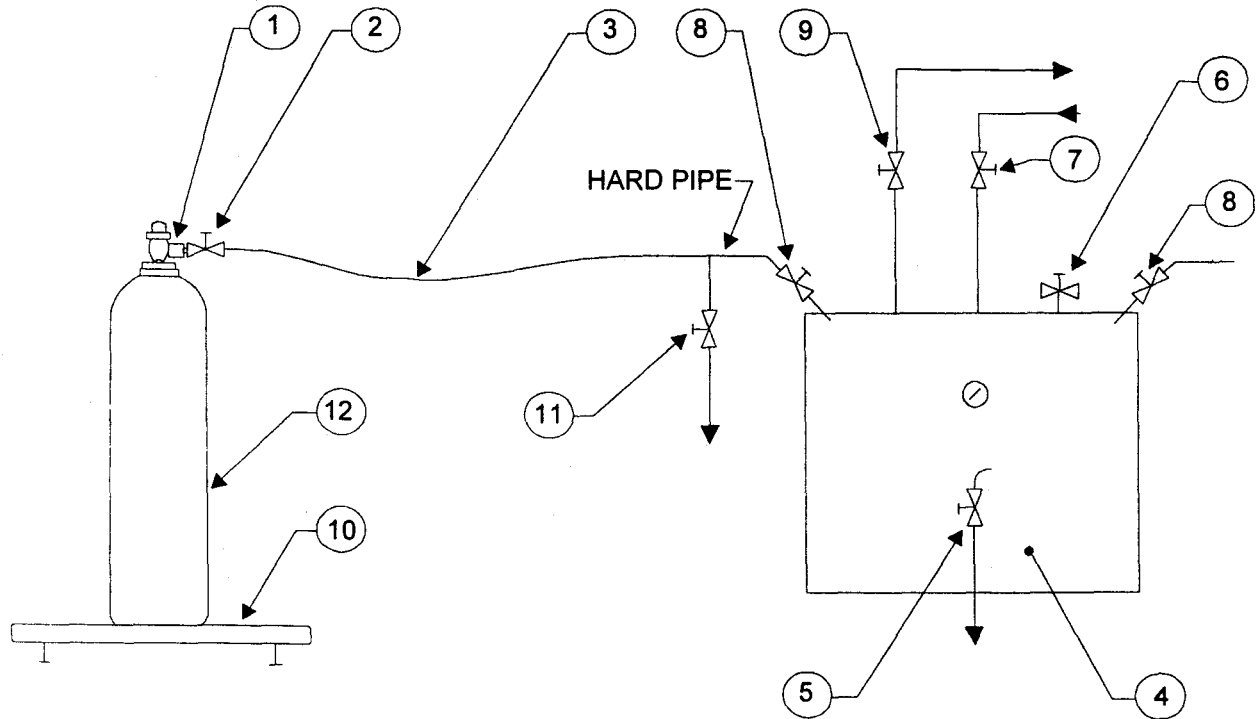
CO<sub>2</sub> cylinders must not be recharged without a retest if more than five (5) years have elapsed since the last test. Retest shall be in accordance with the requirements of 49 CFR, Paragraph 173.301 through 173.308 and 173.324. After retest, cylinder must be thoroughly dried and free of any water vapor.

### WARNING

**UNDER NO CIRCUMSTANCES WHILE PERFORMING EITHER CYLINDER RECHARGE OR LEAK TEST SHOULD A CARBON DIOXIDE CYLINDER HAVE A DISCHARGE HEAD OR CONTROL HEAD ATTACHED TO THE CYLINDER VALVE. WHEN REMOVING CARBON DIOXIDE CYLINDERS, OBSERVE THE FOLLOWING:**

1. EACH CYLINDER IS FACTORY EQUIPPED WITH A VALVE PROTECTION CAP THREADED SECURELY OVER THE VALVE ASSEMBLY. THIS CAP IS A SAFETY DEVICE WHICH PROTECTS THE VALVE FROM DAMAGE DURING CYLINDER HANDLING.
2. THIS DEVICE MUST BE INSTALLED AT ALL TIMES, EXCEPT WHEN THE CYLINDER IS CONNECTED INTO THE SYSTEM PIPING OR BEING FILLED.

3. THE VALVE PROTECTION CAP MUST BE STORED IN A SECURE SPACE AND MADE READILY AVAILABLE FOR USE. NEVER MOVE OR HANDLE CYLINDER WITHOUT THE CAP INSTALLED.



- |                                       |   |
|---------------------------------------|---|
| 1. recharge adapter                   | 7. CO <sub>2</sub> supply inlet control valve |
| 2. flexible line control valve        | 8. CO <sub>2</sub> station valve              |
| 3. flexible hose                      | 9. return line valve                          |
| 4. cylinder filling unit              | 10. weigh scale                               |
| 5. vent valve                         | 11. vent valve                                |
| 6. CO <sub>2</sub> main control valve | 12. CO <sub>2</sub> cylinder/valve assembly   |

Figure 6.12 Typical Carbon Dioxide Recharge Schematic

Recharge carbon dioxide cylinder as follows: (Note - CO<sub>2</sub> cylinders are filled by weight only, not by pressure.)

### CAUTION

CO<sub>2</sub> cylinders are filled with the required quantity using an approved transfer pump. DO NOT use dry ice converters as this may allow water vapor to enter the cylinder, causing internal corrosion.

1. Securely clamp cylinder to a rigid structure.
2. Blow cylinder down through pilot check port to vent off all remaining CO<sub>2</sub> agent.
3. Set empty cylinder (12) on scale (10). Connect charging adapter (1) to the cylinder pilot port.
4. Close vent valve (11), open supply valve (7), main control valve (6), and station valve (8). Record tare weight of the cylinder assembly (12) (with flexible line attached) on cylinder record tag.
5. Open flexible line control valve (2) and observe the weighing scale dial. When the scale weight reaches the sum of the charge weight and the previously recorded tare weight, shut off the flexible line control valve (2) and the main control valve (5). Open the vent valve (11) to vent the CO<sub>2</sub> from the flexible line. Disconnect the flexible line adapter and observe the full weight of the cylinder and valve assembly (12). Record full weight on the cylinder record tag.
6. The charged cylinder is now ready for leak test.

#### **6.12.1 Carbon Dioxide Cylinder Leak Test**

1. Leak test cylinder either by immersing in water using a bell jar over the valve to detect for leaks or
2. Apply soap solution to all pressure connections and observe for bubble leaks.

## 7. List of Approved System Components

### FM-200 Engineered Fire Suppression Systems

#### Cylinder/Valve Assemblies

Vertical Mount Only	Part Number
10 lb. STD	90-100010-001
20 lb. STD	90-100020-001
40 lb. STD	90-100040-001
70 lb. STD	90-100070-001
125 lb. STD	90-100125-001
200 lb. STD	90-100200-101
200 lb. W/LLI	90-100201-101
350 lb. STD	90-100350-001
350 lb. W/LLI	90-100351-001
600 lb. STD	90-100600-001
600 lb. W/LLI	90-100601-001

STD = Standard Cylinder Assembly

W/LLI = Cylinder with liquid level indicator

#### Flexible Discharge Hoses

10-125 lb. Cylinders	283898
200-350 lb. Cylinders	283899
600 lb. Cylinders	283900

#### Cylinder Mounting Straps

10-20 lb.	283945
40-70 lb.	283934
125 lb. & 200 lb	235317
350 lb.	281866
600 lb.	294651

#### Cylinder Mounting Cradles

10-20 lb.	not applicable
40-70 lb.	not applicable
125 lb. & 200 lb	235431
350 lb.	281867
600 lb.	294652

Control Heads

Cable Operated	979469
Lever Operated	870652
Pressure Operated	878737
Pressure Operated, Stackable	878750
Lever/Pressure Operated	878751
Pneumatic	872318
Pneumatic	872335
Pneumatic	872365
Pneumatic	872362
Pneumatic	872310
Pneumatic	872330
Pneumatic	872360

Pressure Control Equipment

Master Cylinder Adapter Kit	844895
Male Branch Tee, 5/16" Flare x 1/8" NPT	6992-0505
Male Elbow, 5/16" Flare x 1/8" NPT	6992-0503
Male Connector, 5/16" Flare x 1/8" NPT	6992-0501
Actuation Hose, 22" (10 - 200 lb Cylinder)	264987
Actuation Hose, 30" (350 - 600 lb Cylinder)	264986
Nitrogen Pilot Cylinder	877940
Mounting Bracket, N <sub>2</sub> Pilot Cylinder	877845
Check Valve, 1/4"	264985
Ball Valve, 1/4"	283888
Nitrogen Pilot Cylinder Adapter	699205-010

Remote Control Equipment, Cable Operated

Pull Box, Break Glass	871403
Remote Cable Pull Station, Watertight	870087
Remote Cable Pull Station, Yacht Type	840098
Corner Pulley, Watertight	803808
1/16" Cable	1593-0002
Dual Pull Equalizer	840051
Dual Pull Mechanism	840058
Cable Housing, Pneumatic Control Head	840044
Cable Housing, Pneumatic Control Head	844481
Cable Housing, Pneumatic Control Head	844515
Cable Housing, Pneumatic Control Head	844733
Cable Housing, Cable Operated Control Head	33157
Cable Housing, Cable Operated Control Head	260702
Cable Housing, Cable Operated Control Head	260951

Cable Housing, Cable Operated Control Head	363602
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Pneumatic/Automatic Control Equipment

Pneumatic Heat Detector	841241
Pneumatic Detection System Tubing, 3/16"	802366
Pneumatic Detection System Tubing, 3/16"	820587
Pneumatic Detection System Tubing, 3/16"	802367
Pneumatic Detection System Tubing, 3/16"	802486
Tubing Nut, 3/16"	5281-0300
3/16" Union without Nuts	5281-0360
3/16" x 1/8" Reducing Union 1/8" Nut without 3/16" Nut	802536
3/16" Tee without Nuts	5281-0370

Auxiliary Equipment

Supervisory Pressure Switch	878709-00
Supervisory Pressure Switch	878709-01
Pressure Operated Switch, Standard	486536
Pressure Operated Switch, Ex Proof	981332
Pressure Trip	874290
Discharge Indicator	845553
Liquid Level Indicator	283894
Pressure Operated Siren	981574
Safety Outlet (N <sub>2</sub> /CO <sub>2</sub> )	803242
Safety Outlet (FM-200)	844346
Nameplate (Warning FM-200)	06-231865-739
Nameplate (Main)	31033
Nameplate (Reserve)	31034
Nameplate (Warning)	218270
Nameplate (Warning)	206561

CO<sub>2</sub> Actuation Equipment

50 lb CO <sub>2</sub> Cylinder	982548
CO <sub>2</sub> 3/4" Discharge Hose	251821
Time Delay Assembly, 30 Second	871071
Time Delay Assembly, 60 Second	897567
Manifold "Y" Fitting (for dual CO <sub>2</sub> cylinder installations)	207877
Plain Nut Discharge Head	872450
CO <sub>2</sub> Cylinder Strap (single cylinder)	270014
CO <sub>2</sub> Cylinder Strap (two cylinder)	241219

Check Valves

Check Valve, 1/2" NPT	800327
Check Valve, 3/4" NPT	800266
Check Valve, 1" NPT	800443
Check Valve, 1-1/4" NPT	800444
Check Valve, 1-1/2" NPT	870152
Check Valve, 2" NPT	870151
Check Valve, 2-1/2" & 3" Flanged	870100
Manifold EL Check Valve, 2" NPT	877690
Manifold EL Check Valve, 2-1/2" NPT	878743

Stop Valves

Stop Valve, 1/2" NPT	870023
Stop Valve, 3/4" NPT	870022
Stop Valve, 1" NPT	870122
Stop Valve, 1-1/4" NPT	870032
Stop Valve, 1-1/2" NPT	870123
Stop Valve, 2" NPT	870049
Stop Valve, 2-1/2" & 3" Flanged	890010
Stop Valve, 4" Flanged	890208



Discharge Nozzles

**WARNING**

**ONLY LISTED KIDDE FM-200 NOZZLES ARE TO BE USED ON KIDDE ECS SERIES FM-200 FIRE SUPPRESSION SYSTEMS. FAILURE TO COMPLY WITH THIS WARNING CAN RESULT IN UNPREDICTABLE AGENT DISTRIBUTION.**

Listed 360 degree nozzles						
Area (in <sup>2</sup> )	1/2" NPT	3/4" NPT	1" NPT	1.-1/4" NPT	1-1/2" NPT	2" NPT
0.0774	90-194023-111					
0.0802	90-194023-113					
0.0845	90-194023-116					
0.0905	90-194023-120					
0.0982	90-194023-125					
0.1037	90-194023-129					
0.1162	90-194023-136					
0.1240	90-194023-141					
0.1303	90-194023-144					
0.1358	90-194023-147	90-194024-147				
0.1404	90-194023-150	90-194024-150				
0.1534	90-194023-156	90-194024-156				
0.1629	90-194023-161	90-194024-161				
0.1731	90-194023-166	90-194024-166				
0.1856	90-194023-172	90-194024-172				
0.1968	90-194023-177	90-194024-177				
0.2035	90-194023-180	90-194024-180				
0.2080	90-194023-182	90-194024-182				
0.2150	90-194023-185	90-194024-185				
0.2244		90-194024-189	90-194025-189			
0.2353		90-194024-194	90-194025-194			
0.2488		90-194024-199	90-194025-199			
0.2653		90-194024-206	90-194025-206			
0.2851		90-194024-213	90-194025-213			
0.3007		90-194024-219	90-194025-219			
0.3069		90-194024-221	90-194025-221			
0.3266		90-194024-228	90-194025-228			
0.3440		90-194024-234	90-194025-234			
0.3559		90-194024-238	90-194025-238			

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 US Coast Guard Rules

Listed 360 degree nozzles						
Area (in <sup>2</sup> )	1/2" NPT	3/4" NPT	1" NPT	1-1/4" NPT	1-1/2" NPT	2" NPT
0.3802			90-194025-246	90-194026-246		
0.3927			90-194025-250	90-194026-250		
0.4150			90-194025-257	90-194026-257		
0.4280			90-194025-261	90-194026-261		
0.4433			90-194025-266	90-194026-266		
0.4649			90-194025-272	90-194026-272		
0.4821			90-194025-277	90-194026-277		
0.5284			90-194025-290	90-194026-290	90-194027-290	
0.5468			90-194025-295	90-194026-295	90-194027-295	
0.5731			90-194025-302	90-194026-302	90-194027-302	
0.6136			90-194025-313	90-194026-313	90-194027-313	
0.6274				90-194026-316	90-194027-316	
0.6555				90-194026-323	90-194027-323	
0.6765				90-194026-328	90-194027-328	
0.6926				90-194026-332	90-194027-332	
0.7221				90-194026-339	90-194027-339	
0.7424				90-194026-344	90-194027-344	
0.8053				90-194026-358	90-194027-358	
0.8115				90-194026-359	90-194027-359	
0.8509				90-194026-368	90-194027-368	90-194028-368
0.8836				90-194026-375	90-194027-375	90-194028-375
0.8930				90-194026-377	90-194027-377	90-194028-377
0.9362				90-194026-386	90-194027-386	90-194028-386
0.9587				90-194026-391	90-194027-391	90-194028-391
0.9903				90-194026-397	90-194027-397	90-194028-397
1.0255				90-194026-404	90-194027-404	90-194028-404
1.0717					90-194027-413	90-194028-413
1.1183					90-194027-422	90-194028-422
1.2026					90-194027-438	90-194028-438
1.2901					90-194027-453	90-194028-453
1.3806					90-194027-469	90-194028-469
1.4742						90-194028-484
1.5708						90-194028-500
1.6705						90-194028-516
1.7733						90-194028-531
1.8791						90-194028-547
1.9880						90-194028-563
2.1000						90-194028-578
2.2151						90-194028-594
2.3332						90-194028-609

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US Coast Guard Rules**

Listed 180 degree nozzles						
Area (in <sup>2</sup> )	1/2" NPT	3/4" NPT	1" NPT	1-1/4" NPT	1-1/2" NPT	2" NPT
0.0770	90-194013-109					
0.0810	90-194013-111					
0.0820	90-194013-113					
0.0875	90-194013-116					
0.0931	90-194013-120					
0.1030	90-194013-125					
0.1072	90-194013-129					
0.1190	90-194013-136					
0.1289	90-194013-141					
0.1342	90-194013-144	90-194014-144				
0.1384	90-194013-147	90-194014-147				
0.1428	90-194013-150	90-194014-150				
0.1605	90-194013-156	90-194014-156				
0.1694	90-194013-161	90-194014-161				
0.1779	90-194013-166	90-194014-166				
0.1909	90-194013-172	90-194014-172				
0.2049		90-194014-177				
0.2113		90-194014-180				
0.2177		90-194014-182	90-194015-182			
0.2215		90-194014-185	90-194015-185			
0.2313		90-194014-189	90-194015-189			
0.2405		90-194014-194	90-194015-194			
0.2597		90-194014-199	90-194015-199			
0.2744		90-194014-206	90-194015-206			
0.3005		90-194014-213	90-194015-213			
0.3080		90-194014-219	90-194015-219			
0.3128		90-194014-221	90-194015-221			
0.3364		90-194014-228	90-194015-228			
0.3504			90-194015-234			
0.3623			90-194015-238			

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Listed 180 degree nozzles						
Area (in <sup>2</sup> )	1/2" NPT	3/4" NPT	1" NPT	1.-1/4" NPT	1-1/2" NPT	2" NPT
0.4039			90-194015-246	90-194016-246		
0.4056			90-194015-250	90-194016-250		
0.4233			90-194015-257	90-194016-257		
0.4400			90-194015-261	90-194016-261		
0.4485			90-194015-266	90-194016-266		
0.4734			90-194015-272	90-194016-272		
0.4954			90-194015-277	90-194016-277		
0.5379			90-194015-290	90-194016-290	90-194017-290	
0.5636				90-194016-295	90-194017-295	
0.5967				90-194016-302	90-194017-302	
0.6382				90-194016-313	90-194017-313	
0.6439				90-194016-316	90-194017-316	
0.6787				90-194016-323	90-194017-323	
0.6875				90-194016-328	90-194017-328	
0.7254				90-194016-332	90-194017-332	
0.7401				90-194016-339	90-194017-339	
0.7884				90-194016-344	90-194017-344	
0.8439				90-194016-358	90-194017-358	90-194018-358
0.8439				90-194016-359	90-194017-359	90-194018-359
0.8767				90-194016-368	90-194017-368	90-194018-368
0.9047				90-194016-375	90-194017-375	90-194018-375
0.9311				90-194016-377	90-194017-377	90-194018-377
0.9588				90-194016-386	90-194017-386	90-194018-386
0.9896					90-194017-391	90-194018-391
1.0140					90-194017-397	90-194018-397
1.0498					90-194017-404	90-194018-404
1.1081					90-194017-413	90-194018-413
1.1699					90-194017-422	90-194018-422
1.2368					90-194017-438	90-194018-438
1.3374						90-194018-453
1.4146						90-194018-469
1.5114						90-194018-484
1.6264						90-194018-500
1.7045						90-194018-516
1.8205						90-194018-531
1.9075						90-194018-547
2.0304						90-194018-563
2.1566						90-194018-578

## **LIMITED WARRANTY STATEMENT**

**Kidde represents that this product is free from defects in material and workmanship, and it will repair or replace any product or part thereof which proves to be defective in workmanship or material for a period of twelve (12) months after shipment to the Seller.**

**For a full description of Kidde's LIMITED WARRANTY, which, among other things, limits the duration of warranties of MERCHANTABILITY and FITNESS FOR A PARTICULAR PURPOSE and EXCLUDES liability for CONSEQUENTIAL DAMAGES, please read the entire LIMITED WARRANTY on the Kidde Quotation. Acceptance of Order and/or Original Invoice which will become a part of your sale agreement. Defective units should be returned to the factory, Ashland, Massachusetts, shipment prepaid. Kidde will repair or replace and ship prepaid.**



## **APPENDIX A SAFETY BULLETINS**

FM-200 fire suppression systems use pressurized equipment; therefore, personnel responsible for fire suppression systems must be aware of the dangers associated with the improper handling, installation or maintenance of this equipment.

Fire suppression system service personnel must be thoroughly trained in the proper handling, installation and service of FM-200 equipment and follow the instructions used in this manual and in the Safety Bulletin and cylinder nameplate contained in this Appendix. Kidde has provided warnings and cautions at appropriate locations throughout the text of this manual. These warnings and cautions are to be adhered to at all times. Failure to do so may result in serious injury to personnel.





**SAFETY BULLETIN 1, MARCH 2, 1987**  
**SUBJECT: SAFE CYLINDER HANDLING PROCEDURES**  
**DANGER! DANGER! DANGER!**

**PRESSURIZED (CHARGED) CYLINDERS ARE EXTREMELY HAZARDOUS AND IF NOT HANDLED PROPERLY ARE CAPABLE OF VIOLENT DISCHARGE. THIS MAY RESULT IN SERIOUS BODILY INJURY, DEATH AND PROPERTY DAMAGE.**

Before handling Kidde system products, all personnel must be thoroughly trained in the safe handling of the containers as well as in the proper procedures for installation, removal, filling, and connection of other critical devices, such as flex hoses, control heads, discharge heads, and anti-recoil devices.

READ, UNDERSTAND and ALWAYS FOLLOW the operation and maintenance manuals, owners manuals, service manuals, etc., that are provided with the individual systems.

The following safety procedures must be observed at all times:

**Moving Container.** Containers must be shipped compactly in the upright position, and properly secured in place. Containers must not be rolled, dragged or slid, nor allowed to be slid from tailgates of vehicles. A suitable hand truck, fork truck, roll platform or similar device must be used.

**Rough Handling:** Containers must not be dropped or permitted to strike violently against each other or other surfaces.

**Storage:** Containers must be stored standing upright where they are not likely to be knocked over, or the containers must be secured.

For additional information on safe handling of compressed gas cylinders, see CGA Pamphlet PI titled "Safe Handling of Compressed Gases in Containers". CGA pamphlets may be purchased from The Compressed Gas Association, Crystal Square Two, 1725 Jefferson Davis Highway, Arlington, VA 22202.



**SAFETY BULLETIN , MAY 1, 1993**

**SUBJECT: SAFE CYLINDER HANDLING PROCEDURES FOR 360 PSI FM-200 CYLINDERS**

**PRESSURIZED (CHARGED) CYLINDERS ARE EXTREMELY HAZARDOUS AND IF NOT HANDLED PROPERLY ARE CAPABLE OF VIOLENT DISCHARGE. THIS WILL RESULT IN SERIOUS BODILY INJURY, DEATH AND PROPERTY DAMAGE.**

BEFORE handling Kidde system products, all personnel must be thoroughly trained in the safe handling of the containers as well as in the proper procedures for installation, removal, filling, and connection of other critical devices, such as flexible hoses, control heads, and safety caps.

READ, UNDERSTAND and ALWAYS FOLLOW the operation and maintenance manuals, owners manuals, service manuals, and other information that is provided with the individual systems.

THESE INSTRUCTIONS MUST BE FOLLOWED IN THE EXACT SEQUENCE AS WRITTEN TO PREVENT SERIOUS INJURY, DEATH OR PROPERTY DAMAGE.

**Safety Cap**

- a. Each FM-200 cylinder is factory equipped with a safety cap installed on the valve outlet, and securely chained to the valve to prevent loss. This device is a safety feature, and will provide controlled safe discharge when installed if the cylinder is actuated accidentally.
- b. The safety cap must be installed in the valve outlet AT ALL TIMES except when the cylinders are connected into the system piping or being filled.
- c. The safety cap is intentionally chained to the cylinder valve to prevent loss while in service and must not be removed from its chain.

Protection Cap. A protection cap is factory installed on the actuation port and securely chained to the valve to prevent loss. The cap is attached to the actuation port to prevent tampering or depression of the actuating pin. No attachments (control head, pressure control head) are to be connected to the actuation port during shipment, storage, or handling.

**Installation**

THIS SEQUENCE FOR CYLINDER INSTALLATION MUST BE FOLLOWED AT ALL TIMES:

1. Install cylinder into bracketing.

**WARNING**

**DISCHARGE HOSES OR VALVE OUTLET ADAPTER MUST BE CONNECTED INTO SYSTEM PIPING BEFORE ATTACHING TO CYLINDER VALVE OUTLET TO PREVENT INJURY IN THE EVENT OF DISCHARGE.**

2. Remove safety cap and connect all cylinder valves into system piping using flex hose or valve outlet adapter.
3. Remove protection cap and attach control heads, pressure control heads, pilot loops, etc. as required.



**WARNING**  
**CONTROL HEADS MUST BE IN THE SET POSITION BEFORE ATTACHING TO THE CYLINDER VALVE ACTUATION PORT, IN ORDER TO PREVENT ACCIDENTAL DISCHARGE.**

Removal From Service

1. Remove all control heads, pressure operated heads, and pilot loops from cylinder valve, and attach protection cap to actuation port.
2. Disconnect cylinders from system piping at the valve outlet. Disconnect valve outlet adapter, if used.
3. Immediately install safety cap on valve outlet.

**DANGER!**  
**DO NOT DISCONNECT THE CYLINDER FROM SYSTEM PIPING IF THE SAFETY CAP IS MISSING. OBTAIN A NEW SAFETY CAP FROM KIDDE.**

4. Remove cylinder from bracketing.

**DANGER!**  
**FAILURE TO FOLLOW THESE INSTRUCTIONS, AND IMPROPER USE OR HANDLING, MAY CAUSE SERIOUS BODILY INJURY, DEATH, AND PROPERTY DAMAGE.**



**APPENDIX B**  
**MATERIAL SAFETY DATA SHEETS**







# MATERIAL SAFETY DATA SHEET

EMERGENCY TELEPHONE (501) 862-5141

IDENTITY - FM-200  
(1,1,1,2,3,3,3-Heptafluoropropane)

-----  
**SECTION I - PRODUCT INFORMATION**

MANUFACTURER'S NAME - GREAT LAKES CHEMICAL CORPORATION

TELEPHONE NUMBER FOR INFORMATION - (317) 497-6100

WHMIS HAZARD CLASS AND DIVISION - A.

CAS REGISTRY NO. 431-89-0      DATE PREPARED 11/92

FORMULA F<sub>7</sub>C<sub>3</sub>H      SUPERSEDES 9/92

CHEMICAL FAMILY - Halogenated Alkane

PREPARED BY - Research Services Department  
Great Lakes Chemical Corporation  
West Lafayette, Indiana 47906

This product is being commercially manufactured under a TSCA Section 5 Consent Order. The Significant New Use Rule (SNUR) for FM-200 can be located in the Code of Federal Regulation 721.8125.

-----  
**SECTION II**

HAZARDOUS COMPONENTS (Specify Chemical Identity: Common Names)

<u>COMPONENT</u>	<u>OSHA PEL</u>	<u>ACGIH TLV</u>	<u>Other Limits Recommended</u>
FM-200.	Not estbl.	Not estbl.	Not estbl.

GLCC Product Code: 109

GREAT LAKES CHEMICAL CORPORATION  
P.O. Box 2200 . Highway 52 NW . West Lafayette, Indiana 47906

SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point	-16.4°C
Specific Gravity (water=1)	1.46
Vapor Pressure (mm Hg)	58.8 psia at 70°F
Melting Point	-131°C
Vapor Density (AIR=1)	Not Available
Evaporation Rate (Butyl Acetate=1)	Not Available
Solubility in Water	Not Available
Appearance and Odor	Colorless gas, odorless

---

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point (Method Used)	Nonflammable gas
Flammable Limits	
LEL	Not Applicable
UEL	Not Applicable

Extinguishing Media

All conventional media are suitable.

Special Fire Fighting Procedures

This material is sold as a fire extinguishing agent.

Unusual Fire and Explosion Hazards

In fire situations, toxic and corrosive hydrogen fluoride may be released.

---

SECTION V - REACTIVITY DATA

Stability            Stable    X            Unstable

Conditions to Avoid:    None known

Incompatibility (Materials to Avoid)

Strong alkalis, strong oxidizers, strong reducing agents.

Hazardous Decomposition or Byproducts

Hydrogen fluoride

Hazardous Polymerization

May Occur	Will Not Occur	X
Conditions to Avoid:	None	

-----  
SECTION VI - HEALTH HAZARD DATA

Route(s) of Entry:

Inhalation? Yes      Skin? No      Ingestion? No

Health Hazards (Acute and Chronic):

To the best of our knowledge, the chronic toxicological properties of this material have not been studied. The acute inhalation 4-hour LC<sub>50</sub> in rats is greater than 788,696 ppm (~80%). A cardiac sensitization study has determined FM-200™ to cause the canine heart to be overly responsive. The NOEL is 8.1% volume/volume, the LOAEL is 10.5% volume/volume and the NOAEL is 9% volume/volume.

Carcinogenicity:

NTP? No    IARC Monographs? No    OSHA Regulated? No

Signs and Symptoms of Exposure: - Not Available

Medical Conditions Generally Aggravated by Exposure:

Not Available

⋮  
Emergency and First Aid Procedures:

Inhalation: Remove person to fresh air; if not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Skin: Flush with water; if frost bite occurs, get medical attention.

Eyes: Flush with water. Get medical attention.

-----  
SECTION VII - PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken in Case Material is Released or Spilled

Evacuate area. Wear protective equipment, ventilate area



# MATERIAL SAFETY DATA SHEET

CARBON DIOXIDE



**LIQUID CARBONIC INDUSTRIES**

810 JORNE BLVD. - DAN BROOK, L 60321-2216 • 706 873-7600

DOT: UN 1013  
HAZ. CL.: Division 2.2  
LABEL: Nonflammable Gas  
June 1991

24 Hour Emergency Phone Numbers: (504) 673-8831; CHEMTREC (800) 424-9300

## SECTION I--PRODUCT IDENTIFICATION

CHEMICAL NAME: Carbon Dioxide  
COMMON NAME AND SYNONYMS: Caseous Carbon Dioxide, Carbon Dioxide,  
Carbon Anhydride, Carbonic Acid Gas FORMULA: CO<sub>2</sub>  
CHEMICAL FAMILY: Carbonate

## SECTION II--HAZARDOUS INGREDIENTS

MATERIAL	VOLUME %	CAS NO.	1992-1993 ACGIH TLV UNITS
Carbon Dioxide	99.5+	124-38-9	TWA = 5,000 Molar PPM STEL = 30,000 Molar PPM OSHA 1991 TWA = 10,000 Molar PPM OSHA 1991 STEL = 30,000 Molar PPM

## SECTION III--PHYSICAL DATA

BOILING POINT (°F.): (Sublimes) -109.3      SPECIFIC GRAVITY (H<sub>2</sub>O=1): \*  
VAPOR PRESSURE: @ 68°F = 831 psig      % VOLATILE BY VOLUME: 100%  
VAPOR DENSITY (AIR=1): @ 68°F = 1.53      EVAPORATION RATE (BUTYL ACETATE=1): N/A  
SOLUBILITY IN WATER: @ 68°F = 87.8% by Volume  
APPEARANCE AND ODOR: Colorless gas, slight pungent odor  
\* @ 1 ATM Solid @ -11°F = 1.56

## SECTION IV--FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (METHOD USED): N/A      FLAMMABLE LIMITS: LEL UEL  
EXTINGUISHING MEDIA: None  
Nonflammable gas - carbon dioxide is an extinguishing agent

### SPECIAL FIRE FIGHTING PROCEDURES:

If cylinders are exposed to a fire, safely relocate or keep cool with water spray.

UNUSUAL FIRE AND EXPLOSION HAZARDS: None

## SECTION V--HEALTH HAZARD DATA

Route(s) of Entry: Inhalation? Yes      Skin? No      Ingestion? No  
Carcinogenicity: NTP? No      IARC Monographs? No      OSHA? No

### EFFECTS OF OVEREXPOSURE:

Inhalation: At 2 to 3% concentration symptoms of simple asphyxia occur; 3 to 5% causes increased respiration and headache; up to 15% causes headache, nausea, vomiting and unconsciousness. Higher concentrations cause rapid circulatory insufficiency leading to a coma and death. CO<sub>2</sub> is the most powerful cerebral vasodilator known. Persons in ill health where such illness would be aggravated by exposure to gaseous carbon dioxide should not be allowed to work with or handle this product.

### EMERGENCY AND FIRST AID PROCEDURE:

If Inhaled: Conscious persons should be assisted to an uncontaminated area and inhale fresh air. If unconscious, provide assisted respiration and supplemental oxygen. Further treatment should be symptomatic and supportive. Self-contained breathing apparatus should be available for rescue personnel.

(Continued on Supplemental Sheet)

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**SECTION VI--REACTIVITY DATA**

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STABILITY: UNSTABLE ( ) STABLE ( x )

CONDITIONS TO AVOID: N/A

INCOMPATIBILITY (MATERIALS TO AVOID): If moisture is present, it may form carbonic acid.

HAZARDOUS DECOMPOSITION PRODUCTS: None

HAZARDOUS POLYMERIZATION: MAY OCCUR ( ) WON'T OCCUR ( x )

CONDITIONS TO AVOID: N/A

---

**SECTION VII--SPILL OR LEAK PROCEDURES**

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**STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:**

Evacuate all personnel from affected area. Ventilate area of leak with supplemental fans. Carbon dioxide is heavier than air and will collect in low areas. Use self-contained breathing apparatus to enter leaking cylinder area.

**WASTE DISPOSAL METHOD:**

If possible, remove cylinder to remote area (downwind) and allow to slowly vent to atmosphere.

---

**SECTION VIII--SPECIAL PROTECTION INFORMATION**

---

RESPIRATORY PROTECTION: Positive pressure air line with mask or self-contained breathing apparatus.

VENTILATION: LOCAL EXHAUST ( x ) Provide adequate ventilation to prevent concentration over the allowable TWA or STEL  
MECHANICAL (GENERAL) ( x )

PROTECTIVE GLOVES: Cotton or leather

EYE PROTECTION: Safety goggles or glasses

**OTHER PROTECTIVE EQUIPMENT:**

Safety shoes. Use low oxygen alarm (less than 18%) where necessary. Use appropriate protective equipment when welding.

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**SECTION IX--SPECIAL PRECAUTIONS**

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**PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING:**

Use only DOT or ASME coded containers. Protect cylinders from physical damage. Store in well-ventilated, cool, and dry areas. Follow normal compressed gas storage recommendations. Do not store cylinders at high temperatures or over 120°F. Store carbon dioxide cylinders with the cap on tight and valve end up. Avoid low storage areas and corrosive chemicals.

**OTHER PRECAUTIONS:**

Compressed gas cylinders should not be refilled except by qualified producers of compressed gases. See Compressed Gas Bulletin SB-2, "Oxygen Deficient Atmospheres," GGA Pamphlets P-1, "Safe Handling of Compressed Gases in Containers;" G-6, "Carbon Dioxide;" G-6.1, "Standard for Low Pressure CO<sub>2</sub> Systems at Consumer Sites;" G-5.3, "Carbon Dioxide Cylinder Filling and Handling Procedures for Beverage Plants, NSDA TD01."

(Continued on Supplemental Sheet)

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SUPPLEMENTAL SHEET - CARBON DIOXIDE MATERIAL SAFETY DATA SHEET

SECTION V--HEALTH HAZARD DATA

EMERGENCY AND FIRST AID PROCEDURES: (Continued)

**CAUTION:** Welding or brazing may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. Use adequate ventilation. See ANSI Z-49.1 "Safety in Welding and Cutting" published by the American Welding Society and OSHA safety regulations under 29 CFR 1910.252 "Welding, Cutting and Brazing." Also see ACGIH TLVs 1990-1991 Appendix B, Section B2, "Welding Fumes." ARC RAYS can injure eyes and burn skin.

SECTION IX--SPECIAL PRECAUTIONS

OTHER PRECAUTIONS: (Continued)

Consult manufacturer's MSDS sheet on welding consumables and related products for reactivity and health hazard data, and for further information regarding welding fumes.

Reporting under SARA, Title III, Section 313 not required.

NFPA 704 No. for carbon dioxide - 1 0 0

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# MATERIAL SAFETY DATA SHEET



An explanation of the terms used herein may be found in OSHA 29 CFR 1910.1200, available from OSHA regional or area offices.  
(Essentially similar to U.S. Department of Labor Form OSHA-20 and generally accepted in Canada for information purposes)  
Do Not Duplicate This Form. Request an Original.



## I. PRODUCT IDENTIFICATION

PRODUCT	Nitrogen		
CHEMICAL NAME	Nitrogen	SYNONYMS	Not applicable
FORMULA	N <sub>2</sub>	CHEMICAL FAMILY	Not applicable
		MOLECULAR WEIGHT	28.01
TRADE NAME	Nitrogen		

## II. HAZARDOUS INGREDIENTS

For mixtures of this product request the respective component Material Safety Data Sheets. See Section IX.

MATERIAL (CAS NO.)	Wt (%)	1984-1985 ACGIH TLV-TWA (OSHA-PEL)
Nitrogen (7727-37-9)	100	Simple asphyxiant (None currently established)

## III. PHYSICAL DATA

BOILING POINT, 760 mm. Hg	-195.8°C (-320.46°F)	FREEZING POINT	-210°C (-345.8°F)
SPECIFIC GRAVITY (H <sub>2</sub> O = 1)	Gas	VAPOR PRESSURE AT 20°C	Gas
VAPOR DENSITY (air = 1)	0.967	SOLUBILITY IN WATER, % by wt.	Negligible
PERCENT VOLATILES BY VOLUME	100	EVAPORATION RATE (Butyl Acetate = 1)	Not applicable
APPEARANCE AND ODOR	Colorless, odorless gas at normal temperature and pressure.		

## EMERGENCY PHONE NUMBER

IN CASE OF EMERGENCIES involving this material, further information is available at all times:  
In the USA 304-744-3487  
In Canada 514-645-5311  
For routine information contact your local supplier

Union Carbide requests the users of this product to study this Material Safety Data Sheet (MSDS) and become aware of product hazards and safety information. To promote safe use of this product a user should (1) notify its employees, agents and contractors of the information on this MSDS and any product hazards and safety information, (2) furnish this same information to each of its customers for the product, and (3) request such customers to notify their employees and customers for the product of the same product hazards and safety information.

UNION CARBIDE CORPORATION  LINDE DIVISION  
UNION CARBIDE CANADA LIMITED  LINDE DIVISION

#### IV. HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE: See Section II.

---

**EFFECTS OF SINGLE (ACUTE) OVEREXPOSURE:**

**SWALLOWING**—This product is a gas at normal temperature and pressure.

**SKIN ABSORPTION**—No evidence of adverse effects from available information.

**INHALATION**—Asphyxiant. Moderate concentrations may cause headache, drowsiness, dizziness, excitation, excess salivation, vomiting, and unconsciousness. Lack of oxygen can cause death.

**SKIN CONTACT**—No harmful effect expected from vapor. Liquid may cause frostbite.

**EYE CONTACT**—No harmful effect expected from vapor.

**EFFECTS OF REPEATED (CHRONIC) OVEREXPOSURE:** No evidence of adverse effects from available information.

**OTHER EFFECTS OF OVEREXPOSURE:** Contact with liquid may cause frostbite.

**MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE:** The toxicology and the physical and chemical properties of the material do not suggest that overexposure is likely to aggravate existing medical conditions.

**SIGNIFICANT LABORATORY DATA WITH POSSIBLE RELEVANCE TO HUMAN HEALTH HAZARD EVALUATION:** None currently known.

**EMERGENCY AND FIRST-AID PROCEDURES:**

**SWALLOWING**—This product is a gas at normal temperature and pressure.

**SKIN CONTACT**—For exposure to liquid, immediately warm frostbite area with warm water (not to exceed 105°F). In case of massive exposure, remove clothing while showering with warm water. Call a physician.

**INHALATION**—Remove to fresh air. Give artificial respiration if not breathing. Give oxygen if breathing is difficult. Call a physician.

**EYE CONTACT**—In case of splash contamination, immediately flush eyes thoroughly with water for at least 15 minutes. See a physician, preferably an ophthalmologist, immediately.

**NOTES TO PHYSICIAN:** *There is no specific antidote. Treatment should be directed at the control of symptoms and the clinical condition.*

**NOTE:** *Suitability for use as a component in underwater breathing gas mixtures is to be determined by or under the supervision of personnel experienced in the use of underwater breathing gas mixtures and familiar with the effects, methods, frequency and duration of use, hazards, side effects and precautions to be taken.*

PRODUCT: Nitrogen

L-4631-B  
August 1985

### V. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (test method)	Not applicable	AUTOIGNITION TEMPERATURE	Not applicable
FLAMMABLE LIMITS IN AIR, % by volume	LOWER Not applicable	UPPER	Not applicable

**EXTINGUISHING MEDIA:**

Nitrogen cannot catch fire. Use media appropriate for surrounding fire.

**SPECIAL FIRE FIGHTING PROCEDURES:**

Evacuate all personnel from danger area. Immediately deluge containers with water spray from maximum distance until cool, then move containers away from fire area if without risk.

**UNUSUAL FIRE AND EXPLOSION HAZARDS:**

Gas cannot catch fire. Container may rupture due to heat of fire. No part of a container should be subjected to a temperature higher than 52°C (approximately 125°F). Most containers are designed to vent contents when they are exposed to elevated temperature.

### VI. REACTIVITY DATA

STABILITY		CONDITIONS TO AVOID: See Section IX.
UNSTABLE	STABLE	
	X	

INCOMPATIBILITY (materials to avoid): Under certain conditions, nitrogen can react violently with lithium, neodymium, titanium, ozone.

HAZARDOUS DECOMPOSITION PRODUCTS: None.

HAZARDOUS POLYMERIZATION		CONDITIONS TO AVOID: None currently known.
May Occur	Will not Occur	
	X	

### VII. SPILL OR LEAK PROCEDURES

**STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:**

Evacuate all personnel from danger area. Use self-contained breathing apparatus where needed. Shut off leak if without risk. Ventilate area of leak or move leaking container to well-ventilated area. Test area, especially confined areas, for sufficient oxygen content prior to permitting re-entry of personnel.

**WASTE DISPOSAL METHOD:**

Slowly release into atmosphere. Discard any product, residue, disposable container or liner in an environmentally acceptable manner, in full compliance with Federal, state and local regulations.

**VIII. SPECIAL PROTECTION INFORMATION**

**RESPIRATORY PROTECTION (specify type):** Select in accordance with OSHA 29 CFR 1910.134. Respirators shall be acceptable to MSHA and NIOSH.

<b>VENTILATION</b>	<b>LOCAL EXHAUST</b> —Preferred.
	<b>MECHANICAL (general)</b> —Acceptable.
	<b>SPECIAL</b> —Not applicable.
	<b>OTHER</b> —Not applicable.

**PROTECTIVE GLOVES:** Preferred for cylinder handling.

**EYE PROTECTION:** Select in accordance with OSHA 29 CFR 1910.133.

**OTHER PROTECTIVE EQUIPMENT:** Metatarsal shoes for cylinder handling. Select in accordance with OSHA 29 CFR 1910.132 and 1910.133.

**IX. SPECIAL PRECAUTIONS**

**CAUTION:** High pressure gas. Use piping and equipment adequately designed to withstand pressures to be encountered. Can cause rapid suffocation due to oxygen deficiency. Store and use with adequate ventilation. Close valve when not in use and when empty.

**MIXTURES:** When two or more gases, or liquefied gases are mixed, their hazardous properties may combine to create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an Industrial Hygienist, or other trained person when you make your safety evaluation of the end product. Remember, gases and liquids have properties which can cause serious injury or death. Be sure to read and understand all labels and other instructions supplied with all containers of this product. For safety information on general handling of compressed gas cylinders, it is recommended that a copy of pamphlet P-1, "Safe Handling of Compressed Gases in Containers," be obtained from the Compressed Gas Association, Inc., 1235 Jefferson Davis Highway, Arlington, VA 22202.

**OTHER HANDLING AND STORAGE CONDITIONS:** Never work on a pressurized system. If there is a leak, close the cylinder valve, blow down the system by venting to a safe place, then repair the leak.

The opinions expressed herein are those of qualified experts within Union Carbide. We believe that the information contained herein is current as of the date of this Material Safety Data Sheet. Since the use of this information and these opinions and the conditions of use of the product are not within the control of Union Carbide, it is the user's obligation to determine the conditions of safe use of the product.



**GENERAL OFFICES**

**IN THE USA:**  
Union Carbide Corporation  
Linde Division  
39 Old Ridgebury Road  
Danbury, CT 06817-0001

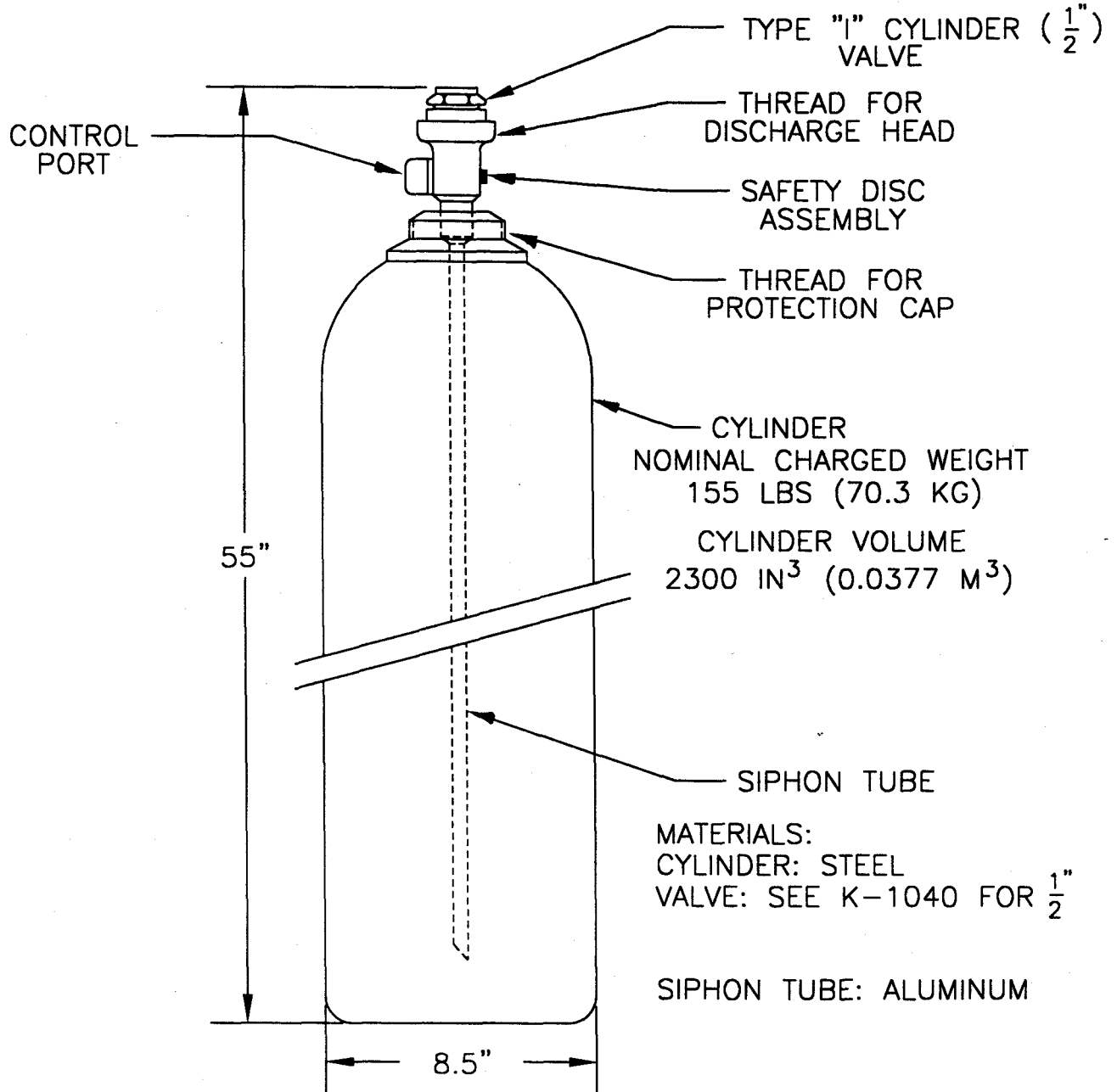
**IN CANADA:**  
Union Carbide Canada Limited  
Linde Division  
123 Eglinton Avenue East  
Toronto, Ontario M4P 1J3

Other offices in principal cities all over the world.

**APPENDIX C**

**COMPONENT DESCRIPTION SHEETS**



50 LB CARBON DIOXIDE CYLINDER

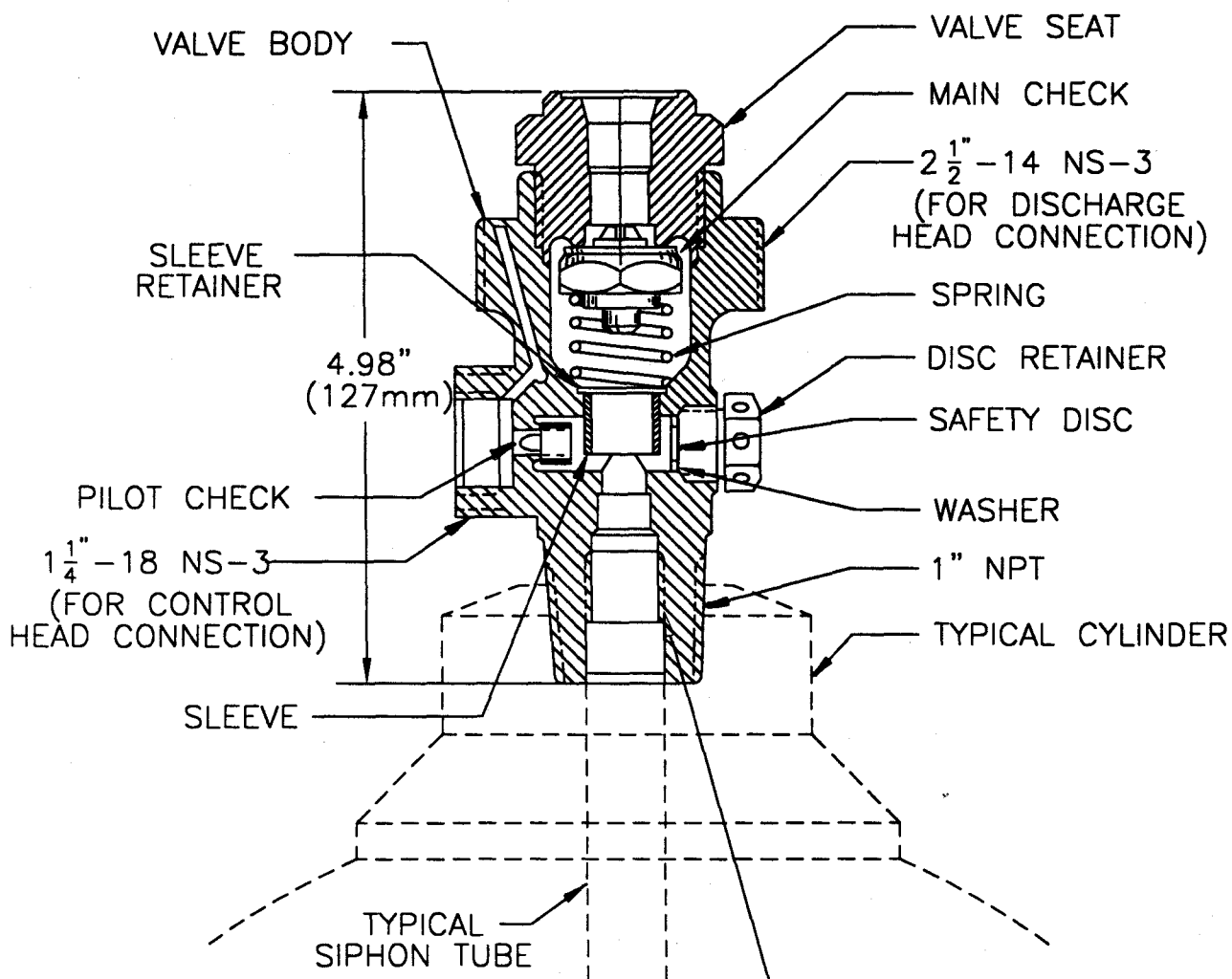
P/N 982528

K-1010M



COMPONENT DESCRIPTION

TYPE "I" CYLINDER VALVE, 1/2"  
WITH TYPICAL CYLINDER



MATERIALS

- VALVE BODY: BRASS
- VALVE SEAT: BRASS
- SLEEVE: BRASS
- SLEEVE RETAINER: BRASS
- MAIN CHECK: BRASS WITH RUBBER SEAT
- PILOT CHECK: STAINLESS STEEL WITH RUBBER SEAT

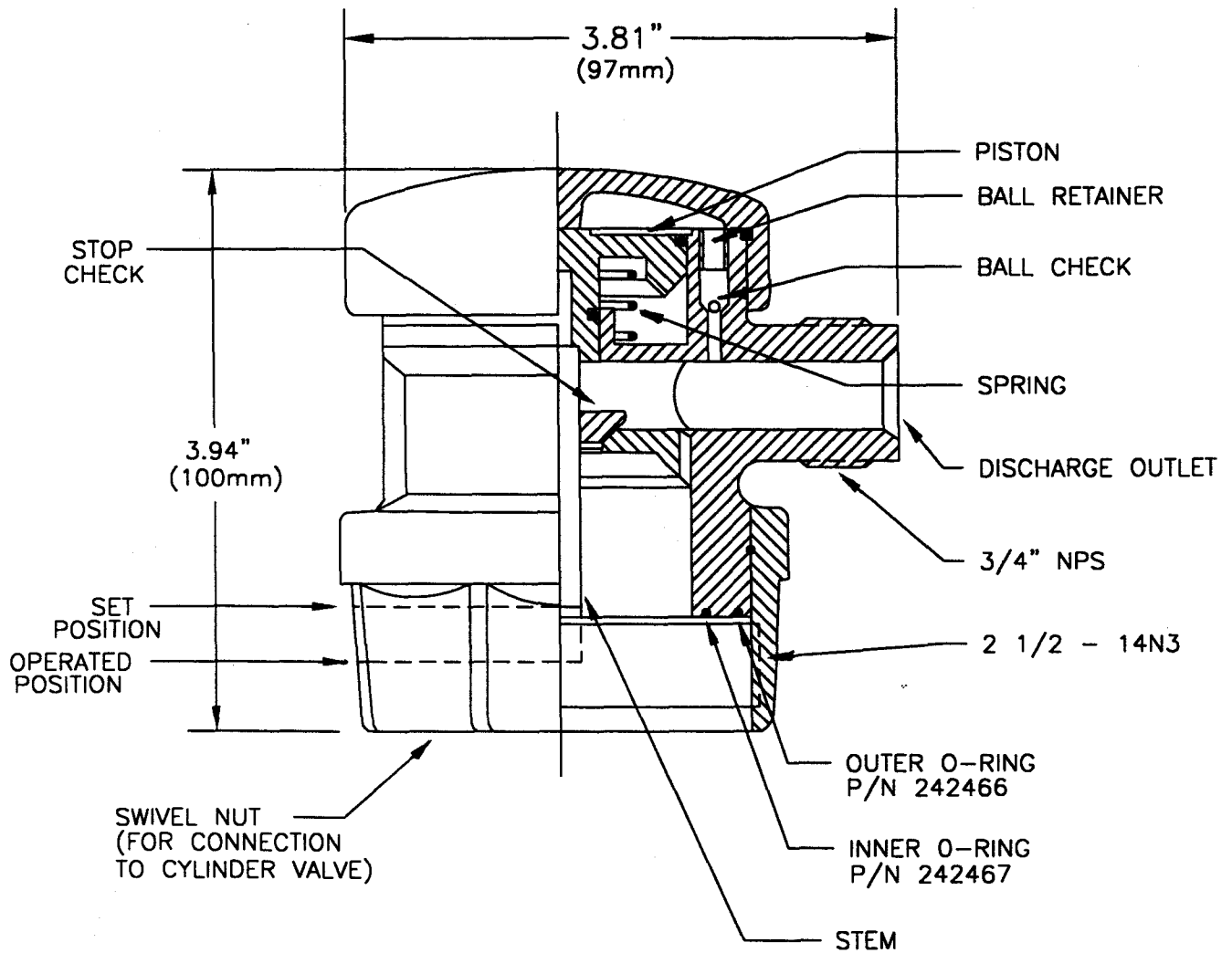
SIPHON TUBE  
THREADED IN PLACE—  
 $\frac{3}{8}$ " NPS

PRODUCT	USE
CO <sub>2</sub>	X
FE-13	
FM-200	
HALON 1301	

P/N - 981372  
K-1040



### DISCHARGE HEAD, PLAIN NUT

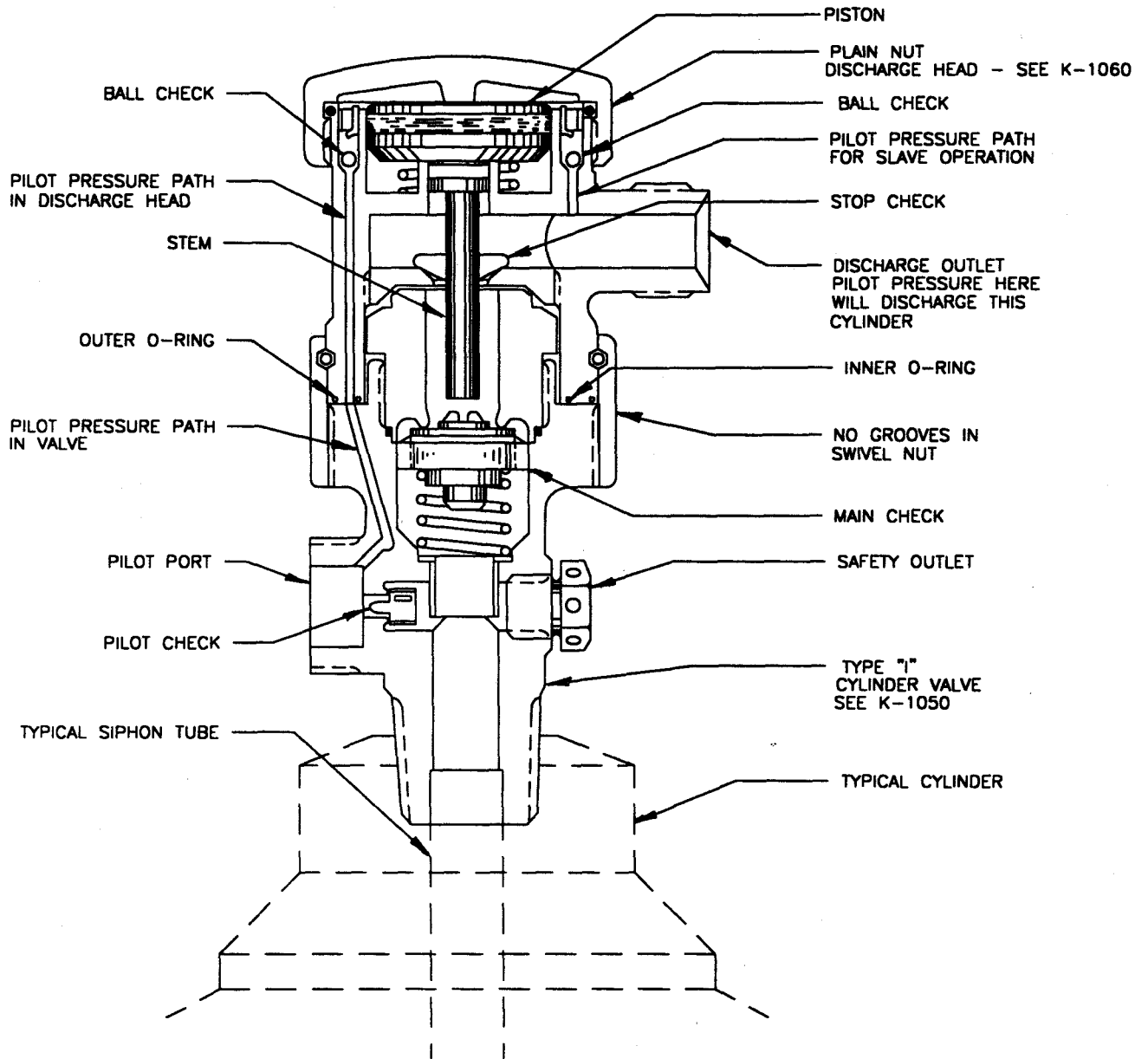


PRODUCT	USE
CO <sub>2</sub>	X
FE-13	
FM-200	
HALON 1301	

**MATERIALS**  
 BODY: BRASS  
 O-RINGS: RUBBER  
 SPRING: STAINLESS STEEL  
 BALL CHECK: MONEL  
 STOP CHECK: BRASS

P/N - 872450  
 K-1060

### ASSEMBLY OF PLAIN NUT DISCHARGE HEAD TO TYPE "1" CYLINDER VALVE



#### CAUTION

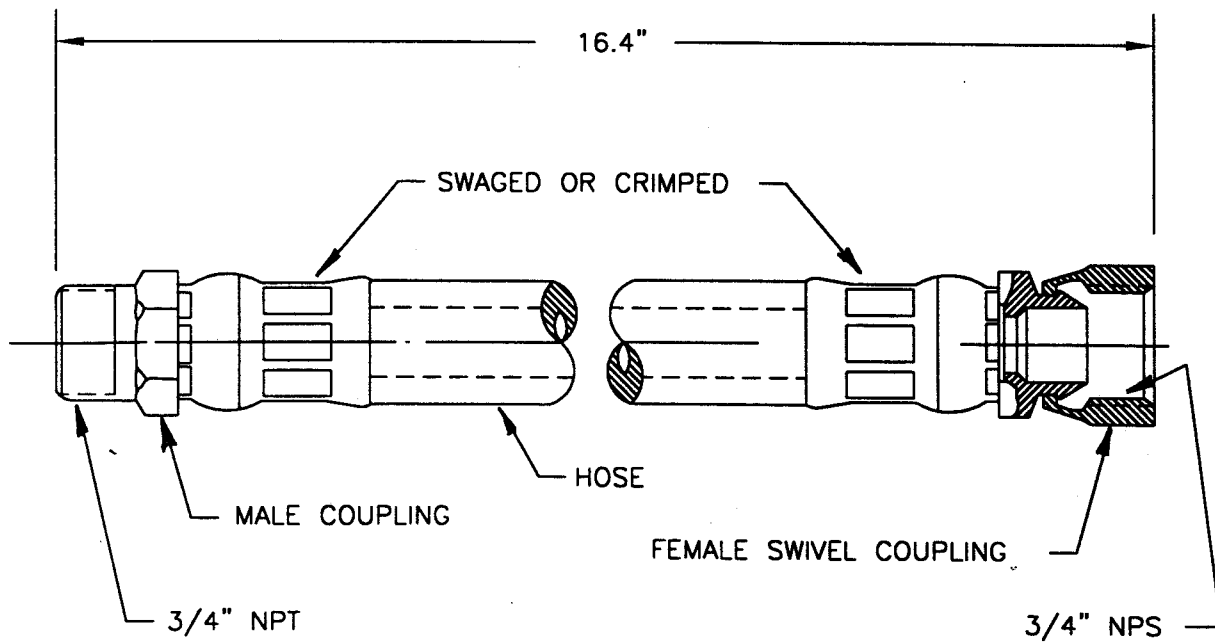
NEVER CONNECT DISCHARGE HEAD TO CYLINDER VALVE WITHOUT FLEX LOOP ATTACHED TO DISCHARGE OUTLET AND CONNECTED TO SYSTEM PIPING. ARRANGEMENT AS SHOWN IS FOR ILLUSTRATION PURPOSES ONLY.

PRODUCT	USE
CO <sub>2</sub>	X
FE-13	
FM-200	
HALON 1301	



COMPONENT DESCRIPTION

FLEX HOSE - 3/4"



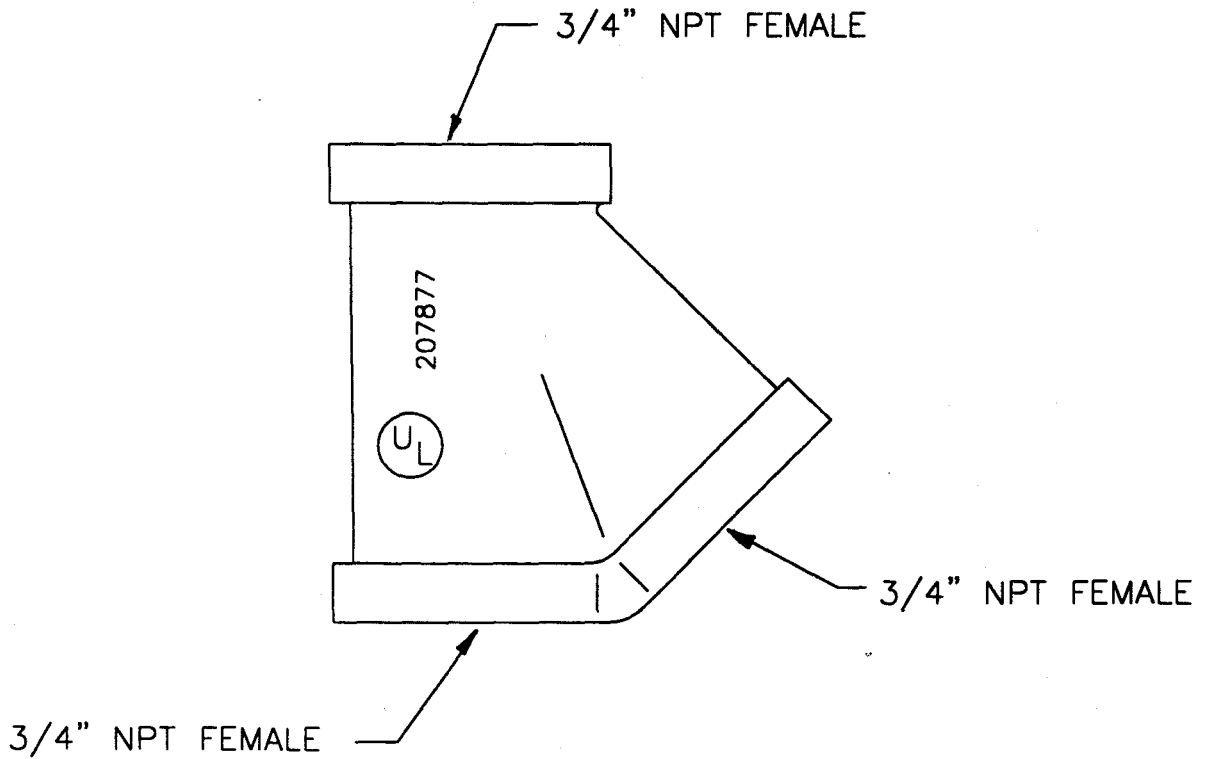
PRODUCT	USE
CO <sub>2</sub>	X
FE-13	
FM-200	
HALON 1301	

P/N - 251821  
K-1090



COMPONENT DESCRIPTION

MANIFOLD "Y" FITTING



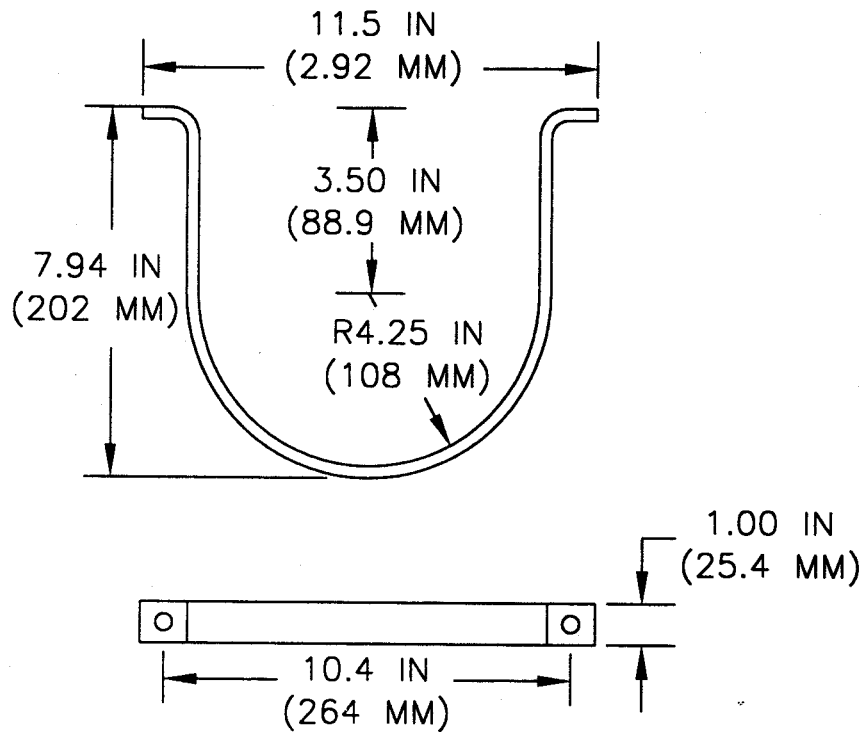
MATERIAL: GALVANIZED MALLEABLE IRON

PRODUCT	USE
CO <sub>2</sub>	X
FE-13	
FM-200	
HALON 1301	

P/N - 207877  
K-1100

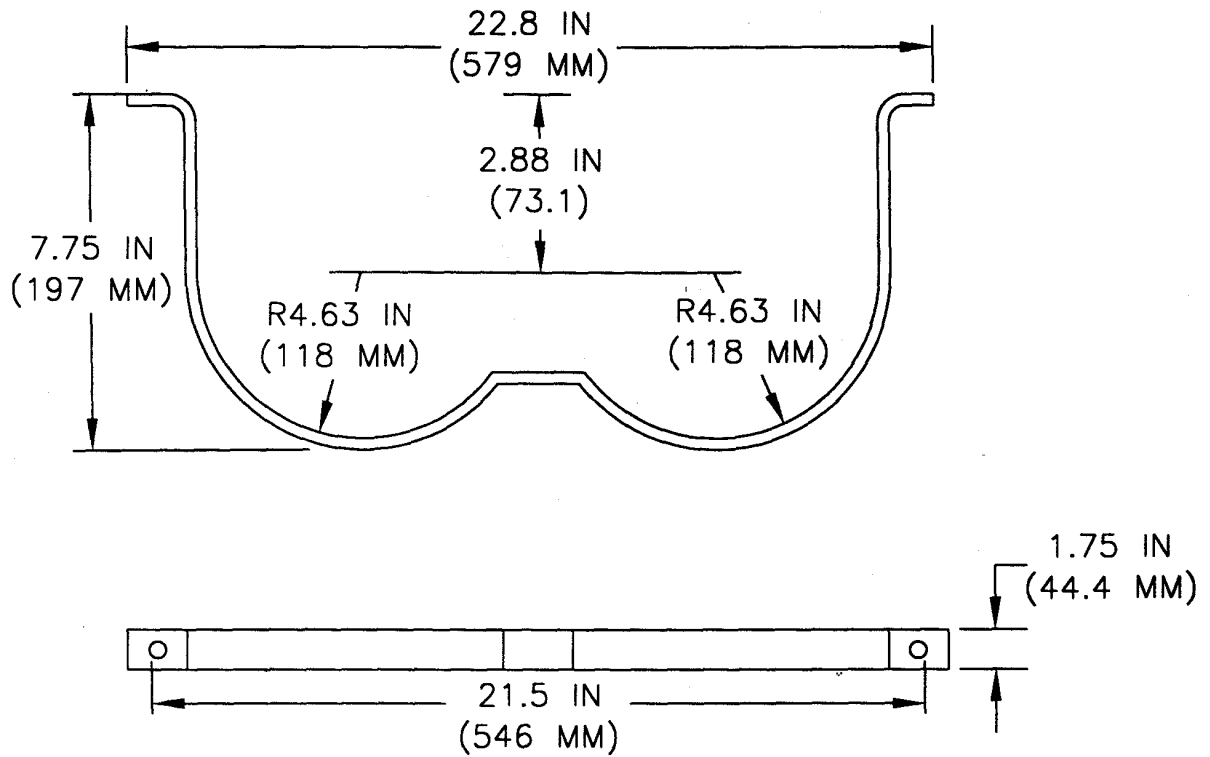


CARBON DIOXIDE SINGLE CYLINDER STRAP (50 LB)



MATERIAL: STEEL

P/N 270014  
K-1230M

CARBON DIOXIDE TWO CYLINDER STRAP (50 LB)

MATERIAL: STEEL

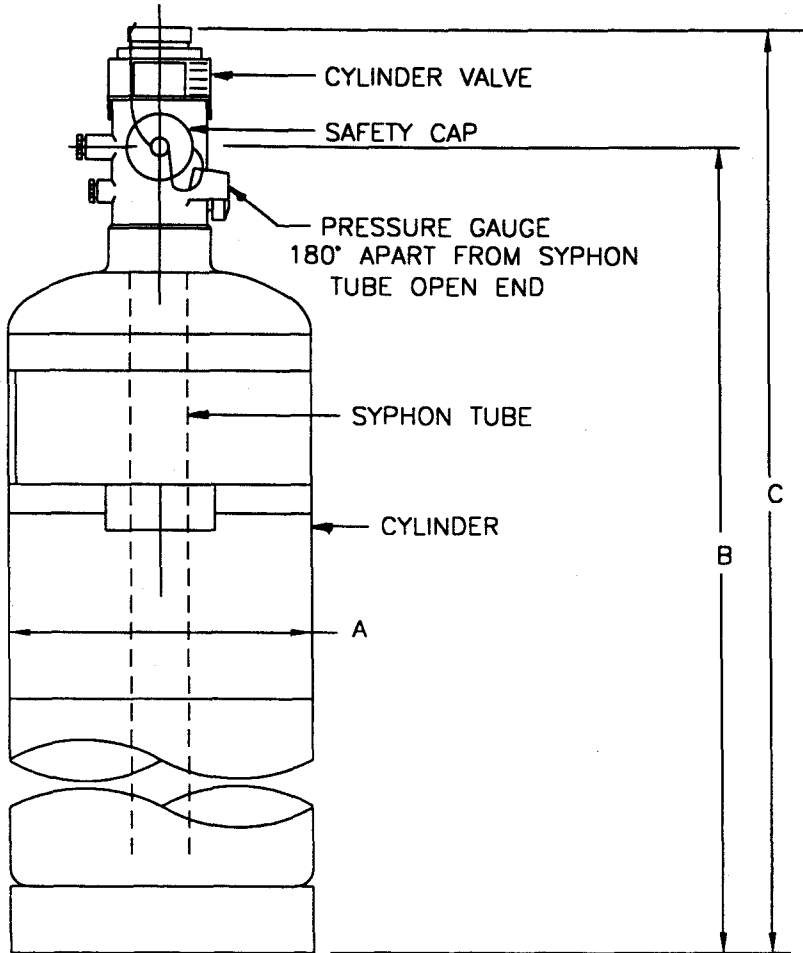
P/N 241219

K-1240M



COMPONENT DESCRIPTION

CYLINDER AND VALVE ASSEMBLIES  
 10 LB.(4.5 KG.) – 70 LB.(31.7 KG.) CAPACITY  
VERTICAL MOUNT ONLY



- NOTES—
1. THE SAFETY CAP MUST BE INSTALLED ON THE VALVE OUTLET AT ALL TIMES EXCEPT WHEN THE CYLINDERS ARE CONNECTED TO THE SYSTEM PIPING OR BEING FILLED. THE SAFETY CAP MUST NOT BE REMOVED FROM ITS CHAIN.
  2. SEE K-2070 FOR ADDITIONAL INFORMATION.
  3. CYLINDERS ARE VERTICAL MOUNT ONLY.

PART NUMBER	CYL. SIZE	DIMENSIONS		
		A*	B*	C*
90-100010-001	10 LBS	7.07	13.34	17.30
90-100020-001	20 LBS	7.07	21.01	24.97
90-100040-001	40 LBS	9.00	22.80	26.76
90-100070-001	70 LBS	9.00	34.87	38.83

\* DIMENSIONS ARE IN INCHES

PRODUCT	USE
CO <sub>2</sub>	
FE-13	
FM-200	X
HALON 1301	

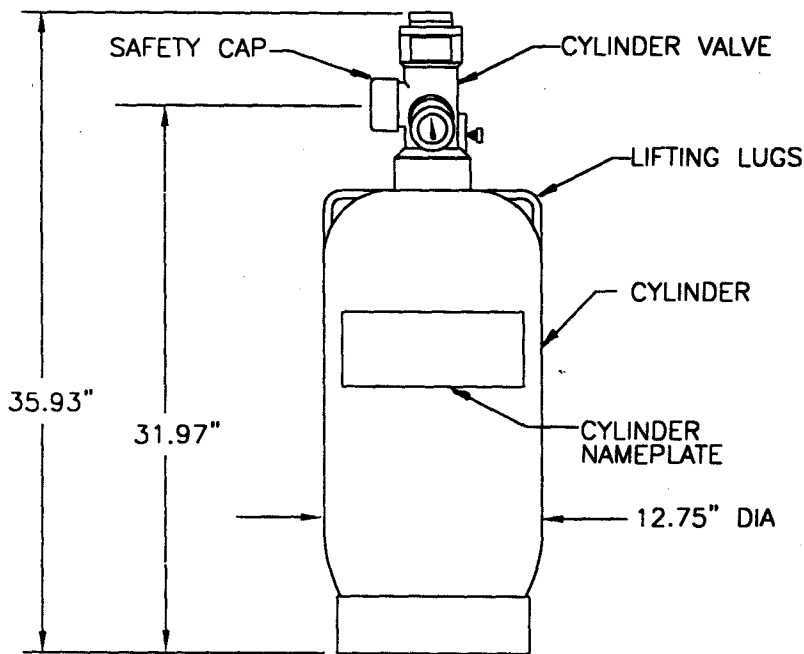
MATERIAL:  
 VALVE BODY: BRASS  
 CYLINDER: STEEL, PAINTED RED

P/N – SEE TABLE  
 K-2010



COMPONENT DESCRIPTION

CYLINDER AND VALVE ASSEMBLY  
125 LB. (56.7 KG.) CAPACITY



NOTES-

1. THE SAFETY CAP MUST BE INSTALLED ON THE VALVE OUTLET AT ALL TIMES EXCEPT WHEN THE CYLINDERS ARE CONNECTED TO THE SYSTEM PIPING OR BEING FILLED. THE SAFETY CAP MUST NOT BE REMOVED FROM ITS CHAIN.
2. SEE K-2070 FOR ADDITIONAL INFORMATION.

MATERIAL:

VALVE BODY: BRASS

CYLINDER: STEEL, PAINTED RED

PRODUCT	USE
CO <sub>2</sub>	
FE-13	
FM-200	X
HALON 1301	

P/N - 90-100125-001

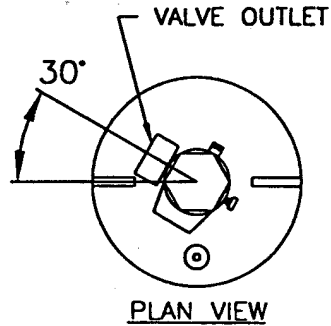
K-2030



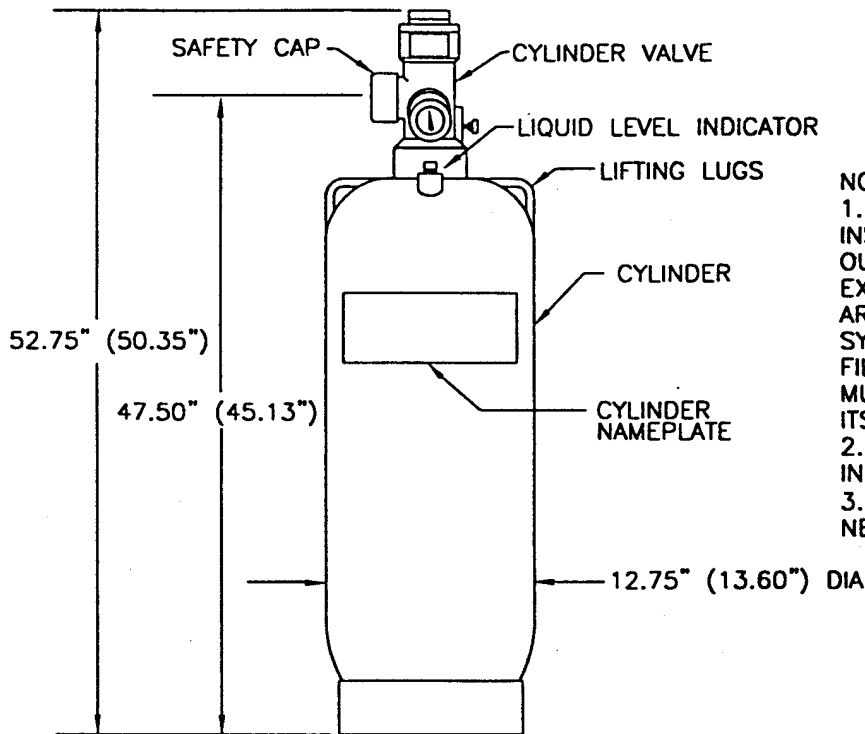


COMPONENT DESCRIPTION

CYLINDER AND VALVE ASSEMBLY  
200 LB. (90.7 KG.) CAPACITY



P/N	DESCRIPTION
90-100200-001	STD
90-100201-001	W/LLI
90-100200-101	STD
90-100201-101	W/LLI



- NOTES-
1. THE SAFETY CAP MUST BE INSTALLED ON THE VALVE OUTLET AT ALL TIMES EXCEPT WHEN THE CYLINDERS ARE CONNECTED TO THE SYSTEM PIPING OR BEING FILLED. THE SAFETY CAP MUST NOT BE REMOVED FROM ITS CHAIN.
  2. SEE K-2070 FOR ADDITIONAL INFORMATION.
  3. OLD CYLINDER DIMENSIONS IN ( ) NEW CYLINDER MFG AFTER 3/98

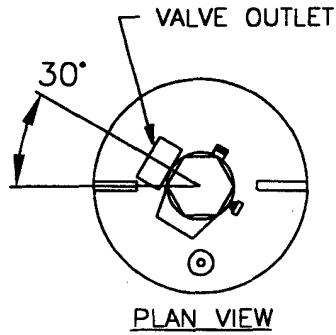
MATERIAL:  
VALVE BODY: BRASS  
CYLINDER: STEEL, PAINTED RED

P/N - SEE TABLE  
K-8040

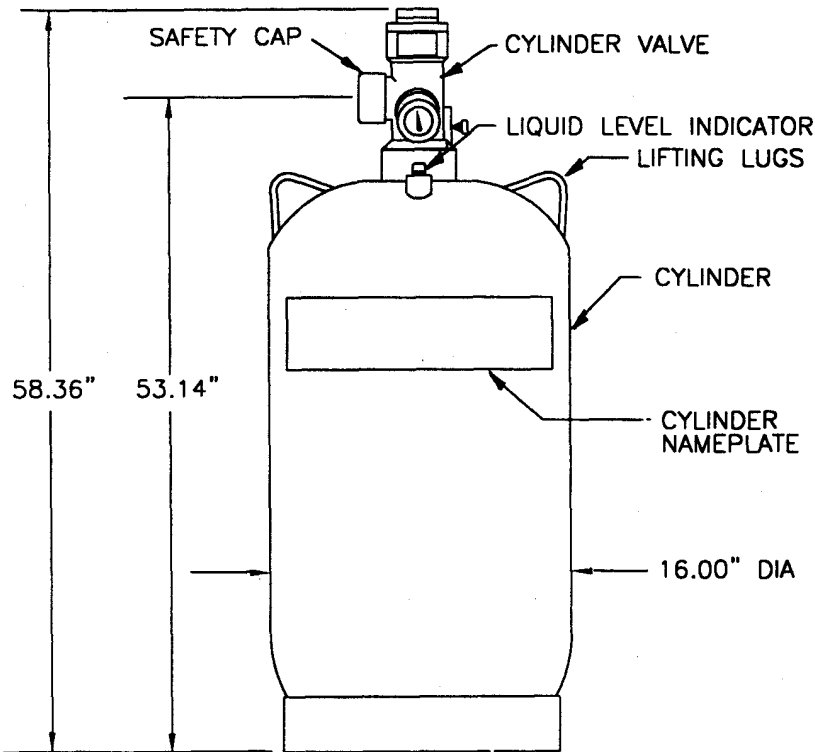


COMPONENT DESCRIPTION

CYLINDER AND VALVE ASSEMBLY  
350 LB.(158.7 KG.) CAPACITY



P/N	DESCRIPTION
90-100350-001	STD
90-100351-001	W/LLI



NOTES-  
 1. THE SAFETY CAP MUST BE INSTALLED ON THE VALVE OUTLET AT ALL TIMES EXCEPT WHEN THE CYLINDERS ARE CONNECTED TO THE SYSTEM PIPING OR BEING FILLED. THE SAFETY CAP MUST NOT BE REMOVED FROM ITS CHAIN.  
 2. SEE K-2070 FOR ADDITIONAL INFORMATION.

MATERIAL:  
 VALVE BODY: BRASS  
 CYLINDER: STEEL, PAINTED RED

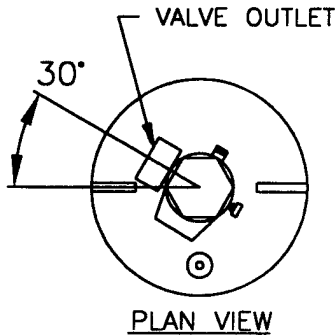
PRODUCT	USE
CO <sub>2</sub>	
FE-13	
FM-200	X
HALON 1301	

P/N - SEE TABLE  
 K-2050

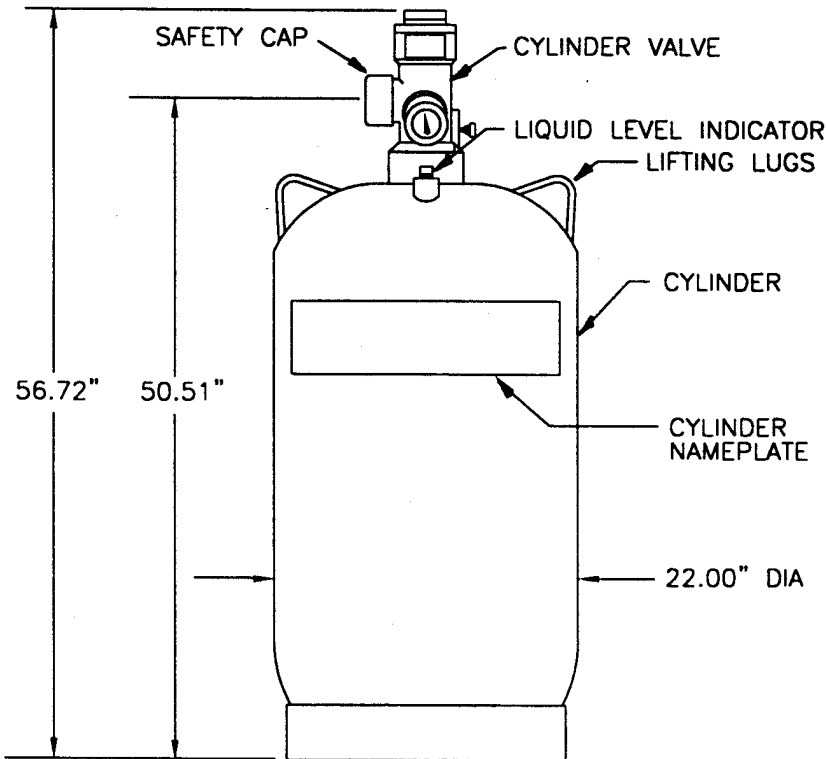


COMPONENT DESCRIPTION

CYLINDER AND VALVE ASSEMBLY  
600 LB.(272.1 KG.) CAPACITY



P/N	DESCRIPTION
90-100600-001	STD
90-100601-001	W/LLI



- NOTES-
1. THE SAFETY CAP MUST BE INSTALLED ON THE VALVE OUTLET AT ALL TIMES EXCEPT WHEN THE CYLINDERS ARE CONNECTED TO THE SYSTEM PIPING OR BEING FILLED. THE SAFETY CAP MUST NOT BE REMOVED FROM ITS CHAIN.
  2. SEE K-2070 FOR ADDITIONAL INFORMATION.

MATERIAL:  
VALVE BODY: BRASS  
CYLINDER: STEEL, PAINTED RED

PRODUCT	USE
CO <sub>2</sub>	
FE-13	
FM-200	X
HALON 1301	

P/N - SEE TABLE  
K-2060



CYLINDER DATA

ENGINEERED SYSTEMS CYLINDER DATA

PART NUMBER	FILL RANGE		EMPTY WEIGHT		GROSS WEIGHT				W/LLI	HEIGHT		DIAMETER		VOLUME	
	LBS	KG	LBS	KG	MIN FILL LBS	MIN FILL KG	MAX FILL LBS	MAX FILL KG		IN	CM	IN	CM	FT <sup>3</sup>	M <sup>3</sup>
90-10001X-001	5-10	3-5	25	11	30	14	35	16	NO	17.30	44	7.07	18	.167	.0047
90-10002X-001	9-20	4-9	31	14	40	18	51	23	NO	24.97	64	7.07	18	.286	.0081
90-10004X-001	17-40	8-18	38	17	55	25	78	35	NO	26.76	68	9.00	23	.572	.0162
90-10007X-001	30-70	14-32	52	24	82	38	123	56	NO	38.83	99	9.00	23	1.000	.0283
90-100125-001	54-125	25-57	96	44	150	69	222	101	NO	35.93	92	12.75	32	1.788	.0506
90-100200-101	86-200	39-91	130	59	216	98	330	150	NO	52.75	134	12.75	32	2.859	.0810
90-100201-101	86-200	39-91	131	59	217	98	331	150	YES	52.75	134	12.75	32	2.859	.0810
90-100350-001	150-350	68-159	201	91	351	159	555	250	NO	58.36	149	16.00	41	5.000	.1416
90-100351-001	150-350	68-159	203	92	351	160	557	251	YES	58.36	149	16.00	41	5.000	.1416
90-100600-001	258-600	114-272	360	163	618	277	966	390	NO	56.72	145	22.00	56	8.572	.2427
90-100601-001	258-600	114-272	362	164	618	278	968	391	YES	56.72	145	22.00	56	8.572	.2427

NOTE: Engineered Systems have a fill density range of 30 lb/cu.ft. to 70 lb/cu.ft.

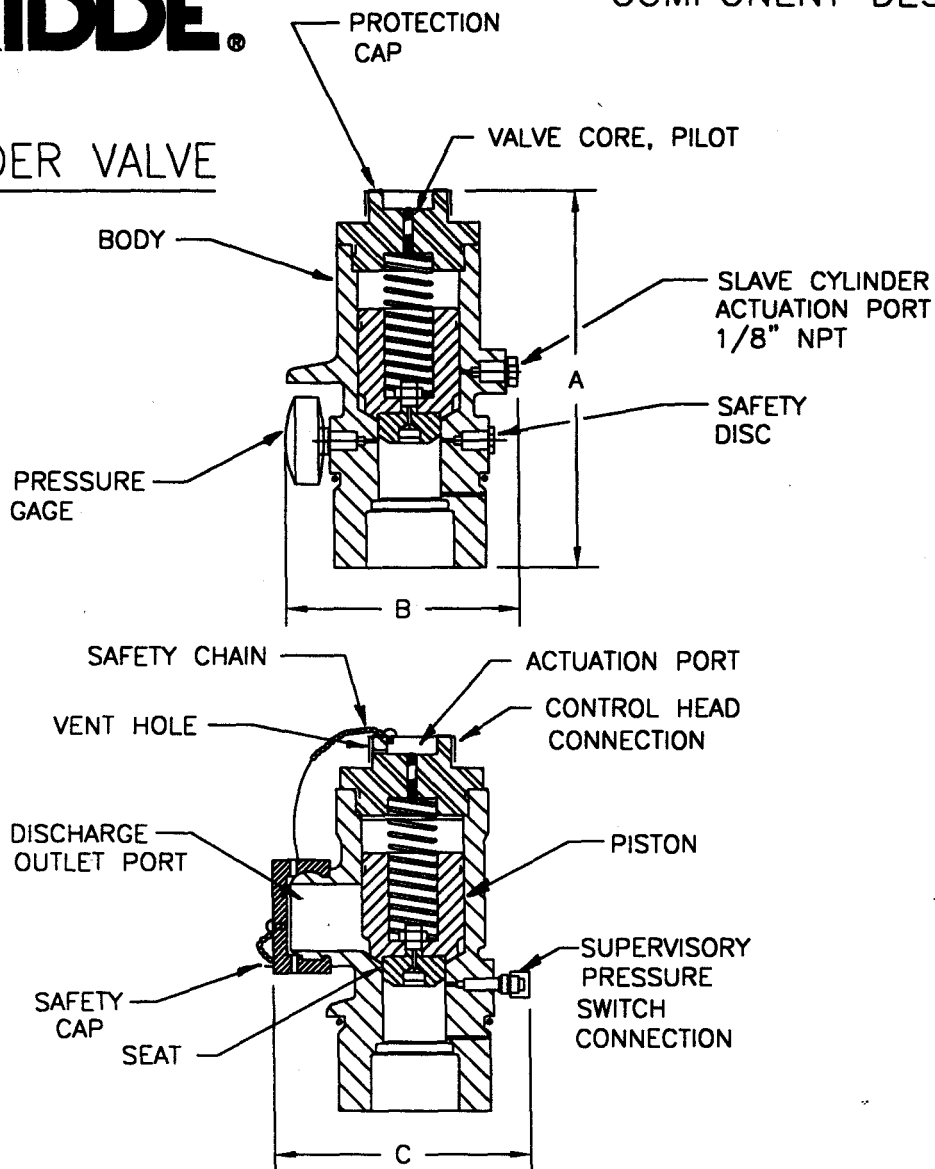
PRODUCT	USE
CO <sub>2</sub>	
FE-13	
FM-200	X
HALON 1301	

K-2070MM



# COMPONENT DESCRIPTION

## CYLINDER VALVE



PART NO.	VALVE SIZE	A	B	C	D	E	F
90-140000-000	1-1/2"	7.63"	4.83"	5.22"	754-900 PSI	242461	9.9 LB
90-150000-000	2"	8.80"	5.32"	6.28"	798-972 PSI	264925	15 LB
90-160000-000	2-1/2"	10.04"	6.30"	6.61"	798-972 PSI	264929	24 LB

D: SAFETY DISC RELIEF PRESSURE  
 E: SAFETY DISC REPL. P/N  
 F: WEIGHT

**MATERIAL:**

VALVE BODY: BRASS  
 PISTON: BRASS  
 FINISH: NATURAL  
 SEAT: RUBBER

WORKING PRESSURE: 360-609 PSI  
 PROOF PRESSURE: 1000 PSI  
 BURST PRESSURE: 2000 PSI  
 TEMPERATURE RANGE: 0 TO 130 F

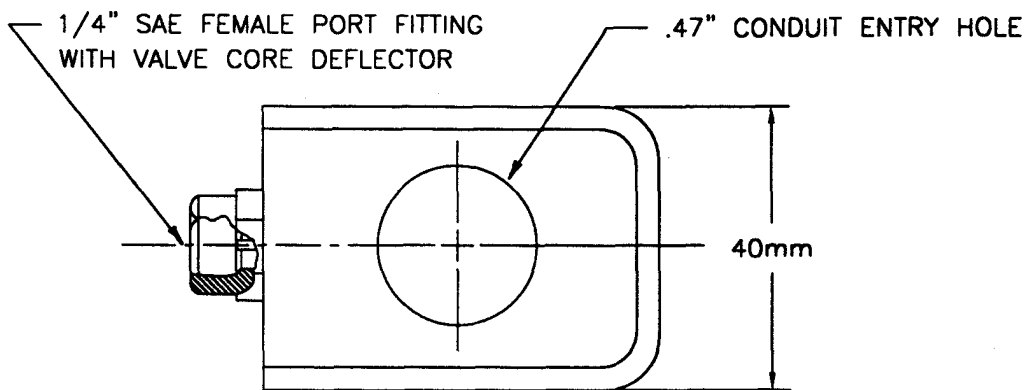
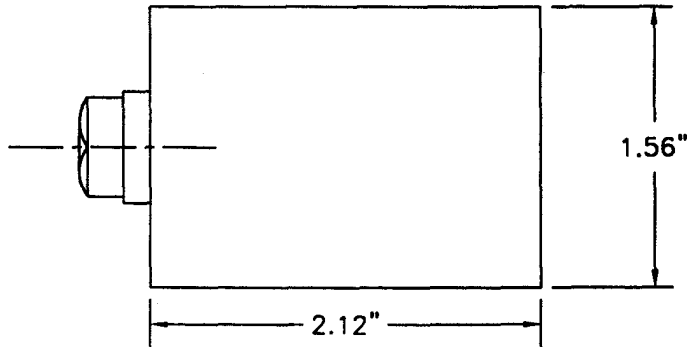
EQUIVALENT LENGTH IN SCH. 40 PIPE:  
 1-1/2" : 16.7' OF 1-1/4"  
 2" : 28.0' OF 2"  
 2-1/2" : 31.5' OF 2-1/2"

P/N - SEE TABLE

K-2080

PRODUCT	USE
CO <sub>2</sub>	
FE-13	
FM-200	X
HALON 1301	

### CYLINDER SUPERVISORY PRESSURE SWITCH



ACTUATION PRESSURE: 320 PSI +/- 10 PSI

DEACTUATION PRESSURE: 250 PSI +/- 10 PSI

ELECTRICAL RATING:

120/240/277 V-AC 375 VA

28V-AC/DC 2 AMPS

5.8 FLA-34.8 LRA @ 120V

2.9 FLA-15 LRA @ 240V

OPERATING TEMPERATURE RANGE: +30 Deg F TO +130 Deg F

878709-000

OPERATION: DEVICE "NORMALLY CLOSED" "OPEN UNDER PRESSURE"  
PRESSURE LOSS GREATER THAN 40 PSI WILL CAUSE CONTACTS TO OPEN

878709-010

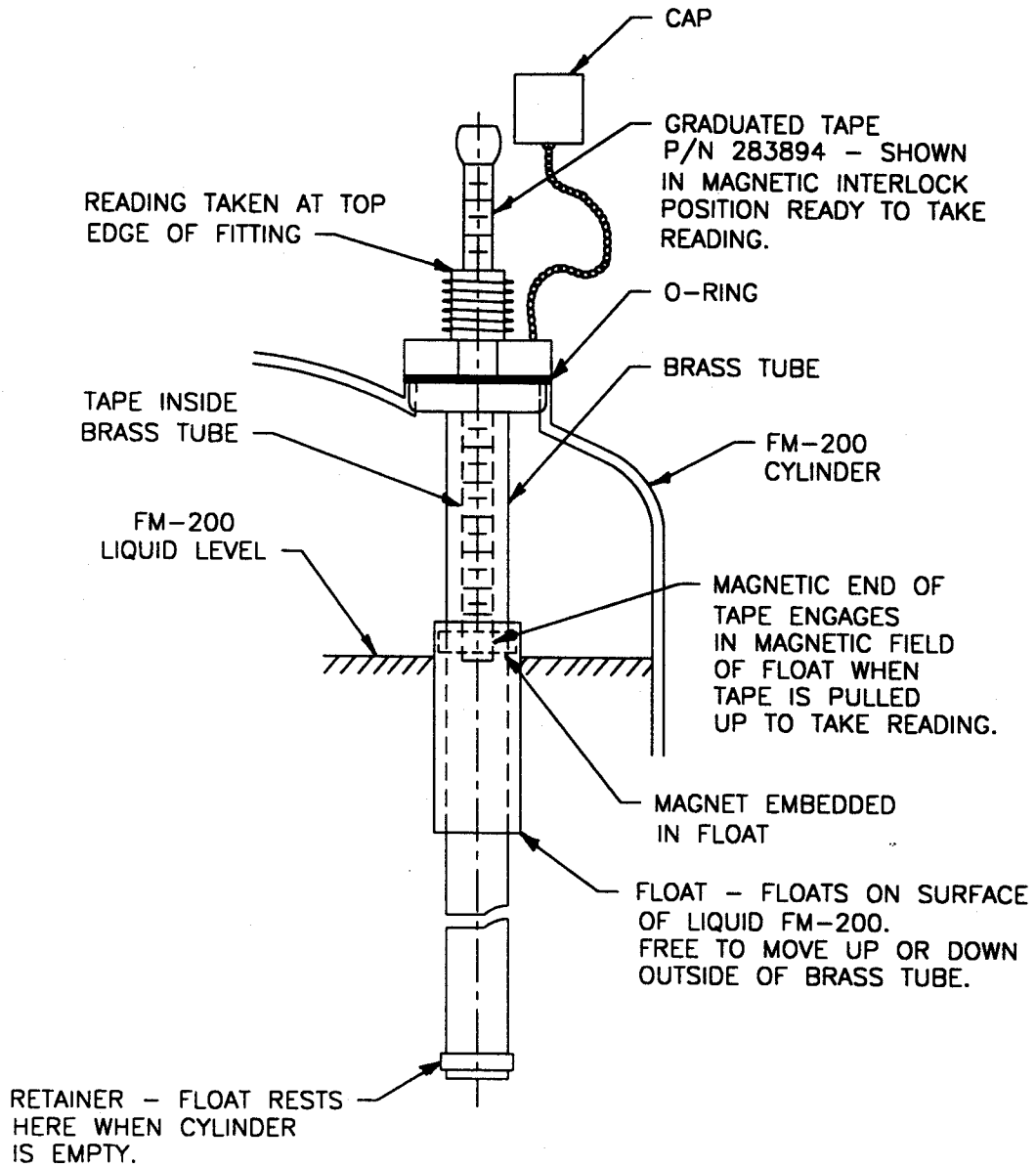
OPERATION: DEVICE "NORMALLY OPEN" "CLOSED UNDER PRESSURE"  
PRESSURE LOSS GREATER THAN 40 PSI WILL CAUSE CONTACTS TO CLOSE

PRODUCT	USE
CO <sub>2</sub>	
FE-13	
FM-200	X
HALON 1301	X

P/N - 878709-0XX

K-2090

### LIQUID LEVEL INDICATOR

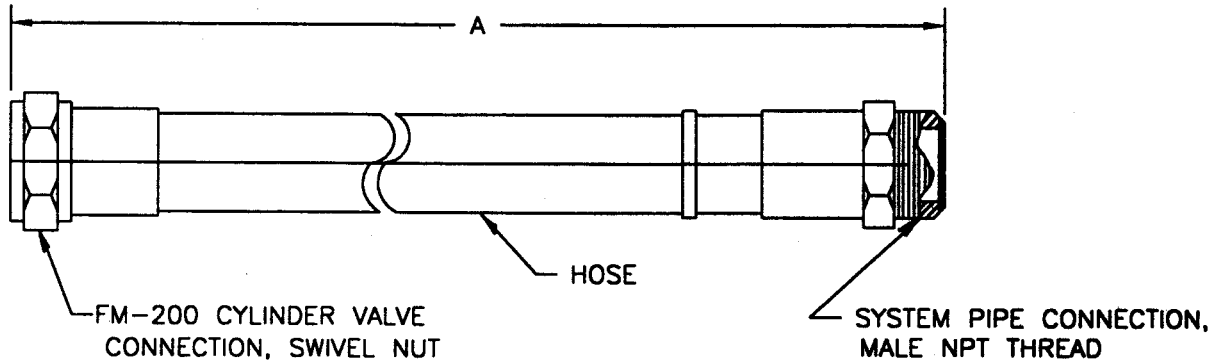


PRODUCT	USE
CO <sub>2</sub>	
FE-13	
FM-200	X
HALON 1301	X



# COMPONENT DESCRIPTION

## FLEXIBLE DISCHARGE HOSES



PART NO.	MALE NPT *	A*	MIN. BEND RADIUS *
283898	1-1/2	24	10.5
283899	2	31	13.5
283900	2-1/2	48	22.5

\* DIMENSIONS ARE IN INCHES

### MATERIAL:

HOSE: REINFORCED RUBBER HOSE

FITTINGS: BRASS

MINIMUM BURSTING PRESSURE: 2000 PSI

WORKING PRESSURE: 500 PSI

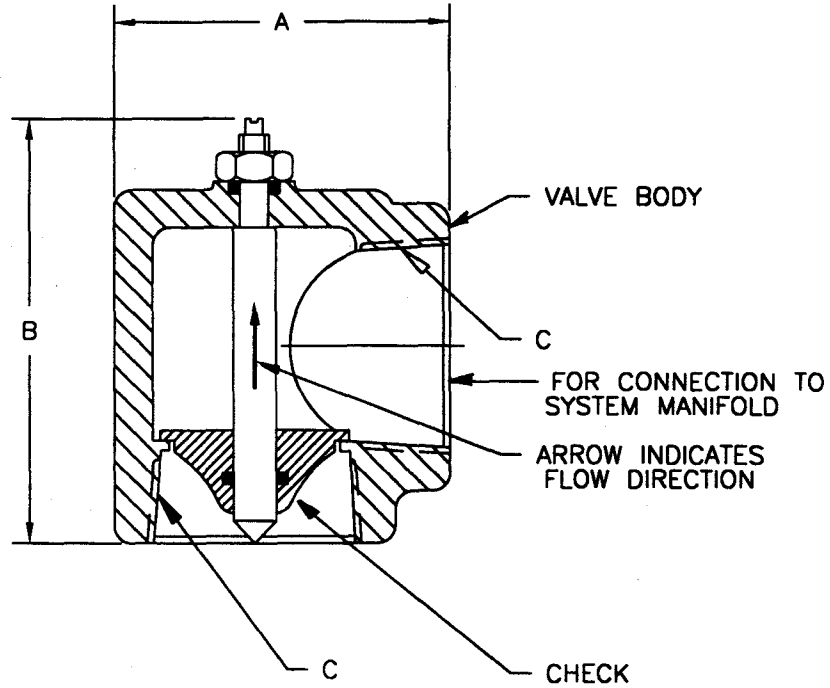
PROOF PRESSURE: 1000 PSI

PRODUCT	USE
CO <sub>2</sub>	
FE-13	
FM-200	X
HALON 1301	X

P/N - SEE TABLE  
K-2120



### MANIFOLD EL-CHECK



PART NO.	SIZE	A*	B*	C*
877690	2	3.93	4.88	2 - 11-1/2 NPT
878743	2-1/2	4.69	5.76	2-1/2 - 8 NPT

\* DIMENSIONS ARE IN INCHES

NOTE: EL-CHECKS ARE TO BE INSTALLED AT SYSTEM MANIFOLD IN VERTICAL DIRECTION AS SHOWN.

NOTE: DO NOT USE AS A MAIN/RESERVE CHECK VALVE WITH MORE THAN 1 MAIN/RESERVE CYLINDER

#### MATERIAL:

VALVE BODY: CAD PLATED STEEL

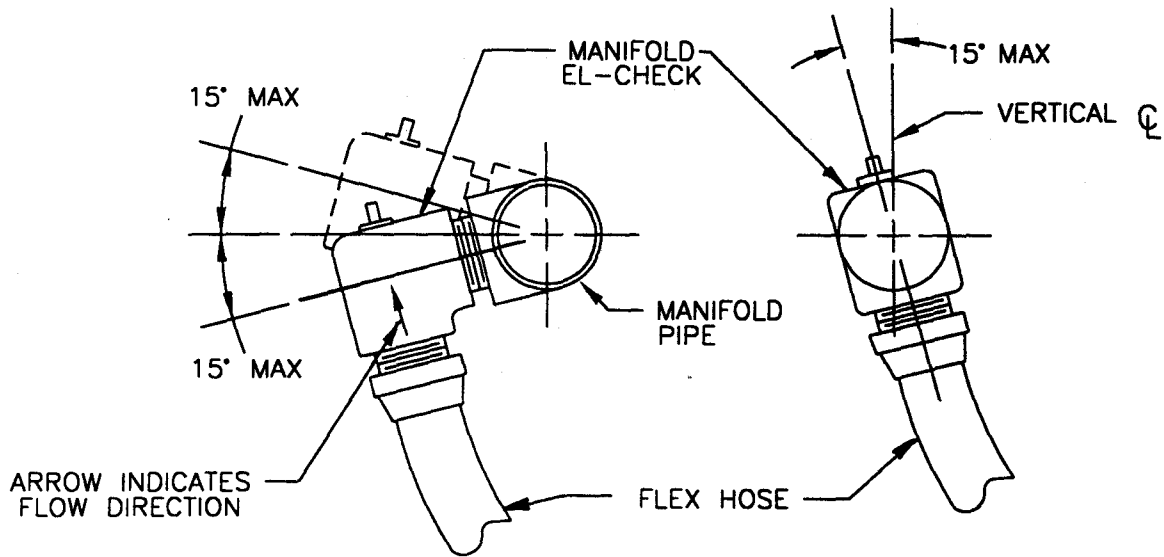
CHECK: STAINLESS STEEL

SEAT: NITRILE RUBBER

PRODUCT	USE
CO <sub>2</sub>	
FE-13	X
FM-200	X
HALON 1301	X

P/N - SEE TABLE  
K-2130

### TYPICAL INSTALLATION OF EL-CHECK



EL-CHECK MAY BE ADJUSTED AS SHOWN TO OBTAIN A SMOOTH RADIUS IN FLEXIBLE DISCHARGE HOSE.

**NOTES:**

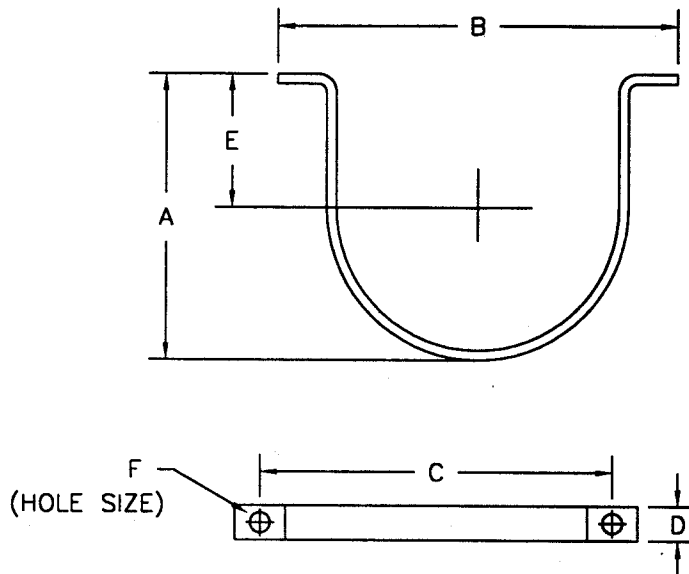
INSTALL EL-CHECKS SO THAT ARROW IS IN DIRECTION AS INDICATED

PRODUCT	USE
CO <sub>2</sub>	
FE-13	X
FM-200	X
HALON 1301	X



COMPONENT DESCRIPTION

ECS SERIES FM-200  
CYLINDER MOUNTING STRAPS



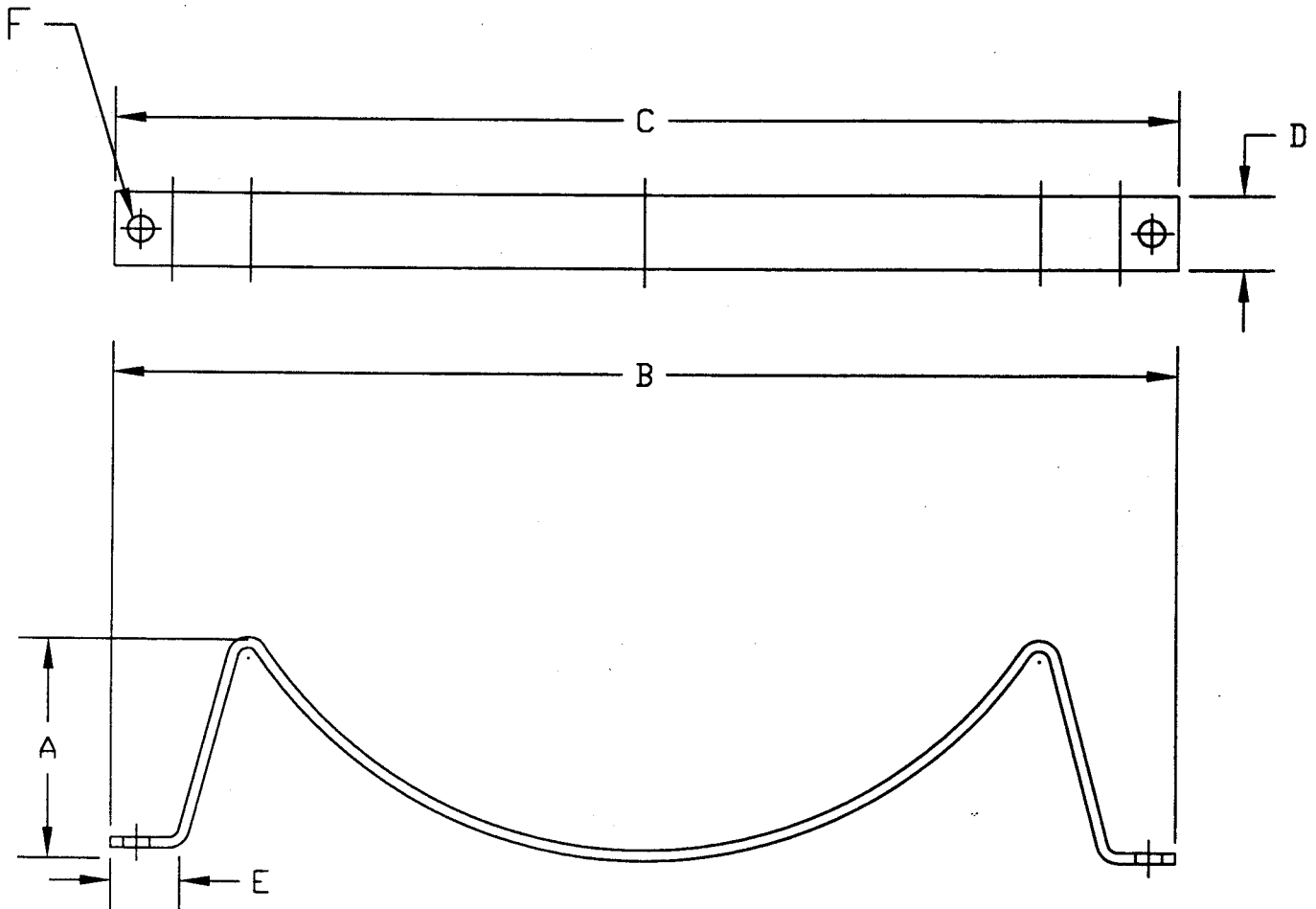
PART NO.	CYL SIZE	CYL O.D.*	A*	B*	C*	D*	E*	F*
283945	10,20	7.07	6.48	9.62	8.62	1.00	2.78	.437
283934	40,70	9.00	8.16	11.69	10.69	1.00	3.50	.437
235317	125,200	12.75	12.93	16.18	14.56	1.75	6.06	.625
281866	350	16.00	15.50	19.50	17.88	1.75	7.25	.625
294651	600	22.00	21.56	25.75	24.12	1.75	10.25	.625

\* DIMENSIONS ARE IN INCHES

MATERIAL: STEEL, PAINTED BLACK

P/N - SEE TABLE  
K-8130M

CYLINDER MOUNTING CRADLE



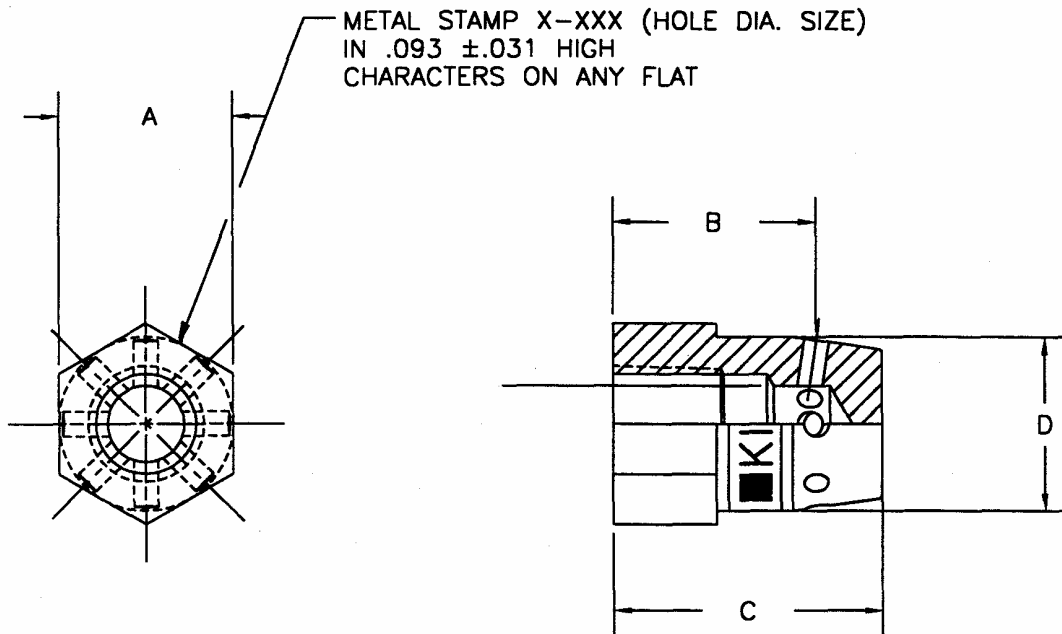
PART NO.	CYL SIZE	CYL O.D.*	A*	B*	C*	D*	E*	F*
235431	125,200	12.75	3.20	16.25	15.00	1.50	1.312	.562
281867	350	16.00	3.58	19.24	18.00	1.50	1.34	.562
294652	600	22.00	4.75	25.24	24.00	1.75	1.34	.562

\* DIMENSIONS ARE IN INCHES

MATERIAL: STEEL, PAINTED GRAY

P/N - SEE TABLE  
K-8150M

### 360 DEGREE PENDANT NOZZLE



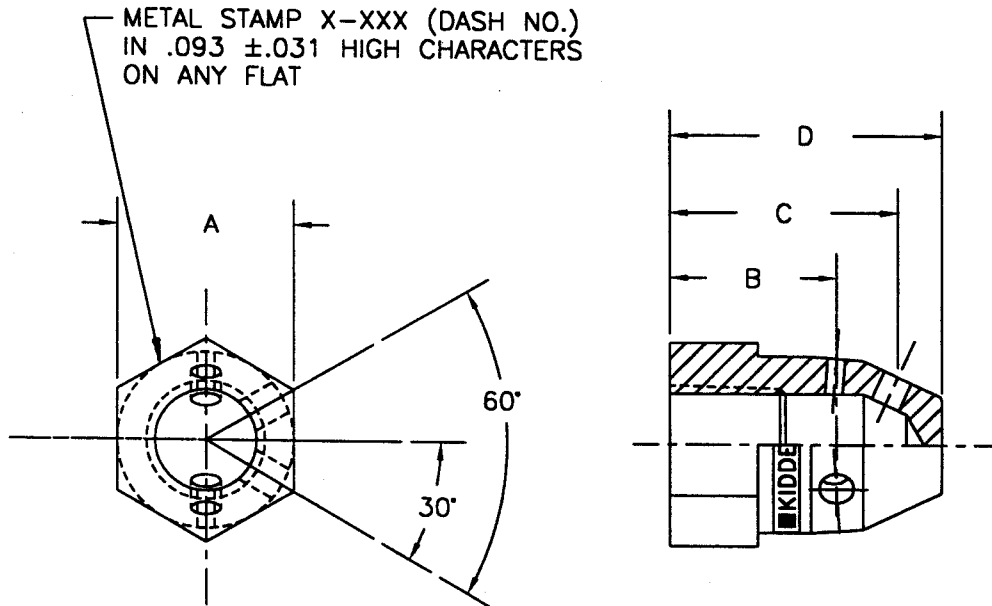
360 DEGREE NOZZLE					
Pipe Size	A	B	C	D	
1/2" (12.20mm)	1.250" (31.75mm)	1.468" (37.28mm)	1.937" (49.19mm)	1.250" (31.75mm)	
3/4" (19.05mm)	1.500" (38.10mm)	1.578" (40.08mm)	2.125" (53.97mm)	1.500" (38.10mm)	
1" (25.40mm)	1.750" (44.45mm)	1.718" (43.63mm)	2.375" (60.32mm)	1.750" (44.45mm)	
1-1/4" (31.75mm)	2.250" (57.15mm)	1.950" (49.53mm)	2.750" (69.85mm)	2.250" (57.15mm)	
1-1/2" (38.10mm)	2.250" (63.50mm)	2.000" (50.80mm)	2.937" (74.59mm)	2.500" (63.50mm)	
2" (50.80mm)	3.000" (76.20mm)	2.062" (52.37mm)	3.125" (79.37mm)	3.000" (76.20mm)	

A Selection of orifices are available for each nozzle size.  
Consult your Kidde Design and Installation Manual for Details.

PRODUCT	USE
CO <sub>2</sub>	
FE-13	
FM-200	X
HALON 1301	

P/N - 90-19402X-XXX  
K-2140

### 180 DEGREE PENDANT NOZZLE



180 DEGREE NOZZLE				
Pipe Size	A	B	C	D
1/2" (12.20mm)	1.250" (31.75mm)	1.250" (31.75mm)	1.687" (42.84mm)	2.000" (50.80mm)
3/4" (19.05mm)	1.500" (38.10mm)	1.375" (34.92mm)	1.950" (48.89mm)	2.296" (58.31mm)
1" (25.40mm)	1.750" (44.45mm)	1.562" (39.67mm)	2.218" (56.33mm)	2.671" (67.84mm)
1-1/4" (31.75mm)	2.250" (57.15mm)	1.750" (44.45mm)	2.656" (67.46mm)	3.250" (82.55mm)
1-1/2" (38.10mm)	2.250" (63.50mm)	1.950" (48.89mm)	2.950" (74.93mm)	3.625" (92.07mm)
2" (50.80mm)	3.000" (76.20mm)	1.968" (49.98mm)	2.875" (73.02mm)	3.656" (92.86mm)

A Selection of orifices are available for each nozzle size.  
Consult your Kidde Design and Installation Manual for Details.

PRODUCT	USE
CO <sub>2</sub>	
FE-13	
FM-200	X
HALON 1301	

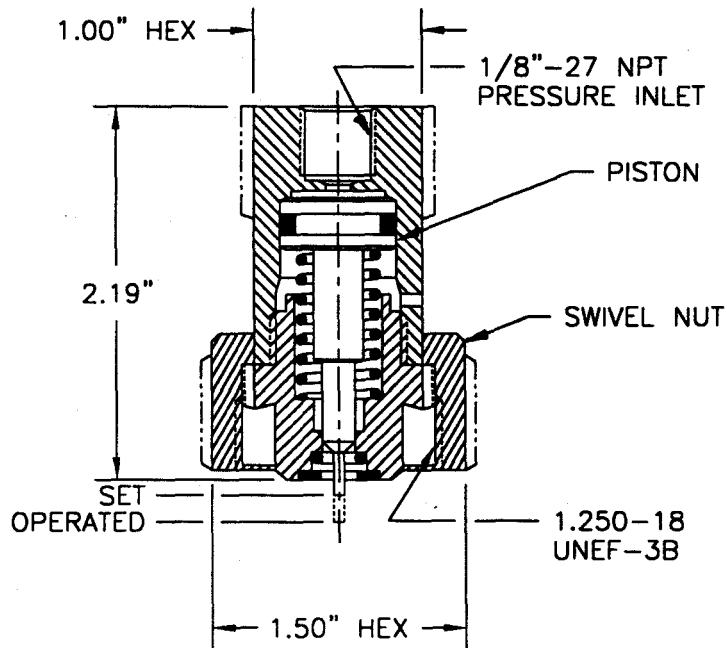
P/N - 90-19401X-XXX

K-2150



COMPONENT DESCRIPTION

PRESSURE OPERATED CONTROL HEAD

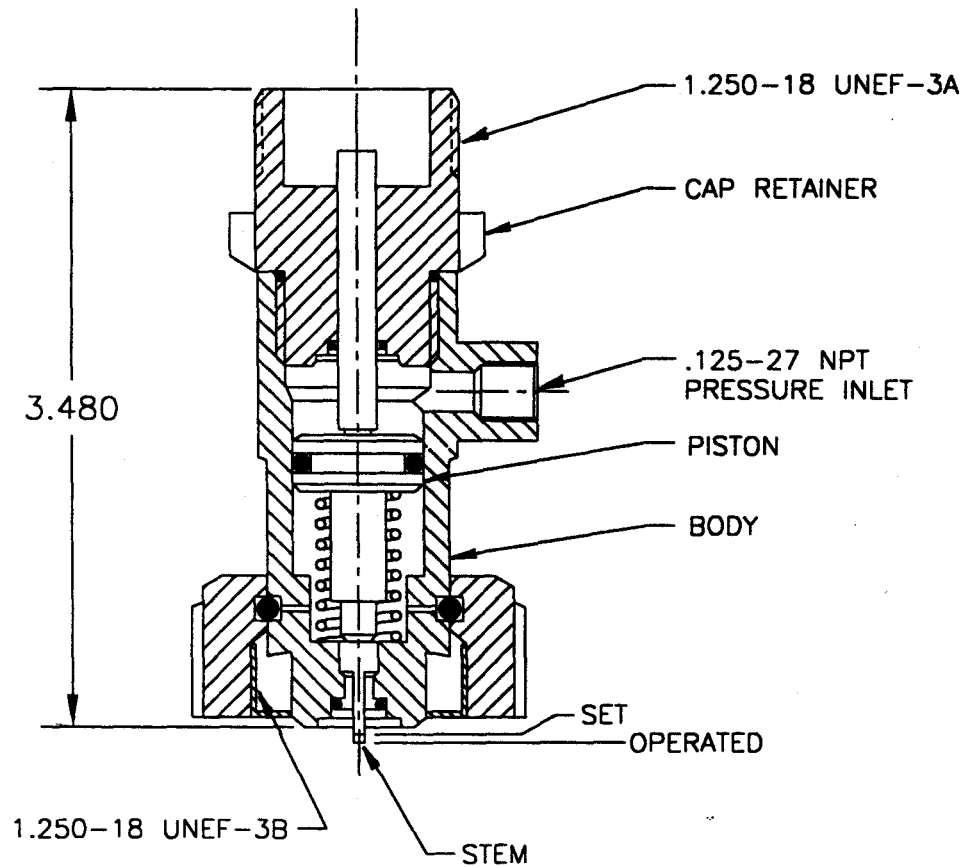


MATERIAL:  
BODY, RETAINING NUT,  
AND PISTON: BRASS

PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 878737  
K-5010

### PRESSURE OPERATED CONTROL HEAD, STACKABLE



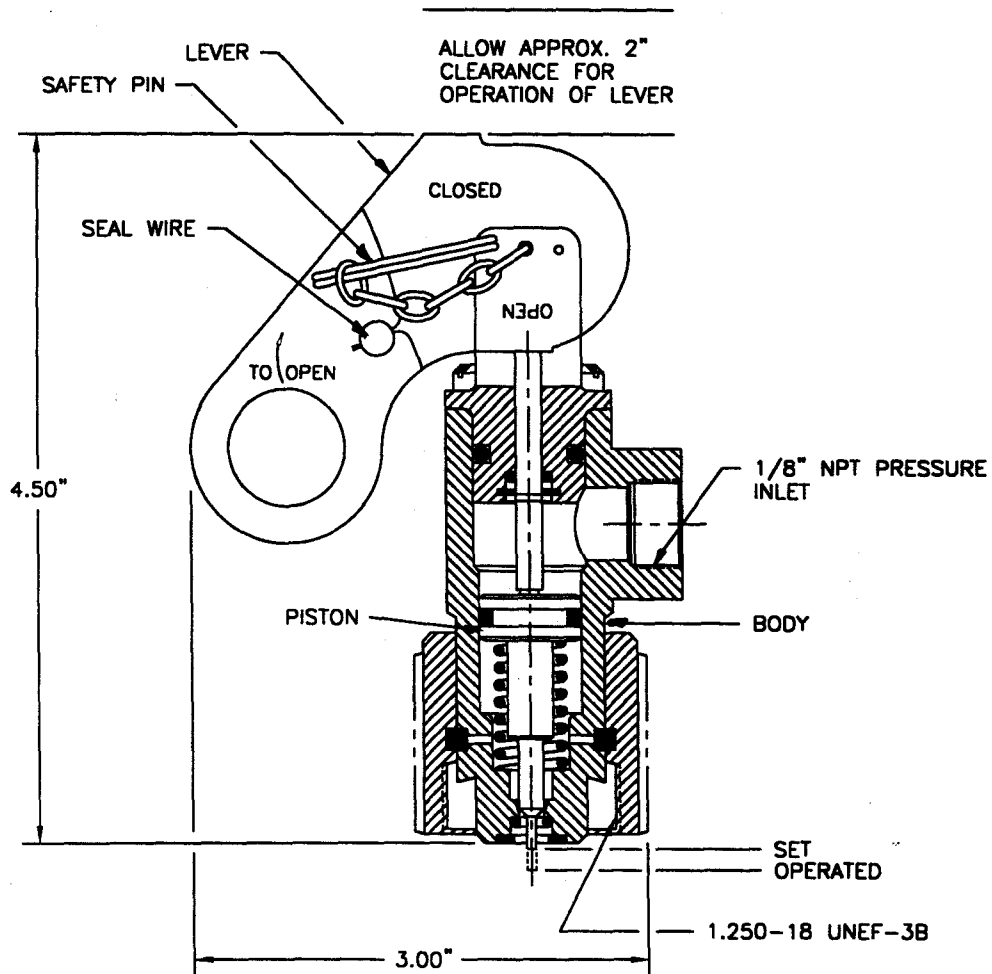
MATERIAL:  
 BODY, RETAINER CAP,  
 PISTON AND MTG. NUT: BRASS

PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 878750  
 K-5020



### LEVER OR PRESSURE OPERATED CONTROL HEAD



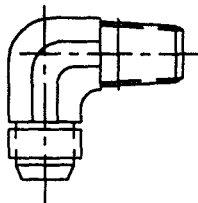
MATERIAL:  
 LEVER: STAINLESS STEEL  
 BODY AND PISTON: BRASS

PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

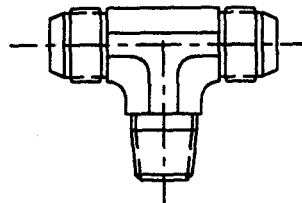
P/N - 878751  
 K-5030



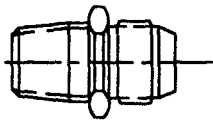
PILOT ACTUATION FITTINGS



MALE ELBOW  
1/8" NPT X 5/16" TUBING  
P/N 6992-0503



MALE BRANCH TEE  
1/8" NPT X 5/16" TUBING  
P/N 6992-0505



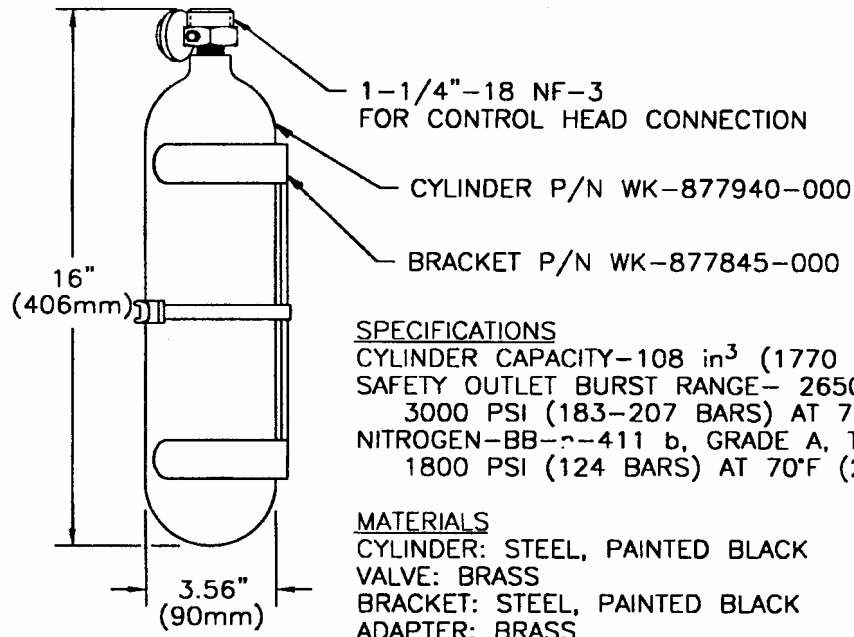
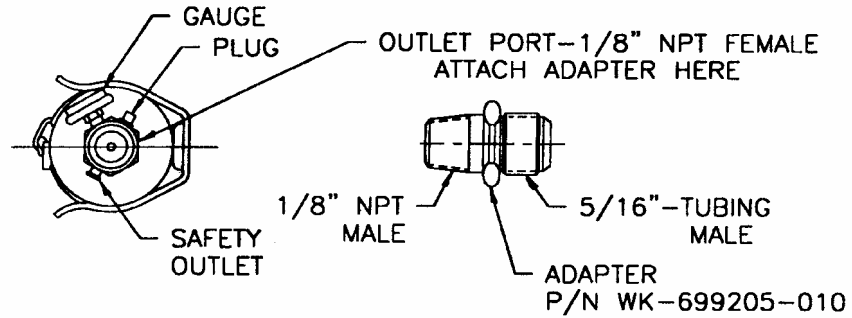
MALE CONNECTOR  
1/8" NPT X 5/16" TUBING  
P/N 6992-0501

MATERIAL: BRASS

PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - SEE ABOVE  
K-5040

NITROGEN PILOT CYLINDER, BRACKET, AND ADAPTER



SPECIFICATIONS

CYLINDER CAPACITY-108 in<sup>3</sup> (1770 CM<sup>3</sup>)  
 SAFETY OUTLET BURST RANGE- 2650-  
 3000 PSI (183-207 BARS) AT 70°F (20°C)  
 NITROGEN-BB-411 b, GRADE A, TYPE I  
 1800 PSI (124 BARS) AT 70°F (20°C)

MATERIALS

CYLINDER: STEEL, PAINTED BLACK  
 VALVE: BRASS  
 BRACKET: STEEL, PAINTED BLACK  
 ADAPTER: BRASS

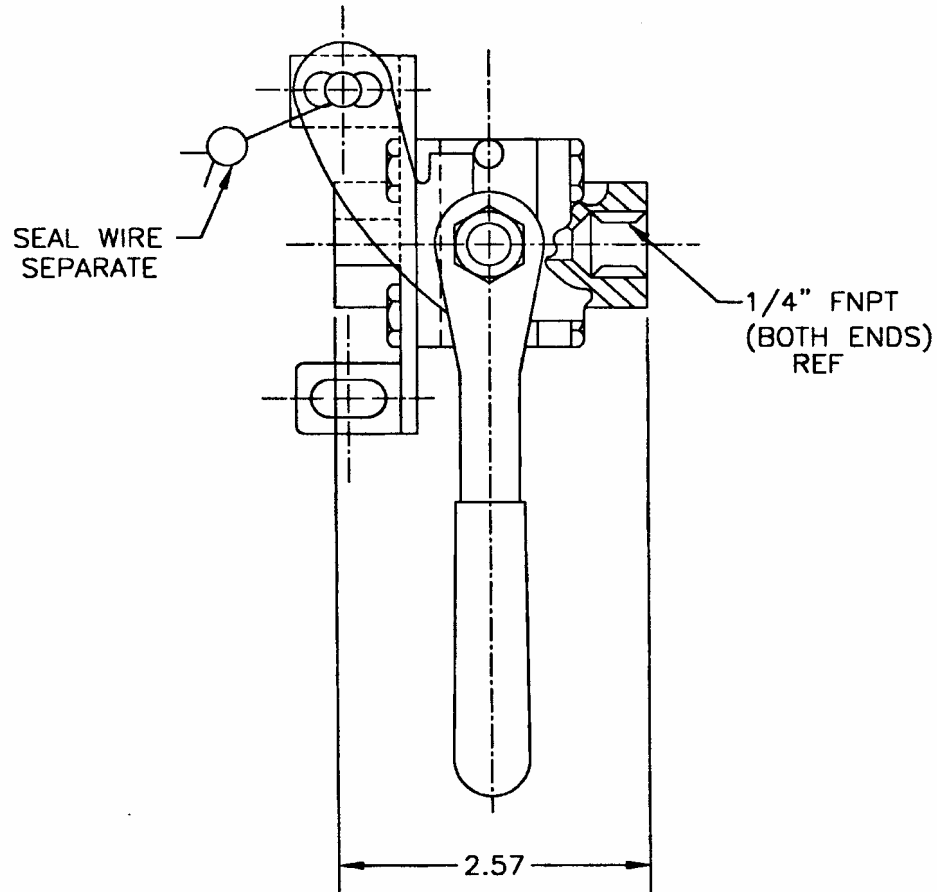
PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - SEE ABOVE  
 K-5050



COMPONENT DESCRIPTION

BALL VALVE, 1/4"

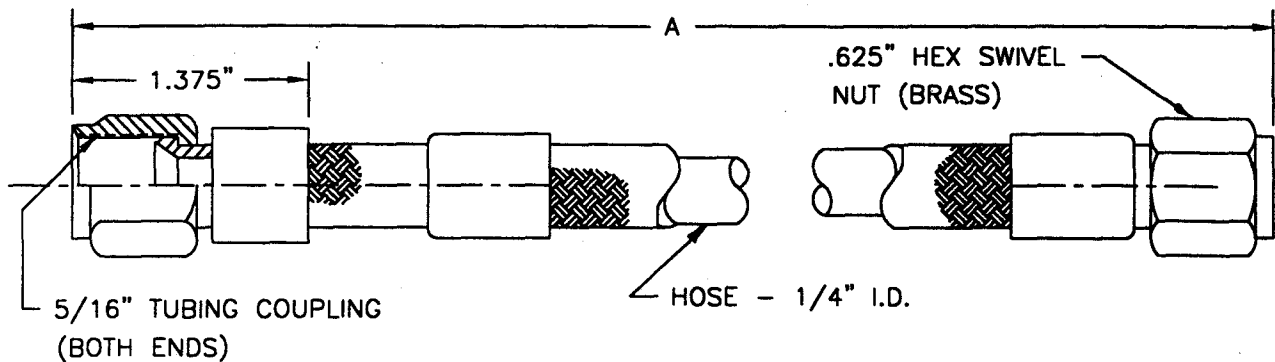


MATERIAL - STAINLESS STEEL, TYPE 316  
OPERATING PRESSURE - 3000 PSIG @ 170°F  
MINIMUM BURSTING PRESSURE 10000 PSI (680 BARS)

PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 283888  
K-5060

### 1/4" FLEXIBLE ACTUATION HOSES



PART NO.	A*
264986	30
264987	22

\* DIMENSIONS ARE IN INCHES

#### MATERIAL:

HOSE: CRES, WIRE BRAIDED, TEFLON LINING

COUPLINGS: BRASS

MINIMUM BURSTING PRESSURE: 5000 PSIG

MINIMUM BEND RADIUS: 2.5"

PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

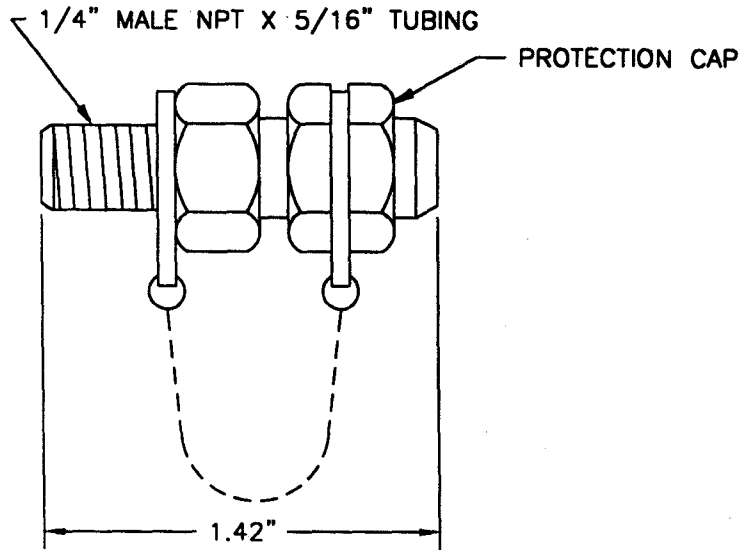
P/N - SEE TABLE

K-5070

### MASTER CYLINDER ADAPTER KIT

CAUTION  
INSTALL CAP  
WHEN  
NOT IN  
USE

LABEL



MATERIAL:  
ADAPTER AND CAP: BRASS  
CHAIN: STAINLESS STEEL  
LABEL: MYLAR

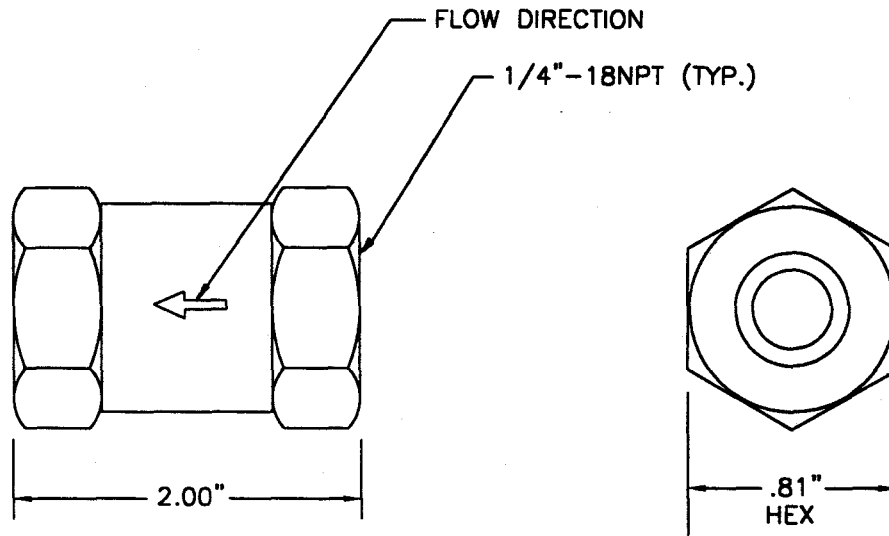
PRODUCT	USE
CO <sub>2</sub>	
FE-13	X
FM-200	X
HALON 1301	X

P/N - 844895  
K-5080



COMPONENT DESCRIPTION

1/4" CHECK VALVE



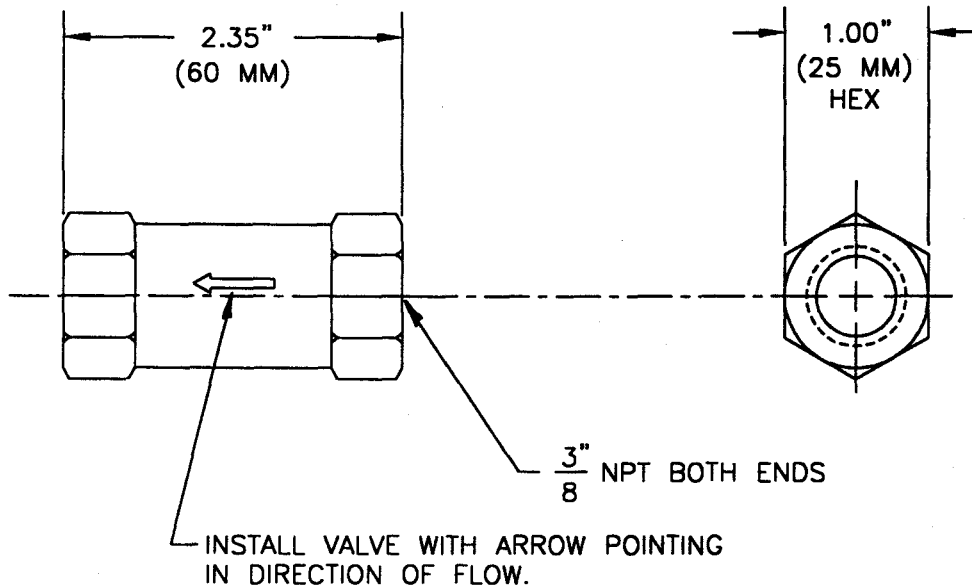
NOTE: INSTALL VALVE WITH ARROW POINTING IN DIRECTION OF FLOW.

MATERIAL: BRASS  
WORKING PRESSURE: 0-1800 PSI  
MINIMUM BURSTING PRESSURE: 5000 PSI

PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 264985  
K-5090

### 3/8" CHECK VALVE



#### MATERIALS

BODY: BRASS

SEAL: BUNA-N

#### TECHNICAL DATA

WORKING PRESSURE: 0 TO 5000 PSI (0 TO 345 BARS)

PROOF PRESSURE: 10,000 PSI (690 BARS)

CRACKING PRESSURE: 2 TO 4 PSI (.14 TO .28 BARS)

OPERATING TEMPERATURE: -40°F TO 250°F  
(-40°C TO 121°C)

PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 261193

K-5100

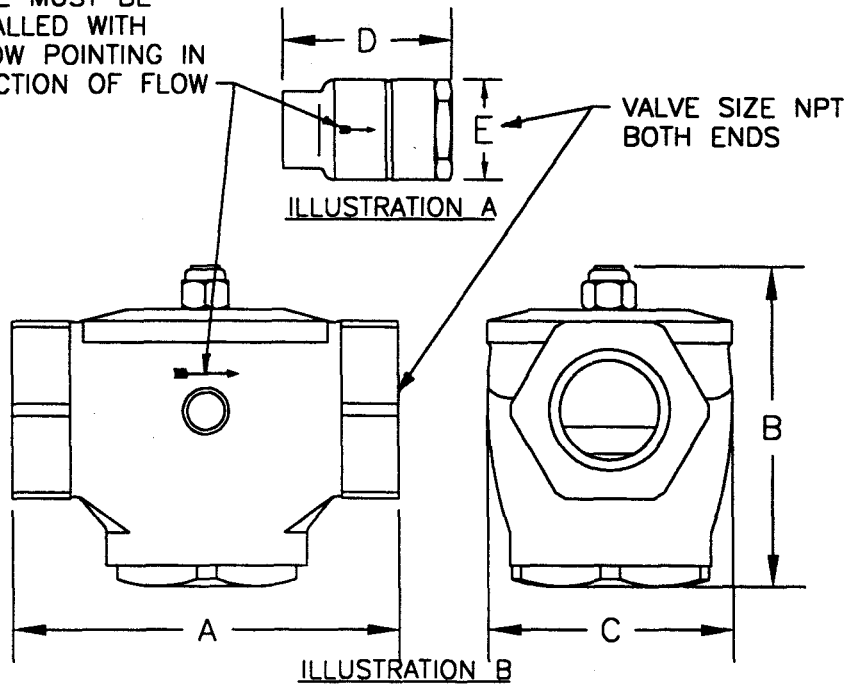




COMPONENT DESCRIPTION

CHECK VALVES, 1/2" THRU 2"

VALVE MUST BE  
INSTALLED WITH  
ARROW POINTING IN  
DIRECTION OF FLOW



PART NUMBER	VALVE SIZE	ILLUSTRATION	A		B		C		D		E	
			IN	mm	IN	mm	IN	mm	IN	mm	IN	mm
81-800327-000	1/2"	A	-	-	-	-	-	-	3.34	85	2	51
81-800266-000	3/4"	A	-	-	-	-	-	-	3.34	85	2	51
WK-800443-000	1"	A	-	-	-	-	-	-	3.97	101	3.18	81
81-800444-000	1-1/4"	A	-	-	-	-	-	-	3.97	101	3.18	81
81-870152-000	1-1/2"	B	7.50	151	6.28	160	4.75	121	-	-	-	-
81-870151-000	2"	B	7.50	151	6.28	160	4.75	121	-	-	-	-

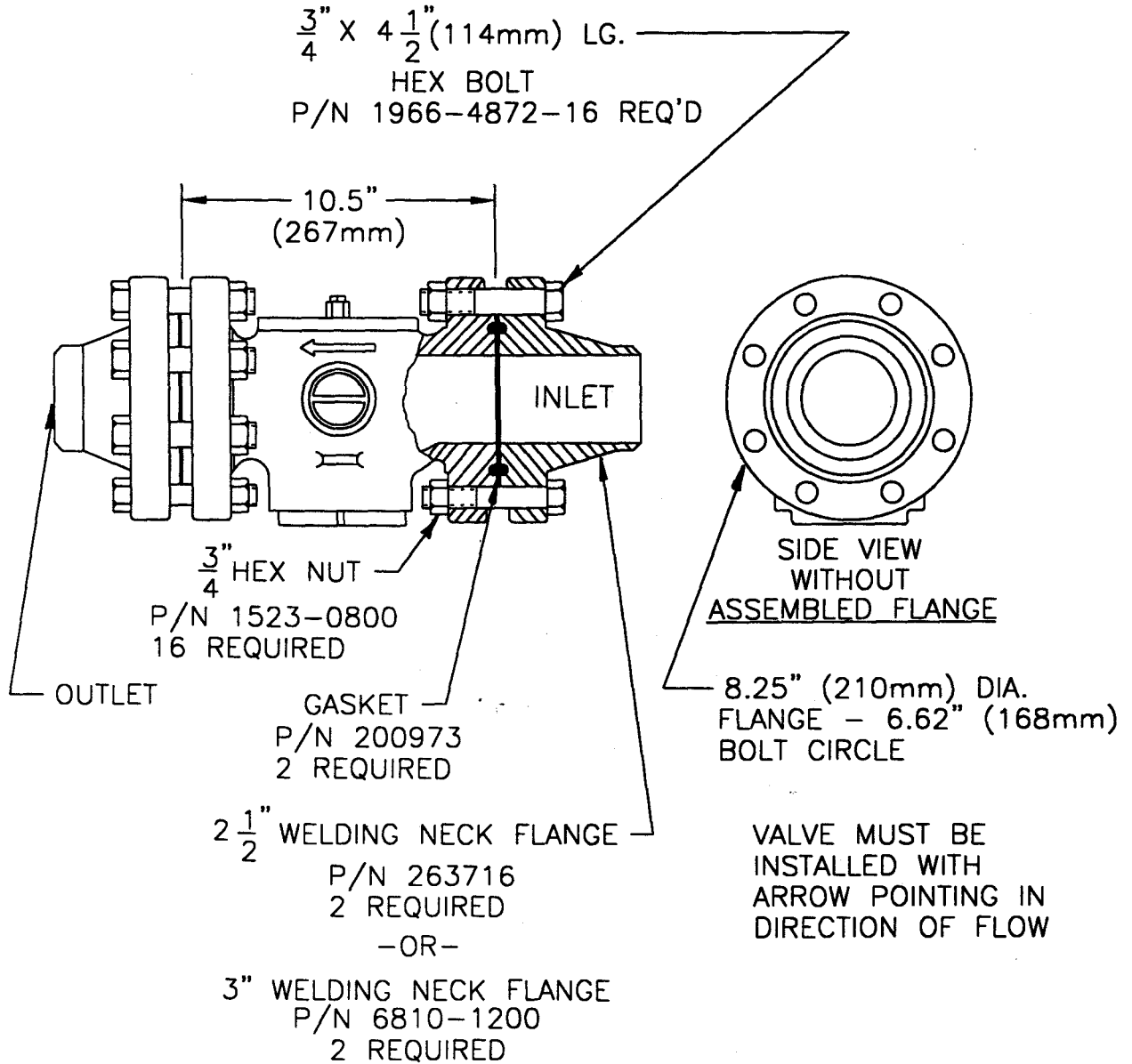
MATERIAL: BRASS

PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - SEE TABLE

K-5110

### CHECK VALVES, 2-1/2" & 3"

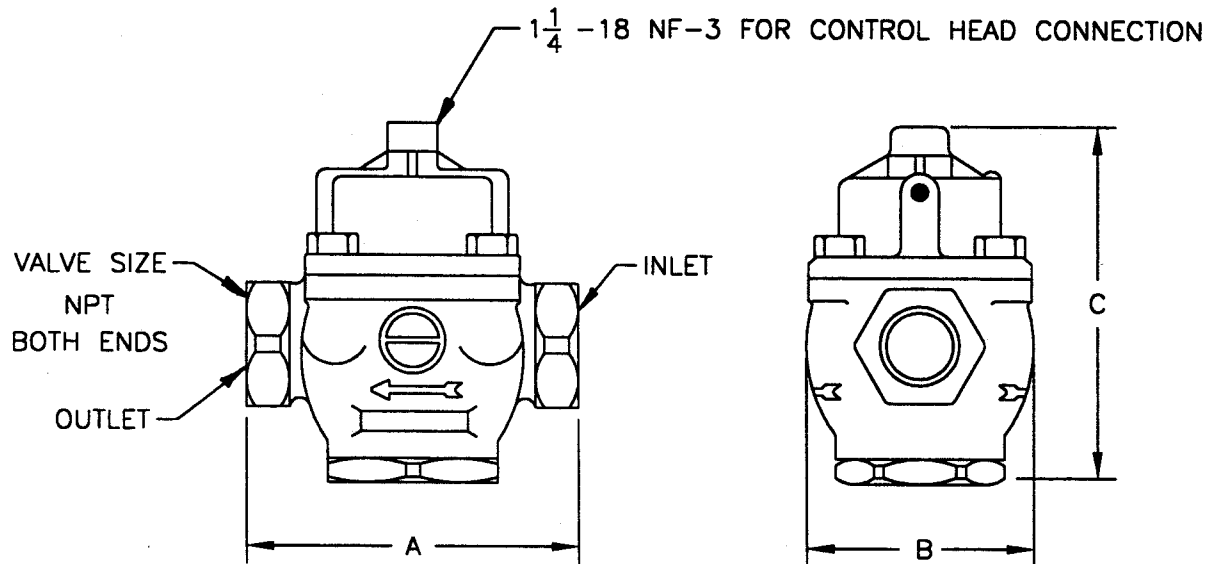


PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

MATERIALS  
 VALVE BODY: BRASS  
 GASKET: IRON  
 FLANGES, BOLTS, & NUTS: STEEL

P/N - 870100  
 K-5120

### STOP (DIRECTIONAL) VALVES, 1/2" THRU 2"



PART NUMBER	VALVE SIZE NPT	A		B		C	
		IN	mm	IN	mm	IN	mm
870023	1/2"	3.75	95	2.5	64	4.68	119
870022	3/4"	4.25	108	2.81	71	5.68	144
870122	1"	5.5	140	3.62	92	6.87	175
870032	1 1/4"	5.5	140	3.62	92	6.87	175
870123	1 1/2"	7.5	191	4.75	121	8.43	214
870049	2"	7.5	191	4.75	121	8.43	214

MATERIAL:  
BODY: BRASS

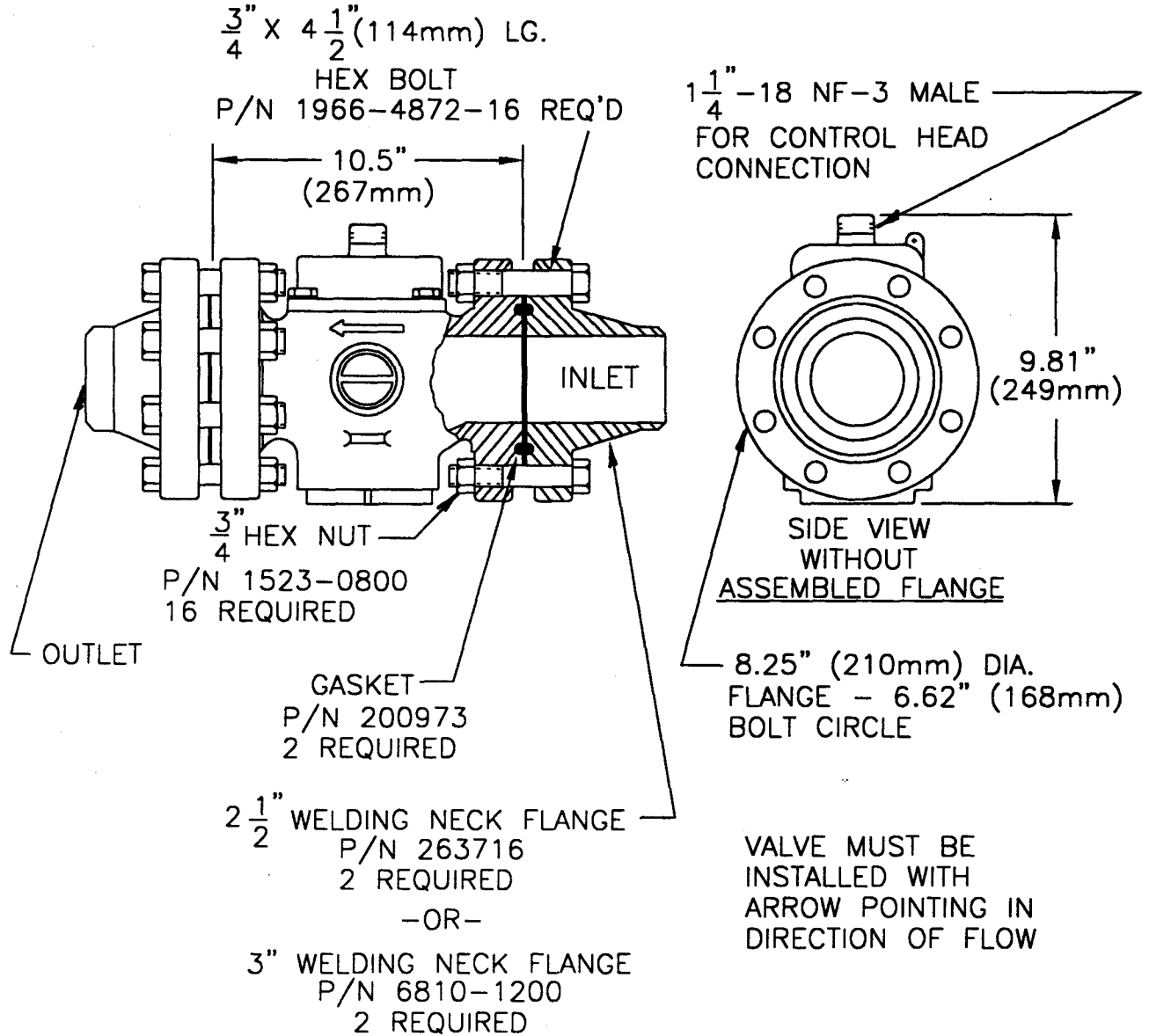
#### NOTES:

1. VALVE MUST BE INSTALLED WITH ARROW POINTING IN DIRECTION OF FLOW.
2. VALVE MAY BE INSTALLED IN HORIZONTAL OR VERTICAL PIPE RUN.

PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - SEE TABLE  
K-5130

### STOP (DIRECTIONAL) VALVES, 2-1/2" & 3"



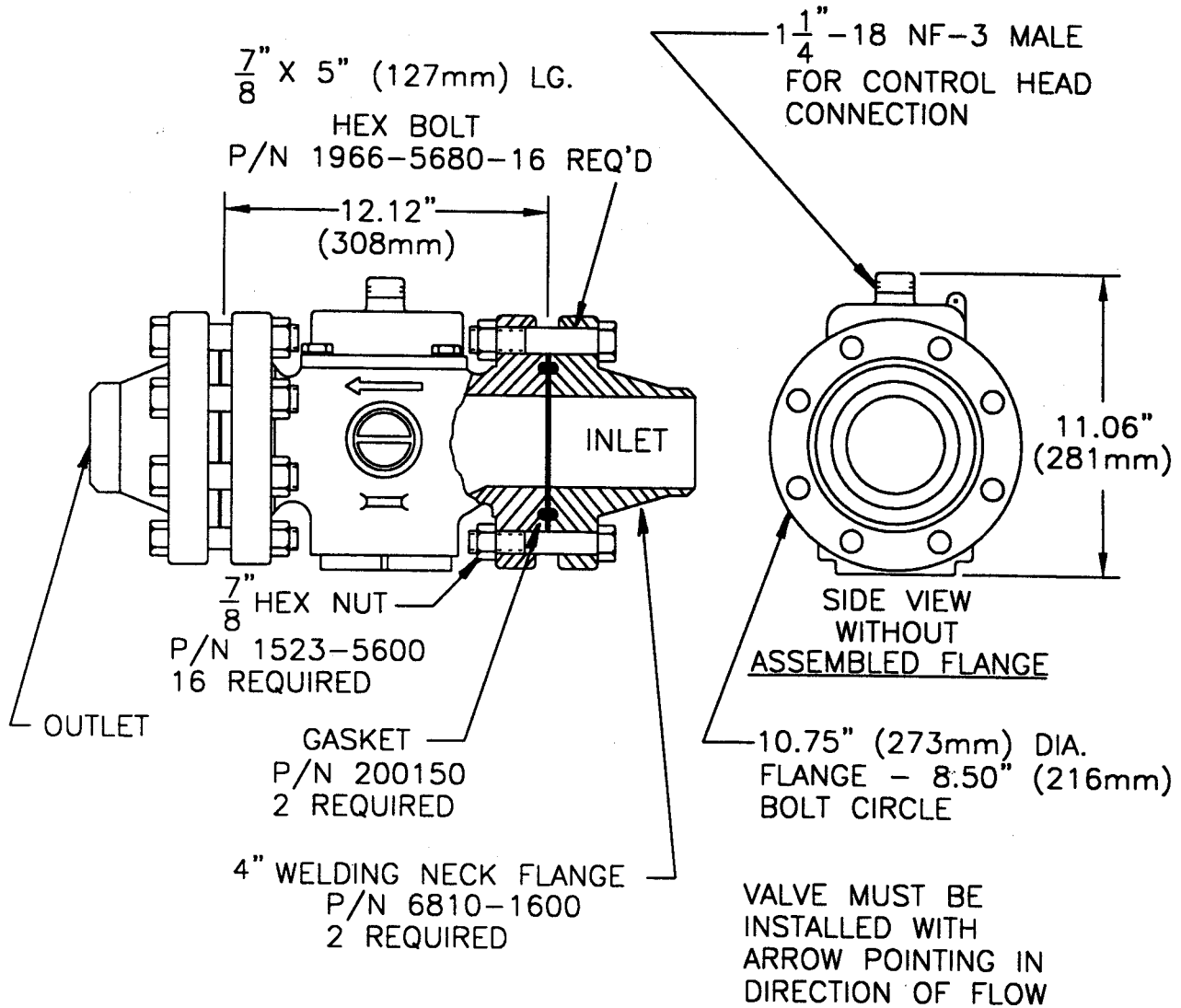
PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

MATERIALS  
 VALVE BODY: BRASS  
 GASKET: IRON  
 FLANGES, BOLTS, & NUTS: STEEL

P/N - 890010

K-5140

### 4" STOP (DIRECTIONAL) VALVE

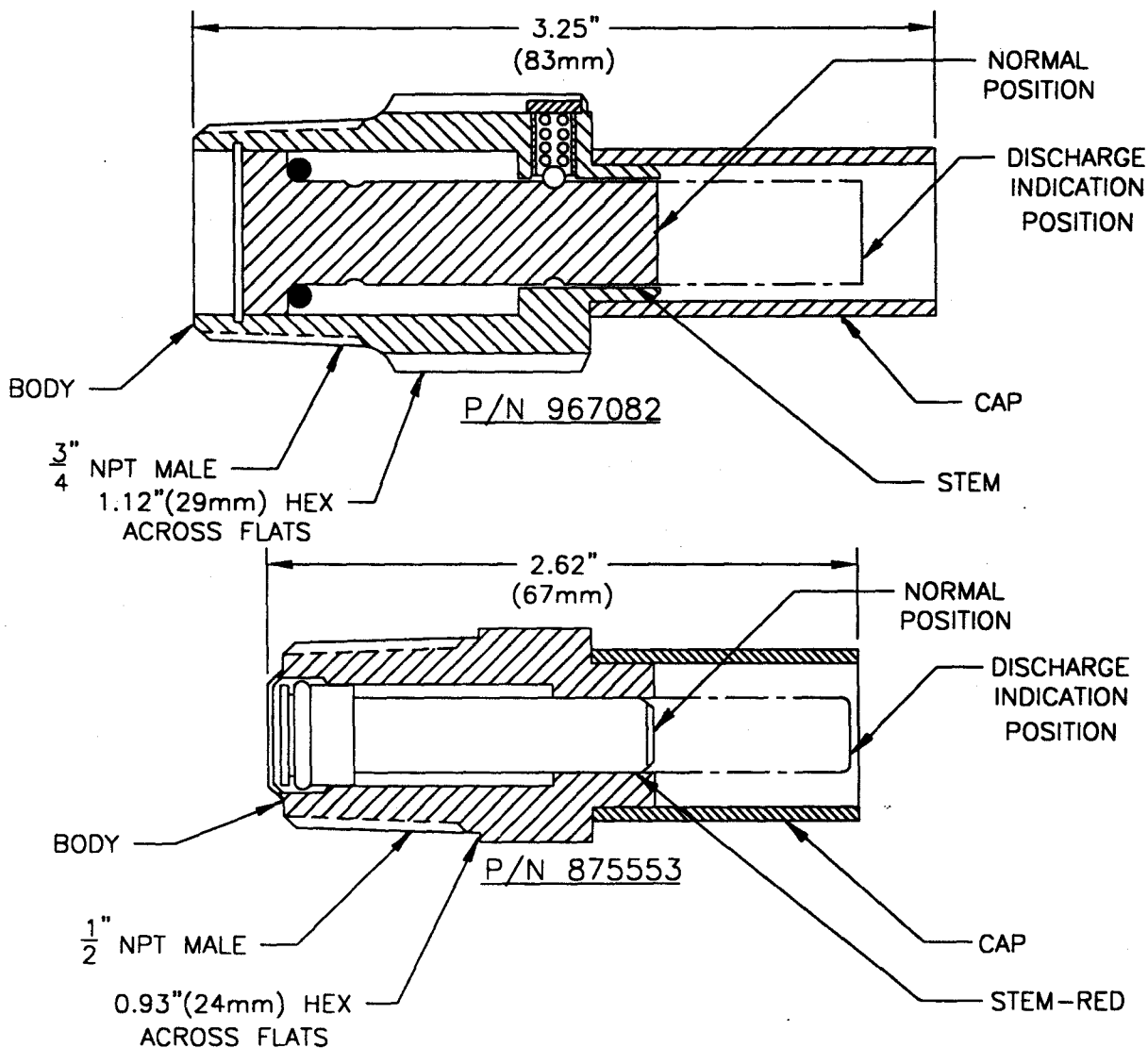


**MATERIALS**  
 VALVE BODY: BRASS  
 GASKET: IRON  
 FLANGES, BOLTS, & NUTS: STEEL

PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 890208  
 K-5150

### DISCHARGE INDICATORS



#### MATERIALS

BODY-967082: BRASS

BODY-875553: ALUMINUM

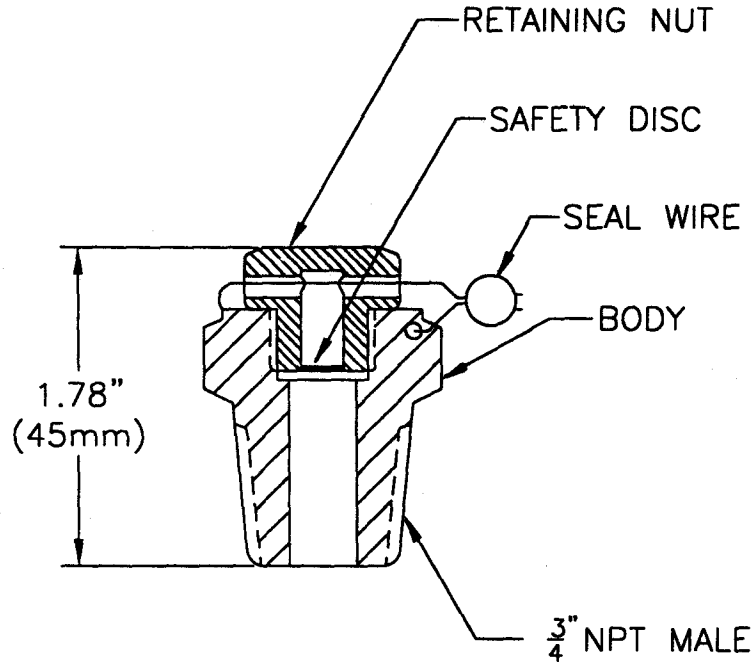
CAPS: CLEAR CELLULOSE ACETATE

PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - SEE ABOVE

K-5160

### SAFETY OUTLETS



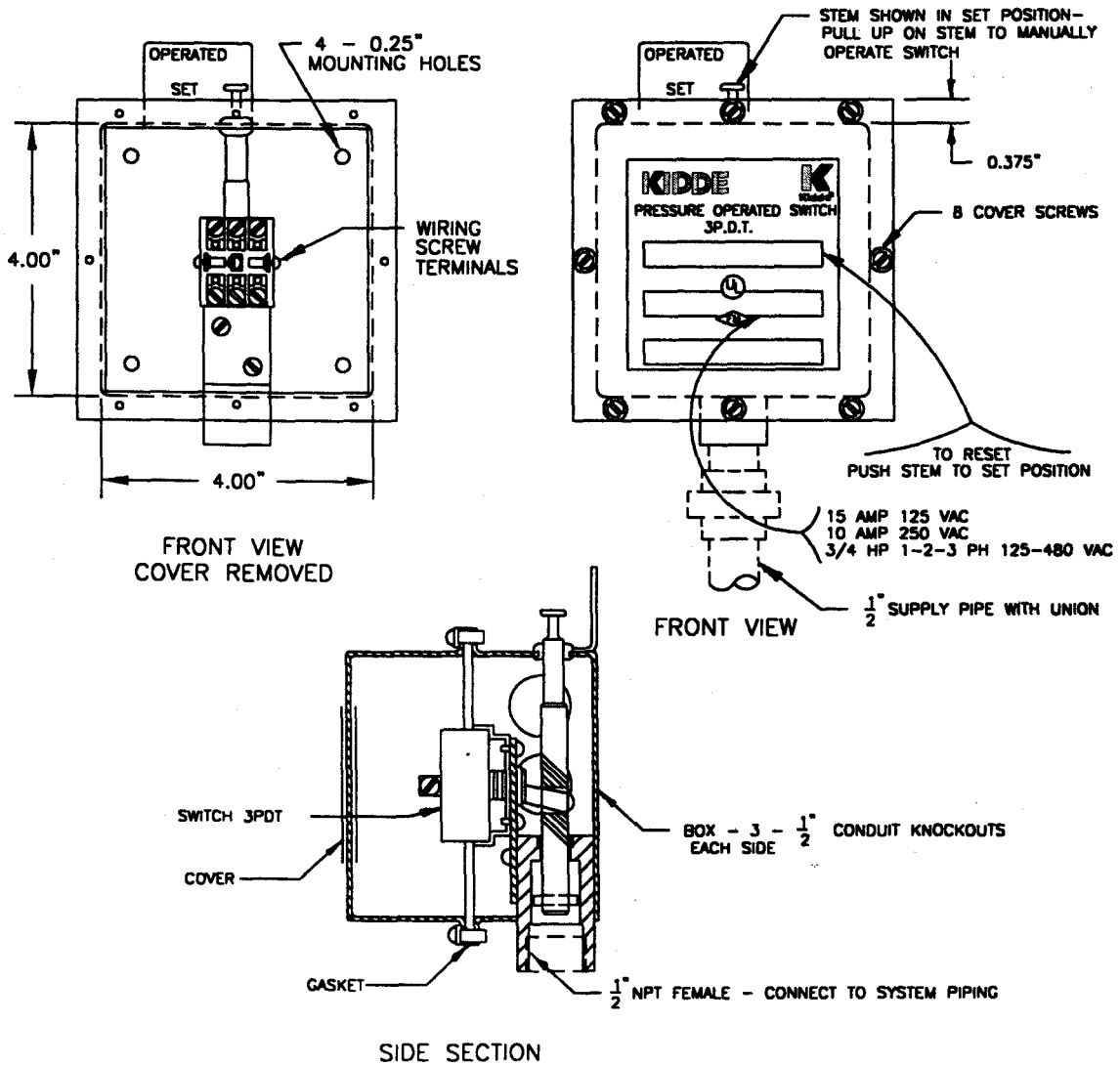
PART NUMBER	AGENT	PRESSURE RELIEF OPERATES AT	
		PSI	BARS
803242	N <sub>2</sub> /CO <sub>2</sub>	2400-2800	166-193
844346	360 PSI HALON 1301	750-900	52-62

MATERIALS  
 BODY AND RETAINING NUT: BRASS  
 SEAL WIRE: COPPER AND LEAD

PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - SEE TABLE  
 K-5170

### PRESSURE OPERATED SWITCH



#### NOTES

1. SWITCH MAY BE MOUNTED IN ANY POSITION BUT PREFERRED INSTALLATION IS UPRIGHT AS SHOWN.
2. ANY LOAD CONNECTED TO THE SWITCH MUST NOT EXCEED SWITCH RATING AND SHALL UTILIZE A SUITABLE PROTECTION DEVICE.(ie. CIRCUIT BREAKER, FUSE)

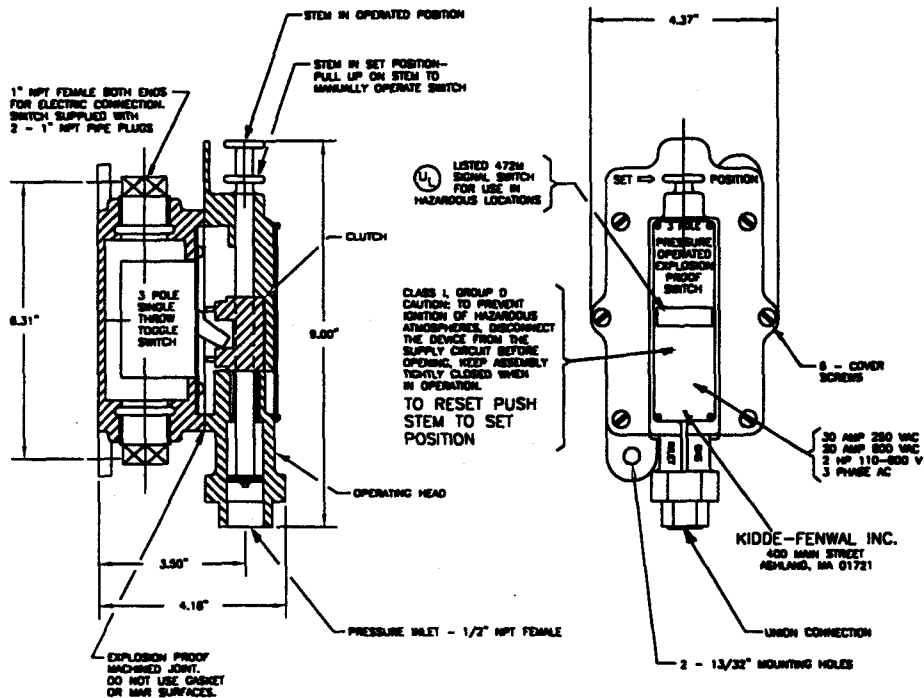
PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 486536

K-5180



### PRESSURE OPERATED SWITCH, EXPLOSION PROOF



**NOTES:**

1. TOGGLE SWITCH MAY BE MOUNTED IN BASE FOR EITHER N.O. TO N.C. OR N.C. TO N.O. CONTACT TRANSFER UPON OPERATION. ILLUSTRATION SHOWS POSITION OF TOGGLE WHEN SWITCH IS IN SET POSITION.
2. ANY LOAD CONNECTED TO THE SWITCH MUST NOT EXCEED SWITCH RATING AND SHALL UTILIZE A SUITABLE PROTECTION DEVICE. (ie CIRCUIT BREAKER, FUSE)
3. REMOVE OPERATING HEAD TO MAKE ELECTRICAL CONNECTIONS TO TOGGLE SWITCH. WHEN REPLACING OPERATING HEAD, ENSURE THAT TOGGLE ENGAGES CLUTCH. TIGHTEN COVER SCREWS SECURELY.

**MATERIAL:**

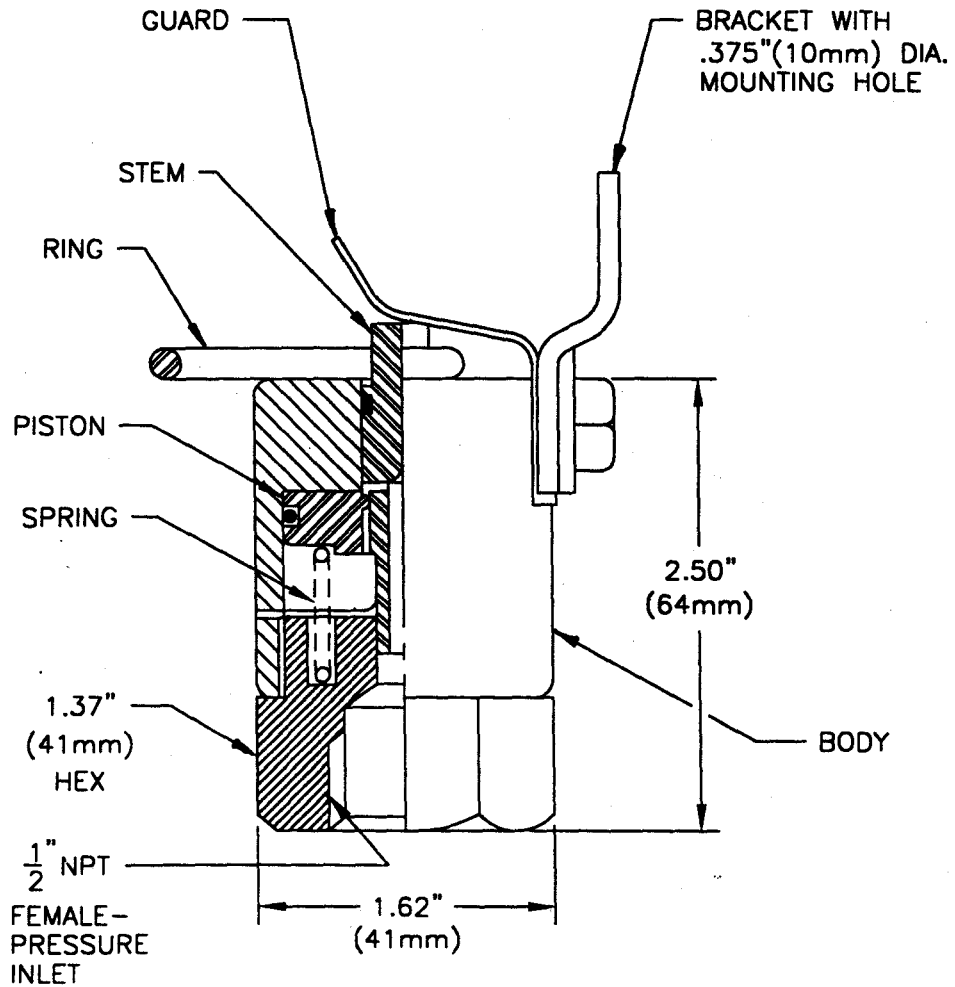
BASE: MALLEABLE IRON  
 OPERATING HEAD: CAST BRONZE

PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 981332

K-5190

### PRESSURE TRIP



MAXIMUM LOAD ON RING- 100 LBS. (45 KG)  
 MINIMUM NOMINAL OPERATING PRESSURE- 50 PSI (3.5 BARS)

#### MATERIALS

BODY, BRACKET, AND PISTON: BRASS

GUARD, STEM, RING, AND SPRING: STAINLESS STEEL

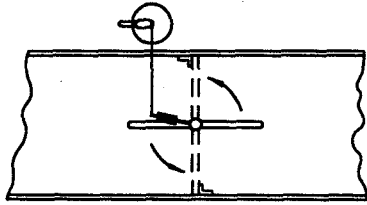
PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 874220

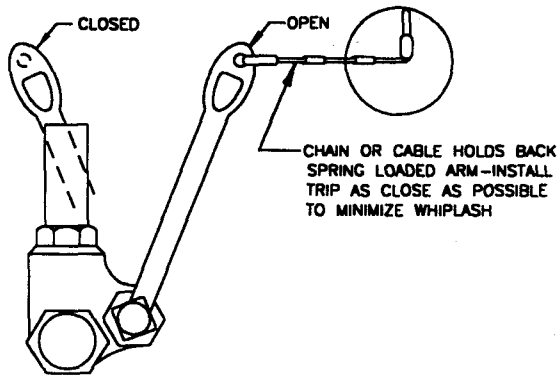
K-5200



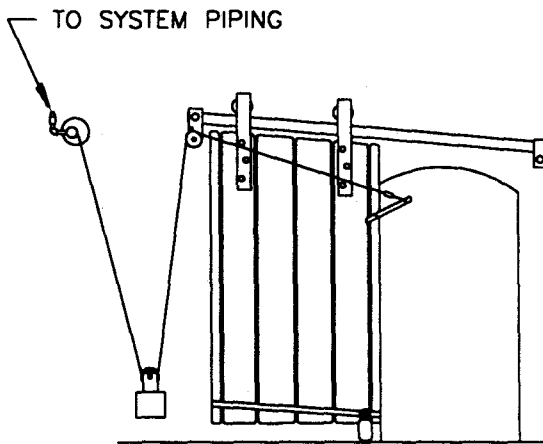
# PRESSURE TRIP APPLICATIONS



HORIZONTAL DUCT DAMPER

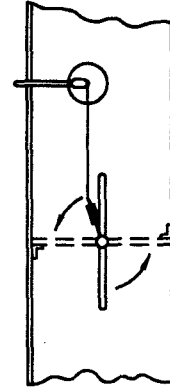


SPRING LOADED LIQUID OR GAS SHUTOFF VALVE

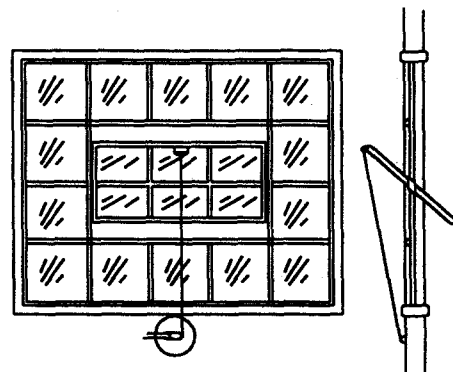


SLIDING DOOR

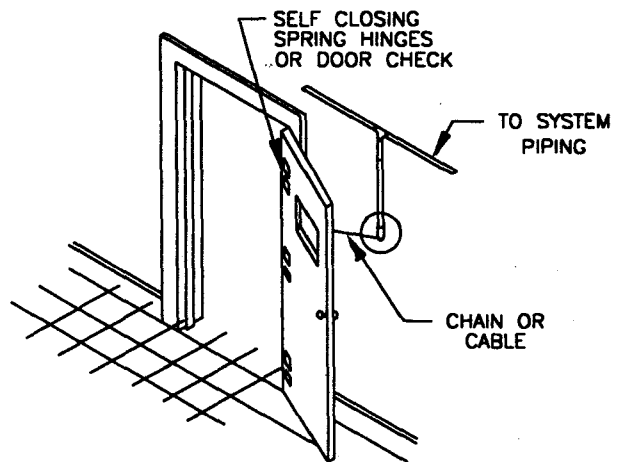
# INSTALLATION DETAIL



VERTICAL DUCT DAMPER



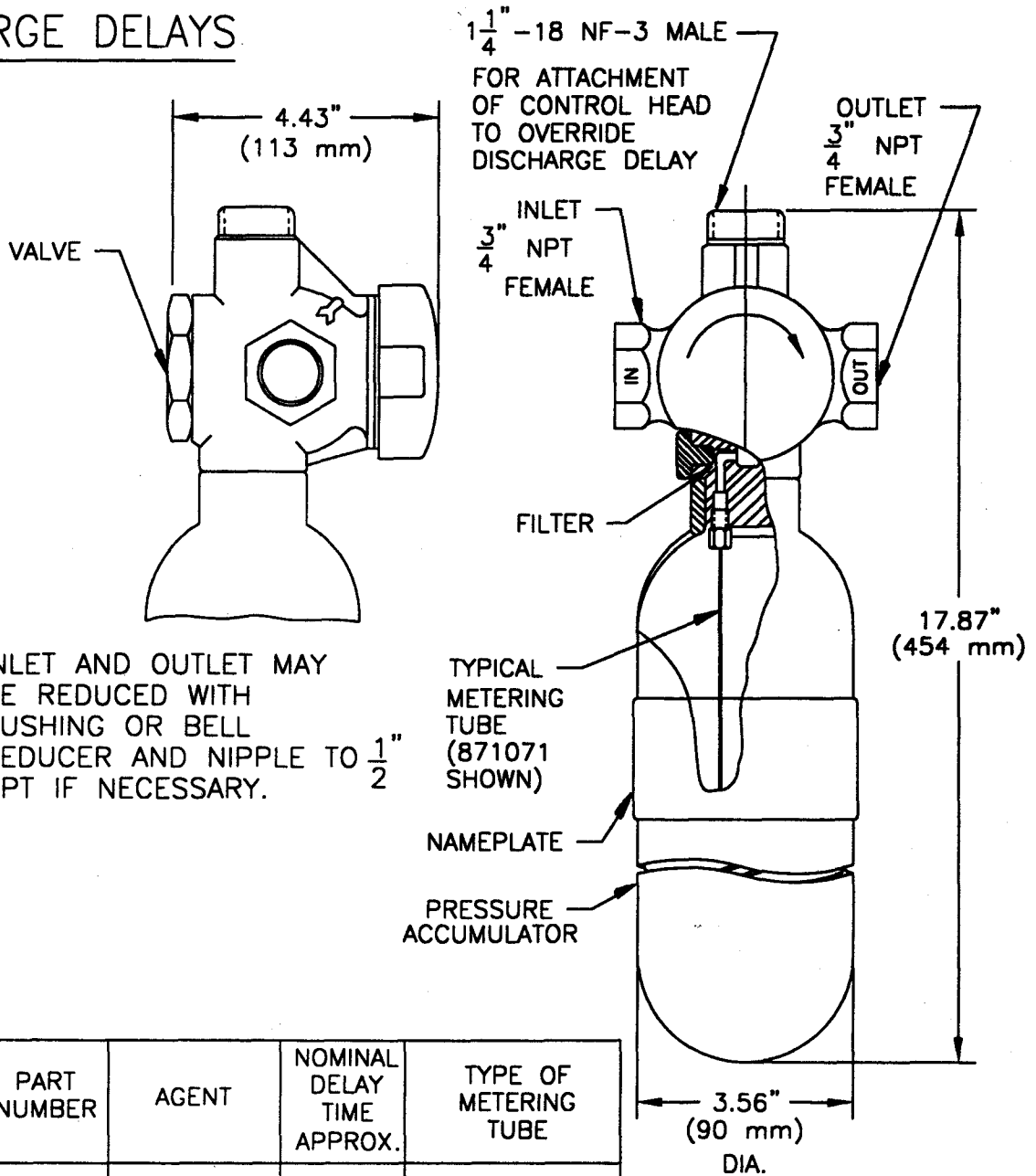
WINDOW--EITHER WEIGHTED OR OFF BALANCE



SWINGING DOOR--SELF CLOSING

PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

### DISCHARGE DELAYS



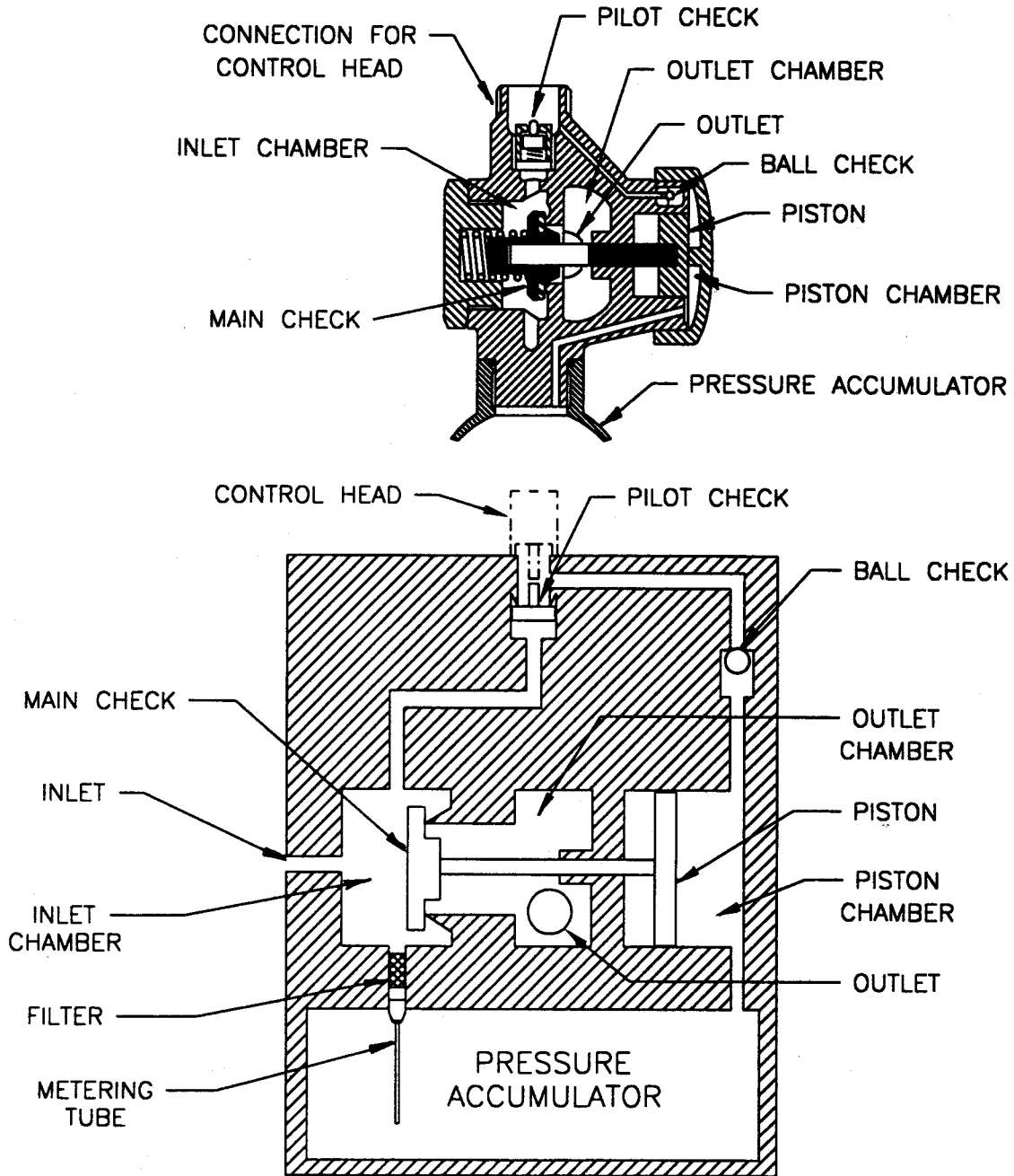
INLET AND OUTLET MAY BE REDUCED WITH BUSHING OR BELL REDUCER AND NIPPLE TO 1/2" NPT IF NECESSARY.

PART NUMBER	AGENT	NOMINAL DELAY TIME APPROX.	TYPE OF METERING TUBE
871071	CO <sub>2</sub>	30	CURLED
897636	CO <sub>2</sub>	60	CURLED

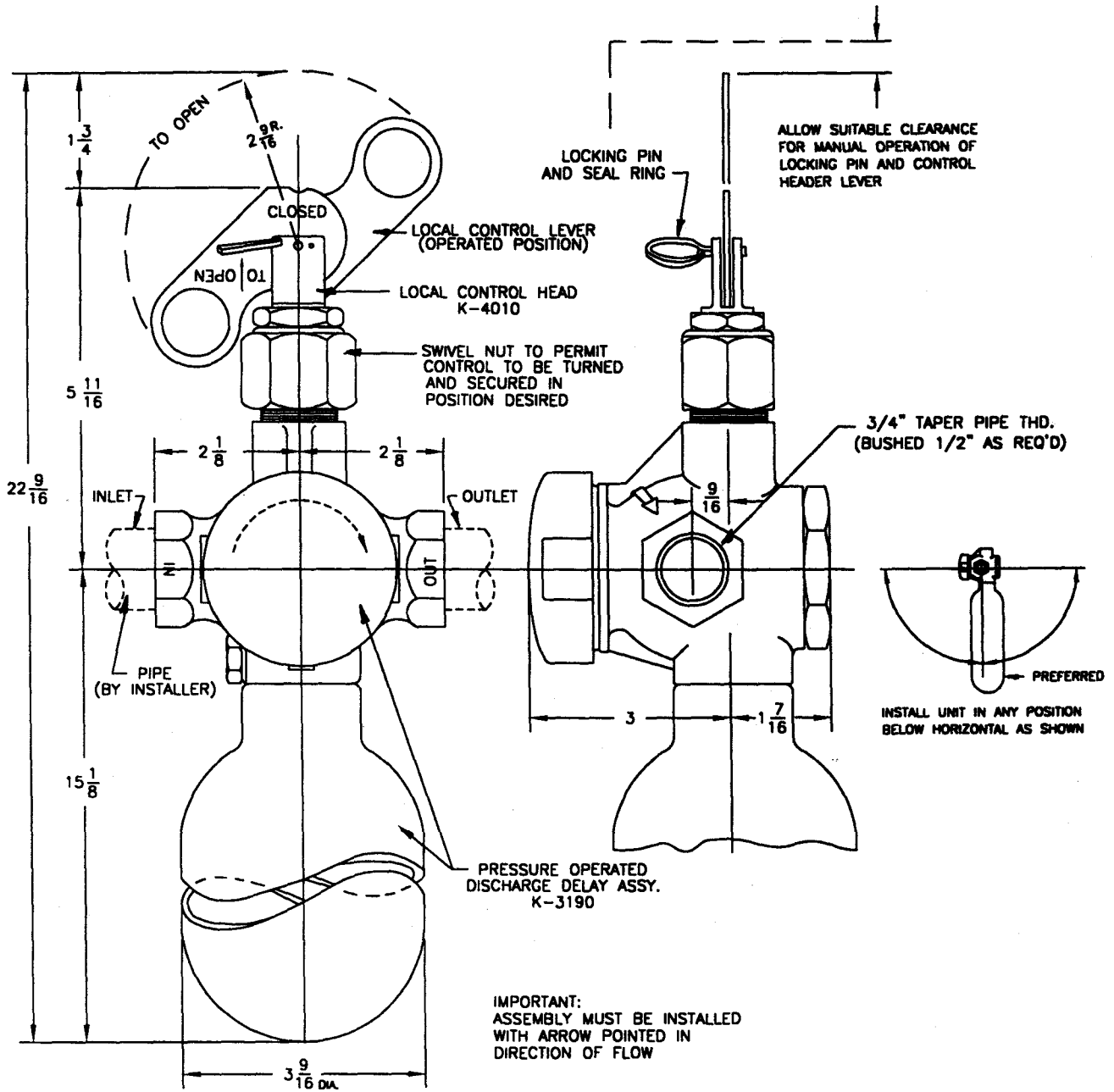
**MATERIALS**  
 PRESSURE ACCUMULATOR: STEEL  
 METERING TUBE: STAINLESS STEEL  
 VALVE BODY: BRASS  
 FINISH: RED PAINT

P/N - SEE TABLE  
 K-5210M

### DISCHARGE DELAYS



### DISCHARGE DELAY WITH MANUAL OPERATED CONTROL HEAD

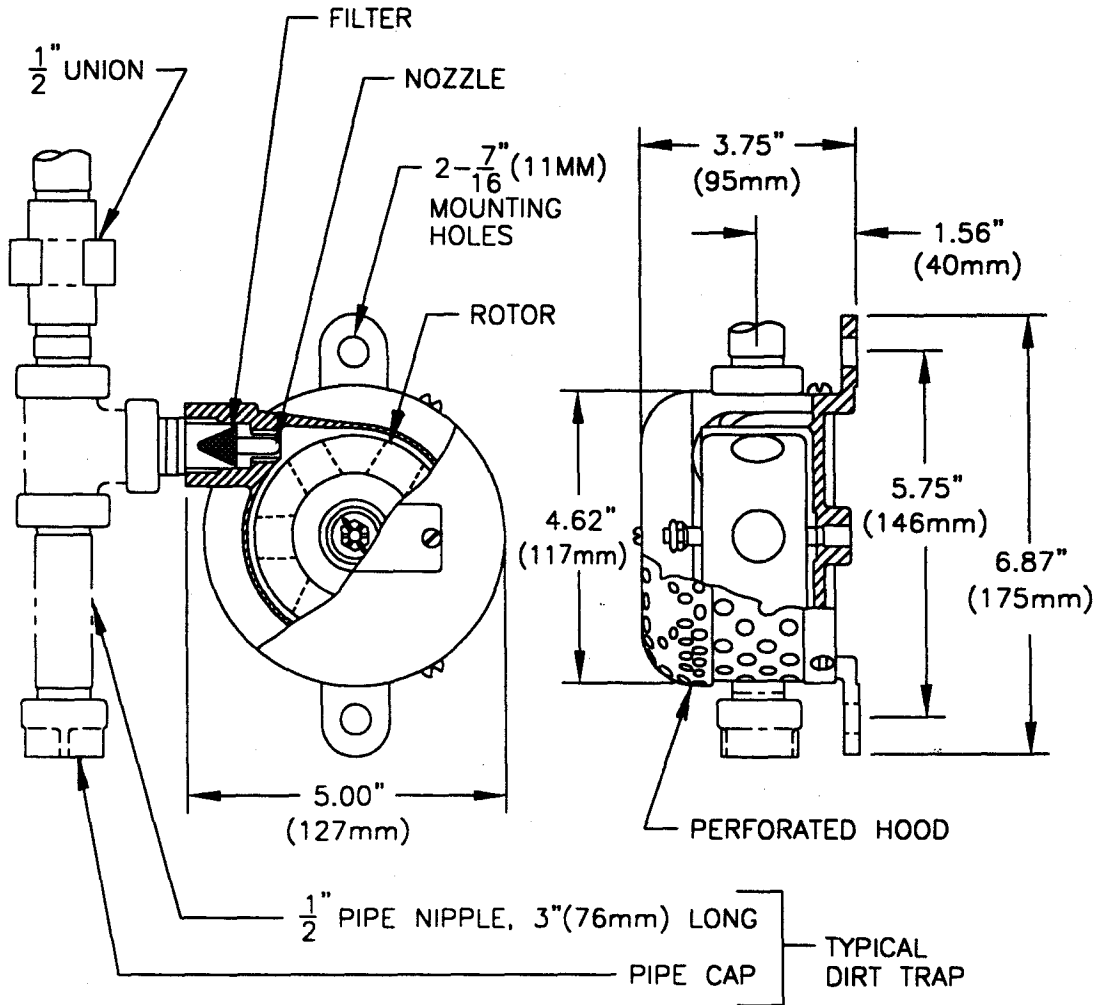




COMPONENT DESCRIPTION

PRESSURE OPERATED SIREN

NOMINAL FLOW RATE AT 70°	
CARBON DIOXIDE	20.4 LBS/MIN
HALON 1301	21.2 LBS/MIN

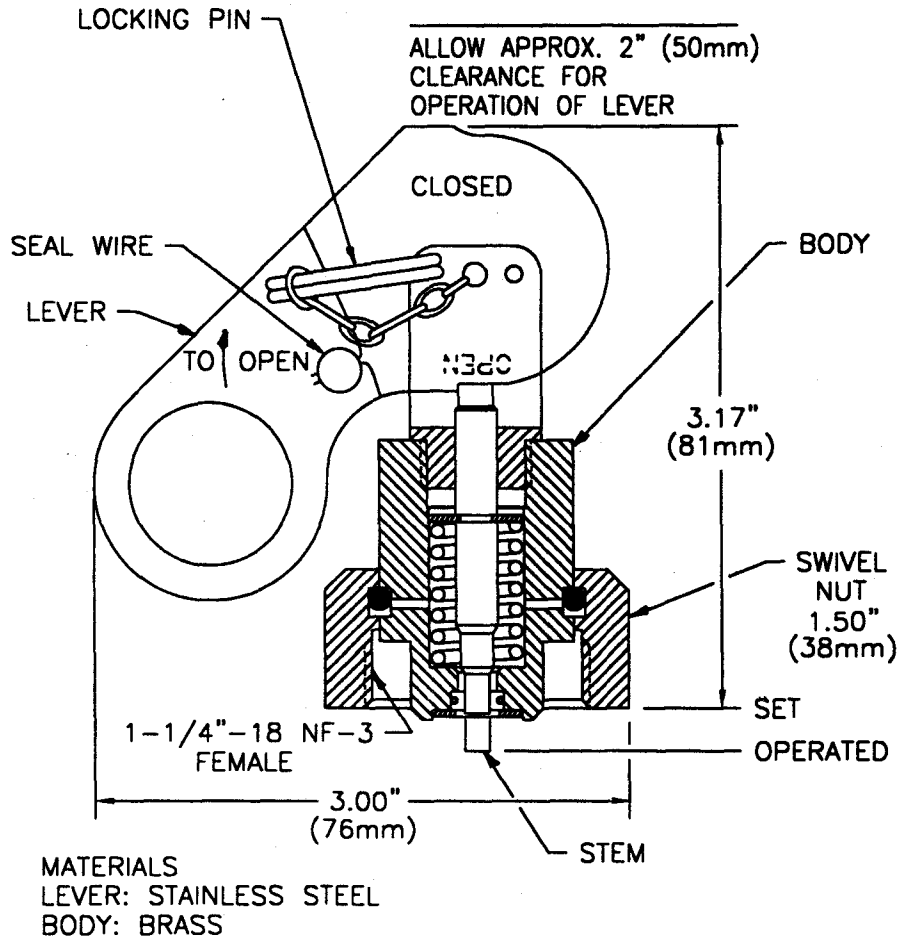


MATERIALS  
 BODY: BRONZE  
 ROTOR: BRASS  
 NOZZLE AND FILTER: MONEL  
 HOOD: STEEL  
 FINISH: RED PAINT

PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 981574  
 K-5220

### LEVER OPERATED CONTROL HEAD

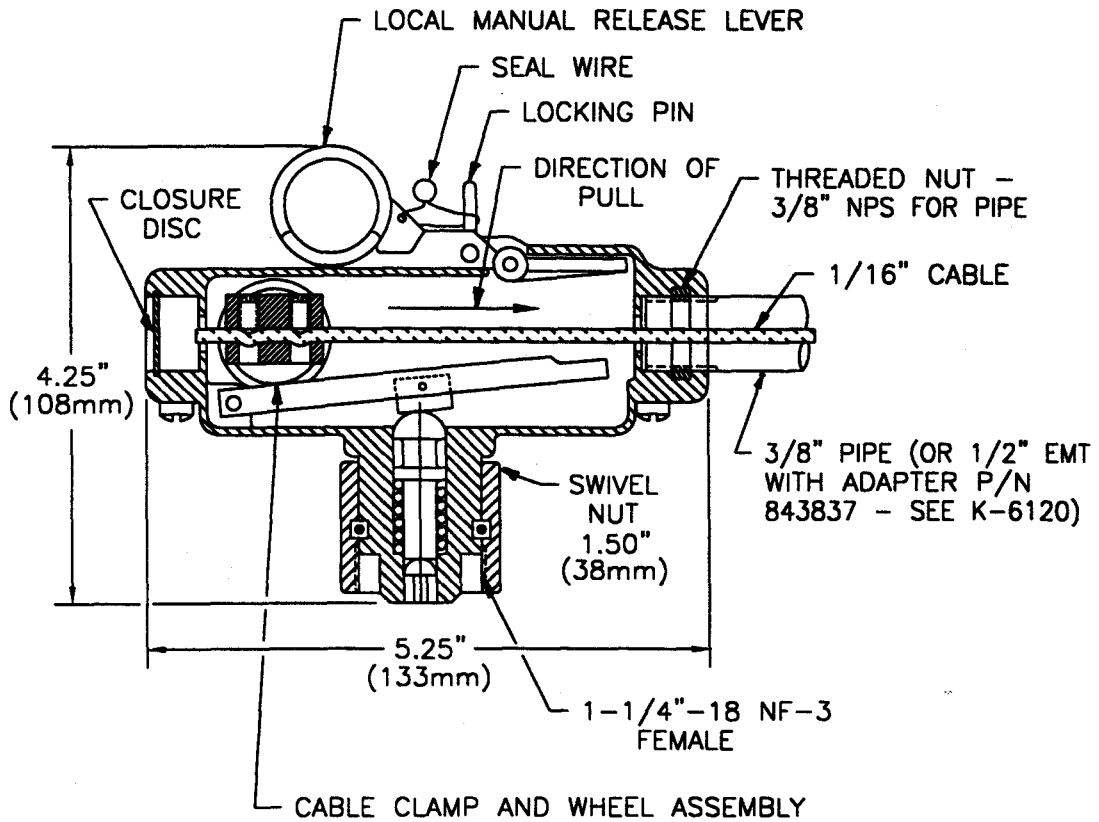


PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 870652  
K-6010



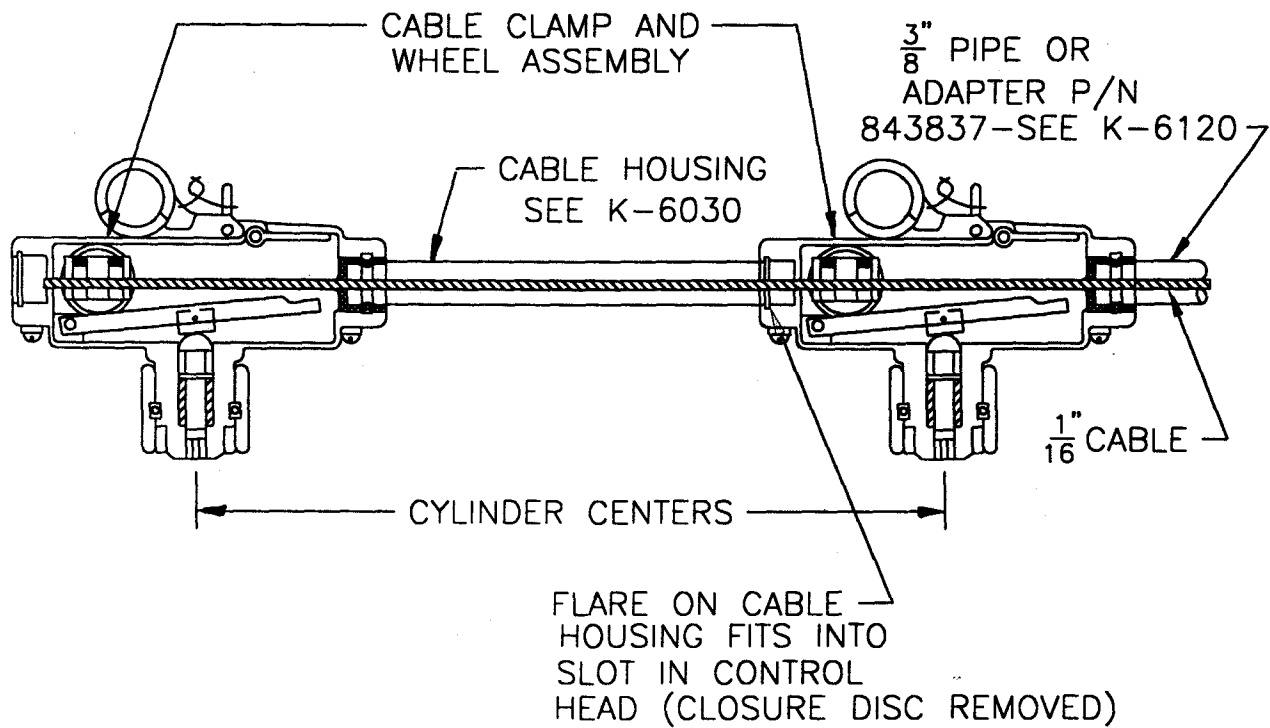
### CABLE OPERATED CONTROL HEAD



PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

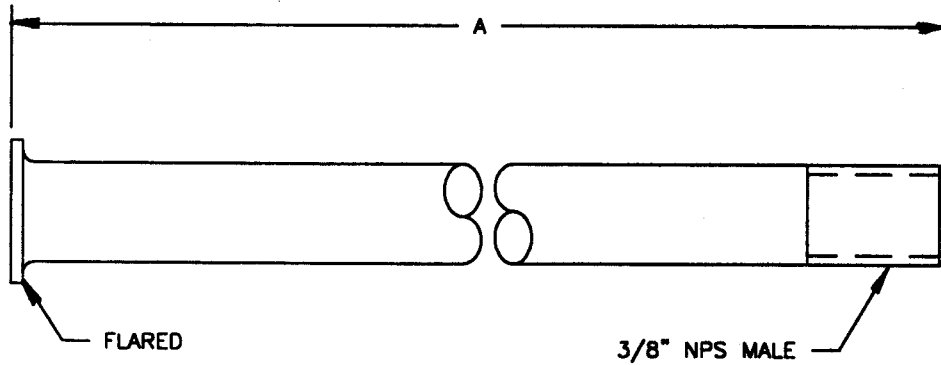
P/N - 979469  
K-6020

### TANDEM CABLE OPERATED CONTROL HEADS



PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

### CABLE HOUSINGS FOR CABLE OPERATED CONTROL HEADS

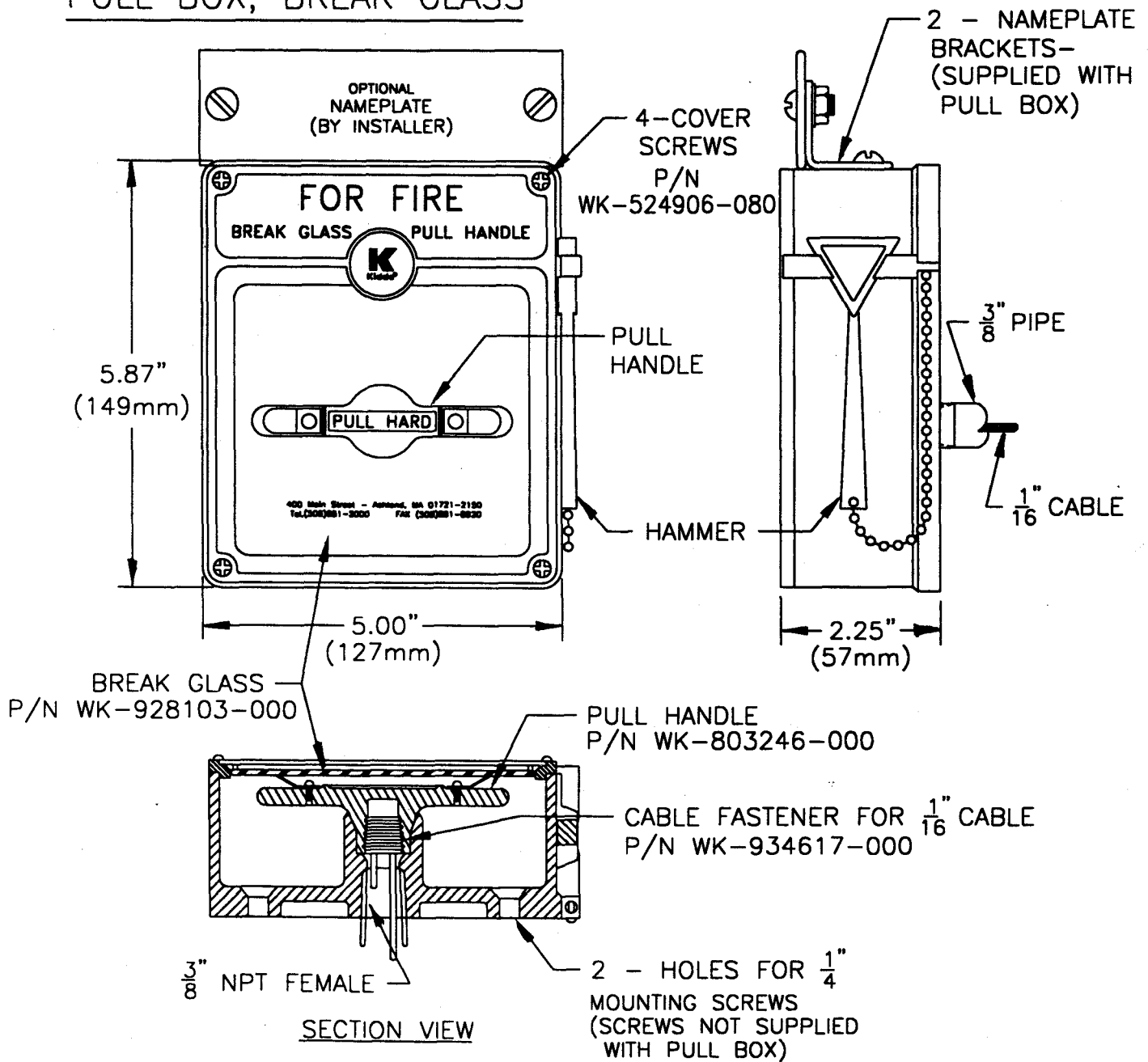


PART NUMBER	CYLINDERS USED WITH		CYLINDER CENTERS		"A" DIMENSION	
	LBS	KG	IN	mm	IN	mm
MARINE CO <sub>2</sub>						
33157	50	22.6	9.5	241	5.12	130
FM-200						
260702	125-200	56.7-90.7	15.0	381	10.6	270
260951	350	158.7	18.0	457	13.6	346
263602	600	272.1	24.0	610	19.6	498

MATERIAL: BRASS, .625" (16mm) O.D. x  
.049" (1.28mm) WALL

P/N - SEE TABLE  
K-6030M

### PULL BOX, BREAK GLASS



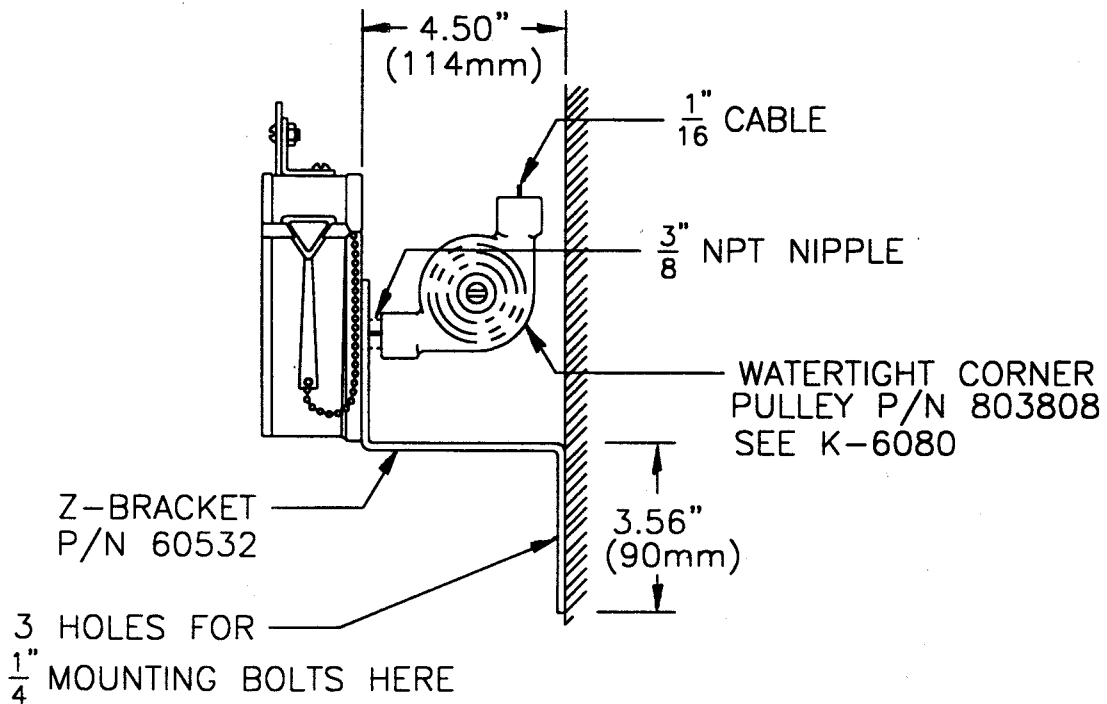
PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

MATERIALS  
BODY: ALUMINUM  
HANDLE: BRASS

P/N - 871403

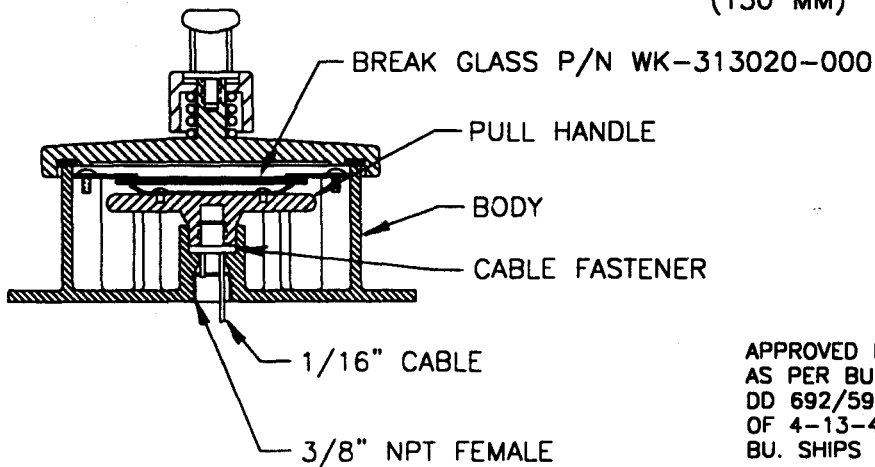
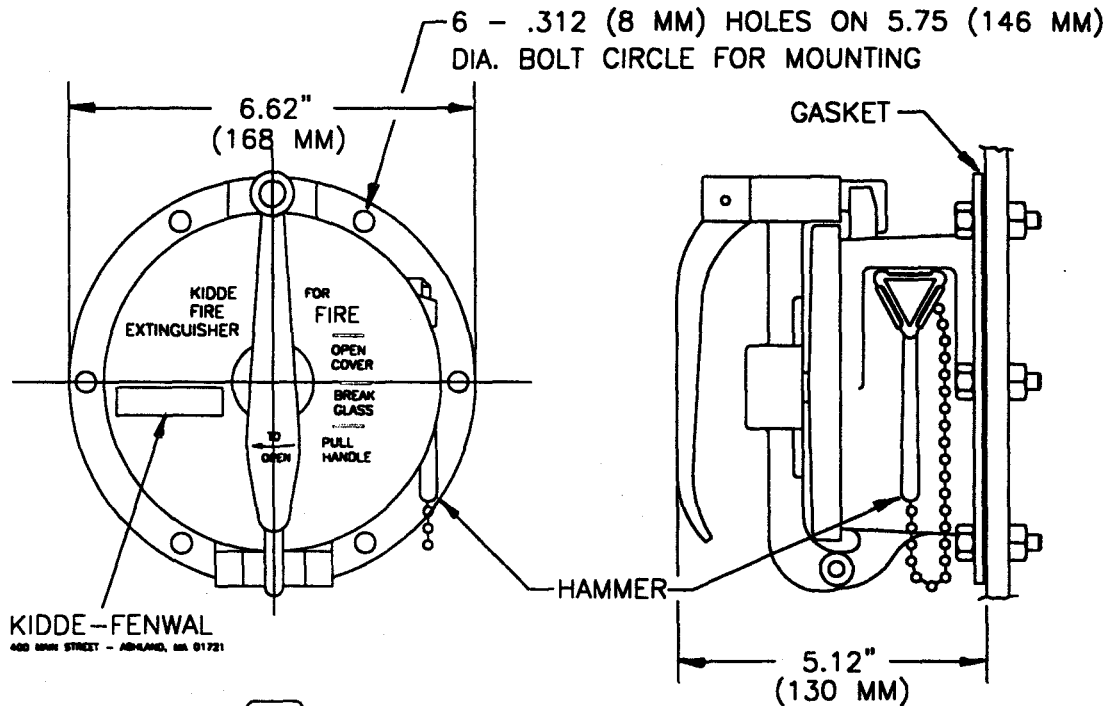
K-6040

### BREAK GLASS PULL BOX USED WITH Z-BRACKET



PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
M-200	X
HALON 1301	X

### WATERTIGHT PULL BOX

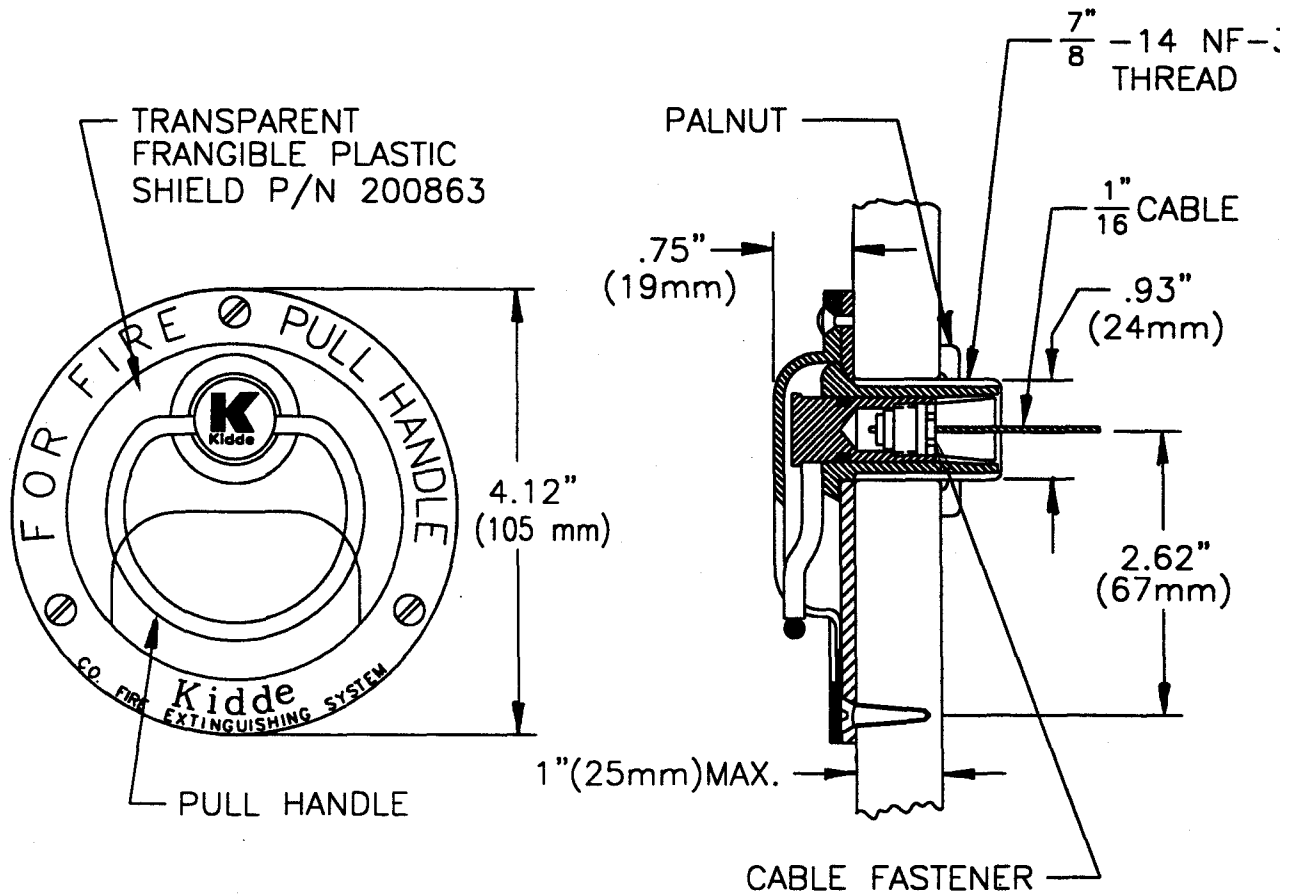


APPROVED BY NAVY DEPT.  
AS PER BU. SHIPS LETTER  
DD 692/593/CV 9/593 (648)  
OF 4-13-44  
BU. SHIPS DWG. 59300-551627

FINISH: RED PAINT WITH BLACK  
RAISED LETTERS.

P/N - 870087  
K-6060M

### FLUSH PULL BOX, YACHT TYPE



MOUNTING HARDWARE PROVIDED:  
 3 - 10-32 FLAT HEAD SCREWS -  $\frac{1}{2}$ " (13mm) LONG  
 3 - NO. 10 FLAT HEAD WOOD SCREWS (SHOWN)  
 $\frac{3}{4}$ " (19mm) LONG

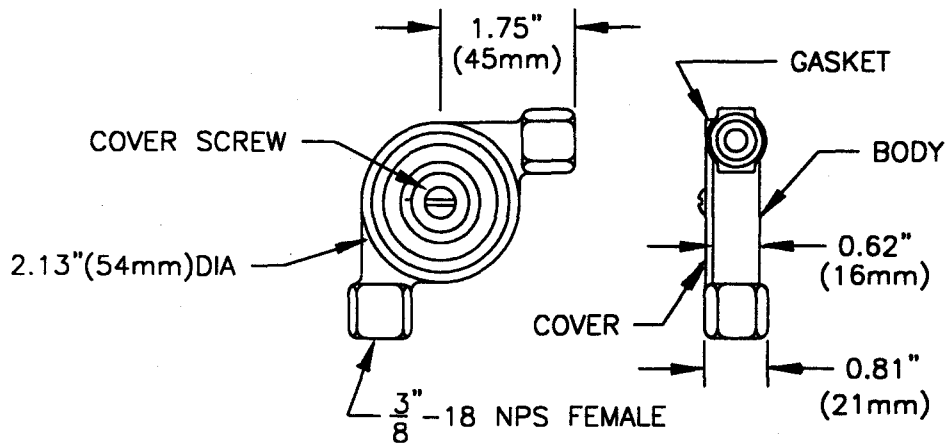
MATERIALS  
 FRANGIBLE SHIELD: LUCITE  
 BODY: BRASS  
 HANDLE: STAINLESS STEEL

PRODUCT	USE
CO <sub>2</sub>	X
FE-13	
FM-200	
HALON 1301	X

P/N - 840098  
 K-6070



WATERTIGHT CORNER PULLEY



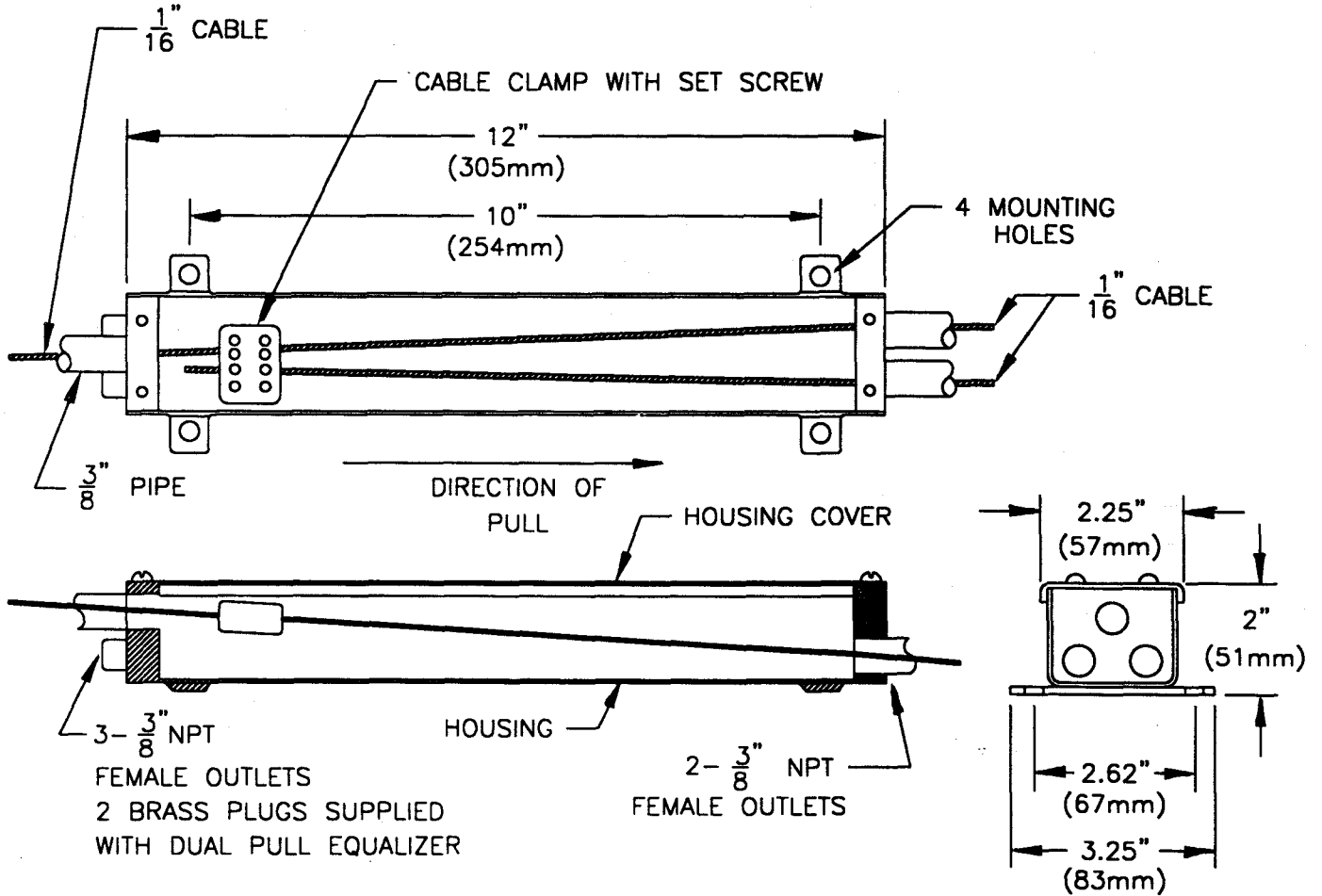
MATERIALS  
COVER AND BODY: BRASS  
GASKET: RUBBER

PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 803808  
K-6080M



### DUAL PULL MECHANISM

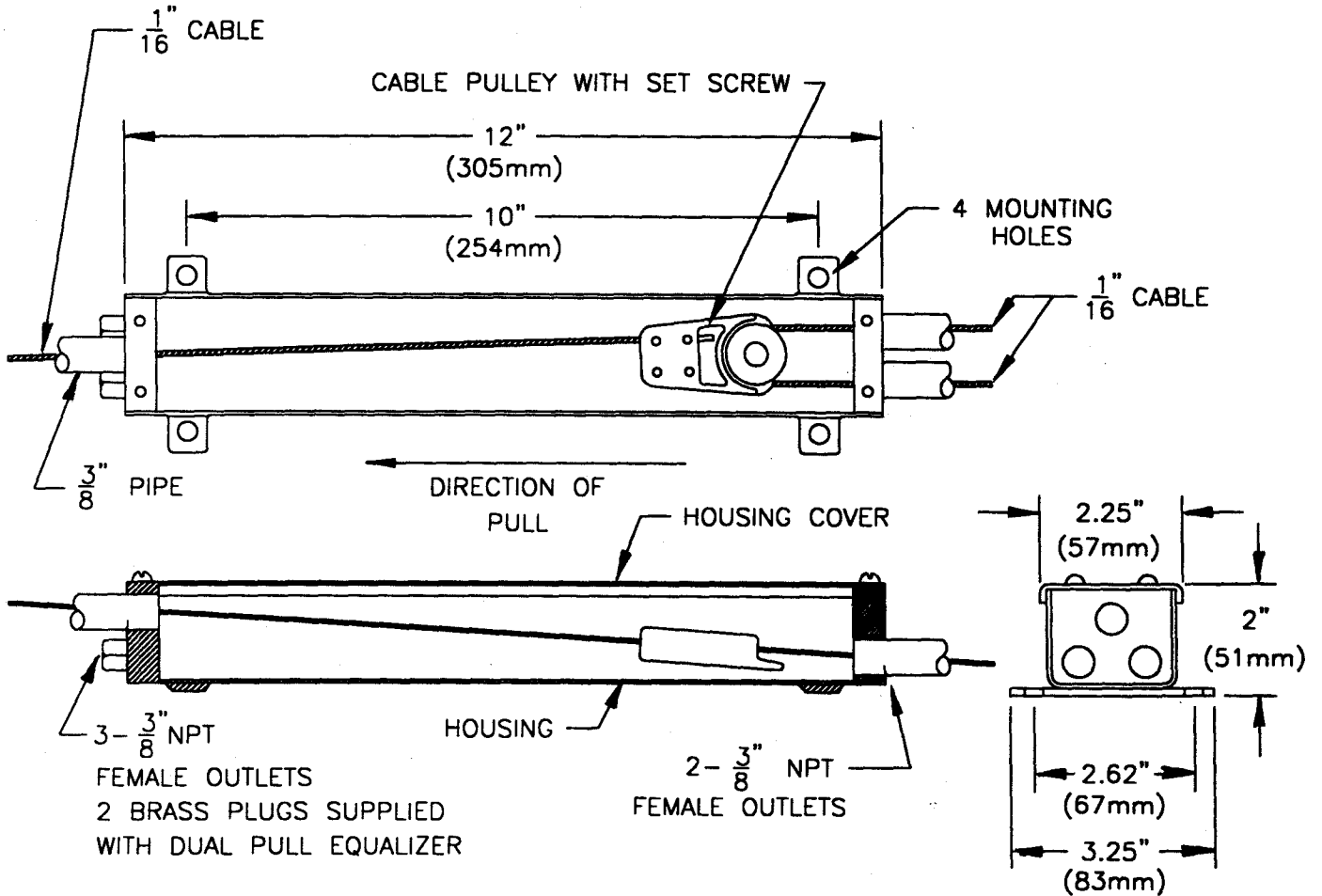


USE  $\frac{3}{32}$ " HEX KEY FOR CABLE PULLEY SET SCREWS.

PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 840058  
K-6100

### DUAL PULL EQUALIZER

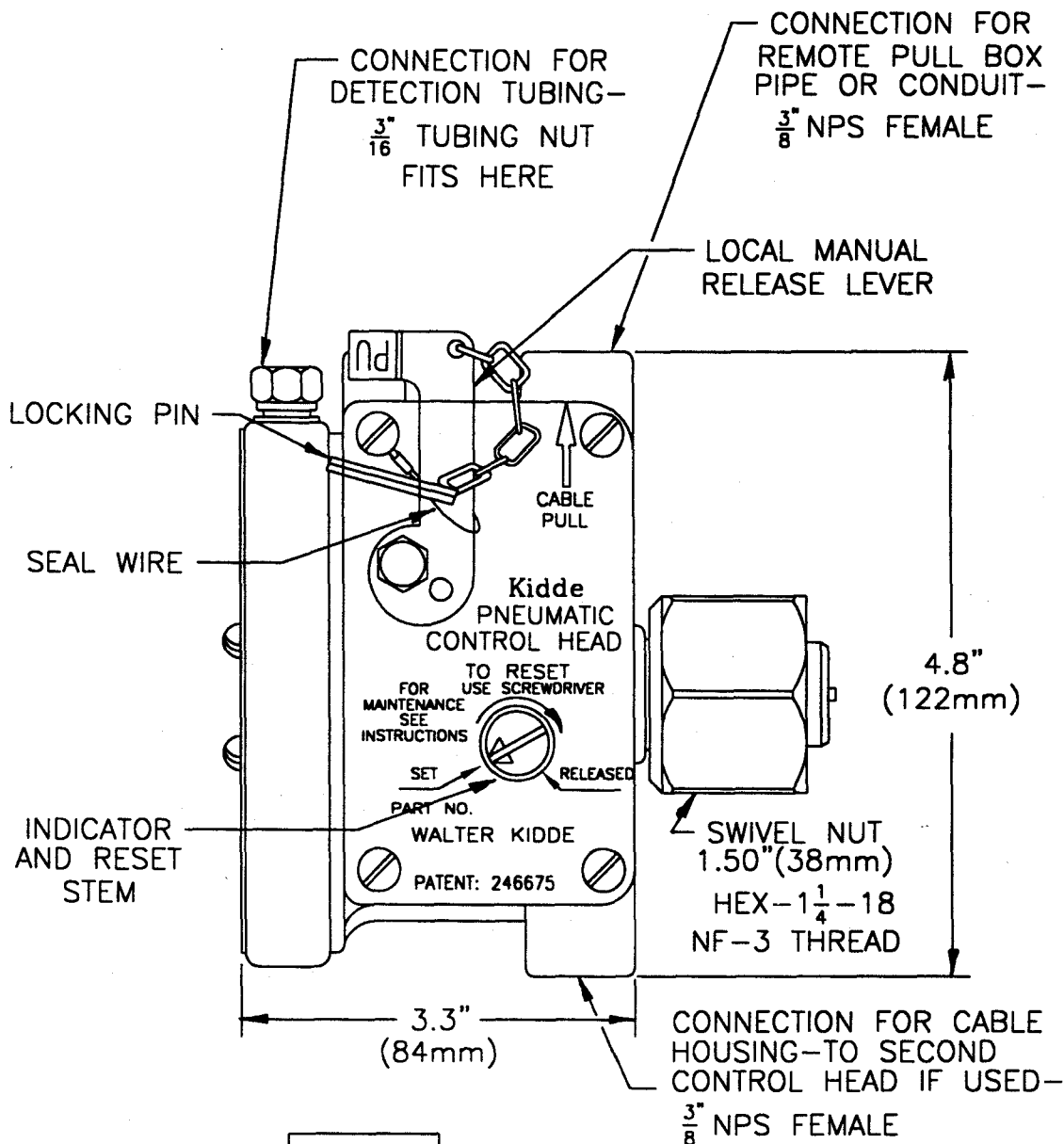


USE  $\frac{3}{32}$ " HEX KEY FOR CABLE PULLEY SET SCREWS.

PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 840051  
K-6110

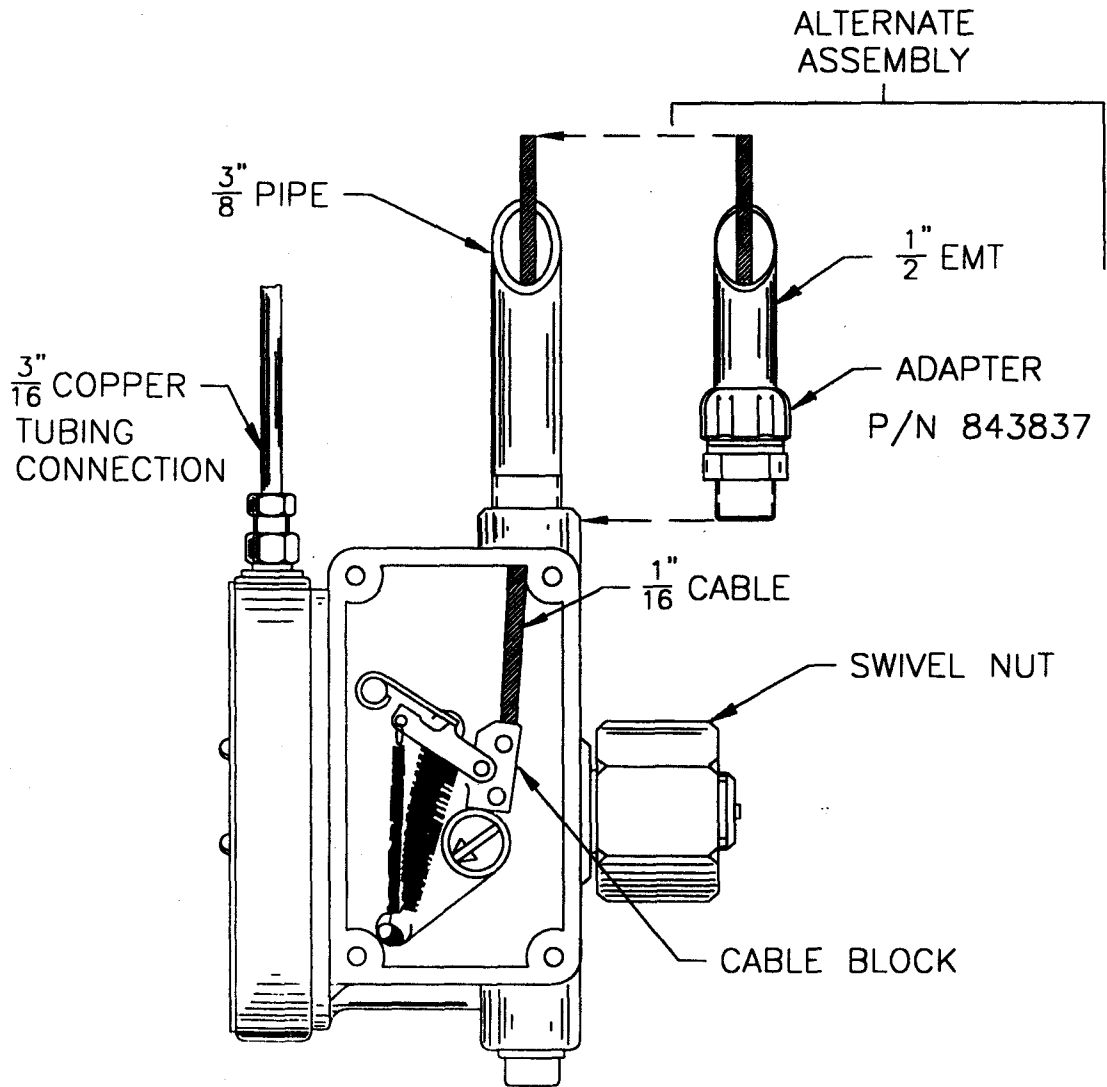
### PNEUMATIC CONTROL HEAD



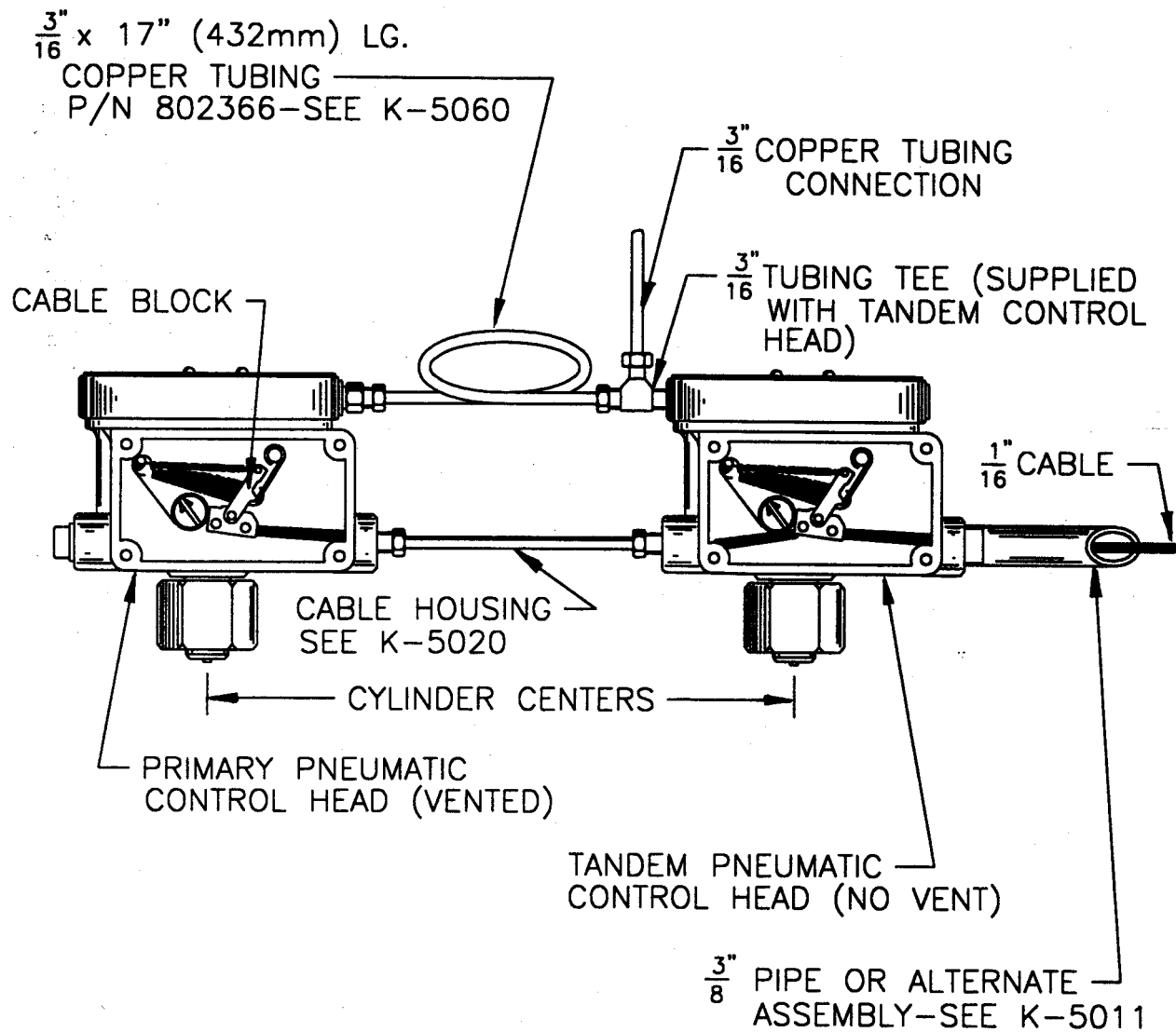
PART NUMBER	CONTROL HEAD
872318	1 IN.—40 SEC.
872335	3 IN.—5 SEC.
872365	6 IN.—5 SEC.
872362	6 IN.—2 SEC.
872310	1 IN.—TANDEM
872330	3 IN.—TANDEM
872360	6 IN.—TANDEM

P/N — SEE TABLE  
K-7010M

### SINGLE PNEUMATIC CONTROL HEAD



### TANDEM PNEUMATIC CONTROL HEADS



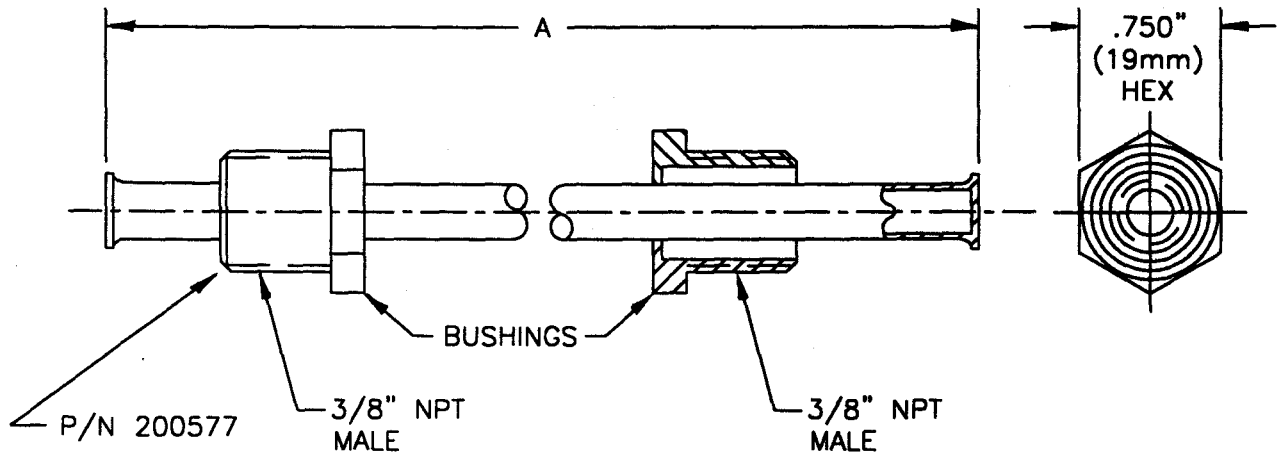


OPERATIONAL DETAIL

PNEUMATIC RATE OF RISE  
CONTROL HEAD SETTING INFORMATION

PART NO. OF CONTROL HEAD	PRES. SETTING	VENT NO.	TEMPERATURE(°F)RISE PER MINUTE FOR NO. OF ACTUATORS EXPOSED TO HEAT					PART NO. OF VENT	WHERE NORMALLY USED
			1	2	3	4	5		
872336	3"	40	15.0	8.6	5.7	4.3	3.4	802746	RECORD STORAGE SLOW TEMP. CHG.
872335	3"	5	28.2	15.0	10.0	8.6	6.9	802745	NORMAL, MODERATE TEMP. CHANGE
872365	6"	5	56.5	28.2	20.0	15.0	12.0	802745	YACHT SYSTEM OUTSIDE WEATHER
872363	6"	3	94.0	47.0	31.4	23.6	20.0	802743	OVENS, DUCTWORK WARM CLIMATE
872362	6"	2	141.0	70.5	47.0	35.3	28.2	802742	OVENS, DUCTWORK COLD CLIMATE
THE FOLLOWING APPLY WHEN MERCURY CHECK CABINETS ARE USED:									
1"-40 CONTROL HEAD AT CYL.'S OR VLV'S 872318	3"	10	20.0	10.0	7.6	5.7	4.6	SAME AS ABOVE	SAME AS ABOVE
	3"	5	37.7	20.0	13.3	10.0	9.2		
	6"	5	61.0	30.5	20.3	17.5	14.0		
	6"	3	110.0	55.0	36.5	27.4	22.0		
	6"	2	165.0	82.0	55.0	41.0	33.0		

### CABLE HOUSINGS FOR PNEUMATIC CONTROL HEADS



PART NUMBER	CYLINDERS USED WITH		CYLINDER CENTERS		"A" DIMENSION	
	LBS	KG	IN	mm	IN	mm
MARINE CO <sub>2</sub>						
840044	50	22.6	9.5	241	4.68	119
FM-200						
844481	125-200	56.7-90.7	15.0	381	10.18	259
844515	350	158.7	18.0	457	13.18	335
844733	600	272.1	24.0	610	19.18	487

MATERIAL:

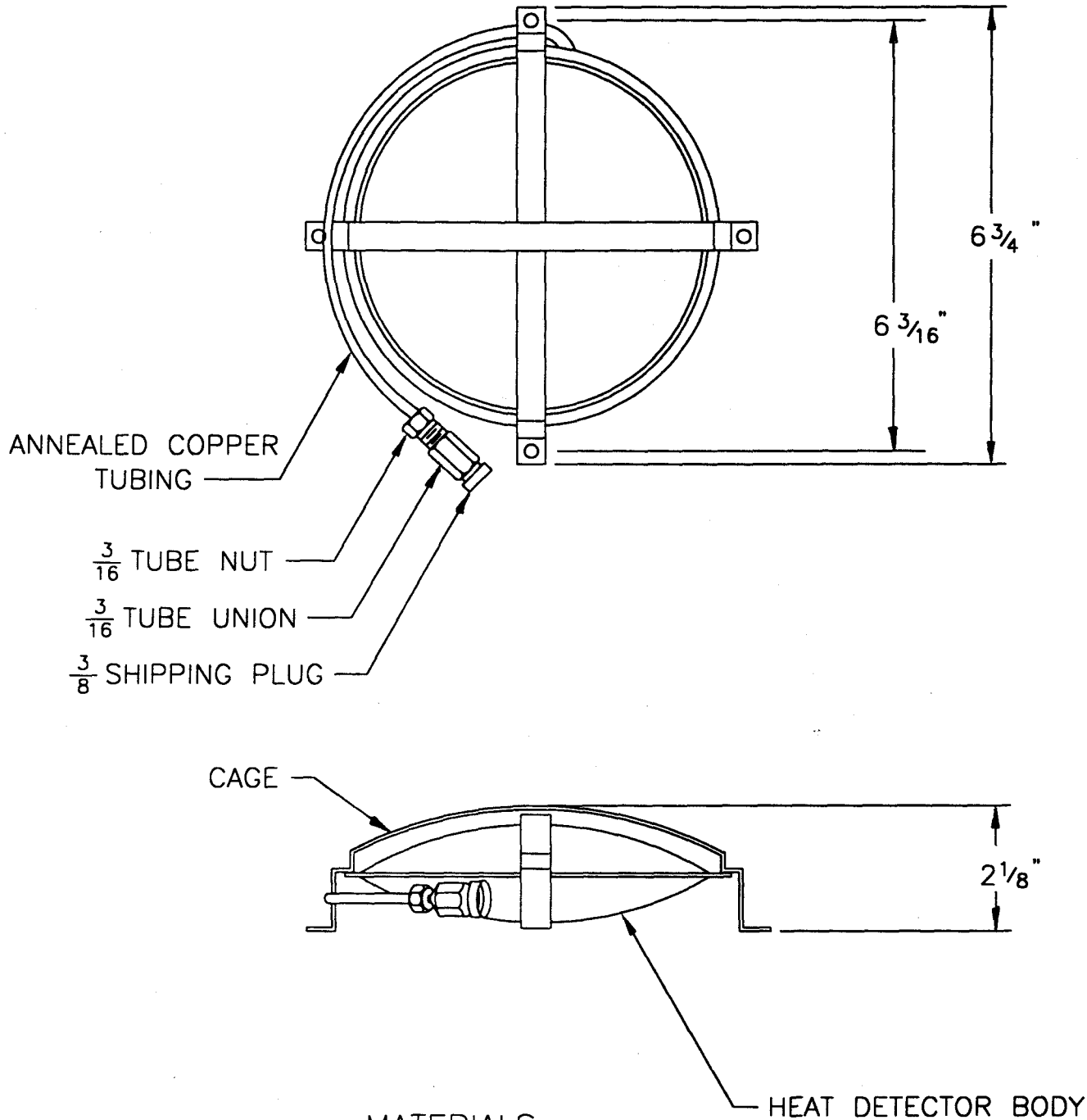
TUBING: BRASS, .312" (8mm) O.D.x

.025" (0.6mm) WALL, CADMIUM PLATED

BUSHING: BRASS, CADMIUM PLATED

SEE TABLE  
K-7020M

### PNEUMATIC HEAT DETECTOR, MARINE



#### MATERIALS—

CAGE AND BODY: STEEL

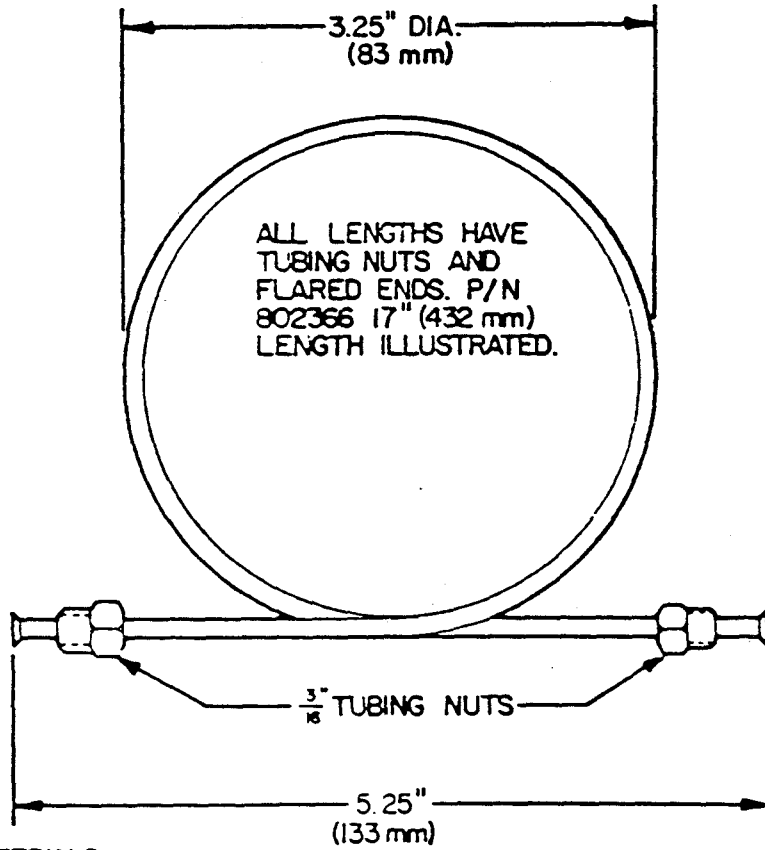
FINISH:  
RED PAINT

P/N — 841241

K-7040M



PART NUMBER	LENGTH
802366	17" (432 mm)
802587	36" (914 mm)
802367	46" (1168 mm)
802486	12' (3.6 m)



MATERIALS  
TUBING: COPPER  
TUBING NUTS: BRASS

**Pneumatic Detection System Tubing, 3/16 Inch**



$\frac{3}{16}$ " TUBING NUT  
P/N 5281-0300



$\frac{3}{16}$ " UNION WITHOUT NUTS  
P/N 5281-0360



$\frac{3}{16}$ " x  $\frac{1}{8}$ " REDUCING UNION  
WITH  $\frac{1}{8}$ " NUT  
WITHOUT  $\frac{3}{16}$ " NUT  
P/N 802536

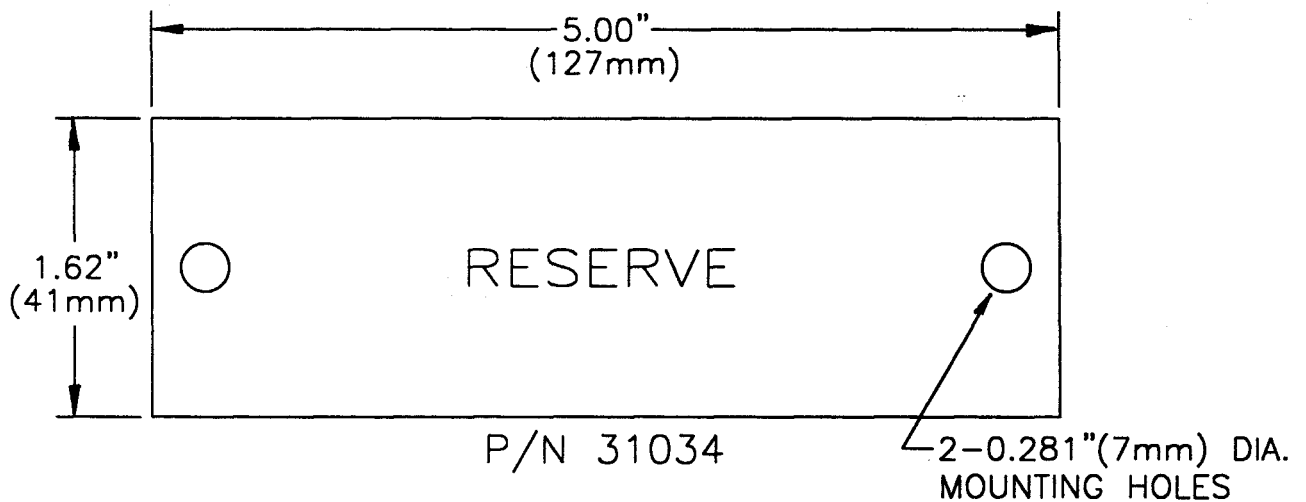
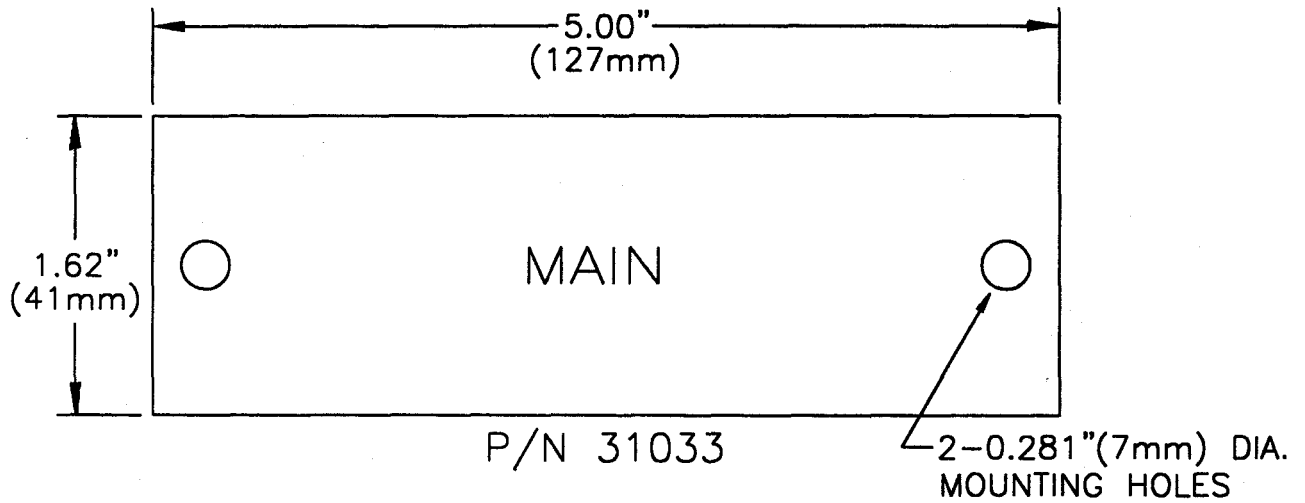


$\frac{3}{16}$ " TEE WITHOUT NUTS  
P/N 5281-0370

MATERIAL: BRASS  
ALL FITTINGS S. A. E. INVERTED FLARE

### Pneumatic Detection System Tubing Fittings

### MAIN AND RESERVE NAMEPLATES



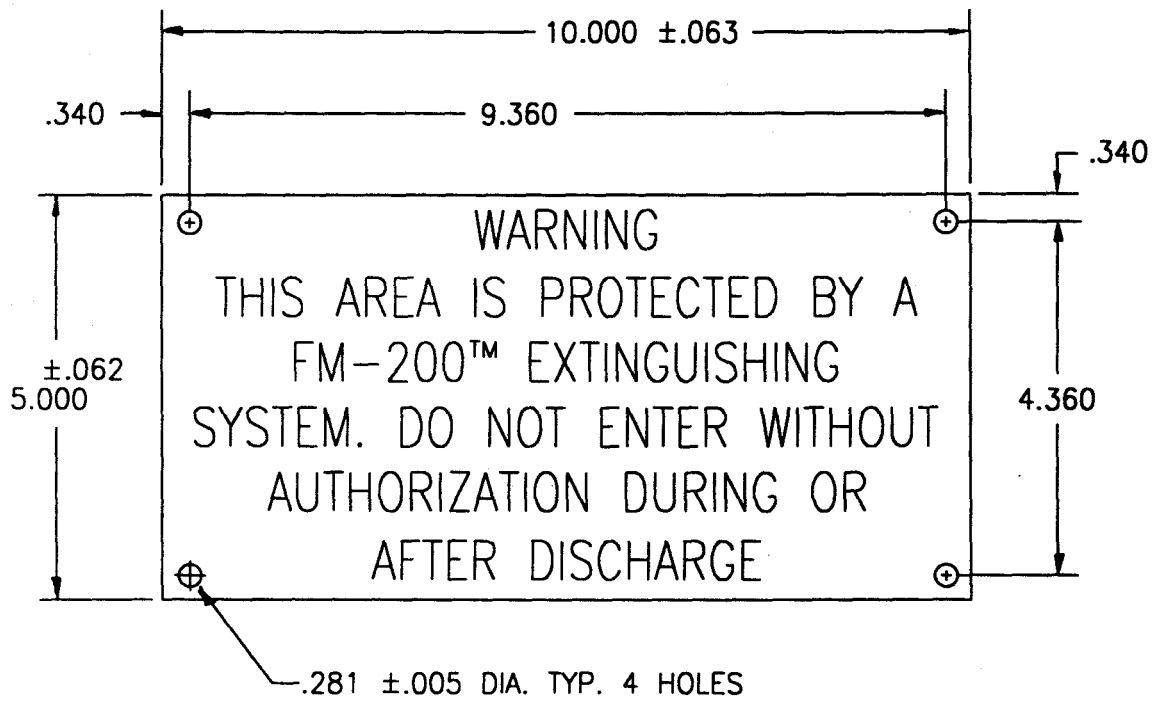
PRODUCT	USE
CO <sub>2</sub>	X
FE-13	X
FM-200	X
HALON 1301	X

MATERIAL: ALUMINUM WITH  
RED PAINT LETTERS

P/N - SEE ABOVE

K-9010

### WARNING NAMEPLATE (FM-200)



#### NOTES:

- MATERIAL: ALUM. TYPE 1100-H14 OR 3003-H14,  $.032 \pm .003$  THICK.  
ALL LETTERS TO BE 48 PT. ALTERNATE GOTHIC #2.  
ETCHED  $.003 - .005$  & FILLED IN WITH RED CHIP PROOF ENAMEL  
COLOR NO. 21105 PER FED. STD. 595.
- FINISH: ONE COAT CLEAR LACQUER BOTH SIDES.

PRODUCT	USE
CO <sub>2</sub>	
FE-13	
FM-200	<b>X</b>
HALON 1301	

P/N - 06-231865-739

K-9030

**APPENDIX D**  
**USCG CERTIFICATE OF APPROVAL**





U.S. Department of Transportation  
**United States Coast Guard**

# Certificate of Approval

COAST GUARD APPROVAL NO: 162.161/1/0                      EXPIRES: MAY 4, 2003  
Engineered Halocarbon Fire Extinguishing Systems

EXTINGUISHING SYSTEM

KIDDE-FENWAL INC.  
400 MAIN STREET  
ASHLAND, MA 01721

FM-200 ECS Series Engineered Fire Suppression System.

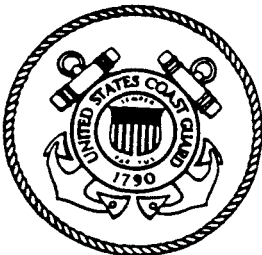
Identifying Data: Underwriters Laboratories File EX 4674  
Kidde Manual 90-FM200-021 Ver 1.0 dated 5-98

System to be in accordance with Kidde FM-200 ECS Series Marine Design,  
Installation, Operation and Maintenance Manual. Meets IMO MSC/Circ 776.

System to be manufactured, installed and maintained in accordance with (1)  
Kidde Design, Installation, Operation and Maintenance Manual For Marine  
FM-200 Systems, (US Coast Guard Rules) P/N 90-FM200M-021 Version 1.0 dated  
May 1998. (2) NFPA 2001 (3) IMO MSC Circular 776, (4) Underwriters  
Laboratories Listing and (5) US Coast Guard requirements.

\*\*\* END \*\*\*

THIS IS TO CERTIFY THAT the above named manufacturer has submitted to the undersigned satisfactory evidence that the item specified herein  
complies with the applicable laws and regulations as outlined on the reverse side of this Certificate, and approval is hereby given. This approval shall be in  
effect until the expiration date hereon unless sooner canceled or suspended by proper authority.



GIVEN UNDER MY HAND THIS 4TH DAY OF  
MAY 1998, AT WASHINGTON D.C.

*R. L. Markle*

R. L. MARKLE  
CHIEF, LIFESAVING & FIRE SAFETY STDS.  
BY DIRECTION OF THE COMMANDANT, U.S.C.G.

**TERMS:** The approval of the item described on the face of the Certificate has been based upon the submittal of satisfactory evidence that the item complies with the applicable provisions of the navigation and shipping laws and the applicable regulations in Title 33 and/or Title 46 of the Code of Federal Regulations. The approval is subject to any conditions noted on this Certificate and in the applicable laws and regulations governing the use of the item on vessels subject to Coast Guard inspection or on other vessels and boats.

Consideration will be given to an extension of this approval provided application is made 3 months prior to the expiration date of this Certificate.

The approval holder is responsible for making sure that the required inspections or tests of materials or devices covered by this approval are carried out during production as prescribed in the applicable regulations.

The approval of the item covered by this certificate is valid only so long as the item is manufactured in conformance with the details of the approved drawings, specifications, or other data referred to. No modification in the approved design, construction, or materials is to be adopted until the modification has been presented for consideration by the Commandant and confirmation received that the proposed alteration is acceptable.

**NOTICE:** Where a manufacturer of safety-at-sea equipment is offering for sale to the maritime industry, directly or indirectly, equipment represented to be approved, which fails to conform with either the design details or material specifications, or both, as approved by the Coast Guard, immediate action may be taken to invoke the various penalties and sanctions provided by law including prosecution under 46 U.S.C. 3318, which provides:

"A person that knowingly manufactures, sells, offers for sale, or possesses with intent to sell, any equipment subject to this part (*Part B. of Subtitle II of Title 46 U.S.C.*) and the equipment is so defective as to be insufficient to accomplish the purpose for which it is intended, shall be fined not more than \$10,000, imprisoned for not more than 5 years, or both."



**APPENDIX E**

**(DELETED)**



**APPENDIX F**

**(DELETED)**



**APPENDIX G**  
**SYSTEM DESIGN CHECKLIST**



All FM-200 designs must be submitted to Kidde for review to ensure compliance with this technical manual. The attached checklist has been developed to assist the marine FM-200 system designer in assembling an FM-200 submittal for review.

Upon receipt of each new submittal, Kidde will open a project file. Kidde will also fax an acknowledgment to confirm receipt of the submittal and provide the designer with the FM-200 project number assigned to the project file. Until the review process is complete and the documents have been submitted to Kidde Customer Services for order processing, one must reference this FM-200 project number on all inquiries.







400 Main Street      Tel:      (508) 881-2000  
Ashland, MA 01721      Fax:      (508) 881-8920

## MARINE FM-200 SYSTEM REVIEW CHECKLIST

**Distributor:** \_\_\_\_\_  
**Distributor Contact Name:** \_\_\_\_\_  
**Designer Name** \_\_\_\_\_  
**Telephone No.:** \_\_\_\_\_  
**Fax No.:** \_\_\_\_\_  
**Distributor PO No.:** \_\_\_\_\_  
**Project Name/Hull #:** \_\_\_\_\_  
**Hazard Description:** \_\_\_\_\_

- Hazard information (check all that apply):
- Class A      Possible Deep-Seated:     YES     NO
  - Class B      Materials: \_\_\_\_\_
  - Class C
  - Minimum design concentration (%) : \_\_\_\_\_
  - Design temperature range (°F): Min. \_\_\_\_\_ Max. \_\_\_\_\_
  - Plan view drawings (including dimensions or scale, cylinder and nozzle locations)
  - Elevation view drawings (including dimensions or scale)
  - Isometric drawings (including pipe sizes and dimensions) for engineered systems
  - Main system only    OR     Main/Reserve system
- Calculations
- Complete flow calculation(s) for engineered systems (All pages required).
  - Model check valves, el-checks and stop valves in the appropriate node section.
  - Calculation is run at hazard design temperature range indicated above
  - Ensure that **all warnings** in the **System Data** section of the flow calculation are resolved.
  - Ensure that all flow splits are of acceptable configuration including requirement for 15x pipe diameter runs needed to ensure flow equilibration.
- Indicate if a notification of system approval is required.

**NOTE:**      All FM-200 project submittals shall include a **completed** Checklist (with the associated information). Incomplete project submittals received without this Checklist will delay the review process and shipment of product.



**APPENDIX H**  
**FM-200 AGENT**  
**CONCENTRATIONS TABLE**



<b>Fuel</b>	<b>Design Concentration, %v/v (cup burner + 30%)</b>	<b>Fuel</b>	<b>Design Concentration, %v/v (cup burner + 30%)</b>
Acetone	9.0	Hydraulic Fluid	8.5
Acetonitrile	5.6	Hydraulic Oil	7.7
t-Amyl Alcohol	9.5	Hydrogen	17.2
AV Gas	8.5	Isobutyl Alcohol	9.9
Benzene	7.2	Isopropanol	9.8
n-Butane	8.6	JP4	9.0
n-Butanol	9.9	JP5	9.0
2-Butoxyethanol	9.6	Kerosene	9.6
2-Butoxyethyl Acetate	9.0	Methane	7.2
n-Butyl Acetate	9.1	Methanol	13.5
Carbon Disulfide	15.3	2-Methoxyethanol	12.2
Chloroethane	8.2	Methyl Ethyl Ketone	9.6
Crude Oil	8.5	Methyl Isobutyl Ketone	9.1
Cyclohexane	9.4	Mineral Spirits	8.6
Cyclohexylamine	8.7	Morpholine	10.3
Cyclopentanone	9.6	Nitromethane	12.9
1,2 -Dichloroethane	3.4	n-Pentane	8.8
Diesel	8.7	Propane	8.7
N,N -Diethylethanolamine	10.1	1-Propanol	10.0
Diethyl Ether	9.8	Propylene	8.1
Ethane	8.7	Propylene Glycol	11.2
Ethanol	10.8	Pyrrolidine	9.5
Ethyl Acetate	8.8	Tetrahydrofuran	9.6
Ethyl Benzene	8.2	Tetrahydrothiophene	8.6
Ethylene	10.9	Toluene	7.3
Ethylene Glycol	9.9	Tolyene-2, 4-Diisocyanate	5.2
Gasoline	9.0	Transformer Oil	9.5
n-Hexane	9.0	Xylene	7.8
1-Hexene	7.5		

**FM-200 Agent Concentrations Table**



**APPENDIX I**

**FM-200 MARINE SYSTEM ARRANGEMENTS**





1



FM-200 CYLINDER



CO<sub>2</sub> PILOT CYLINDER WITH DISCHARGE HEAD

2



NITROGEN PILOT CYLINDER



TIME DELAY (CO<sub>2</sub> OPERATED)



CONTROL HEAD, CABLE OPERATED\*



SIREN, PRESSURE OPERATED



CONTROL HEAD, LEVER OPERATED\*



SIREN, ELECTRICALLY OPERATED



CONTROL HEAD, PNEUMATICALLY OPERATED\*



DISCHARGE NOZZLE



CONTROL HEAD, LEVER/PRESSURE OPERATED\*



CONTROL HEAD, PRESSURE OPERATED



SAFETY OUTLET



PRESSURE SWITCH



DISCHARGE INDICATOR



PRESSURE TRIP



EL-CHECK

3



STOP VALVE, PRESSURE OPERATED



BALL VALVE



STOP VALVE, CABLE OPERATED



MANUAL STATION, CABLE OPERATED



PNEUMATIC HEAT DETECTOR



MANUAL STATION, ELECTRICALLY OPERATED

4

\*CONTROL HEAD IS EQUIPPED WITH MANUAL RELEASE LEVER TO ENABLE LOCAL ACTUATION

**KIDDE**

KIDDE-FORMIL, INC.  
400 MAIN STREET  
BRIMFIELD, MA 01701

FM-200 MARINE ECS SERIES  
USCG TYPE

TITLE  
SYMBOL LEGEND

CODE IDENT NO. OKDP7	SIZE A	SKETCH NO. LG-1CG	REV A
SCALE None	DATE APR-87	SHEET 1 of 1	

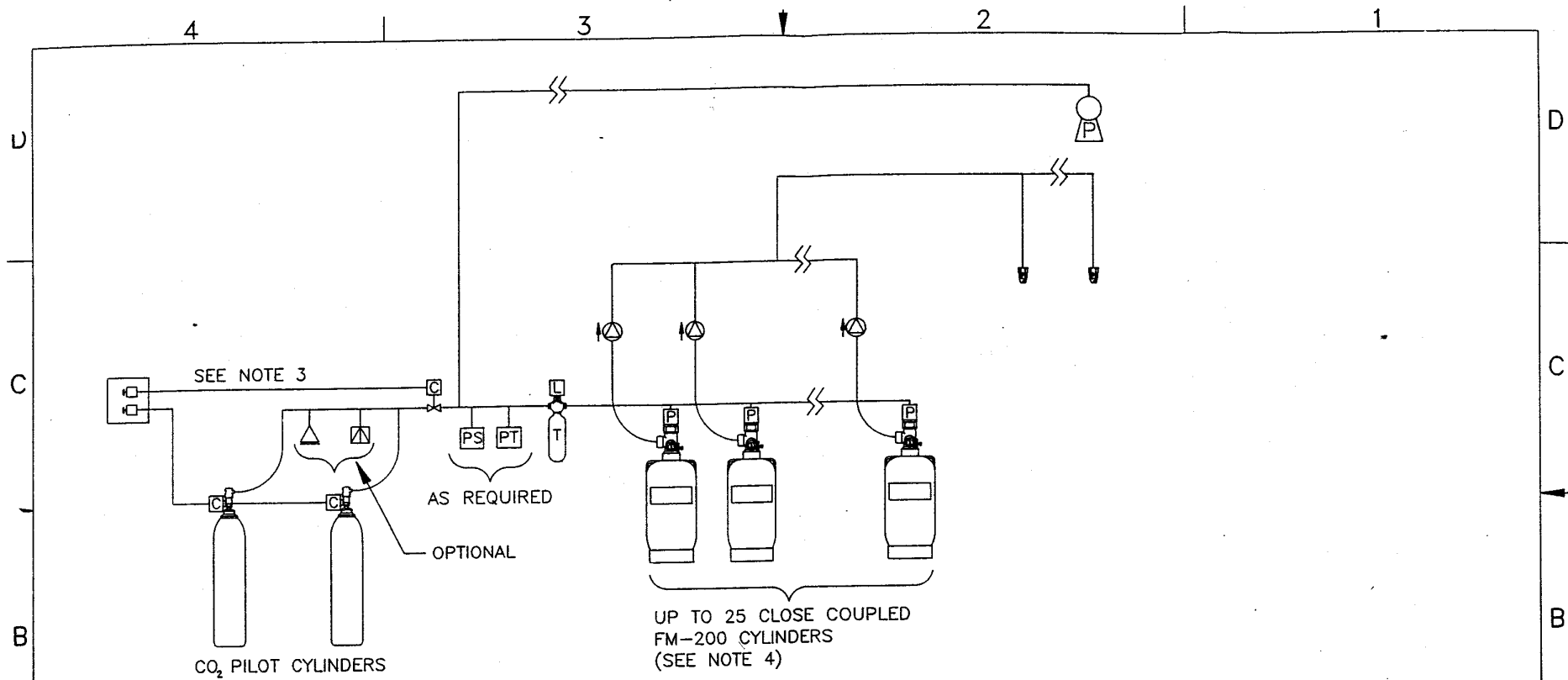
A

B

C

D

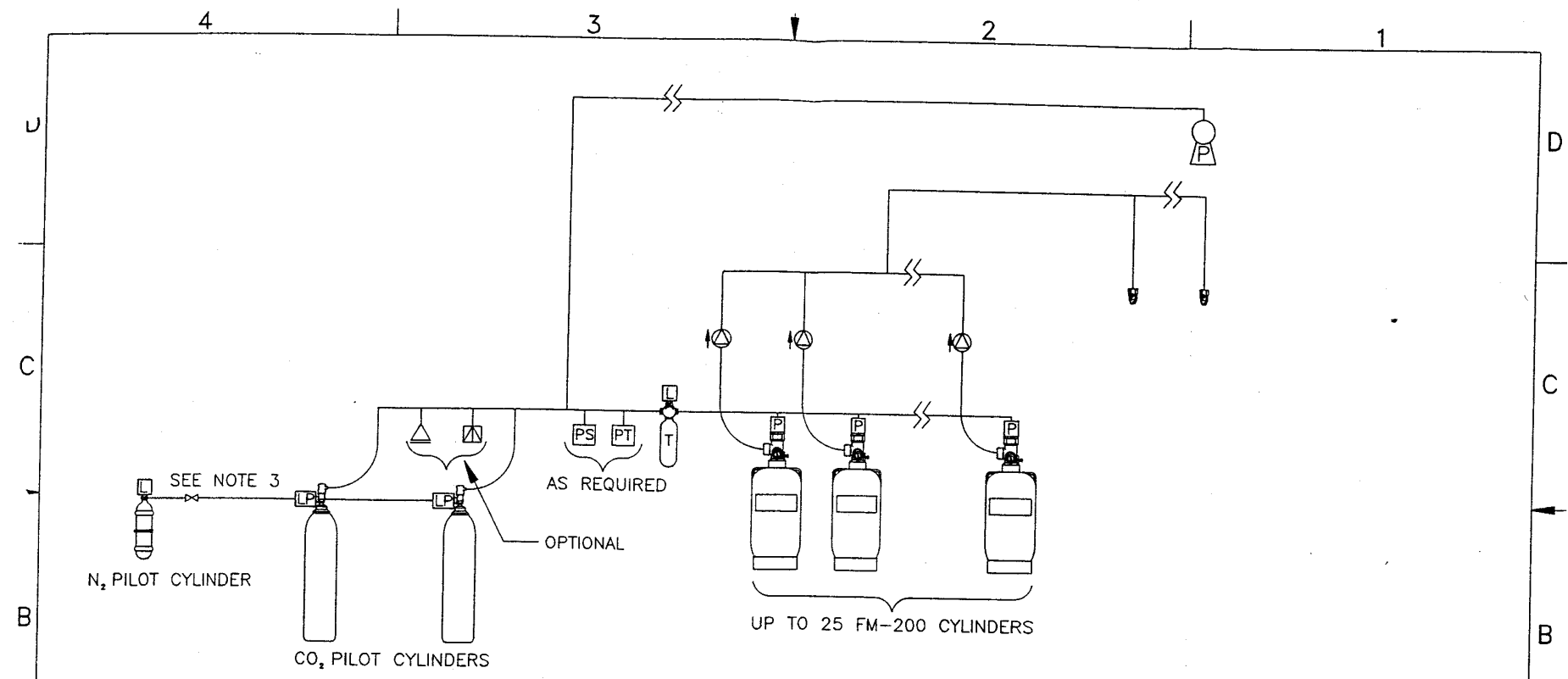




- NOTES:
1. TWO SEPARATE AND DISTINCT OPERATIONS PROVIDED PER USCG RULES
  2. LINE BETWEEN PRESSURE OPERATED PILOT CYLINDERS AND PRESSURE OPERATED SIREN SHALL BE 1/2" PIPE WITH A MAXIMUM LENGTH OF 250 FEET
  3. SEE SECTION 3.6.2.1 OF MANUAL FOR CORNER PULLEY & CABLE LIMITATIONS
  4. DWG SHOWS CLOSE COUPLED FM-200 CYLINDERS ACTUATED BY PRESSURE OPERATED CONTROL HEADS WITH CO<sub>2</sub> PRESSURE. IT IS ALSO POSSIBLE TO HAVE MASTER AND SLAVE FM-200 CYLINDERS WHERE MASTER FM-200 CYLINDERS ACTUATED BY PRESSURE OPERATED CONTROL HEADS WITH CO<sub>2</sub> IN TURN ACTUATE SLAVE FM-200 CYLINDERS ACTUATED BY PRESSURE OPERATED CONTROL HEADS WITH FM-200  
SEE SECTION 3.6.2.2 OF MANUAL FOR DETAILS

		KIDDE-FENVAL, INC. 400 MAIN STREET ASHLAND, MA 01721	
<b>FM-200 MARINE ECS SERIES USCG TYPE</b>			
TITLE			
<b>MANUAL CABLE ACTUATION</b>			
CODE IDENT NO.	SIZE	SKETCH NO.	REV
OKDP7	B	BC-1CG	A
SCALE None	DATE JUL-97	SHEET 1 of 1	

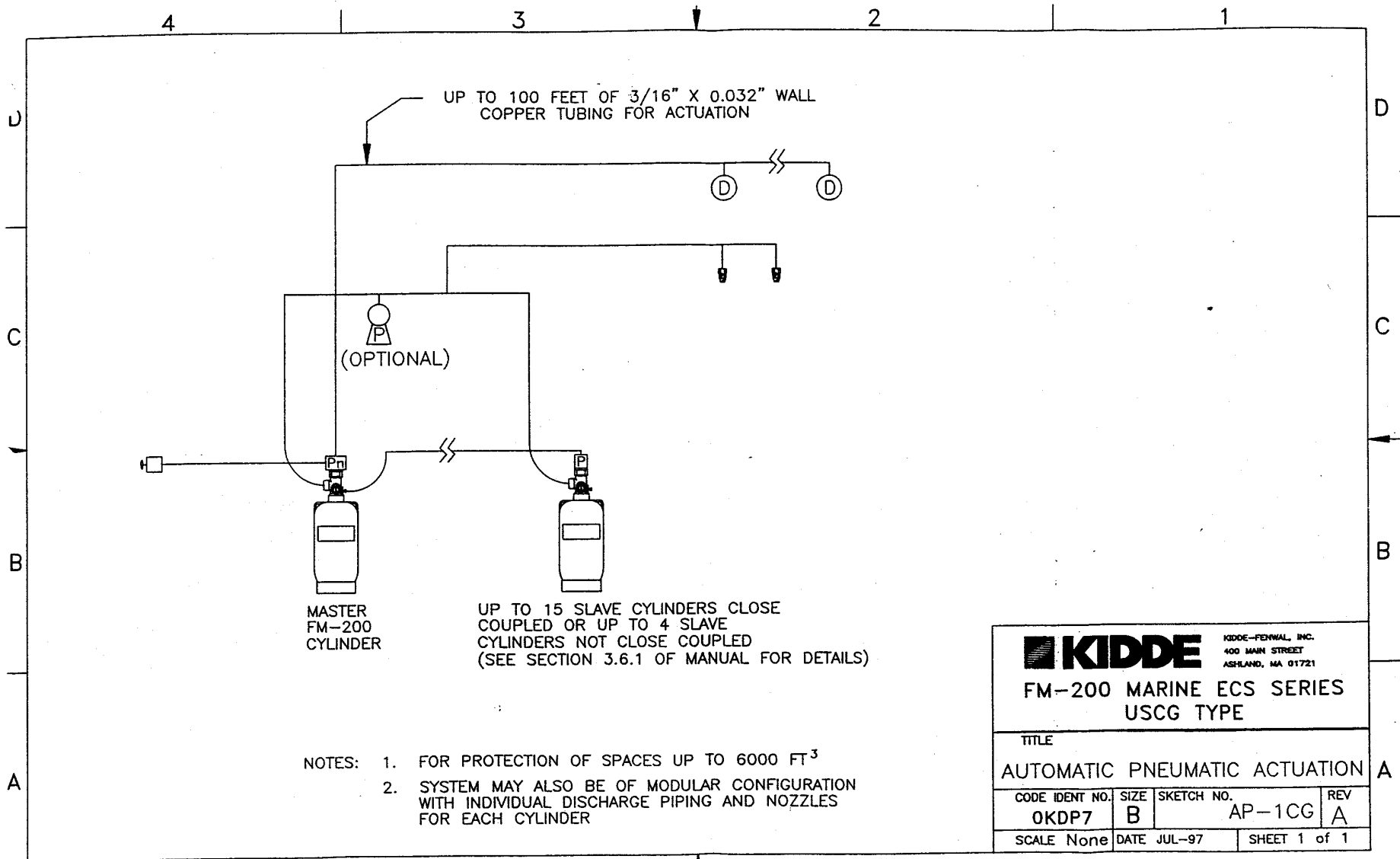




- NOTES:
1. TWO SEPARATE AND DISTINCT OPERATIONS PROVIDED PER USCG RULES
  2. LINE BETWEEN PRESURE OPERATED PILOT CYLINDERS AND PRESURE OPERATED SIREN SHALL BE 1/2" PIPE WITH A MAXIMUM LENGTH OF 250 FEET
  3. SEE SECTION 3.6.2.2 OF MANUAL FOR PILOT LINE LIMITATIONS
  4. DWG SHOWS CLOSE COUPLED FM-200 CYLINDERS ACTUATED BY PRESSURE OPERATED CONTROL HEADS WITH CO<sub>2</sub> PRESSURE. IT IS ALSO POSSIBLE TO HAVE MASTER AND SLAVE FM-200 CYLINDERS WHERE MASTER FM-200 CYLINDERS ACTUATED BY PRESSURE OPERATED CONTROL HEADS WITH CO<sub>2</sub> IN TURN ACTUATE SLAVE FM-200 CYLINDERS ACTUATED BY PRESSURE OPERATED CONTROL HEADS WITH FM-200 SEE SECTION 3.6.2.2 OF MANUAL FOR DETAILS

<b>KIDDE</b>		KIDDE-FENVAL, INC. 400 MAIN STREET ASHLAND, MA 01721	
<b>FM-200 MARINE ECS SERIES USCG TYPE</b>			
TITLE			
<b>MANUAL PRESSURE ACTUATION</b>			
CODE IDENT NO. OKDP7	SIZE B	SKETCH NO. BP-1CG	REV A
SCALE None	DATE JUL-97	SHEET 1 of 1	





MASTER  
FM-200  
CYLINDER

UP TO 15 SLAVE CYLINDERS CLOSE  
COUPLED OR UP TO 4 SLAVE  
CYLINDERS NOT CLOSE COUPLED  
(SEE SECTION 3.6.1 OF MANUAL FOR DETAILS)

(OPTIONAL)

UP TO 100 FEET OF 3/16" X 0.032" WALL  
COPPER TUBING FOR ACTUATION

- NOTES: 1. FOR PROTECTION OF SPACES UP TO 6000 FT<sup>3</sup>  
2. SYSTEM MAY ALSO BE OF MODULAR CONFIGURATION  
WITH INDIVIDUAL DISCHARGE PIPING AND NOZZLES  
FOR EACH CYLINDER

<b>KIDDE</b>				KIDDE-FENNAL, INC. 400 MAIN STREET ASHLAND, MA 01721	
FM-200 MARINE ECS SERIES USCG TYPE					
TITLE					
AUTOMATIC PNEUMATIC ACTUATION					
CODE IDENT NO.	SIZE	SKETCH NO.	REV		
OKDP7	B	AP-1CG	A		
SCALE	None	DATE	JUL-97	SHEET 1 of 1	





## **SECTION III**

### **PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS) FOR FM-200 AND WATER WASHDOWN SYSTEM (WWS)**



**PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS) FOR FM-200 SYSTEM.**

**SYSTEM MAINTENANCE.** In order to ensure each FM-200 system operates as designed and installed, Preventive Maintenance Checks and Services (PMCS) must be performed in accordance with the following requirements.

**PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS) FOR ENGINE ROOM FM-200 SYSTEM.** The following identifies the PMCS required to maintain the Engine Room FM-200 system in a fully operational condition:

Item No.	Interval	Item to be Inspected	Maintenance Level	Procedure
1	Monthly	Pressure, FM-200 cylinders	Crew	Check pressure gauges for proper operating pressure. If pressure gauge indicator is not in green, submit Work Order to General Support (GS) Maintenance to have cylinder recharged.
2	Monthly	Liquid level, FM-200 cylinders*	Crew	Take liquid level readings in accordance with instructions contained in Section II of this document. If liquid level is low, submit Work Order to General Support (GS) Maintenance to have cylinder recharged.
3	Monthly	Complete FM-200 System	Crew	Inspect system components in accordance with instructions contained in Section II of this document. If any component is damaged, submit Work Order to General Support (GS) Maintenance.
4	Quarterly	Ventilation dampers and closures	Crew	Operate and service Engine Room Supply Air Dampers (Port and Starboard), Engine Room Exhaust Air Dampers (Port and Starboard).
5	Quarterly	Steering Gear Compartment Sliding Watertight Door	Crew	Operate door to verify operation in accordance with manufacturer's manual. Perform maintenance in accordance with manufacturer's maintenance instructions.
6	Semi-Annually	FM-200 Pressure Switches	Crew	Ensure all diesel engines and powered ventilation system shutdowns are in operation. Manually raise plunger on Pressure Switch. Confirm automatic shutdown of operating engines and ventilation systems. Confirm activation of Warning Lights, Electric Horn/Strobe and Warning Bell. Reset plunger on Pressure Switches. If any engine or ventilation system fails to shutdown automatically, submit Work Order to General Support (GS) Maintenance. If any Warning Lights, Electric Horn/Strobe or Warning Bell fail to operate, repair component.

Item No.	Interval	Item to be Inspected	Maintenance Level	Procedure
7	Annually	Complete FM-200 system	General Support	Obtain services of Manufacturer's Certified Technical Representative and perform Annual Recertification.
8	Post system disassembly	FM-200 piping and distribution system	General Support	Perform test of FM-200 piping and distribution system per testing requirements identified on Drawing LSV-1-5553-1.
9	Post system activation	Complete FM-200 system	General Support	Obtain services of Manufacturer's Certified Technical Representative and request System Recertification.

\* Note - Refer to the Kidde Fire Systems FM-200 ECS Series Engineered Design, Installation, Operation and Maintenance Manual for Marine FM-200 Systems for temperature correction charts.

**PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS) FOR PAINT LOCKER FM-200 SYSTEM.** The following identifies the PMCS required to maintain the Paint Locker FM-200 system in a fully operational condition:

Item No.	Interval	Item to be Inspected	Maintenance Level	Procedure
1	Monthly	Pressure, FM-200 cylinder	Crew	Check pressure gauge for proper operating pressure. If pressure gauge indicator is not in green, submit Work Order to General Support (GS) Maintenance to have cylinder recharged.
2	Monthly	Complete FM-200 System	Crew	Inspect system components in accordance with instructions contained in Section II of this document. If any component is damaged, submit Work Order to General Support (GS) Maintenance.
3	Semi-Annually	FM-200 Pressure Switch	Crew	Ensure powered ventilation system shutdown is in operation. Manually raise plunger on Pressure Switch. Confirm automatic shutdown of ventilation system. Confirm activation of Warning Bell. Reset plunger on Pressure Switch. If ventilation system fails to operate, submit work order to General Support (GS) Maintenance. If Warning Bell fails to operate, repair Warning Bell.
4	Annually	Complete FM-200 system	General Support	Obtain services of Manufacturer's Certified Technical Representative and perform Annual Recertification.
5	Post system disassembly	FM-200 piping and distribution system	General Support	Test piping and distribution system per testing requirements identified on Drawing LSV-1-5553-1
6	Post system activation	Complete FM-200 system	General Support	Obtain services of Manufacturer's Certified Technical Representative to perform System Recertification.

**PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS) FOR BOW THRUSTER COMPARTMENT FM-200 SYSTEM.** The following identifies the PMCS required to maintain the Bow Thruster Room FM-200 system in a fully operational condition:

Item No.	Interval	Item to be Inspected	Maintenance Level	Procedure
1	Monthly	Pressure, FM-200 cylinders	Crew	Check pressure gauges for proper operating pressure. If pressure gauge indicator is not in green, submit Work Order to General Support (GS) Maintenance to have cylinder recharged.
2	Monthly	Liquid level, FM-200 cylinders*	Crew	Take liquid level readings in accordance with instructions contained in Section II of this document. If liquid level is low, submit Work Order to General Support (GS) Maintenance to have cylinder recharged.
3	Monthly	Complete FM-200 System	Crew	Inspect system components in accordance with instructions contained in Section II of this document. If any component is damaged, submit Work Order to General Support (GS) Maintenance.
4	Quarterly	Ventilation dampers	Crew	Verify proper operation of and service Supply Damper and Exhaust Damper
5	Semi-Annually	FM-200 Pressure Switches	Crew	Ensure diesel engine and powered ventilation system shutdowns are in operation. Manually raise plunger on Pressure Switches. Confirm automatic shutdown of operating engine and ventilation system. Confirm activation of Warning Light, Electric Horn/Strobe and Warning Bell. Reset plunger on Pressure Switches. If diesel engine or ventilation system fails to shutdown automatically, submit Work Order to General Support (GS) Maintenance. If any Warning Lights, Electric Horn/Strobe or Warning Bell fails to operate, repair component.
6	Annually	Complete FM-200 system	General Support	Obtain services of Manufacturer's Certified Technical Representative and perform Annual Recertification.
7	Post system disassembly	FM-200 piping and distribution system	General Support	Perform test of FM-200 piping and distribution system per testing requirements identified on Drawing LSV-5553-1.
8	Post system activation	Complete FM-200 system	General Support	Obtain services of Manufacturer's Certified Technical Representative and request System Recertification.

\* **Note** - Refer to the Kidde Fire Systems FM-200 ECS Series Engineered Design, Installation, Operation and Maintenance Manual for Marine FM-200 Systems (This document is provided at Section II) for temperature correction charts.

**PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS) FOR EMERGENCY GENERATOR ROOM FM-200 SYSTEM.** The following identifies the PMCS required to maintain the Emergency Generator Room FM-200 system in a fully operational condition:

Item No.	Interval	Item to be Inspected	Maintenance Level	Procedure
1	Monthly	Pressure, FM-200 cylinder	Crew	Check pressure gauge for proper operating pressure. If pressure gauge indicator is not in green, submit Work Order to General Support (GS) Maint. to have cylinder recharged.
2	Monthly	Complete FM-200 System	Crew	Inspect system components in accordance with instructions contained in Section II of this document. If any component is damaged, submit Work Order to General Support (GS) Maint.
3	Quarterly	Ventilation Damper	Crew	Verify proper operation and service Emergency Generator Room Supply Air Damper.
4	Quarterly	Ventilation Covers	Crew	Install three (3) ventilation covers (Stbd. Mooring Station). Verify fit and service securements.
5	Semi-Annually	FM-200 Pressure Switches	Crew	Ensure diesel engine and powered ventilation system shutdowns are in operation. Manually raise plunger on Pressure Switches. Confirm automatic shutdown of diesel engine and ventilation system. Confirm activation of Warning Light, Electric Horn/Strobe, and Warning Bell. Reset plunger on Pressure Switches. If diesel engine or ventilation system fail to shutdown automatically, submit Work Order to General Support (GS) Maintenance. If Warning Light, Electric Horn/Strobe, or Warning Bell fails to operate, repair component.
6	Annually	Complete FM-200 system	General Support	Obtain services of Manufacturer's Certified Technical Representative and perform Annual Recertification.
7	Post system disassembly	FM-200 piping and distribution system	General Support	Perform test of FM-200 piping and distribution system per testing requirements identified on Drawing LSV-1-5553-1.
8	Post system activation	Complete FM-200 system	General Support	Obtain services of Manufacturer's Certified Technical Representative and request System Recertification.

**PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR WATER WASHDOWN SYSTEM (WWS)**

The following provides the preventive maintenance checks and services required to maintain each WWS in a fully operational condition:

Item No.	Interval	Item to be Inspected	Maintenance Level	Procedure
1	Weekly	Control valve	Crew	Charge fire main to operating pressure, perform a visual inspection to verify WWS is free of leaks. If leaks are discovered, repair Control Valve.
2	Monthly	Control valve	Crew	Verify fire main is not charged. Inspect control valve handle locking mechanism to ensure it is free and operates properly. Exercise WWS control valve by unlocking valve handle and operating control valve through two (2) openings and closings. Close valve and verify lock is engaged. If control valve fails to operate, repair or replace.
3	Monthly	Strainer blow off	Crew	Verify fire main is not charged. Exercise WWS strainer blow off procedure through two (2) openings and closings. Leave WWS strainer blow off valve in closed position. If valve fails to operate, replace valve.
4	Post system disassembly	Complete system	General Support	Test the system per testing requirements identified on Drawing LSV-5231-1. If system fails to meet test requirements, repair system, and retest system.
5	Triennial	Control valve, strainer, and piping	General Support	Perform a flow test. Refer to drawing LSV-5231-1 for system flow requirements. If system fails to meet flow requirements, repair Bow Thruster Emergency Fire Pump and/or Engine Room Fire Pump(s) and retest.
6	Post system activation	Strainer	Crew	Remove, clean, and reinstall strainer basket.





## **SECTION IV**

**Kwik-Draw Sampling Pump Operation and Maintenance  
Manual/w Brochure 08-00-02, Detector Tubes and Kwik-Draw Pump**





# Kwik-Draw® Sampling Pump Operation and Maintenance

- **Deluxe Model with End-of-Stroke Indicator (P/N 487500)**
- **Basic Model (P/N 488543)**

The Kwik-Draw Pump is designed to measure concentrations of gases and vapors when used with AUER/MSA Detector Tubes.

## Description

The Kwik-Draw Pump is a one-handed, manually-operated bellows pump of 100 cc capacity.

### Tube Holder

This rubber part permits mounting of detector tubes, remote sampling lines or other detectors.

### Filter Disc

This porous plastic disc mounted in the rubber Tube Holder protects the Pump from dirt and dust particles which may alter the flow or damage the pump.

### Exhaust Valve

Located under the valve cover, this valve closes as the bellows re-inflates, and readily opens on the exhaust stroke so blow-back through the tube holder is negligible.

### Stroke Counter

For convenience, a stroke counter is incorporated into the Pump handle.

### End-of-stroke Indicator

As the bellows begins to re-inflate, and after the knob is released, the indicator eyeball turns high-visibility green. As the vacuum decreases, the eye begins to roll back to black. The stroke is over when the eye is all black.

**NOTE:** Kwik-Draw Pump (P/N 488543) does not have an end-of-stroke indicator.

## Operation

1. Using the breaker on the Pump, break off both tips of the Detector Tube.
2. Using a twisting motion, insert the Tube into the rubber tube holder. The arrow on the Tube should point toward the Pump.
3. Re-zero stroke counter.
4. With all four fingers on the handle, depress the knob with your palm.

**NOTE:** Watch the stroke counter; to ensure proper sample volume, the counter will only advance if a full pump stroke is taken.

5. Release the knob.
6. As the Pump re-inflates, the end-of stroke indicator turns to high-visibility green. The stroke is over when the eye returns to the all black state.

**NOTE:** If your Pump does not have the end-of-stroke indicator, wait 30 seconds after full bellows inflation to ensure that all 100 cc of the sample is drawn through the tube. The Detector Tube must be held in the sampling area during this period.

7. To evaluate the stain, follow the instructions provided with the Detector Tubes.

## Remote Sampling

Remote sampling is accomplished by putting the pump, connecting tube, remote sampling line and Detector Tube together, in that order.

## Maintenance

Under conditions of normal use, this Pump should require little maintenance. Depending on the frequency of use, periodic cleaning and checks for correct performance are recommended.

### Tube Holder

Replace the Tube Holder when it shows signs of wear or loss of elasticity. If filter is not clogged or cracked, save the Filter Disc for re-use in the new Tube Holder.

### Filter Disc

Periodically remove the Filter Disc for cleaning or replacement.

1. Remove the Filter Disc from the Tube Holder by rolling the flange part of the Tube Holder down and away from the Disc.
2. Gently tap or blow on the surface to remove any foreign matter.
3. Replace Disc so previously exposed surface is once again facing away from Pump.

### Shaft

If the shaft is dirty or the bellows inflation is jerky, remove the shaft by unscrewing; then, clean with auto wax.

### Valves

1. With the valve cover removed, check the valves for dirt or debris.
2. Remove dirt with a gentle puff of air or by using a soft brush.
3. Replace valve(s) if necessary.

### Pump Performance Test

After extended idleness and periodically during use, check the Pump for proper performance with the following test:

### Field Leakage Test

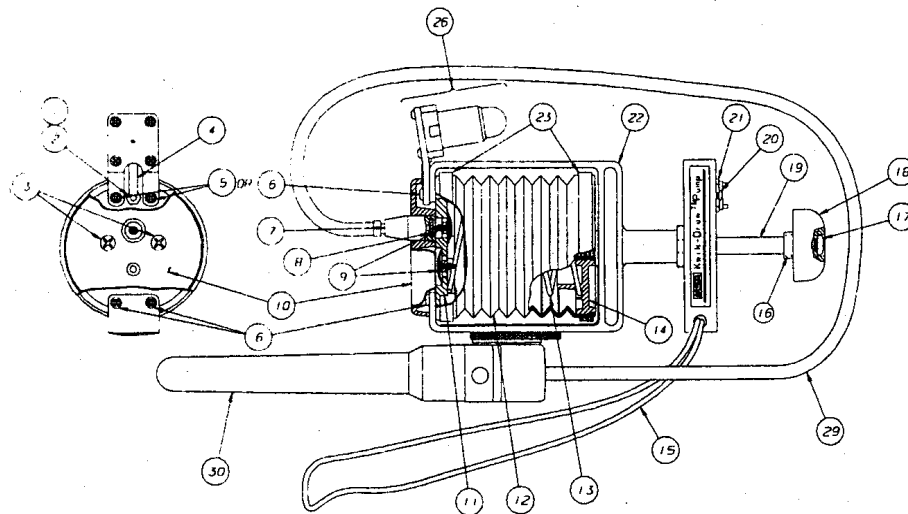
1. Plug the Pump inlet by inserting an unbroken Detector Tube into the Tube Holder.
2. Deflate the Pump fully, release, and wait 10 minutes. The Pump is leak-free if the distance from the bellows to the frame is 1/2-inch or greater after 10 minutes. If the Pump leaks, check the Tube Holder and, if necessary, the valves (see "Maintenance"). After repair, re-test for leakage.

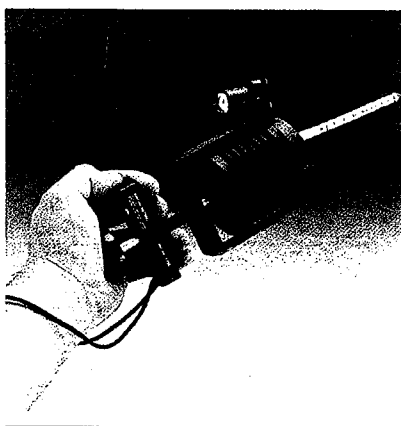
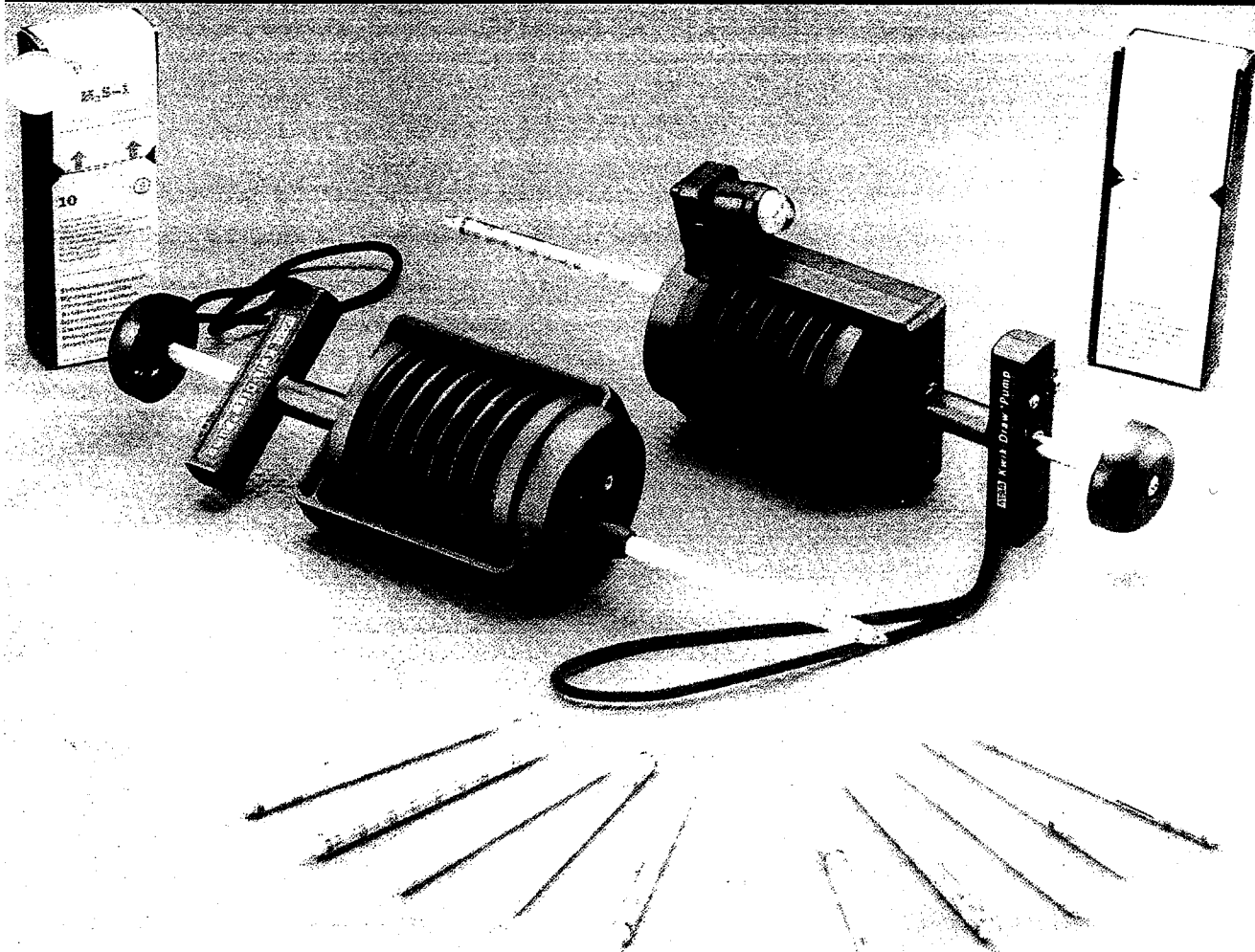
### ⚠ WARNING

Use of a Pump that leaks may result in the under-estimation of a hazard and could result in property damage, injury or death.

If Pump performance is inadequate and cannot be corrected by these measures, return the Pump to MSA for repair. Call (1-800-MSA-2222) for the location of your nearest service center.

ITEM NO.	DESCRIPTION	PART NO.
**1	Elbow Fitting	634181
2	Plug, 10-32	630019
3	Screw, 6-32 x 5/8	634373
**4	Tubing	603278
**5	Screw, 4-40 x 1/2	634372
6	Screw, 4-40 x 5/16	634371
7	Tube Holder	463801
8	Filter Disc	463799
9	Valve (see Item 29)	
10	Cover Assembly	489006
11	Front Cap	487501
12	Bellows Replacement Kit	488940
	Bellows with Rings	
	Belt, 2 ea. (item 23)	
13	Spring	487490
14	Back Cap	487502
15	Wrist Strap	488034
16	Roll Pin	627587
17	Screw, 10-32 x 3/8	634374
18	Knob	487074
19	Shaft	487487
20	Screw, 4 x 3/8 self tapping	628515
21	Counter	487833
22	Frame with Bushings	487601
23	Belt	634542
**26	End-of-Stroke Indicator Assembly	488835
	Indicator	
	Screw, 2 ea. (item 5)	
	Tubing (item 4)	
	Elbow Fitting (item 1)	
*27	Pouch	488394
*28	Instructions	488781
***29	Tubing, 20'	602294
***30	Holder Assembly	485233
* LISTED BUT NOT SHOWN		
**DELUXE MODEL ONLY		
***HAZMAT KIT ONLY		





## FEATURES

- Quick and inexpensive to use.
- A reliable method of testing more than 120 hazardous gases and vapors.
- Kwik-Draw pumps offer accurate one-handed automatic stroke counter and unique end-of-stroke indicator on deluxe version.
- Tubes are printed with easy-to-read scales.
- Specialized kits are available for use in HazMat work and underground storage tank applications.

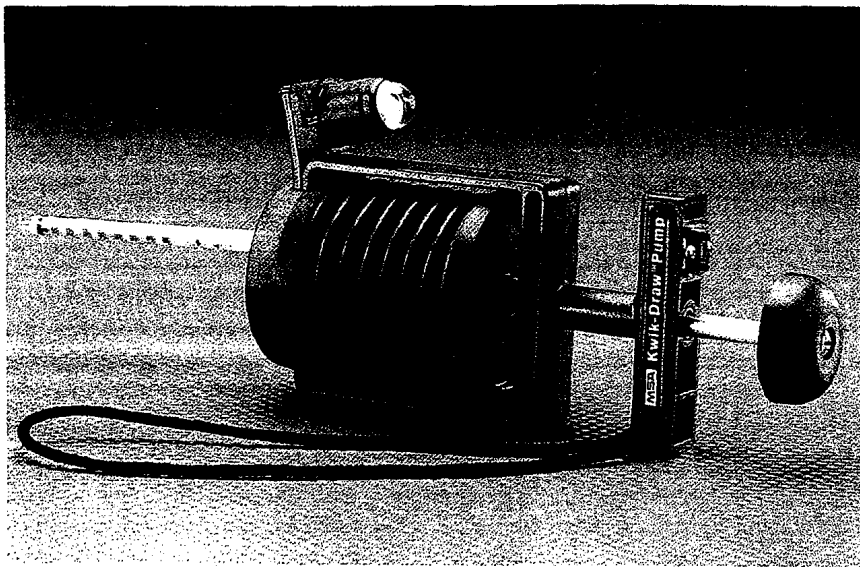
## DESCRIPTION

MSA's Kwik-Draw and Kwik-Draw Deluxe Pumps can be used with an assortment of MSA detector tubes to spot-test the atmosphere for a wide variety of toxic substances.

Kwik-Draw Pumps are designed for one-hand operation and consistent delivery of a sample draw volume of 100 milliliters (ml). The pumps are constructed with a shaft-guided compression system for more consistent and replicable flow rate and volume per stroke than may be available with hand-guided pumps.

MSA offers detector tubes for measuring more than 150 gases and vapors.

## PUMPS



### Kwik-Draw Detector Tube Pumps

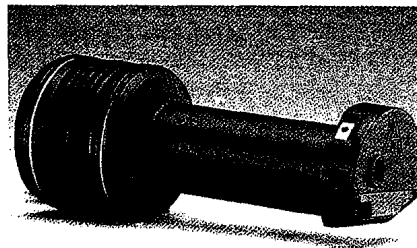
Kwik-Draw Pumps allow detection of gases and vapors with the squeeze of a handle. To obtain a precise (100 ml) sample volume, the user simply grasps the hand grip and pushes the knob. The pump's compression system provides the guiding action to drive a spring-loaded bellows pump.

An integral, easy-to-read stroke counter shows the exact number of strokes performed and provides a positive stop when the stroke is fully compressed.

A second model, the Kwik-Draw Deluxe Pump, has a unique end-of-stroke indicator that "winks" after the precise volume of air is drawn, confirming that enough air has been sampled for a successful reading.

### Gas-Tester II H Pump

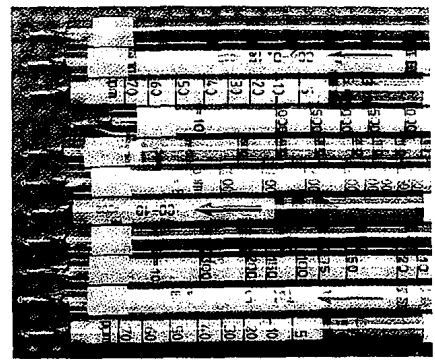
The Gas-Tester II H Pump is set for action by compressing the bellows. A pump stroke is started by pressing the release button. When the sample (100ml) is drawn through the tube, the end-of-stroke indicator changes color. An accurate measurement is obtained because the sample draw procedure itself is controlled only by the specifications of the pump and the flow resistance of the detector tube.



Gas-Tester II H Pump

Part No.	Description
487500	Kwik-Draw Deluxe Detector Tube Pump, with end-of-stroke indicator, remote sampling adapter and carrying pouch
488543	Kwik-Draw Basic Detector Tube Pump, with remote sampling adapter and carrying pouch
696944	Gas-Tester II H Pump

## DETECTOR TUBES



MSA/Auer detector tubes are made of glass, have break-off tips and are filled with treated chemical granules for sampling a variety of substances. Most MSA/Auer detector tubes are packaged 10 in a box.

For ordering information, see Detector Tube Summary Chart, which begins on page 3. After selecting the appropriate tube, the user would break off the tube's end tips and attach the tube to the sampling pump.

After air is drawn through the tube by the pump, the chemical layer in the tube changes color if the test gas or vapor is present in the air.

The length or shade of the color change indicates the concentration of the gas or vapor in the air. A scale is printed on each tube for interpretation of data.

### Controlled Interchangeability of MSA/AUER Detector Tubes and Pumps with Other Manufacturers' Tubes and Pumps

As long as a pump meets the following criteria, it may be used with any detector tube designed for use with that kind of pump. Pumps meeting this criteria are interchangeable.

1. The characteristics of the pump - volume per stroke, sampling time and flow - must be within the same accuracy range.
2. The detector tubes must have an outer diameter of 7 mm and be factory-calibrated with a pump that meets the criteria of (1) above.
3. The manufacturer of tubes and pumps must operate under a certified quality assurance program.

Based on these criteria, the following pumps are interchangeable:

- MSA's Kwik-Draw Pumps
- AUER's Gas-Tester II H Pump
- Draeger's Model 31 Bellows Pump
- Draeger's accuro® Pump

# DETECTOR TUBE SUMMARY CHART

Substance measured	Detector Tube applicable	Part No. (one package of 10 tubes)	Measuring range	Threshold Limit value 1995-1996 ACGIH (ppm)
Acetaldehyde	Formaldehyde-0.1	497649	5 - 50 ppm	25 (ceiling)
Acetic Acid	Acetic Acid-1	804138	1 - 80 ppm	10
Acetone	Acetone-100	804141	100-10,000	750
	Qualitest QL	497665	n/a	
Acetylene dichloride, cis and trans (1,2-Dichloroethylene)	Trichloroethane-5	487343	10 - 500 ppm	200
	Qualitest QL	497665	n/a	
Acetylene tetrabromide (1,1,2,2-Tetrabromoethane)	Trichloroethane-5	487343	50 - 200 ppm	1
	Qualitest QL	497665	n/a	
Acetylene tetrachloride (1,1,2,2-Tetrachloroethane)	Trichloroethane-5	487343	50-1000 ppm	1
	Qualitest QL	497665	n/a	
Ammonia	NH <sub>3</sub> - 2	804405	2 - 500 ppm	25
	NH <sub>3</sub> - 20	800300	20 - 1000 ppm	
	NH <sub>3</sub> - 0.1%	804406	0.1 - 10 Vol.-%	
n-Amyl chloride (1-Chloropentane)	Trichloroethane-5	487343	5 - 550 ppm	—
Benzene	C <sub>6</sub> H <sub>6</sub> -1	807024	0.5 - 25 ppm	
	C <sub>6</sub> H <sub>6</sub> -5	804411	5 - 100 ppm	
	Aromatic HC	804132	5 - 500 ppm	10
	Qualitest QL	497665	n/a	
Bromine	Cl <sub>2</sub> -0.2	803944	0.2 - 30 ppm	0.1
Bromobenzene	Aromatic HC	804132	30 - 720 ppm	—
Bromoethane (Ethyl bromide)	Trichloroethane-5	487343	15 - 400 ppm	5
Bromoform (Tribromomethane)	Trichloroethane-5	487343	7 - 200 ppm	0.5
Bromomethane (Methyl bromide)	Trichloroethane-5	487343	20 - 270 ppm	5
1,3-Butadiene	Ethylene-50	804428	100 - 1200 ppm	2
	Qualitest QL	497665	n/a	
n-Butane	Propane-200	804418	200 - 3800 ppm	800
	Qualitest QL	497665	n/a	
n-Butanol (Butyl Alcohol)	Ethanol-100	804136	100 - 3900 ppm	50 (ceiling)
sec-Butanol (sec.-Butyl Alcohol)	Ethanol-100	804136	300 - 5100 ppm	100
1-Butene (1-Butylene)	Ethylene-50	804428	100 - 5000 ppm	—
	Qualitest QL	497665	n/a	
2-Butylene, cis and trans (2-Butylene)	Ethylene-50	804428	200 - 5000 ppm	—
	Qualitest QL	497665	n/a	
Butyl Alcohol (n-Butanol)	Ethanol-100	804136	100 - 3900 ppm	50 (ceiling)

Substance measured	Detector Tube applicable	Part No. (one package of 10 tubes)	Measuring range	Threshold Limit value 1995-1996 ACGIH (ppm)
sec.-Butyl Alcohol (sec-Butanol)	Ethanol-100	804136	300 - 5100 ppm	100
n-Butylamine	Triethylamine-5	804134	2 - 28 ppm	5 (ceiling)
iso-Butylamine	Triethylamine-5	804134	3 - 36 ppm	—
sec-Butylamine	Triethylamine-5	804134	2 - 18 ppm	—
t-Butylamine	Triethylamine-5	804134	2 - 14 ppm	—
n-Butylchloride (1-Chlorobutane)	Trichloroethane-5 Qualitest QL	487343 497665	5 - 170 ppm n/a	—
1-Butylene (1-Butene)	Ethylene-50 Qualitest QL	804428 497665	100 - 5000 ppm n/a	—
2-Butylene (2-Butene, cis and trans)	Ethylene-50 Qualitest QL	804428 497665	200 - 5000 ppm n/a	—
n-Butyl mercaptan	Ethyl mercaptan-0.5	804589	1.5 - 15 ppm	0.5
t-Butyl mercaptan	Ethyl mercaptan -0.5	804589	0.8 - 5 ppm	—
Carbon Dioxide	CO <sub>2</sub> -100 CO <sub>2</sub> -0.1% CO <sub>2</sub> -1%	497606 487333 804419	100 - 3000 ppm 0.1 - 7.0 Vol.-% 1 - 20 Vol.-%	5000
Carbon Disulfide	CS <sub>2</sub> -2 Qualitest QL	492514 497665	2 - 300 ppm n/a	10
Carbon Monoxide	CO-5 CO-10 CO-0.5% CO-10/color, with special orifice assembly Qualitest QL	803943 487334 487335 47134 (497652) 497665	5 - 1000 ppm 10 - 3000 ppm 0.5 - 7.0 Vol.-% 10-1000 n/a	25
Chlorine	Cl <sub>2</sub> -0.2 Cl <sub>2</sub> -0.5	803944 804133	0.2 - 30 ppm 1 - 46 ppm	0.5
Chlorine dioxide	ClO <sub>2</sub> -0.05	804133	0.05 - 5 ppm	0.1
Chlorobenzene	Aromatic HC	804132	40 - 610 ppm	10
Chlorobromomethane	Trichloroethane-5	487343	5 - 180 ppm	200
1-Chlorobutane (n-Butylchloride)	Trichloroethane-5 Qualitest QL	487343 497665	5 - 170 ppm n/a	—
Chloroethane (Ethyl chloride)	Trichloroethane-5	487343	50 - 8000 ppm	100
Chloroethane (Vinyl Chloride)	VC-1 Trichloroethane-5	803950 487343	1 - 70 ppm 20 - 550 ppm	5
Chloroform (Trichloromethane)	Trichloroethane-5	487343	8 - 100 ppm	10
1-Chloropentane (n-Amylchloride)	Trichloroethane-5	487343	5 - 550 ppm	—
1-Chloropropane (1-Propylchloride)	Trichloroethane-5	487343	5 - 220 ppm	—



Substance measured	Detector Tube applicable	Part No. (one package of 10 tubes)	Measuring range	Threshold Limit value 1995-1996 ACGIH (ppm)
2-Chloropropane (2-Propylchloride)	Trichloroethane-5	487343	8 - 1700 ppm	—
Cycloheptane	Hexane-20	497664	80 - 3300 ppm	—
Cyclohexane	Hexane-20 Qualitest QL	497664 497665	20 - 3400 ppm n/a	300
Cyclohexylamine	Triethylamine-5	804134	7 - 38 ppm	10
Cyclooctane	Hexane-20	497664	20 - 2100 ppm	—
Cyclopentane	Hexane-20	497664	80 - 2700 ppm	600
n-Decane	Hexane-20	497664	50 - 500 ppm	—
1,2-Dibromoethane (Ethylene dibromide)	Trichloroethane-5	487343	25 - 700 ppm	—
Dibromomethane (Methylene dibromide)	Trichloroethane-5	487343	9 - 200 ppm	—
1,1-Dichloroethane (Ethylidene chloride)	Trichloroethane-5	487343	8 - 300 ppm	100
1,2-Dichloroethane (Ethylene dichloride)	CH <sub>2</sub> Cl <sub>2</sub> -50	804416	30 - 720 ppm	10
1,1-Dichloroethylene (Vinylidene chloride)	Trichloroethane-5	487343	10 - 600 ppm	5
1,2-Dichloroethylene (Acetylene dichloride, cis and trans)	Trichloroethane-5	487343	10 - 500 ppm	200
Dichloromethane (Methylene chloride)	CH <sub>2</sub> Cl <sub>2</sub> -50	804416	50 - 1000 ppm	50
1,2-Dichloropropane (Propylene dichloride)	Trichloroethane-5	487343	5 - 440 ppm	75
1,3-Dichloropropane (Trimethylene dichloride)	Trichloroethane-5	487343	5 - 220 ppm	—
Diesel Oil	Qualitest QL	497665	n/a	—
Diethylamine	Triethylamine-5	804134	3 - 27 ppm	5
Dimethylamine	Triethylamine-5	804134	3 - 27 ppm	5
2,3-Dimethylbutane	Hexane-20	497664	100 - 4900 ppm	—
Ethanol (Ethyl Alcohol)	Ethanol-100 Qualitest QL	804136 497665	100 - 6000 ppm n/a	1000
Ethene (Ethylene)	Ethylene-50 Qualitest QL	804428 497665	25 - 5000 ppm n/a	—
Ethyl Alcohol (Ethanol)	Ethanol-100 Qualitest QL	804136 497665	100 - 6000 ppm n/a	1000
Ethylamine	Triethylamine-5	804134	4 - 55 ppm	5
Ethyl benzene	Tol.-5	803947	5 - 1800 ppm	100
Ethyl bromide (Bromoethane)	Trichloroethane-5	487343	15 - 400 ppm	5

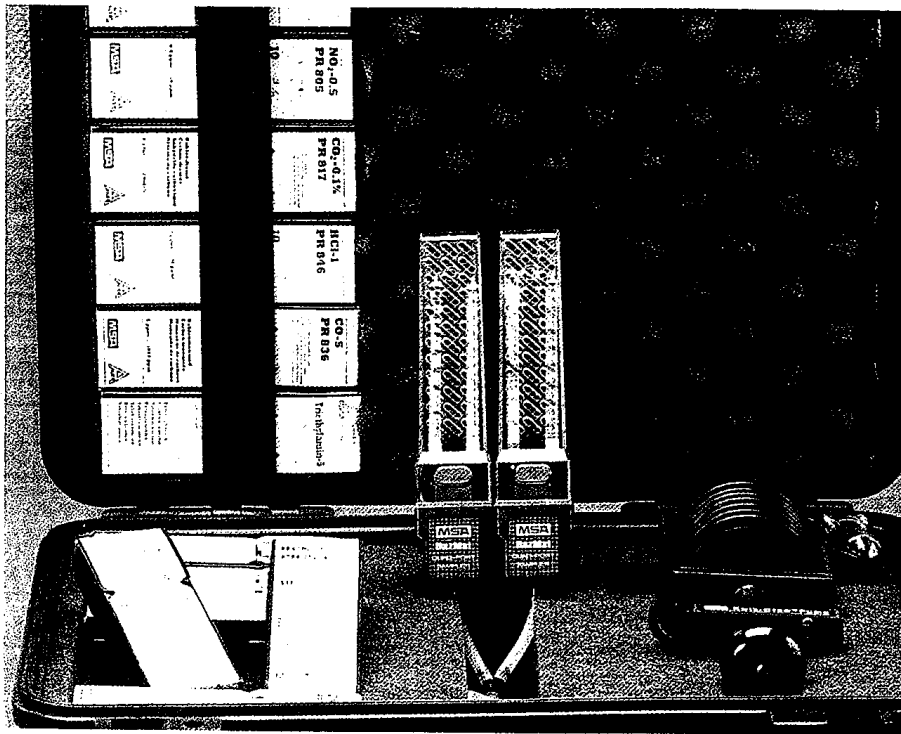
Substance measured	Detector Tube applicable	Part No. (one package of 10 tubes)	Measuring range	Threshold Limit value 1995-1996 ACGIH (ppm)
Ethyl chloride (Chloroethane)	Trichloroethane-5	487343	50 – 8000 ppm	100
Ethylene (Ethene)	Ethylene-50 Qualitest QL	804428 497665	25 – 5000 ppm n/a	—
Ethylenediamine	Triethylamine-5	804134	5 – 27 ppm	10
Ethylene dibromide (1,2-Dibromoethane)	Trichloroethane-5	487343	25 – 700 ppm	—
Ethylene dichloride (1,2-Dichloroethane)	CH <sub>2</sub> Cl <sub>2</sub> -50	804416	30 – 720 ppm	10
Ethylidene chloride (1,1-Dichloroethane)	Trichloroethane-5	487343	8 – 300 ppm	100
Ethyl mercaptan	Ethyl mercaptan-0.5	804589	0.5 – 80	0.5
Formaldehyde	Formaldehyde-0.15	497649	0.15 – 10 ppm	0.3 (ceiling)
Formic Acid	Qualitest QL Acetic Acid-1	497665 804138	n/a 2 – 160 ppm	
Gasoline	Gasoline-30 Qualitest QL	492870 497665	30 – 6000 ppm n/a	300
n-Heptane	Hexane-20	497664	20 – 2600 ppm	400
n-Hexane	Hexane-20	497664	20 – 3200 ppm	50
Hydrogen Chloride	HCl-1 Qualitest QL	803948 497665	1 – 30 ppm n/a	5 (ceiling)
Hydrogen Cyanide	HCN-2	803945	2 – 50 ppm	4.7 (ceiling)
Hydrogen Fluoride	HF-1	804142	1 – 50 ppm	3 (ceiling)
Hydrogen Sulfide	H <sub>2</sub> S-1 H <sub>2</sub> S-100 Qualitest QL	487339 487340 497665	1 – 200 ppm 100 – 4000 ppm n/a	10
Isobutane (Methylpropane)	Propane-200	804418	200 – 4200 ppm	—
Isobutanol (Isobutyl Alcohol, 2-Methylpropyl Alcohol)	Ethanol-100	804136	150 – 2900 ppm	50
Isobutene (Isobutylene, Methylpropene)	Ethylene-50	804428	400 – 2600 ppm	—
iso-Butylamine	Triethylamine-5	804134	3 – 36 ppm	—
Isobutylene (Isobutene, Methylpropene)	Ethylene-50	804428	400 – 2600 ppm	—
Isobutyl Alcohol (Isobutanol, 2-Methylpropyl Alcohol)	Ethanol-100	804136	150 – 2900 ppm	50
Isopropanol (Isopropyl Alcohol, 2-Propanol)	Ethanol-100 Qualitest QL	804136 497665	200 – 5000 ppm n/a	400
Isopropyl Alcohol (Isopropanol, 2-Propanol)	Ethanol-100 Qualitest QL	804136 497665	200 – 5000 ppm n/a	400

Substance measured	Detector Tube applicable	Part No. (one package of 10 tubes)	Measuring range	Threshold Limit value 1995-1996 ACGIH (ppm)
Isopropylamine	Triethylamine-5	804134	5 - 30 ppm	5
Isopropyl mercaptan	Ethyl mercaptan 0.5	804589	0.5 - 5.5 ppm	—
Kerosene	Qualitest QL	497665	n/a	—
Liquified Petroleum Gases	Gasoline-30 Qualitest QL	492870 497665	Semiquantitative n/a	—
Mercury	Hg-0.1	497663	0.1 - 0.8 mg/m <sup>3</sup> (0.01 - 0.08 ppm)	0.025 mg/m <sup>3</sup> (inorganic)
Methanol (Methyl Alcohol)	Ethanol-100	804136	100 - 2350 ppm	200
Methyl Alcohol (Methanol)	Ethanol-100	804136	100 - 2350 ppm	200
Methylamine	Triethylamine-5	804134	4 - 55 ppm	5
Methyl benzene (Toluene)	Tol.-5	803947	5 - 1000 ppm	50
Methyl bromide (Bromomethane)	Trichloroethane-5	487343	9 - 200 ppm	5
2-Methyl butane	Hexane-20	497664	50 - 3000 ppm	—
Methyl chloroform (1,1,1-Trichloroethane)	Trichloroethane-5	487343	5 - 1500 ppm	350
Methylcyclohexane	Hexane-20	497664	80 - 4900 ppm	400
Methylcyclopentane	Hexane-20	497664	150 - 3700 ppm	—
Methylene chloride (Dichloromethane)	CH <sub>2</sub> Cl <sub>2</sub> -50	804416	50 - 1000 ppm	50
Methylene dibromide (Dibromomethane)	Trichloroethane-5	487343	9 - 200 ppm	—
Methyl ethyl ketone (MEK)	MEK-50 Qualitest QL	813334 497665	50 - 4000 ppm n/a	200
Methyl mercaptan	Ethyl mercaptan-0.5	804589	0.5 - 5 ppm	0.5
2-Methyl pentane	Hexane-20	497664	150 - 4500 ppm	—
3-Methyl pentane	Hexane-20	497664	100 - 3700 ppm	—
Methylpropane (Isobutane)	Propane-200	804418	200 - 4200 ppm	—
Methylpropene (Isobutylene, Isobutene)	Ethylene-50	804428	400 - 2600 ppm	—
2-Methylpropyl Alcohol (Isobutanol, Isobutyl Alcohol)	Ethanol-100	804136	150 - 2900 ppm	50
Nitrogen Dioxide	NO <sub>2</sub> -0.5 NO <sub>2</sub> -2	487341 804435	0.5 - 50 ppm 2 - 140 ppm	3
Nitrous Fumes	Nitr.-0.5 Nitr.-2 Nitr.-10 Nitr.-50	487336 804425 803946 804426	0.5 - 50 ppm 2 - 140 ppm 10 - 300 ppm 50 - 3000 ppm	—

Substance measured	Detector Tube applicable	Part No. (one package of 10 tubes)	Measuring range	Threshold Limit value 1995-1996 ACGIH (ppm)
n-Nonane	Hexane-20	497664	50 - 2800 ppm	200
n-Octane	Hexane-20	497664	50 - 3000 ppm	300
Ozone	Ozone-0.05	804140	0.05 - 5 ppm	0.1 (ceiling)
Pentachloroethane	Trichloroethane-5	487343	10 - 300 ppm	—
n-Pentane	Hexane-20	497664	50 - 3900 ppm	600
	Qualitest QL	497665	n/a	
Perchloroethylene (Tetrachloroethylene)	Per-5	804429	5 - 200 ppm	25
	Per-10	487337	10 - 500 ppm	
	Qualitest QL	497665	n/a	
Phenol	Phenol-1	813778	1 - 25 ppm	5
	Qualitest QL	497665	n/a	
Phosgene	Phosgene-0.1	803949	0.1 - 20 ppm	0.1
Phosphine	PH <sub>3</sub> -0.05	497101	0.05 - 3 ppm	0.3
	PH <sub>3</sub> -0.1	485680	0.1 - 100 ppm	
	PH <sub>3</sub> -50	489119	50 - 2000 ppm	
Propane	Propane-200	804418	200 - 4000 ppm	—
	Qualitest QL	497665	n/a	
1-Propanol (Propyl Alcohol)	Ethanol-100	804136	100 - 3000 ppm	200
	Qualitest QL	497665	n/a	
2-Propanol (Isopropanol, Isopropyl Alcohol)	Ethanol-100	804136	200 - 5000 ppm	400
	Qualitest QL	497665	n/a	
Propene (Propylene)	Ethylene-50	804428	20 - 5000 ppm	—
	Qualitest QL	497665	n/a	
Propyl Alcohol (n-Propanol)	Ethanol-100	804136	100 - 3000 ppm	200
	Qualitest QL	497665	n/a	
n-Propylamine	Triethylamine-5	804134	2 - 28 ppm	—
1-Propylchloride (1-Chloropropane)	Trichloroethane-5	487343	5 - 220 ppm	—
2-Propylchloride (2-Chloropropane)	Trichloroethane-5	487343	8 - 1700 ppm	—
Propylene (Propene)	Ethylene-50	804428	20 - 5000 ppm	—
	Qualitest QL	497665	n/a	
Propylene dichloride (1,2-Dichloropropane)	Trichloroethane-5	487343	5 - 440 ppm	75
n-Propyl mercaptan	Ethyl mercaptan-0.5	804589	0.7 - 8.0 ppm	—
Styrene	Styrene-10	804135	10 - 300 ppm	50
	Qualitest QL	497665	n/a	
Sulfur Dioxide	SO <sub>2</sub> -1	487338	0.5 - 25 ppm	2
	SO <sub>2</sub> -5	497662	5 - 120 ppm	
	SO <sub>2</sub> -100	497661	100 - 4000 ppm	
Sulfur hexafluoride decomposition products	SF <sub>6</sub> Decomposition Products	804433	0.5 - 15.0	1000

Substance measured	Detector Tube applicable	Part No. (one package of 10 tubes)	Measuring range	Threshold Limit value 1995-1996 ACGIH (ppm)
1,1,2,2-Tetrabromoethane (Acetylene tetrabromide)	Trichloroethane-5	487343	25 - 200 ppm	—
1,1,2,2-Tetrachloroethane (Acetylene tetrachloride)	Trichloroethane-5	487343	50 - 1000 ppm	1
Tetrachloroethylene (Perchloroethylene)	Per-5	804429	5 - 200 ppm	25
	Per-10	487337	10 - 500 ppm	
	Qualitest QL	497665	n/a	
Toluene (Methyl benzene)	Tol.-5	803947	5 - 1000 ppm	50
	Qualitest QL	497665	n/a	
Tribromomethane (Bromoform)	Trichloroethane-5	487343	7 - 200 ppm	0.5
1,1,1-Trichloroethane (Methyl chloroform)	Trichloroethane-5	487343	5 - 1500 ppm	350
	Qualitest QL	497665	n/a	
1,1,2-Trichloroethane (Vinyltrichloride)	Trichloroethane-5	487343	10 - 170 ppm	10
Trichloroethene (Trichloroethylene)	Tri-5	487342	5 - 250 ppm	50
Trichloroethylene (Trichloroethene)	Tri-5	487342	5 - 250 ppm	50
Trichloromethane (Chloroform)	Trichloroethane-5	487343	8 - 100 ppm	10
1,2,3-Trichloropropane	Trichloroethane-5	487343	10 - 1200 ppm	10
Triethylamine	Triethylamine-5	804134	5 - 30 ppm	1
Trimethylamine	Triethylamine-5	804134	5 - 30 ppm	5
Trimethylene dichloride (1,3-Dichloropropane)	Trichloroethane-5	487343	5 - 220 ppm	—
2,2,4-Trimethylpentane	Hexane-20	497664	100 - 3000 ppm	—
Vinyl Chloride (Chloroethane)	VC-1	803950	1 - 70 ppm	5
	Qualitest QL	497665	n/a	
Vinylidene chloride (1,1-Dichloroethylene)	Trichloroethane-5	487343	10 - 600 ppm	5
Vinyltrichloride (1,1,2-Trichloroethane)	Trichloroethane-5	487343	10 - 170 ppm	10
o-Xylene (1,2-Xylene)	Tol.-5	803947	5 - 2500 ppm	100
	Qualitest QL	497665	n/a	
m-Xylene (1,3-Xylene)	Tol.-5	803947	5 - 2500 ppm	100
	Qualitest QL	497665	n/a	
p-Xylene (1,4 Xylene)	Tol.-5	803947	5 - 1200 ppm	100
	Qualitest QL	497665	n/a	

## SPECIALIZED APPLICATION KITS



**HazMat Response Detector Tube Kit**  
Quickly and easily detects the presence of certain classes of contaminants in the atmosphere.

The HazMat Kit is divided into three sets of four Detector Tubes each. Its multiple-tube holder assembly allows four tubes to be used simultaneously. Gas is drawn through the tubes using a Kwik-Draw pump and a manifold assembly.

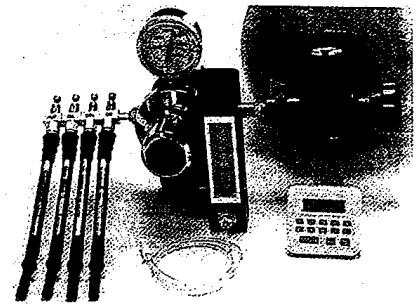
An easy-to-follow interpretation chart helps identify these classes of chemicals: oxidizing gases, carbon monoxide, aromatic hydrocarbons, organic gases, mercaptans, unsaturated hydrocarbons, acidic gases, hydrogen cyanide, amines, halogenated hydrocarbons, alcohols, and carbon dioxide.

Once the class of a contaminant is established, its concentration can be measured using MSA Detector Tubes and the appropriate Pump. (For more information, see Data Sheet 08-03-02.)

### **⚠ WARNING**

Results of the HazMat Kit should not, under any circumstances, be used as the only evidence of the presence or absence of a particular contaminant. The kit should be used only in conjunction with other test means or information to confirm the identity of an unknown atmosphere.

Part No.	Description
807472	HazMat Response Detector Tube Kit
485233	Multiple Tube Holder



### **Breathing Air Test Kit**

By allowing four separate tests to be performed at the same time, the Breathing Air Test Kit saves time when checking for contamination of air cylinders or compressed air sources.

The kit simultaneously tests for the presence of CO, CO<sub>2</sub>, water vapor and oil vapors, thus eliminating sequential testing of individual detector tubes.

The kit's carrying case contains a four-tube manifold, a countdown timer with alarm, a tube breaker and a regulator, including a vertical stand and Flowmeter.

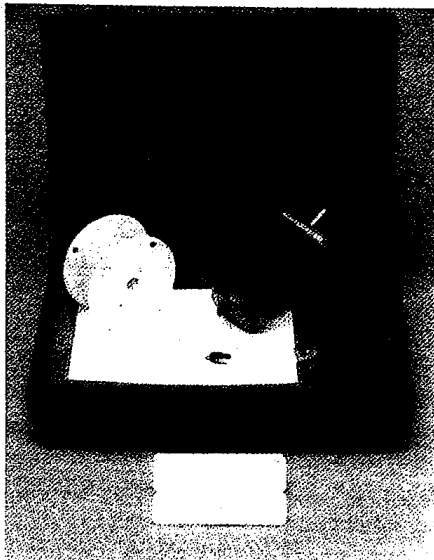
In operation, an air sample is released from the test kit regulator into the manifold and then simultaneously into the four detector tubes. Complete easy-to-follow instructions are included, and an NFPA test for all four gases can be completed in about five minutes.

Part No.	Description
491932	Complete Kit with Tubes (for use with cylinders)
492892	Complete Kit with Tubes (maximum pressure 200 psi, for use with compressed air lines)

#### **Replacement Parts**

488906	Carbon Monoxide Tube, 5 to 70 ppm
488907	Carbon Dioxide Tube, 100 to 2000 ppm
488909	Oil Vapor Tube, 1 to 3 mg/m <sup>3</sup>
488908	Water Vapor Tube, 5 to 70 mg/m <sup>3</sup> (7 to 110 ppm)
804403	Scrubber Tube for use with carbon monoxide and Water Vapor Tubes
492085	Manifold
696188	Tube Holder
635213	Timer

Note: While this kit will detect the specific listed contaminants, it will not test for oxygen deficiency.



### Tank-Check™ Leak Detection Kits

These kits offer a low-cost alternative to liquid level gauges and continuous gas detection, tank-pressure testing and ground water monitoring systems.

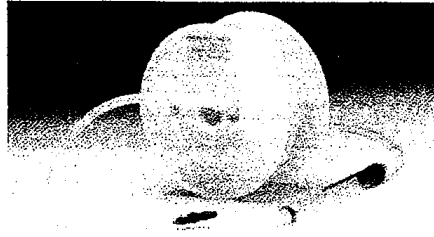
The basic kit consists of the Kwik-Draw Detector Tube Pump, a 25-foot reel of fuel-resistant tubing, a carrying case, detector tube holder and instructions. MSA Detector Tubes are purchased separately to meet customer needs.

The deluxe kit is similar except it includes a Kwik-Draw Deluxe Pump and the two most popular gasoline detector tubes.

Sampling is simple, quick and accurate. Insert the appropriate detector tube in the tube holder, attach tube holder to fuel-resistant tubing and attach tubing to the pump. Many tubes can be used with the kit. The most commonly used are shown below. For more information, request Data Sheet 08-04-02.

Part No.	Description
488690	Basic Tank-Check Leak Detection Kit, less tubes
493571	Deluxe Tank-Check Leak Detection Kit, complete with 492870 and 804132 Gasoline detector tubes

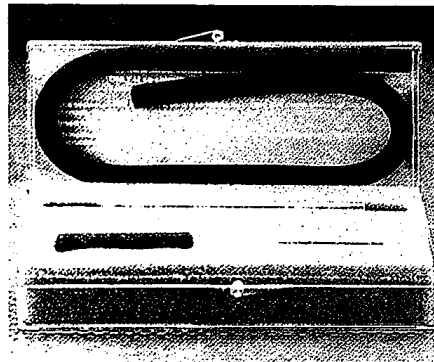
## ACCESSORIES



### Remote Sampling

Various length sampling lines are available for use with the Kwik-Draw Pump to make it easier to test for the presence of toxic gases or vapors in hard-to-reach areas. A remote sampling adapter should be used to attach line to pump.

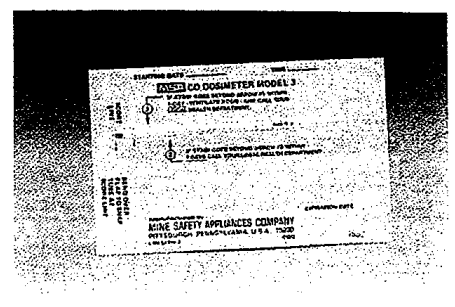
Part No.	Description
73067	Sampling line, 10 ft.
73068	Sampling line, 25 ft.
73069	Sampling line, 50 ft.
87970	Remote Sampling Adapter (required for above sampling line)
488780	Solvent Resistant Sampling Line, 25 ft., with reel
488872	Tube Holder (required for 488780 line above)



### Flue Gas Kit

The Flue Gas Kit cools a furnace exhaust gas sample to 125°F or less (from a maximum 1000°F). The kit is used with any pump and an appropriate MSA Detector Tube. The user connects one end of the Detector Tube to the probe and the other end to the pump with rubber tubing.

Part No.	Description
470321	Flue Gas Kit



### MiniCO® Carbon Monoxide Detector Tube Cards

The MiniCO Carbon Monoxide detector tube, is a sealed glass tube affixed to a calibrated backing card. It is used in sponsored residential or office screening programs. The tube is activated by opening and placing in an appropriate location. Calibration markings are provided for 25 ppm TWA over 24 hours and 7 days.

Part No.	Description
481954	MiniCO® Carbon Monoxide Detector Tube Cards (box of 10)

## MSA/Auer Trainer Tubes

A Trainer Tube is a tool for training detector-tube users on the stain color to expect from a detector tube and how to read the concentration from the tube.

Trainer Tube Labeled	MSA/Auer Detector Tube	
	Part No.	Description
AMK	804405	NH3-2
	800300	NH3-20
	804134	Triethylamine-5
AMS	803943	CO-5
	487334	CO-10
	804423	CO-0.1%
	497665	Qualitest
	487343	Trichloroethane-5
	492514	CS2
	804429	Per-5
	487337	Per-10
	804416	Dichloromethane-50
CLR	803944	Cl2-0.2
	804133	ClO2-0.05
	487341	NO2-0.5
	804435	NO2-2
	487336	Nitr-0.5
	804425	Nitr-2
	803946	Nitr-10
	803950	VC-1
CWS	803948	HCl-1
ETL	804136	Ethanol-100
	497665	Qualitest
	497664	Hexane
OCT	492870	Gasoline
	804428	Ethylene
	497665	Qualitest
	487343	Trichloroethane
	492514	CS2-2
	804429	Per-5
	487337	Per-10
SDO	487338	SO2-1
	497662	SO2-5
	497661	SO2-100
SWS	487339	H2S-1
	487340	H2S-100
	485680	PH3-0.1
	489119	PH3-50
	497665	Qualitest
TCE	487337	Per-10
	804429	Per-5
	803950	VC-1
	487342	Tri-5
	492514	CS2
	487343	Trichloroethane-5
	497665	Qualitest
TLL	803947	Tol-5
	807024	Benzene-1
	804411	Benzene-5
	804132	Aromatic HC
	497665	Qualitest

Part No.	Description
804437	Box of 10 Trainer Tubes (assortment)
809047	Box of 10 Carbon Monoxide Trainer Tubes
809046	Box of 10 Hydrogen Sulfide Trainer Tubes

## SERVICE

MSA's strategically located Regional Service Centers are staffed with specialists who have the knowledge and the equipment to provide testing and service of pumps, detector tubes and accessories, with genuine MSA replacement parts. Product modification or repair by anyone other than certified MSA personnel may void warranties and approvals. Call MSA toll-free at 1-800-MSA-2222 for the location of your nearest Service Center.

Note: This Data Sheet contains only a general description of MSA Kwik-Draw Pumps, MSA/Auer Detector Tubes and Accessories. While uses and performance capabilities are described, under no circumstances should the products be used except by qualified, trained personnel and then not until the instructions, labels or other literature accompanying them have been carefully read and understood and the precautions therein set forth followed. Only they contain the complete and detailed information concerning these pieces.



Offices and Representatives in principal cities worldwide.  
**In U.S. call the Customer Service Center toll free at 1-800-MSA-2222.**  
**To reach MSA International, call (412) 967-3354 or Fax (412) 967-3451.**

Corporate Headquarters: P.O. Box 426, Pittsburgh, PA 15230 USA.



## **SECTION V**

### **Appendix A Maintenance Allocation Chart (MAC)**



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**UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE FM-200  
FIREFIGHTING SYSTEM AND WATER WASHDOWN SYSTEM (WWS)  
MAINTENANCE ALLOCATION CHART**

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## **MAINTENANCE ALLOCATION CHART (MAC)**

### **A-1 INTRODUCTION**

#### **The Army Maintenance System MAC**

This introduction provides a general explanation of all maintenance and repair functions authorized at various maintenance levels under the standard Army Maintenance System concept.

The MAC (immediately following the introduction) designates overall authority and responsibility for the performance of maintenance functions on the identified end item or component. The application of the maintenance functions to the end item or component shall be consistent with the capacities and capabilities of the designated maintenance levels, which are shown on the MAC in column (4) as:

Unit – includes two subcolumns, C (operator/crew) and O (unit) maintenance.

Direct Support – includes an F subcolumn.

General Support – includes an H subcolumn.

Depot – includes a D subcolumn.

The tools and test equipment requirements (immediately following the MAC) list the tools and test equipment (both special tools and common tool sets) required for each maintenance function as referenced from the MAC.

The remarks (immediately following the tools and test equipment requirements) contain supplemental instructions and explanatory notes for a particular maintenance function.

#### **A-2 Maintenance Functions**

Maintenance functions are limited to and defined as follows:

1. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination; e.g., by sight, sound, or feel.
2. Test. To verify serviceability by measuring the mechanical, pneumatic, hydraulic, or electrical characteristics of an item and comparing those characteristics with prescribed standards on a scheduled basis.
3. Service. Operations required periodically to keep an item in proper operating condition; e.g., to clean (includes decontaminate, when required), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or gases.
4. Adjust. To maintain or regulate, within prescribed limits, by bringing into proper position, or by setting the operating characteristics to specified parameters.
5. Align. To adjust specified variable elements of an item to bring out optimum or desired performance.
6. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments of test, measuring, and diagnostic equipment used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

7. Remove/Install. To remove and install the same item when required to perform service or other maintenance functions. Install may be the act of emplacing, seating, or fixing into position a spare, repair part, or module (component or assembly) in a manner to allow the proper functioning of equipment or a system.
8. Replace. To remove an unserviceable item and install a serviceable counterpart in its place. "Replace" is authorized by the MAC and assigned maintenance level is shown as the third position code of the Source, Maintenance and Recoverability (SMR) code.
9. Repair. The application of maintenance services, including fault location/troubleshooting, removal/installation, disassembly/assembly procedures, and maintenance actions to identify troubles and restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

#### NOTE

The following definitions are applicable to the "Repair" maintenance function:

Services – Inspect, test, service, adjust, align, calibrate, and/or replace.

Fault location/troubleshooting – The process of investigating and detecting the cause of equipment malfunctioning; the act of isolating a fault within a system or Unit Under Test (UUT).

Disassembly/assembly – The step-by-step breakdown (taking apart) of a spare/functional group coded item to the level of its least component that is assigned an SMR code for the level of maintenance under consideration (i.e., identified as maintenance significant).

Actions – Welding, grinding, riveting, straightening, facing, machining, and/or resurfacing.

10. Overhaul. That maintenance effort (service/action) prescribed to restore an item to a completely serviceable/operational condition as required by maintenance standards in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.
11. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of material maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (e.g., hours/miles) considered in classifying Army equipment/components.

#### A-3 Explanation of Columns in the MAC

Column (1) – Group Number. Column (1) lists functional group code (FGC) numbers, the purpose of which is to identify maintenance significant components, assemblies, subassemblies, and modules with the Next Higher Assembly (NHA). End item group number shall be "00."

Column (2) – Component/Assembly. Column (2) contains the item names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

Column (3) – Maintenance Function. Column (3) lists the functions to be performed on the item listed in column (2). (For a detailed explanation of these functions refer to "Maintenance Functions" outlined above.)

Column (4) – Maintenance Level. Column (4) specifies each level of maintenance authorized to perform each function listed in column (3), by indicating work time required (expressed as man-hours in whole hours or decimals) in the appropriate sub-column. This work time figure represents the active time required to perform that maintenance function at the indicated level of maintenance. If the number or complexity of the tasks within the listed maintenance function varies at different maintenance levels, appropriate work time figures are to be shown for each level. The work time figure represents the average time required to restore an item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time (including any necessary disassembly/assembly time), troubleshooting/fault location time, and quality assurance time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the MAC. The symbol designations for the various maintenance levels are as follows:

C – Operator or crew maintenance

O – Unit maintenance

F – Direct support maintenance

L – Specialized repair activity (SRA)

H – General support maintenance

D – Depot maintenance

**NOTE**

The “L” maintenance level is not included in column (4) of the MAC. Functions to this level of maintenance are identified by a work time figure in the “H” column of column (4), and an associated reference code is used in the REMARKS column (6). This code is keyed to the remarks and the SRA complete repair application is explained there.

Column (5) – Tools and Test Equipment Reference Code. Column (5) specifies, by code, those common tool sets (not individual tools), common Test, Measurement and Diagnostic Equipment (TMDE), and special tools, special TMDE and special support equipment required to perform the designated function. Codes are keyed to the entries in the tools and test equipment table.

Column (6) – Remarks Code. When applicable this column contains a letter code, in alphabetical order, which is keyed to the remarks table entries.

**A-4 Explanation of Columns in the Tool and Test Equipment Requirements**

Column (1) – Tool or Test Equipment Reference Code. The tool or test equipment reference code correlates with a code used in column (5) of the MAC.

Column (2) – Maintenance Level. The lowest level of maintenance authorized to use the tool or test equipment.

**TM 55-1915-251-24&P**

Column (3) – Nomenclature. Name or identification of the tool or test equipment.

Column (4) – National Stock Number (NSN). The NSN of the tool or test equipment.

Column (5) – Tool Number. The manufacturer's part number, model number, or type number.

**A-5 Explanation of Columns in the Remarks**

Column (1) – Remarks Code. The code recorded in column (6) of the MAC.

Column (2) – Remarks. This column lists information pertinent to the maintenance function being performed as indicated in the MAC.

**Section I Maintenance Allocation Chart for FM-200 Fire Fighting Systems**

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS & TEST EQUIPMENT REF CODE	(6) REMARKS CODE
			UNIT		DIRECT SUPPORT	GENERAL SUPPORT	DEPOT		
			C	O	F	H	D		
18	Basic Craft	Inspect	100						A
		Test	2.0						
		Replace				100.0			
		Repair	10.0	10.0	40.0	80.0			
1821	FM-200 Fire Fighting System	Test	1.0			1.0		1, 2, 3	
		Inspect	1.0						
		Service	0.5			1.0			
		Repair	0.5			1.0			
1821	Water Washdown System (WWS)	Test				1.0			
		Inspect	1.0						
		Service	0.5			1.0			

**Section II Tools and Test Equipment for FM-200 Fire Fighting Systems**

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE LEVEL	NOMENCLATURE	NATIONAL STOCK NUMBER	TOOL NUMBER
1	C	Kwik-Draw Deluxe Detector Tube Pump w/ End of Stroke Indicator, Remote Sampling Adapter, and Carrying Pouch		(7L021) 487500
2	C	Detector Tube, Hydrogen Fluoride Gas (HF-1), 125 ppm Range, 3 ppm Threshold Limit Value (TLV)		(7L021) 804142
3	C	Sampling Line, 10 feet long		(7L021) 73076

Section III REMARKS

REMARKS CODE	REMARKS
A	BASIC CRAFT MAC GROUP 18 LISTED FOR TRACKING INFORMATION ONLY



**SECTION VI**

**APPENDIX B COMPONENTS OF END ITEMS (COEI)  
AND BASIC ISSUE ITEMS (BII) LIST**



## COMPONENTS OF END ITEM (COEI) AND BASIC ISSUE ITEMS (BII) LISTS

### INTRODUCTION

#### B-1 Scope

This section lists COEI and BII for the FM-200 and Water Washdown System (WWS) to help inventory items for safe and efficient operation of the equipment.

#### B-2 General

The COEI and BII information is divided into the following lists:

**Components of End Item (COEI).** This list is for informational purposes only, and is not authority to requisition replacements. These items are part of the FM-200 and WWS. As part of the end item, these items must be with the end item whenever it is issued or transferred between property accounts. Items of COEI are removed and separately packaged for transportation or shipment only when necessary. Illustrations are furnished to help you find and identify the items.

**Basic Issue Items (BII).** These essential items are required to place the FM-200 and WWS in operation, operate it, and to do emergency repairs. Although shipped separately packaged, BII must be with the FM-200 and WWS during operation and when it is transferred between property accounts. Listing these items is your authority to request/requisition them for replacement based on authorization of the end item by TOE/MTOE. Illustrations are furnished to help find and identify the items.

#### B-3 Explanation of Columns in the COEI List and BII List

Column (1) – Illus Number. Gives you the number of the item illustrated.

Column (2) – National Stock Number (NSN). Identifies the stock number of the item to be used for requisitioning purposes.

Column (3) – Description, CAGEC, and Part Number. Identifies the Federal item name (in all capital letters) followed by a minimum description when needed. The stowage location of COEI and BII is also included in this column. The last line below the description is the CAGEC (commercial and Government entity code) (in parentheses) and the part number.

Column (4) – Usable on Code. When applicable, gives you a code if the item you need is not the same for different models of equipment.

Column (5) – Unit of Measure (U/M). Indicates the physical measurement or count of the item as issued per the NSN shown in column (2).

Column (6) – Qty Rqr. Indicates the quantity required.

**Table B-1. Components of End Item List.**

None

**Table B-1. Continued - Onboard Spares FM-200**

(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER (NSN)	(3) DESCRIPTION, CAGEC AND PART NO.	(4) USABLE ON CODE	(5) UNIT OF MEASURE (U/M)	(6) QTY RQR.
Dwg. LSV-1- 5553-1 Find 81		REPLACEMENT GLASS, PULL BOX, (1DA54) 31302		EA	2
Dwg. LSV-1- 5553-1 Find 87		REPLACEMENT GLASS, PULL BOX, (1DA54) 928103		EA	2
Dwg. LSV-1- 5555-1 Find Various		SEAL WIRE (1DA54) 15262		EA	12

**Table B-1. Continued - Onboard Spares WWS**

(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER (NSN)	(3) DESCRIPTION, CAGEC AND PART NO.	(4) USABLE ON CODE	(5) UNIT OF MEASURE (U/M)	(6) QTY RQR.
Dwg. LSV-5231-1 Find 5		NOZZLE, SPRAY, MODEL TF, 120 DEGREE, FULL CONE, ¼ MPT , CRES (99134) TF10		EA	2
Dwg. LSV-5231-1 Find 79		GUARD, SPRINKLER (7N423) SPC1		EA	2

Table B-2. Basic Issue Items List.

(1) ILLUS. NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC AND PART NUMBER	(4) USABLE ON CODE	(5) U/M	(6) QTY RQR.
1		TECHNICAL MANUAL, UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE FM-200 FIRE FIGHTING SYSTEM FOR LSV TM 55-1915-251-24&P		EA	1



## **SECTION VII**

### **Appendix C** **Material Safety Data Sheets for Hydrogen** **Fluoride (HF) Gas, FM-200, Nitrogen and** **Carbon Dioxide (CO<sub>2</sub>)**





# BOC GASES

## MATERIAL SAFETY DATA SHEET

**PRODUCT NAME: HYDROGEN FLUORIDE**

### 1. Chemical Product and Company Identification

BOC Gases,  
Division of  
The BOC Group, Inc.  
575 Mountain Avenue  
Murray Hill, NJ 07974

BOC Gases  
Division of  
BOC Canada Limited  
5975 Falbourne Street, Unit 2  
Mississauga, Ontario L5R 3W6

TELEPHONE NUMBER: (908) 464-8100  
24-HOUR EMERGENCY TELEPHONE NUMBER:  
CHEMTREC (800) 424-9300

TELEPHONE NUMBER: (905) 501-1700  
24-HOUR EMERGENCY TELEPHONE NUMBER:  
(905) 501-0802  
EMERGENCY RESPONSE PLAN NO: 20101

PRODUCT NAME: HYDROGEN FLUORIDE  
CHEMICAL NAME: Hydrogen fluoride  
COMMON NAMES/SYNONYMS: Hydrofluoric acid, anhydrous  
TDG (Canada) CLASSIFICATION: 8 (6.1)  
WHMIS CLASSIFICATION: A, E, D2B, D1A

PREPARED BY: Loss Control (908)464-8100/(905)501-1700  
PREPARATION DATE: 6/1/95  
REVIEW DATES: 6/7/96

### 2. Composition, Information on Ingredients

INGREDIENT	% VOLUME	PEL-OSHA <sup>1</sup>	TLV-ACGIH <sup>2</sup>	LD <sub>50</sub> or LC <sub>50</sub> Route/Species
Hydrogen Fluoride FORMULA: HFI CAS: 7664-39-3 RTECS #: MW7875000	> 99.9	3 ppm TWA	3 ppm Ceiling	LC 50 1276ppm/1H (rat)

<sup>1</sup> As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993).

<sup>2</sup> As stated in the ACGIH 1994-95 Threshold Limit Values for Chemical Substances and Physical Agents

### 3. Hazards Identification

#### EMERGENCY OVERVIEW

Corrosive and irritating to the eyes, skin, and mucous membranes. Inhalation may result in chemical pneumonitis and pulmonary edema.

**PRODUCT NAME: CARBON DIOXIDE GAS****ROUTE OF ENTRY:**

Skin Contact Yes	Skin Absorption No	Eye Contact Yes	Inhalation Yes	Ingestion Yes
---------------------	-----------------------	--------------------	-------------------	------------------

**HEALTH EFFECTS:**

Exposure Limits Yes	Irritant No	Sensitization No
Teratogen No	Reproductive Hazard No	Mutagen No
Synergistic Effects None reported		

Carcinogenicity: -- NTP: No IARC: No OSHA: No

**EYE EFFECTS:**

No adverse effects anticipated.

**SKIN EFFECTS:**

No adverse effects anticipated.

**INGESTION EFFECTS:**

No adverse effects anticipated.

**INHALATION EFFECTS:**

Carbon dioxide is the most powerful cerebral vasodilator known. Inhaling large concentrations causes rapid circulatory insufficiency leading to coma and death. Asphyxiation is likely to occur before the effects of carbon dioxide overexposure. Chronic, harmful effects are not known from repeated inhalation of low concentrations. Low concentrations of carbon dioxide cause increased respiration and headache.

Effects of oxygen deficiency resulting from simple asphyxiants may include: rapid breathing, diminished mental alertness, impaired muscular coordination, faulty judgement, depression of all sensations, emotional instability, and fatigue. As asphyxiation progresses, nausea, vomiting, prostration, and loss of consciousness may result, eventually leading to convulsions, coma, and death.

Oxygen deficiency during pregnancy has produced developmental abnormalities in humans and experimental animals.

**NFPA HAZARD CODES**

Health: 1  
Flammability: 0  
Reactivity: 0

**HMIS HAZARD CODES**

Health: 1  
Flammability: 0  
Reactivity: 0

**RATINGS SYSTEM**

0 = No Hazard  
1 = Slight Hazard  
2 = Moderate Hazard  
3 = Serious Hazard  
4 = Severe Hazard

**PRODUCT NAME: HYDROGEN FLUORIDE****SKIN:**

Remove contaminated clothing as rapidly as possible. Flush affected area with copious quantities of water. Seek immediate medical attention.

**INGESTION:**

Not specified. Seek immediate medical attention.

**INHALATION:**

**PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF OVEREXPOSURE. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS.**

Victims should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. If breathing has stopped administer artificial resuscitation and supplemental oxygen. Further treatment should be symptomatic and supportive. Assure that mucous or vomited material does not obstruct the airway by use of positional drainage. Delayed pulmonary edema may occur. Keep patient under medical observation for at least 24 hours.

**5. Fire Fighting Measures**

Conditions of Flammability: Not flammable		
Flash point: None	Method: Not Applicable	Autoignition Temperature: None
LEL(%): None	UEL(%): None	
Hazardous combustion products: None		
Sensitivity to mechanical shock: None		
Sensitivity to static discharge: None		

**FIRE AND EXPLOSION HAZARDS:**

Reactions of hydrogen fluoride with metal piping and vessels generates hydrogen creating a potential explosion.

**EXTINGUISHING MEDIA:**

Nonflammable.

**6. Accidental Release Measures**

Evacuate all personnel from affected area. Use appropriate protective equipment. If leak is in user's equipment, be certain to purge piping with inert gas prior to attempting repairs. If leak is in container or container valve, contact the appropriate emergency telephone number listed in Section 1 or call your closest BOC location.

**7. Handling and Storage****Electrical classification:**

Non-hazardous.

Most metals corrode rapidly with wet hydrogen fluoride. Copper-nickel alloys and copper-tin alloys as well as stainless steel and nickel-chromium alloys offer best resistance to HF corrosion. Kel-F® and Teflon® are best for gasketing materials. Do not use Buna S®, Buna N®, or Neoprene.

Use only in well-ventilated areas. Valve protection caps must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Use a pressure reducing regulator when connecting cylinder to lower pressure (<400 psig) piping or

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**PRODUCT NAME: CARBON DIOXIDE, GAS**

Dry carbon dioxide can be handled in most common structural materials. Moist carbon dioxide is generally corrosive by its formation of carbonic acid. For applications with moist Carbon Dioxide, 316, 309 and 310 stainless steels may be used as well as Hastelloy ® A, B, & C, and Monel ®. Ferrous Nickel alloys are slightly susceptible to corrosion. At normal temperatures carbon dioxide is compatible with most plastics and elastomers.

Use only in well-ventilated areas. Carbon dioxide vapor is heavier than air and will accumulate in low areas. Valve protection caps must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Use a pressure reducing regulator when connecting cylinder to lower pressure (<3000 psig) piping or systems. Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous back flow into the system.

Protect cylinders from physical damage. Store in cool, dry, well-ventilated area away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 125°F (52°C). Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Full and empty cylinders should be segregated. Use a "first in-first out" inventory system to prevent full cylinders being stored for excessive periods of time.

For additional storage recommendations, consult Compressed Gas Association's Pamphlet P-1.

Never carry a compressed gas cylinder or a container of a gas in cryogenic liquid form in an enclosed space such as a car trunk, van or station wagon. A leak can result in a fire, explosion, asphyxiation or a toxic exposure.

Maximum use for potable water 100 mg/l.

## 8. Exposure Controls, Personal Protection

### EXPOSURE LIMITS<sup>1</sup>:

INGREDIENT	% VOLUME	PEL-OSHA <sup>2</sup>	TLV-ACGIH <sup>3</sup>	LD <sub>50</sub> or LC <sub>50</sub> Route/Species
Carbon Dioxide FORMULA: CO <sub>2</sub> CAS: 124-38-9 RTECS #: FF6400000	99.8 TO 99.999	5000 ppm TWA	5000 ppm TWA 30,000 ppm STEL	Not Available

<sup>1</sup> Refer to individual state of provincial regulations, as applicable, for limits which may be more stringent than those listed here.

<sup>2</sup> As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993)

<sup>3</sup> As stated in the ACGIH 1994-1995 Threshold Limit Values for Chemical Substances and Physical Agents.

IDLH (Carbon Dioxide): 50,000 ppm

### ENGINEERING CONTROLS:

Use local exhaust to prevent accumulation of high concentrations so as to reduce the oxygen level in the air to less than 19.5% and the carbon dioxide concentration below the exposure limit.

### EYE/FACE PROTECTION:

Safety goggles or glasses as appropriate for the job.

### SKIN PROTECTION:

Protective gloves of any material appropriate for the job.

### RESPIRATORY PROTECTION:

MSDS: G-8

Revised: 6/7/96

## 9. Physical and Chemical Properties

PARAMETER	VALUE	UNITS
Physical state (gas, liquid, solid)	: Gas	
Vapor pressure at °F	: 15.6	psia
Vapor density at STP (%) (Air = 1)	: 2.0	
Evaporation point	: Not Available	
Boiling point	: 67.1	°F
	: 19.5	°C
Freezing point	: -118.1	°F
	: -83.4	°C
pH	: Not Available	
Specific gravity	: Not Available	
Oil/water partition coefficient	: Not Available	
Solubility (H <sub>2</sub> O)	: Not Available	
Odor threshold	: Not Available	
Odor and appearance	: Pungent irritating odor; colorless liquid	

## 10. Stability and Reactivity

### STABILITY:

Stable

### CONDITIONS TO AVOID (STABILITY):

None

### INCOMPATIBLE MATERIALS:

Water, organic materials and metals.

### HAZARDOUS DECOMPOSITION PRODUCTS:

Hydrogen and toxic fluoride compounds in certain reactions.

### HAZARDOUS POLYMERIZATION:

Will not occur.

## 11. Toxicological Information

LC<sub>50</sub> (Rat) - Inhalation of 1276 ppm/1H.

Experimental data indicates this compound may produce teratogenic, mutagenic, or reproductive effects.

Extended low level systemic absorption of hydrogen fluoride may cause fluorosis, an abnormal calcification pattern of the skeletal system. Prolonged repeated exposure may cause changes in the bone and chronic irritation and congestion of the nose, throat and bronchial tubes.

## 12. Ecological Information

No data given.

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**PRODUCT NAME: CARBON DIOXIDE GAS**

Carbon dioxide is the most powerful cerebral vasodilator known. Inhaling large concentrations causes rapid circulatory insufficiency leading to coma and death. Chronic, harmful effects are not known from repeated inhalation of low (3 to 5 molar %) concentrations.

**12. Ecological Information**

No data given.

**13. Disposal Considerations**

Do not attempt to dispose of residual waste or unused quantities. Return in the shipping container PROPERLY LABELED, WITH ANY VALVE OUTLET PLUGS OR CAPS SECURED AND VALVE PROTECTION CAP IN PLACE to BOC Gases or authorized distributor for proper disposal.

**14. Transport Information**

PARAMETER	United States DOT	Canada TDG
PROPER SHIPPING NAME:	Carbon Dioxide	Carbon Dioxide
HAZARD CLASS:	2.2	2.2
IDENTIFICATION NUMBER:	UN 1013	UN 1013
SHIPPING LABEL:	NONFLAMMABLE GAS	NONFLAMMABLE GAS

**15. Regulatory Information****SARA TITLE III NOTIFICATIONS AND INFORMATION****SARA TITLE III HAZARD CLASSES:**

Acute Health Hazard

Sudden Release of Pressure Hazard

## **16. Other Information**

Compressed gas cylinders shall not be refilled without the express written permission of the owner. Shipment of a compressed gas cylinder which has not been filled by the owner or with his/her (written) consent is a violation of transportation regulations.

### **DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES:**

Although reasonable care has been taken in the preparation of this document, we extend no warranties and make no representations as to the accuracy or completeness of the information contained herein, and assume no responsibility regarding the suitability of this information for the user's intended purposes or for the consequences of its use. Each individual should make a determination as to the suitability of the information for their particular purpose(s).







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**SECTION I - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION**

<b>Product Name:</b>	FM-200		
<b>Manufacturer:</b>	Great Lakes Chemical Corporation		
<b>Address:</b>	P.O. Box 2200		
<b>City:</b>	West Lafayette		
<b>State:</b>	Indiana		
<b>Zip:</b>	47906-0200		
<b>Emergency Telephone Number:</b>	1-800-949-5167		
<b>Information</b>			
<b>Telephone Number:</b>	1-765-497-6100	<b>Fax:</b>	1-765-497-6123
<b>Chemtrec Phone:</b>	1-800-424-9300		
<b>Effective Date:</b>	8/11/97		
<b>Supercede Date:</b>	2/96		
<b>MSDS Prepared By:</b>	Regulatory Affairs Department/Great Lakes Chemical Corporation		
<b>Synonyms:</b>	1,1,1,2,3,3,3-Heptafluoropropane, 2H-Heptafluoropropane		
<b>Product Use:</b>	Fire extinguishing, fire suppression, explosion suppression and inerting agent		
<b>Chemical Name:</b>	1,1,1,2,3,3,3-Heptafluoropropane		
<b>Chemical Family:</b>	Halogenated alkane		

*Additional Information*

No information available

**SECTION II - COMPOSITION/INFORMATION ON INGREDIENTS**

INGREDIENT NAME	CAS No.	%	EXPOSURE LIMITS
1,1,1,2,3,3,3-Heptafluoropropane	431890	>99	Y (Hazardous) Not established (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) Not established (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)

\*Mixture. Indented chemicals components of mixture.

*Additional Information*

No information available

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## SECTION III - HAZARDS IDENTIFICATION

<b>Emergency Overview:</b>	Colorless gas Odorless Direct eye or skin contact with the liquid or cold gas can cause chilling or possibly frostbite of exposed tissues. May cause central nervous system effects. Inhalation of high concentrations can be harmful or fatal due to oxygen deprivation and/or heart irregularities.
<b>Relevant Routes of Exposure:</b>	Inhalation
<b>Signs and Symptoms of Overexposure:</b>	Symptoms similar to oxygen deprivation (headache, nausea, dizziness or loss of consciousness) may result from overexposure by inhalation. Heart irregularities such as irregular pulse or heart palpitations may indicate cardiac sensitivity. Cold, white or discolored skin or in severe cases blistering, can be a sign of frostbite caused by cold liquids or gases.
<b>Medical Conditions Generally Aggravated By Exposure:</b>	Persons with preexisting cardiac, respiratory, or central nervous system disorders may be more susceptible to effects of an overexposure. The use of epinephrine or similar compounds can increase susceptibility to heart irregularities caused by excessive exposure to these types of compounds.
<b>Potential Health Effects:</b>	See Section XI for additional information.
<b>Eyes:</b>	Direct eye contact with the liquid or cold gas can cause chilling or possibly frostbite of exposed tissues.
<b>Skin:</b>	Direct skin contact with the liquid or cold gas can cause chilling or possibly frostbite of exposed tissues.
<b>Ingestion:</b>	Not expected to be a hazard in normal industrial use.
<b>Inhalation:</b>	Inhalation of high concentrations can be harmful or fatal due to oxygen deprivation and/or heart irregularities (arrhythmias). Misuse of the product by deliberately inhaling high concentrations of this gas could cause death without warning.
<b>Carcinogenicity:</b>	
<b>NTP:</b>	No
<b>IARC:</b>	No
<b>OSHA:</b>	No
<b>ACGIH:</b>	No
<b>OTHER:</b>	No

### *Additional Information*

No information available

## SECTION IV - FIRST AID MEASURES

<b>Eyes:</b>	Flush with water. Get medical attention.
<b>Skin:</b>	Flush with water; if frostbite occurs get medical attention.
<b>Ingestion:</b>	No information available
<b>Inhalation:</b>	Remove person to fresh air; if not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

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### SECTION IV - FIRST AID MEASURES

**Antidotes:** No information available

**Notes to Physicians and/or Protection for First-Aiders:** The use of epinephrine or similar compounds can increase susceptibility to heart irregularities caused by excessive exposure to these types of compounds.

#### *Additional Information*

No information available

### SECTION V - FIRE FIGHTING MEASURES

**Flammable Limits in Air (% by Volume):** Not applicable

**Flash Point:** Nonflammable gas

**Autoignition Temperature:** Not available

**Extinguishing Media:** All conventional media are suitable.

**Fire Fighting Instructions:** Keep cylinders cool with a water spray applied from a safe distance. Use a self-contained breathing apparatus if containers rupture or release under fire conditions. Do not allow reentry into areas where this material has been released without first ventilating to remove products of combustion/decomposition.

**Unusual Fire and Explosion Hazards:** Although containers of our product are provided with pressure and temperature relief devices, containers can rupture if exposed to localized heat. Thermal decomposition will generate toxic and corrosive gases.

**Flammability Classification:** Nonflammable gas

**Known or Anticipated Hazardous Products of Combustion:** Decomposition by elevated temperatures (fire conditions, glowing metal surfaces) may generate hazardous decomposition products common to other CFCs, HCFCs or HBFCs. These can include hydrogen fluoride, carbon monoxide, carbon dioxide and others.

#### *Additional Information*

No information available

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## SECTION VI - ACCIDENTAL RELEASE MEASURES

without appropriate protective equipment including a self-contained breathing apparatus.  
**Personal Precautions:** See Section VIII.  
**Environmental Precautions:** No information available

### *Additional Information*

No information available

## SECTION VII - HANDLING AND STORAGE

**Handling:** Use the same type of precautions as would be used in handling any cryogenic gas. Protect container from damage. Handle in well-ventilated areas. When this material is used as a firefighting agent in fixed or portable extinguishing systems, follow manufacturer's instructions for operation, inspection, maintenance and repair of the system.  
**Storage:** Store in a cool, dry, well-ventilated area away from incompatible materials.  
Keep container tightly closed.  
**Other Precautions:** No information available

### *Additional Information*

No information available

## SECTION VIII - EXPOSURE CONTROLS/PERSONAL PROTECTION

**Engineering Controls:** No information available  
**Ventilation Requirements:** Use local ventilation to minimize exposure to gas.  
Use mechanical ventilation for general area control.  
**Personal Protective Equipment:**  
**Eye/Face Protection:** Chemical splash goggles when handling liquid  
**Skin Protection:** Use lined neoprene gloves if handling liquid.  
Clothing designed to minimize skin contact  
**Respiratory Protection:** Wear a NIOSH/MSHA approved self-contained breathing apparatus in emergency situations.  
Consult the OSHA respiratory protection information located at 29CFR 1910.134 and the American National Standard Institute's Practices of Respiratory Protection Z88.2.  
**Other Protective Clothing or Equipment:** No information available  
**Exposure Guidelines:** See Section II.  
**Work Hygienic Practices:** Wash thoroughly after handling.  
Wash contaminated clothing before reuse.  
Make sure piping is empty before doing maintenance work.

### *Additional Information*

No information available

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## SECTION IX - PHYSICAL & CHEMICAL PROPERTIES

<b>Appearance:</b>	Colorless gas
<b>Boiling Point:</b>	-16.4 degrees C (3 degrees F)
<b>Bulk Density:</b>	Not available
<b>Color:</b>	Colorless
<b>Decomposition Temperature:</b>	Not available
<b>Evaporation Rate:</b>	Not available
<b>Evaporation Rate Basis:</b>	Not available
<b>Freezing Point:</b>	Not available
<b>Heat Value:</b>	Not available
<b>Melting Point:</b>	-131 degrees C (-204 degrees F)
<b>Molecular/Chemical Formula:</b>	C3HF7
<b>Molecular Weight:</b>	170
<b>Octanol/Water Partition Coefficient:</b>	Not available
<b>Odor:</b>	Odorless
<b>Odor Threshold:</b>	Not available
<b>Particle Size:</b>	Not available
<b>Percent Volatile:</b>	Not available
<b>pH Value:</b>	Not available
<b>pH Concentration:</b>	Not available
<b>Physical State:</b>	Gas
<b>Reactivity in Water:</b>	Not water reactive
<b>Saturated Vapor Concentration:</b>	Not available
<b>Softening Point:</b>	Not available
<b>Solubility in Water:</b>	260 mg/L
<b>Specific Gravity or Density (Water=1):</b>	1.46
<b>Vapor Density:</b>	6.04
<b>Vapor Pressure:</b>	58.8 psia at 70 degrees F (21 degrees C)
<b>Viscosity:</b>	Not available
<b>Volatile Organic Compounds:</b>	Not available
<b>Water/Oil Distribution Coefficient:</b>	Not available
<b>Weight Per Gallon:</b>	Not available

### *Additional Information*

No information available

## SECTION X - STABILITY AND REACTIVITY

<b>Stability:</b>	Stable under normal conditions of handling and use.
<b>Conditions to Avoid:</b>	None
<b>Incompatibility With Other Materials:</b>	Powdered metals (ex. Al, Mg, or Zn) and strong alkalis, oxidizers or reducing agents are not compatible with this and most other halogenated

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## SECTION X - STABILITY AND REACTIVITY

organic compounds.

### Hazardous Decomposition

#### Products:

Thermal decomposition may produce the following:

Hydrogen fluoride

Carbon monoxide and carbon dioxide

### Hazardous Polymerization:

Will not occur

#### Conditions to Avoid:

None

### Additional Information

No information available

## SECTION XI - TOXICOLOGICAL INFORMATION

VALUE	ANIMAL	ROUTES	COMPONENTS
>788,696 ppm/4H	Rat	Acute Inhalation	1,1,1,2,3,3,3-Heptafluoropropane

### Toxicological Information:

The human health hazards of this product are expected to be similar to other liquified gases including N<sub>2</sub>, CO<sub>2</sub>, CFCs, HCFCs, and HBFCs. Therefore, direct eye or skin contact with the liquid or cold gas can cause chilling or possibly frostbite of exposed tissues. Inhalation of high concentrations can be harmful or fatal due to oxygen deprivation and/or heart irregularities (arrhythmias). Misuse of the product by deliberately inhaling high concentrations of this gas could cause death without warning. Persons with preexisting cardiac or central nervous system disorders may be more susceptible to effects of an overexposure.

When tested with and without metabolic activation over a concentration range of 43.9-93.5%, heptafluoropropane was not mutagenic in *S. typhimurium*. Neither toxicity nor mutagenicity was observed in a mouse lymphoma assay when heptafluoropropane was tested to a concentration of 56.8%. Neither toxicity nor an increase in micronuclei was observed in mice exposed to 10.5% heptafluoropropane. Therefore, there is no evidence that heptafluoropropane is capable of inducing gene or chromosomal mutations in vitro or chromosomal effects in vivo. In other studies, heptafluoropropane did not show genotoxicity or cytotoxicity.

Animal studies have found the rat 4 hour LC<sub>50</sub> to be >788,696 ppm (~80%), the highest level tested. A cardiac sensitization study in dogs found the No Observable Adverse Effect Level (NOAEL) to be 9.0%. The Lowest Observable Adverse Effect Level (LOAEL) for this study was reported to be 10.5%. A 90 day inhalation study did not find any exposure related effects at 105,000 ppm (10.5% vol./vol.), the highest level tested. Inhalation studies looking for developmental effects on pregnant rabbits and rats or their offspring did not show any exposure related effects at the highest concentrations tested (105,000 ppm).

### Additional Information

No information available

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## SECTION XII - ECOLOGICAL INFORMATION

**Ecological Information:** No information available

### *Additional Information*

No information available

## SECTION XIII - DISPOSAL CONSIDERATIONS

**Disposal Considerations:** Non-contaminated product is reclaimable. Contact Great Lakes Chemical Corporation for information. Otherwise, dispose of waste in an approved chemical incinerator equipped with a scrubber as allowed by current Local, State/Province, Federal/Canadian laws and regulations.

### *Additional Information*

No information available

## SECTION XIV - TRANSPORT INFORMATION

### U.S. DOT

**Proper Shipping Name:** Heptafluoropropane  
**Hazard Class:** 2.2  
**ID Number:** UN3296  
**Packing Group:** N/A  
**Labels:** Nonflammable gas  
**Special Provisions:** N/A  
**Packaging Exceptions:** 306  
**Non-Bulk Packaging:** 304  
**Bulk Packaging:** 314, 315  
**Air/Rail Limit:** 75 kg  
**Air Cargo Limit:** 150 kg  
**Vessel Stowage:** A  
**Other Stowage:** N/A  
**Reportable Quantity:** N/A

### AIR - ICAO OR IATA

**Proper Shipping Name:** Heptafluoropropane  
**Hazard Class:** 2.2  
**ID Number:** UN3296  
**Risk:** N/A  
**Packing Group:** N/A  
**Hazard Labels:** Nonflammable gas  
**Packing Instructions:** 200  
**Air Passenger Limit Per Package:** 75 kg  
**Packing Instruction - Cargo:** 200  
**Air Cargo Limit Per Package:** 150 kg  
**Special Provisions Code:** N/A

# MATERIAL SAFETY DATA SHEET

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## SECTION XIV - TRANSPORT INFORMATION

### WATER - IMDG

**Proper Shipping Name:** Heptafluoropropane  
**Hazard Class:** 2.2  
**ID Number:** UN3296  
**Packing Group:** N/A  
**Risk:** N/A  
**Emergency Procedures Code:** NA  
**Medical First Aid Guide Code:** N/A

### *Additional Information*

No information available

## SECTION XV - REGULATORY INFORMATION

**U.S. Federal Regulations:** The components of this product are either on the TSCA Inventory or exempt (i.e. impurities) from the Inventory.

This product is being commercially manufactured under a TSCA Section 5 Consent Order. The Significant New Use Rule (SNUR) for this chemical can be located in 40 CFR Part 721.8125. For use as an ODC alternative, consult 40 CFR Part 82.170 for approved SNAP uses or contact Great Lakes Chemical Corporation.

**State Regulations:** None known

**International Regulations:** This material (or each component) is listed on the following inventories:  
EU - EINECS

Canadian WHMIS Hazard Class and Division = A.

### SARA Hazards:

**Acute:** Yes  
**Chronic:** No  
**Reactive:** No  
**Fire:** No  
**Pressure:** No

### *Additional Information*

The above regulatory information represents only selected regulations and is not meant to be a complete list.

## SECTION XVI - OTHER INFORMATION

### NFPA Codes:

**Health:** 1  
**Flammability:** 0  
**Reactivity:** 0  
**Other:** 0



## MATERIAL SAFETY DATA SHEET

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### SECTION XVI - OTHER INFORMATION

**HMIS Codes:**

**Health:** 1  
**Flammability:** 0  
**Reactivity:** 0  
**Protection:** X

**Label Statements:** Not available

**Other Information:**

Abbreviations:

(L) = Loose bulk density in g/ml

LOEC = Lowest observed effect concentration

MATC = Maximum acceptable toxicant concentration

NA = Not available

N/A = Not applicable

NL = Not limited

NOEC = No observed effect concentration

NR = Not rated

(P) = Packed bulk density in g/ml

PNOC = Particulates Not Otherwise Classified

PNOR = Particulates Not Otherwise Regulated

REL = Recommended exposure limit

TS = Trade secret

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*Additional Information*

Information on this form is furnished solely for the purpose of compliance with OSHA's Hazard Communication Standard, 29CFR 1910.1200 and The Canadian Environmental Protection Act, Canada Gazette Part II, Vol. 122, No. 2 and shall not be used for any other purpose.

**Revision Information:**

Replaces JSD:843

New Format

Section XI - Toxicological





**MATERIAL SAFETY DATA SHEET**

**PRODUCT NAME: NITROGEN**

**1. Chemical Product and Company Identification**

**BOC Gases,  
Division of  
The BOC Group, Inc.  
575 Mountain Avenue  
Murray Hill, NJ 07974**

**BOC Gases  
Division of  
BOC Canada Limited  
5975 Falbourne Street, Unit 2  
Mississauga, Ontario L5R 3W6**

**TELEPHONE NUMBER: (908) 464-8100  
24-HOUR EMERGENCY TELEPHONE NUMBER:  
CHEMTREC (800) 424-9300**

**TELEPHONE NUMBER: (905) 501-1700  
24-HOUR EMERGENCY TELEPHONE NUMBER:  
(905) 501-0802  
EMERGENCY RESPONSE PLAN NO: 20101**

**PRODUCT NAME: NITROGEN  
CHEMICAL NAME: Nitrogen  
COMMON NAMES/SYNONYMS: Nitrogen, compressed; Nitrogen gas  
TDG (Canada) CLASSIFICATION: 2.2  
WHMIS CLASSIFICATION: A**

**PREPARED BY: Loss Control (908)464-8100/(905)501-1700  
PREPARATION DATE: 6/1/95  
REVIEW DATES: 6/7/96**

**2. Composition, Information on Ingredients**

INGREDIENT	% VOLUME	PEL-OSHA <sup>1</sup>	TLV-ACGIH <sup>2</sup>	LD <sub>50</sub> or LC <sub>50</sub> Route/Species
Nitrogen FORMULA: N <sub>2</sub> CAS: 7727-37-9 RTECS #: QW9700000	99.995 to 99.999	Simple Asphyxiant	Simple Asphyxiant	Not Available

<sup>1</sup> As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993)

<sup>2</sup> As stated in the ACGIH 1994-95 Threshold Limit Values for Chemical Substances and Physical Agents

**3. Hazards Identification**

**EMERGENCY OVERVIEW**

**Simple Asphyxiant - This product does not contain oxygen and may cause asphyxia if released in a confined area. Maintain oxygen levels above 19.5%. Nonflammable.**

**PRODUCT NAME: NITROGEN**

**ROUTE OF ENTRY:**

Skin Contact Yes	Skin Absorption No	Eye Contact Yes	Inhalation Yes	Ingestion No
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**HEALTH EFFECTS:**

Exposure Limits No	Irritant No	Sensitization No
Teratogen No	Reproductive Hazard No	Mutagen No
Synergistic Effects None reported		

Carcinogenicity: – NTP: No IARC: No OSHA: No

**EYE EFFECTS:**

No adverse effects anticipated.

**SKIN EFFECTS:**

No adverse effects anticipated.

**INGESTION EFFECTS:**

No adverse effects anticipated.

**INHALATION EFFECTS:**

Product is a non-toxic simple asphyxiant. Effects of oxygen deficiency resulting from simple asphyxiants may include: rapid breathing, diminished mental alertness, impaired muscular coordination, faulty judgement, depression of all sensations, emotional instability, and fatigue. As asphyxiation progresses, nausea, vomiting, prostration, and loss of consciousness may result, eventually leading to convulsions, coma, and death.

Oxygen deficiency during pregnancy has produced developmental abnormalities in humans and experimental animals.

**NFPA HAZARD CODES**

Health: 0  
Flammability: 0  
Reactivity: 0

**HMIS HAZARD CODES**

Health: 0  
Flammability: 0  
Reactivity: 0

**RATINGS SYSTEM**

0 = No Hazard  
1 = Slight Hazard  
2 = Moderate Hazard  
3 = Serious Hazard  
4 = Severe Hazard

**4. First Aid Measures**

**EYES:**

Never introduce ointment or oil into the eyes without medical advice! If pain is present, refer the victim to an ophthalmologist for treatment and follow up.

**PRODUCT NAME: NITROGEN**

**SKIN:**

Remove contaminated clothing and flush affected areas with lukewarm water. If irritation persists, seek medical attention.

**INGESTION:**

Ingestion is unlikely as product as a gas at room temperature.

**INHALATION:**

PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF OVEREXPOSURE. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS. Victims should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. Unconscious persons should be moved to an uncontaminated area, and if breathing has stopped, administer artificial resuscitation and supplemental oxygen. Further treatment should be symptomatic and supportive.

**5. Fire Fighting Measures**

<b>Conditions of Flammability: Nonflammable</b>		
<b>Flash point:</b> None	<b>Method:</b> Not Applicable	<b>Autoignition Temperature:</b> None
<b>LEL(%):</b> None	<b>UEL(%):</b> None	
<b>Hazardous combustion products:</b> None		
<b>Sensitivity to mechanical shock:</b> None		
<b>Sensitivity to static discharge:</b> None		

**FIRE AND EXPLOSION HAZARDS:**

None. Nonflammable.

**EXTINGUISHING MEDIA:**

None required. Use as appropriate for surrounding materials.

**6. Accidental Release Measures**

Evacuate all personnel from affected area. Use appropriate protective equipment. If leak is in container or container valve, contact the appropriate emergency telephone number listed in Section 1 or call your closest BOC location.

**7. Handling and Storage**

**Electrical classification:**

Non-hazardous.

This gas mixture is noncorrosive and may be used with all common structural materials.

Use only in well-ventilated areas. Valve protection caps must remain in place unless container is secured with valve protection outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Use a pressure reducing regulator when connecting cylinder to lower pressure (<3000 psig) piping or systems. Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder.

MSDS: G-7  
Revised: 6/7/96

**PRODUCT NAME: NITROGEN**

Protect cylinders from physical damage. Store in cool, dry, well-ventilated area of non-combustible construction away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 125°F (52°C). Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Use a "first in-first out" inventory system to prevent full cylinders being stored for excessive periods of time.

For additional recommendations, consult Compressed Gas Association Pamphlets P-1, P-14, P-9, and Safety Bulletin SB-2.

Never carry a compressed gas cylinder or a container of a gas in cryogenic liquid form in an enclosed space such as a car trunk, van or station wagon. A leak can result in a fire, explosion, asphyxiation or a toxic exposure.

**8. Exposure Controls, Personal Protection**

**EXPOSURE LIMITS<sup>1</sup>:**

INGREDIENT	% VOLUME	PEL-OSHA <sup>2</sup>	TLV-ACGIH <sup>3</sup>	LD <sub>50</sub> or LC <sub>50</sub> Route/Species
Nitrogen FORMULA: N <sub>2</sub> CAS: 7727-37-9 RTECS #: QW9700000	99.995 to 99.999	Simple Asphyxiant	Simple Asphyxiant	Not Available

<sup>1</sup> Refer to individual state of provincial regulations, as applicable, for limits which may be more stringent than those listed here.

<sup>2</sup> As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993)

<sup>3</sup> As stated in the ACGIH 1994-1995 Threshold Limit Values for Chemical Substances and Physical Agents.

**ENGINEERING CONTROLS:**

Local exhaust to prevent accumulation of high concentrations so as to reduce the oxygen level in the air to less than 19.5%.

**EYE/FACE PROTECTION:**

Safety goggles or glasses as appropriate for the job.

**SKIN PROTECTION:**

Protective gloves of material appropriate for the job.

**RESPIRATORY PROTECTION:**

Positive pressure air line with full-face mask and escape bottle or self-contained breathing apparatus should be available for emergency use.

**OTHER/GENERAL PROTECTION:**

Safety shoes or other footwear as appropriate for the job.

**9. Physical and Chemical Properties**

<b>PARAMETER</b>	<b>VALUE</b>	<b>UNITS</b>
Physical state (gas, liquid, solid)	: Gas	
Vapor pressure	: Not Available	
Vapor density (Air = 1)	: 0.97	
Evaporation point	: Not Available	
Boiling point	: -320.4	°F
	: -195.8	°C
Freezing point	: -345.9	°F
	: -209.9	°C
pH	: Not Applicable	
Specific gravity	: Not Available	
Oil/water partition coefficient	: Not Available	
Solubility (H <sub>2</sub> O)	: Very slightly soluble	
Odor threshold	: Not Applicable	
Odor and appearance	: Colorless, odorless gas	

**10. Stability and Reactivity****STABILITY:**

Stable

**INCOMPATIBLE MATERIALS:**

None

**HAZARDOUS POLYMERIZATION:**

Does not occur.

**11. Toxicological Information**

Oxygen deficiency during pregnancy has produced developmental abnormalities in humans and experimental animals.

No data given in the Registry of Toxic Effects of Chemical Substances (RTECS) or Sax, Dangerous Properties of Industrial Materials, 7th ed.

**12. Ecological Information**

No data given.

**13. Disposal Considerations**

Do not attempt to dispose of residual waste or unused quantities. Return in the shipping container PROPERLY LABELED, WITH ANY VALVE OUTLET PLUGS OR CAPS SECURED AND VALVE PROTECTION CAP IN PLACE to BOC Gases or authorized distributor for proper disposal.

**PRODUCT NAME: NITROGEN**

#### 14. Transport Information

PARAMETER	United States DOT	Canada TDG
PROPER SHIPPING NAME:	Nitrogen, compressed	Nitrogen, compressed
HAZARD CLASS:	2.2	2.2
IDENTIFICATION NUMBER:	UN 1066	UN 1066
SHIPPING LABEL:	NONFLAMMABLE GAS	NONFLAMMABLE GAS

#### 15. Regulatory Information

##### SARA TITLE III NOTIFICATIONS AND INFORMATION

##### SARA TITLE III - HAZARD CLASSES:

Sudden Release of Pressure Hazard

#### 16. Other Information

Compressed gas cylinders shall not be refilled without the express written permission of the owner. Shipment of a compressed gas cylinder which has not been filled by the owner or with his/her (written) consent is a violation of transportation regulations.

##### DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES:

Although reasonable care has been taken in the preparation of this document, we extend no warranties and make no representations as to the accuracy or completeness of the information contained herein, and assume no responsibility regarding the suitability of this information for the user's intended purposes or for the consequences of its use. Each individual should make a determination as to the suitability of the information for their particular purpose(s).



# BOC GASES

## MATERIAL SAFETY DATA SHEET

**PRODUCT NAME: CARBON DIOXIDE, GAS**

### 1. Chemical Product and Company Identification

BOC Gases,  
Division of  
The BOC Group, Inc.  
575 Mountain Avenue  
Murray Hill, NJ 07974

BOC Gases  
Division of  
BOC Canada Limited  
5975 Falbourne Street, Unit 2  
Mississauga, Ontario L5R 3W6

TELEPHONE NUMBER: (908) 464-8100

TELEPHONE NUMBER: (905) 501-1700

24-HOUR EMERGENCY TELEPHONE NUMBER:  
CHEMTREC (800) 424-9300

24-HOUR EMERGENCY TELEPHONE NUMBER:  
(905) 501-0802

EMERGENCY RESPONSE PLAN NO: 20101

PRODUCT NAME: CARBON DIOXIDE, GAS  
CHEMICAL NAME: Carbon Dioxide  
COMMON NAMES/SYNONYMS: Carbonic Anhydride  
TDG (Canada) CLASSIFICATION: 2.2  
WHMIS CLASSIFICATION: A

PREPARED BY: Loss Control (908)464-8100/(905)501-1700

PREPARATION DATE: 6/1/95

REVIEW DATES: 6/7/96

### 2. Composition, Information on Ingredients

INGREDIENT	% VOLUME	PEL-OSHA <sup>1</sup>	TLV-ACGIH <sup>2</sup>	LD <sub>50</sub> or LC <sub>50</sub> Route/Species
Carbon Dioxide FORMULA: CO <sub>2</sub> CAS: 124-38-9 RTECS #: FF6400000	99.8 TO 99.999	5000 ppm TWA	5000 ppm TWA 30,000 ppm STEL	Not Available

<sup>1</sup> As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993)

<sup>2</sup> As stated in the ACGIH 1994-95 Threshold Limit Values for Chemical Substances and Physical Agents

### 3. Hazards Identification

#### EMERGENCY OVERVIEW

Oxygen levels below 19.5% may cause asphyxia. Carbon dioxide exposure can cause nausea and respiratory problems. High concentrations may cause vasodilation leading to circulatory collapse.

**PRODUCT NAME: HYDROGEN FLUORIDE****ROUTE OF ENTRY:**

Skin Contact Yes	Skin Absorption No	Eye Contact Yes	Inhalation Yes	Ingestion Yes
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**HEALTH EFFECTS:**

Exposure Limits Yes	Irritant Yes	Sensitization No
Teratogen No	Reproductive Hazard No	Mutagen No
Synergistic Effects None Reported		

Carcinogenicity: – NTP: No IARC: No OSHA: No

**EYE EFFECTS:**

Corrosive and irritating to the eyes. Contact with the liquid or vapor causes painful burns and ulcerations. Burns to the eyes result in lesions and possible loss of vision.

**SKIN EFFECTS:**

Corrosive and irritating to the skin and all living tissue. It hydrolyzes very rapidly yielding hydrofluoric acid so that skin burns and mucosal irritation are like that from exposure to that acid. Toxic level exposure to dermal tissue causes acid-like burns and skin lesions resulting in early necrosis and scarring. Burns are progressive while any residual active fluorides remain. Hydrofluoric acid burns exhibit severe pain, redness, possible swelling, and early necrosis.

**INGESTION:**

Corrosive and irritating to the gastrointestinal system. It hydrolyzes very rapidly yielding hydrofluoric acid so that skin burns and mucosal irritation are like that from exposure to that acid.

**INHALATION EFFECTS:**

Corrosive and irritating to the upper and lower respiratory tract and all mucosal tissue. Symptoms include lachrymation, cough, labored breathing, and excessive salivary and sputum formation. Excessive irritation causes chemical pneumonitis and pulmonary edema which could be fatal.

**NFPA HAZARD CODES**

Health: 4  
Flammability: 0  
Reactivity: 1

**HMIS HAZARD CODES**

Health: 4  
Flammability: 0  
Reactivity: 1

**RATINGS SYSTEM**

0 = No Hazard  
1 = Slight Hazard  
2 = Moderate Hazard  
3 = Serious Hazard  
4 = Severe Hazard

**4. First Aid Measures****EYES:**

PERSONS WITH POTENTIAL EXPOSURE SHOULD NOT WEAR CONTACT LENSES. Flush contaminated eyes with copious quantities of water. Part eyelids to assure complete flushing. Continue for a minimum of 30 minutes. Seek immediate medical attention.

#### 4. First Aid Measures

**EYES:**

Never introduce oil or ointment into the eyes without medical advice! If pain is present, refer the victim to an ophthalmologist for further treatment and follow up.

**SKIN:**

No adverse effects anticipated.

**INGESTION:**

Not anticipated.

**INHALATION:**

PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF OVEREXPOSURE TO CARBON DIOXIDE. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS. Conscious persons should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. Unconscious persons should be moved to an uncontaminated area, given mouth-to-mouth resuscitation and supplemental oxygen. Further treatment should be symptomatic and supportive.

#### 5. Fire Fighting Measures

Conditions of Flammability: Nonflammable		
Flash point: None	Method: Not Applicable	Autoignition Temperature: None
LEL(%): None	UEL(%): None	
Hazardous combustion products: None		
Sensitivity to mechanical shock: None		
Sensitivity to static discharge: None		

**FIRE AND EXPLOSION HAZARDS:**

None. Nonflammable

#### 6. Accidental Release Measures

Evacuate all personnel from affected area. Use appropriate protective equipment. If leak is in user's equipment, be certain to purge piping with inert gas prior to attempting repairs. If leak is in container or container valve, contact the appropriate emergency telephone number listed in Section 1 or call your closest BOC location.

#### 7. Handling and Storage

**Electrical Classification:**

Non-Hazardous

**PRODUCT NAME: HYDROGEN FLUORIDE**

systems. Do not heat cylinder by any means to increase rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent Hazardous back flow into cylinder.

Protect cylinders from physical damage. Store in cool, dry, well-ventilated areas of non-combustible construction away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 130°F (54°C). Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Full & empty cylinders should be segregated. Use a "first in-first out" inventory system to prevent full cylinders from being stored for excessive periods of time.

For additional storage recommendations, consult Compressed Gas Association Pamphlet P-1.

Never carry a compressed gas cylinder or a container of a gas in cryogenic liquid form in an enclosed space such as a car trunk, van or station wagon. A leak can result in a fire, explosion, asphyxiation or a toxic exposure.

**8. Exposure Controls, Personal Protection**

**EXPOSURE LIMITS<sup>1</sup>:**

INGREDIENT	% VOLUME	REL-OSHA	TLV-ACGIH <sup>3</sup>	LD <sub>50</sub> or LC <sub>50</sub> Route/Species
Hydrogen Fluoride FORMULA: HF CAS: 7664-39-3 RTECS #: MW7875000	> 99.9	3 ppm TWA	3 ppm Ceiling	LC 50 1276ppm/1H (rat)

<sup>1</sup> Refer to individual state or provincial regulations, as applicable, for limits which may be more stringent than those listed here.

<sup>2</sup> As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993)

<sup>3</sup> As stated in the ACGIH 1994-1995 Threshold Limit Values for Chemical Substances and Physical Agents.

**ENGINEERING CONTROLS:**

Hood with forced ventilation.

Use local ventilation to prevent accumulation above the exposure limit.

**EYE/FACE PROTECTION:**

Safety goggles or glasses, plus a face shield.

**SKIN PROTECTION:**

Plastic or rubber.

**RESPIRATORY PROTECTION:**

Positive pressure air line with full-face mask and escape bottle or self-contained breathing apparatus should be available for emergency use.

**OTHER/GENERAL PROTECTION:**

Safety shoes, safety shower, eyewash "fountain", protective apron.

**PRODUCT NAME: CARBON DIOXIDE, GAS**

Positive pressure air line with full-face mask and escape bottle or self-contained breathing apparatus should be available for emergency use.

**OTHER/GENERAL PROTECTION:**

Safety shoes.

**9. Physical and Chemical Properties**

PARAMETER	VALUE	UNITS
Physical state (gas, liquid, solid)	: Gas	
Vapor pressure at 70 °F	: 856	psia
Vapor density at 70 °F, 1 atm (Air = 1)	: 1.53	
Evaporation point	: Not Available	
Boiling point (CO2 Sublimes)	: -109.3	°F
	: -78.5	°C
Freezing point	: -69.8	°F
	: -56.6	°C
pH	: Not Available	
Specific gravity	: Not Available	
Oil/water partition coefficient	: Not Available	
Solubility (H2O)	: Very soluble	
Odor threshold	: Not Applicable	
Odor and appearance	: A colorless, odorless gas.	

**10. Stability and Reactivity**

**STABILITY:**

Stable

**INCOMPATIBLE MATERIALS:**

Certain reactive metals, hydrides, moist cesium monoxide, or lithium acetylene carbide diammino may ignite. Passing carbon dioxide over a mixture of sodium peroxide and aluminum or magnesium may explode.

**HAZARDOUS DECOMPOSITION PRODUCTS:**

Carbon monoxide and oxygen when heated above 3092 °F (1700°C). Carbonic acid is formed in the presence of moisture.

**HAZARDOUS POLYMERIZATION:**

Will not occur.

**11. Toxicological Information**

**REPRODUCTIVE:**

Oxygen deficiency during pregnancy has produced developmental abnormalities in humans and experimental animals.

Exposure of female rats to 60,000 ppm carbon dioxide for 24 hours has produced toxic effects to the embryo and fetus in pregnant rats. Toxic effects to the reproductive system have been observed in other mammalian species at similar concentrations.

**OTHER:**

MSDS: G-8

Revised: 6/7/96

**PRODUCT NAME: HYDROGEN FLUORIDE**

**13. Disposal Considerations**

Do not attempt to dispose of residual waste or unused quantities. Return in the shipping container PROPERLY LABELED, WITH ANY VALVE OUTLET PLUGS OR CAPS SECURED AND VALVE PROTECTION CAP IN PLACE to BOC Gases or authorized distributor for proper disposal.

**14. Transport Information**

PARAMETER	United States DOT	Canada TDG
PROPER SHIPPING NAME:	Hydrogen Fluoride, Anhydrous	Hydrogen Fluoride, Anhydrous
HAZARD CLASS:	8	8 (6.1)
IDENTIFICATION NUMBER:	UN 1052	UN 1052
SHIPPING LABEL:	CORROSIVE, POISON	CORROSIVE, POISON

**Additional Marking Requirement:** "Inhalation Hazard"

If net weight of product  $\geq$  100 pounds, the container must be also marked with the letters "RQ".

**Additional Shipping Paper Description Requirement:** "Poison Inhalation Hazard, Zone C"

If net weight of product  $\geq$  100 pounds, the shipping papers must be also marked with the letters "RQ".

**Packing Group:** I

**15. Regulatory Information**

**SARA TITLE III NOTIFICATIONS AND INFORMATION**

Hydrogen fluoride is listed as an extremely hazardous substance (EHS) subject to state and local reporting under Section 304 of SARA Title III (EPCRA).

The presence of hydrogen fluoride in quantities in excess of the threshold planning quantity (TPQ) of 100 pounds requires certain emergency planning activities to be conducted.

Releases of hydrogen fluoride in quantities equal to or greater than the reportable quantity (RQ) of 100 pounds are subject to reporting to the National Response Center under CERCLA, Section 304 SARA Title III.

**SARA TITLE III - HAZARD CLASSES:**

- Acute Health Hazard
- Chronic Health Hazard
- Fire Hazard
- Sudden Release of Pressure Hazard
- Reactivity Hazard

**SARA TITLE III - SECTION 313 SUPPLIER NOTIFICATION:**

This product contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372:

CAS NUMBER	INGREDIENT NAME	PERCENT BY VOLUME
7664-39-3	HYDROGEN FLUORIDE	> 99.9

This information must be included on all MSDSs that are copied and distributed for this material.

## 16. Other Information

Compressed gas cylinders shall not be refilled without the express written permission of the owner. Shipment of a compressed gas cylinder which has not been filled by the owner or with his/her (written) consent is a violation of transportation regulations.

### **DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES:**

Although reasonable care has been taken in the preparation of this document, we extend no warranties and make no representations as to the accuracy or completeness of the information contained herein, and assume no responsibility regarding the suitability of this information for the user's intended purposes or for the consequences of its use. Each individual should make a determination as to the suitability of the information for their particular purpose(s).





## **SECTION VIII**

### **Appendix D Component Manufacturers' Repair Part Data Sheets for FM-200 and Water Washdown System Installation with Distributor Listing**

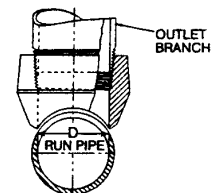
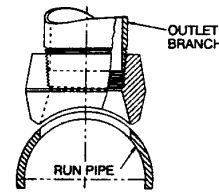
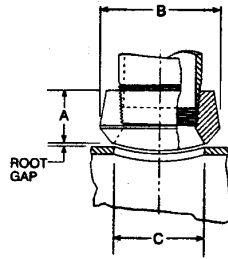


# B<sup>®</sup> THREDOLET<sup>®</sup> REDUCING, SIZE ON SIZE AND FLAT

BONNEY FORGE

**CL 3000**

**CL 6000**



SIZE ON SIZE

## REDUCING SIZES

	Outlet Size Inches	Dimensions			Appx. Weight Pounds
		A	B	C	
<b>CL 3000</b>	1/8	3/4	1	5/8	.10
	1/4	3/4	1	5/8	.10
	3/8	13/16	1-1/4	3/4	.20
	1/2	1	1-13/32	15/16	.25
	3/4	1-1/16	1-23/32	1-5/32	.35
	1	1-5/16	2	1-7/16	.60
	1-1/4	1-5/16	2-9/16	1-3/4	.90
	1-1/2	1-3/8	2-27/32	2	1.00
	2	1-1/2	3-15/32	2-9/16	1.75
	2-1/2	1-13/16	4-1/16	3	3.00
	3	2	4-13/16	3-11/16	4.35
	3-1/2	2-1/8	5-7/32	4	5.75
<b>CL 6000</b>	4	2-1/4	5-31/32	4-3/4	7.10
	5	2-5/8	7-5/16	5-9/16	12.00
	6	2-3/4	8-5/8	6-11/16	15.30
	1/4	1-1/8	1-11/32	9/16	.30
	3/8	1-1/8	1-11/32	9/16	.30
	1/2	1-1/4	1-23/32	3/4	.45
	3/4	1-7/16	1-51/64	1	.75
	1	1-9/16	2-7/16	1-5/16	1.25
	1-1/4	1-5/8	2-23/32	1-1/2	1.60
	1-1/2	1-11/16	3-1/4	1-15/16	1.95
2	2-1/16	4-1/32	2-3/4	5.00	

## SIZE ON SIZE

	Outlet Size Inches	Dimensions				Appx. Weight Pounds
		A	B	C	D	
<b>CL 3000</b>	1/2	1	1-3/8	15/16	5/8	.15
	3/4	1-1/16	1-5/8	1-3/16	13/16	.25
	1	1-5/16	2	1-7/16	1-1/16	.45
	1-1/4	1-5/16	2-3/8	1-3/4	1-3/8	.70
	1-1/2	1-3/8	2-7/8	2	1-5/8	.90
	2	1-1/2	3-1/2	2-9/16	2-1/16	1.40
	2-1/2	1-29/32	4-1/16	3	2-1/2	2.50
	3	2	4-13/16	3-11/16	3-1/16	4.30
	3-1/2	2-1/8	5-3/8	4-7/16	3-9/16	4.50
	4	2-1/4	6-1/16	4-3/4	4-1/16	6.80
	5	2-7/16	7-1/4	5-1/4	5-1/4	9.20
	6	2-3/4	8-11/16	5-3/4	5-3/4	15.70

Each outlet size listed is available to fit any run curvature. Threaded ends are in accordance with ANSI/ASME B1.20.1 Design per MSS-SP-97

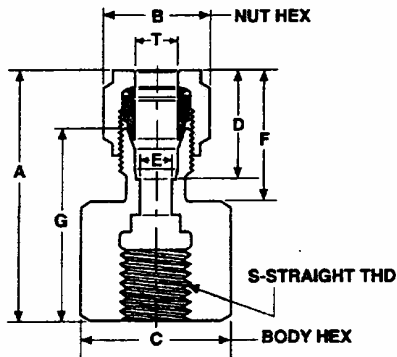
RUN PIPE SIZES Outlet sizes noted above fit a number of run pipe sizes, and the fittings are marked accordingly. See page 34 for run pipe size combination table(s).

FLATS A flat Thredolet for use on welding caps, elliptical heads and flat surfaces is available.

ORDERING When ordering a Thredolet fitting, see page 7.

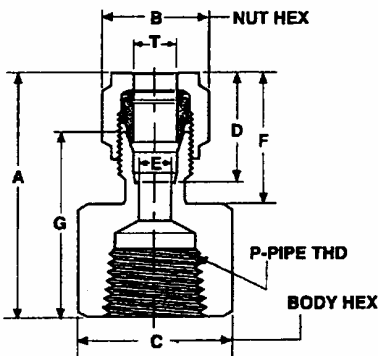


## Female Connector with RG Ends: CF/RG



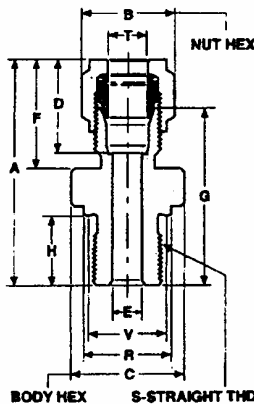
PART NUMBER*	T	S	DIMENSIONS						
	Tube O.D.	Thd. Size	A	B	C	D	E min.	F	G
2CF2 - □/RG	1/8	1/8	1 11/32	7/16	5/8	9/16	3/32	43/64	1 1/32
4CF4 - □/RG	1/4	1/4	1 35/64	9/16	3/4	4 1/64	3/16	49/64	1 1/8
4CF8 - □/RG	1/4	1/2	1 7/8	9/16	1 1/16	4 1/64	3/16	49/64	1 13/32
6CF6 - □/RG	3/8	3/8	1 29/32	1 1/16	1 5/16	2 3/32	1 9/64	53/64	1 3/8
8CF6 - □/RG	1/2	3/8	1 29/32	7/8	1 5/16	3 1/32	2 7/64	59/64	1 27/64

## Female Connector with RT Ends: CF/RT



PART NUMBER*	T	P	DIMENSIONS						
	Tube O.D.	Pipe Thd.	A	B	C	D	E min.	F	G
4CF2 - □/RT	1/4	1/8	1 1/4	9/16	5/8	4 1/64	3/16	49/64	1 5/16
4CF6 - □/RT	1/4	3/8	1 1/2	9/16	7/8	4 1/64	3/16	49/64	1 3/16
6CF4 - □/RT	3/8	1/4	1 17/32	1 1/16	3/4	2 3/32	1 9/64	53/64	1 3/16
6CF8 - □/RT	3/8	1/2	1 29/32	1 1/16	1 1/16	2 3/32	1 9/64	53/64	1 7/16
8CF6 - □/RT	1/2	3/8	1 29/32	7/8	7/8	3 1/32	2 7/64	59/64	1 1/4
10CF8 - □/RT	5/8	1/2	1 7/8	1	1 1/16	1	1/2	59/64	1 7/16

## Male Connector with RP Ends: CM/RP



PART NUMBER*	T	S	DIMENSIONS									
	Tube O.D.	Thd. Size	A	B	C	D	E min.	F	G	H	R	V
2CM2 - □/RP	1/8	1/8	1 1/4	7/16	5/8	9/16	3/32	43/64	1 5/16	5/16	35/64	33/64
4CM2 - □/RP	1/4	1/8	1 11/32	9/16	5/8	4 1/64	3/16	49/64	1 1/64	5/16	35/64	33/64
4CM6 - □/RP	1/4	3/8	1 35/64	9/16	1 1/16	4 1/64	3/16	49/64	1 7/32	1 9/32	55/64	53/64
6CM4 - □/RP	3/8	1/4	1 35/64	1 1/16	3/4	2 3/32	1 7/64	53/64	1 15/64	1 5/32	45/64	43/64



# Threadless Rigid Connectors & Couplings

## Compression Connectors Type "31-" Series

Gland compression type. For threadless rigid conduit.


**Features:** Concretetight Male hub threads (NPS 1/2" thru 2"; NPT above 2").

**Material/Finish:** Malleable Iron, Zinc Plated

**Optional Finish:** Hot Dip Galvanized and/or Mechanically Galvanized. Contact your local representative for pricing and availability.

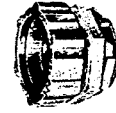
**Standard Sizes:** 1/2" thru 6"

**Third Party Certification:**

 File No. E-11853



31-050 thru 31-200



31-250 thru 31-600

Catalog Number	Trade Size Inches	Dimensions in Inches			Wt. Per 100
		Body Length	Max. Dia.	Thread Length	
31-050	1/2	3/4	1 3/8	7/16	20
31-075	3/4	7/8	1 9/16	7/16	28
31-100	1	1 1/16	1 15/16	9/16	40
31-125	1 1/4	1 3/8	2 1/16	5/8	76
31-150	1 1/2	1 3/8	2 5/8	5/8	105
31-200	2	1 1/2	3 5/16	1 1/16	143
*31-250	2 1/2	2 1/8	4 1/32	1	298
*31-300	3	2 1/16	4 13/16	1	402
*31-350	3 1/2	2 5/8	5 1/2	1 3/16	600
*31-400	4	2 5/16	6 1/8	1 1/4	673
*31-500	5	2 3/16	7 3/8	1 1/2	760
*31-600	6	2 3/8	8 9/16	1 3/8	1100

Catalog Number	Trade Size Inches	Dimensions in Inches			Wt. Per 100
		Body Length	Max. Dia.	Thread Length	
31-050T	1/2	3/4	1 3/8	7/16	19
31-075T	3/4	7/8	1 9/16	7/16	28
31-100T	1	1 1/16	1 15/16	9/16	41
31-125T	1 1/4	1 3/8	2 1/16	5/8	61
31-150T	1 1/2	1 3/8	2 5/8	5/8	83
31-200T	2	1 1/2	3 5/16	1 1/16	140
*31-250T	2 1/2	2 1/8	4 1/32	1	298
*31-300T	3	2 1/16	4 13/16	1	383
*31-350T	3 1/2	2 5/8	5 1/2	1 3/16	610
*31-400T	4	2 5/16	6 1/8	1 1/4	640
*31-500T	5	2 3/16	7 3/8	1 1/2	352
*31-600T	6	2 3/8	8 9/16	1 3/8	452

\*Not UL Listed

## Compression Couplings Type "30-" Series

Gland compression type. For threadless rigid conduit.


**Features:** Concretetight

**Material/Finish:** Malleable Iron, Zinc Plated

**Optional Finish:** Hot Dip Galvanized and/or Mechanically Galvanized. Contact your local representative for pricing and availability.

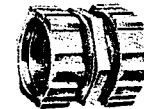
**Standard Sizes:** 1/2" thru 6"

**Third Party Certification:**

 File No. E-11853



30-050 thru 30-200



30-250 thru 30-600

Catalog Number	Trade Size Inches	Dim. in Inches		Wt. Per 100
		Length	Max Dia.	
30-050	1/2	1 1/16	1 3/8	28
30-075	3/4	1 3/4	1 9/16	32
30-100	1	1 15/16	1 15/16	48
30-125	1 1/4	2 1/2	2 5/16	92
30-150	1 1/2	2 7/16	2 5/8	146
30-200	2	2 1/8	3 5/16	200
*30-250	2 1/2	3 15/16	4 1/32	480
*30-300	3	4 5/16	4 13/16	508
*30-350	3 1/2	4 1/2	5 1/2	770
*30-400	4	4 9/16	6 1/8	805
*30-500	5	3 7/8	7 3/8	1220
*30-600	6	4 1/4	8 9/16	1300

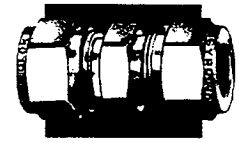
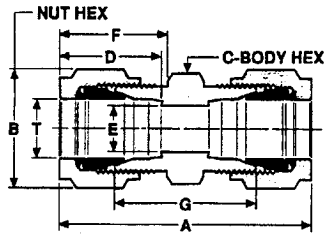
\*Not UL Listed



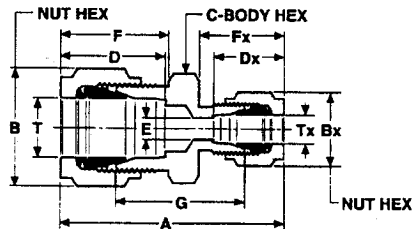




## Union: U



PART NUMBER*	T TUBE O.D.	DIMENSIONS							
		A	B	C	D	E min.	F	G	
1U - □	1/16	1 1/8	5/16	5/16	13/32	3/64	31/64	1 1/16	
2U - □	1/8	1 1/2	7/16	7/16	9/16	3/32	49/64	7/8	
3U - □	3/16	1 39/64	1/2	7/16	19/32	1/8	45/64	63/64	
4U - □	1/4	1 3/4	9/16	1/2	41/64	3/16	49/64	1 3/32	
6U - □	3/8	1 57/64	1 1/16	5/8	23/32	19/64	53/64	1 13/64	
8U - □	1/2	2 5/32	7/8	13/16	31/32	27/64	59/64	1 7/32	
10U - □	5/8	2 5/32	1	1 5/16	1	1/2	59/64	1 9/32	
12U - □	3/4	2 3/32	1 1/8	1 1/16	1	21/32	31/32	1 19/32	
14U - □	7/8	2 3/32	1 1/4	1 3/16	1 1/16	23/32	31/32	1 13/32	
16U - □	1	2 7/64	1 1/2	1 3/8	1 5/16	7/8	1 5/64	1 19/32	



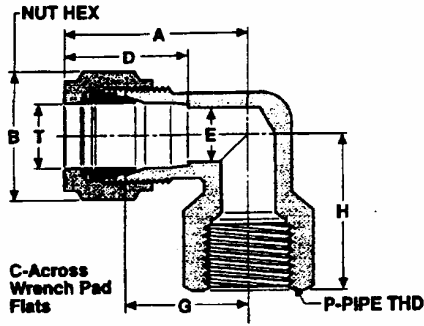
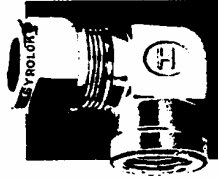
## Reducing Union: RU



PART NUMBER*	T Tube O.D.	Tx Tube O.D.	DIMENSIONS									
			A	B	Bx	C	D	Dx	E min.	F	Fx	G
2RU1 - □	1/16	1/16	1 19/64	7/16	5/16	7/16	9/16	13/32	3/64	43/64	31/64	49/64
3RU1 - □	3/16	1/16	1 11/32	1/2	5/16	7/16	19/32	13/32	3/64	45/64	31/64	13/16
3RU2 - □	3/16	1/8	1 35/64	1/2	7/16	7/16	19/32	9/16	3/32	45/64	43/64	59/64
4RU1 - □	1/4	1/16	1 31/64	9/16	5/16	1/2	41/64	13/32	3/64	49/64	31/64	15/16
4RU2 - □	1/4	1/8	1 21/32	9/16	7/16	1/2	41/64	9/16	3/32	49/64	43/64	1 1/64
4RU3 - □	1/4	3/16	1 43/64	9/16	1/2	1/2	41/64	45/64	1/8	49/64	45/64	1 1/32
6RU1 - □	3/8	1/16	1 1/2	1 1/16	5/16	5/8	23/32	13/32	3/64	53/64	31/64	15/16
6RU2 - □	3/8	1/8	1 49/64	1 1/16	7/16	5/8	23/32	9/16	3/32	53/64	43/64	1 3/32
6RU4 - □	3/8	1/4	1 53/64	1 1/16	9/16	5/8	23/32	41/64	3/16	53/64	49/64	1 5/32
8RU2 - □	1/2	1/8	1 15/16	7/8	7/16	13/16	31/32	9/16	3/32	59/64	43/64	1 5/32
8RU4 - □	1/2	1/4	1 61/64	7/8	9/16	13/16	31/32	41/64	3/16	59/64	49/64	1 5/32
8RU6 - □	1/2	3/8	2 1/32	7/8	1 1/16	13/16	31/32	23/32	19/64	59/64	53/64	1 7/32
10RU6 - □	5/8	3/8	2 3/64	1	1 1/16	1 5/16	1	23/32	19/64	59/64	53/64	1 1/4
10RU8 - □	5/8	1/2	2 5/32	1	7/8	1 5/16	1	31/32	27/64	59/64	59/64	1 1/4
12RU4 - □	3/4	1/4	2 5/32	1 1/8	9/16	1 1/16	1	41/64	3/16	31/32	49/64	1 23/64
12RU6 - □	3/4	3/8	2 7/32	1 1/8	1 1/16	1 1/16	1	23/32	19/64	31/32	53/64	1 13/32
12RU8 - □	3/4	1/2	2 1/4	1 1/8	7/8	1 1/16	1	31/32	27/64	31/32	59/64	1 11/32
12RU10 - □	3/4	5/8	2 1/4	1 1/8	1	1 1/16	1	1	1/2	31/32	59/64	1 3/8
14RU12 - □	7/8	3/4	2 21/64	1 1/4	1 1/8	1 3/16	1 1/16	1	21/32	31/32	31/32	1 7/16
16RU8 - □	1	1/2	2 39/64	1 1/2	7/8	1 3/8	1 5/16	31/32	27/64	1 5/64	59/64	1 9/16
16RU12 - □	1	3/4	2 35/64	1 1/2	1 1/8	1 3/8	1 5/16	1	21/32	1 5/64	31/32	1 17/32
16RU14 - □	1	7/8	2 37/64	1 1/2	1 1/4	1 3/8	1 5/16	1 1/16	23/32	1 5/64	31/32	1 9/16

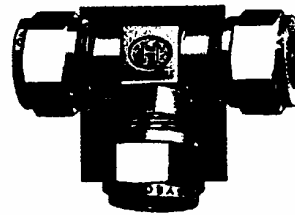
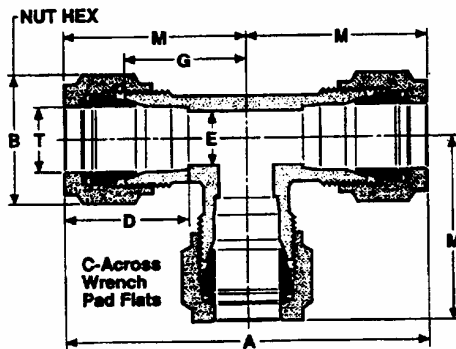


# Female Elbow: LF



PART NUMBER*		T TUBE O.D.	P PIPE SIZE	DIMENSIONS						
				A	B	C	D	E min.	G	H
1LF1	- □	1/16	1/16	23/32	5/16	7/16	13/32	3/64	9/16	3/4
1LF2	- □	1/16	1/8	27/32	5/16	1/2	13/32	3/64	5/8	3/4
2LF2	- □	1/8	1/8	1	7/16	1/2	9/16	3/32	11/16	3/4
2LF4	- □	1/8	1/4	1 1/8	7/16	1 1/16	9/16	3/32	13/16	27/32
3LF2	- □	3/16	1/8	1 1/32	1/2	1/2	19/32	1/8	23/32	3/4
4LF2	- □	1/4	1/8	1 1/64	9/16	1/2	41/64	3/16	3/4	13/16
4LF4	- □	1/4	1/4	1 13/64	9/16	1 1/16	41/64	3/16	7/8	27/32
4LF6	- □	1/4	3/8	1 23/64	9/16	15/16	41/64	3/16	1	27/32
4LF8	- □	1/4	1/2	1 29/64	9/16	1	41/64	3/16	1 1/8	1 1/8
6LF2	- □	3/8	1/8	1 13/16	1 1/16	1/2	23/32	19/64	27/32	1 1/8
6LF4	- □	3/8	1/4	1 13/32	1 1/16	1 1/16	23/32	19/64	19/16	27/32
6LF6	- □	3/8	3/8	1 1/8	1 1/16	1 3/16	23/32	19/64	1 1/32	27/32
6LF8	- □	3/8	1/2	1 31/64	1 1/16	1	23/32	19/64	1 1/8	1 1/8
8LF4	- □	1/2	1/4	1 7/16	7/8	1 1/16	31/32	27/64	31/32	29/32
8LF6	- □	1/2	3/8	1 1/2	7/8	1 3/16	31/32	27/64	1 1/32	29/32
8LF8	- □	1/2	1/2	1 19/32	7/8	1	31/32	27/64	1 1/8	1 1/8
8LF12	- □	1/2	3/4	1 21/32	7/8	1 1/4	31/32	27/64	1 3/16	1 1/4
10LF6	- □	5/8	3/8	1 15/32	1	1 3/16	1	1/2	1 1/32	29/32
10LF8	- □	5/8	1/2	1 1/16	1	1	1	1/2	1 1/8	1 1/8
12LF8	- □	3/4	1/2	1 19/32	1 1/8	1	1	21/32	1 5/32	1 1/8
12LF12	- □	3/4	3/4	1 11/32	1 1/8	1 1/4	1	21/32	1 1/4	1 1/4
14LF12	- □	7/8	3/4	1 11/16	1 1/4	1 1/4	1 1/16	23/32	1 3/4	1 1/4
16LF12	- □	1	3/4	1 7/8	1 1/2	1 1/4	1 1/16	3/8	1 5/16	1 1/4
18LF16	- □	1	1	2 1/16	1 1/2	1 1/16	1 1/16	3/8	1 1/2	1 1/2

HOKE Gyrolok  
offers material  
options for safer  
handling of  
corrosive fluids.



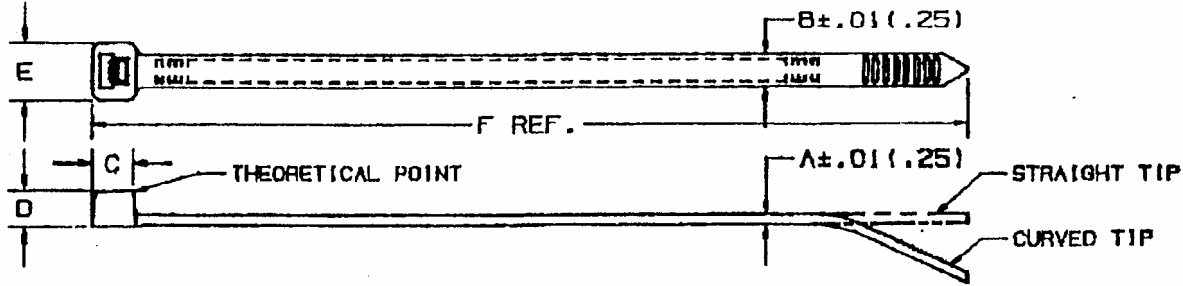
# Union Tee: TTT

PART NUMBER*		T Tube O.D.	DIMENSIONS						
			A	B	C	D	E min.	G	M
1TTT	- □	1/16	1 1/16	5/16	7/16	13/32	3/64	9/16	23/32
2TTT	- □	1/8	1 1/16	7/16	7/16	9/16	3/32	27/32	31/32
3TTT	- □	3/16	2	1/2	7/16	19/32	1/8	1 1/16	1
4TTT	- □	1/4	2 1/32	9/16	7/16	41/64	3/16	23/32	1 3/64
6TTT	- □	3/8	2 3/8	1 1/16	1/2	23/32	19/64	27/32	1 3/16
8TTT	- □	1/2	2 7/8	7/8	1 1/16	31/32	27/64	31/32	1 1/16
10TTT	- □	5/8	2 15/16	1	13/16	1	1/2	1 1/32	1 13/32
12TTT	- □	3/4	3 1/16	1 1/8	1	1	21/32	1 5/32	1 19/32
14TTT	- □	7/8	3 1/16	1 1/4	1 1/4	1 1/16	23/32	1 5/32	1 23/32
16TTT	- □	1	3 3/4	1 1/2	1 1/4	1 1/16	3/8	1 1/16	1 1/8

\*See page 5 for part number material codes.  
Dimensions for reference only, subject to change.



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PANDUIT PART NO.	BUNDLE DIA.		A In (mm)	B In (mm)	C In (mm)	D In (mm)	E In (mm)	F In (mm)	MIN. LOOP TENSILE <sup>1</sup> Lbs (N)	CROSS SECTION	TIP STYLE	WEIGHT Lbs./100 pcs. (g)
	MIN. In (mm)	MAX. In (mm)										
PLT.6SM	.01 (.3)	.6 (15.2)	.030 (.76)	.070 (1.8)	.148 (3.8)	.095 (2.4)	.125 (3.2)	2.8 (71)	8 (36)	SUB-MINIATURE	CURVED	.02 (9.0)
PLT.7M	.03 (.8)	.68 (17.3)	.032 (.81)	.090 (2.3)	.148 (3.8)	.115 (2.9)	.180 (4.6)	3.1 (79)	18 (80)	MINIATURE	CURVED	.04 (16)
PLT1M	.08 (1.5)	.87 (22)	.043 (1.1)	.098 (2.5)	.169 (4.3)	.154 (3.9)	.180 (4.6)	3.9 (99)	18 (80)	MINIATURE	CURVED	.07 (32)
PLT1.5M	.08 (1.5)	1.25 (32)	.043 (1.1)	.098 (2.5)	.169 (4.3)	.154 (3.9)	.180 (4.6)	5.6 (142)	18 (80)	MINIATURE	CURVED	.10 (45)
PLT2M	.08 (1.5)	2.00 (50)	.043 (1.1)	.098 (2.5)	.169 (4.3)	.154 (3.9)	.180 (4.6)	8.0 (203)	18 (80)	MINIATURE	CURVED	.13 (59)
PLT1.5	.08 (1.5)	1.38 (35)	.045 (1.2)	.142 (3.6)	.206 (5.2)	.180 (4.6)	.240 (6.1)	5.8 (142)	40 (178)	INTERMEDIATE	CURVED	.14 (64)
PLT2I	.08 (1.5)	2.00 (50)	.045 (1.2)	.142 (3.6)	.206 (5.2)	.180 (4.6)	.240 (6.1)	8.0 (203)	40 (178)	INTERMEDIATE	CURVED	.20 (91)
PLT2.5I	.08 (1.5)	2.50 (64)	.052 (1.3)	.142 (3.6)	.208 (5.2)	.180 (4.6)	.240 (6.1)	9.7 (246)	40 (178)	INTERMEDIATE	CURVED	.22 (100)

DIMENSIONS IN PARENTHESES ARE IN METRIC UNITS

PANDUIT  
CORP., TINLEY PARK, ILLINOIS  
MAY 14 1997  
PAN-TY CABLE TIES  
PLT SERIES

23	3-4-87	JAD	CC	ADDED THEORETICAL POINT	5540	23	IMP					
22	4-18-87	JAD	VOP	PLT.6SM-CATALOG TOOL APPLIED STRENGTH B WAS 12 LBS	5540	22	VOP					
21	4-4-88	FKS	HVP	SHEET 1 OF 4 WAS SHEET 1 OF 3	5540	21	HVP					
20	3-8-88	RAM	HVP	PLT.6SM MIN. LOOP TENSILE WAS 8 (36)	5540	20	HVP					

UNLESS OTHERWISE SPECIFIED, DIMENSIONAL TOLERANCES ARE: 1.XI ± .....(1.00X) ± .020(1.51) 1.XX ± .....(1.02X) ± .021(5.08)		UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE GIVEN TO TOLERANCE, UNLESS OTHERWISE SPECIFIED.
MADE BY CEW	MAT'L NYLON 6/6	GRADE NONE
DATE 12-27-84		STAMP NO. SS-5540
		REV A



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PANDUIT PART NO.	BUNDLE DIA.		A		B		C		D		E		F		MIN. LOOP TENSILE (lbs.)	CROSS SECTION	TIP STYLE	WEIGHT (lbs./1000 pwr.) (oz.)
	MM. (in.)	IN. (mm.)	IN. (mm.)	IN. (mm.)	IN. (mm.)	IN. (mm.)	IN. (mm.)	IN. (mm.)	IN. (mm.)	IN. (mm.)	IN. (mm.)	IN. (mm.)	IN. (mm.)	IN. (mm.)				
PLT2.5H	.188 (4.8)	2.50 (63.5)	.075 (1.9)	.300 (7.6)	.320 (8.1)	.290 (7.4)	.480 (12.2)	10.0 (254)	120 (534)	HEAVY	STRAIGHT	.80 (408)						
PLT3H	.188 (4.8)	3.00 (76)	.075 (1.9)	.300 (7.6)	.320 (8.1)	.290 (7.4)	.480 (12.2)	11.4 (290)	120 (534)	HEAVY	STRAIGHT	1.01 (472)						
PLT4H	.188 (4.8)	4.00 (102)	.075 (1.9)	.300 (7.6)	.320 (8.1)	.290 (7.4)	.480 (12.2)	14.5 (368)	120 (534)	HEAVY	STRAIGHT	1.28 (581)						
PLT5H	.188 (4.8)	5.00 (127)	.075 (1.9)	.350 (8.9)	.406 (10.3)	.340 (8.6)	.580 (14.7)	17.7 (450)	175 (778)	HEAVY	STRAIGHT	2.06 (934)						
PLT6H	.188 (4.8)	6.00 (152)	.075 (1.9)	.350 (8.9)	.406 (10.3)	.340 (8.6)	.580 (14.7)	20.8 (530)	175 (778)	HEAVY	STRAIGHT	2.46 (1118)						
PLT8H	.188 (4.8)	8.00 (203)	.075 (1.9)	.350 (8.9)	.406 (10.3)	.340 (8.6)	.580 (14.7)	30.8 (778)	175 (778)	HEAVY	STRAIGHT	3.36 (1524)						
PLT13H	.188 (4.8)	13.00 (330)	.075 (1.9)	.350 (8.9)	.406 (10.3)	.340 (8.6)	.580 (14.7)	43.3 (1100)	175 (778)	HEAVY	STRAIGHT	4.59 (2080)						

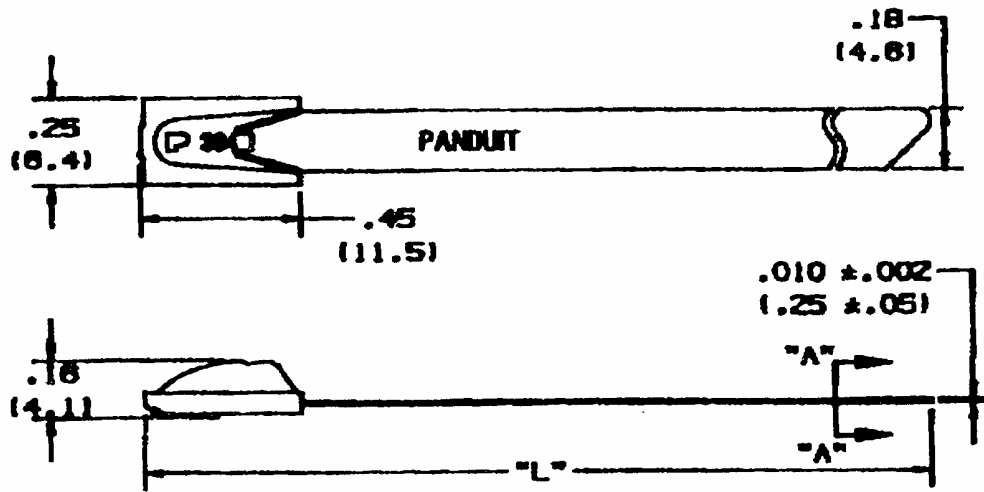
**NOTES:**

- 1) RECOGNIZED UNDER THE COMPONENT PROGRAM OF UNDERWRITERS LABORATORIES INC.
- 2) SEE CURRENT PRICE SHEET FOR PART NUMBER SUFFIX DESIGNATION FOR PACKAGE SIZE & PART COLOR.

DIMENSIONS IN PARENTHESES ARE IN METRIC UNITS.											
<b>PANDUIT</b> CORP. <span style="float: right;">12-27-84</span> YINLEY PARK, ILLINOIS											
<b>PAN-TY CABLE TIES</b> <b>PLT SERIES</b>											
UNLESS OTHERWISE SPECIFIED, DIMENSIONAL TOLERANCES ARE: [K] ± .0005 [MM] ± .001 [H] [XX] ± .001 ANGLES ± .0005								UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE GIVEN IN INCHES THIRD ANGLE PROJECTION.			
I	FORM	REV	1	SEE SHEET 1 OF 4 OR SEE SHEET 1 OF 3	5540	I	DRAWN BY	NAT L.	SCALE	NONE	
R	FORM	REV		PLT2.5H F DIM. WAS 9.0 (251) DRAWING RELEASED E	5540	R	DATE	12-27-84	SEE SHEET 1 OF 4	GRADING NO.	SS-5540
KEY	DATE	BY	CKN	DESCRIPTION	ICH	R	COST	SUP		REV	A
PART 4 OF 4											







PANDUIT PART NO.	MAX BUNDLE DIA.	PACKAGE QTY	LENGTH L ±.2 (5)
MLT15-CP	1" (25)	100	5.0" (127)
MLT25-CP	2" (50)	100	7.9" (201)
MLT2.75-CP	2.7" (70)	100	10.2" (259)
MLT45-CP	4" (100)	100	14.2" (361)
MLT55-CP	5" (125)	100	17.0" (432)
MLT65-CP	6" (150)	100	20.5" (521)
MLT85-CP	8" (200)	100	26.8" (681)
MLT105-CP	10" (250)	100	33.0" (838)
MLT125-Q	12" (300)	25	39.3" (998)
MLT145-Q	14" (350)	25	45.5" (1158)
MLT155-Q	15" (380)	25	49.2" (1250)
MLT165-Q	16" (400)	25	51.8" (1318)
MLT305-Q	30" (760)	25	96.4" (2449)

**NOTES:**

1. APPLICATION TOOLS: 654MT, PPTMT & HTMT, ST2MT.
2. MINIMUM LOOP TENSILE STRENGTH: 100 lbs (445 N).
3. DIM'S IN ( ) ARE mm.
4. TOLERANCES:  
 .XXX = ±.010(.25) .XX = ±.02(.5)  
 .X = ±.03(.8) ANGLES = ±2°
5. MATERIAL: 304 STAINLESS STEEL

SECTION "A-A"  
4x SCALE

AISI NO. 1 FULL RADIUSED  
EDGES ALONG STRAP BODY

541005\_13

DATE	BY	CHK	DESCRIPTION	REV #	QTY	PR	SAM	BJO	2x	541005
12/97	TM	JD	ADDED MLT165-Q	06507	JL	OK				
6/98	JKD	JD	REVISED TO REFLECT CURRENT PART	04784	LA	DH				
2/98	MS	JD	ADDED MLT55-CP PART	02888	LA	MLSE				
							<b>PANDUIT</b> CORP.      THULEY PARK, ILLINOIS <b>METAL LOCKING TIE</b> <b>STANDARD SERIES - 304 STAINLESS STEEL</b>			





180 Northfield Avenue, Edison, NJ 08837  
1-800-345-0294 Outside New Jersey

Raritan Center

Tel: (732) 348-0000 / NY (212) 678-1100  
Fax: (732) 348-8777

## PRO-3008, 3016, 3032

### PRODUCT:

PRO-3008, 3016, 3032

### DESCRIPTION:

A white closed cell, cross linked polyethylene, foam coated on both sides with a high performance synthetic rubber adhesive.

### DENSITY:

Approximately 6 lbs.

### LINER:

Silicone treated Kraft.

### THICKNESS:

1/8", 1/16" AND 1/32".

### PEEL ADHESION:

No peel possible. Peel strength of adhesive is greater than internal strength of foam.




### GENERAL USE:

For use in mounting applications of all types adheres well to variety of surfaces such as metal, wood and most plastics. Surfaces to be bonded should be clean and dry.





# Outlet Boxes and Covers


## 5 Hole Standard Boxes \*Raintight

Catalog No.	Hub Size	Description
 S-47 S-48	1/2" 3/4"	<b>Box only</b> 5 outlets, 4 closure plugs, mounting lugs
 S-49 S-50	1/2" 3/4"	<b>Box with Cover</b> 5 outlets, 4 closure plugs, mounting lugs, gasket, screws, and cover with one 1/2" hole
 S-51	1/2"	<b>Box with Cover</b> 5 outlets, 4 closure plugs, mounting lugs, gasket, screws, and cover with three 1/2" holes



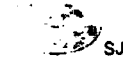

## 7 Hole Standard Boxes, \*Raintight

Catalog No.	Hub Size	Description
 S-71	1/2"	<b>Box only</b> 7 outlets, 4 closure plugs with mounting lugs
 S-73	1/2"	<b>Box with Cover</b> 7 outlets, 4 closure plugs, mounting lugs, gasket, screws, and cover with one 1/2" hole

## Extensions



Cat. No.	Hub Size	Description
 SE-47 SE-48	1/2" 3/4"	<b>Round Extension Ring</b> 4 outlets, 4 closure plugs, gasket and screws

## Covers For Standard Boxes \*Raintight


Catalog No.	Description
<b>Standard Cover 4" Diameter with Gasket and Screws</b>	
 S-1	SS-B Blank (Replaces cat. no. S-B)
S-1	One 1/2" NPT tapped hole
S-12	One 3/4" NPT tapped hole
 S-3	S-3 Three 1/2" NPT tapped holes
<b>Jumbo Covers 4 1/2" Diameter with Gasket and Screws</b>	
 SJ-11	SJ-B Blank
SJ-11	One 1/2" NPT tapped hole
SJ-21	Two 1/2" NPT tapped holes
 SJ-31	SJ-31 Three 1/2" NPT tapped holes

\* Boxes are raintight when used with corresponding Red Dot covers.


## Deep Boxes

Catalog No.	Hub Size	Description
 •JBU-1 •JBU-2	1/2" 3/4"	5 outlets, 2 closure plugs with mounting lugs
 JBX-1 JBX-2	1/2" 3/4"	4 outlets, 2 closure plugs with mounting lugs

## Vaportight Boxes for use with V Series Fixtures

Catalog No.	Hub Size	Description
 LVX-1 LVX-2	1/2" 3/4"	5 outlets, 4 close-up plugs with mounting lugs

## Covers for Vaportight & Deep Boxes \*Raintight

Vaportight LVX Boxes	Deep J. Boxes	Hub Size
 Blank	V-B JBK-B	None

• Denotes items made to order. Consult factory for minimum quantities and lead time.



## CORD CONNECTORS Fittings

### S E R I E S

## Z

#### APPLICATIONS

Use to secure and seal cords or cables entering enclosures or raceways.

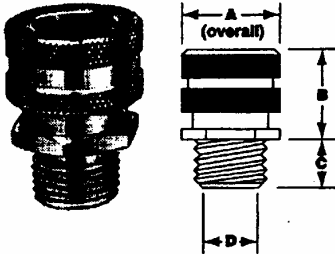
Z Series connectors are also suitable for use in hazardous locations per National Electrical Code (Articles 501-4(b), 502-4(a&b), 503-3(a&b)). Consult these article for sealing requirements that may apply.

#### FEATURES

- Aluminum construction resists corrosion
- Neoprene grommet seals out oil and moisture
- Nylon retention ring ensures superior holding power
- Wide range of sizes and configurations

LISTED - FILE E22698

CERTIFIED - FILE LR73478  
See files for details or call Killark.



### Optional Locknuts and Sealing Washers

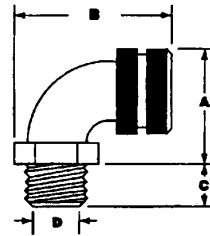
NPT SIZES	CATALOG NUMBER	
	STEEL LOCKNUTS*	SEALING WASHERS*
¾"	LN-375	-
½"	LN-1	KOR-1
¾"	LN-2	KOR-2
1"	LN-3	KOR-3
1½"	LN-4	KOR-4
1½"	LN-5	KOR-5
2"	LN-6	KOR-6
2½"	LN-7	-
3"	LN-8	-

Ⓛ 2½" through 3" are malleable, with hexhead flats.  
Ⓜ Neoprene washers are mounted on steel reinforcing bands.

### Straight Connectors

NPT SIZE	CORD RANGE	COLOR CODE	CATALOG NUMBER	DIMENSIONS			
				A	B	C	D
¾"	.062-.125	GREEN	ZS801	.99	.90	.425	.453
	.125-.187	ORANGE	ZS802	.99	.90	.425	.453
	.187-.250	RED	ZS903	.99	.90	.425	.453
	.250-.312	BLACK	ZS064	.99	.90	.425	.453
	.312-.375	WHITE	ZS066	.99	.90	.425	.453
.375-.437	BLUE	ZS067	.99	.90	.425	.453	
1/2"	.062-.125	GREEN	ZS101	1.13	1.10	.55	.635
	.125-.187	ORANGE	ZS102	1.13	1.10	.55	.635
	.187-.250	RED	ZS103	1.13	1.10	.55	.635
	.250-.375	WHITE	ZS105	1.13	1.10	.55	.635
	.375-.500	BLUE	ZS108	1.13	1.10	.55	.635
	.500-.625	BROWN	ZS109	1.13	1.10	.55	.635
	.625-.750	YELLOW	ZS110*	1.40	1.50	.55	.635
.750-.875	PURPLE	ZS111*	1.40	1.50	.55	.635	
¾"	.062-.125	GREEN	ZS201	1.29	1.10	.55	.635
	.125-.187	ORANGE	ZS202	1.29	1.10	.55	.635
	.187-.250	RED	ZS203	1.29	1.10	.55	.635
	.250-.375	WHITE	ZS205	1.29	1.10	.55	.635
	.375-.500	BLUE	ZS208	1.29	1.10	.55	.635
	.500-.625	BROWN	ZS209	1.29	1.10	.55	.635
	.625-.750	YELLOW	ZS210	1.40	1.50	.55	.815
.750-.875	PURPLE	ZS211*	1.40	1.50	.55	.815	
1"	.375-.500	BLUE	ZS300	1.81	1.60	.71	1.015
	.500-.625	BROWN	ZS308	1.81	1.60	.71	1.015
	.625-.750	YELLOW	ZS310	1.81	1.60	.71	1.015
	.750-.875	PURPLE	ZS311	1.81	1.60	.71	1.015
	.875-1.000	GRAY	ZS312	1.81	1.60	.71	1.015
	1.000-1.125	PINK	ZS313*	2.31	1.70	.66	1.015
	1.125-1.250	-	ZS314*	2.31	1.70	.66	1.015
1.250-1.375	-	ZS315*	2.31	1.70	.66	1.015	
1½"	.750-.875	-	ZS411	2.31	1.70	.74	1.255
	.875-1.000	-	ZS412	2.31	1.70	.74	1.255
	1.000-1.125	-	ZS413	2.31	1.70	.74	1.255
	1.125-1.250	-	ZS414	2.31	1.70	.74	1.255
	1.250-1.375	-	ZS415*	2.31	1.70	.74	1.255

\* Cable jacket may have to be stripped to pass through connector body on all sizes.



### 90° Connectors

NPT SIZE	CORD RANGE	COLOR CODE	CATALOG NUMBER	DIMENSIONS			
				A	B	C	D
1/2"	.062-.125	GREEN	ZN101	1.56	2.30	.50	.546
	.125-.187	ORANGE	ZN102	1.56	2.30	.50	.546
	.187-.250	RED	ZN103	1.56	2.30	.50	.546
	.250-.375	WHITE	ZN105	1.56	2.30	.50	.546
	.375-.500	BLUE	ZN108	1.56	2.30	.50	.546
.500-.625	BROWN	ZN109	1.56	2.30	.50	.546	
¾"	.375-.500	BLUE	ZN208	1.79	2.80	.562	.765
	.500-.625	BROWN	ZN209	1.79	2.80	.562	.765
	.625-.750	YELLOW	ZN210*	1.79	2.80	.562	.765
.750-.875	PURPLE	ZN211*	1.79	2.80	.562	.765	
1"	.375-.500	BLUE	ZN308	2.08	3.20	.703	1.00
	.500-.625	BROWN	ZN309	2.08	3.20	.703	1.00
	.625-.750	YELLOW	ZN310	2.08	3.20	.703	1.00
	.750-.875	PURPLE	ZN311	2.08	3.20	.703	1.00
	.875-1.000	GRAY	ZN312*	2.08	3.20	.703	1.00
1.000-1.125	PINK	ZN313*	2.08	3.20	.703	1.00	

NPT SIZE	CORD RANGE	COLOR CODE	CATALOG NUMBER	DIMENSIONS			
				A	B	C	D
1/2"	.750-.875	-	ZS511	2.31	1.70	.75	1.38
	.875-1.000	-	ZS512	2.31	1.70	.75	1.38
	1.000-1.125	-	ZS513	2.31	1.70	.75	1.38
	1.125-1.250	-	ZS514	2.31	1.70	.75	1.38
	1.250-1.375	-	ZS515	2.31	1.70	.75	1.38
	1.375-1.500	-	ZS516	3.00	2.20	.75	1.50
	1.500-1.625	-	ZS517*	3.00	2.20	.75	1.50
2"	1.625-1.750	-	ZS518*	3.00	2.20	.75	1.50
	1.750-1.875	-	ZS520*	3.00	2.20	.75	1.50
	1.250-1.375	-	ZS615	3.25	2.20	.80	1.92
	1.375-1.500	-	ZS616	3.25	2.20	.80	1.92
	1.500-1.625	-	ZS617	3.25	2.20	.80	1.92
	1.625-1.750	-	ZS618	3.25	2.20	.80	1.92
	1.750-1.875	-	ZS620*	3.25	2.20	.80	1.92
2½"	1.688-1.812	-	ZS619	4.06	2.70	1.27	1.94
	1.812-1.937	-	ZS621	4.06	2.70	1.27	1.94
	1.937-2.062	-	ZS622*	4.06	2.70	1.27	1.94
	2.062-2.188	-	ZS623*	4.06	2.70	1.27	1.94
	2.188-2.312	-	ZS624*	4.06	2.70	1.27	1.94
	2.312-2.437	-	ZS625*	4.06	2.70	1.27	1.94
	1.688-1.812	-	ZS719	4.33	2.70	1.27	2.34
1.812-1.937	-	ZS721	4.33	2.70	1.27	2.34	
1.937-2.062	-	ZS722	4.33	2.70	1.27	2.34	
2 1/2"	2.062-2.188	-	ZS723	4.33	2.70	1.27	2.34
	2.188-2.312	-	ZS724	4.33	2.70	1.27	2.34
	2.312-2.437	-	ZS725*	4.33	2.70	1.27	2.34
	2.437-2.625	-	ZS726*	4.87	2.70	1.27	2.38
	2.625-2.812	-	ZS727*	4.87	2.70	1.27	2.38
3"	1.688-1.812	-	ZS819	4.33	2.70	1.30	2.54
	1.812-1.937	-	ZS821	4.33	2.70	1.30	2.54
	1.937-2.062	-	ZS822	4.33	2.70	1.30	2.54
	2.062-2.188	-	ZS823	4.33	2.70	1.30	2.54
	2.188-2.312	-	ZS824	4.33	2.70	1.30	2.54
	2.312-2.437	-	ZS825	4.33	2.70	1.30	2.54
	2.437-2.625	-	ZS826	4.87	2.70	1.38	3.00
	2.625-2.812	-	ZS827	4.87	2.70	1.38	3.00
	2.812-3.000	-	ZS828	4.87	2.70	1.38	3.00
	3.000-3.250	-	ZS829*	4.87	2.70	1.38	3.00

\* Cable jacket may have to be stripped to pass through connector body.





# Fittings

**S E R I E S**  
**ENY/EYS/EY**  
**Installation Data**

LUB SIZE	OVERALL LENGTH			OVERALL WIDTH			OUNCES OF SEALING COMPOUND PACKING FIBER REQUIRED PER FITTING				MINIMUM TURN RADIUS			
	ENY	EYS	EY	ENY	EYS	EY	ENY	EYS	EY	PACKING FIBER	ENY	EYS	WITH GAP	EY
1/2	3 3/4	2 3/4	3 3/4	1 1/4	1 1/4	2 3/4	1.5	3.0	1.0	1/2	1 1/4	1 1/4	2 3/4	2 3/4
3/4	4 1/4	2 3/4	3 3/4	2 1/4	1 1/4	2 1/4	2.0	3.0	2.0	3/4	1 1/4	1 1/4	2 3/4	1 1/4
1	4 3/4	3 3/4	4 1/4	2 1/4	2 1/4	3 3/4	3.0	8.0	4.5	1	1 1/4	2	3 3/4	2 3/4
1 1/4	5 1/4	4	5 1/4	3	2 1/4	3 3/4	6.5	8.5	7.5	3/4	1 1/4	2 3/4	3 3/4	2 3/4
1 1/2	5 3/4	4 1/4	5 1/4	3 3/4	3 3/4	4 1/4	8.5	17.5	12.0	1	1 1/4	2 3/4	3 3/4	3 3/4
2	6 1/4	5 1/4	5 1/4	3 3/4	3 3/4	5 1/4	15.0	27.0	24.0	2	2 3/4	3	3 3/4	4 1/4
2 1/2	-	7 1/4	7	-	4 1/4	6 1/4	-	42.0	44.0	3	-	3 3/4	4 1/4	4 1/4
3	-	7 1/4	7	-	4 1/4	6 1/4	-	47.0	44.0	4	-	3 3/4	4 1/4	4 1/4
3 1/2	-	7 1/4	8 1/4	-	5 1/4	7 1/4	-	56.0	75.0	6	-	3 3/4	4 1/4	5 1/4
4	-	7 1/4	8 1/4	-	5 1/4	7 1/4	-	56.0	75.0	9	-	3 3/4	4 1/4	5 1/4

⊕ Does not include nipple    ⊕ ENY suitable for horizontal or vertical applications

**S E R I E S**  
**SC/PF/LUBG**  
**Sealing Materials**

**SEALING COMPOUND**

SC Series Sealing compound is a cement used extensively for sealing conduit to prevent the spread of explosive gases. It is non-shrinking and a secure seal is formed. SC Series resists acids, water, oil, etc. It is UL Listed for use with Killark ENY, EY, and EYS Series. Also CSA certified for use with any CSA certified sealing fitting.

**PACKING FIBER**

Killark's Packing Fiber is made from an environmentally safe, non-asbestos material. It is easy to use and forms a positive dam to hold compound (Killark SC Type) in ENY, EY, and EYS Series fittings.

**THREAD LUBRICANTS**

Two special blends of lubricants have been developed by Killark for use with threaded joints. These lubricants are to be used to prevent galling of pipe threads when threaded into a coupling, junction box, etc. They insure a quick release and undamaged male and female threads when parts are disassembled.

LUBG is a general purpose lubricant to be used in temperatures ranging from 0° to 125°F.

LUBT is a high quality lubricant to be used in temperatures ranging from -40° to + 500°F. It is recommended to be used on hazardous location lighting fixtures.

**Sealing Compound**  
**Ordering Information**

SIZE PACKAGE	CATALOG NUMBER
4 oz.	SC-4-OZ.
8 oz.	SC-8-OZ.
1 lb.	SC-1-LB.
5 lbs.	SC-5-LB.



**Packing Fiber**  
**Ordering Information**

SIZE PACKAGE	CATALOG NUMBER
2 oz.	PF-2
4 oz.	PF-4
1 lb.	PF-16



**Thread Lubricants**  
**Ordering Information**

CONTAINER PACKAGE	CATALOG NUMBER
2 oz.	LUBT-2
6 oz.	LUBG-6



SECTION 1



# Series MAX Industrial Strobes

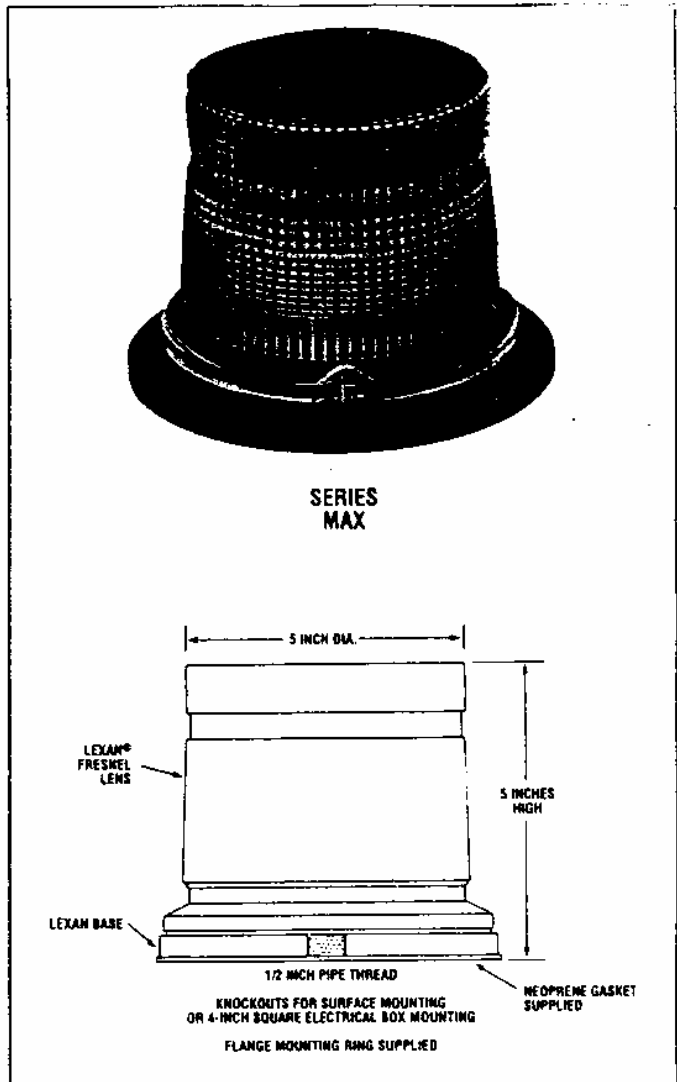
WHEELOCK'S Series MAX Industrial Strobes are the most versatile warning lights available for any vehicular or stationary application.

Each MAX-DC model operates on all standard battery voltages from 12 to 90 VDC. MAX-AC models operate consistently from 110 to 120 VAC. All MAX models provide high efficiency double flash operation and include all popular mounting options supplied with each unit.

As the leading supplier of strobes for life safety signaling and fire protection systems, Wheelock has designed the Series MAX Industrial Strobes with the exceptional quality and dependability required for critical applications.

## Features

- UL listed for indoor or outdoor use
- One model covers all standard battery voltages (12, 24, 36, 48, 72, 80 and 90 VDC).
- One strobe covers all popular mounting methods (pipe, surface, flange, electrical box)
- High visibility double flash operation (60 times per minute; 7 1/2 joules per flash)
- High efficiency for longer battery life (1.0 amp at 12 VDC to 0.120 amp at 90 VDC)
- Compact size to fit all applications (5-inch high by 5-inch diameter)
- Durable, high impact Lexan® construction
- Standard lens colors per SAE specifications (clear, red, blue and amber)



## Ordering Information

Model Number	Order Code	Lens Color	Rated Voltage	Current Draw	Flash Energy	Flash Rate	Effective Candela	Temperature Range
MAX-DC-A	4700	Amber	12 VDC to 90 VDC	925A @ 12 VDC	7.5 joules per double flash	60 per minute	80 cd	-35C (-31F) to +66C (+151F)
MAX-DC-R	4793	Red		385A @ 24 VDC			20 cd	
MAX-DC-B	4794	Blue		250A @ 36 VDC			12 cd	
MAX-DC-C	4792	Clear		200A @ 48 VDC			100 cd	
MAX-AC-A	4699	Amber	102 VAC to 127 VAC	.19A @ 115 VAC	7.5 joules per double flash	60 per minute	80 cd	-35C (-31F) to +66C (+151F)
MAX-AC-R	4790	Red					20 cd	
MAX-AC-B	4791	Blue					12 cd	
MAX-AC-C	4789	Clear					100 cd	

### NOTES:

1. All models are UL listed per UL standard 1638
2. Minimum effective candela is measured per UL and IES standards (Clear Lens)
3. All lenses are interchangeable. Order MAX-A, R, B or C for extra lenses (A = amber, R = red, B = blue, C = clear)
4. All flashtubes are replaceable. Order MAX-FT for extra flashtubes
5. Lexan® is a Registered TM of General Electric



PRODUCT SPECIFICATION  
WHELOCK INC.  
LONG BRANCH, NJ, USA

NO DEVIATION FROM THIS SPECIFICATION NOR ANY CHANGES SHALL BE MADE WITHOUT  
PRIOR ENGINEERING APPROVAL

ANY MATERIAL EXTRAPOLATED FROM THIS DOCUMENT OR FROM WHELOCK MANUALS OR OTHER DOCUMENTS DESCRIBING THE PRODUCT FOR USE IN PROMOTIONAL OR ADVERTISING CLAIMS, OR FOR ANY OTHER USE, INCLUDING DESCRIPTION OF THE PRODUCT'S APPLICATION, OPERATION, INSTALLATION AND TESTING IS USED AT THE SOLE RISK OF THE USER AND WHELOCK WILL NOT HAVE ANY LIABILITY FOR SUCH USE.

PRODUCT NAME: MAX STROBE  
MODEL CODE(S): MAX-AC, MAX-DC  
TOP ASSEMBLY NO.(S): A8179, A8185

1. SCOPE: Series Max Strobes are double flash visual warning devices designed for use on mobile or stationary equipment.

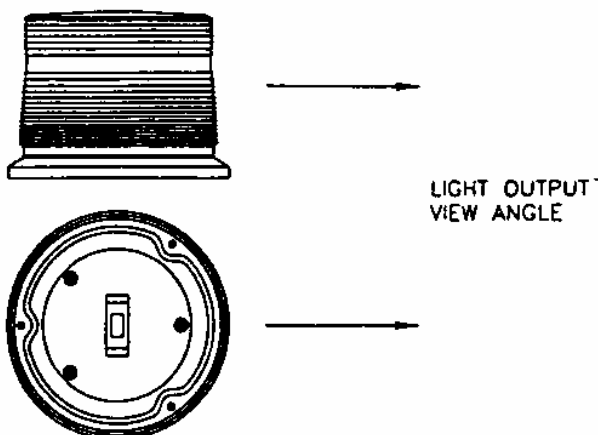
2. ELECTRICAL/PERFORMANCE

MODEL NUMBER	MINIMUM VOLTAGE	RATED VOLTAGE	MAXIMUM VOLTAGE	CURRENT mA +/-15%			FLASHTUBE VOLTAGE (V) @ RATED VOLTAGE		NOMINAL ENERGY (J) @ RATED VOLTAGE		FLASH RATE +/-10%	FLASH SEPARATION +/-10%	
							FLASH 1	FLASH 2	FLASH 1	FLASH 2			
MAX-DC	8.5VDC	---	---	1300			AVG. DC	MIN 290 MAX 438	MIN 195 MAX 285	5.8 +10% -25%	2.0 +50% -10%	53 FLASHES PER MINUTE	.35 SEC
	---	12VDC	---	925									
	---	24VDC	---	385									
	---	36VDC	---	250									
	---	48VDC	---	200									
	---	72VDC	---	140									
	---	80VDC	---	130									
	---	90VDC	---	120									
	---	---	99VDC	110									
MAX-AC	102VAC	---	---	290	TYP.	180	AVG. AC	MIN 288 MAX 315	MIN 220 MAX 290	4.5 +/-20%	3.25 +/-20%		
	---	115VAC	---	340	AC	180							
	---	---	127VAC	380	PEAK	200							

MODEL NUMBER	RATED VOLTAGE	EFFECTIVE CANDELA (cd)	PEAK CANDLE POWER (cp)	LIGHT OUTPUT TOLERANCE	TEMPERATURE RANGE
MAX-DC-C	12-90VDC	100 TYP.	110,000cp	-10%, +30%	-35C (-31F)  +66C (+151F)
MAX-AC-C	115VAC		85,000cp	+/-20%	
MAX-DC-A	12-90VDC	80 TYP.	90,000cp	-10%, +30%	
MAX-AC-A	115VAC		70,000cp	+/-20%	
MAX-DC-R	12-90VDC	20 TYP.	15,000cp	-10%, +30%	
MAX-AC-R	115VAC		12,000cp	+/-20%	
MAX-DC-B	12-90VDC	12 TYP.	15,000cp	-10%, +30%	
MAX-AC-B	115VAC		12,000cp	+/-20%	

A. Refer to STP 1001 for strobe light output test procedures.

The distance from the front of the lens to the detector reference plane should be 25 feet when measuring effective candela (cd).



B. All models are UL listed per standard 1638 general signaling category.

3. **ENDURANCE/RELIABILITY**

The flashtube is field replaceable with a rated life of 5,000 hours MTBF. The power supply circuitry is designed for 5,000 hours of operation at rated voltage.

4. **APPROVALS**

UL Pending

5. **MOUNTING**

The industrial strobe can be mounted to a standard 4 inch or weather resistant (WBB) electrical box, a 100mm electrical box, 1/2 inch NPT threaded pipe, tamper proof surface mount, or flange mount. All mounting options are standard. The unit can be used outdoors as indicated by the chart below.

MOUNTING OPTIONS	MOUNTING GASKET		OUTDOOR USE	
	Yes	No	Yes	No
Pipe Mount		X	X	
4 inch WBB		X	X	
4 inch or 100mm backbox		X		X
	X		X	
Surface Mount		X		X
	X		X	
Flange Mount (with wire access hole)		X		X
	X		X	
Flange Mount (without wire access hole)		X		X
	X		X	

6. **OPTIONS**

Replacement flashtube and lenses may be ordered separately under the following model codes.

COMPONENT	ORDER CODE
Flashtube Assembly	MAX - FT
Clear Lens	MAX - C
Amber Lens	MAX - A
Red Lens	MAX - R
Blue Lens	MAX - B

ORIGINATED BY: KB 3/19/92  
 REVISIONS: C ECN 4771 1/30/92  
 D ECN 4852 7/29/92  
 E ECN 6384 10/10/96

# CFL Full Threaded Base Studs

Ordering Example:  
Nelson Type CFL, 1/4-20 x 1, Part No. 101-010-011

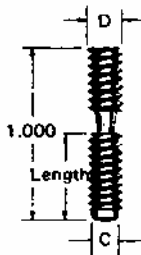
Stud Material: Low Carbon Steel per ASTM A108 Grades 1010 through 1020

Thread Dia. D	Length	Part No.	C	Weld Fillet Dimensions		Fillet Clear.	Ferrule Part No.	Chuck	Grip	Foot*
				E	F					
1/4-20	3/4	101-010-003	.215	.359	.109	.437	100-101-077 100-101-067	500-001-007	501-001-005 501-001-007	502-001-137 502-001-001
	3/4	101-010-316**								
	25/32	101-010-006								
	7/8	101-010-008								
	1	101-010-011								
	1	101-010-318**								
	1-1/8	101-010-019								
1-1/4	101-010-023									
5/16-18	3/4	101-010-062	.275	.437	.109	.500	100-101-030 100-101-024	500-001-009	501-001-007 501-001-008	502-001-137 502-001-001
	7/8	101-010-065								
	1	101-010-067								
	1	101-010-333**								
	1-1/8	101-010-071								
3/8-16	3/4	101-010-110	.330	.500	.125	.593	100-101-031 100-101-025	500-001-011	501-001-008 501-001-007	502-001-137 502-001-001
	7/8	101-010-112								
	1	101-010-113								
	1	101-010-342**								
	1-1/8	101-010-117								
	1-1/4	101-010-118								
1/2-13	1	101-010-177	.448	.687	.156	.750	100-101-027	500-001-014	501-001-009	502-001-137 502-001-001
	1-1/8	101-010-179								
	1-1/4	101-010-180								
	1-1/2	101-010-183								

\*\* 18-8 Stainless Steel

# CFL Full Threaded Knockoff (K/O) Studs

Ordering Example:  
Nelson Type CFL, 1/4-20 x 1 K/O 5/8, Part No. 101-010-017



Stud Material: Low Carbon Steel per ASTM A108 Grades 1010 through 1020

Thread Dia. D	Length	Part No.	C	Weld Fillet Dimensions		Fillet Clear.	Ferrule Part No.	Chuck	Grip	Foot*
				E	F					
1/4-20	1 K/O 1/2	101-010-014	.215	.359	.109	.437	100-101-067	500-001-007	501-001-007	502-001-137 502-001-001
	1 K/O 5/8	101-010-017								

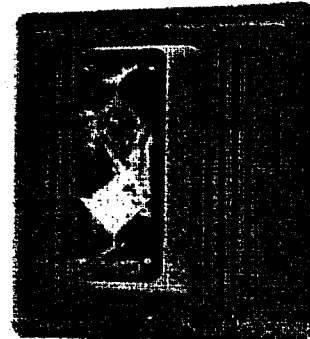
\*502-001-137 or 502-001-138 Feet used with Standard Duty Guns

\*\*2-001-001 or 502-001-002 Feet used with Heavy Duty Guns





# Edwards® 867STR AdaptaBeacon® Indoor Surface Mount Electronic Horn/Strobe



## Features

- Low current draw
- High dB output
- Terminals for easy wiring
- Gray Flame resistant housing
- 150 candela strobe (clear lens)
- Complete with gasket and surface back box

## Description

The Edwards 867STR AdaptaBeacon series is a bright, low current, high decibel, surface mount, combination electronic horn/strobe for indoor use. It has been designed for mounting with the supplied back box. Strobe and horn may be operated independently.

## Agency Approvals

- Strobe - UL 1638 Listed
- Horn - UL 464 Listed
- Engineered thermoplastic housing

## Specifications

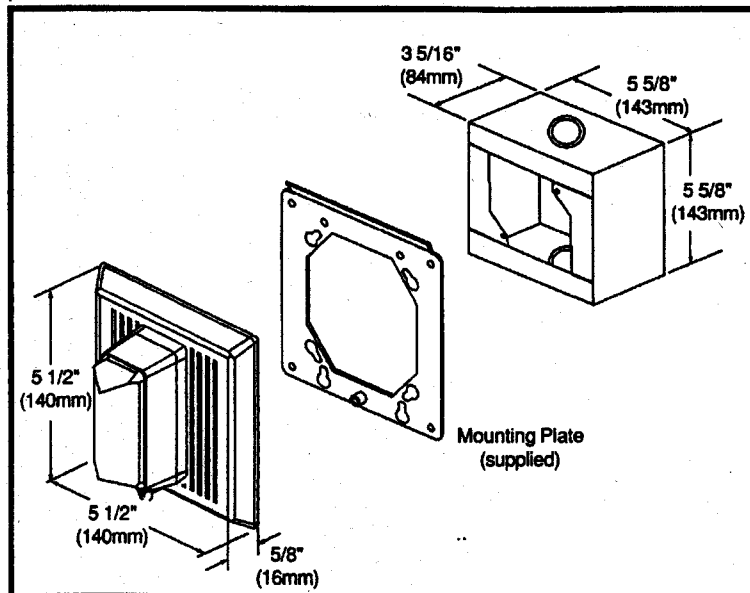
- Operating voltage: -20% to +10% of nominal voltage
- Outdoor Operating Environment: 85% relative humidity at 86°F (30°C); 32°F to 120°F (0° to 49°C) variable ambient

## Installation

The 867STR mounts to the gray, corrosion resistant surface box supplied with the unit. The box measures 5 5/8" (143mm) square by 3 5/16" (84mm) deep.

## Applications

The 867STR AdaptaBeacon is for indoor wall mounting in manufacturing sites. Used where a distinctive visual or audible signal is required for timing, scheduling, paging, process control, and general alarm applications.



Catalog Number	867STR(*)-N5	867STR(*)-AQ	
Operating Voltage	120V AC	24V AC	24V DC
Operating Current - Horn**	21 mA	60 mA	20 mA
Operating Current - Strobe**	90 mA (RMS)	158 mA (RMS)	219 mA (AVG)
Flash Rate (per second)	1 fps		
Sound Level Output @ 10 ft. (3.05m) Anechoic Chamber	90 dBA	90 dBA	
Light Output (cd) UL 1638	150 cd - Clear lens only (Reduced light output for other lens colors).		

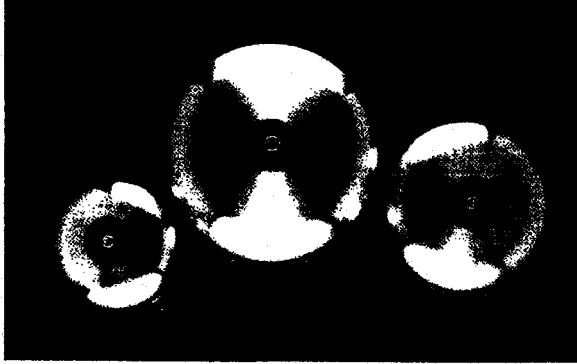
\* Insert lens color, C = Clear, R = Red, G = Green, B = Blue or A = Amber  
 \*\* Horn and strobe currents are additive when connected in parallel.



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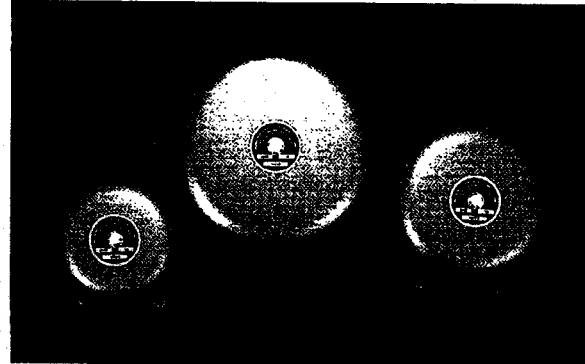
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## Bells/Horns & Sirens



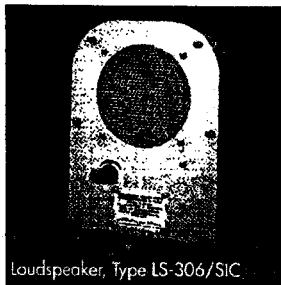
### New Explosion Proof/Low Drain Alarm Bells

- The new Hose-McCann, HL Series, Explosion Proof Bell offers both energy efficiency and cost savings. It is UL Listed for use in Class 1, Division 2, Groups A,B,C, and D Hazardous Locations.
- The HL Series Bells are housed in a lightweight, high corrosion-resistant aluminum alloy (Almag-35), and available in three gong sizes: 6, 8, and 10-inch diameters. Gongs are available in steel or brass.
- A wide selection of voltages is available in alternating and direct current (AC/DC).
- The low drain HL Series Bell has been designed to minimize the ampere capacity and physical dimensions of the batteries required to operate the general alarm system.
- The resulting energy savings will reduce the size and current capacity of the cable required for the ship's general alarm system.
- UL Listed
- ABS approved

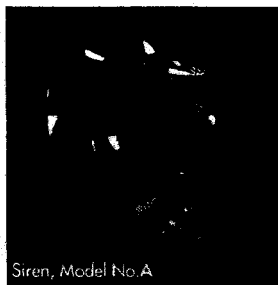


### General Alarm Bells/Watertight

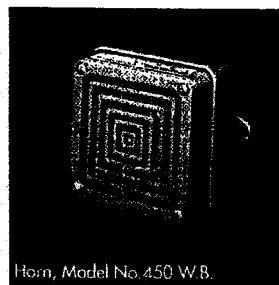
- The Hose-McCann watertight, vibrating, underdome bell has been designed primarily for use in the general alarm system.
- The standard bell comes with an 8-inch steel gong, finished in grey enamel. Gongs are also available in 6, 10, or 12-inch steel or brass. The bell enclosure is manufactured with a lightweight, high corrosion-resistant aluminum alloy (Almag-35), with alternate availability in bronze.
- The standard voltage for our General Alarm Bell is 24V DC with a low drain coil. Hose-McCann can also provide a wide variety of alternating and direct current (AC/DC) voltages upon request.
- ABS approved
- USCG accepted



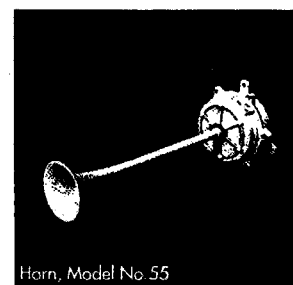
Loudspeaker, Type LS-306/SIC.



Siren, Model No. A



Horn, Model No. 450 W.B.



Horn, Model No. 55

### Additional Audible Signaling Devices



For more information on Hose-McCann's Audible Signaling Devices contact our sales department.

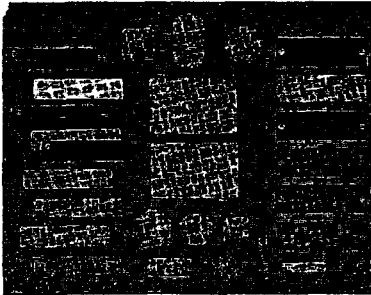
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# PANDUIT® Stainless Steel, Brass, & Aluminum Markers

## Stainless Steel, Brass, and Aluminum Marker Plates and Tags



- Identify pipes, conduit, valves, cables and equipment in petrochemical plants, pulp and paper mills, refineries, offshore oil rigs and in many other harsh environments.
- All marker plates/tags can be custom marked by PANDUIT with one of two computer controlled systems (laser and embosser) to provide permanent identification to resist corrosion, abrasion and radiation. (See page 15 for details.)
- Use with PANDUIT® **PAN-STEEL™** cable ties (Refer to pages 6 and 7.), or with "S" hooks, jack chains and beaded chains (Refer to page 18.) for fast installation at lowest installed cost.

Most tags are provided with one ¼" (6.35mm) hole.

Styles	Part Numbers	Used with PAN-STEEL Ties	Plate/Tag Size Inches W x L (mm)		Material	Thickness	Pkg. Qty.	Ctn. Qty.
 MMP350-C	MMP350-C	MLT-S	.75" x 3.50"	(19 x 89)	304 Stainless	.010" (.254 mm)	100	1000
		MLT-S	.75" x 3.50"	(19 x 89)	316 Stainless		100	1000
		MLT-S/H	.75" x 3.50"	(19 x 89)	304 Stainless		100	1000
		MLT-S/H	.75" x 3.50"	(19 x 89)	316 Stainless		100	1000
		MLT-S	.38" x 3.50"	(9.6 x 89)	304 Stainless		100	1000
		MLT-S	.38" x 3.50"	(9.6 x 89)	316 Stainless		100	1000
		MLT-S	.75" x 1.72"	(19 x 44)	304 Stainless		100	1000
		MLT-S	.75" x 1.72"	(19 x 44)	316 Stainless		100	1000
		MLT-S	.38" x 1.72"	(9.6 x 44)	304 Stainless		100	1000
		MLT-S	.38" x 1.72"	(9.6 x 44)	316 Stainless		100	1000
 MT172W38-C	MT172W38-C	MLT-S*	.75" x 3.50"	(19 x 89)	304 Stainless	.010" (.254 mm)	100	1000
		MLT-S*	.75" x 3.50"	(19 x 89)	316 Stainless		100	1000
		MLT-S*	.38" x 3.50"	(9.6 x 89)	304 Stainless		100	1000
		MLT-S*	.38" x 3.50"	(9.6 x 89)	316 Stainless		100	1000
		MLT-S*	.75" x 1.72"	(19 x 44)	304 Stainless		100	1000
		MLT-S*	.75" x 1.72"	(19 x 44)	316 Stainless		100	1000
		MLT-S*	.38" x 1.72"	(9.6 x 44)	304 Stainless		100	1000
 MT350W17-Q	MT350W17-Q	MLT-S*	2.13" x 3.38"	(54 x 86)	304 Stainless	.015" (.381 mm)	25	250
		MLT-S*	2.13" x 3.38"	(54 x 86)	Brass		25	250
		MLT-S*	1.73" x 3.50"	(44 x 89)	304 Stainless		25	250
		MLT-S*	1.73" x 3.50"	(44 x 89)	Brass		25	250
 MMP338W21-Q	MMP338W21-Q	MLT-S*	2.13" x 3.38"	(54 x 86)	304 Stainless	.015" (.381 mm)	25	250
		MLT-S*	2.13" x 3.38"	(54 x 86)	Brass		25	250
		MLT-S*	1.73" x 3.50"	(44 x 89)	304 Stainless		25	250
		MLT-S*	1.73" x 3.50"	(44 x 89)	Brass		25	250
 MT1D-Q	MT1D-Q	MLT-S*	1.00" CIRCULAR (25)		304 Stainless	.035" (.89 mm)	25	250
		MLT-S*	1.00" CIRCULAR (25)		Brass		25	250
		MLT-S*	1.50" CIRCULAR (38)		304 Stainless		25	250
		MLT-S*	1.50" CIRCULAR (38)		Brass		25	250
		MLT-S*	2.13" CIRCULAR (54)		304 Stainless		25	250
		MLT-S*	2.13" CIRCULAR (54)		Brass		25	250
 MT206W119A-Q	MT206W119A-Q	MLT-S*	1.19" x 2.06" DOG TAG (30 x 52)		304 Stainless	.015" (.381 mm)	25	250
		MLT-S*	1.19" x 2.06" DOG TAG (30 x 52)		Brass		25	250
 MT1S-Q	MT1S-Q	MLT-S*	1.00" SQUARE (25)		304 Stainless	.035" (.89 mm)	25	250
		MLT-S*	1.00" SQUARE (25)		Brass		25	250
		MLT-S*	1.25" SQUARE (32)		304 Stainless		25	250
		MLT-S*	1.25" SQUARE (32)		Brass		25	250
		MLT-S*	1.36" SQUARE (35)		Brass		25	250
 MT125B-Q	MT125B-Q	MLT-S*	1.25" OCTAGON (32)		304 Stainless	.035" (.89 mm)	25	250
		MLT-S*	1.25" OCTAGON (32)		Brass		25	250
		MLT-S*	1.50" OCTAGON (38)		304 Stainless		25	250
		MLT-S*	1.50" OCTAGON (38)		Brass		25	250
 AP350HW86-C	AP350HW86-C	MLT-S/H	.86" x 3.50"	(22 x 89)	Aluminum	.015" (.381 mm)	100	1000

\*Also used with "S" Hooks, Jack Chain, or Beaded Chain (Refer to page 18 for details).

Galvanic reaction may occur between stainless steel ties and aluminum marker plates in certain environments causing the aluminum to corrode.

Std. Pkg. -Q = 25 pcs., and -C = 100 pcs. Order the number of marker plates/tags required in multiples of std. pkg. qty.



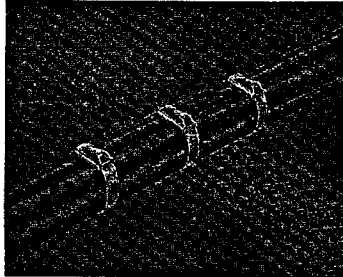
# PANDUIT® PAN-STEEL™ Stainless Steel Ties - MLT Series

## Part Number System Example

(Stock Size Tie)

<b>MLT</b>	<b>6</b>	<b>S</b>	<b>—</b>	<b>CP</b>	
<b>Part Description</b>	<b>Maximum Bundle Diameter</b>	<b>Cross-Section</b>		<b>Package Qty.</b>	<b>Material</b>
Metal Tie	(inches)	S = Standard H = Heavy		Q = 25 L = 50 LP = 50 CP = 100	(blank) = 304 316 = 316 321 = 321

## PAN-STEEL Stainless Steel Ties



MLT-S Standard Cross-Section:  
.18" (4.6mm) wide.



MLT-H Heavy Cross-Section:  
.31" (7.9mm) wide.

The PAN-STEEL system provides a strong durable method of bundling, identifying and fastening. Can be used in virtually all indoor, outdoor and underground (including direct burial) applications, especially where severe environmental conditions exist.



Three types of material available:  
AISI 304 non-magnetic stainless steel—for most applications;  
AISI 316 non-magnetic stainless steel—for applications requiring superior corrosion resistance;  
Type AISI 321 non-magnetic stainless steel—for high temperature applications. Rated up to 1700°F (925°C)

### Military Cross Reference (MIL-S-23190E)

Panduit Part Number	Current Military Std. Part Number
MLT-S-CP	M23190/3-1
MLT-S-CP316	M23190/3-1
MLT-S-CP	M23190/3-2
MLT-S-CP316	M23190/3-2
MLT-S-CP	M23190/3-3
MLT-S-CP316	M23190/3-3
MLT-S-CP	M23190/3-4
MLT-S-CP316	M23190/3-4

Stock Part Number	Material & Cross Section	Min. Loop Tensile Strength Lbs. (N)*	Max. Bundle Dia. in. (mm)	Length** in. (mm)	Thickness & Width in. (mm)	Recommended PANDUIT*** Installation Tool Part No.	Pkg. Qty.	Ctn. Qty.
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### Type AISI 304

MLT-S-CP MLT-S-CP316 MLT-S-CP MLT-S-CP316 MLT-S-CP MLT-S-CP316 MLT-S-CP MLT-S-CP316 MLT-S-CP MLT-S-CP316	304 Std.	100 (445)	1.00 (25)	5.0 (127)	.10 (.254) X .18 (4.6)	PPTMT GS4MT ST2MT or HTMT	100	500
			2.00 (50)	7.9 (201)				
			2.00 (50)	7.9 (201)				
			2.70 (69)	10.2 (259)				
			4.00 (102)	14.3 (362)				
			4.00 (102)	14.3 (362)				
			6.00 (152)	20.5 (521)				
			8.00 (203)	26.8 (679)				
			10.00 (254)	33.0 (838)				
			12.00 (305)	42.0 (1067)				
14.00 (356)	47.0 (1194)							
MLT-H-CP MLT-H-CP316 MLT-H-CP MLT-H-CP316 MLT-H-CP MLT-H-CP316 MLT-H-CP MLT-H-CP316 MLT-H-CP MLT-H-CP316	304 Hvy.	250 (1112)	2.00 (50)	7.9 (201)	.10 (.254) X .31 (7.9)	PPTMT GS4MT ST2MT or HTMT	50	250
			2.00 (50)	7.9 (201)				
			2.70 (69)	10.2 (259)				
			4.00 (102)	14.3 (362)				
			6.00 (152)	20.5 (521)				
			6.00 (152)	20.5 (521)				
			8.00 (203)	26.8 (679)				
			10.00 (254)	33.0 (838)				
			12.00 (305)	42.0 (1067)				
			14.00 (356)	47.0 (1194)				

### Type AISI 316

MLT-S-CP MLT-S-CP316 MLT-S-CP MLT-S-CP316 MLT-S-CP MLT-S-CP316	316 Std.	100 (445)	1.00 (25)	5.0 (127)	.10 (.254) X .18 (4.6)	PPTMT GS4MT ST2MT or HTMT	100	500
			2.00 (50)	7.9 (201)				
			4.00 (102)	14.3 (362)				
			6.00 (152)	20.5 (521)				
			8.00 (203)	26.8 (679)				
			10.00 (254)	33.0 (838)				
MLT-H-CP MLT-H-CP316 MLT-H-CP MLT-H-CP316 MLT-H-CP MLT-H-CP316	316 Hvy.	250 (1112)	2.00 (50)	7.9 (201)	.10 (.254) X .31 (7.9)	PPTMT GS4MT ST2MT or HTMT	50	250
			4.00 (102)	14.3 (362)				
			6.00 (152)	20.5 (521)				
			8.00 (203)	26.8 (679)				
			10.00 (254)	33.0 (838)				
			10.00 (254)	33.0 (838)				

### Type AISI 321

MLT-S-CP MLT-S-CP316 MLT-S-CP MLT-S-CP316 MLT-S-CP	321 Std.	100 (445)	2.00 (50)	7.9 (201)	.10 (.254) X .18 (4.6)	PPTMT GS4MT ST2MT or HTMT	100	500
			4.00 (102)	14.2 (360)				
			6.00 (152)	20.4 (521)				
			8.00 (203)	26.8 (679)				
			10.00 (254)	33.0 (838)				
MLT-H-CP MLT-H-CP316 MLT-H-CP MLT-H-CP316 MLT-H-CP	321 Hvy.	250 (1112)	2.00 (50)	7.9 (201)	.10 (.254) X .31 (7.9)	PPTMT GS4MT ST2MT or HTMT	50	250
			4.00 (102)	14.2 (360)				
			6.00 (152)	20.4 (521)				
			8.00 (203)	26.8 (679)				
			10.00 (254)	33.0 (838)				

\*Per Military Specification MIL-S-23190. For additional details, see page 21.

\*\*Other lengths available, contact factory.

\*\*\*Refer to pages 10, 11 and 12 for information on installation tools.

Order the number of ties required in multiples of std. pkg. qty.





# 601 SERIES

## ELECTRICAL RATING:

1/3 Breakdown Voltage — 1100 VOLTS RMS  
 Current rating — 20 AMPS  
 Agency rating — 300 Volts

## HARDWARE:

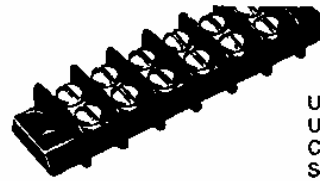
crews — brass, nickel plated  
 Terminals, Solder terminals — brass, tin plated

## WIRE SIZE:

Wire Range AWG #16 to 14.

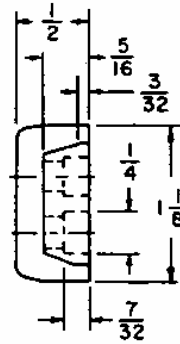
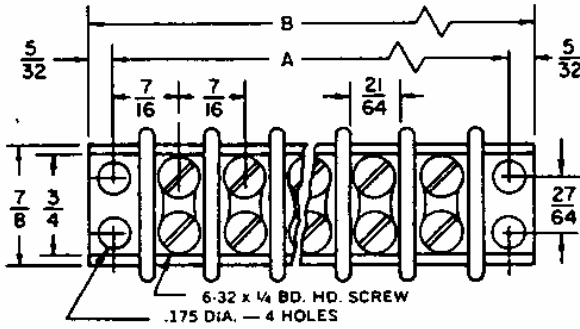
## MOLDED MATERIAL:

G.P. phenolic  
 GDI-30F.



UL Recognized  
 UL File No. E47811  
 CSA File No. LR19766  
 See U/L, CSA Page 53

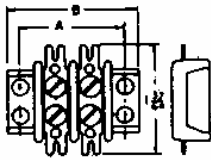
# 601 SERIES



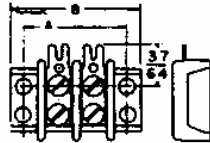
Number of Terminals	Dimensions	
	A	B
1	1/2	1 1/4
2	1 1/4	1 3/4
3	1 3/4	2 1/4
4	2 1/4	2 3/4
5	2 3/4	3 1/4
6	3 1/4	3 3/4
7	3 3/4	4 1/4
8	4 1/4	4 3/4
9	4 3/4	5 1/4
10	5 1/4	5 3/4
11	5 3/4	6 1/4
12	6 1/4	6 3/4
13	6 3/4	7 1/4
14	7 1/4	7 3/4
15	7 3/4	8 1/4
16	8 1/4	8 3/4
17	8 3/4	9 1/4
18	9 1/4	9 3/4
19	9 3/4	10 1/4
20	10 1/4	10 3/4
21	10 3/4	11 1/4
22	11 1/4	11 3/4
23	11 3/4	12 1/4

## HARDWARE VARIATIONS AND ACCESSORIES FOR 601 SERIES

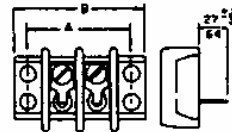
### 601-ST LUG



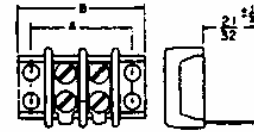
### 601-3/4ST LUG



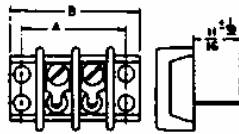
### 601-Y LUG



### 601-Z LUG



### 601-YSY LUG



### KLIPTITES



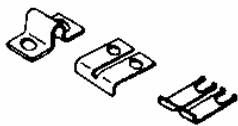
For more information, see KlipTite section.

### STUD & TURRET



For more information, see page 32.

### JUMPERS



For more information, see Hardware section.

### STRADDLE PLATE



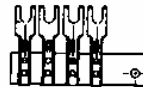
For more information, see Hardware section.

### MARKER STRIPS



For more information, see Marker & Insulator Strip section.

### FANNING STRIPS



For more information, see Hardware section.

### MARKING ON TERMINAL BOARDS



Standard method of marking terminal boards is rubber stamping. We use inks which contrast with the surface of the board; white on dark surfaces, and black on light surfaces.

For more information, see Terminal Board Marking section.

## ORDERING CODE EXAMPLE

For convenience and accuracy in ordering, please specify catalog numbers as shown.

SERIES	MAT. CODE	LUG TYPE	NO. OF TERM	HARDWARE	SERVICE

- FOR MARKER STRIPS USE A "MS" PREFIX ON THE SERIES
- FOR INSULATOR STRIPS USE AN "IS" PREFIX ON THE SERIES





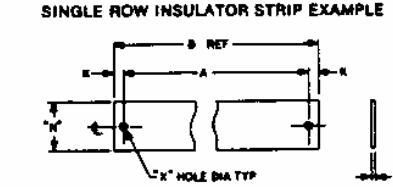
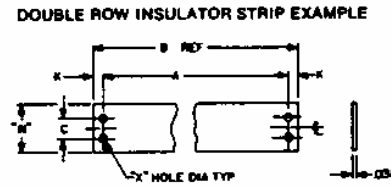
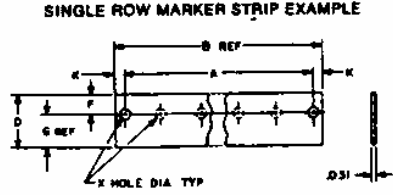
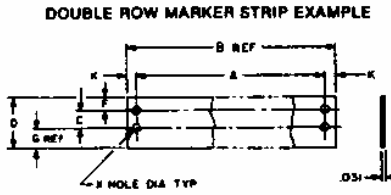
# MARKER AND INSULATOR STRIPS

Kulka marker strips serve as insulation between terminal blocks and chassis, as well as providing a marking surface for terminal identification. When specified, they can be printed to show terminal designations by numbers, letters, symbols or any combination thereof. Insulator strips offer the same properties, but do not provide space for terminal identification. Both marker and insulator strips can be supplied pre-mounted on the back of each block thereby simplifying assembly and inventory control.

## DRAWING AND DIMENSIONS

Marker and insulator strips are available for Kulka's Terminal Blocks. These include double & single row, single row insulated turret and single & double row wide "Z". Drawings for these different types and the various printing styles offered are shown on pages 2 and 3. Marker strip dimensions are listed in Tables I and II.

Dimensions for insulator strips, which are narrower (see dimension "N" in Table II) and do not afford a marking surface, are the same as marker strips except for dimension "D". Material options and ordering information for both marker and insulator strips are listed below.



## ORDERING INFORMATION

**AVAILABILITY:** Marker and insulator strips are available to fit most Kulka Terminal Blocks. See SERIES reference numbers in Table II for a complete listing. If not listed in Table II, consult the factory for availability. Designate appropriate suffix (MS for marker strip or IS for insulator strip) in front of the SERIES number when ordering.

**MATERIAL:** To specify material use Kulka code letters shown above.

**FEED-THRU STYLE:** For feed-thru terminal blocks, see styles, 2, 3, 5, 6, 8 & 9 on page 41. Insert applicable feed-thru style designation in ordering code, i.e. Y, YSY, XY, 1904, 1921, 2000, 2004, 2020, 2021, 2100, 2104 2120, 3000 SERIES, 3100 SERIES, 4000 SERIES, 4100 SERIES.

## PRINTING:

- Marker strips are available in many printing styles as illustrated on page 41. The maximum number of characters per station is two (2).
- Please specify printing style.
- If unprinted marker strips are desired, insert the letter "X" in the printing style space of the ordering code.
- Printing is the standard method of marking.
- Printing color is silver (white) on dark surfaces and black on light surfaces.

**PROTECTIVE COATING:** Marker and insulator strips can be supplied with a fungus proof varnish (MIL-V-173A) cover coating. State on order: "coat after printing with MIL-V-173A varnish".

CODE "FP"

\*See block dimension for overall length and mounting

## ORDERING CODE EXAMPLE

MS  
OR  
IS

SERIES	MAT. CODE	NO. OF TERM	STYLE OF PRINTING





KRPA



KRP



KA

# KRPA, KRP, KA, KR series

## 5 to 10 Amp General Purpose Relay

File E29244, E22575, E81558 (KR Hermetic)

File LR15734

### Features

- Industry standard octal-type termination for quick installation.
- Contact arrangements from 1 Form A (SPST - NO) to 3 Form C (3PDT).
- Indicator lamp and push-to-test options available on certain models.
- The KRPA series is the automated manufactured version of the KRP series.
- Hermetically sealed option available with KR UL recognized for Class I Div. 2 Hazardous locations, Groups A, B, C, D.

### Contact Data @ 25°C

Arrangements: See Ordering Information Table.

Materials: Silver or silver-cadmium oxide, with or without gold flashing.

Expected Life: 10 million operations min., mechanical; 100,000 operations min. @ rated loads.

### KA, KRP, KRPA UL/CSA Contact Ratings @ 25°C (Except KR)

Y&L (Silver)	1, 2, 3 Poles	5A @ 120VAC 3A @ 240VAC 1/10HP @ 120VAC 1/8HP @ 240VAC
G&N (Silver-Cad. Oxide)	1, 2, 3 Poles	10A @ 240VAC 1/2 HP @ 240VAC 1/3HP @ 120VAC

### KRP, KRPA Factory Ratings

Y&L	1, 2, 3 Poles	5A @ 28VDC, 120VAC, 80% PF
G&N	1, 2, 3 Poles	10A @ 28VDC, 120VAC, 80% PF 5A @ 250VAC

### KA UL Contact Ratings

Y	KA <sup>1</sup>	5A @ 120VAC, 3A @ 240VAC, 1/10 HP @ 120VAC, 1/8 HP @ 240VAC
G	KA <sup>2</sup>	10A @ 120VAC, 6A @ 240VAC 1/6 HP @ 120VAC, 1/3 HP @ 240VAC

<sup>1</sup>Listed by C.S.A. for 5A @ 120VAC 80% PF  
<sup>2</sup>Listed by C.S.A. for 10A @ 120VAC 80% PF

### Initial Dielectric Strength

Between Open Contacts: 500V rms.  
Between All Elements: 1,500V rms.

Note: See KRPA, KRP, KA, KR-E Ordering Information table on page 106.

### Coil Data @ 25°C

		Nominal Power	Maximum Power
KRP	AC	2VA	Open Models - 5VA Enclosed Models - 4VA
	DC	1.2W	Open Models - 4W Enclosed Models - 3W
KRPA	AC	2VA	Open Models - 4VA
	DC	125mW per movable arm	Open Models - 4W

Duty Cycle: Continuous.

Initial Insulation Resistance: KRP, KRPA - 1000 Megohms, min.  
KA - 100 Megohms, min.

### Coil Data @ 25°C

Coils	Resistance (Ω)	DC Resistance (Ω)	Max. Initial Coil Current (mA)
DC Coils	6	32	188
	12	120	100
	24	472	51
	48	1,800	26.6
	110	10,000	11.5
Use 110V relay with 10,000 Ω 5W Resistor in series			
AC Coils	6	6	335
	12	24	168
	24	85	84
	120	2,250	17.5
	240	9,110	8.75

### Operate Data @ 25°C

Must-Operate Voltage:

DC: 75% or less of nominal voltage.  
AC: 85% or less of nominal voltage.

Operate Time (Excluding Bounce):

15 milliseconds typical @ nominal voltage.

Release Time (Excluding Bounce):

10 milliseconds typical @ nominal voltage.

### Environmental Data

Temperature Range:

Open Models: AC: -45°C to +70°C.

DC: -45°C to +85°C.

Enclosed Models: AC: -45°C to +55°C.

DC: -45°C to +70°C.

### Mechanical Data

Open Models: Solder terminals.

Enclosed Models: Octal-type plug.

Enclosures: Transparent polycarbonate (except KR).

Hermetically sealed metal case available with KR only.

Weight: KA: 1.7 oz. (48.2g) approximately.

KRPA, KRP: 3.0 oz. (85g) approximately.

Ordering Information

Typical Part No. ▶

-5

Y

-120

2. Contact Arrangement:

- |                            |                         |
|----------------------------|-------------------------|
| 1 = 1 Form A (SPST-NO)     | 7 = 2 Form A (DPST-NO)  |
| 2 = 1 Form B (SPST-NC)     | 8 = 2 Form B (DPST-NC)  |
| 3 = 1 Form X (SPST-NO-DM)  | 11 = 2 Form C (DPDT)    |
| 4 = 1 Form Y (SPST-NC-DB)  | 12 = 3 Form A (3PST-NO) |
| 5 = 1 Form C (SPDT)        | 13 = 3 Form B (3PST-NC) |
| 6 = 1 Form Z (SPDT(DB-DM)) | 14 = 3 Form C (3PDT)    |

4. Contact Rating and Indicator Lamp Option:

TYPE	KRPA	KRP	KR	KA
Codes Available	Y, G, L, N, YF, GF, LF, NF	Y, G, N, YF, GF, NF	Y, G, GF	Y, G,

- Leave Blank = Silver, no indicator lamp for hermetically sealed KR (option E below).  
 Y = Silver, no indicator lamp  
 G = Silver-cadmium oxide, no indicator lamp  
 L = Silver, with indicator lamp\*  
 N = Silver-cadmium oxide, with indicator lamp\*  
 YF = Silver gold-flashed, no indicator lamp  
 GF = Silver-cadmium oxide gold-flashed, no indicator lamp  
 LF = Silver gold-flashed contacts, with indicator lamp\*  
 NF = Silver-cadmium oxide gold-flashed contacts, with indicator lamp\*

6. Coil Voltage:

- Up to 277VAC  
Up to 125VDC

\*Indicator Lamp not available on 25-80V coils. Only 120-240VAC and 110VDC models are UL recognized and CSA certified.

Stock Items - The following items are normally maintained in stock for immediate delivery.

KA-5AG-120	KR-11DGE-24	KRP-14AN-120	KRPA-11AN-24	KRPA-14AG-120
KA-5AY-120	KR-14AGE-120	KRP-14AY-120	KRPA-11AN-120	KRPA-14AG-240
KA-5DG-8	KR-14DGE-24	KRP-14DG-12	KRPA-11AN-240	KRPA-14AN-24
KA-5DG-12	KRP-5AG-120	KRP-14DG-24	KRPA-11AY-6	KRPA-14AN-120
KA-5DG-110	KRP-11AG-24	KRP-14DG-110	KRPA-11AY-12	KRPA-14AN-240
KA-11AG-120	KRP-11AG-120	KRP-14DN-24	KRPA-11AY-24	KRPA-14AY-24
KA-11AY-6	KRP-11AG-240	KRPA-5AG-24	KRPA-11AY-120	KRPA-14AY-120
KA-11AY-24	KRP-11AN-24	KRPA-5AG-120	KRPA-11AY-240	KRPA-14AY-240
KA-11AY-120	KRP-11AN-120	KRPA-5AY-120	KRPA-11DG-6	KRPA-14DG-12
KA-11DG-12	KRP-11AY-120	KRPA-5DG-6	KRPA-11DG-12	KRPA-14DG-24
KA-11DG-24	KRP-11DG-12	KRPA-5DG-12	KRPA-11DG-24	KRPA-14DG-48
KA-11DG-110	KRP-11DG-24	KRPA-5DG-24	KRPA-11DG-48	KRPA-14DG-110
KA-14AG-120	KRP-11DG-48	KRPA-5DY-12	KRPA-11DG-110	KRPA-14DN-24
KA-14AY-120	KRP-11DG-110	KRPA-5DY-24	KRPA-11DN-12	KRPA-14DY-24
KA-14DG-24	KRP-11DG-125	KRPA-11AG-6	KRPA-11DN-24	
KA-14DG-110	KRP-11DN-12	KRPA-11AG-12	KRPA-11DN-110	
KR-11AE-120	KRP-11DN-24	KRPA-11AG-24	KRPA-11DY-12	
KR-11AGE-120	KRP-11DY-24	KRPA-11AG-120	KRPA-11DY-24	
KR-11DE-24	KRP-14AG-120	KRPA-11AG-240	KRPA-14AG-12	
KR-11DGE-12	KRP-14AG-240	KRPA-11AN-12	KRPA-14AG-24	

# Definite Purpose Contactors

## Types DP, DPA, and SYD Application Data – Class 8910

### 2 Normally Open & 2 Normally Closed 4 Pole Contactors – 600V AC Maximum

Full Load Amperes	Resistive Load Amperes	N.O. Poles	N.C. Poles*	Class 8910		Price
				Type	Form	
20	25	2	2	DPA14v	Y392	\$ 143.00
25	35	2	2	DPA24v	Y392	154.00
30	40	2	2	DPA34v	Y392	165.00
40	50	2	2	DPA44v	Y392	180.00

v Voltage code must be specified to order this product. Refer to standard voltage codes listed below.

= Above 240 volts, all lines must be switched.

\* N.C. poles on outside. N.C. poles "open" before N.O. poles "close."

### Auxiliary Contacts

For Use With Class 8910 Type	Contact Arrangement	Class 8909 Type	Price
DPA	1 N.O.	D10	\$ 15.00
	1 N.C.	D01	15.00
	1 N.O. & 1 N.C.	D11	28.50
	2 N.O.	D20	28.50
DPA122 DPA123 SYD	1 N.O.	SX6	38.00
	1 N.C.	SX7	38.00
	1 N.O. & 1 N.C.	SX8	51.00

### NEMA Type 1 General Purpose Enclosures for Type DP and DPA Contactors

Class 8910 Type	Full Load Amperes	Poles	Class 8991 Type	Price
DP	20-40	1 & 2	DPG1	\$ 34.80
DPA	20-40	2 & 3	DPG3	34.80
DPA	50 20-40	2 & 3 4	DPG2	44.30
DPA	60-75	2 & 3	DPG3	63.00
DPA	90-120	2 & 3	DPG4	127.80

### Application Data

Mechanical Life: 500,000 operations

Electrical Life: 100,000 operations

Type DP 200,000 operations

Type DPA, SYD Continuous

Duty Cycle: Continuous

Approvals:

UL Component Recognized

UL Listed (Form U1)

CSA Certified

File E42240, CCN NLDX2

File E42240, CCN NLDX

File LR25490, Class 321104

### Class 8910 Type DPA Replacement Coils

Full Load Amperes	Poles	Class 8908 Type	Volt Amperes†		Price‡
			Inrush	Sealed	
20-40A	2 & 3	DA1V*	56	6	\$ 32.70
20-40A	4	DA2V*	109	10	44.30
50-60A	2 & 3	DA2V*	109	10	44.30
75-90A	2 & 3	DA3V*	214	19	55.00

\* Replace asterisk with suffix from DPA Coil Table, shown below. Example: Coil for Class 8910 DPA33V02 120 volt 60 Hz would be a Class 8908 Type DA1V02.

† For Types DP11 thru DP32: Inrush 30 VA; Sealed 5 VA.

‡ CP10 Discount Schedule, not CP1.

### Type DPA Coil Table

Voltage, 60 Hz	Voltage, 50 Hz	Voltage Code
24	24	V14
120	110	V02
208-240	220	V09
Z77		V04
480	440	V08A
600	550	V07A

‡ Available for Type DPA contactors only.

Full Load Amperes	Power Terminals	
	Type of Lug	Wire Size† Minimum-Maximum
20-30A	Binder Head	#14-#8
40A	Box Lug	#14-#6
50-60A	Box Lug	#14-#2
75-90A	Box Lug	#14-#0
120A	Box Lug	#14-#0C
132A	Box Lug	#6-350 MCM
220A	Box Lug	#6-350 MCM
352A	Box Lug	#4-500 MCM

† Solid or stranded copper wire only.

### Miscellaneous Parts

Description	Class 8999 Type	Price
DIN mounting bracket attachment	DMB1	\$ 7.40
DIN parts kits for Type DP only – 10 sets per box	DMB2	31.70

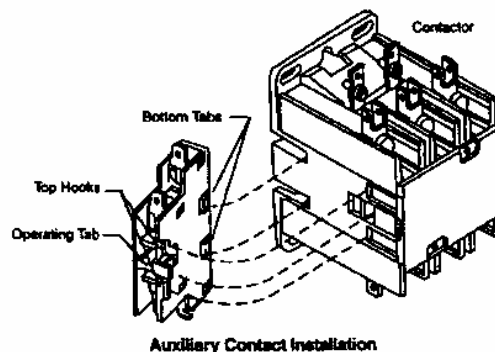
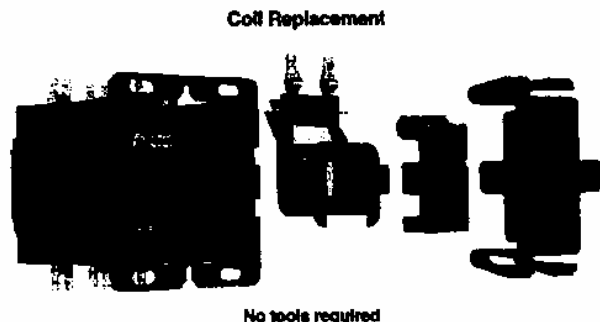
### Factory Modifications

Auxiliary contacts can be factory installed along with a DIN mounting bracket option. Special terminations are also available.

Modification	Form	Price
Factory installed auxiliary contacts	•	•
Pressure wire connectors (20 - 30 amp)	Y122	\$1.80 per pole
Box lugs (20 - 30 amp)	Y124	\$3.30 per pole
DIN mounting bracket attached (35mm style)‡	Y135	\$3.20 for Type DP \$8.40 for Type DPA

• Contact your local Square D office.

‡ Available for 20 through 60 amp only.



For additional information, reference Catalog # 8910CT9301R6/97 or D-FAX™ # 1517.



10/97

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12-89

12 NEMA DEFINITE PURPOSE TYPE CONTACTORS AND STARTERS













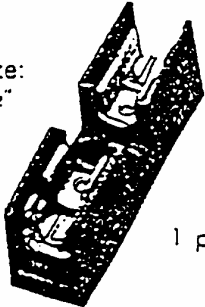


# 30 AMPS - 600 VOLTS FUSEHOLDERS CLASS M

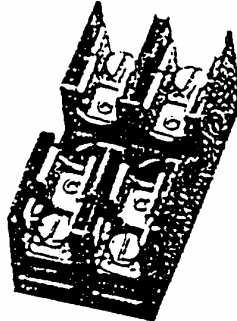
UL FILE  
E51742

Spring Reinforced Ferrule Clip

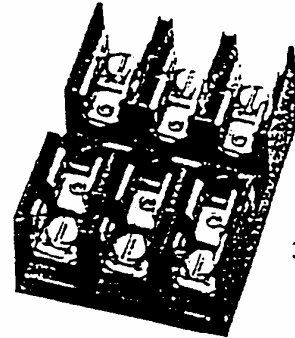
Accepts  
Fuse Size:  
 $1\frac{1}{32}'' \times 1\frac{1}{2}''$



1 pole



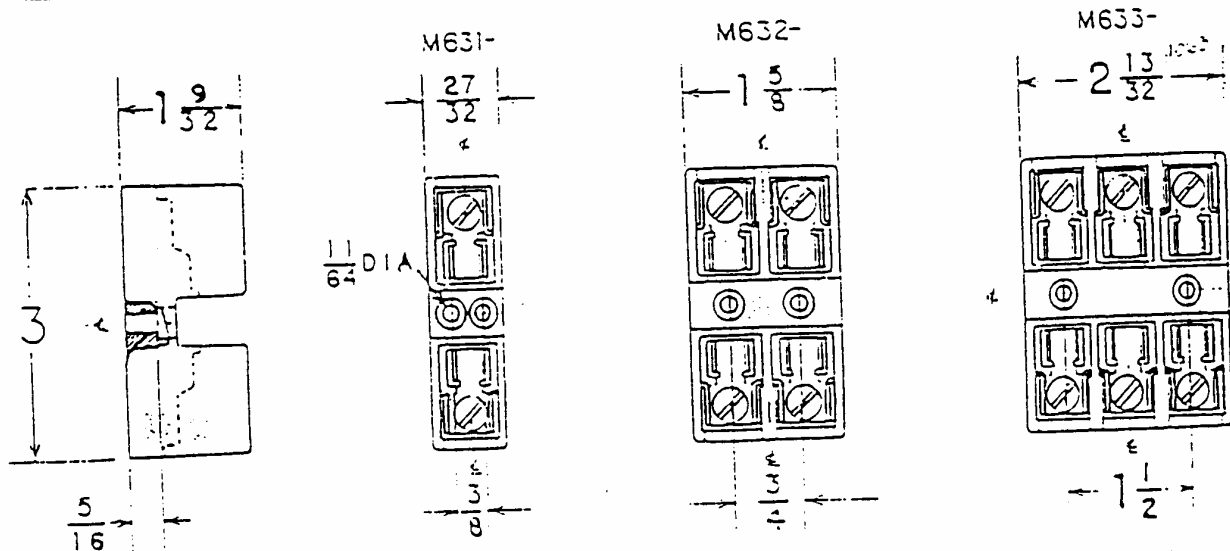
2 pole



3 pole

Also available with rejection feature (use prefix MR)

CATALOG #	VOLTS	AMPS	POLES		WIRE TERMINATION METHODS	
M631-33	600	30	1		Binding head screw #10 maximum CU or AL	
* M632-33	600	30	2			
M633-33	600	30	3			
M631-44	600	30	1		Pressure plate screw #10 maximum CU only	
M632-44	600	30	2			
M633-44	600	30	3			
M631-55	600	30	1		Double Quick-connect 20 Amp maximum	
M632-55	600	30	2			
M633-55	600	30	3			
M631-66	600	30	1		Combination of: Double quick-connect, 20A max. and binding head screw, #10 maximum CU/AL	
M632-66	600	30	2			
M633-66	600	30	3			
M631-77	600	30	1		Combination of: Double quick-connect, 20A max. and pressure plate screw, #10 maximum CU only	
M632-77	600	30	2			
M633-77	600	30	3			
MH	Fuseholder Marking Strip for single pole unit (for 2 and 3 pole markers consult factory)					
PF1	Fuse Puller					
LPF1	Lighted Fuse Puller—120 volt standard (consult factory for other voltages)					





# Sigmaform™ Adapters

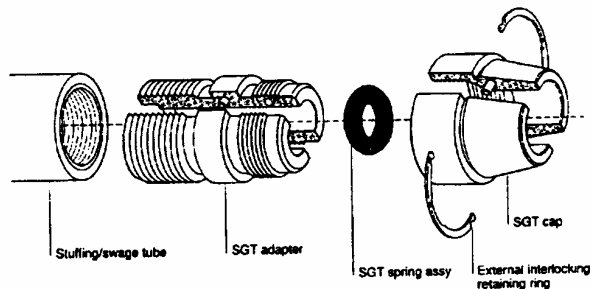
## Cable shield grounding adapters: Split type

### Applications

Sigmaform CSGA (s) adapter provides 360-degree grounding to overall shielded cables at the entrance to MIL-S-24235 stuffing tubes. The adapter comes in 19 different sizes to accommodate stuffing tube sizes A through X.

### Features/Benefits

- Installs without cutting cable.
- Has ShrinkAround™ sleeve that provides positive weather sealing and meets NAVSEA 803-5001027, Sheet 7, requirements.
- Provides EMI/EMP grounding.
- Meets MIL-STD 1310 grounding requirement.
- Offers an operating temperature of -55°C to 85°C.



### Product Dimensions (in inches)

#### Split-type Grounding Adapter

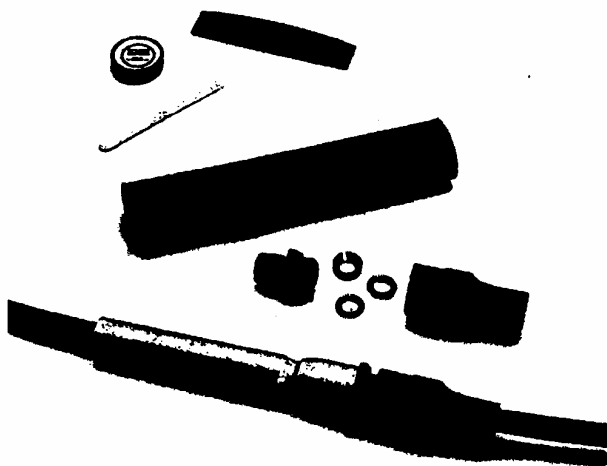
Kit <sup>a</sup> Identification	Stuffing Tube size	Max. O.D. of cable	Min. O.D. of shield
CSGA-A(s)	A	.406	.200
CSGA-B(s)	B	.515	.260
CSGA-C(s)	C	.640	.400
CSGA-D(s)	D	.750	.400
CSGA-E(s)	E	.812	.430
CSGA-F(s)	F	.843	.470
CSGA-G(s)	G	.953	.580
CSGA-J(s)	J	1.062	.690
CSGA-K(s)	K	1.172	.800
CSGA-L(s)	L	1.265	.890
CSGA-M(s)	M	1.406	1.010
CSGA-N(s)	N	1.515	1.130
CSGA-P(s)	P	1.625	1.130
CSGA-R(s)	R	1.750	1.250
CSGA-S(s)	S	1.875	1.380
CSGA-T(s)	T	2.062	1.560
CSGA-V(s)	V	2.187	1.690
CSGA-W(s)	W	2.312	1.810
CSGA-X(s)	X	2.500	2.000

<sup>a</sup>Each CSGA (s) kit contains the following:

- Specified grounding adapter
- Required quantity of MIL-T-22361 antiseize compound and applicator
- Cable jacket cleaning strip
- ShrinkAround sleeve
- Installation instructions

# Sigmaform Adapters

## Cable shield grounding adapters: Standard type for threaded pipes and stuffing tubes



### Applications

Sigmaform CSGA adapter provides 360-degree grounding to overall shielded cables at the entrance to MIL-S-24235 stuffing tubes. The adapter comes in 19 different sizes to accommodate stuffing tube sizes A through X.

### Features/Benefits

- Uses standard Sigmaform CES heat-shrinkable boot adapters as specified by NAVSEA 803-500102, Sheet 13.
- Supplied in kit form with a Sigmaform heat-shrinkable adhesive-lined tubing to complete the environmental seal over the adapter and stuffing tube.
- Meets MIL-STD 1310 grounding requirements.
- Provides EMI/EMP grounding.
- Offers an operating temperature range of -55°C to 85°C.

### Product Dimensions (in inches)

#### Standard male grounding adapter for original installation

Kit <sup>®</sup> Identification	Thread size	Maximum O.D. of cable	Minimum O.D. of shield
CSGA-A(sm)	7/8-12UN-2	0.250	0.125
CSGA-A	7/8-12UN-2	0.406	0.200
CSGA-B	1-12UN-2	0.515	0.260
CSGA-C	1 1/8-12UN-2	0.640	0.400
CSGA-D	1 1/4-12UN-2	0.750	0.400
CSGA-E	1 1/4-12UN-2	0.812	0.430
CSGA-F	1 5/16-12UN-2	0.843	0.470
CSGA-G	1 1/2-12UN-2	0.953	0.580
CSGA-J	1 5/8-12UN-2	1.062	0.690
CSGA-K	1 3/4-12UN-2	1.172	0.800
CSGA-L	1 13/16-12UN-2	1.265	0.890
CSGA-M	2-12UN-2	1.406	1.010
CSGA-N	2 1/16-12UN-2	1.515	1.130
CSGA-P	2 3/16-12UN-2	1.625	1.130
CSGA-R	2 5/16-12UN-2	1.750	1.250
CSGA-S	2 11/16-12UN-2	1.875	1.380
CSGA-T	2 7/8-12UN-2	2.062	1.560
CSGA-V	3-12UN-2	2.187	1.690

\*Each CSGA kit contains the following:

- Specified grounding adapter
- Required quantity of MIL-T-22361 anti-seize compound and applicator
- Cable jacket cleaning strip
- Sealing sleeve
- Installation instructions





**PREFCO PRODUCTS, INC.**  
 P.O. Box 425 Buckingham, PA 18912  
 (215) 794-7413 • 1-800-437-6653 • Fax: (215) 794-0808  
 Web Site: <http://www.prefco-inc.com>

**SUBMITTAL SHEET  
 COMBINATION  
 AIR-SMOKE-FIRE DAMPER**



CALIFORNIA STATE  
 FIRE MARSHALL  
 LISTING NO.S  
 3225-1518:100  
 3230-1518:106

**MODEL 5020 MULTI BLADE DAMPER**

A Basic 5000 Damper with a Thermal-Manual Operator

- AMCA Tested
- Wyle Laboratory & Frankin Institute Seismic & Fragility Rated
- Fire & Leakage Tested To 4 Hours Under International Standards BS/ISOVDIN

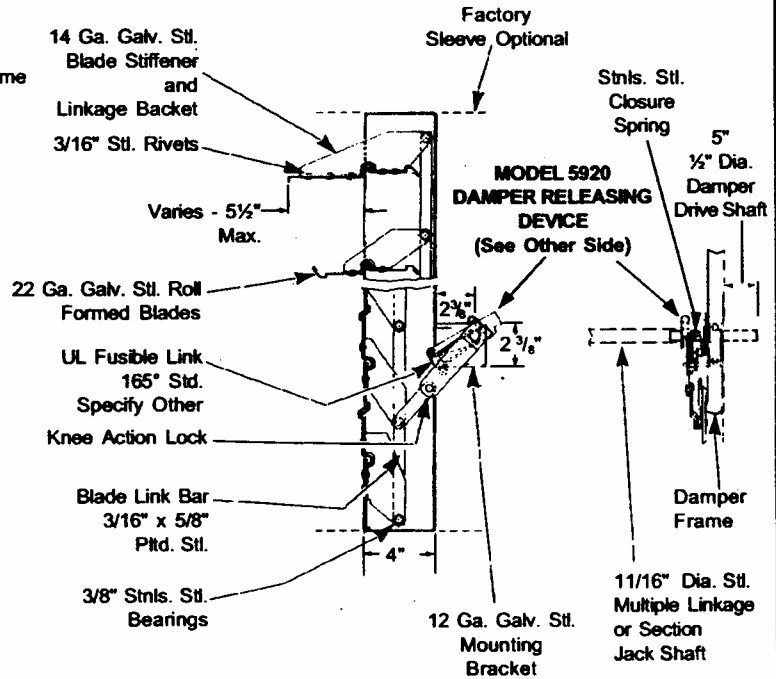
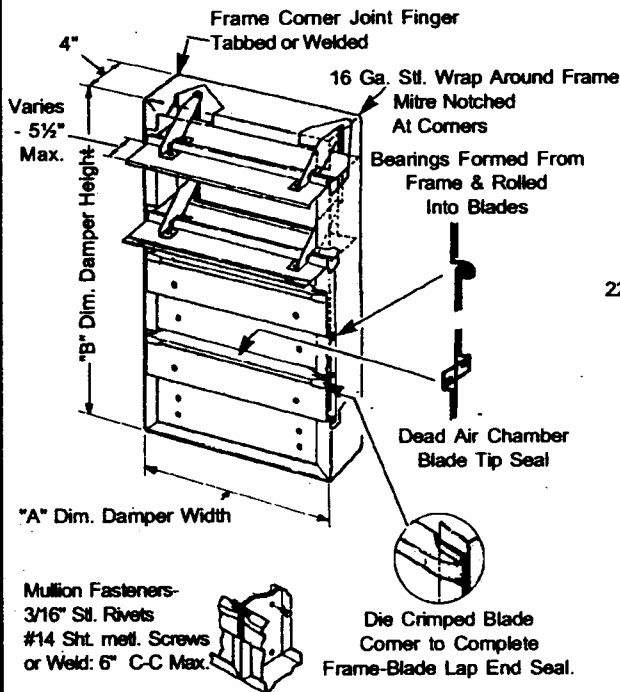


1-500 DAMPER  
 CLASSIFIED  
 UND. LAB. INC.<sup>®</sup>  
 AND  
 RECOGNIZABLE  
 CLASS - IT  
 PREFCO, INC.

R 11370 UL 555S  
 Flow and Leakage Rated at Elevated Temperatures  
 Class III Standard @ 250°F, 350°F, 450°F, 550°F or 850°F  
 Class I or II Optional @ 250°F, 350°F, 450°F or 550°F  
 R7664-UL 864 Reopenable Fire/Smoke Damper Operator  
 R 7113-UL 873 Releasing Devices  
 BS 476: Part 8; Part 20 & Part 22;  
 ISOVDIS 834-1 & 10294-1; prEN 1366-2  
 Internationally Tested 4 Hr. High Temperature Leakage

R 6189-UL 555 1½ or 3 Hr. Rated  
 1½ Hr. Vertical - 6" x 6" Min. to 72" x 84" and 120" x 30" Max.  
 1½ Hr. Horizontal - 6" x 6" Min. and 52" x 48" Max.  
 3 Hr. Vertical - 6" x 6" Min. to 30" x 30" Max.  
 Larger sizes Available - Non UL Rated  
 R7569-UL 33

UND. LAB. INC.<sup>®</sup>  
 CLASSIFIED  
**FIRE DAMPER**  
 FIRE RESISTANCE RATED  
 PREFCO PRODUCTS, INC.  
 BUCKINGHAM, PA 18912



**NOTES:**

1. 'A' & 'B' dimensions are reduced by ¼" from sizes ordered.
2. Required clearance between sleeve and wall or floor openings is 1/8" for each 12" of width and height (heat expansion allowance) ¼" minimum clearance.
3. Consider duct and sleeve thickness and all necessary clearances when ordering.
4. When sleeve is not factory supplied field caulking is required between damper and sleeve (also between joint on multiple sections) for compliance with UL 555S leakage requirements. See Installation Instructions.
5. Factory Sleeves Optional Per UL 555.
6. Model 5920 damper operator provides damper release to closed and locked position. (Single blade dampers under 10" in height utilize the Thermal Lock Clip instead of the Knee Action Linkage Lock.)
7. Consult UL, N.F.P.A., & pertinent local codes for application and installation, see UL installation instructions provided with shipment.

**OPTIONS:**

1. Blade position switches available.
2. Various Actuators Optional - See our current Motor Brochure.
3. Heavy Duty Option for high static pressure and/or high velocity see Sheet 5150SS for details.
4. Various damper/motor springs available for field adjustments.
5. Q.A. available at extra cost.

JOB \_\_\_\_\_  
 ENGINEER \_\_\_\_\_  
 CONTRACTOR \_\_\_\_\_  
 CUSTOMER ORDER NO. \_\_\_\_\_ DATE \_\_\_\_\_

REPRESENTED BY:



# Instant Adhesives (Cyanocrlates)

Choose from the industry's widest selection of application-specific, instant adhesives. **LOCTITE®** instant adhesives are available in a range of viscosities, cure speeds, gap-filling capabilities, and substrate compatibilities.

## TECHNICAL INFORMATION

Product Number	Super Bonder® Products						
	404	409	414	415	416	420	422
Typical Use	Rubber "O" Ring Bonder	General Purpose Gel Adhesive	Plastic Bonder	Gap Filling Metal Bonder	Gap Filling Plastic Bonder	Wicking Type Plastic Bonder	Gap Filling Plastic Bonder
Color	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Gap Fill	.005"	.010"	.006"	.008"	.008"	.002"	.008"
Resin Base	Ethyl	Ethyl	Ethyl	Methyl	Ethyl	Ethyl	Ethyl
Viscosity cP	80	Gel	110	1500	1500	2	2500
Strength psi <sup>Δ</sup> Tensile Shear	3,500	3,200	3,200	3,600	3,200	2,900	3,200
Temperature Range	-65°F to 180°F	-65°F to 180°F	-65°F to 180°F	-65°F to 180°F	-65°F to 180°F	-65°F to 180°F	-65°F to 180°F
Cure Speed* Fixture	30 sec.	75 sec.	20 sec.	30 sec.	30 sec.	20 sec.	30 sec.
Full	24 hrs.	24 hrs.	24 hrs.	24 hrs.	24 hrs.	24 hrs.	24 hrs.
Specific Gravity	1.09	1.10	1.05	1.09	1.05	1.05	1.09
Availability	N. America	N. America	N. America	N. America	N. America	N. America	N. America
Technical Data Sheet*	404	409	414	415	416	420	422

\* Varies with substrates.

Δ Grill blasted steel.

+ For Additional Technical Information, Request Technical Data Sheet Specified.

## ORDERING INFORMATION

Product Number	Super Bonder® Products						
	404	409	414	415	416	420	422
3 gm Tube		40904	41404				
1/3 oz Bottle	46551						
10 gm Syringe		21992					
20 gm Tube/Bottle		40945					
1 oz Bottle			41450	41550	41650	42050	42250
4 oz Bottle	46548						
200 gm Tube		40974					
300 gm Cartridge		18030					
1 lb. Bottle	46561		41461	41561	41661	42061	42261
2 Kg (4.4 lbs) Bottle			41480		41689	17122 <sup>(MTO)</sup>	42288 <sup>(MTO)</sup>
Gluematic® Pen							

MTO - Make-to-Order

## PRODUCT APPROVALS AND SPECIFICATION

Product Number	Super Bonder® Products						
	404	409	414	415	416	420	422
MIL-SPEC (A-46050C)	Type II, Class II		Type II, Class II	Type I, Class III	Type II, Class III	Type II, Class I	Type II, Class III

Shaded columns indicate worldwide availability.



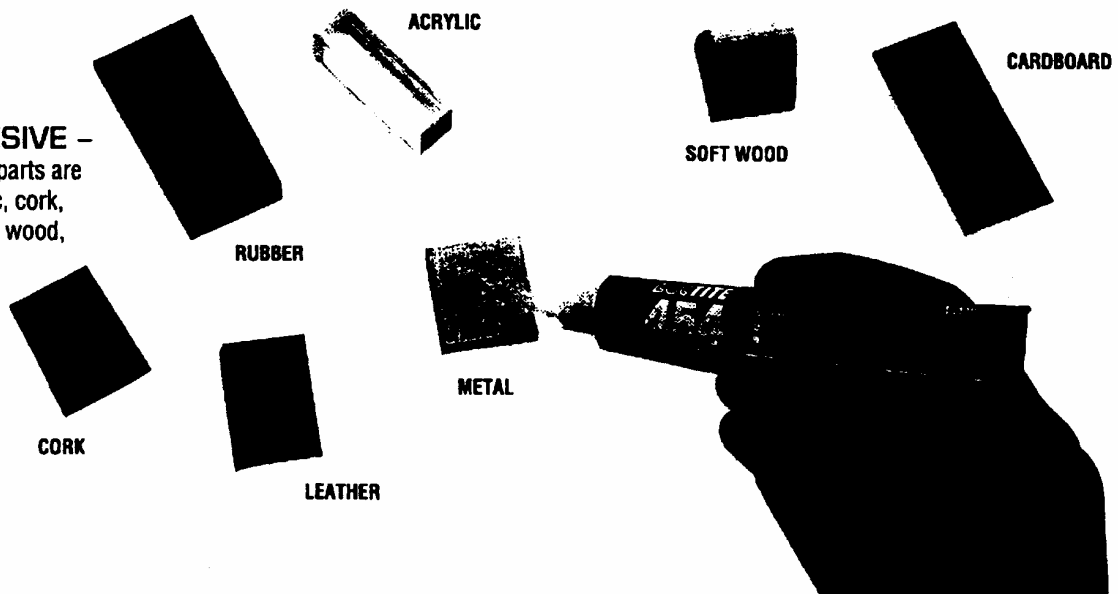
# ADHESIVES

Adhesive	Adhesive Appearance	Common Surfaces Adhesive Will Bond	Temperature Resistance	Bond Time*	Key Specifications
480 Instant Adhesive	Black liquid	Metal, plastic, rubber	-65° to 223°F (-54° to 106°C)	Set-up - 10-150 sec. Full strength - 24 hrs.	NSF std. -61 certification pending
454 Instant Adhesive	Clear gel	Metal, plastic, rubber, cork, cardboard, leather	-65° to 180°F (-54° to 82°C)	Set-up - 15-90 sec. Full strength - 24 hrs.	—
404 Instant Adhesive	Clear liquid	rubber, metal, plastic	-65° to 180°F (-54° to 82°C)	Set-up - 20-40 sec. Full strength - 1-2 hrs.	Can be certified to MIL-A-46050
Super Glue GelMATIC™	Clear gel	Metal, plastic, rubber, cork, cardboard, leather	-65° to 180°F (-54° to 82°C)	Set-up - 15-90 sec. Full strength - 24 hrs.	—
All-Purpose Spray Adhesive	Clear-drying Semi-translucent foam	Lightweight porous and non-porous materials	100° to 120°F (38° to 49°C)	Let dry 15-20 min. before assembly. Sets on contact.	—
Super Weatherstrip Adhesive	Thick yellow liquid	Weatherstripping, vinyl, rubber, wood, metal	—	Let dry 3-4 min. before assembly. Sets on contact.	—
Black Super Weatherstrip Adhesive	Thick black liquid	Weatherstripping, vinyl, rubber, wood, metal	—	Let dry 3-4 min. before assembly. Sets on contact.	—
Poxy Pouches®	Clear to slightly yellow liquid	Metal, rubber, ceramic, glass, wood, masonry	To 150°F (65°C)	Set-up - 5 min. Full strength - 24 hrs.	—
Metal Repair Stick	Gray putty	Metal, concrete, ceramic	To 250°F (121°C)	Set-up - 5 min. Full strength - 24 hrs.	—
Fiberglass Repair Stick	White putty	Fiberglass, PVC, ceramic	To 250°F (121°C)	Set-up - 5 min. Full strength - 24 hrs.	—
RapidMetal™ Epoxy Mixer Cups	Gray paste	Ferrous and non-ferrous metal, concrete, ceramic	To 300°F (149°C)	Set-up - 5 min. Full strength - 24 hrs.	—
DuraMetal™ Epoxy Paste	Gray paste	Ferrous and non-ferrous metal, concrete, ceramic	To 300°F (149°C)	Set-up - 30 min. Full strength - 24 hrs.	—
330 Depend® Adhesive	Amber liquid	Glass, wood, metal, concrete, ceramic, rubber	-60° to 250°F (-51 to 121°C)	Set-up - 1-2 min. Full strength - 24 hrs.	NSF std. -61 certification pending

\* Times are based on bonding steel to steel parts.

## LOCTITE 454 INSTANT ADHESIVE -

Whatever your broken parts are made of - metal, acrylic, cork, rubber, leather, or soft wood, 454 Instant Adhesive will bond them together in seconds.







# TF

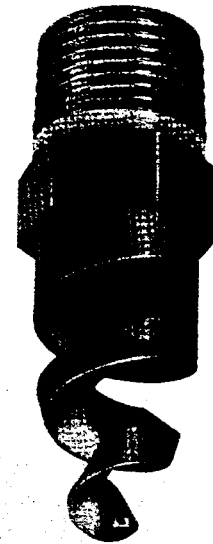
## Wide Range of Flows and Angles

### DESIGN FEATURES

- The original spiral nozzle
- High energy efficiency
- One piece/no internal parts
- Clog-resistant performance
- High discharge velocity
- Male connection standard; female connection available by special order

### SPRAY CHARACTERISTICS

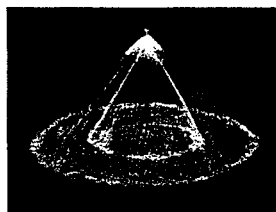
- Wide range of flow rates and spray angles
  - Fine atomization
- Spray patterns:** Full and Hollow Cone  
**Spray angles:** 50° to 180°  
**Flow rates:** 0.7 to 3320 gpm (Higher flow rates available)



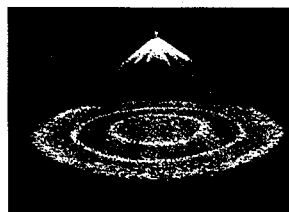
60°, 90°, 120° Metal



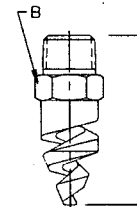
Full Cone 60° (NN)



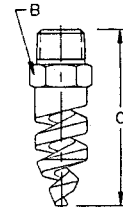
Full Cone 90° (FCN)



Full Cone 150°/170°



60°, 90°, 120°



150°, 170°

### TF Full Cone Flow Rates and Dimensions

Full Cone, 60° (NN), 90° (FCN or FFCN), 120° (FC or FFC), 150° and 170° Spray Angles, 1/8" to 4" Pipe Sizes

Male Pipe Size	Nozzle Number	Available Spray Angles	K Factor	GALLONS PER MINUTE @ PSI												Approx. (in.)		Dim. (in.) for Metal Only*		Wt. (oz.)		
				5 PSI	10 PSI	20 PSI	30 PSI	40 PSI	50 PSI	60 PSI	80 PSI	100 PSI	200 PSI	400 PSI	Orif. Dia.	Pass. Dia.	A	B	C	60° 90° Metal Plas.	120° Metal Plas.	
1/8	TF6	60° 90° 120°	0.221	0.70	0.99	1.21	1.40	1.57	1.71	1.98	2.21	2.13	4.43	0.09	0.09	1.69	0.56			1.00	0.20	
	TF8	60° 90° 120°	0.411	1.30	1.84	2.25	2.60	2.91	3.18	3.68	4.11	5.81	8.22	0.13	0.13							
1/4	TF6	60° 90° 120°	0.221	0.70	0.99	1.21	1.40	1.57	1.71	1.98	2.21	3.13	4.43	0.09	0.09	1.88	0.56			1.25	0.20	
	TF8	60° 90° 120°	0.411	1.30	1.84	2.25	2.60	2.91	3.18	3.68	4.11	5.81	8.22	0.13	0.13							
	TF10	60° 90° 120°	0.632	2.00	2.83	3.46	4.00	4.47	4.90	5.66	6.32	8.94	12.6	0.16	0.13							
	TF6	60°	0.221	0.70	0.99	1.21	1.40	1.57	1.71	1.98	2.21	3.13	4.43	0.09	0.09							
	TF8	60°	0.411	1.30	1.84	2.25	2.60	2.91	3.18	3.68	4.11	5.81	8.22	0.13	0.13							
	TF10	60°	0.632	2.00	2.83	3.46	4.00	4.47	4.90	5.66	6.32	8.94	12.6	0.16	0.13							
3/8	TF12	60° 90° 120° 150° 170°	0.949	3.00	4.24	5.20	6.00	6.71	7.35	8.49	9.49	13.4	19.0	0.19	0.13	1.88	0.69	2.38	1.63	0.25		
	TF14	60° 90° 120° 150° 170°	1.28	4.05	5.73	7.01	8.10	9.06	9.92	11.5	12.8	18.1	25.6	0.22	0.13							
	TF16	60° 90° 120° 150° 170°	1.68	5.30	7.50	9.18	10.6	11.9	13.0	15.0	16.8	23.7	33.5	0.25	0.13							
	TF20	60° 90° 120° 150° 170°	2.61	8.25	11.7	14.3	16.5	18.4	20.2	23.3	26.1	36.9	52.2	0.31	0.13							
1/2	TF24	60° 90° 120° 150° 170°	3.81	8.52	12.1	17.0	20.9	24.1	26.9	29.5	34.1	38.1	53.9	76.2	0.38	0.19	2.50	0.88	3.06	3.00	0.50	
	TF28	60° 90° 120° 150° 170°	5.22	11.7	16.5	23.3	28.6	33.0	36.9	40.4	46.7	52.2	73.8	104	0.44	0.19						
3/4	TF32	60° 90° 120° 150° 170°	6.64	14.8	21.0	29.7	36.4	42.0	47.0	51.4	59.4	66.4	93.9	133	0.50	0.19	2.75	1.13	3.50	5.50	0.88	
	TF40	60° 90° 120° 150° 170°	10.6	23.7	33.5	47.4	58.0	67.0	74.9	82.1	94.8	106	150	212	0.63	0.25						
1	TF48	60° 90° 120° 150° 170°	15.0	33.6	47.5	67.2	82.3	95.0	106	116	134	150	212	300	0.75	0.25	3.63	1.38	4.38	8.50	2.50	
	TF56	60° 90° 120° 150° 170°	20.4	45.6	64.5	91.2	112	129	144	158	182	204	289	408	0.88	0.31						
1 1/2	TF64	60° 90° 120° 150° 170°	26.7	59.7	84.5	120	146	169	189	207	239	267	378	534	1.00	0.31	4.38	2.00	5.38	22.0	4.25	
	TF72	60° 90° 120° 150° 170°	30.4	67.9	96.0	136	166	192	215	235	272	304	429	607	1.13	0.31						
2	TF88	90° 120° 150° 170°	44.3	99.0	140	198	242	280	313	343	396	443	626	885	1.38	0.44	5.63	2.50	6.88	46.0	8.00	
	TF96	90° 120° 150° 170°	55.9	125	177	250	306	354	395	433	500	559	791	1120	1.50	0.44						
3	TF112	90° 120°	81.0	181	256	362	443	512	572	627	724	810	1150	1620	1.75	0.56	8.63	3.50		114	20.0	
	TF128	90° 120°	107	239	339	480	588	679	759	831	960	1070	1510	2150	2.00	0.56						
4	TF160	90° 120°	166	371	525	742	909	1050	1170	1290	1480	1660	2350	3320	2.50	0.63	10.1	4.50			169	27.0

Flow Rate (GPM) =  $K \sqrt{PSI}$  \*Dimensions are for bar stock, cast sizes may vary. † Three turn nozzles

Standard Materials: Brass, 316 Stainless Steel, PVC, Polypropylene and PTFE (Poly. not available for TF6 & TF8). See chart on page 17 for complete list.

TO ORDER specify pipe size, connection type, nozzle number, spray angle, and material.



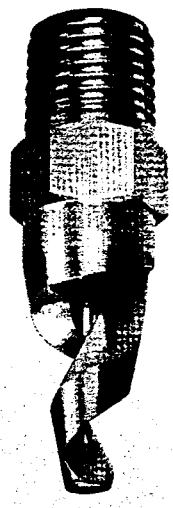




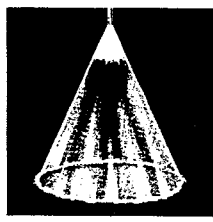
150°, 170° Metal



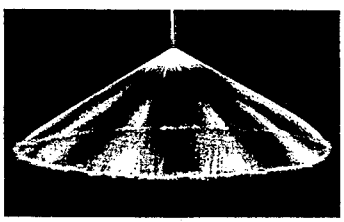
180° Metal



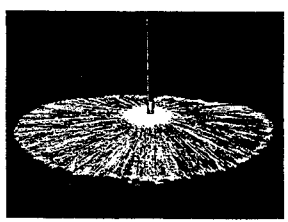
50° Metal



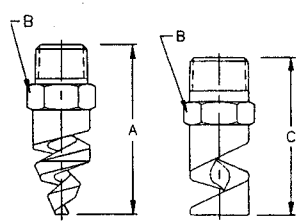
Hollow Cone 50° (N)



Hollow Cone 120° (W)



Hollow Cone 180° (XW)



50°, 120°

180°

**TF Hollow Cone Flow Rates and Dimensions**  
 Hollow Cone, 50° (N), 120° (W), and 180° (XW) Spray Angles, 1/4" to 1 1/2" Pipe Sizes

Male Pipe Size	Nozzle Number	Available Spray Angles			K Factor	GALLONS PER MINUTE @ PSI													Approx. (in.)		Wt. (oz.) 180° Metal Plas.
		50°	120°	180°		5	10	20	30	40	50	60	80	100	200	400	Free Orif. Dia.	Pass. Dia.	Dim. (in.) for Metal Only* A B C		
1/4	TF6	50°	120°		0.221	0.70	0.99	1.21	1.40	1.57	1.71	1.98	2.21	3.13	4.43	0.09	0.09	1.88 0.56			
	TF8	50°	120°	180°	0.411	1.30	1.84	2.25	2.60	2.91	3.18	3.68	4.11	5.81	8.22	0.13	0.13	1.88 0.56 1.88	1.25 0.25		
	TF10	50°	120°	180°	0.632	2.00	2.83	3.46	4.00	4.47	4.90	5.66	6.32	8.94	12.6	0.16	0.13	1.88 0.56 1.88			
3/8	TF12	50°	120°	180°	0.949	3.00	4.24	5.20	6.00	6.71	7.35	8.49	9.49	13.4	19.0	0.19	0.13				
	TF14	50°	120°	180°	1.28	4.05	5.73	7.01	8.10	9.06	9.92	11.5	12.8	18.1	25.6	0.22	0.13	1.88 0.69 1.88	1.75 0.25		
	TF16	50°	120°	180°	1.68	5.30	7.50	9.18	10.6	11.9	13.0	15.0	16.8	23.7	33.5	0.25	0.13				
1/2	TF20	50°	120°	180°	2.61	8.25	11.7	14.3	16.5	18.4	20.2	23.3	26.1	36.9	52.2	0.31	0.13				
	TF24	50°	120°	180°	3.81	8.52	12.1	17.0	20.9	24.1	26.9	34.1	38.1	53.9	76.2	0.38	0.19	2.50 0.88 <sup>2</sup> 2.38	3.00 0.50		
	TF28	50°	120°	180°	5.22	11.7	16.5	23.3	28.6	33.0	36.9	40.4	46.7	52.2	73.8	104	0.44	0.19			
3/4	TF32	50°	120°	180°	6.64	14.8	21.0	29.7	36.4	42.0	47.0	51.4	59.4	66.4	93.9	133	0.50	0.19	2.75 1.13 3.00	3.00 1.00	
1	TF40	180°			10.6	23.7	33.5	47.4	58.0	67.0	74.9	82.1	94.8	106	150	212	0.63	0.25	1.38 <sup>2</sup> 3.63	15.0 3.00	
	TF48	180°			15.0	33.6	47.5	67.2	82.3	95.0	106	116	134	150	212	300	0.75	0.25			
1 1/2	TF56	180°			20.4	45.6	64.5	91.2	112	129	144	158	182	204	288	408	0.88	0.31			
	TF64	180°			26.7	59.7	84.5	120	146	169	189	207	239	267	378	534	1.00	0.31	2.00 4.38	30.0 6.00	
	TF72	180°			30.4	67.9	96.0	136	166	192	215	235	272	304	429	607	1.13	0.31			

Flow Rate (GPM) =  $K \sqrt{PSI}$  \*Dimensions are for bar stock. cast sizes may vary. <sup>1</sup> 1.00 for 180° <sup>2</sup> 1.63 for 180°

Standard Materials: Brass, 316 Stainless Steel, PVC, Polypropylene and PTFE (Poly. not available for TF6 & TF8). See chart on page 17 for complete list.

Call for the name of your nearest BETE representative. CALL 413-772-2166







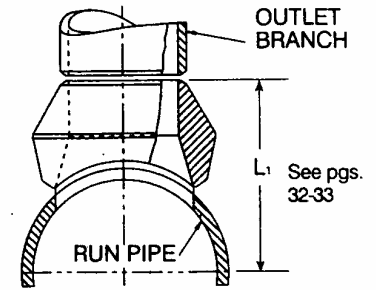
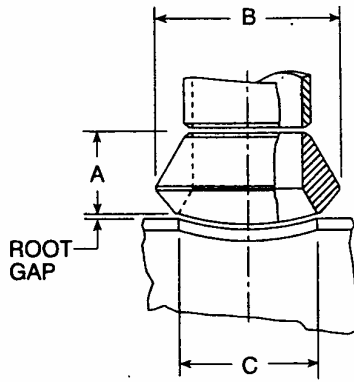
**WELDOLET®**

BONNEY FORGE

**REDUCING AND FLAT SIZE**

**STANDARD WEIGHT, RUN AND BRANCH**

**FORGED**

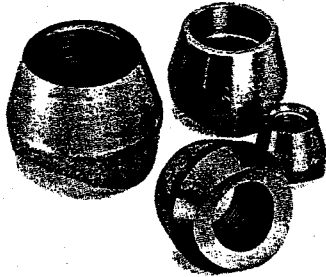
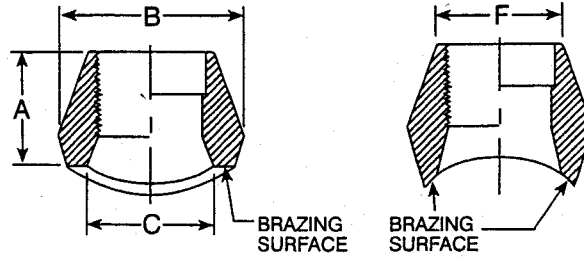


Outlet Size Inches	Dimensions			Appx. Weight Pounds
	A	B	C	
1/8	5/8	1	5/8	.10
1/4	5/8	1	5/8	.10
3/8	3/4	1-1/4	3/4	.15
1/2	3/4	1-3/8	15/16	.20
3/4	7/8	1-3/4	1-3/16	.25
1	1-1/16	2-1/8	1-7/16	.50
1-1/4	1-1/4	2-9/16	1-3/4	.80
1-1/2	1-5/16	2-7/8	2	1.00
2	1-1/2	3-1/2	2-9/16	1.75
2-1/2	1-5/8	4-1/16	3	2.50
3	1-3/4	4-13/16	3-11/16	4.00
3-1/2	1-7/8	5-5/8	4	5.50
4	2	6	4-3/4	6.30
5	2-1/4	7-1/16	5-9/16	10.25
6	2-3/8	8-1/2	6-11/16	12.00
8	2-3/4	10-3/8	8-11/16	23.00
10	3-1/16	12-11/16	10-13/16	36.00
12	3-3/8	14-7/8	12-13/16	59.00
14	3-1/2	16-1/8	14-1/16	66.00
16	3-11/16	18-1/4	16-1/16	75.00
18	3-13/16	20-1/2	18-1/16	97.00
20	4	22-1/2	20	118.00
24	4-9/16	27-1/8	24-3/16	220.00
26	4-11/16	29-1/16	26-1/4	265.00
30	5-3/8	34-1/16	30-7/16	430.00
36	5-3/8	34-1/16	36-1/2	900.00

See footnotes at bottom of page 9.

Larger outlet sizes available on application.





**FOR PIPE AND TUBING**

The Brazolet® is a bronze brazing outlet fitting for silver brazing to copper or brass pipe or tubing. It is available for use on Type TP tubing, nominal pipe sizes and types K, L & M tubing. The branch outlets are machined with either threaded ends or for silver brazing the corresponding type of pipe or tubing. The use of the Brazolet enables installation of full straight lengths of pipe or tubing and cutting in branches afterwards.

Available in Reducing Sizes Only - For Run Sizes Through 14"

Also available: grooved for rings per MIL-F-1183

**BRAZOLET FOR IPS PIPE  
ASME SB-98 UNS C65500 ALLOY A**

Outlet Sizes	A	B	C	Brazing Surface	F-MIN. MIL-F-1183
1/4	11/16	1	9/16	.188	.700
3/8	13/16	1-1/4	3/4	.190	.855
1/2	1	1-7/16	7/8	.220	1.020
3/4	1-1/16	1-3/4	1-1/8	.240	1.250
1	1-1/4	2-1/8	1-7/16	.270	1.535
1-1/4	1-5/16	2-9/16	1-3/4	.300	1.900
1-1/2	1-3/8	2-7/8	2	.330	2.160
2	1-1/2	3-1/2	2-9/16	.360	2.675
2-1/2	1-13/16	4-1/8	3	.384	3.215
3	2	4-13/16	3-11/16	.442	3.880
4	2-1/4	6	4-3/4	.476	4.940
5	2-5/8	7-1/16	5-9/16	.656	6.163

**BRAZOLET FOR TUBING  
TYPE K, L AND M TUBING. ASME SB-98 UNS C65500 ALLOY A**

Outlet Sizes	A	B	C	Brazing Surface	F-MIN. MIL-F-1183
1/4	11/16	1	9/16	.188	.700
3/8	13/16	1-1/4	3/4	.190	.855
1/2	13/16	1-1/4	3/4	.190	.855
3/4	1	1-7/16	7/8	.220	1.020
1	1-1/16	1-3/4	1-1/8	.240	1.250
1-1/4	1-1/4	2-1/8	1-7/16	.270	1.535
1-1/2	1-5/16	2-9/16	1-3/4	.300	1.900
2	1-3/8	2-7/8	2	.330	2.160
2-1/2	1-1/2	3-1/2	2-9/16	.360	2.675
3	1-13/16	4-1/8	3	.384	3.215
4	2-1/8	5-1/2	4-5/16	.437	4.400



# Apollo® 76-100 Series

## Stainless Steel Ball Valve

Threaded, 1/4"-1" 2000 PSIG WOG, 1-1/4"-2" 1500 PSIG WOG, 2-1/2"-3" 1000 PSIG WOG  
 Cold Non-Shock, 150 PSIG Saturated Steam, Vacuum Service to 29 inches Hg.  
 Federal Specification: WW-V-35C, Type: II, Composition: SS, Style: 3.

### FEATURES

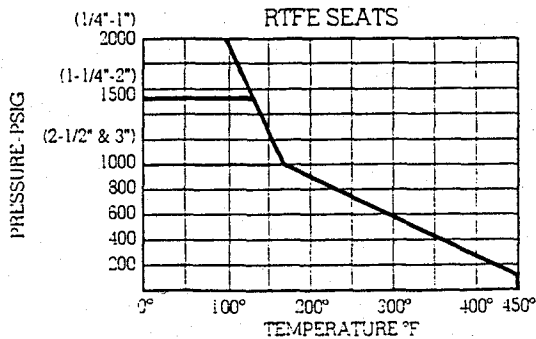
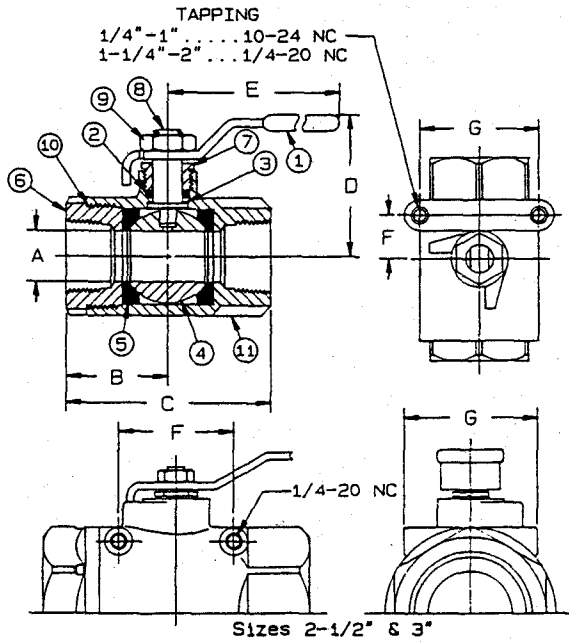
- Investment cast components
- Reinforced TFE seats and stuffing box ring
- Mounting pad for easy Actuator Mounting
- Blow-out-proof stem design
- Adjustable packing gland
- Meets NACE MR-01-75
- Stainless steel lever and nut
- (-24) 1/4" to 2" Certified to API 607, 4th Edition, Class 600 burn

### STANDARD MATERIAL LIST

1. Lever and grip	304 Stainless steel w/vinyl	7. Gland nut	A276-316
2. Stem packing	Reinforced TFE	8. Stem	A276-316
3. Stem bearing	Reinforced TFE	9. Lever nut	18-8 Stainless steel
4. Ball	A276-316	10. Body seal	TFE
5. Seat (2)	Reinforced TFE	(1-1/4"-3")	
6. Retainer	A276-316 (1/4"-1")	11. Body	A351-CF8M
	A351-CF8M (1-1/4"-3")		

### OPTIONS AVAILABLE ARE:

(SUFFIX NUMBER)	OPTION	SIZES
-02-	Static Grounded	1/4" to 3"
-03-	1-1/4" Stem Extension	1/4" to 3"
-04-	2-1/4" Stem Extension	1/4" to 3"
-07-	Tee Handle	1/4" to 2"
-08-	90° Reversed Stem	1/4" to 3"
-14-	Vented Ball	1/4" to 2"
-15-	Round Handle	1/4" to 2"
-16-	Vertical Chain Lever	3/4" to 2"
-19-	Lock Plate	1/4" to 2"
-21-	UHMWPE	1/4" to 3"
-24-	Graphite Stem Packing	1/4" to 3"
-27-	Latch Lock Lever	1/4" to 3"
-30-	CamLock Handle	1/4" to 2"
-32-	S.S. Tee Handle & Nut	1/4" to 2"
-35-	Virgin TFE Trim	1/4" to 3"
-36-	S.S. Hi-Rise Round Handle & Nut	1/4" to 2"
-39-	S.S. Latch Lock Wheel Handle	1/4" to 2"
-40-	Cyl-Loc	1/4" to 2"
-44-	Seal Welded	1/4" to 2"
-45-	Less Lever & Nut	1/4" to 3"
-47-	S.S. Latch Lock Oval Handle	1/4" to 1"
-49-	Assembled Dry	1/4" to 3"
-56-	Multifill Seats	1/4" to 3"
-57-	Cleaned For Gaseous Oxygen	1/4" to 3"
-58-	Horizontal Chain Lever	3/4" to 2"
-60-	Static Grounded Bail & Stem	1/4" to 3"
-64-	250 Lb. Steam Trim	1/4" to 3"



### STAINLESS STEEL BALL VALVE

NUMBER	SIZE	A	B	C	D	E	F	G
76-101-01	1/4"	.37	1.03	2.06	1.75	3.87	.50	1.12
76-102-01	3/8"	.37	1.03	2.06	1.75	3.87	.50	1.12
76-103-01	1/2"	.50	1.12	2.25	1.81	3.87	.50	1.12
76-104-01	3/4"	.68	1.50	3.00	2.12	4.87	.87	1.37
76-105-01	1"	.87	1.68	3.37	2.25	4.87	.87	1.37
76-106-01	1-1/4"	1.00	2.00	4.00	2.62	5.50	.93	1.50
76-107-01	1-1/2"	1.25	2.18	4.37	3.05	8.00	.93	1.50
76-108-01	2"	1.50	2.75	5.50	3.24	8.00	.93	1.50
76-109-01	2-1/2"	2.50	3.37	6.75	4.12	8.00	2.75	3.37
76-100-01	3"	2.50	3.37	6.75	4.12	8.00	2.75	3.37





# Apollo® 85-200 Series

## Stainless Steel 3-Piece Socket Weld Ball Valve

Standard Port Socket Weld, 1000 PSIG WOG, Cold Non-Shock. 150 PSIG Saturated Steam.

Vacuum Service to 29 inches Hg.

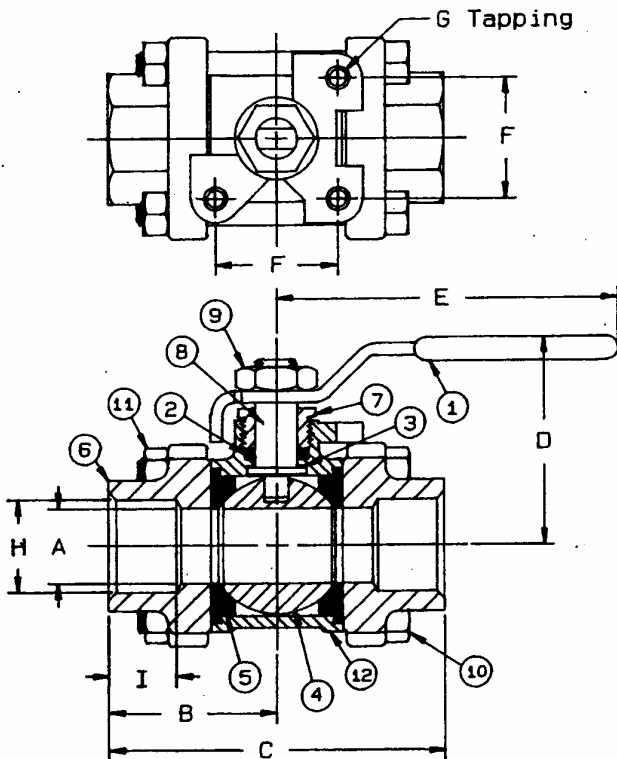
Federal Specification: WW-V-35C, Type: II, Composition: SS, Style: 1.

### FEATURES

- Meets N.A.C.E. MR-01-75
- Blow-out-proof stem design
- In-line repairable
- Adjustable packing gland
- Investment cast components
- Actuator mounting pad (1"-2")
- Reinforced TFE seats and seals

### STANDARD MATERIAL LIST

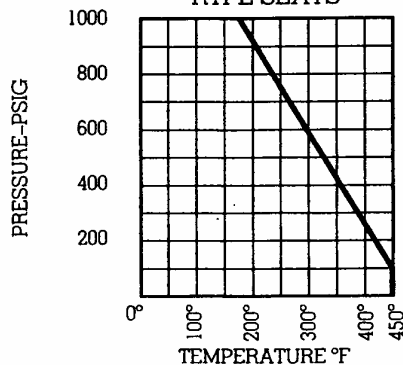
1. Lever and grip	304 Stainless steel w/vinyl	7. Gland nut	A276-316
2. Stem packing	Reinforced TFE	8. Stem	A276-316
3. Stem bearing	Reinforced TFE	9. Lever nut	18-8 Stainless steel
4. Ball	A276-316	10. Body bolt (4)	18-8 Stainless steel
5. Seat (2)	Reinforced TFE	11. Hex nut (4)	18-8 Stainless steel
6. End cap (2)	A351-CF3M	12. Body	A351-CF8M



### OPTIONS AVAILABLE ARE:

(SUFFIX NUMBER)	OPTION	SIZES
-02 -	Static Grounded	1/2" to 2"
-03 -	1-1/4" Stem Extension	1/2" to 2"
-04 -	2-1/4" Stem Extension	1/2" to 2"
-07 -	Tee Handle	1/2" to 2"
-08 -	90° Reversed Stem	1/2" to 2"
-10 -	S.S. Lever & Nut	1/2" to 2"
-14 -	Vented Ball	1/2" to 2"
-15 -	Round Handle	1/2" to 2"
-16 -	Vertical Chain Lever	3/4" to 2"
-18 -	Plain Yellow Grip	1/2" to 2"
-24 -	Graphite Stem Packing	1/2" to 2"
-27 -	Latch Lock Lever	1/2" to 2"
-30 -	CamLock Handle	1/2" to 3/4"
-32 -	S.S. Tee Handle & Nut	1/2" to 2"
-35 -	Virgin TFE Trim	1/2" to 2"
-45 -	Less Lever & Nut	1/2" to 2"
-49 -	Assembled Dry	1/2" to 2"
-57 -	Cleaned For Gaseous Oxygen	1/2" to 2"
-58 -	Horizontal Chain Lever	3/4" to 2"
-60 -	Static Grounded Ball & Stem	1/2" to 2"

RTFE SEATS

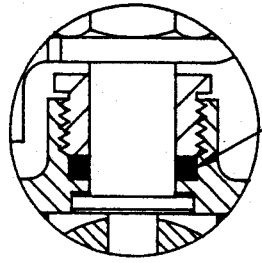


STAINLESS STEEL 3-PIECE SOCKET WELD BALL VALVE

NUMBER	SIZE	A	B	C	D	E	F	G	H	I
85-203-01	1/2"	.50	1.28	2.56	1.81	3.87	N/A	N/A	.855	.43
85-204-01	3/4"	.62	1.38	2.75	1.93	4.87	N/A	N/A	1.065	.56
85-205-01A	1"	.81	1.70	3.40	2.18	4.87	1.25	1/4-20	1.330	.68
85-206-01A	1-1/4"	1.00	1.95	3.91	2.60	5.50	1.62	5/16-18	1.675	.81
85-207-01A	1-1/2"	1.25	2.22	4.45	2.82	5.50	1.62	5/16-18	1.915	.87
85-208-01A	2"	1.50	2.51	5.02	3.37	8.00	1.62	5/16-18	2.406	1.06

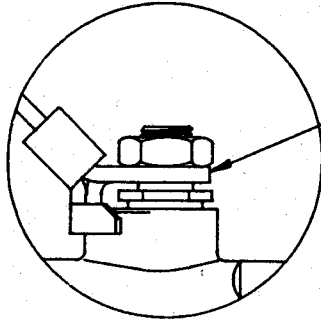


# Options



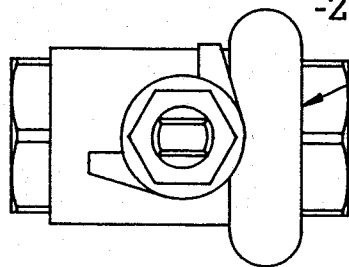
-24

Graphite Stem Packing - Necessary for Firesafe Design



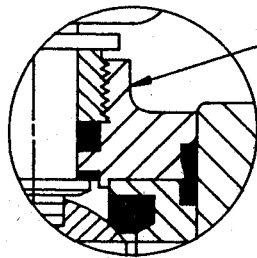
-27

S.S. Latch-Lock Handle and S.S. nut



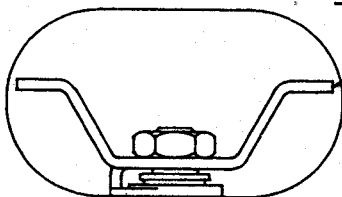
-28

Mounting Pads Not Threaded



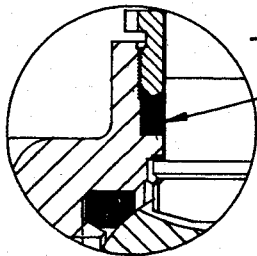
-29

1500 P.S.I. 3-Piece Firesafe Design  
Graphite packing and gaskets



-32

S.S. Tee Handle And Nut

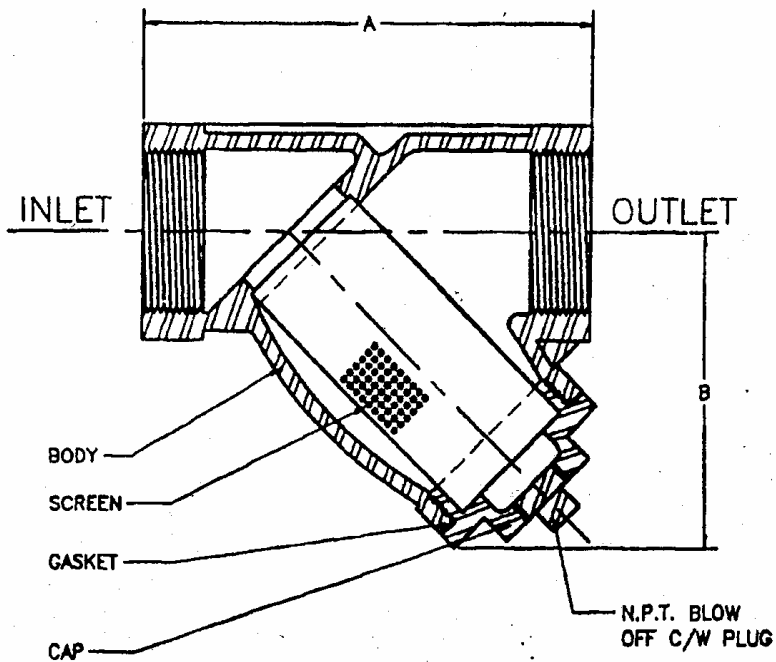


-35

Virgin TFE Trim  
Reduces operating torque approx. 30%



# SS. MODEL 300YTSS / 300YSWSS STAINLESS STEEL Y-STRAINER



## DIMENSIONAL DATA

SIZE	A	B	BLOW-OFF N.P.T.	WEIGHT LBS.
1/2	2 5/16	1 9/16	3/8	0.5
3/4	3 1/8	2 1/8	3/8	0.82
1	3 5/16	2 5/8	1/2	1.55
1 1/4	4 1/8	3	1/2	1.9
1 1/2	4 11/16	3 3/16	1/2	2.7
2	5 7/16	3 13/16	1/2	4.2

## FEATURES

SSI STAINLESS STEEL "Y" STRAINERS ARE FURNISHED WITH A MACHINED SEAT WHICH ALLOWS THE SCREEN TO BE SELF ALIGNING AND ASSURES A PERFECT FIT. ALL SIZES COME COMPLETE WITH A BLOW-OFF CONNECTION AND AN EASILY REMOVABLE STAINLESS STEEL SCREEN.

## CONSTRUCTION

BODY, COVER AND PLUG ARE CONSTRUCTED OF ASTM A351 GRADE CF8M STAINLESS STEEL. ALL SCREENS ARE CONSTRUCTED FROM 316 SS STAINLESS STEEL.

## OPERATING PRESSURES AND TEMPERATURES

STEAM: 497 PSIG AT 450°F  
 WATER, OIL, GAS: 720 PSIG AT 100°F

## STANDARD SCREENS

SIZE	OPENING	STD. MESH/PERF.
1/2" - 2"	0.032"	1/32" PERF.

NOTES - OTHER PERFORATIONS AND SCREEN MATERIALS AVAILABLE. DIMENSIONS SHOWN ARE SUBJECT TO CHANGE. CONTACT THE FACTORY FOR CERTIFIED PRINTS (EXACT DIMENSIONS) WHEN REQUIRED.

FOR HIGHER TEMPERATURE SERVICE, OTHER GASKET MATERIALS AVAILABLE ON REQUEST.

<small>This drawing is the property of SSI Equipment Inc. and is subject to patent application. It shall not be copied or distributed in any manner and shall not be exhibited to outside parties for reproduction without the consent of SSI Equipment Inc. It shall be used for reference to such other vessels or processes submitted by our customers only.</small>		REF.	REVISION	DATE
		DATE	APPROVED BY	DESIGNED BY
		MANUFACTURER	FINISHER	MODEL
		DESCRIPTION	SIZE	AS SHOWN
300YTSS CAST STEEL SCREWED Y-STRAINER		DRAWING NO. D-1682		



# Kidde - Fenwal, Inc.

## Worldwide Listing of Manufacturer's Certified Technicians/Distributors

### UNITED STATES

#### ALABAMA

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Firemaster 2512 Commerce Square West Birmingham, AL 35210	205-951-2088	205-951-2285
Hiller Investments P.O. Box 2567 2 South Water Street Mobile, AL 36652	334-432-5570	334-432-5650
Hiller Systems, Inc. 3710 Lakeside Court Mobile, AL 36693	334-661-1275	334-666-3062

#### ALASKA

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Yukon Fire Protection Services 330 East International Airport Rd. Anchorage, AK 99518	907-563-3608	907-561-2352

#### ARIZONA

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Tri-State Fire Extinguisher Co. Inc. P.O. Box 1191 Ft. Smith, AZ 72902	501-782-6678	501-782-4833
Firemaster 3440 E. Roesser Road Phoenix, AZ 85040	602-244-9741	602-276-8595
Aidant Fire Protection Co. 15836 N 77th St. Scottsdale, AZ 85260	602-607-4600	602-607-4601
United Fire Safety Equipment Co. 335 North 4th Ave. Tucson, AZ 85705	520-622-3639	520-882-3991

**ARKANSAS**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Fire Protection of Arkansas, Inc. Highway 49 South P. O. Box 472 Jonesboro, AR 72401	501 -932-2643	501-933-9220
Mozark Fire Extinguisher 705 E. Robinson Springdale, AR 72764	501-751-8282	501-751-8283
Metropolitan Fire 319 Hickory Texarkana, AR 71854	501-772-0863	

**CALIFORNIA**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
General Fire & Safety P.O. Box 81104 Bakersfield, CA 93380	805-392-0935	805-327-9268
Avstar Fire Safety 801 Southampton Rd #147 Benicia, CA 94510	707-745-1271	707-746-7823
Firemaster 5220 Edison Avenue #400 Chino, CA 91710-5719	909-464-8288	909-464-8286
R. G. E. 8214 N. Armstrong Clovis, CA 93611	209-297-7175	209-298-8055
Solon Fire Control 13405 Folsom Blvd Folsom, CA 95630	916-985-2655	916-985-4374
Firemaster Fresno 3299 S. Cedar Avenue Fresno, CA 93725	209-233-2168	209-233-0229
Orange County Fire Protection 11541 Salinaz Drive Garden Grove, CA 92643	714-534-5061	714-534-9217
C-O-Two Fire Equipment Company of CA 117 S Vermont Ave. Glendora, CA 91741	818-914-1997	818-914-4631
Master Fire Protection DBA/Firemaster 2684 Lacy Street Los Angeles, CA 90031	213-225-6666	213-225-2639
J & M Fire Extinguisher Co. 623 Maple Montbello, CA 90640	213-726-0982	213-722-7517



**CALIFORNIA (CONTD)**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Delta Fire Protection & Equipment 13136 Saticoy, Suite F North Hollywood, CA 91605	818-764-7990	818-764-7852
Global Fire & Safety 2601 Adeline, Suite 150 Oakland, CA 94607	510-834-2323	510-834-2326
Fire Services, Inc. 315 W. Brenna Lane Orange, CA 92667	800-941-9696	714-633-1029
L & J Fire Equipment Co. 15342 Pimento Paramount, CA 90723	562-602-1064	562-602-1465
Trans Bay Fire Protection, Inc. 3942 Valley Ave. Suite G Pleasanton, CA 94566	510-846-9484	510-846-9710
Safety Systems Technology 23141 Arroyo Vi sta Ranch Santa Margarita, CA 92688-2613	714-573-1769	714-731 -0274
Wilgus Fire Control Inc. 1703 Sonoma St Redding, CA 96001.	916-241-2465	916-241-2473
Dehl-Beck Electric Co. 2775 Goodrich Drive Richmond, CA 94801	510-237-2325	510-237-0608
Carlson's Fire, Inc. P.O. Box 4548 Salinas, CA 93912-4548	408-424-6152	408-424-1079
Firemaster San Diego Fire Equipment Co. 7198 Convoy Court San Diego, CA 92111	619-569-3888	619-569-3877
KSI of San Diego, Inc. 9025 Rohr Place San Diego, CA 92123	619-541-2575	619-541-1717
Durbiano Fire Equipment 232 E. Gutierrez Santa Barbara, CA 93101	805-965-6894	805-966-4234
Life Safety Engineering 562 Weddel Drive, Suite 6 Sunnyvale, CA 94089	408-747-0457	408-747-0612

**CALIFORNIA (CONTD)**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Firemaster 466 Forbes Blvd. S. San Francisco, CA 94080	415-872-3888	415-952-0528
Firemaster, Ventura 1502 Eastman Ave, Suite B Ventura, CA 93003	805-650-6333	805-650-6366
Integrated Fire & Safety 2186 Eastman Avenue, Suite 105 Ventura, CA 93003	805-650-5906	805-650-1365
Firemaster, Inc. 1525 South Mooney Blvd., Suite E Visalia, CA 93277	209-635-3300	209-635-1965

**COLORADO**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Aaron Fire & Safety 3333 Mariposa Street Denver, CO 80211	303-455-3340	303-455-8743
American Fire Systems, Inc. 5454 N. Washington, Suite 5 Denver, CO 80216	303-292-5580	303-292-5686

**CONNECTICUT**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Stuart L White Company 543 Boston Post Road Milford, CT 06460	203-878-6311	203-877-3945

**FLORIDA**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Suncoast Fire & Safety, Inc. 498 Palm Springs Dr., Suite 100 Altamonte Springs, FL 32701	407-261-8455	407-261-8979
Broward Fire Equipment Inc. 101 S.W. 6th Street Fort Lauderdale, FL 33301	954-467-6625	954-463-9750
Suncoast Fire & Safety, Inc. 4651 SW 51st St., Suite 804 Ft. Lauderdale, FL 33314	954-581-2204	954-581-2320
Jacksonville Fire Equipment 3215 N. Pearl Street Jacksonville, FL 32206	904-355-1838	904-355-5210

**FLORIDA (CONTD)**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
American Fire 135 Mingo Trail #246 Longwood, FL 32750	407-331-5566	407-331-5506
Centralarm Caracas C.A. M 196 P. O. Box 020010 Miami, FL 33102-0010	582-261-1222	582-265-8963
Miami Fire Equipment 150 S.W. 27th Ave. Miami, FL 33135	305-642-6626	305-643-6312
Triangle Fire Inc. 7720 N. W. 53rd St. Miami, FL 33166	305-592-3011	305-592-5254
Hiller Systems 3245 W. Fairfield Dr. Pensacola, FL 32505	904-438-4078	904-433-1271
AAA Fire Protection Systems 1360 NW 65th Avenue Plantation, FL 33313	954-587-2434	954-587-3992
Gulfcoast Fire & Safety 6329 US Highway 301 South Riverview, FL 33569	813-671-3733	813-671-3827
Suncoast Fire & Safety, Inc. 4366 Independence Court Sarasota, FL 34234	941-955-2202	941 -954-4213
Firemaster 12495-D 34th St North St. Petersburg, FL 33716	813-573-3377	813-573-9798
Interstate Fire Systems, Inc. 219 E. Pershing Street Tallahassee, FL 32301	904-224-3731	904-224-0172

**GEORGIA**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Automated Fire Suppression Systems P.O. Box 48317 Doraville, GA 30362	770-242-7360	770-448-2377
Georgia Fire Protection/Vitco 779 Fifth Sreet Macon, GA 31201	912-746-0111	912-745-5916
Savannah/Charleston Fire 10 Enterprise Dr. Savannah, GA 31401	912-234-9842	912-234-9844

**GEORGIA (COND)**

**Company**

**Telephone**

**Facsimile**

Fire Systems, Inc.  
4700 Highlands Pkwy  
Smyrna, GA 30082

770-333-7979

770-333-9954

**HAWAII**

**Company**

**Telephone**

**Facsimile**

Fire Master, Honolulu  
949 Kawaiaheo Street  
Honolulu, HI 96814

808-591-9256

808-596-2860

**IDAHO**

**Company**

**Telephone**

**Facsimile**

General Fire, Inc.  
4021 Overland Road  
Boise, ID 83705

208-344-8711

208-342-1882

**ILLINOIS**

**Company**

**Telephone**

**Facsimile**

Illinois Fire Extinguisher Co., Inc.  
702 South Highway 53  
Addison, IL 60101

630-629-2413

630-629-3006

Reliable Fire Equipment  
12845 South Cicero  
Alsip, IL 60685

708-597-4600

708-389-1150

Fredriksen & Sons Fire Equipment  
760 Thomas Drive  
Bensenville, IL 60106

630-595-9500

630-595-3548

Fox Valley Fire & Safety Co.  
1730 Berkley Ave.  
Elgin, IL 60123

847-695-5990

847-695-3699

Fire-Safety Sales & Service  
420 N. Wood River Ave.,  
P.O. Box 45  
Wood River, IL 62095

618-254-2323

618-254-0713

**INDIANA**

**Company**

**Telephone**

**Facsimile**

Fire Systems, Inc.  
1901 Production Road  
Fort Wayne, IN 46808-3647

219-484-2531

219-484-2533

Jacob Dietz Co.  
2708 E. Michigan Street  
Indianapolis, IN 46201

317-631-2304

317-631-3117

**INDINIA (CONTD)**

**Company**

**Telephone**

**Facsimile**

United Export Corporation  
P O. Box 147  
South Bend, IN 46624

219-232-8286

219-232-8295

**IOWA**

**Company**

**Telephone**

**Facsimile**

Iowa Fire Equipment Co.  
2800 Delaware Ave  
Des Moines, IA 50317-3543

515-265-8030

515-265-7649

Sigler Fire Equipment  
P.O. Box 1794  
Sioux City, IA 51102  
Sioux City, IA 51105

712-255-5929

712-255-2358

**KANSAS**

**Company**

**Telephone**

**Facsimile**

Keller Fire & Safety  
1138 Kansas Ave.  
Kansas City, KS 66119

913-371-8494

913-321-0962

**KENTUCKY**

**Company**

**Telephone**

**Facsimile**

Booth Fire Control Co.  
P.O. Box 3540  
626 College Street  
Bowling Green, KY 42101

502-781-3330

502-781-9554

FESCO  
868 South 21st Street  
Louisville, KY 40210

502-776-1551

502-774-8776

**LOUISIANA**

**Company**

**Telephone**

**Facsimile**

Louisiana Fire Extinguisher  
8339 Athens Avenue  
Baton Rouge, LA 70814-2302

504-924-2420

504-924-2421

Total Safety  
5749 Highway 90 East  
Broussard, LA 70518

318-234-1419

Herbert S Hiller Corporation  
401 Commerce Point  
Harahan, LA 70123

504-736-0008

S & S Fire & Safety Co.  
3223 Cameron  
Lafayette, LA 70506

318-233-3830

318-233-3869

**LOUISIANA (CONTD)**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Fire-Quip Corp P.O. Box 6017 Monroe, LA 71211	318-343-6970	318-345-4790
Fire-Quip Corp P.O. Box 6017 Monroe, LA 71211	318-343-6970	318-345-4790
System Sales 2601 Chartres Street New Orleans, LA 70117	504-949-4994	504-949-9464
AAA Safety, Inc 6249 Dillingham Shreveport, LA 71106	318-868-8833	318-868-5903
Mid-South Fire Protection 215 Kansas City Avenue Shreveport, LA 71137	318-226-9821	318-226-8703

**MAINE**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
University Rubber Co. DBA Eastern Fire & Safety 511 Riverside Industrial Pky Portland, ME 04103	207-797-5067	207-797-7370

**MARYLAND**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
BFPE International 7512 Connelley Drive Hanover, MD 21076	410-768-2200	410-768-3105

**MASSACHUSETTS**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Fire & Safety Engineering Inc. 99 Paugus Road Holden, MA 01520	508-853-1805	508-853-3805
Boston Fire Systems 172 Commercial Street Lynn, MA 01905	617-592-3473	617-581-6230
Pittsfield Fire & Safety 107 Mill Street Pittsfield, MA 01201	413-442-8833	413-442-5275
Cornerstone International Corp. 28 South Main Street #194 Randolph, MA 02368	508-238-8190	508-238-8551

**MASSACHUSETTS (CONTD)**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
New England Fire Patrol 117 Lancaster Street Quincy, MA 02169	617-479-0215	617-472-3731
Keane Fire & Safety 1500 Main Street Waltham, MA 02154	617-899-6565	617-899-2848
Bay State Fire Protection P. O. Box 294 161-R Merrimac Street Woburn, MA 01801	617-935-5536	617-935-1248
O'Connell Fire Protection Inc. 261 Brooks Street Worcester, MA 01606	508-852-7227	508-853-7046

**MICHIGAN**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Fire Fighter Sales & Service 3015 Madison Ave. Grand Rapids, MI 49548	616-452-2184	616-452-8886
Approved Fire Protection 2513 N. Burdick Kalamazoo, MI 49007	616-342-2748	616-381-2363
Fire Suppression Sales & Service 12930 Capital St. Oak Park, MI 48237	248-543-6240	248-543-3314

**MINNESOTA**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Detector Electronics 6901 West 110th St. Minneapolis, MN 55438	612-829-8717	612-829-8750
J.N. Johnson Sales & Service 4200 West 76th St. Minneapolis, MN 55435-5108	612-835-4700	612-835-4153
Nardini Fire Equipment 405 W. County Road E St. Paul, MN 55126	612-483-6631	612-483-6945

**MISSISSIPPI**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Fisher Fire 236 Oakdale Jackson, MS 39201	601 -354-5551	601-352-9133

**MISSISSIPPI (CONTD)**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
International Fire & Safety 405 West Drive Laurel, MS 39440	601-649-0888	601-649-0897

**MISSOURI**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Fire-Safety Sales & Service (Branch) 1801 Vandiver Columbia, MO 65201	573-474-1544	573-474-4569
Firemaster 1113 East 13 <sup>th</sup> Street Kansas City, MO 64106	816-474-3473	816-474-1347
George Hay Co. 600 N Washington Box 907 Springfield, MO 65801	417-865-1313	417-865-6516
All-Type Quality Midwest P O. Box 32432 St. Louis, MO 63132	314-426-7100	314-426-7782
Fire-Safety Sales & Service (Branch) 1146 Lindbergh Business Court St. Louis, MO 63123	314-421-0264	314-845-2021

**MONTANA**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Fire Suppression Systems, Inc. 2171 Industrial Drive Bozeman, MT 59715	406-586-9510	406-586-8701
Fire Suppression Leasing Inc. P.O. Bob 5445 Helena, MT 59604	406-442-4980	406-442-8990

**NEBRASKA**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
General Fire & Safety 3920 N. 27th Lincoln, NE 68521	402-467-4497	402-467-4280
Firemaster (AKA Anderson Fire) 5720 S 86th Circle Omaha, NE 68127	402-331-2700	402-331-3591
General Fire & Safety (Branch) 4623 Dodge Omaha, NE 68132	402-556-6100	402-556-8055



**NEBRASKA (CONTD)**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Protection Specialties 4315 So. 79th Circle Omaha, NE 68127	402-592-1999	402-592-1599

**NEVADA**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Nevada Fire Control P.O Box 247 Winnemucca, NV 89446	702 625-1166	702-625-3473

**NEW HAMPSHIRE**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Concrete Systems, Inc. Commercial Ave. Hudson, NH 03051	603-889-4163	603-889-6379
Granite State Fire 8030 South Willow Street Building 3 Manchester, NH 03103	603-623-3473	603-623-4467
New England Fire Equipment Co. 9 Congress Street Nashua, NH 03062	603-886-1100	603-598-2567

**NEW JERSEY**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Firemaster (Branch) 133 Yellowbrook Road Farmingdale, NJ 07727	908-938-3473	908-919-0503
General Fire Sales & Service 1450 Crescent Blvd. Gloucester, NJ 08030	609-456-7790	609-456-4655
Atlas Fire Equipment 1035 Jersey Ave. Gloucester City, NJ 08030	609-456-3299	609-456-8722
HF Fire International 206 Main Street Hackettstown, NJ 07840	908-813-8531	908-813-3269
Firemaster 760 Fairfield Avenue Kenilworth, NJ 07033	908-241-2950	908-241-9109
Atlas Fire Equipment (Branch) 329 South Fifth Street Milville, NJ 08322	609-327-5955	609-327-5959

**NEW JERSEY (CONTD)**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Approved Fire Protection 911 U. S. Route 22 North Plainfield, NJ 07060	908-755-2222	908-755-5450
Associated Fire 100 Jackson Street Paterson, NJ 07501	201-684-4500	201-684-4511
C-O-Two, Inc. Sea Safety Supply 10 Wood Avenue Secaucus, NJ 07094	201-330-3225	201-330-0448
Absolute Fire Protection 2800 Hamilton Blvd. Plainfield, NJ 07080	908-757-3616	
FKC International Corp. 48 Marlin Drive Suite A Whippany, NJ 07981-1279	201-428-0727	201-428-0604

**NEW YORK**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Sanders Industrial Equipment 1095 Central Ave. Albany, NY 12205	518-438-8811	518-438-8077
Lund Fire Products 40-33 215th Place Bayside, NY 11361	718-423-1900	718-428-1128
J & J Fire Safety Corp. 2207 Newbridge Road Bellmore, NY 11710	516-781-2266	516-781-1211
Master Fire Prevention 1776 East Tremont Avenue Bronx, NY 10460	718-828-6424	718-863-2509
Firemasters, Inc. 656 62nd St. Brooklyn, NY 11220	718-439-3765	718-439-3782
Lane Fire Equipment Sub. Integrated Products & Service 1243 Miliary Road Buffalo, NY 14217	716-871-9986	716-871-0902
Sanford & Burtis Fire Equipment Road 2, Box 122 Route 57N Fulton, NY 13069	315-593-1424	315-593-2676

**NEW YORK (CONTD)**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
JGB Enterprises 115 Metropolitan Drive Liverpool, NY 13088	315-451-2770	315-451-8503
Fire Foe 36-23 Review Avenue Long Island City, NY 11101	718-937-9700	718-937-9868
Gebhardt, Inc. 140 E. Second Street Mineola, NY 11501	516-742-1130	516-742-1811
Monroe Extinguisher Co. 105 Dodge St. Rochester, NY 14606	716-235-3310	716-235-7312
Allstate Fire & Safety 610 Jerusalem Avenue Uniondale, NY 11553	516-747-2232	516-292-0228

**NORTH CAROLINIA**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Automated Fire Systems Division of Carolina Fire P. O. Box 18008 Charlotte, NC 28218	704-375-7731	
Atlantic Fire Systems 815 Persons Street Fayetteville, NC 28301	910-483-5357	910-483-5083
T & S Fire & Security 3025 Randleman Greensboro, NC 27406	919-851-5101	919-851-1805
Hatteras Yacht P.O. Box 2690 High Point, NC 27261	910-889-6621	910-889-3352
BFPE International 2733 N. Wesleyan Blvd. Rocky Mount, NC 27804	919-977-6293	919-977-0959
Kellers, Inc. 6750 Gordon Rd. Wilmington, NC 28405	910-392-7011	910-392-5272

**NORTH DAKOTA**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Nardini Fire Equipment Co. 3313 Fiechtner Fargo, ND 58109	701-235-4224	701-235-5089

**OHIO**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Auto-Tech Fire Systems, Inc. 577 Miami St. Akron, OH 44311	330-762-3343	330-762-3651
Praxair Distribution, Inc. 925 South Main Street Akron, OH 44311	330-535-4343	330-535-2894
3S Incorporated 607 Redna Terrace #200 Cincinnati, OH 45215-1108	513-772-1301	513-772-1316
Fyr-Fyter Sales & Service 2520 Reading Road Cincinnati, OH 45206	513-751 -8384	513-751 -0095
Silco Fire Protection 24 Landy Lane Cincinnati, OH 45215	513-733-5655	513-483-3787
ABCO Fire Protection, Inc. 4545 West 160th Street Cleveland, OH 44135	216-433-7200	216-433-7209
GPS Fire 7310 Associated Ave. Cleveland, OH 44144-1198	216-651-8300	216-651-3435
Guardian Technology, Inc. 2500 Brookpark Rd. Cleveland, OH 44134-1407	216-741-6000	216-741-6008
AAA Fire & Security 2742 Keenan Avenue Dayton, OH 45414	937-278-9603	937-278-8945
Megacity Fire Protection, Inc. 3318 Successful Way Dayton, OH 45414	937-236-3020	937-236-3125

**OKLAHOMA**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Firemaster, Inc. 333 N. Portland Road Oklahoma City, OK 73107	405-943-1111	405-943-1889
Pendergraph, Inc. 6916 East 12th Street Tulsa, OK74112	918-835-8403	918-835-7125
Sunbelt Fire Protection, Inc. 720 S. Kenosha Tulsa, OK 74120	918-582-8200	918-582-4925

**OREGON**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Valley Fire Control 217 Main S.E. Albany, OR 97321	541-928-9523	541-967-8034
Valley Fire Control (Branch) 234 N.E. First Street Newport, OR 97365	541-265-9019	
Huser Sales & Service 1313 N.W. 17th Avenue Portland, OR 97209	503-227-6688	503-227-5941

**PENNSYLVANIA**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
A. Dancheck, Inc. 101-103 Main Street Kingston, PA 18704	717-288-4571	717-288-2467
George B. Clair Associates P.O. Box 10455 Lancaster, PA 17605	717-394-4771	717-394-3207
Keystone Fire Protection 108 Park Drive Suite 3 Montgomeryville, PA 18936	215-641-0100	215-641-9638
Extinguishing Systems, Inc. P.O. Box 7948 3023 W. Liberty Avenue Pittsburgh, PA 15216-0948	412-531-2300	412-531-2735
Fire Fighter Sales & Service 1721 Main Street Pittsburgh, PA 15215	412-782-2800	412-782-2811
Gormley Fire Equipment Co. 846 Nicalls Street P.O. Box 13056 Reading, PA 19604	610-374-4004	610-376-8912
Bell-Fast Fire Protection 700 Chester Pike Ridley Park, PA 19078	610-583-8677	610-583-9789

**RHODE ISLAND**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Able RI-Conn Fire Systems 63 Beverage Hills Avenue Pawtucket, RI 02860	401-727-1220	401-725-9746
Northeast Fire & Safety 855 Social Street Woonsocket, RI 02895	401-765-2300	401-765-1360

**SOUTH CAROLINIA**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Charleston Fire & Safety 3329 Business Circle Charleston, SC 29418	803-767-3080	803-767-5596
Anchor Fire & Safety 217 Old Piedmont Highway Greenville, SC 29605	864-269-0403	864-269-7686
Carolina Fire Equipment Co. P O. Box 5644 Greenville, SC 29606	864-234-8828	864-234-8829
Superior Fire & Safety Equipment Co. 106G Bon Air Street Mauldin, SC 29662	864-676-1301	864-676-1301

**SOUTH DAKOTA**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Sigler Fire Equipment Co. 710 N. Western Ave. Sioux Falls, SD 57104	605-332-7181	605-332-6981

**TENNESSEE**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Guardian Fire Protection Systems P. O. Box 4776 Chattanooga, TN 37405-0776	423-267-9774	423-757-7521
State Systems, Inc. 2335 Highway 51 South Dyersburg, TN 38024	901-285-0112	901-286-2855
Key Fire Protection Inc. 252 Highway 42 East Jackson, TN 38305	901-424-0130	901-424-9285
Floied Fire Extinguisher Co. 3050 Lamar Avenue Memphis, TN 38114	901-743-3345	901 -743-7849
State Systems, Inc. P.O. Box 18439 Memphis, TN 38181 Memphis, TN 38118	800-727-5512	901-542-0622
Fire Control Equipment 405 45th Avenue North P. O. Box 90967 Nashville, TN 37209	615-383-2492	615-383-2492

**TENNESSEE (CONTD)**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Creech Fire 101 Willson St. Hwy 11 Niota, TN 37826	423-745-7731	423-568-3064

**TEXAS**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
American Quality Fire 611 East House Street Alvin, TX 77511	281-331-6866	281-331-5475
Central Texas Fire & Safety 6700 Guadalupe Alvin, TX 78752	512-451-0011	
Fire Hawk 3219 Commerce Amarillo, TX 79106	806-351-0011	806-351-0021
AAA Fire & Safety 6700 C-Guadalupe Austin, TX 78752	512-451 -4116	512-451-4101
Safe Environment, Inc. 1823 W Anderson Lane Austin, TX 78757	512-374-9923	512-374-9451
Bacon Equipment Co. 2709 North Beckley Ave. Dallas, TX 75208	214-742-5871	214 741 5932
Great Southwestern Fire & Safety 310 West Commerce Dallas, TX 75208	214-653-1100	214-653-1724
Koetter Fire Protection Service 9759 Brockbank Drve Dallas, TX 95220	214-358-3593	214-350-9930
Dooley-Tackaberry 5006 Railroad Avenue Deer Park, TX 77536	281-884-0123	281-479-3479
Franklin Fire & Safety 1611 Beech Suite B El Paso, TX 79925	915-778-4434	915-772-8346
American Automatic Sprinkler, Inc. 600 De Costa Street Box 7705 Fort Worth, TX 76111	817-831-0366	817-834-2420

**TEXAS (CONTD)**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Alexander/Ryan Marine & Safety Co. P. O. Box 9363 Houston, TX 77261	713-923-1671	713-923- 1972
A-1 Fire Equipment Co., Inc. P O Box 9953 Houston, TX 77213	713-455-0296	713-455-4323
Eppsc Fire Protection 1430 Upland Road Houston, TX 77043	713-932-6691	713-461-4714
A-1 Fire & Security Waco, TX 76708 2813 North 19th Street	817-753-0336	817-752-1366
Fire Protection Service, Inc. P. O. Box 9266 Houston, TX 77261	713-924-9600	713-923-6272
Firemaster 8555 West Monroe Road Houston, TX 77061	713-943-0920	713-473-3008
Firemaster-Fibrebond 8555 West Monroe Road Houston, TX 77061	713-943-0920	713-473-3008
Hiller International 10620 Stebbins Circle #F Houston, TX 77043-3244	713-467-0004	713-465-4704
Technical Products & Controls 2908 Rodgerdale Houston, TX 77042	713-977-7333	713-977-8115
Total Safety 4811 Cripple Creek Houston, TX 77017	713-941 -0306	713-941 -0807
Vantec International 11250 West Rd Building I Houston, TX 77065	281-890-6349	281-890-6714
Webb, Murray & Associates (Branch) 1730 Nasa Road One #202 Houston, TX 77058	281-335-1668	281-335-1682
Firemaster 3301 East Carpenter Freeway Irving, TX 75062	972-445-3473	972-554-1085
Webb, Murray & Associates 608 North 14th St. La Porte, TX 77571	281-471-8104	281-471-1854



**TEXAS (CONTD)**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Firetron 10129 Greenridge Stafford, TX 77497	281499-1500	281-499-3711
American Fire & Safety 3310 East Adams Street Temple, TX 76501	817-778-2041	817-778-2097
A-1 Fire & Security 2813 North 19 <sup>th</sup> Street Waco, TX 76708	817-753-0336	817-752-1366

**UTAH**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Associated Fire Protection 933 West 1820 South Salt Lake City, UT 84104	801-973-4306	
Firemaster 1761 South 900 West Branch of Master Protection Salt Lake City, UT 84104	801-973-2122	801-973-2208
Firetrol Protection Systems, Inc. 142 West 2260 South Salt Lake City, UT 84115-2625	801-485-6900	801-485-6902
MountainWest Systems 2612 South 2700 West Salt Lake City, UT 84119	801-973-9617	801-973-0803

**VERMONT**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
Advanced Fire & Safety Branch of New England Fire 128 Bridge St. Springfield, VT 05256	802-885-5599	802-885-5505

**VIRGINIA**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
BFPE International 832 Professional Place West Chesapeake, VA 23320	757-436-1301	757-436-3176
Hiller Systems, Inc. 833 Principal Lane Chesapeake, VA 23320	757-549-9123	757-549-1083

**VIRGINIA (CONTD)**

<b><u>Company</u></b>	<b><u>Telephone</u></b>	<b><u>Facsimile</u></b>
USA Services Inc./Paxton P.O. Box 12103 1111 Ingleside Road Norfolk, VA 23502	757-855-2233	757-853-7709
BFPE International 22636 Glenn Dr. Sterling, VA 20164	703-834-5399	703-834-5396

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Firemaster, Inc. 505 Puyallup Avenue Tacoma, WA 98421	206-383-3804	206-383-3807
Cascade Fire & Safety P O. Box 244 Vancouver, WA 98666	360-695-9212	360-695-3286
Fire Control, Inc. 1113 North 6th Avenue Yakima, WA 98902	509-453-3434	509-453-1355

**WISCONSON**

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Acme Fire & Safety Co., Ltd. 3427 Kingsway Vancouver, BC, Canada V5R 5L3	604-437-8555	604-437-1301
Don Brenton's Fire Protection S & S 1 Lakeside Drive Unit #12 Lakeside, Halifax, Canada BOJ 1Z1	902-876-7870	902-876-1976
Fire Protection of Canada 360 Longman Crescent N. Regini, Saskatchewan, Canada S4N 6J4	306-721-6490	306-789-3450
Integrated Protection, Inc. 1197 Fewster Drive Mississauga, Ontario, Canada L4W 1A2	905-624-4020	905-624-9783
Levitt Safety, Ltd. 2872 Bristol Circle Oakville, Ontario, Canada L6H 5T5	905-829-3299	905-829-2919
Martin's Fire Safety P.O. Box 13908 45 Pippy Place St. John's, NFL, Canada A1B 4G7	709-753-8872	709-753-9821
Pacific Coast Fire Equipment, Ltd. 2712 Rock Bay Avenue Victoria, BC, Canada V8T 4R9	250-386-8321	250-386-3488
Safety First Fire Prevention 2805 Boulevard Losch St. Hubert, Quebec, Canada J3Y 3V6	514-866-8683	514-445-4250
SIS Cronin 245 Walker Drive Brampton, Ontario, Canada LOT 4H2	905-793-8500	905-793-8593
Steel City Fire Protection P.O Box 307 LC Depot #1 Hamilton, Ontario, Canada L8L 7V7	905-545-6969	905-545-8688
Superior Safety 782 MacDonell St. Thunder Bay, Ontario, Canada P7B 4A6	807-344-3473	807-344-1716
Westech Fire Systems Co. 2235 30th Ave. NE Bay #2 Calgary, Alberta, Canada T2E 7C7	403-291-2729	403-291-2813

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331-493-94130

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331-466-60808

331-466-62324

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Maquinaria IGSA S.A. de C.V. Prol. Paseo De La Reforma 2977 Del. Cuajimalpa 05000 Mexico D.F., Mexico	525-626-5419	525-626-5441
National Fire S.A. de C.V. Guerrero 73 Col. Del Carmen Coyoacan Mexico D. F. 04100, Mexico	525-658-9555	525-554-2880
Besco Sistemas de Seguridad Ave. Diagonal de Patriotismo No. 4 Col. Hipodromo Condesa Mexico DF 06170, Mexico	525-515-4822	525-272-8636
Distribuidor Int'l de Seguridad S.A. Degollado 453 Sur Co. Ma. Luisa Monterrey N.L. 64000, Mexico	528-340-4781	528-344-8056

**LEBANON**

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**SECTION IX**

**Appendix E As Built/Installation Drawings**



The as-built drawings contained in this section are LSV vessel class drawings.

Some FM-200 components are both vessel/hull number unique and system location specific. These components are not interchangeable.

Reference specific set of vessel/hull number as-built drawings to determine correct FM-200 component part number and system installation location.



NOTES:

1. THIS DRAWING HAS BEEN DEVELOPED AS A DETAILED DESIGN/INSTALLATION DRAWING FOR THE INSTALLATION OF FM-200 FIRE SUPPRESSION SYSTEM ON THE U.S. ARMY LOGISTICS SUPPORT VESSEL (LSV).

2. ALL WORK SHALL BE PERFORMED UTILIZING GOOD COMMERCIAL PRACTICES AND SHALL SATISFY THE STANDARDS, REGULATIONS, REQUIREMENTS, AND RECOMMENDED PRACTICES OF THE CODE OF FEDERAL REGULATIONS (CFR), THE STATEMENT OF WORK ASSOCIATED WITH THIS CONTRACT, AND THE FOLLOWING DRAWINGS AND INSTALLATION SPECIFICATION:

- LSV-5553-1 FM-200 SYSTEM PIPING INSTALLATION AND DETAILS
- LSV-5553-2 FM-200 SYSTEM MISCELLANEOUS MODIFICATIONS
- LSV-5553-3 FM-200 SYSTEM ELECTRICAL MODIFICATIONS
- LSV-5553-4 FM-200 SYSTEM LABEL PLATES AND PLACARDS
- LSV-5231-1 WWS PIPING INSTALLATION AND DETAILS
- LSV-5231-2 WWS LABEL PLATES AND PLACARD
- LSV-97-5553-SPEC FM-200/WWS INSTALLATION SPECIFICATION

3. ANY DEVIATIONS IN ROUTING OF SYSTEM PIPING OR NUMBER OF FITTINGS SHALL BE APPROVED BY THE DESIGN ENGINEER, REGISTERED ENGINEER (FP), AND THE GOVERNMENT CONTRACTING ACTIVITY PRIOR TO INSTALLATION.

4. PIPING MUST BE REAMED FREE OF BURRS AND RIDGES AFTER CUTTING, WELDING, OR THREADING. ALL THREADED JOINTS SHALL CONFORM TO AMERICAN NATIONAL STANDARD TAPER PIPE THREADS IN ACCORDANCE WITH ASME B1.20.1. JOINT COMPOUND OR THREAD TAPE SHALL BE APPLIED ONLY TO MALE PIPE THREADS, EXCLUDING THE FIRST TWO THREADS.

5. REQUIRED PIPE LENGTHS ARE DISCLOSED AS "xx/xx/xx", REPRESENTING FITTING TO FITTING CENTER LINE DISTANCE IN FT/IN/FOURTHS.

6. "Z" DIMENSION REPRESENTS DISTANCE FROM DECK ABOVE TO PIPE CENTERLINE.

7. PIPE HANGERS:  
 ALL PIPING SHALL BE SUPPORTED BY PIPE HANGERS TO PREVENT VIBRATION AND PROTECT AGAINST DAMAGE. PIPE HANGERS SHALL BE DESIGNED TO SUPPORT FIVE TIMES THE WEIGHT OF THE PIPE WHEN FILLED WITH WATER PLUS 250 LB. AT EACH POINT OF PIPING SUPPORT. PIPE HANGERS SHALL BE IN ACCORDANCE WITH ASTM F 708 (SEE VIEW 15-A):  
 - STANDOFF: ANGLE, 42" L  
 - LINER: SYNTHETIC RUBBER - NUTS: NYLOCK OR EQUIVALENT  
 - FINISH: PRIMER

SPACING OF PIPE HANGERS SHALL BE IN ACCORDANCE WITH TABLE 2, ASTM F 708 TITLED; PIPE HANGER SPACING. SPACING OF PIPE HANGERS AS DISCLOSED IN THE FIELD OF THE DRAWING BY SYMBOL " " ARE FOR GUIDANCE ONLY.

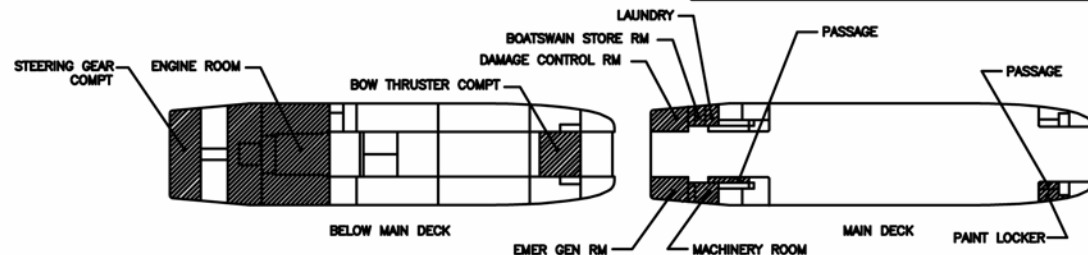
8. EXISTING INSULATION DISTURBED OR DAMAGED BY THIS INSTALLATION SHALL BE REPLACED OR REPAIRED TO A LIKE NEW CONDITION.

9. ALL WATERTIGHT BOUNDARY PENETRATIONS ABANDONED BY THE REMOVAL OF HALON FIRE EXTINGUISHING SYSTEMS AND VESSEL MODIFICATIONS SHALL BE WELDED CLOSED. OTHER ABANDONED BULKHEAD, DECK, AND FRAMING PENETRATIONS SHALL BE WELDED CLOSED AND ALL BRACKETS REMOVED. ALL WELDED FITTINGS SHALL BE GROUND FLUSH, PRIMED, AND PAINTED IN ACCORDANCE WITH TB 43-0144, "PAINTING OF WATERCRAFT".

10. PRIOR TO PERFORMING FUNCTIONAL TESTING, SYSTEM PIPING INSTALLATION, INCLUDING ALL WELDING, SHALL BE COMPLETE. PRIOR TO INSTALLATION OF DISCHARGE NOZZLES AND CONNECTION TO CYLINDERS, SYSTEM PIPING SHALL BE CLEANED, BLOWN OUT, AND SUBJECTED TO A PNEUMATIC LEAK TEST IN ACCORDANCE WITH 46 CFR 56.97-35 (EXCLUDING (F)) AND NYC 6-72, CHANGE 1, SECTION D.3. THE GAS USED AS A TEST MEDIUM SHALL NOT BE FLAMMABLE (NITROGEN OR OTHER INERT GAS). IF CO2 IS USED AS THE TEST MEDIUM, IT SHALL BE VAPORIZED AND AT AMBIENT CONDITIONS PRIOR TO AND DURING TESTING. TEST PRESSURE SHALL BE 1.5 TIMES THE MAXIMUM SYSTEM WORKING PRESSURE AND SHALL BE HELD FOR A MINIMUM OF 10 MINUTES. AT THE END OF 10 MINUTES, THE PRESSURE DROP SHALL NOT EXCEED FIVE (5) PERCENT OF THE TEST PRESSURE. FOR SYSTEMS WHERE THE FIVE (5) PERCENT PRESSURE DROP IS EXCEEDED, THE PIPING SHALL BE CHECKED USING SOAPY WATER TO LOCATE LEAKS. EXTREME CAUTION SHALL BE USED WHILE THE SYSTEM PIPING IS CHARGED.  
 IN LIEU OF PNEUMATIC TESTING, SMALL INDEPENDENT SYSTEM PIPING INSTALLATIONS PROTECTING SPACES SUCH AS EMERGENCY GENERATOR ROOMS AND PAINT LOCKERS MAY BE TESTED IN ACCORDANCE WITH 46 CFR 95.15-15(j) (4). (BLOWING OUT THE SYSTEM PIPING WITH AIR AT A PRESSURE OF AT LEAST 100 PSI AND CHECK EACH JOINT FOR LEAKS WITH SOAPY WATER).

DISTRIBUTION STATEMENT A.  
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 DISTRIBUTION IS UNLIMITED.

(NOTES CONTINUED ON SHEET 3)



SHEETS													STATUS OF REVISION								
18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	ZONE	REV	DESCRIPTION	DATE	APPROVED

PARTS LIST CONTINUED ON SHEET 2

1 EA	1 EA		1 EA	53	IDA54	897636		3 EA	DISCHARGE DELAY, 60 SECOND	COML (KIDDE)	STEEL	13.00
6 EA				52	IDA54	283900		6 EA	DISCHARGE HOSE, FM-200, 2 1/2"	COML (KIDDE)	RUBBER	14.00
3 EA		1 EA	2 EA	51	IDA54	486536		6 EA	PRESSURE SWITCH	COML (KIDDE)	STEEL	3.00
6 EA				50	IDA54	878743		6 EA	MANIFOLD, EL-CHECK, 2 1/2 NPS	COML (KIDDE)	STEEL	11.00
11 EA	2 EA			49				13 EA	NIPPLE, THD, CLOSE, 2 1/2 NPS, GALV	ASTM A 733	STEEL	1.21
2 EA				48				2 EA	CAP, THD, CL 300, 3 NPS, GALV	ASME B16.3	MI	4.90
2 EA				47				2 EA	COUPLING, RDCR, THD, CL 300, CONC, 2 TO 1 NPS, GALV	ASME B16.3	MI	2.30
4 EA	7 EA			46				11 EA	ELBOW, 90°, THD, CL 300, 1 NPS, GALV	ASME B16.3	MI	1.10
			2 EA	45				2 EA	NUT, HEX, 3/8-16 UNC-2B, ZINC PL	ASME B18.2.2	STEEL	-
			2 EA	44				2 EA	WASHER, LOCK, HLCL SPR, RGLR, 3/8 NOM, ZINC PL	ASME B18.21.1	STEEL	-
			2 EA	43		B1821BHO38C100N		2 EA	SCREW, CAP, HEX HD, 3/8-16 UNC-2A X 1" L, GRADE 8, ZINC CTD	ASME B18.2.1	STEEL	0.05
1 EA				42	IDA54	90-194028-516		1 EA	NOZZLE, DISCHARGE, 360°, 2 NPS (E1-N2) PORT ENG RM	COML (KIDDE)	BRASS	1.00
1 EA				41	IDA54	90-194024-228		1 EA	NOZZLE, DISCHARGE, 360°, 3/4 NPS (E2-N5) PORT ENG RM	COML (KIDDE)	BRASS	1.00
1 EA				40	IDA54	90-194024-213		1 EA	NOZZLE, DISCHARGE, 360°, 3/4 NPS (E2-N2) PORT ENG RM	COML (KIDDE)	BRASS	1.00
1 EA				39	IDA54	90-194024-199		1 EA	NOZZLE, DISCHARGE, 360°, 3/4 NPS (E2-N4) STBD ENG RM	COML (KIDDE)	BRASS	1.00
1 EA				38	IDA54	90-194024-199		1 EA	NOZZLE, DISCHARGE, 360°, 3/4 NPS (E2-N5) STBD ENG RM	COML (KIDDE)	BRASS	1.00
1 EA		2 EA	2 EA	37				5 EA	CAP, THD, CL 300, 1/2 NPS, GALV	ASME B16.3	MI	0.30
			1 EA	36	IDA54	981574		1 EA	SIREN, PRESSURE OPERATED	COML (KIDDE)		4.00
6 EA	3 EA	2 EA	4 EA	35				15 EA	UNION, THD, CL 300, 1/2 NPS, GALV	ASME B16.39	MI	0.50
7 EA	3 EA	1 EA	3 EA	34				14 EA	TEE, THD, CL 300, 1/2 NPS, GALV	ASME B16.3	MI	0.70
2 EA	1 EA		1 EA	33				4 EA	ELBOW, 45°, THD, CL 300, 1/2 NPS, GALV	ASME B16.3	MI	0.50
6 EA				32				6 EA	COUPLING, RDCR, THD, CL 300, CONC, 1 1/4 X 3/4 NPS, GALV	ASME B16.3	MI	1.10
1 EA				31	IDA54	90-194028-516		1 EA	NOZZLE, DISCHARGE, 360°, 2 NPS (E1-N1) STBD ENG RM	COML (KIDDE)	BRASS	1.00
1 EA	1 EA			30				2 EA	TEE, THD, CL 300, 2 1/2 NPS, GALV	ASME B16.3	MI	8.90
90 FT	45 FT			29				135 FT	PIPE, SMLS, 2.875 OD X .203 WALL, GALV (2 1/2 NPS)	ASTM A 53	STEEL	5.79
6 EA				28				6 EA	COUPLING, RDCR, THD, CL 300, CONC, 3 TO 2 1/2 NPS, GALV	ASME B16.3	MI	8.00
1 EA				27	IDA54	90-194024-194		1 EA	NOZZLE, DISCHARGE, 360°, 3/4 NPS (E2-N2) STBD ENG RM	COML (KIDDE)	BRASS	1.00
1 EA				26	IDA54	90-194024-194		1 EA	NOZZLE, DISCHARGE, 360°, 3/4 NPS (E2-N1) STBD ENG RM	COML (KIDDE)	BRASS	1.00
1 EA				25	IDA54	90-194028-516		1 EA	NOZZLE, DISCHARGE, 360°, 2 NPS (E1-N2) STBD ENG RM	COML (KIDDE)	BRASS	1.00
		3 EA		24				3 EA	ELBOW, 90°, THD, CL 300, 2 NPS, GALV	ASME B16.3	MI	4.00
		30 FT		23				30 FT	PIPE, SMLS, 2.375 OD X .154 WALL, GALV (2 NPS)	ASTM A 53	STEEL	3.65
5 EA	2 EA			22				7 EA	COUPLING, RDCR, THD, CL 300, CONC, 2 1/2 TO 2 NPS, GALV	ASME B16.3	MI	4.40
1 EA				21	IDA54	90-194024-199		1 EA	NOZZLE, DISCHARGE, 360°, 3/4 NPS (E2-N3) STBD ENG RM	COML (KIDDE)	BRASS	1.00
1 EA				20	IDA54	90-194024-199		1 EA	NOZZLE, DISCHARGE, 360°, 3/4 NPS (E2-N1) PORT ENG RM	COML (KIDDE)	BRASS	1.00
2 EA				19				2 EA	TEE, THD, CL 300, 1 NPS, GALV	ASME B16.3	MI	1.50
40 FT	60 FT			18				100 FT	PIPE, SMLS, 1.315 OD X .133 WALL, GALV (1 NPS)	ASTM A 53	STEEL	1.68
7 EA				17				7 EA	NIPPLE, THD, CLOSE, 3 NPS, GALV	ASTM A 733	STEEL	1.65
1 EA				16	IDA54	90-194028-531		1 EA	NOZZLE, DISCHARGE, 360°, 2 NPS (E1-N1) PORT ENG RM	COML (KIDDE)	BRASS	1.00
8 EA	2 EA			15				10 EA	NIPPLE, THD, CLOSE, 2 NPS, GALV	ASTM A 733	STEEL	7.50
3 EA				14				3 EA	COUPLING, RDCR, THD, CL 300, CONC, 3 X 2 NPS, GALV	ASME B16.3	MI	7.10
1 EA				13	IDA54	90-194024-219		1 EA	NOZZLE, DISCHARGE, 360°, 3/4 NPS (E2-N3) PORT ENG RM	COML (KIDDE)	BRASS	1.00
10 EA				12				10 EA	NIPPLE, THD, CLOSE, 3/4 NPS, GALV	ASTM A 733	STEEL	0.09
14 EA				11				14 EA	ELBOW, 90°, THD, CL 300, 3/4 NPS, GALV	ASME B16.3	MI	0.80
125 FT				10				125 FT	PIPE, SMLS, 1.050 OD X .113 WALL, GALV (3/4 NPS)	ASTM A 53	STEEL	1.13
4 EA				9				4 EA	COUPLING, RDCR, THD, CL 300, CONC, 1 X 3/4 NPS, GALV	ASME B16.3	MI	0.70
1 EA				8	IDA54	90-194024-213		1 EA	NOZZLE, DISCHARGE, 360°, 3/4 NPS (E2-N4) PORT ENG RM	COML (KIDDE)	BRASS	1.00
7 EA	4 EA	6 EA	4 EA	7				21 EA	NIPPLE, THD, CLOSE, 1/2 NPS, GALV	ASTM A 733	STEEL	0.08
23 EA	6 EA	1 EA	5 EA	6				35 EA	ELBOW, 90°, THD, CL 300, 1/2 NPS, GALV	ASME B16.3	MI	0.50
230 FT	45 FT	10 FT	25 FT	5				310 FT	PIPE, SMLS, 0.840 OD X .109 WALL, GALV (1/2 NPS)	ASTM A 53	STEEL	0.85
		1 EA	1 EA	4				2 EA	COUPLING, THD, CL 3000, 1 1/4 NPS	ASME B16.11	STEEL	0.38
11 EA				3				11 EA	TEE, THD, CL 300, 3 NPS, GALV	ASME B16.3	MI	13.00
200 FT				2				200 FT	PIPE, SMLS, 3.500 OD X .216 WALL, GALV (3 NPS)	ASTM A 53	STEEL	7.58
8 EA				1				8 EA	ELBOW, 90°, THD, CL 300, 3 NPS, GALV	ASME B16.3	MI	9.80

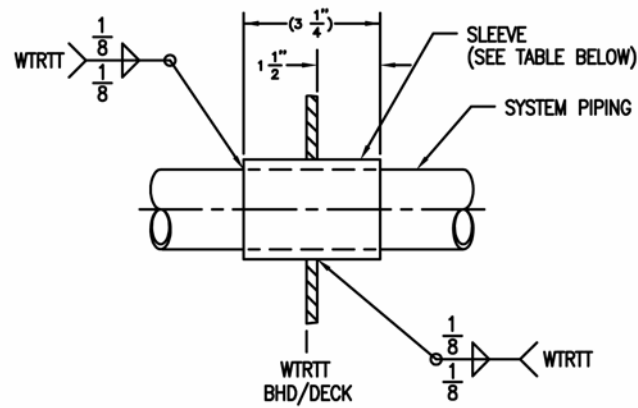
QUANTITY REQUIRED	QUANTITY REQUIRED	QUANTITY REQUIRED	QUANTITY REQUIRED	FIND NO.	CAGE CODE	PART OR IDENTIFYING NUMBER	TOTAL QUANTITY REQUIRED	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL	UNIT WEIGHT (LB)
ENG RM	BT	PAINT LK	EMER GEN								

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	CONTRACT NUMBER DTR57-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±	CONTRACTOR 2R341	
DRAWN BY AM	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882	
CHECKER JAS	DATE 03/23/98 ENGINEER AK	
CLASS DESIGN APPROVAL MARK GENTILE		U.S. ARMY LSV FM-200 SYSTEM PIPING INSTALLATION AND DETAILS
CLASS DRAWING APPROVAL MARK GENTILE 4/26/99		SIZE D
		CAGE CODE 19207
		SCALE 3"=1'-0"
		SHEET 1 OF 18

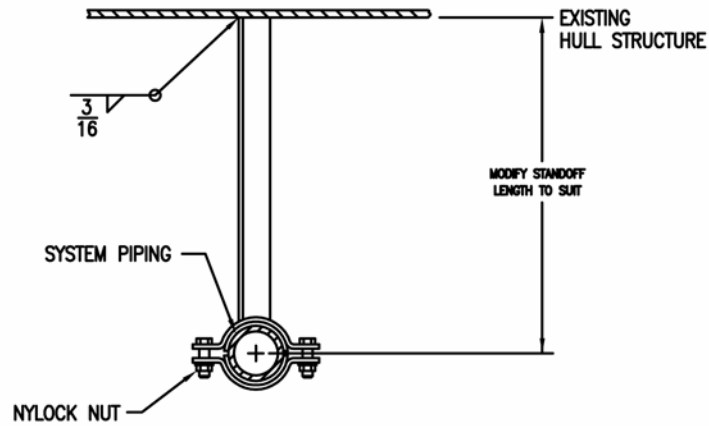






VIEW 15-C  
TYPICAL WATERTIGHT BULKHEAD/DECK PENETRATION  
NOT TO SCALE

PIPE SIZE	SLEEVE FIND NO.
1/2 NPS	98
1 1/4 NPS	151
2 1/2 NPS	104
3 NPS	99



VIEW 15-A  
TYPICAL PIPE HANGER ASSEMBLY  
NOT TO SCALE

PIPE SIZE	HANGER ASSEMBLY FIND NO.
1/2 NPS	193
3/4 NPS	194
1 NPS	195
1 1/4 NPS	196
2 NPS	197
2 1/2 NPS	198
3 NPS	199

NOMINAL PIPE SIZE (IN.)	HANGER SPACING (FT.)
1/2" NPS	5 FEET
3/4" NPS	5 FEET
1" NPS	6 FEET
1 1/4" NPS	6 FEET
1 1/2" NPS	6 FEET
2" NPS	8 FEET
2 1/2" NPS	8 FEET
3" NPS	8 FEET
3 1/2" NPS	8 FEET
4" NPS	8 FEET

PARTS LIST CONTINUED ON SHEET 3											
QTY	QTY	QTY	QTY	FIND	CAGE	PART OR IDENTIFYING NUMBER	TOTAL QTY REQUIRED	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL	UNIT WEIGHT (LB)
2 EA	1 EA			108			3 EA	COUPLING, RDCR, THD, CL 300, CONC, 2 TO 1 1/4 NPS, GALV	ASME B16.3	MI	3.00
	1 EA			107	IDA54	90-194028-609	1 EA	NOZZLE, DISCHARGE, 360°, 2 NPS (E1-N1) BT COMPT	COML (KIDDE)	BRASS	1.00
	2 EA			106			2 EA	UNION, THD, CL 300, 2 NPS, GALV	ASME B16.39	MI	4.10
	4 EA			105			4 EA	ELBOW, 45°, THD, CL 300, 2 1/2 NPS, GALV	ASME B16.3	MI	5.80
	3 EA			104			3 EA	PIPE, SMLS, 3.500 OD X .300 WALL, 3 1/4" L (3 NPS)	ASTM A 53	STEEL	2.05
	2 EA			103			2 EA	UNION, THD, CL 300, 2 1/2 NPS, GALV	ASME B16.39	MI	7.20
18 EA	4 EA			102			22 EA	ELBOW, 90°, THD, CL 300, 2 1/2 NPS, GALV	ASME B16.3	MI	7.20
	1 EA			101	IDA54	283906	1 EA	VALVE OUTLET ADAPTER, 2 1/2 NPS	COML (KIDDE)	BRASS	6.00
	1 EA			100	IDA54	90-100350-001	1 EA	CYLINDER ASSY, 350 LB (344 LB FM-200)	COML (KIDDE)	STEEL	547.00
3 EA				99			3 EA	PIPE, SMLS, 4.000 OD X .226 WALL, 3 1/4" L (3 1/2 NPS)	ASTM A 53	STEEL	2.47
5 EA	1 EA		1 EA	98			7 EA	TUBING, ROUND, 1.125 OD X .109 WALL, 3 1/4" L	ASTM A 513	STEEL	0.32
10 EA				97	28968	4U-SS	10 EA	UNION, TUBE, SIZE 4 (1/4" TUBE)	COML (HOKE)	CRES	0.20
2 EA				96	28968	4CMB-SS	2 EA	CONNECTOR, MALE, 1/4" OD TUBE TO 1/2 NPS	COML (HOKE)	CRES	0.20
100 FT				95			100 FT	TUBING, SMLS, 0.250 OD X .035 WALL	ASTM A269	CRES	0.20
9 EA	7 EA	8 EA	4 EA	94	IDA54	803808	28 EA	CORNER PULLEY, WATERTIGHT	COML (KIDDE)	BRASS	1.00
1 EA				93			1 EA	COUPLING, RDCR, THD, CL 300, CONC, 1 1/2 TO 1/2 NPS, GALV	ASME B16.3	MI	1.60
1 EA	1 EA	1 EA	1 EA	92	39428	3610T13	4 EA	CHAIN, SASH, TRADE SIZE 8	COML (McMASTER)	CRES	0.25
2 EA	2 EA	2 EA	2 EA	91			8 EA	SCREW, TAPPING, PAN HD, TYPE I, CROSS REC, 8-32 UNC-2A X 3/8" L, ZINC CTD	ASME B18.6.4	STEEL	-
2 EA				90			2 EA	NUT, HEX, 1/4-20 UNC-2B, GRADE 8, ZINC PL	ASME B18.2.2	STEEL	-
2 EA				89			2 EA	WASHER, LOCK, HLCL SPR, RGLR, 1/4 NOM, ZINC PL	ASME B18.21.1	STEEL	-
2 EA				88			2 EA	SCREW, MACHINE, FLAT, 80° CTSK HD, 1/4-20 UNC-2A X 3/8" L, GRADE 8, ZINC CTD	ASME B18.6.3	STEEL	-
1 EA				87	IDA54	871403	1 EA	PULL BOX, BREAK GLASS	COML (KIDDE)	STEEL	2.00
6 EA	6 EA	6 EA	6 EA	86			24 EA	NUT, HEX, 1/4-20 UNC-2B	ASME B18.2.2	CRES	-
6 EA	6 EA	6 EA	6 EA	85			24 EA	WASHER, LOCK, HLCL SPR, RGLR, 1/4 NOM	ASME B18.21.1	CRES	-
6 EA	6 EA	6 EA	6 EA	84			24 EA	WASHER, PLAIN, TYPE B, RGLR, 1/4 NOM	ASME B18.22.1	CRES	-
6 EA	6 EA	6 EA	6 EA	83			24 EA	SCREW, CAP, HEX HD, 1/4-20 UNC-2A X 1 1/4" L	ASME B18.2.1	CRES	-
1 EA	1 EA	1 EA	1 EA	82			4 EA	SHEET, 50 DUROMETER, M1BC510, 1/4 STK, 12" SQ	ASTM D 2000	NEOPRENE	0.20
1 EA	1 EA	1 EA	1 EA	81	IDA54	870087	4 EA	PULL BOX, WATERTIGHT	COML (KIDDE)	STEEL	10.00
1 EA				80	IDA54	840058	1 EA	DUAL PULL MECHANISM	COML (KIDDE)	STEEL	1.00
2 EA				79			2 EA	ANGLE, 2 1/2 X 2 1/2 X 3/16 STK, 4" L	ASTM A 36	STEEL	1.02
4 EA				78			4 EA	NUT, MACHINE, HEX, NO. 8-32 UNC-2B, ZINC PL	ASME B18.2.2	STEEL	-
4 EA				77			4 EA	WASHER, PLAIN, TYPE B, RGLR, NO. 8 NOM, ZINC PL	ASME B18.22.1	STEEL	-
6 EA	2 EA	2 EA	2 EA	76			12 EA	WASHER, LOCK, HLCL SPR, RGLR, NO. 8 NOM, ZINC PL	ASME B18.21.1	STEEL	-
4 EA				75			4 EA	SCREW, MACHINE, PAN HD, PHILLIPS, 8-32 UNC-2A X 1" L, ZINC PL	ASME B18.6.3	STEEL	-
70 FT	70 FT	70 FT	70 FT	74	IDA54	15900002	280 FT	CABLE, 1/16" DIA	COML (KIDDE)	CRES	-
4 EA	1 EA		1 EA	73	IDA54	878737	6 EA	PRESSURE OPERATED CONTROL HEAD	COML (KIDDE)	BRASS	1.00
6 EA	2 EA		2 EA	72	IDA54	69920501	10 EA	CONNECTOR, MALE, 5/16" FLARE X 1/8 NPT	COML (KIDDE)	BRASS	1.00
8 EA	1 EA		1 EA	71	IDA54	264986	10 EA	ACTUATION HOSE, 30" L	COML (KIDDE)	RUBBER	1.00
2 EA	1 EA		1 EA	70			4 EA	BUSHING, HEX HD, THD, 1/2 X 1/8 NPS, GALV	ASME B16.14	MI	0.30
12 EA				69	IDA54	294651	12 EA	STRAP, CYLINDER, 600 LB	COML (KIDDE)	STEEL	7.00
6 EA				68	IDA54	90-100601-001	6 EA	CYLINDER ASSY, 600 LB (270 LB FM-200)	COML (KIDDE)	STEEL	632.00
4 EA				67			4 EA	ANGLE, 3 X 3 X 1/4 STK, 6'-5 1/4" L	ASTM A 36	STEEL	31.54
2 EA				66			2 EA	CHANNEL, C5 X 9.00 STK, 6'-5 1/4" L	ASTM A 36	STEEL	57.94
28 EA	8 EA	4 EA	8 EA	65			48 EA	NUT, HEX, 1/2-13 UNC-2B, GRADE 8, ZINC PL	ASME B18.2.2	STEEL	-
28 EA	8 EA	4 EA	8 EA	64			48 EA	WASHER, LOCK, HLCL SPR, RGLR, 1/2 NOM, ZINC PL	ASME B18.21.1	STEEL	-
28 EA	8 EA	4 EA	8 EA	63		B1821BH050C200N	48 EA	SCREW, CAP, HEX HD, 1/2-13 UNC-2A X 2" L, GRADE 8, ZINC CTD	ASME B18.2.1	STEEL	0.03
2 EA	2 EA		2 EA	62	IDA54	270014	6 EA	STRAP, CYLINDER, 25 LB CO2	COML (KIDDE)	STEEL	1.00
1 EA	1 EA	1 EA		61			3 EA	CHANNEL, C4 X 6.25 STK, 12" L	ASTM A 36	STEEL	6.25
2 EA	2 EA			60			4 EA	ANGLE, 2 1/2 X 2 1/2 X 3/16 STK, 12" L	ASTM A 36	STEEL	3.07
1 EA	1 EA		1 EA	59	IDA54	870486	3 EA	CYLINDER ASSY, CO2 (25 LB)	COML (KIDDE)	STEEL	87.00
1 EA	1 EA	1 EA	1 EA	58	IDA54	979469	4 EA	CONTROL HEAD, CABLE OPERATED	COML (KIDDE)	STEEL	3.00
1 EA	1 EA		1 EA	57	IDA54	872450	3 EA	DISCHARGE HEAD, PLAIN NUT	COML (KIDDE)	STEEL	4.00
1 EA	1 EA		1 EA	56	IDA54	252184	3 EA	DISCHARGE HOSE, CO2, 1/2"	COML (KIDDE)	RUBBER	1.00
2 EA	2 EA		2 EA	55			6 EA	BUSHING, HEX HD, THD, 3/4 TO 1/2 NPS, GALV	ASME B16.14	MI	0.50
1 EA	1 EA		1 EA	54	IDA54	870652	3 EA	LEVER OPERATED CONTROL HEAD	COML (KIDDE)	BRASS	1.00

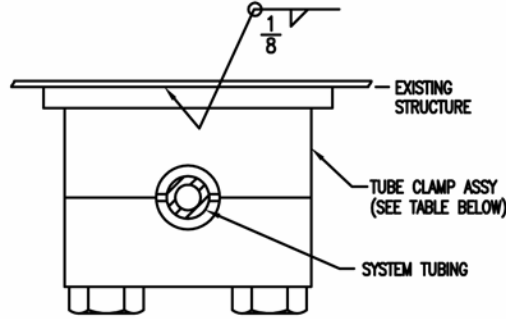
PARTS LIST (CONTINUED FROM SHEET 1)

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTR557-97-C-00049		U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± — ± — ± —		CONTRACTOR 2R341		U.S. ARMY LSV FM-200 SYSTEM PIPING INSTALLATION AND DETAILS	
DRAWN BY AM	DATE 03/23/98	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882		SIZE D	CAGE CODE 19207
CHECKER JAS	ENGINEER AK			LSV-5553-1	
CLASS DESIGN APPROVAL MARK GENTILE				SCALE	SHEET 2 OF 18
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99					



ACTUATION CABLE TABLE

SYSTEM CABLE	COMPONENT/LOCATION
ENGINE ROOM	CYLINDER, CONTROL HEAD
	DUAL PULL MECHANISM SEE VIEW 63-C
	LONG BHD 16"-8" OFF CL
	EXTERIOR PULL STATION SEE VIEW 59-C
BOW THRUSTER COMPARTMENT	WTRIT BHD 111
	LONG BHD 16"-8" OFF CL
	INTERIOR PULL STATION SEE VIEW 57-C
	CYLINDER, CONTROL HEAD
PAINT LOCKER	WTRIT BHD 16
	EXTERIOR PULL STATION SEE VIEW 59-C
	CYLINDER, CONTROL HEAD
	LONG BHD 13"-4" OFF CL
EMERGENCY GENERATOR ROOM	LONG BHD 16"-8" OFF CL
	WTRIT BHD 16
	EXTERIOR PULL STATION SEE VIEW 59-C
	CYLINDER, CONTROL HEAD



VIEW 22-C  
TYPICAL TUBE CLAMP ASSEMBLY  
NOT TO SCALE

TUBING SIZE	TUBE CLAMP ASSY FIND NO.
1/4" OD	181

ACTUATION CABLE RUN SHALL BE MADE USING PIPE, FIND NO. 116, CORNER PULLEY, FIND NO. 94, AND CABLE, FIND NO. 74

CO2 ACTUATION TUBING TABLE	
SYSTEM TUBING	COMPONENT/LOCATION
ENGINE ROOM	STEERING GEAR COMPT (STBD)
	STEERING GEAR COMPT (PORT)

ENGINE ROOM CO2 ACTUATION TUBING SHALL BE MOUNTED IN THE OVERHEAD AS HIGH AS PRACTICAL. WHERE TUBING IS SUBJECT TO DAMAGE, ADEQUATE PROTECTION SHALL BE PROVIDED. THE TUBING SHALL CROSS THE VESSEL TRANSVERSELY ALONG THE OVERHEAD, AFT OF FR 125, IN THE STEERING GEAR COMPARTMENT.

CO2 ACTUATION TUBING RUN SHALL BE MADE USING TUBE, FIND NO. 95, CONNECTOR, FIND NO. 96, UNION, FIND NO. 97, AND COUPLING, FIND NO. 182. CO2 ACTUATION TUBING SHALL BE SUPPORTED BY USING TUBE CLAMP ASSEMBLY (SEE VIEW 22-C), MOUNTED TO EXISTING STRUCTURE.

NOTES: (CONTINUED FROM SHEET 1)

- SYSTEM PIPING, NEWLY INSTALLED MATERIAL AND EQUIPMENT, AND DISTURBED AREAS SHALL BE CLEANED, PAINTED, AND MARKED USING DEPARTMENT OF THE ARMY TECHNICAL BULLETIN TB 43-0144 "PAINTING OF WATERCRAFT" AS A GUIDE.
- DRILL HOLE, USING NO. 29 BIT, FOR SCREW, FIND NO. 91.
- PULL BOX, FIND NO. 81 AND 87, TO BE NEWLY INSTALLED, SHALL BE MOUNTED NO HIGHER THAN 48 INCHES, MEASURED FROM THE DECK.
- TEMPLATE NUMBER, SIZE, AND SPACING OF ACCESS AND MOUNTING HOLES ON DECK PLATE FROM TREAD PLATE, FIND NO. 178. DRILL HOLES AND TAP DECK PLATES. ASSEMBLE USING MACHINE SCREWS, FIND NO. 179.
- DECK PLATES SHALL BE MODIFIED TO ALLOW FOR EASE OF REMOVAL AROUND NEW DECK PLATE PENETRATIONS. ANGLE, FIND NO. 180, SHALL BE UTILIZED TO SUPPORT THE ALTERED DECK PLATES.
- MACHINERY ROOM SPACE HEATER RELOCATION:
  - DISCONNECT ELECTRICAL CABLE 7P2 BETWEEN HEATER CONTROLLER AND HEATER. DISCARD ELECTRICAL CABLE AND RETAIN CABLE TAG AND STUFFING TUBES FOR REUSE.
  - REMOVE HEATER, INCLUDING HEATER FOUNDATION, AND RETAIN FOR RELOCATION.
  - MOUNT HEATER AT LOCATION SHOWN IN VIEW 61-C.
  - CONNECT NEW ELECTRICAL CABLE, FIND NO. 187, BETWEEN HEATER CONTROLLER AND HEATER. REUSE STUFFING TUBES.
  - RETAG NEW ELECTRICAL CABLE (7P2).

- TEMPLATE NUMBER, SIZE, AND SPACING OF MOUNTING HOLES ON ANGLE, FIND NO. 192, FROM PRESSURE SWITCH, FIND NO. 191.

PARTS LIST CONTINUED ON SHEET 16

										REVISION				
										ZONE	REV	DESCRIPTION	DATE	APPROVED
2 EA										2 EA	ANGLE, 1 X 1 X 1/4 STK, 24" L	ASTM A 36	STEEL	3.10
4 EA	4 EA									8 EA	NUT, HEX, 3/8-16 UNC-2B, GRADE 8, ZINC PL	ASME B18.2.2	STEEL	-
4 EA	4 EA									8 EA	WASHER, PLAIN, TYPE B, RGLR, 3/8 NOM, ZINC PL	ASME B18.22.1	STEEL	-
4 EA	4 EA									8 EA	SCREW, CAP, HEX HD, 3/8-16 UNC-2A X 1 1/4" L, GRADE 8, ZINC CTD	ASME B18.2.1	STEEL	-
2 EA										2 EA	MASTER CYLINDER ADAPTER KIT	COML (KIDDE)	BRASS	0.50
4 EA										4 EA	TEE, BRANCH, MALE, 5/16" FLARE X 1/8 NPS	COML (KIDDE)	BRASS	0.50
2 EA										2 EA	LEVER/PRESSURE OPERATED CONTROL HEAD	COML (KIDDE)	STEEL	1.00
2 EA										2 EA	BUSHING, HEX HD, THD, 1/2 X 1/4 NPS, GALV	ASME B16.14	MI	0.10
2 EA										2 EA	NIPPLE, THD, CLOSE, 1/4 NPS, GALV	ASTM A 733	STEEL	0.03
2 EA										2 EA	VALVE, CHECK, 1/4 NPS	COML (KIDDE)	BRASS	1.00
2 EA										2 EA	BUSHING, HEX HD, THD, 1/4 X 1/8 NPS, GALV	ASME B16.14	MI	0.10
2 EA										2 EA	BUSHING, HEX HD, THD, 1/4 X 1/2 NPS, GALV	ASME B16.14	MI	0.40
2 RO	2 RO	2 RO	2 RO	1 FA	152					8 RO	TAPE, ANTI-SEIZE, SIZE IT	MIL-T-27730	PTFF	0.03
				2 EA	151					3 EA	TUBING, ROUND, 2.250 OD X .156 WALL, 3 1/4" L	ASTM A 513	STEEL	0.94
				1 FA	150					1 FA	CHANNEL, C4 X 6.25, STK, 9" L	ASTM A 36	STEEL	4.68
				1 FA	149					1 FA	ANGLE, 3 X 3 X 1/4 STK, 11" L	ASTM A 36	STEEL	8.82
				1 FA	148					1 FA	CHANNEL, C4 X 6.25, STK, 14" L	ASTM A 36	STEEL	7.29
				1 FA	147					1 FA	ANGLE, 3 X 3 X 1/4 STK, 11" L	ASTM A 36	STEEL	8.82
				1 FA	146					1 FA	ANGLE, 3 X 3 X 1/4 STK, 29" L	ASTM A 36	STEEL	22.72
				1 FA	145	IDA54	90-100125-001			1 FA	CYLINDER ASSY, 125 LB (87 LB FM-200)	COML (KIDDE)	STEEL	183.00
				1 FA	144	IDA54	90-194026-328			1 FA	NOZZLE, DISCHARGE, 360°, 1 1/4 NPS (E1-N1) EMER GEN RM	COML (KIDDE)	BRASS	1.00
4 EA	1 FA	1 FA	1 FA	143						7 EA	UNION, THD, CL 300, 1 1/4 NPS, GALV	ASME B16.39	MI	2.20
6 EA	2 EA	1 FA	1 FA	142						10 EA	NIPPLE, THD, CLOSE, 1 1/4 NPS, GALV	ASTM A 733	STEEL	1.00
				1 FA	141					2 EA	BUSHING, HEX HD, THD, 1 1/2 X 1 1/4 NPS, GALV	ASME B16.14	MI	2.00
				1 FA	140					2 EA	ELBOW, 90°, THD, CL 300, 1 1/2 NPS, GALV	ASME B16.3	MI	2.40
				1 FA	139					2 EA	NIPPLE, THD, CLOSE, 1 1/2 NPS, GALV	ASTM A 733	STEEL	1.00
				1 FA	138	IDA54	283904			2 EA	VALVE, OUTLET ADAPTER, 1 1/2 NPS	COML (KIDDE)	BRASS	1.00
				1 FA	137	IDA54	90-100125-001			1 FA	CYLINDER ASSY, 125 LB (91 LB FM-200)	COML (KIDDE)	STEEL	187.00
				2 EA	136					2 EA	ANGLE, 3 X 3 X 1/4 STK, 17 1/16" L	ASTM A 36	STEEL	6.97
				2 EA	135	IDA54	292971			4 EA	STRAP, CYLINDER, 125 LB	COML (KIDDE)	STEEL	7.00
				1 FA	134					1 FA	PIPE, SMLS, 0.840 OD X .109 WALL, 12" L, GALV (1/2 NPS)	ASTM A 53	STEEL	0.84
				1 FA	133					1 FA	ANGLE, 1 1/2 X 1 1/2 X 1/4 STK, 7" L	ASTM A 36	STEEL	1.40
				1 FA	132	IDA54	90-194026-377			1 FA	NOZZLE, DISCHARGE, 360°, 1 1/4 NPS (E1-N1) PT LKR	COML (KIDDE)	BRASS	1.00
4 EA	1 FA	6 EA	4 EA	131						15 EA	ELBOW, 90°, THD, CL 300, 1 1/4 NPS, GALV	ASME B16.3	MI	1.80
				1 FA	130		FIG. 6850-397			1 FA	COUPLING, REDUCING, FEM SWLDG, 2" X 1"	COML (FLAGG)	CNA	1.46
				1 FA	129					1 FA	TUBE, MECHANICAL, ROUND, 1.750 OD X .125 WALL, 3" L	ASTM A 513	STEEL	0.54
				10 FT	128					10 FT	TUBING, SEAMLESS, 1.125 OD X .625 WALL	ASTM B 466	CNA	0.47
				1 FA	127	72423	FIG. 6860-200			1 FA	ADAPTER, FEM SWLDG X MALE THD, 1 NPS	COML (FLAGG)	CNA	0.47
				1 EA	126					1 EA	CAP, THD, CL 300, 1 NPS, GALV	ASME B16.3	MI	0.70
				1 EA	125					1 EA	COUPLING, THD, CL 3000, 1 NPS	ASME B16.11	STEEL	0.70
				1 EA	124					1 EA	PLATE, 1/4 STK, 11" L X 12" W	ASTM A 36	STEEL	9.35
				1 EA	123					1 EA	PLATE, 1/4 STK, 12" L X 5" W	ASTM A 36	STEEL	4.25
				2 EA	122					2 EA	PLATE, 1/4 STK, 11 1/2" L X 5" W	ASTM A 36	STEEL	4.07
				4 EA	121					4 EA	PIPE, SMLS, 0.840 OD X .109 WALL, 4 13/16" L, GALV (1/2 NPS)	ASTM A 53	STEEL	0.34
				2 EA	120	IDA54	281866			2 EA	STRAP, CYLINDER, 350 LB	COML (KIDDE)	STEEL	6.00
				2 EA	119					2 EA	ANGLE, 2 X 2 X 3/8 STK, 29 1/2" L	ASTM A 36	STEEL	11.55
				4 EA	118					4 EA	ANGLE, 2 X 2 X 3/8 STK, 7" L	ASTM A 36	STEEL	2.74
				1 EA	117					1 EA	CHANNEL, C4 X 6.25, STK, 17 1/2" L	ASTM A 36	STEEL	9.11
70 FT	70 FT	70 FT	70 FT	116						280 FT	PIPE, SMLS, 0.675 OD X .091 WALL, GALV (3/8 NPS)	ASTM A 53	STEEL	0.57
				1 EA	115	IDA54	90-194025-250			1 EA	NOZZLE, DISCHARGE, 360°, 1 NPS (E2-N1) BT COMPT	COML (KIDDE)	BRASS	1.00
				1 EA	114	IDA54	90-194025-250			1 EA	NOZZLE, DISCHARGE, 360°, 1 NPS (E2-N2) BT COMPT	COML (KIDDE)	BRASS	1.00
4 EA	2 EA			113						6 EA	NIPPLE, THD, CLOSE, 1 NPS, GALV	ASTM A 733	STEEL	0.21
2 EA	2 EA			112						4 EA	UNION, THD, CL 300, 1 NPS, GALV	ASME B16.39	MI	1.40
				2 EA	111					2 EA	COUPLING, RDCR, THD, CL 300, CONC, 1 1/4 TO 1 NPS, GALV	ASME B16.3	MI	1.30
4 EA	1 EA	2 EA		110						7 EA	TEE, THD, CL 300, 1 1/4 NPS	ASME B16.3	MI	2.60
65 FT	15 FT	45 FT	40 FT	109						185 FT	PIPE, SMLS, 1.680 OD X .140 WALL, GALV (1 1/4 NPS)	ASTM A 53	STEEL	2.27
QUANTITY REQUIRED	QUANTITY REQUIRED	QUANTITY REQUIRED	QUANTITY REQUIRED	FIND NO.	CAGE CODE	PART OR IDENTIFYING NUMBER	TOTAL QUANTITY REQUIRED	NOMENCLATURE OR DESCRIPTION		SPECIFICATION	MATERIAL	UNIT WEIGHT (LB)		

PARTS LIST (CONTINUED FROM SHEET 2)

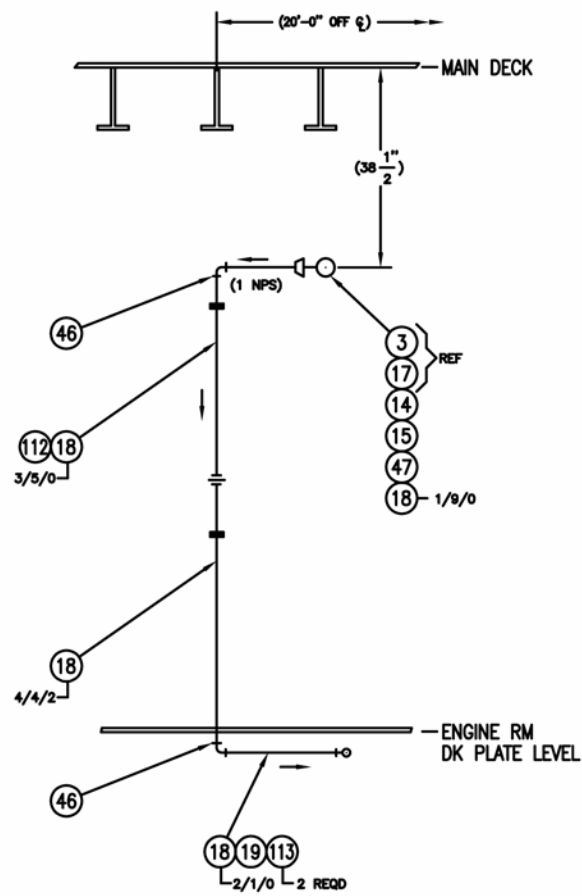
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTR57-97-C-00049		U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±		CONTRACTOR 2R341		U.S. ARMY LSV FM-200 SYSTEM PIPING INSTALLATION AND DETAILS	
DRAWN BY AM	DATE 03/23/98	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882		SIZE D	
CHECKER JAS	ENGINEER AK	CLASS DESIGN APPROVAL MARK GENTILE		CAGE CODE 19207	
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99				LSV-5553-1	



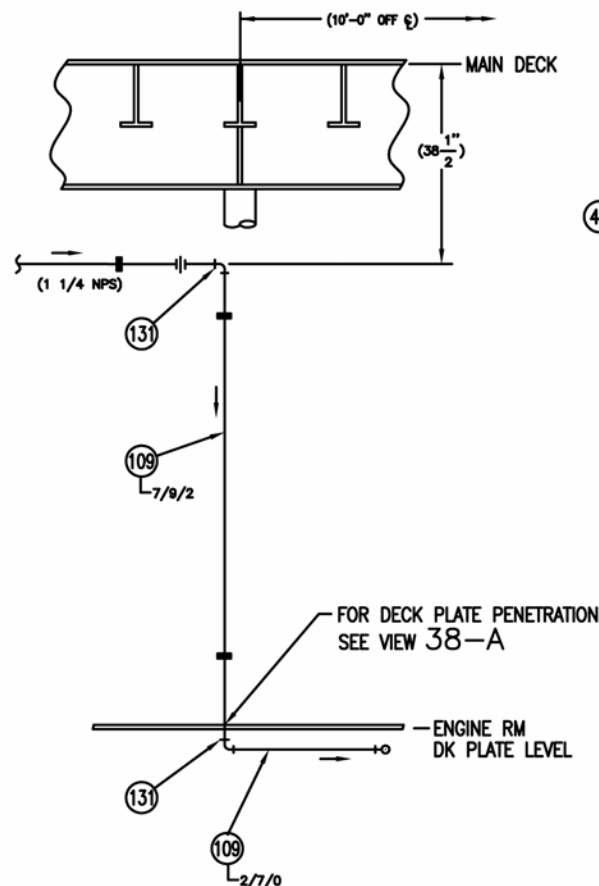




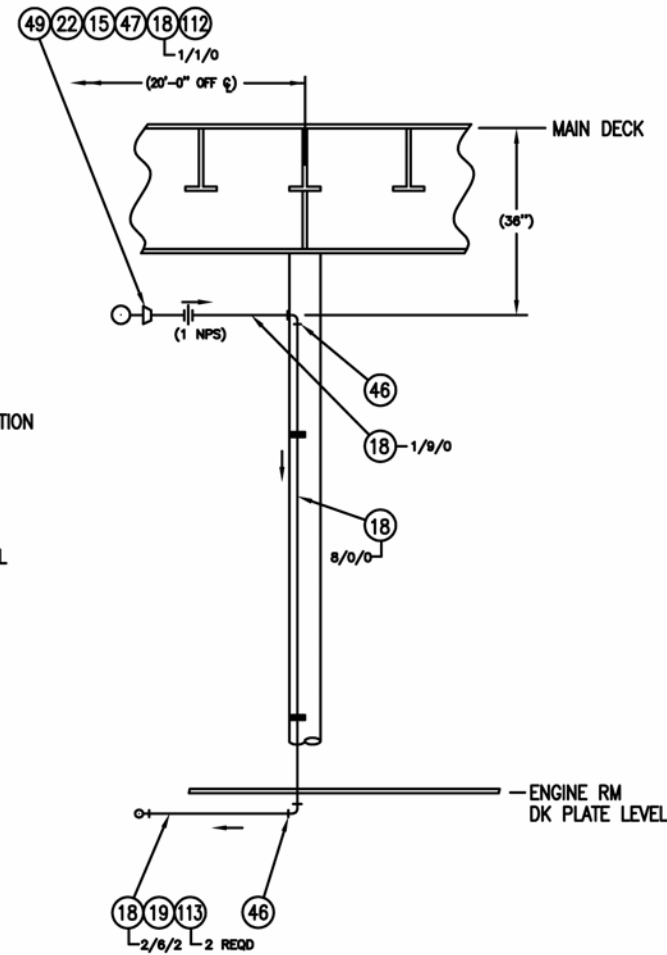
REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



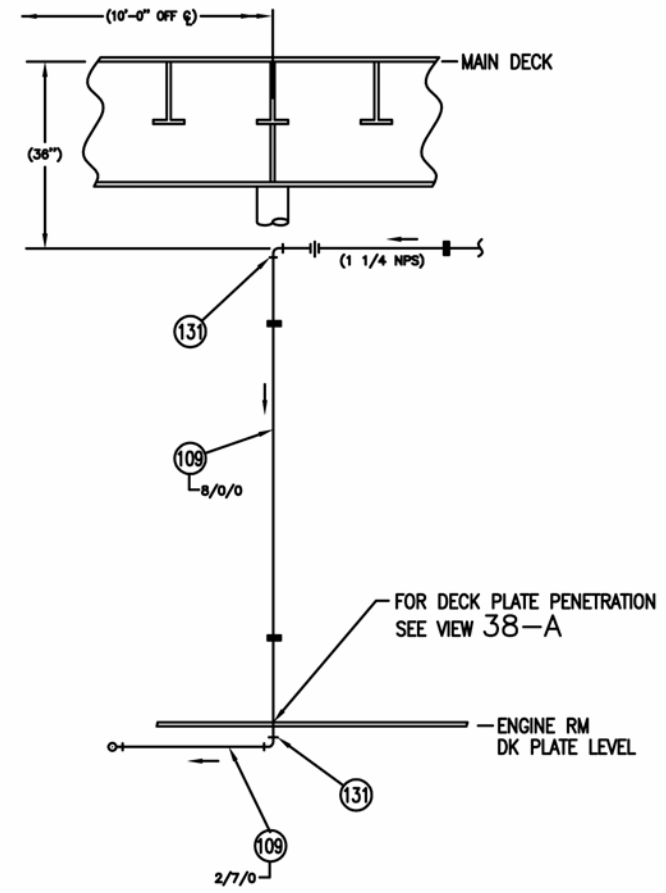
**VIEW 39-B**  
(29-D)  
ENGINE ROOM FM-200 SYSTEM  
PIPING INSTALLATION AND DETAILS  
FR 96, PORT SIDE  
LOOKING FORWARD  
SCALE 3/4"=1'-0"  
ITEMS NOT SHOWN  
OMITTED FOR CLARITY  
ROTATED 90° CCW



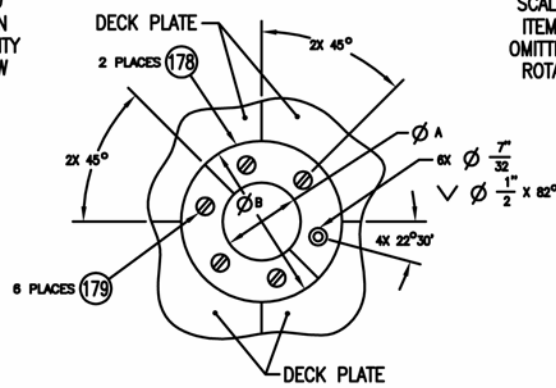
**VIEW 37-B**  
(29-C)  
ENGINE ROOM FM-200 SYSTEM  
PIPING INSTALLATION AND DETAILS  
FR 100, PORT SIDE  
LOOKING FWD  
SCALE 3/4"=1'-0"  
ITEMS NOT SHOWN  
OMITTED FOR CLARITY  
ROTATED 90° CCW



**VIEW 36-B**  
(29-B)  
ENGINE ROOM FM-200 SYSTEM  
PIPING INSTALLATION AND DETAILS  
FR 96, STBD SIDE  
LOOKING FORWARD  
SCALE 3/4"=1'-0"  
ITEMS NOT SHOWN  
OMITTED FOR CLARITY  
ROTATED 90° CCW



**VIEW 34-B**  
(29-C)  
ENGINE ROOM FM-200 SYSTEM  
PIPING INSTALLATION AND DETAILS  
FR 100, STBD SIDE  
LOOKING FWD  
SCALE 3/4"=1'-0"  
ITEMS NOT SHOWN  
OMITTED FOR CLARITY  
ROTATED 90° CCW



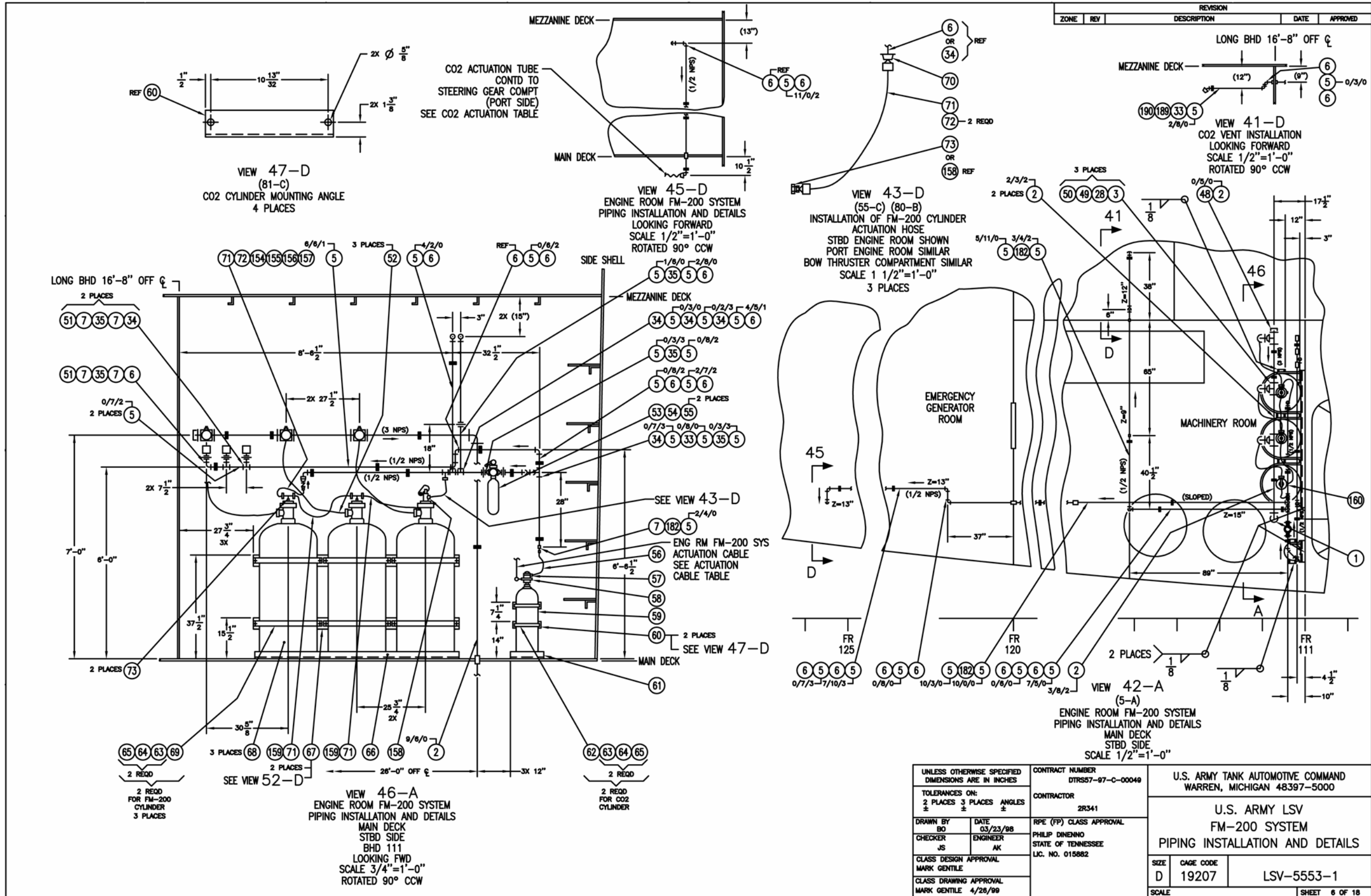
PIPE SIZE	COLLAR SIZE	
	A	B
1 NPS	1 3/8"	3 3/8"
1 1/4 NPS	1 3/4"	3 3/4"

**VIEW 38-A**  
(77-D)  
TYPICAL DECK PLATE PENETRATION  
SEE NOTES 14 AND 15  
NOT TO SCALE

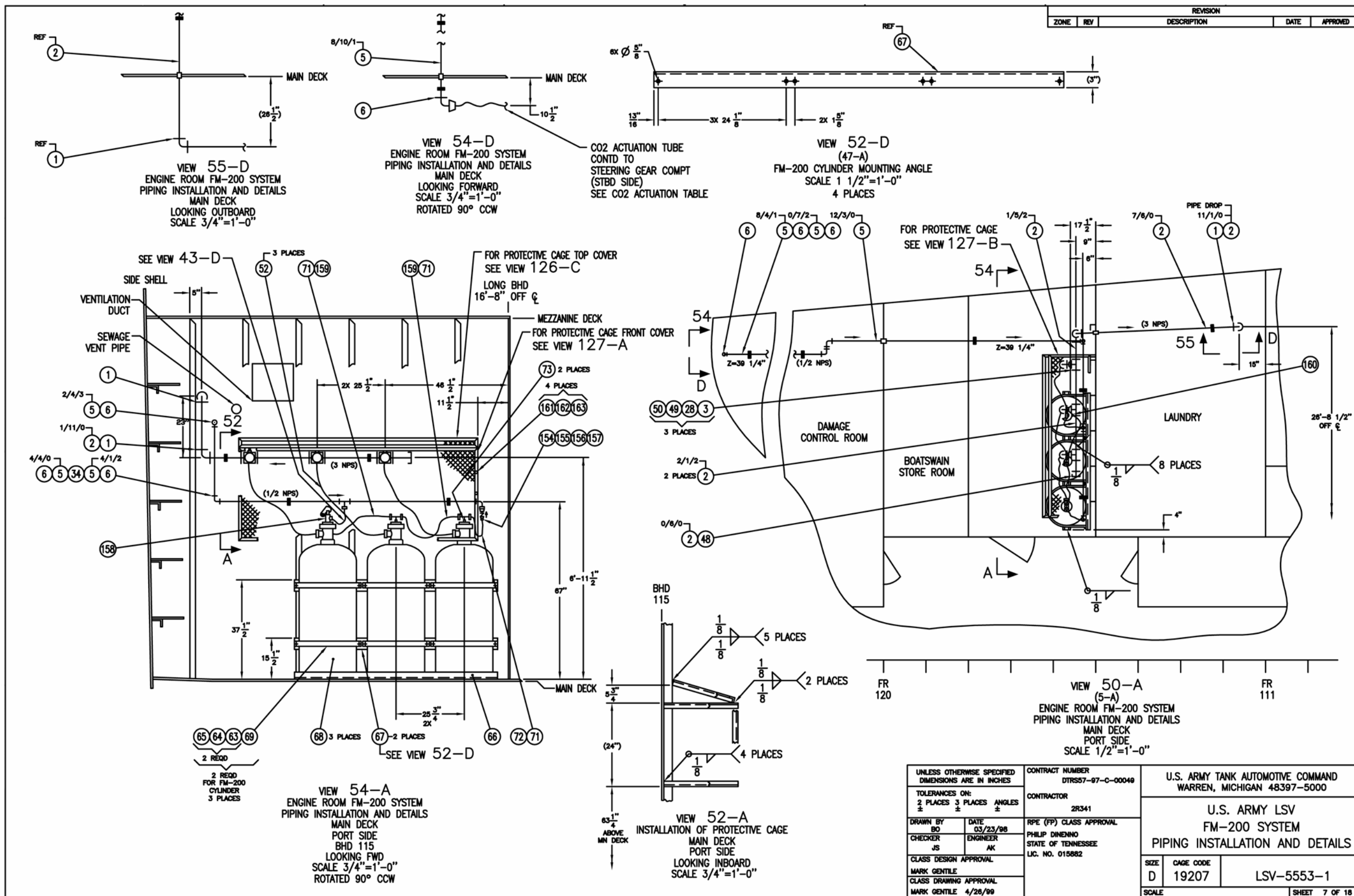
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTR57-97-C-00049		U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±		CONTRACTOR 2R341		U.S. ARMY LSV FM-200 SYSTEM PIPING INSTALLATION AND DETAILS	
DRAWN BY BO	DATE 03/23/98	RPE (FP) CLASS APPROVAL PHILIP DIMENNO STATE OF TENNESSEE LIC. NO. 015882		SIZE D	CAGE CODE 19207
CHECKER JS/AK	ENGINEER AK	CLASS DESIGN APPROVAL MARK GENTILE		LSV-5553-1	
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99				SCALE	SHEET 5 OF 18





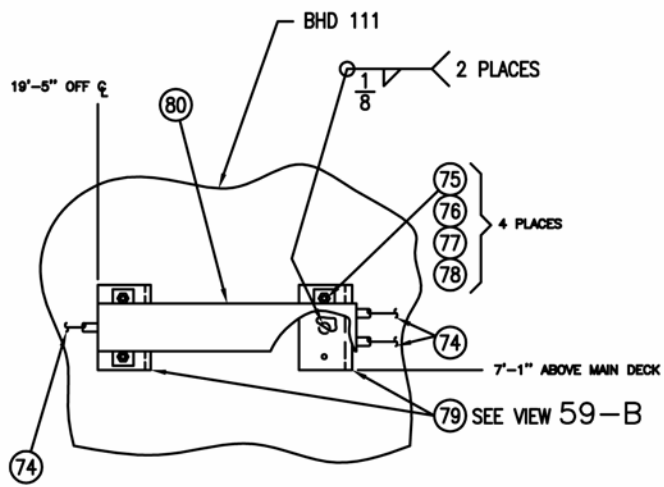




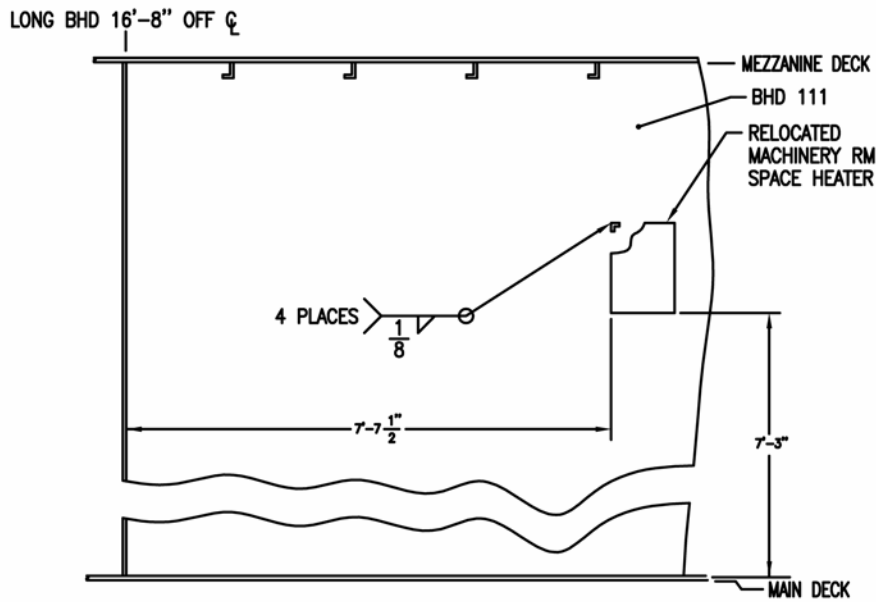




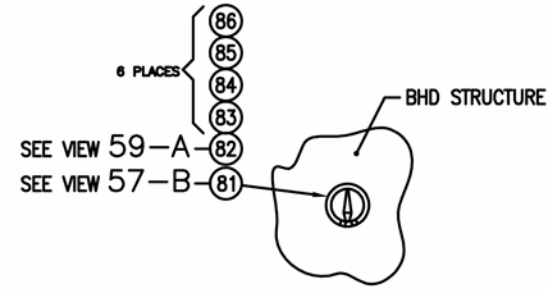
REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



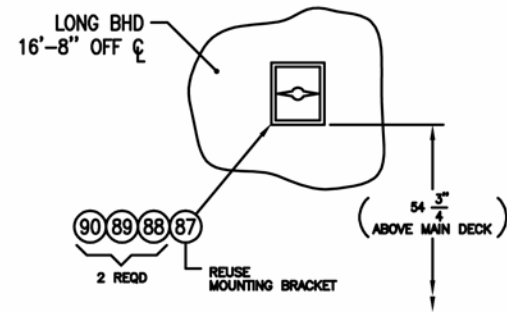
VIEW 63-C  
INSTALLATION OF DUAL PULL MECHANISM  
MAIN DECK  
SEE ACTUATION CABLE TABLE



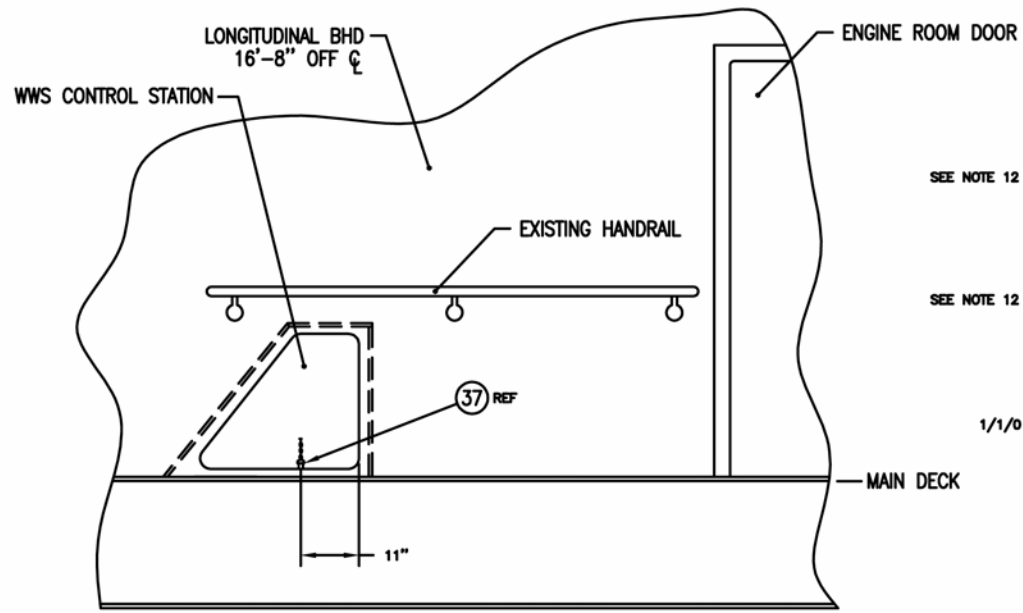
VIEW 61-C  
RELOCATION OF MACHINERY RM SPACE HEATER  
LOOKING FWD  
SCALE 3/4"=1'-0"  
SEE NOTE 16



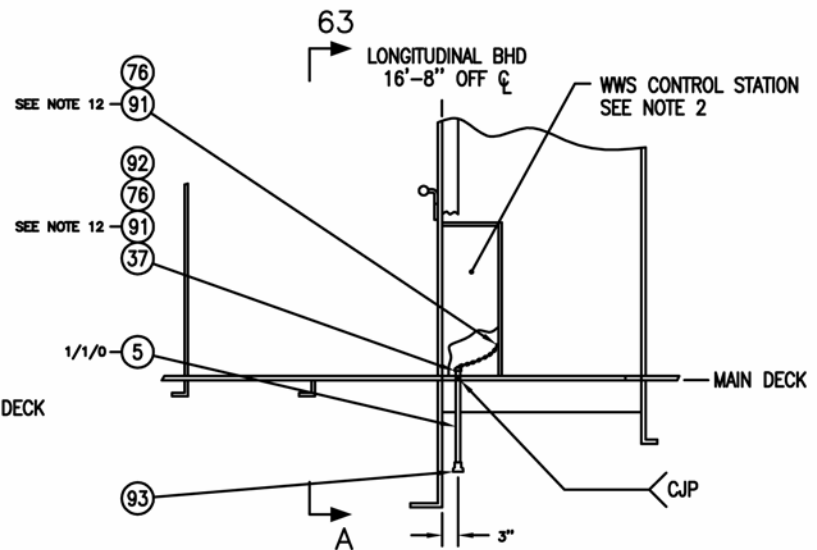
VIEW 59-C  
FM-200 SYSTEM  
INSTALLATION OF EXTERIOR PULL STATION  
MAIN DECK  
SCALE 1 1/2"=1'-0"  
SEE ACTUATION CABLE TABLE  
SEE NOTE 13



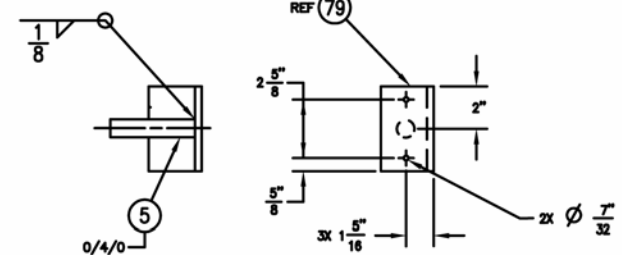
VIEW 57-C  
INSTALLATION OF INTERIOR PULL STATION  
MAIN DECK  
SCALE 1 1/2"=1'-0"  
SEE ACTUATION CABLE TABLE



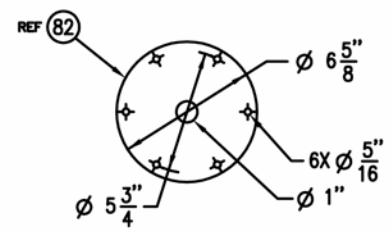
VIEW 63-A  
INSTALLATION OF ENGINE ROOM  
SAMPLING PORT  
WWS CONTROL STATION  
STBD SIDE  
LOOKING OUTBOARD  
SCALE 3/4"=1'-0"



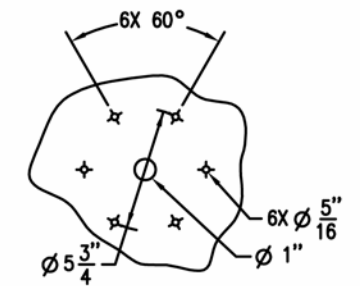
VIEW 60-A  
(5-A)  
INSTALLATION OF ENGINE ROOM  
SAMPLING PORT  
WWS CONTROL STATION  
STBD SIDE  
LOOKING FWD  
SCALE 3/4"=1'-0"



VIEW 59-B  
DUAL PULL MECHANISM  
MOUNTING ANGLE



VIEW 59-A  
EXTERIOR PULL STATION GASKET

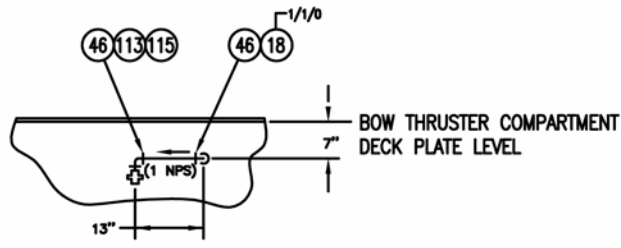


VIEW 57-B  
INSTALLATION OF EXTERIOR PULL STATION  
BULKHEAD CUTOUT  
MAIN DECK  
LONG BHD 16'-8" OFF CL  
LOOKING OUTBOARD

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTR557-97-C-00049		U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±		CONTRACTOR 2R341		U.S. ARMY LSV FM-200 SYSTEM PIPING INSTALLATION AND DETAILS	
DRAWN BY BO	DATE 03/23/98	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882		SIZE D	CAGE CODE 19207
CHECKER JS	ENGINEER AK	CLASS DESIGN APPROVAL MARK GENTILE		LSV-5553-1	
CLASS DRAWING APPROVAL MARK GENTILE 4/26/99		SCALE		SHEET 8 OF 18	

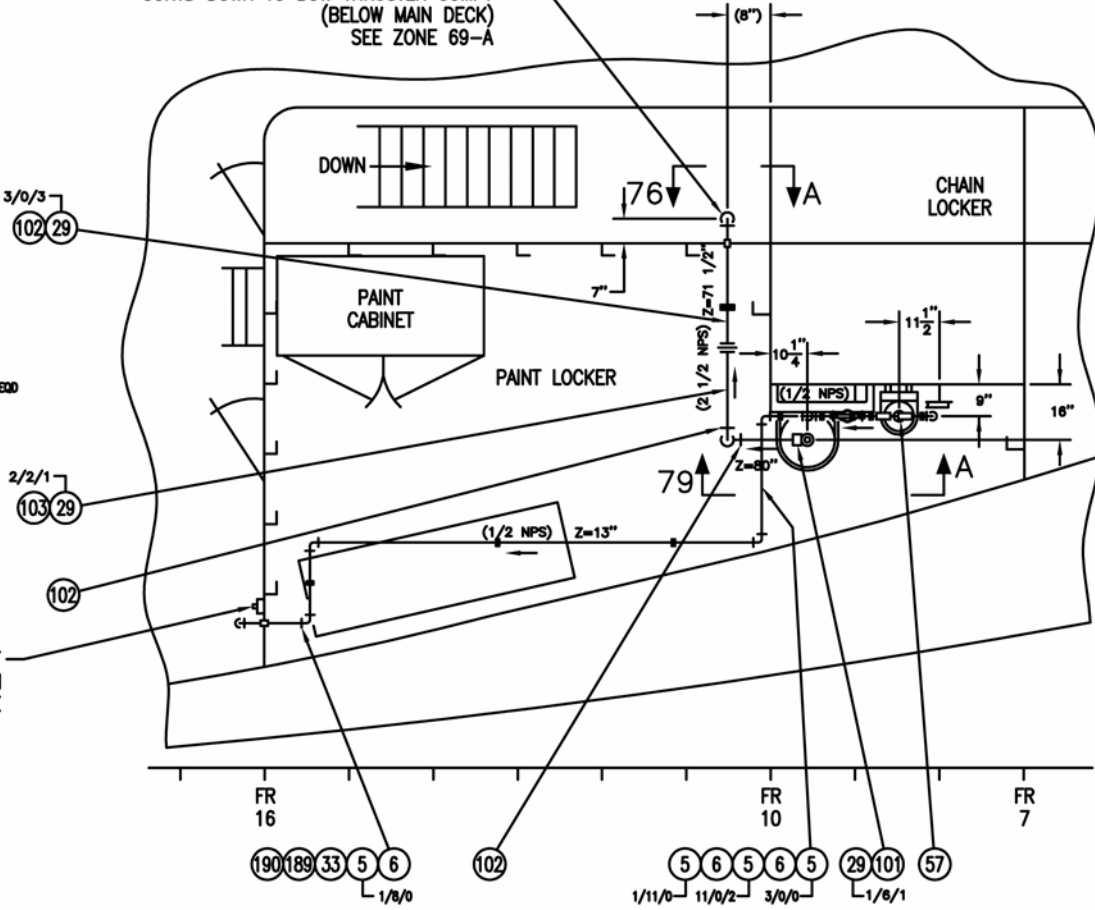


REVISION			
ZONE	REV	DESCRIPTION	DATE



VIEW 68-D  
BOW THRUSTER COMPARTMENT FM-200 SYSTEM  
PIPING INSTALLATION AND DETAILS  
BOW THRUSTER ROOM BILGE  
LOOKING OUTBOARD  
SCALE 3/4"=1'-0"  
ROTATED 180°

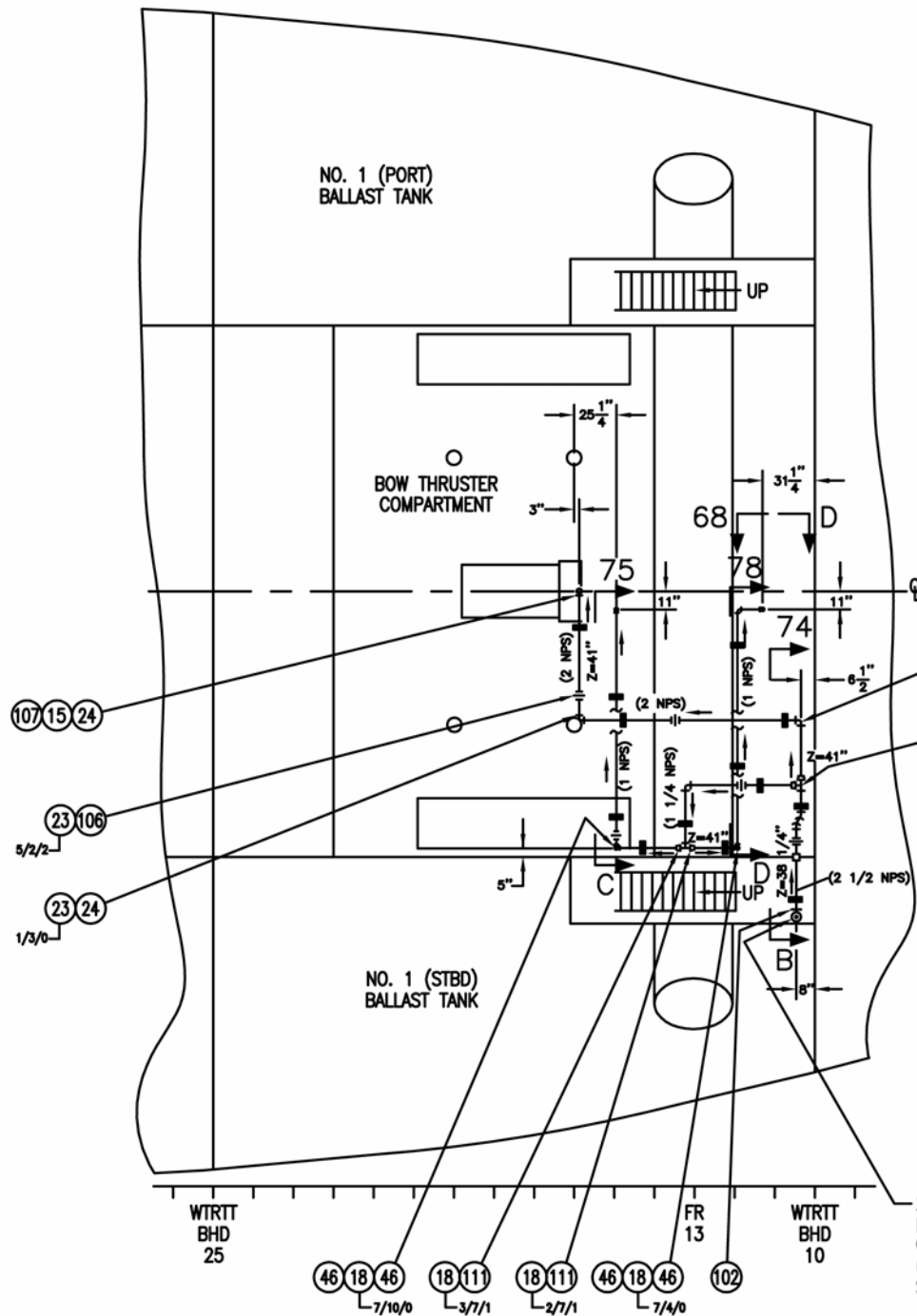
2 1/2 NPS BOW  
THRUSTER COMPT FM-200 PIPING  
CONTD DOWN TO BOW THRUSTER COMPT  
(BELOW MAIN DECK)  
SEE ZONE 69-A



VIEW 66-A  
BOW THRUSTER COMPARTMENT FM-200 SYSTEM  
PIPING INSTALLATION AND DETAILS  
MAIN DECK  
SCALE 1/2"=1'-0"

FOR INSTALLATION OF  
EXTERIOR PULL STATION  
SEE ACTUATION CABLE TABLE

2 1/2 NPS  
BOW THRUSTER COMPT FM-200 PIPING  
CONTD FROM PAINT LOCKER  
(MAIN DECK)  
SEE ZONE 67-C



VIEW 70-A  
BOW THRUSTER COMPARTMENT FM-200 SYSTEM  
PIPING INSTALLATION AND DETAILS  
BELOW MAIN DECK  
SCALE 1/4"=1'-0"

- LOCAL NOTES:
- "■" INDICATES APPROXIMATE PIPE HANGER LOCATION, SEE NOTE 7.
  - FOR PIPE PENETRATION INSTALLATION AND DETAILS, SEE VIEW 15-C.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	CONTRACT NUMBER DTRSS7-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±	CONTRACTOR 2R341	U.S. ARMY LSV FM-200 SYSTEM PIPING INSTALLATION AND DETAILS	
DRAWN BY AM	DATE 3/23/98	RPE (FP) CLASS APPROVAL	SIZE D
CHECKER JS/RF	ENGINEER MB	PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882	CAGE CODE 19207
CLASS DESIGN APPROVAL MARK GENTILE			SCALE
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99			SHEET 9 OF 18

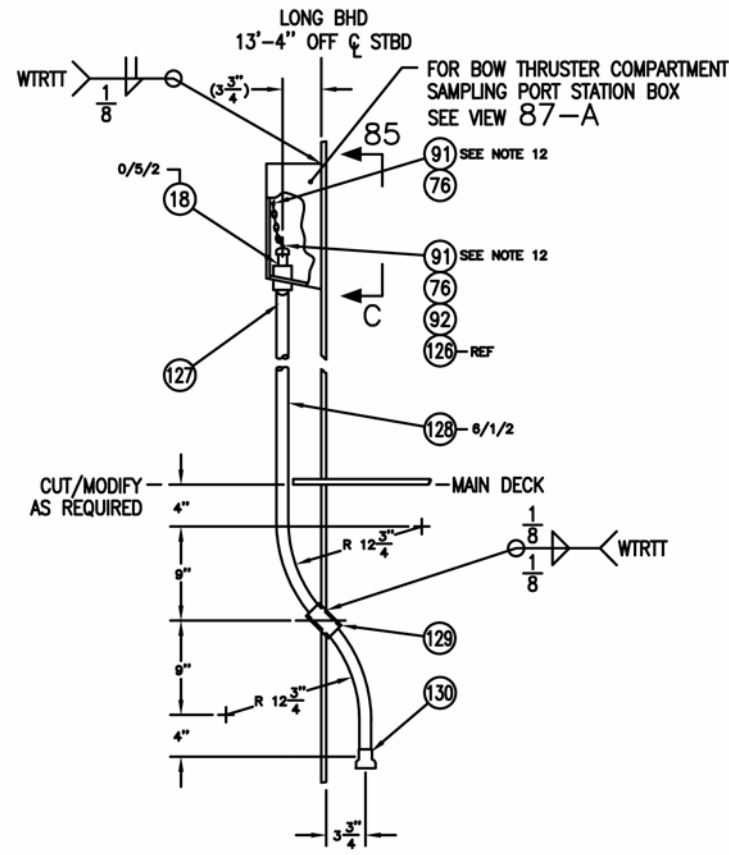




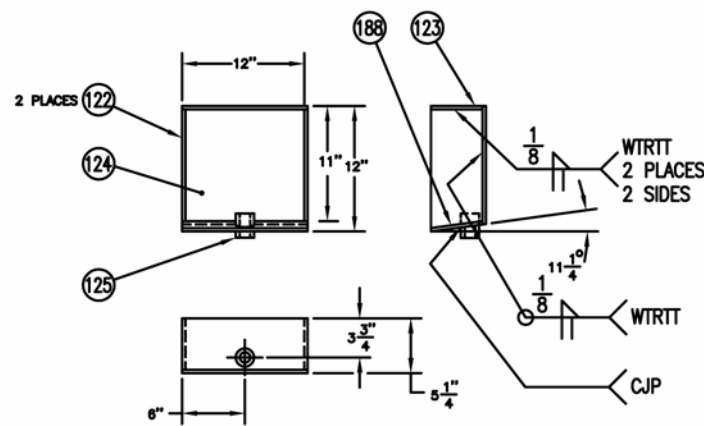




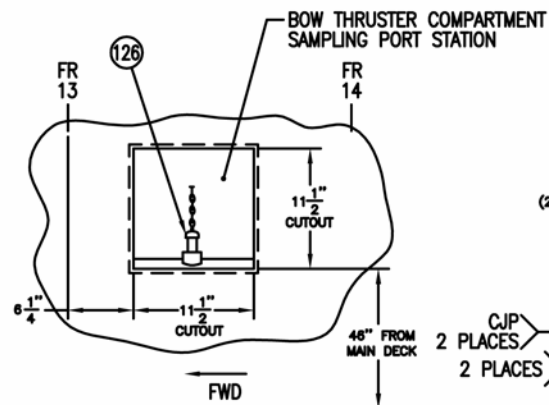
REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



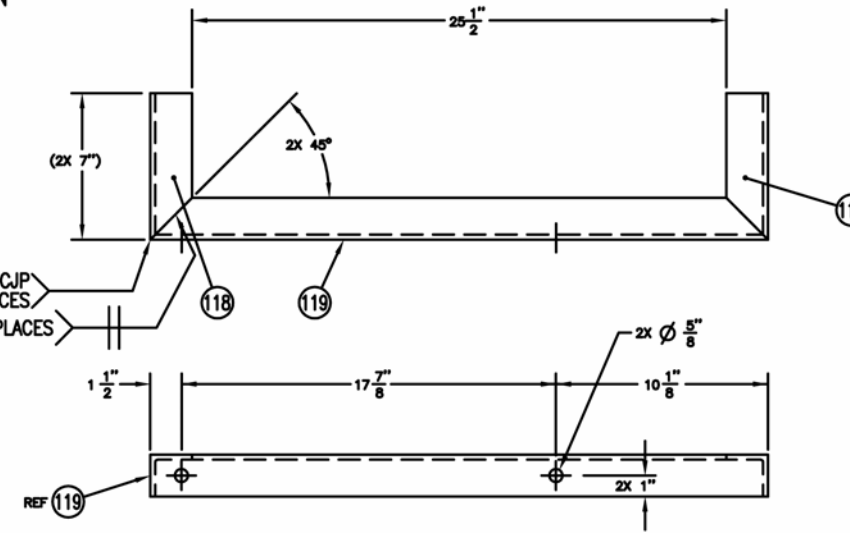
**VIEW 87-B**  
(4-A)  
INSTALLATION OF  
BOW THRUSTER COMPARTMENT FM-200 SYSTEM  
SAMPLING PORT  
MAIN DECK  
STBD SIDE  
LOOKING AFT  
SCALE 1 1/2"=1'-0"



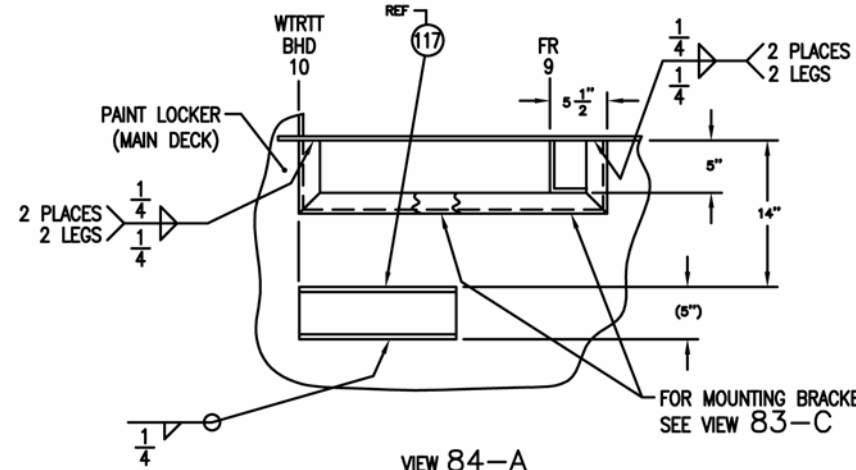
**VIEW 87-A**  
BOW THRUSTER COMPARTMENT FM-200 SYSTEM  
SAMPLING PORT STATION BOX  
SCALE 1 1/2"=1'-0"



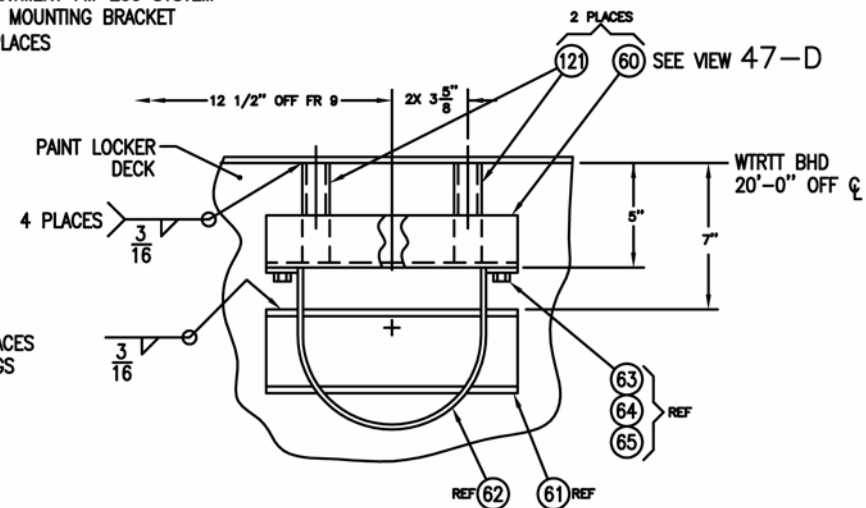
**VIEW 85-C**  
INSTALLATION OF  
BOW THRUSTER COMPARTMENT FM-200 SYSTEM  
SAMPLING PORT  
MAIN DECK  
LONG BHD 13'-4" OFF CL  
STBD SIDE  
LOOKING OUTBOARD  
SCALE 1 1/2"=1'-0"



**VIEW 83-C**  
BOW THRUSTER COMPARTMENT FM-200 SYSTEM  
FM-200 CYLINDER MOUNTING BRACKET  
2 PLACES



**VIEW 84-A**  
(79-B)  
BOW THRUSTER COMPARTMENT FM-200 SYSTEM  
FM-200 CYLINDER FOUNDATION  
AND MOUNTING BRACKET  
PAINT LOCKER  
MAIN DECK  
STBD SIDE  
LOOKING DOWN  
ITEMS NOT SHOWN  
OMITTED FOR CLARITY  
SCALE 1 1/2"=1'-0"

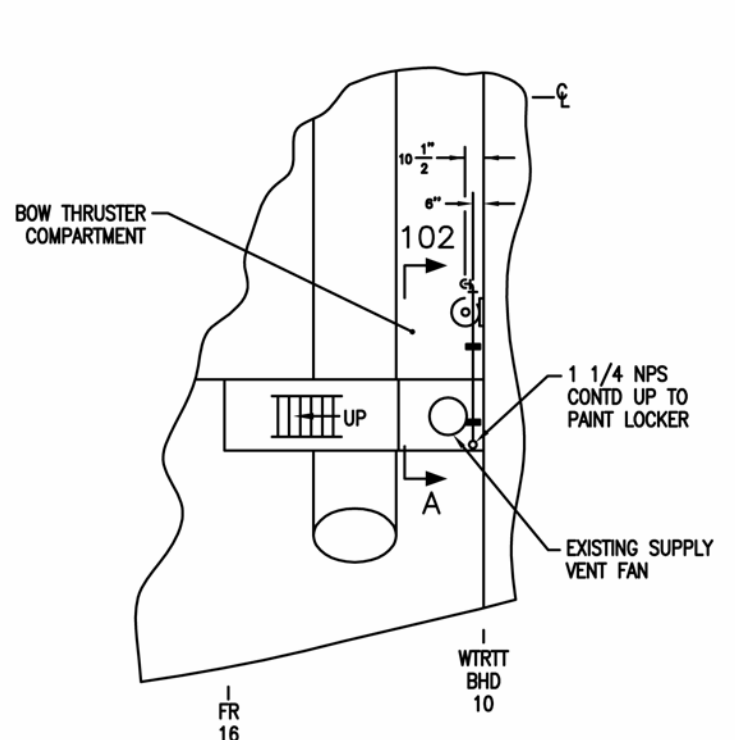


**VIEW 82-B**  
(79-B)  
BOW THRUSTER COMPARTMENT FM-200 SYSTEM  
CO2 CYLINDER FOUNDATION  
AND MOUNTING BRACKET  
PAINT LOCKER  
MAIN DECK  
STBD SIDE  
LOOKING DOWN  
ITEMS NOT SHOWN  
OMITTED FOR CLARITY

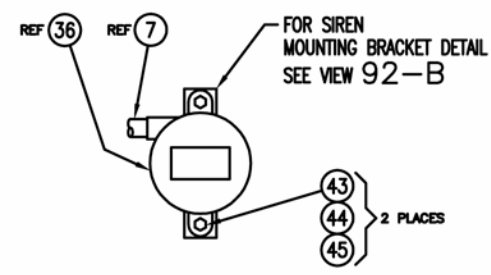
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	CONTRACT NUMBER DTR57-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±	CONTRACTOR 2R341	U.S. ARMY LSV FM-200 SYSTEM PIPING INSTALLATION AND DETAILS
DRAWN BY AM	DATE 3/23/98	SIZE D
CHECKER JS	ENGINEER MB	CAGE CODE 19207
CLASS DESIGN APPROVAL MARK GENTILE	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882	SCALE LSV-5553-1
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99		SHEET 11 OF 18



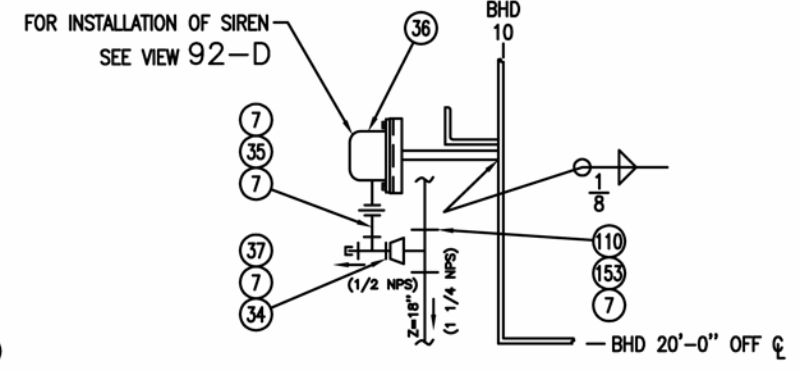
REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



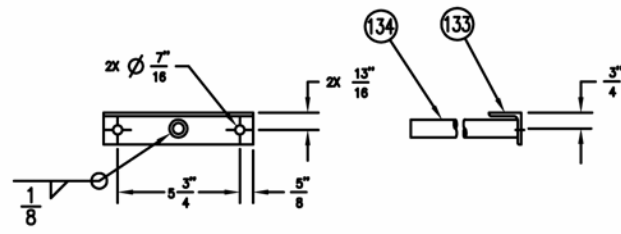
VIEW 95-C  
PAINT LOCKER FM-200 SYSTEM  
PIPING INSTALLATION AND DETAILS  
BOW THRUSTER COMPARTMENT  
SCALE 1/4"=1'-0"



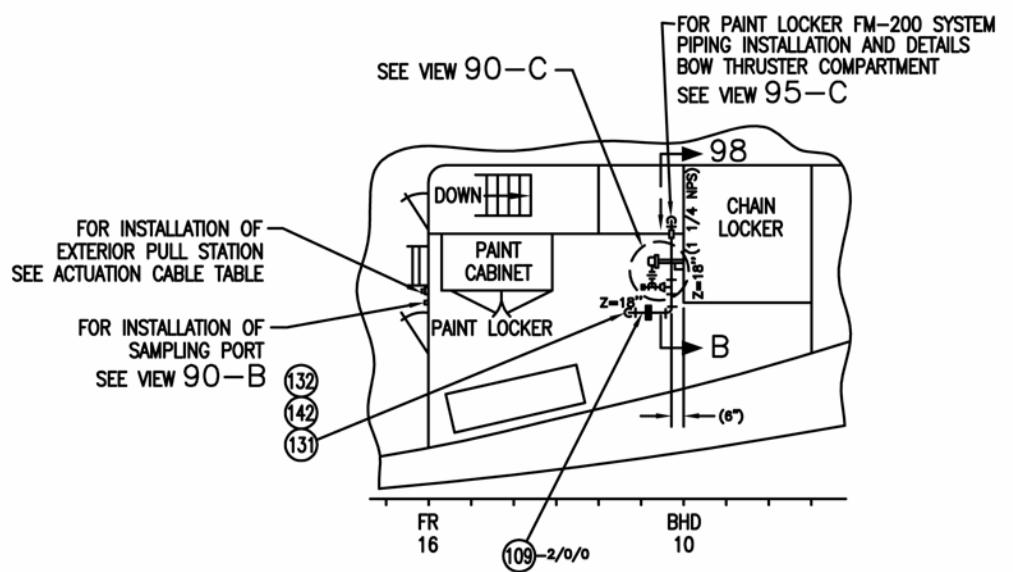
VIEW 92-D  
PAINT LOCKER FM-200 SYSTEM  
INSTALLATION OF SIREN



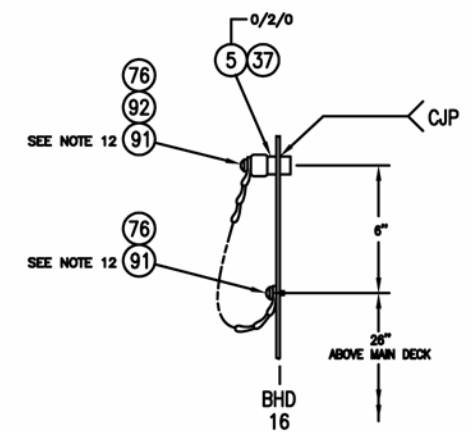
VIEW 90-C  
PAINT LOCKER FM-200 SYSTEM  
PIPING INSTALLATION AND DETAILS  
PAINT LOCKER  
SCALE 1 1/2"=1'-0"



VIEW 92-B  
SIREN MOUNTING BRACKET DETAIL



VIEW 94-A  
PAINT LOCKER FM-200 SYSTEM  
PIPING INSTALLATION AND DETAILS  
MAIN DECK  
SCALE 1/4"=1'-0"

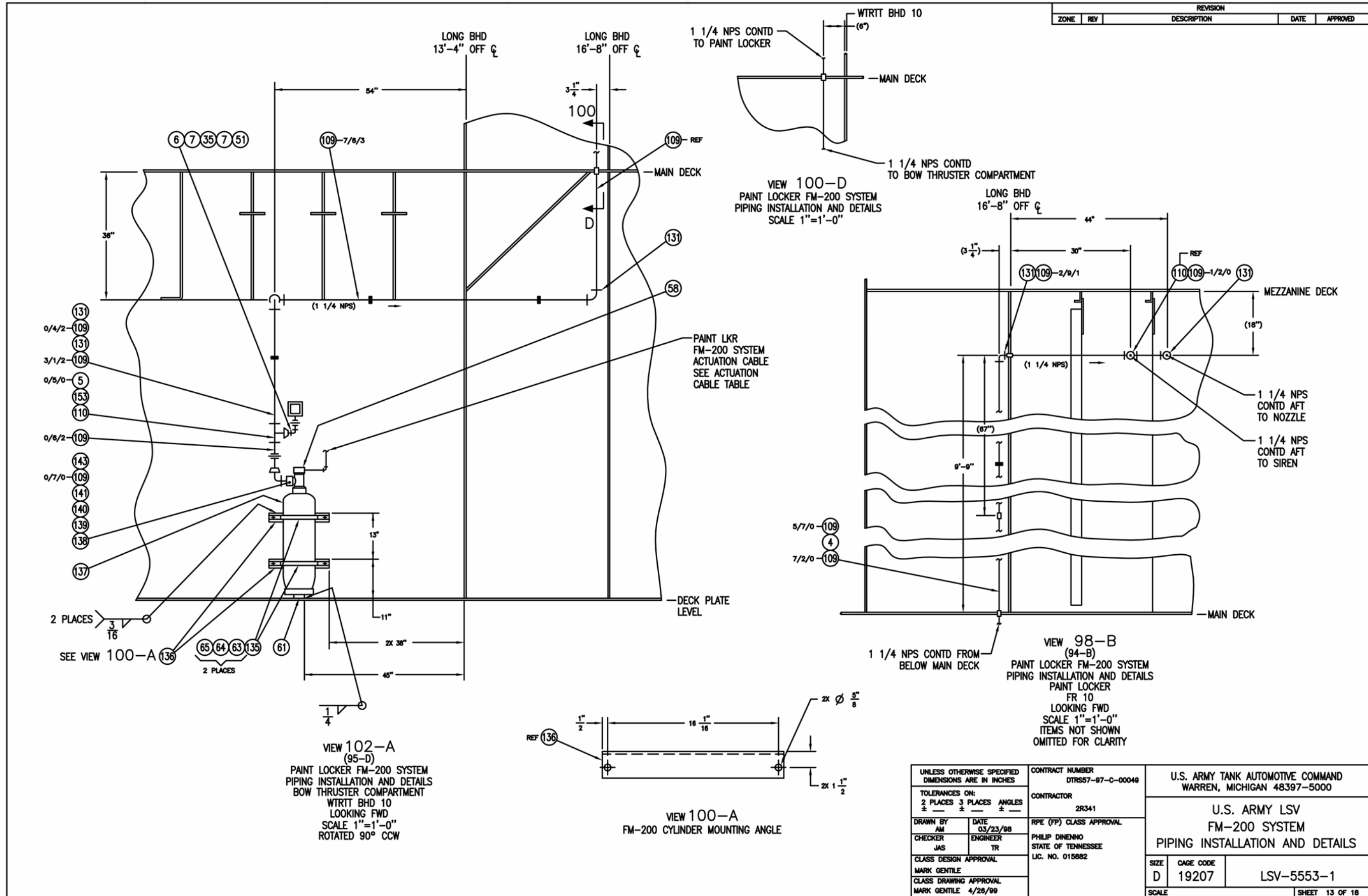


VIEW 90-B  
INSTALLATION OF PAINT LOCKER FM-200 SYSTEM  
SAMPLING PORT  
MAIN DECK  
LOOKING INBOARD  
20'-2" OFF CL

LOCAL NOTE:  
1. "■" INDICATES APPROXIMATE PIPE HANGERS LOCATION, SEE NOTE 7,  
2. FOR PIPE PENETRATION INSTALLATION AND DETAILS, SEE VIEW 15-C.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTRSS7-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±		CONTRACTOR 2R341	U.S. ARMY LSV FM-200 SYSTEM PIPING INSTALLATION AND DETAILS	
DRAWN BY AM	DATE 03/23/98	RPE (FP) CLASS APPROVAL	SIZE D	CAGE CODE 19207
CHECKER JS	ENGINEER AK	PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882	LSV-5553-1	
CLASS DESIGN APPROVAL MARK GENTILE		CLASS DRAWING APPROVAL MARK GENTILE 4/28/99	SCALE	SHEET 12 OF 18

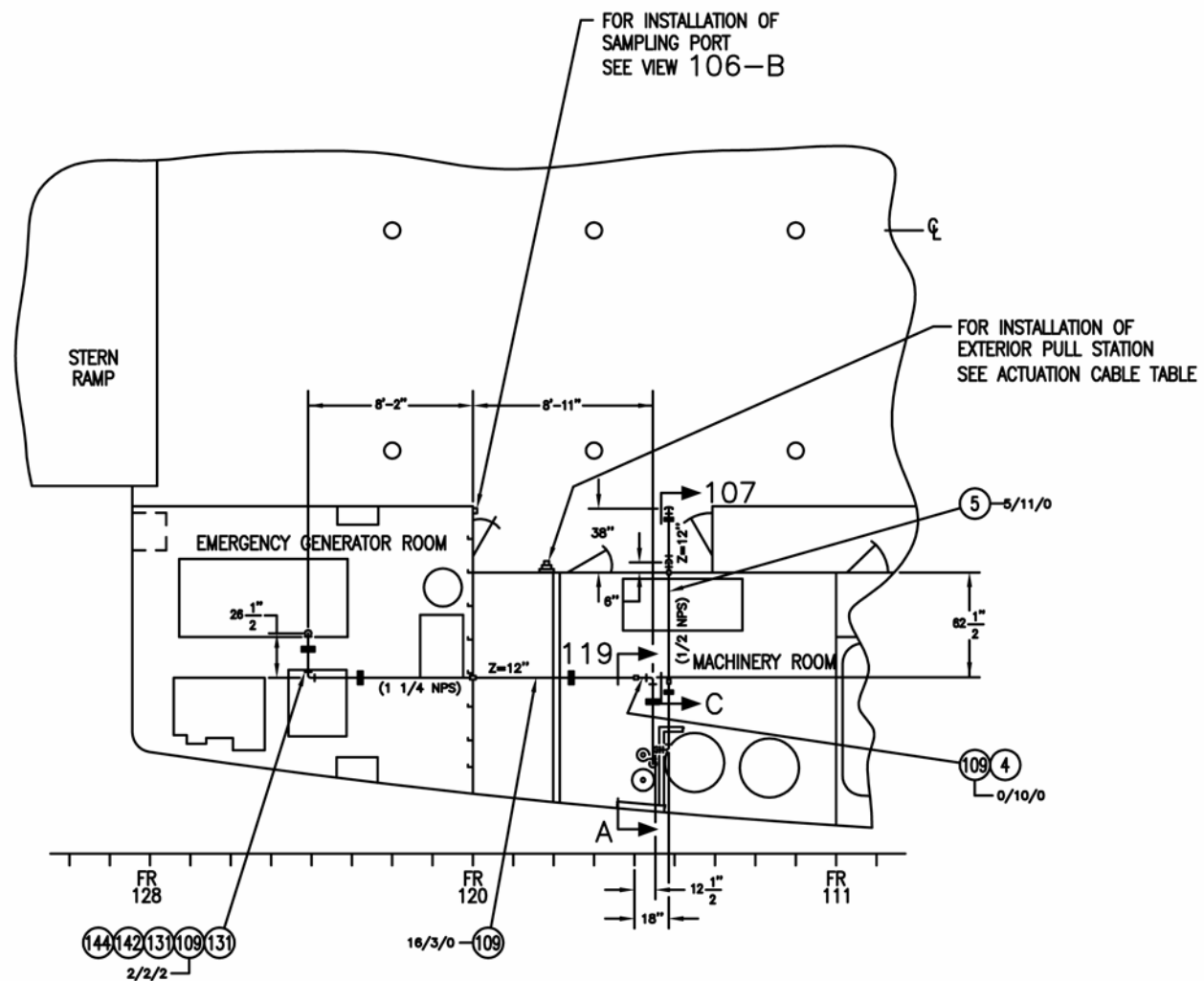






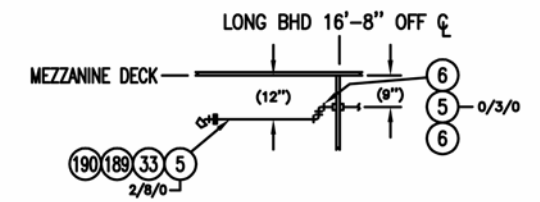


REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED

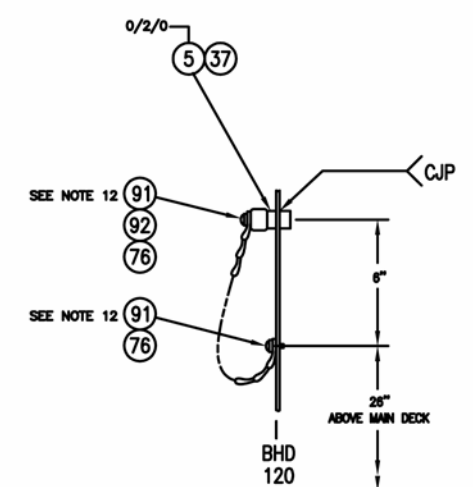


VIEW 110-A  
EMERGENCY GENERATOR ROOM FM-200 SYSTEM  
PIPING INSTALLATION AND DETAILS  
MAIN DECK  
SCALE 1/4"=1'-0"

LOCAL NOTE:  
1. "H" INDICATES APPROXIMATE PIPE HANGERS LOCATION, SEE NOTE 7,  
2. FOR PIPE PENETRATION INSTALLATION AND DETAILS, SEE VIEW 15-C.



VIEW 107-C  
CO2 VENT INSTALLATION  
LOOKING FORWARD  
SCALE 1/2"=1'-0"  
ROTATED 90° CCW

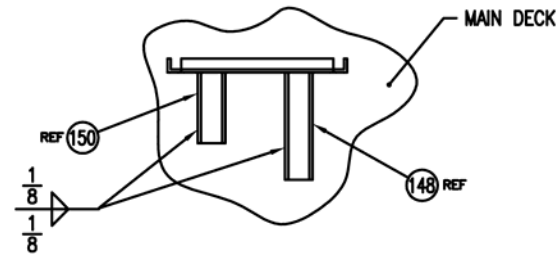


VIEW 106-B  
INSTALLATION OF EMERGENCY GENERATOR ROOM FM-200 SYSTEM  
SAMPLING PORT  
MAIN DECK  
LOOKING OUTBOARD  
BHD 120, 17'-3/4" OFF CL

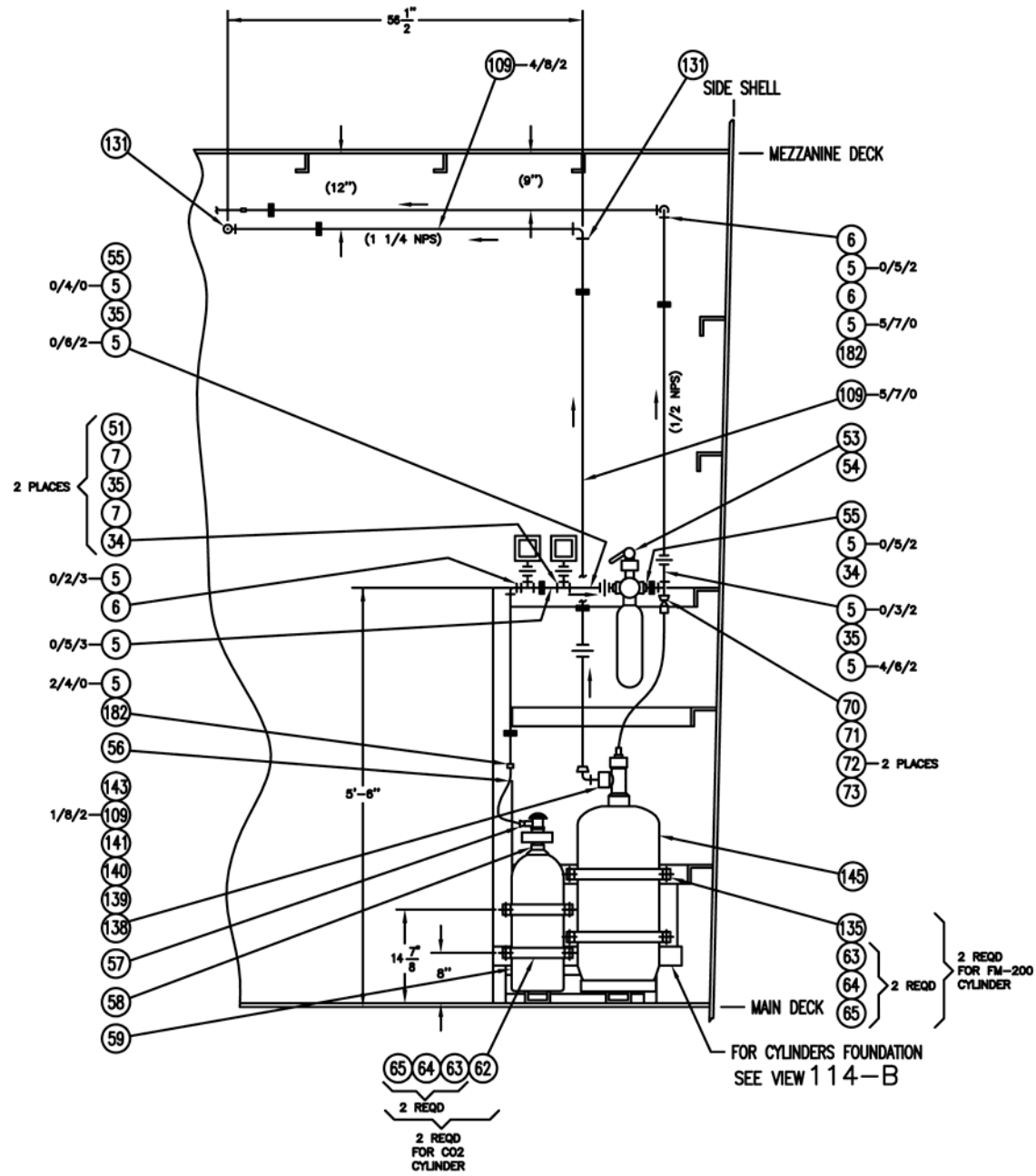
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTR557-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± — ± — ± —		CONTRACTOR 2R341	U.S. ARMY LSV FM-200 SYSTEM PIPING INSTALLATION AND DETAILS	
DRAWN BY AM	DATE 03/23/98	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882	SIZE D	CAGE CODE 19207
CHECKER JAS	ENGINEER TR		LSV-5553-1	
CLASS DESIGN APPROVAL MARK GENTILE			SCALE	SHEET 14 OF 18
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99				



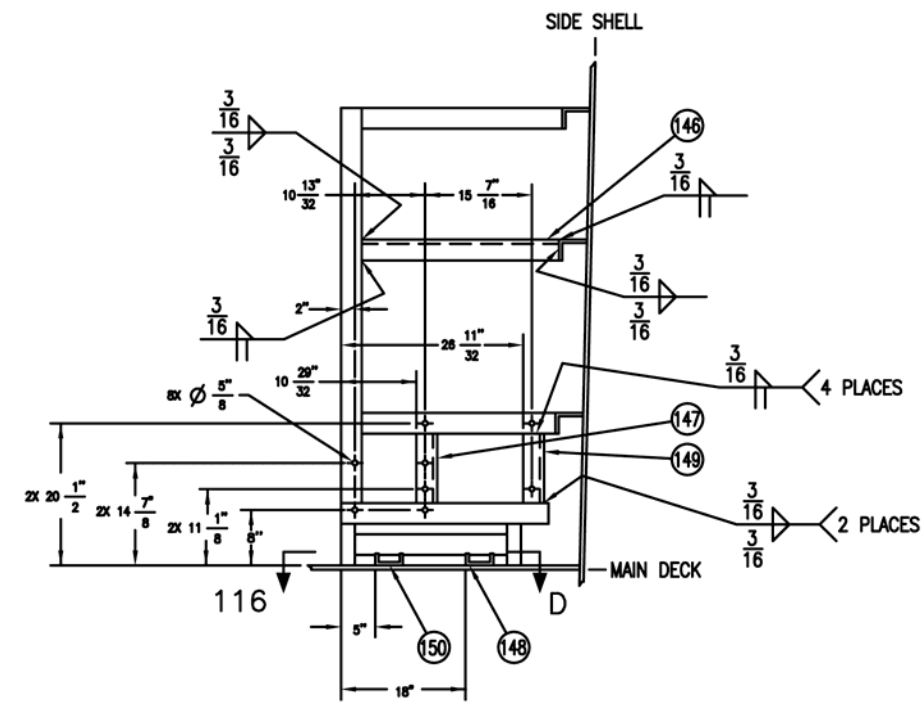
REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



VIEW 116-D  
EMERGENCY GENERATOR ROOM FM-200 SYSTEM  
CYLINDER DECK FOUNDATION  
SCALE 1"=1'-0"



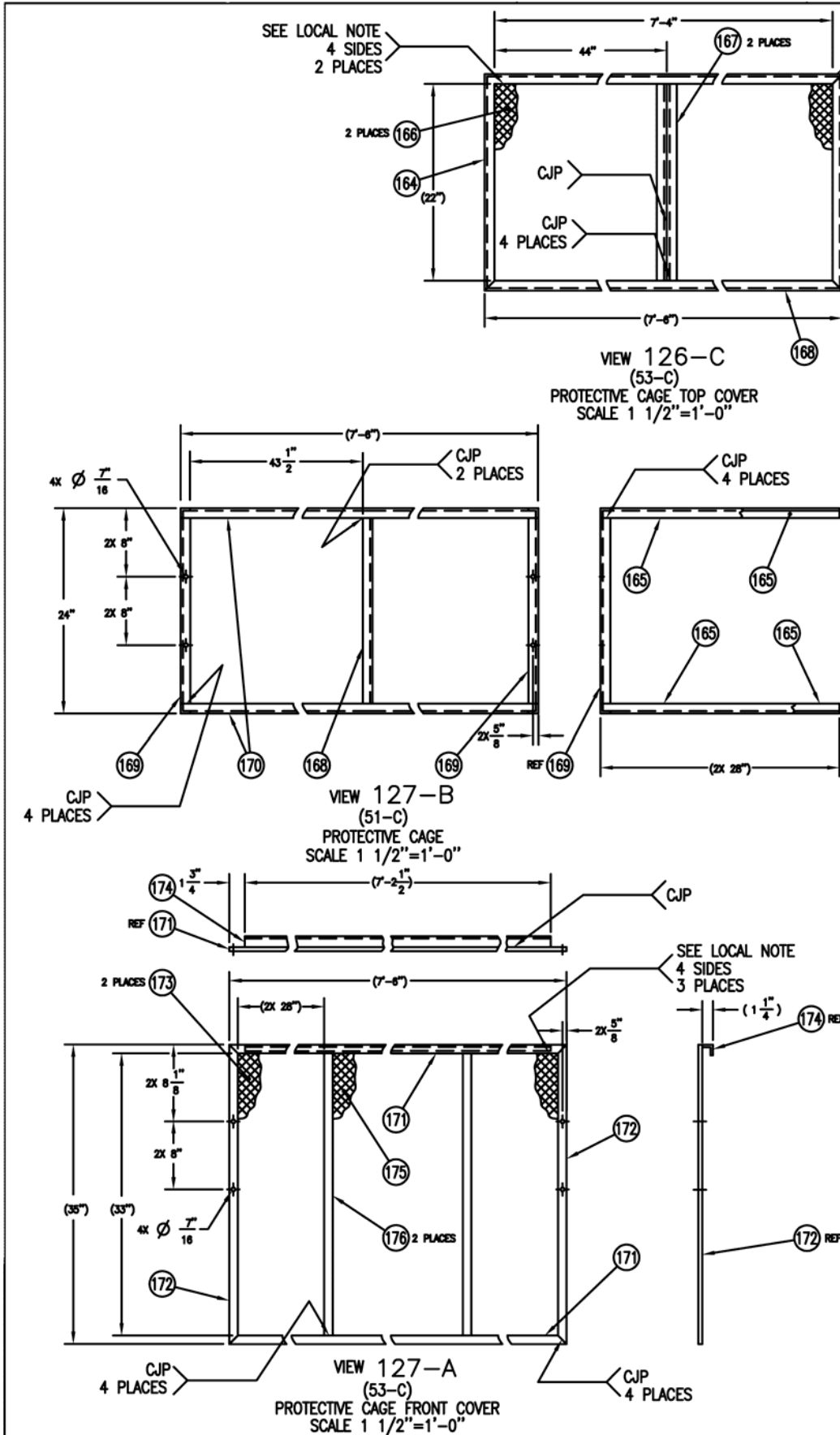
VIEW 119-A  
(110-B)  
EMERGENCY GENERATOR ROOM FM-200 SYSTEM  
PIPING INSTALLATION AND DETAILS  
MACHINERY ROOM  
MAIN DECK  
FR 115 1/2  
LOOKING FWD  
SCALE 1"=1'-0"  
ROTATED 90° CCW



VIEW 114-B  
EMERGENCY GENERATOR ROOM FM-200 SYSTEM  
CYLINDERS FOUNDATION  
MACHINERY ROOM  
FR 115 1/2  
LOOKING FWD  
SCALE 1"=1'-0"

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTR57-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±		CONTRACTOR 2R341	U.S. ARMY LSV FM-200 SYSTEM PIPING INSTALLATION AND DETAILS	
DRAWN BY AM	DATE 03/23/98	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015862	SIZE D	CAGE CODE 19207
CHECKER JAS	ENGINEER TR			LSV-5553-1
CLASS DESIGN APPROVAL MARK GENTILE				
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99				
SCALE			SHEET 15 OF 18	





LOCAL NOTE: WELD THE OVERLAPPING PORTION OF EXPANDED METAL, FIND NO. 166 OR 175, TO THE PROTECTIVE CAGE FRONT/TOP COVER FRAME WHERE POSSIBLE.

REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED

20 EA				199			20 EA	HANGER ASSY. SPLIT CAP. SGL LEG STDF. W/LINER 3 NPS	ASTM F 708	SEE NOTE 7	3.00
12 EA	3 EA			198			15 EA	HANGER ASSY. SPLIT CAP. SGL LEG STDF. W/LINER 2 1/2 NPS	ASTM F 708	SEE NOTE 7	2.50
	3 EA			197			3 EA	HANGER ASSY. SPLIT CAP. SGL LEG STDF. W/LINER 2 NPS	ASTM F 708	SEE NOTE 7	2.00
9 EA	2 EA	5 EA	6 EA	196			22 EA	HANGER ASSY. SPLIT CAP. SGL LEG STDF. W/LINER 1 1/4 NPS	ASTM F 708	SEE NOTE 7	1.25
4 EA	8 EA			195			12 EA	HANGER ASSY. SPLIT CAP. SGL LEG STDF. W/LINER 1 NPS	ASTM F 708	SEE NOTE 7	1.00
26 EA				194			26 EA	HANGER ASSY. SPLIT CAP. SGL LEG STDF. W/LINER 3/4 NPS	ASTM F 708	SEE NOTE 7	0.75
25 EA	8 EA		4 EA	193			37 EA	HANGER ASSY. SPLIT CAP. SGL LEG STDF. W/LINER 1/2 NPS	ASTM F 708	SEE NOTE 7	0.50
	2 EA			192			2 EA	ANGLE 1 1/2 X 1 1/2 X 1/4 STK. 25 1/4" L	ASTM A 36	STEEL	4.92
	2 EA			191	IDA54	981332	2 EA	PRESSURE SWITCH, EXPLOSION PROOF	COML (KIDDE)		3.00
1 EA	1 EA		1 EA	190	IDA54	264986	3 EA	FITTING, VENT. 1/16" DIA OPENING, 1/4 NPT	COML (KIDDE)		0.10
1 EA	1 EA		1 EA	189			3 EA	BUSHING, HEX HD, THD. 1/2 X 1/4 NPS, GALV	ASME B16.14	MI	0.10
	1 EA			188			1 EA	PLATE, 1/4 STK. 12" L X 5 1/8" W	ASTM A 36	STEEL	4.26
5 FT				187		M24643/16-02UN	5 FT	CABLE, ELECTRICAL, 1000 V, TYPE LSTSGU-4	MIL-C-24643/16		0.12
1 EA				186			1 EA	UNION, THD. CL 300, 3/4 NPS, GALV	ASME B16.39	MI	0.75
1 EA				185			1 EA	ELBOW, 45° THD. CL 300, 3 NPS, GALV	ASME B16.3	MI	6.00
2 EA				184			2 EA	COUPLING, THD. CL 3000, 3 NPS	ASME B16.11	STEEL	0.60
4 EA				183			4 EA	COUPLING, RDCR, THD. CL 300, CONC. 3 X 2 1/2 NPS, GALV	ASME B16.3	MI	1.60
5 EA	1 EA		2 EA	182			8 EA	COUPLING, THD. CL 3000, 1/2 NPS	ASME B16.11	STEEL	0.18
25 EA				181	39428	3015T21	25 EA	TUBE CLAMP ASSY. DAMPING, VIBRATION, WELD MOUNT, 1/4" OD TUBE	COML (McMASTER CARR)		1.00
4 EA	2 EA			180			6 EA	ANGLE, 3/4 X 3/4 X 1/8 STK. 12" L	ASTM A 36	STEEL	3.19
12 EA	6 EA			179			18 EA	SCREW, MACHINE, FLAT CTSK HD, SLOTTED, 1/4-20 UNC-2A X 3/4" L	ASME B18.6.3	GRES	-
4 EA	2 EA			178			6 EA	PLATE, TREAD, RAISED DIAMOND PATTERN, .188 STK, 3 7/8" L X 1 15/16" W	ASME B632	AL ALY	0.15
1 EA				177			1 EA	UNION, THD. CL 300, 3 NPS, GALV	ASME B16.39	MI	11.00
2 EA				176			2 EA	BAR, FLAT, 1/4 X 1 STK. 33" L	ASTM A 36	STEEL	2.34
1 EA				175			1 EA	EXPANDED METAL, FLATTENED, STYLE 1/4, NO. 18 GA, 30" L X 33" W	ASTM A 36	STEEL	7.84
1 EA				174			1 EA	ANGLE, 1 1/4 X 1 1/4 X 1/8 STK. 7'-2 1/2" L	ASTM A 36	STEEL	7.28
2 EA				173			2 EA	EXPANDED METAL, FLATTENED, STYLE 1/4, NO. 18 GA, 28" L X 33" W	ASTM A 36	STEEL	6.68
2 EA				172			2 EA	BAR, FLAT, 1/4 X 1 STK. 35" L	ASTM A 36	STEEL	2.48
2 EA				171			2 EA	BAR, FLAT, 1/4 X 1 STK. 7'-6" L	ASTM A 36	STEEL	6.38
4 EA				170			4 EA	ANGLE, 1 X 1 X 1/4 STK. 7'-6" L	ASTM A 36	STEEL	11.18
2 EA				169			2 EA	ANGLE, 1 X 1 X 1/4 STK. 22" L	ASTM A 36	STEEL	2.86
1 EA				168			1 EA	ANGLE, 1 X 1 X 1/4 STK. 22" L	ASTM A 36	STEEL	2.86
2 EA				167			2 EA	ANGLE, 1 X 1 X 1/4 STK. 22" L	ASTM A 36	STEEL	2.86
2 EA				166			2 EA	EXPANDED METAL, FLATTENED, STYLE 1/4, NO. 18 GA, 43" L X 22" W	ASTM A 36	STEEL	7.50
4 EA				165			4 EA	ANGLE, 1 X 1 X 1/4 STK. 28" L	ASTM A 36	STEEL	3.48
QUANTITY REQUIRED ENG RM	QUANTITY REQUIRED BT	QUANTITY REQUIRED PAINT LKR	QUANTITY REQUIRED EMER GEN	FIND NO.	CAGE CODE	PART OR IDENTIFYING NUMBER	TOTAL QUANTITY REQUIRED	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL	UNIT WEIGHT (LB)

PARTS LIST (CONTINUED FROM SHEET 3)

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	CONTRACT NUMBER DTR557-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±	CONTRACTOR 2R341	
DRAWN BY AM	DATE 03/23/98	U.S. ARMY LSV FM-200 SYSTEM PIPING INSTALLATION AND DETAILS
CHECKER ENGINEER JAS MB	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882	
CLASS DESIGN APPROVAL MARK GENTILE	CLASS DRAWING APPROVAL MARK GENTILE 4/26/99	SIZE D
		CAGE CODE 19207
		LSV-5553-1
		SCALE
		SHEET 16 OF 18



REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED

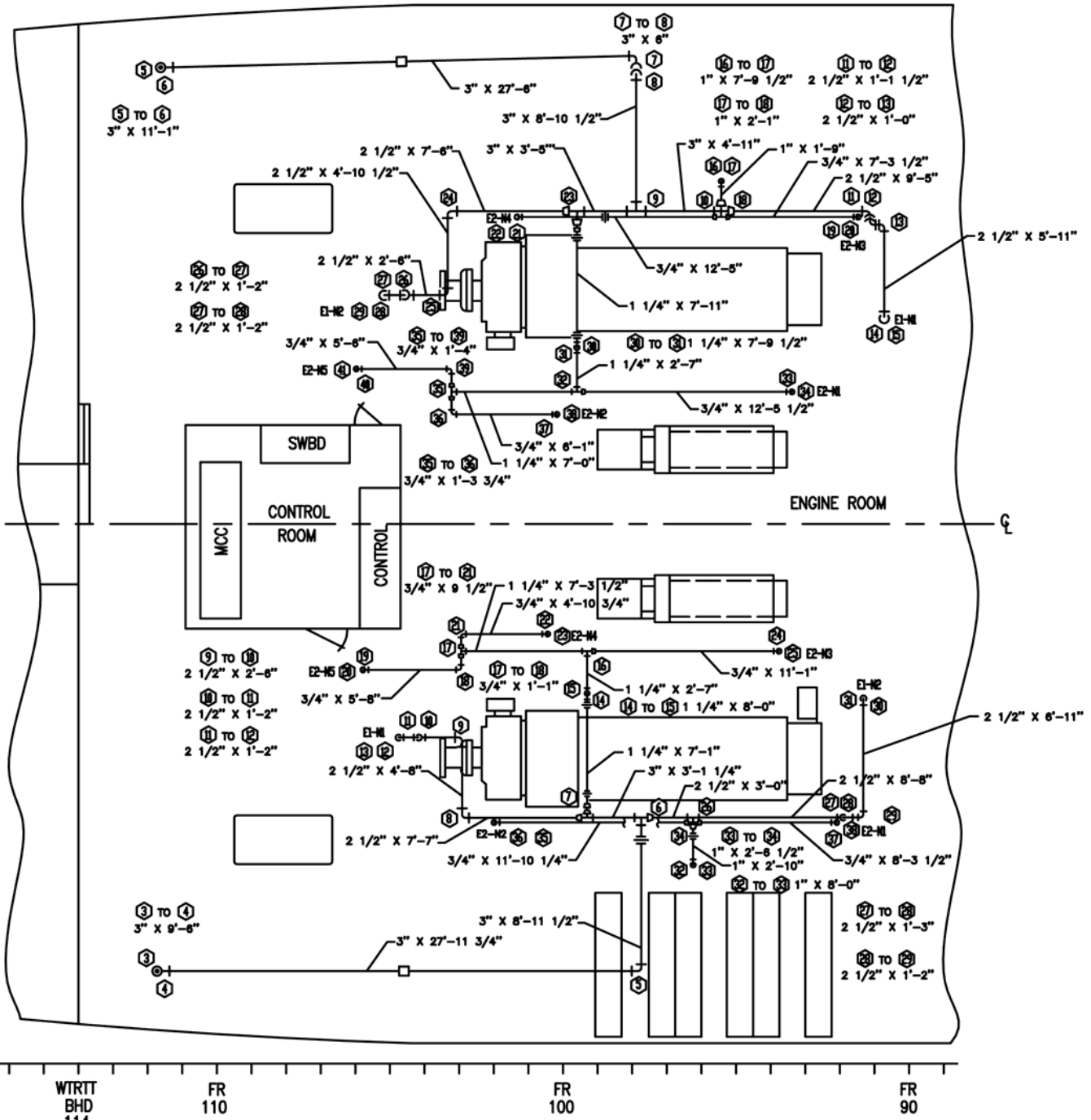


DIAGRAM 134-A  
ENGINE ROOM FM-200 SYSTEM  
MODELING AND FLOW ANALYSIS DIAGRAM  
BELOW MAIN DECK  
SCALE 1/4"=1'-0"

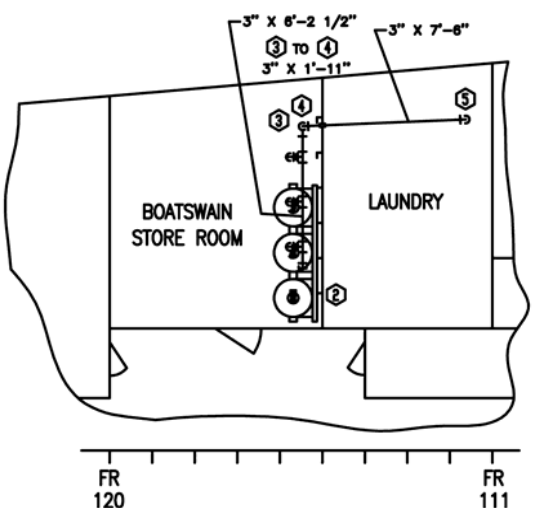


DIAGRAM 132-C  
ENGINE ROOM FM-200 SYSTEM  
MODELING AND FLOW ANALYSIS DIAGRAM  
MAIN DECK  
PORT SIDE  
SCALE 1/4"=1'-0"

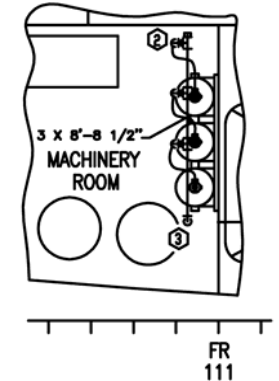


DIAGRAM 132-A  
ENGINE ROOM FM-200 SYSTEM  
MODELING AND FLOW ANALYSIS DIAGRAM  
MAIN DECK  
STBD SIDE  
SCALE 1/4"=1'-0"

NOZZLE FLOW CHART		
NODE POINT	DESCRIPTION	FLOW
13	STBD SIDE ENGINE ROOM E1-N1	327.6 Lbs.
20	E2-N5	30.9 Lbs.
23	E2-N4	31.0 Lbs.
25	E2-N3	31.0 Lbs.
31	E1-N2	327.5 Lbs.
36	E2-N2	31.0 Lbs.
38	E2-N1	31.0 Lbs.
PORT SIDE ENGINE ROOM		
15	E1-N1	327.6 Lbs.
41	E2-N5	30.9 Lbs.
22	E2-N4	31.0 Lbs.
20	E2-N3	31.0 Lbs.
29	E1-N2	327.5 Lbs.
38	E2-N2	31.0 Lbs.
34	E2-N1	31.0 Lbs.
BOW THRUSTER COMPARTMENT		
14	E1-N1	275.4 Lbs.
21	E2-N1	34.3 Lbs.
25	E2-N2	34.3 Lbs.
PAINT LOCKER		
8	E1-N1	91.0 Lbs.
EMERGENCY GENERATOR ROOM		
7	E1-N1	87.0 Lbs.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	CONTRACT NUMBER DTR557-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± — ± — ± —	CONTRACTOR 2R341	U.S. ARMY LSV FM-200 SYSTEM PIPING INSTALLATION AND DETAILS	
DRAWN BY AM	DATE 03/23/98	RPE (FP) CLASS APPROVAL	
CHECKER JAS	ENGINEER AK	PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882	
CLASS DESIGN APPROVAL MARK GENTILE	CLASS DRAWING APPROVAL MARK GENTILE 4/26/99	SIZE D	CAGE CODE 19207
		SCALE LSV-5553-1	
		SHEET 17 OF 18	





REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED

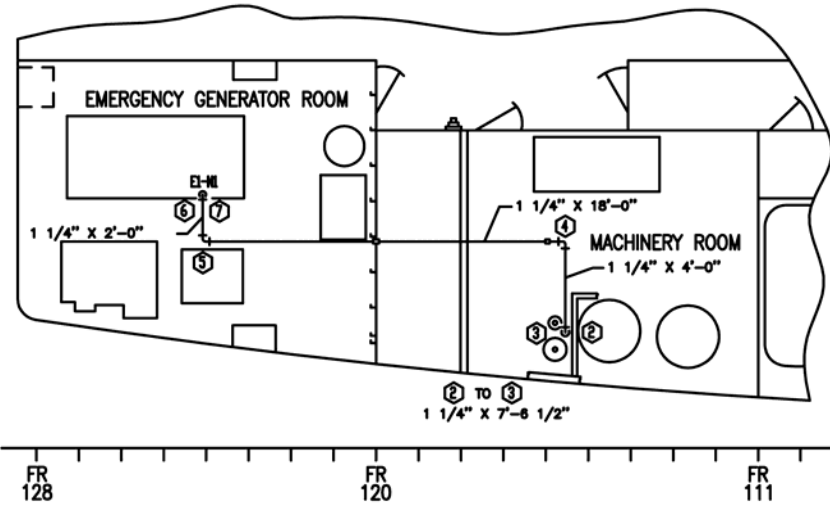


DIAGRAM 142-C  
EMERGENCY GENERATOR ROOM FM-200 SYSTEM  
MODELING AND FLOW ANALYSIS DIAGRAM  
MAIN DECK  
SCALE 1/4"=1'-0"

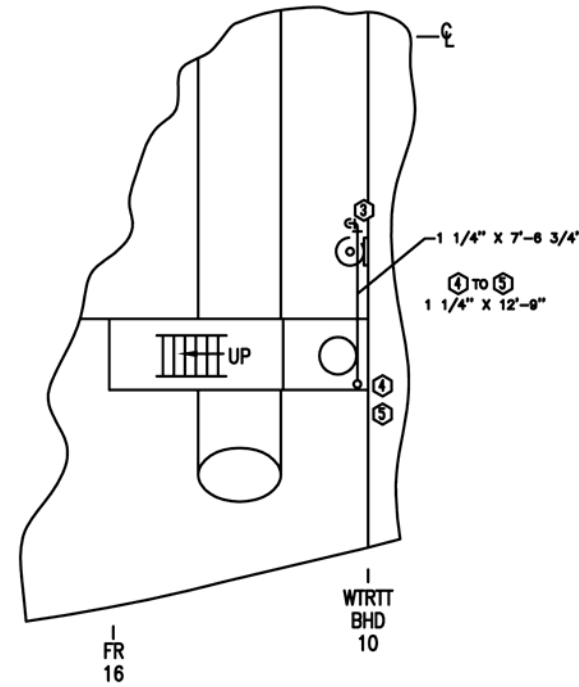


DIAGRAM 139-C  
PAINT LOCKER FM-200 SYSTEM  
MODELING AND FLOW ANALYSIS DIAGRAM  
BELOW MAIN DECK  
SCALE 1/4"=1'-0"

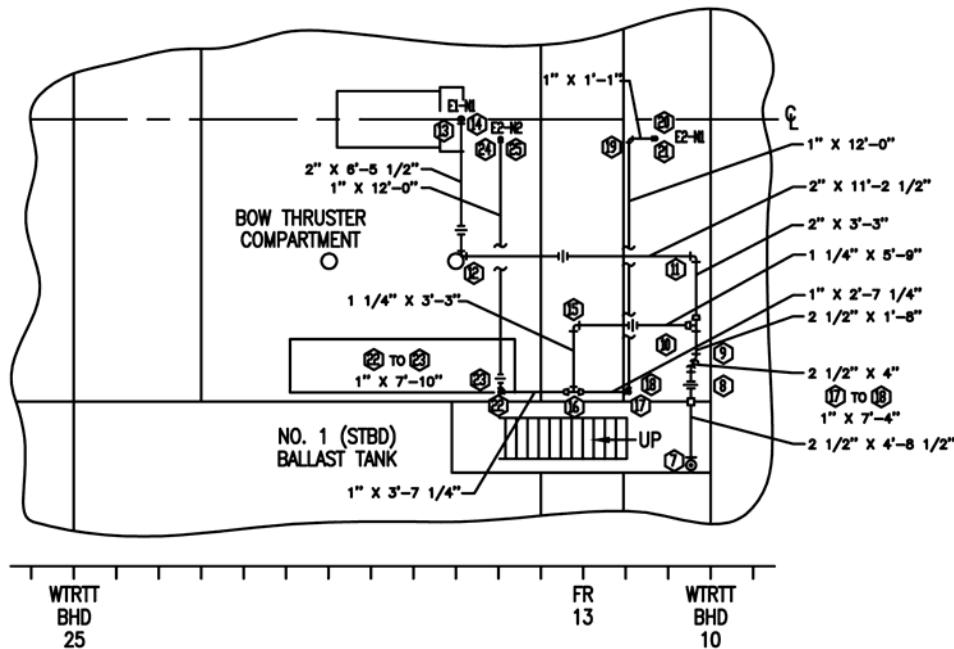


DIAGRAM 143-A  
BOW THRUSTER COMPARTMENT FM-200 SYSTEM  
MODELING AND FLOW ANALYSIS DIAGRAM  
BELOW MAIN DECK  
SCALE 1/4"=1'-0"

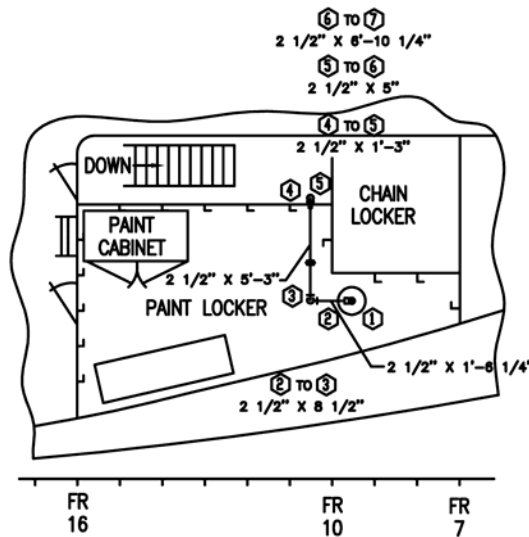


DIAGRAM 140-A  
BOW THRUSTER COMPARTMENT FM-200 SYSTEM  
MODELING AND FLOW ANALYSIS DIAGRAM  
MAIN DECK  
SCALE 1/4"=1'-0"

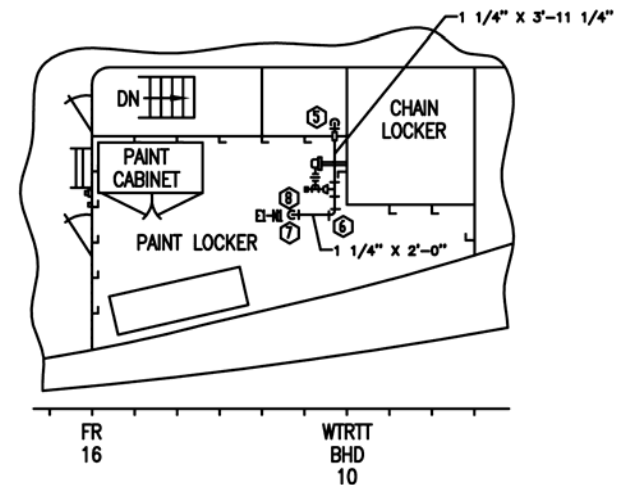


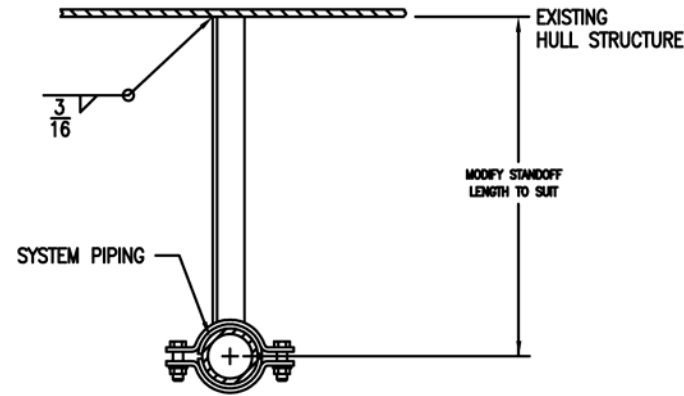
DIAGRAM 138-A  
PAINT LOCKER FM-200 SYSTEM  
MODELING AND FLOW ANALYSIS DIAGRAM  
MAIN DECK  
SCALE 1/4"=1'-0"

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	CONTRACT NUMBER DTRS57-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000		
	CONTRACTOR 2R341			
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ± ± ±	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882	U.S. ARMY LSV FM-200 SYSTEM PIPING INSTALLATION AND DETAILS		
DRAWN BY AM	DATE 3/23/98			
CHECKER JAS	ENGINEER AK	SIZE D	CAGE CODE 19207	LSV-5553-1
CLASS DESIGN APPROVAL MARK GENTILE	CLASS DRAWING APPROVAL MARK GENTILE 4/28/99	SCALE	SHEET 18 OF 18	



NOTES:

- THIS DRAWING HAS BEEN DEVELOPED AS AN INSTALLATION DRAWING FOR MISCELLANEOUS MODIFICATIONS ASSOCIATED WITH THE FM-200 FIRE SUPPRESSION SYSTEM ON THE U.S. ARMY LOGISTICS SUPPORT VESSEL (LSV).
- ALL WORK SHALL BE PERFORMED UTILIZING GOOD COMMERCIAL PRACTICES AND SHALL SATISFY THE STANDARDS, REGULATIONS, REQUIREMENTS, AND RECOMMENDED PRACTICES OF THE CODE OF FEDERAL REGULATIONS (CFR) AND THE STATEMENT OF WORK ASSOCIATED WITH THIS CONTRACT.
- NEWLY INSTALLED MATERIAL, EQUIPMENT, AND DISTURBED AREAS SHALL BE CLEANED, PAINTED, AND MARKED USING DEPARTMENT OF THE ARMY TECHNICAL BULLETIN TB 43-0144, PAINTING OF WATERCRAFT, AS A GUIDE.
- PIPING MUST BE REAMED FREE OF BURRS AND RIDGES AFTER CUTTING, WELDING, OR THREADING. ALL THREADED JOINTS SHALL CONFORM TO AMERICAN NATIONAL STANDARD TAPER PIPE THREADS IN ACCORDANCE WITH ASME B1.20.1. JOINT COMPOUND OR THREAD TAPE SHALL BE APPLIED ONLY TO MALE PIPE THREADS, EXCLUDING THE FIRST TWO THREADS.
- EXISTING INSULATION DISTURBED OR DAMAGED BY THIS INSTALLATION SHALL BE REPLACED OR REPAIRED TO A LIKE NEW CONDITION.
- DOOR SWEEP, FIND NO. 24, SHALL BE CUT TO LENGTH TO ACCOMMODATE EXISTING STEEL DOOR AND FIRE HOSE PORT.
- TEMPLATE MOUNTING HOLES FROM DOOR SWEEP, FIND NO. 24, DRILL HOLES AND ASSEMBLE USING HARDWARE FURNISHED WITH DOOR SWEEP.
- REMOVE AND DISCARD EXISTING LOUVER AND HARDWARE.
- PULL BOX, FIND NO. 16, SHALL BE PAINTED YELLOW, SO AS TO NOT BE CONFUSED WITH FM-200 SYSTEM PULL BOX.
- PIPE HANGERS: ALL PIPING SHALL BE SUPPORTED BY PIPE HANGERS TO PREVENT VIBRATION AND PROTECT AGAINST DAMAGE. PIPE HANGERS SHALL BE DESIGNED TO SUPPORT FIVE TIMES THE WEIGHT OF THE PIPE WHEN FILLED WITH WATER PLUS 250 LB. AT EACH POINT OF PIPING SUPPORT. PIPE HANGERS SHALL BE IN ACCORDANCE WITH ASTM F 708 (SEE VIEW 5-C):  
 - STANDOFF: ANGLE, 42° L  
 - LINER: SYNTHETIC RUBBER - NUTS: NYLOCK OR EQUIVALENT  
 - FINISH: PRIMER  
 SPACING OF PIPE HANGERS SHALL BE IN ACCORDANCE WITH TABLE 2, ASTM F 708 TITLED; PIPE HANGER SPACING. SPACING OF PIPE HANGERS AS DISCLOSED IN THE FIELD OF THE DRAWING BY SYMBOL "H" ARE FOR GUIDANCE ONLY.



VIEW 5-C  
TYPICAL PIPE HANGER ASSEMBLY  
NOT TO SCALE

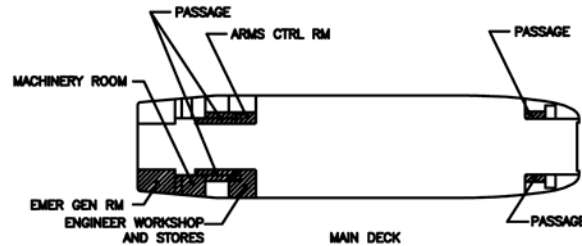
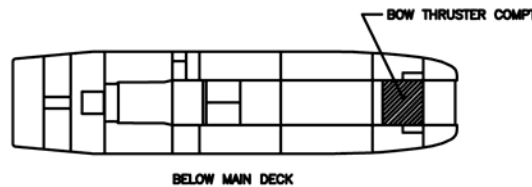
PIPE SIZE	HANGER ASSEMBLY FIND NO.
3/8 NPS	33

ACTUATION CABLE TABLE

SYSTEM CABLE	COMPONENT/LOCATION
ENGINE ROOM PORT SIDE VENT	VENT CLOSURE MECHANISM BHD 102
	INTERIOR PULL STATION SEE VIEW 29-A
ENGINE ROOM STBD SIDE VENT	VENT CLOSURE MECHANISM
	LONG BHD 16"-8" OFF CL. INTERIOR PULL STATION SEE VIEW 26-C

ACTUATION CABLE RUN SHALL BE MADE USING PIPE, FIND NO. 28, COUPLING, FIND NO. 29, CORNER PULLEY, FIND NO. 30, NIPPLE, FIND NO. 31, PIPE HANGER, FIND NO. 33, AND CABLE, FIND NO. 32.

NOMINAL PIPE SIZE (IN.)	HANGER SPACING (FT.)
1/2" NPS	5 FEET
3/4" NPS	5 FEET
1" NPS	6 FEET
1 1/4" NPS	6 FEET
1 1/2" NPS	6 FEET
2" NPS	8 FEET
2 1/2" NPS	8 FEET
3" NPS	8 FEET
3 1/2" NPS	8 FEET
4" NPS	8 FEET



SHEETS					STATUS OF REVISION				
6	5	4	3	2	ZONE	REV	DESCRIPTION	DATE	APPROVED

33		8 EA	HANGER ASSY, SPLIT CAP, SGL LEG STDF, W/LINER 3/8 NPS	ASTM F 708	SEE NOTE 10	0.65
32	IDA54 15900002	130 FT	CABLE, 1/16"	COML (KIDDE)	CRES	-
31		2 EA	NIPPLE, THD, CLOSE, 3/8 NPS, GALV	ASTM A 733	STEEL	0.05
30	IDA54 803808	12 EA	CORNER PULLEY, WATERTIGHT	COML (KIDDE)		1.00
29		1 EA	COUPLING, THD, CL 3000, 3/8 NPS	ASME B16.11	STEEL	0.20
28		130 FT	PIPE, SMLS, .675 OD X .091 WALL, GALV (3/8 NPS)	ASTM A 53	STEEL	0.57
27	39428 90048A196	1 EA	SCREW, TAPPING, FLAT, 82° CTSK HD, PHILLIPS, TYPE A, SHARP POINT, NO. 10 X 5/8" L, ZINC PL (PKG OF 100)	COML (McMASTER CARR)	STEEL	-
26	39428 1142A11	4 EA	GASKET, DOOR, COMPRESSION, EXTRUDED BLACK, 12 FT	COML (McMASTER CARR)	RUBBER	-
25		45 FT	BAR, FLAT, 1/8 X 1/2 STK	ASTM A 36	STEEL	0.21
24	39428 17815A53	2 EA	DOOR SWEEP, SINGLE FLAP NEOPRENE INSERT, CRES FLANGE	COML (McMASTER CARR)		-
23		1 EA	SHEET, 10 GAUGE (.1345), 13 3/4" X 13 3/4"	ASTM A 569	STEEL	7.39
22		20 EA	WASHER, LOCK, HLCL SPR, RGLR, NO. 10 NOM, ZINC PL	ASME B18.21.1	STEEL	-
21	39428 92470A242	1 EA	SCREW, TAPPING, PAN HD PHILLIPS, TYPE A, SHARP POINT, NO. 10 X 1/2" L, ZINC PL (PKG OF 100)	COML (McMASTER CARR)	STEEL	-
20	39428 2030K111	1 EA	DAMPER, BACKRAFT, MANUAL ACTUATOR, STD FLANGE, A=12", B=12", GALV	COML (McMASTER CARR)		20.00
19		4 EA	NUT, HEX, 1/4-20 UNC-2B, GRADE 8, ZINC CTD	ASME B18.2.2	STEEL	-
18		4 EA	WASHER, LOCK, HLCL SPR, RGLR, 1/4 NOM, ZINC PL	ASME B18.22.1	STEEL	-
17		4 EA	SCREW, MACHINE, FLAT, 80° CTSK HD, 1/4-20 UNC-2A X 3/4" L, ZINC CTD	ASME B18.6.3	STEEL	-
16	IDA54 871403	2 EA	PULL BOX, BREAK GLASS	COML (KIDDE)		5.00
15		3 EA	NUT, HEX, 5/16-18 UNC-2B, GRADE 8, ZINC CTD	ASME B18.2.2	STEEL	-
14		6 EA	WASHER, PLAIN, TYPE B, RGLR, 5/16 NOM, ZINC PL	ASME B18.22.1	STEEL	-
13		6 EA	WASHER, LOCK, HLCL SPR, RGLR, 5/16 NOM, ZINC PL	ASME B18.22.1	STEEL	-
12	B1821BH031C125N	3 EA	SCREW, CAP, HEX HD, 5/16-18 UNC-2A X 1 1/4" L, GRADE 8, ZINC CTD	ASME B18.2.1	STEEL	-
11		1 EA	SHEET, 10 GAUGE (.1345), 5" X 12" L	ASTM A 569	STEEL	2.34
10		2 EA	CONDUIT, CABLE, FLARED END, 3/8 NPS	COML (ANSUL)	BRASS	-
9	39428 3755T15	1 EA	SLEEVE, OVAL, COMPRESSION, 1/8" (PKG OF 10)	COML (McMASTER CARR)	CRES	0.10
8		1 EA	BAR, FLAT, 3/4 X 1 1/2 STK, 31" L	ASTM A 36	STEEL	9.88
7		1 EA	BAR, FLAT, 1/4 X 1 1/2 STK, 31" L	ASTM A 36	STEEL	3.29
6		2 EA	ANGLE, 6 X 3 1/2 X 5/16 STK, 26" L	ASTM A 36	STEEL	21.23
5	39428 2030K999	1 EA	DAMPER, BACKRAFT AUTOMATIC, STD FLANGE, A=31", B=23", GALV	COML (McMASTER CARR)		20.00
4		1 EA	BAR, FLAT, 1/4 X 1 1/2 STK, 31" L	ASTM A 36	STEEL	3.29
3		34 EA	WASHER, PLAIN, TYPE B, RGLR, 1/4 NOM, ZINC PL	ASME B18.22.1	STEEL	-
2	39428 90096A540	1 EA	SCREW, TAPPING, HEX WASHER HD, TYPE F, BLUNT POINT, SLTD, 1/4-20 UNC-2A X 3/4" L (PKG OF 100)	COML (McMASTER CARR)	STEEL	-
1	39428 2030K121	1 EA	DAMPER, BACKRAFT AUTOMATIC, STD FLANGE, A=30", B=30", GALV	COML (McMASTER CARR)		20.00

DISTRIBUTION STATEMENT A  
APPROVED FOR PUBLIC RELEASE;  
DISTRIBUTION IS UNLIMITED.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± .005 ± .005 ± .005		DTR57-97-C-00049	
DRAWN BY AM DATE 03/23/98		CONTRACTOR 2R341	
CHECKED BY JS ENGINEER TR 4/28/99		RPE (FP) CLASS APPROVAL	
CLASS DESIGN APPROVAL MARK GENTILE		PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882	
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99			

U.S. ARMY TANK AUTOMOTIVE COMMAND  
WARREN, MICHIGAN 48397-5000

U.S. ARMY LSV  
FM-200 SYSTEM  
MISCELLANEOUS MODS

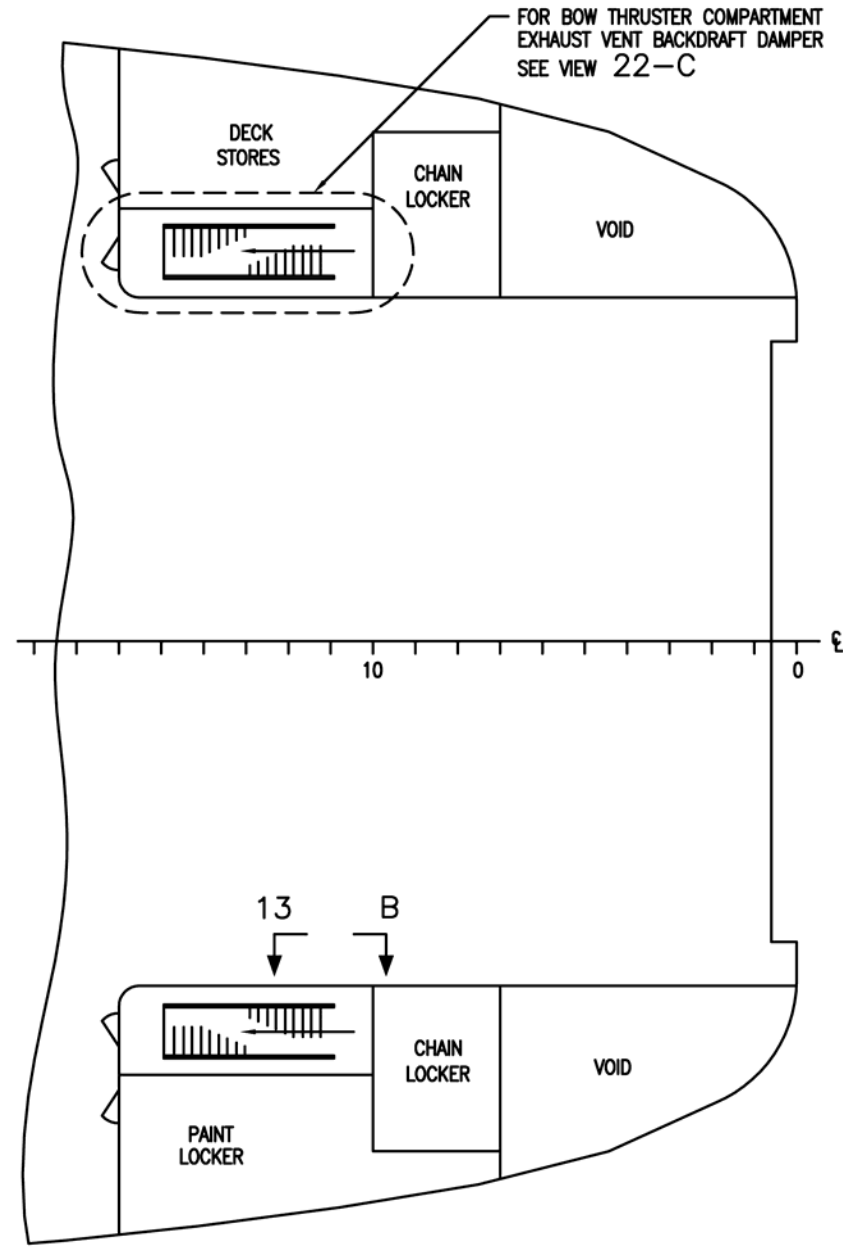
SIZE	CAGE CODE	SCALE	SHEET
D	19207	1 1/2" = 1'-0"	1 OF 8

NO.	DRAWING TITLE	DRAWING NUMBER
1	FM-200 LABEL PLATES AND PLACARDS	LSV-5553-4

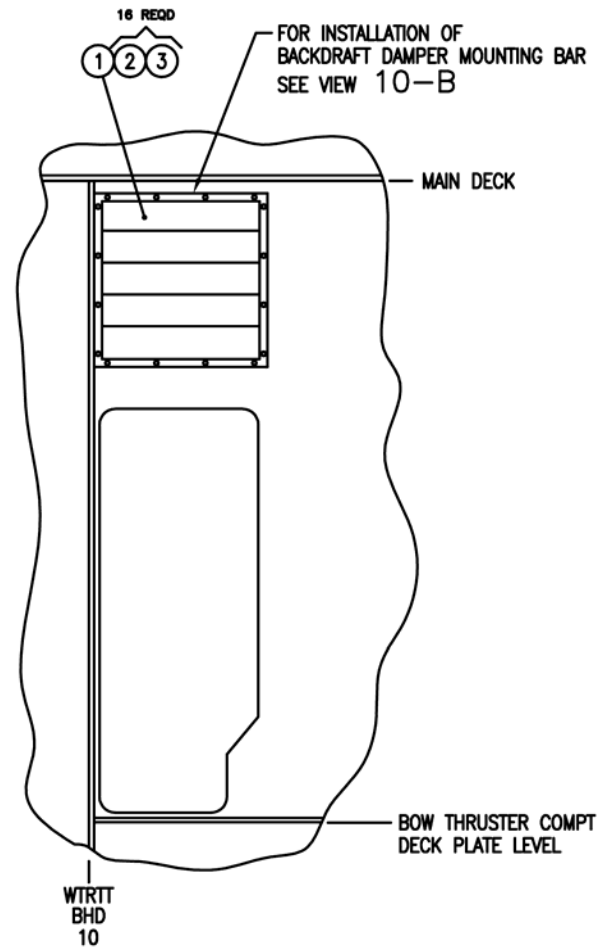
LIST OF REFERENCES



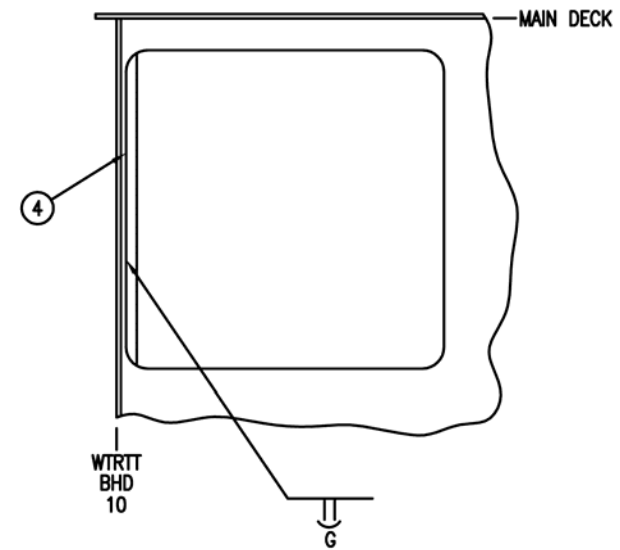
ZONE		REV	REVISION DESCRIPTION	DATE	APPROVED



VIEW 15-A  
INSTALLATION OF BOW THRUSTER COMPARTMENT  
SUPPLY AND EXHAUST VENT BACKDRAFT DAMPERS  
MAIN DECK/FOCSLE DECK  
SCALE 1/4"=1'-0"



VIEW 13-B  
BOW THRUSTER COMPARTMENT  
SUPPLY VENT BACKDRAFT DAMPER  
LONG BHD 13'-4" OFF E  
STBD SIDE  
LOOKING OUTBOARD  
SCALE 3/4"=1'-0"  
ITEMS NOT SHOWN  
OMITTED FOR CLARITY  
ROTATED 180°

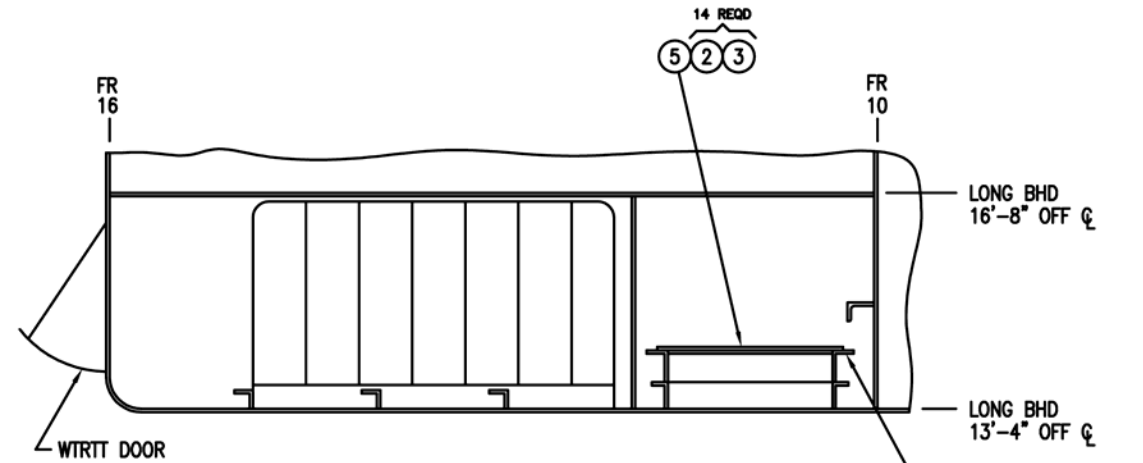


VIEW 10-B  
INSTALLATION OF BACKDRAFT DAMPER  
MOUNTING BAR  
BOW THRUSTER COMPARTMENT  
STBD SIDE  
LOOKING OUTBOARD  
ITEMS NOT SHOWN  
OMITTED FOR CLARITY

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTR57-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±		CONTRACTOR 2R341	U.S. ARMY LSV FM-200 SYSTEM MISCELLANEOUS MODS	
DRAWN BY BO	DATE 03/23/98	RPE (FP) CLASS APPROVAL	SIZE D	CAGE CODE 19207
CHECKER JS	ENGINEER TR	PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882	LSV-5553-2	
CLASS DESIGN APPROVAL MARK GENTILE		CLASS DRAWING APPROVAL MARK GENTILE 4/26/99	SCALE	
CLASS DRAWING APPROVAL MARK GENTILE 4/26/99			SHEET 2 OF 6	

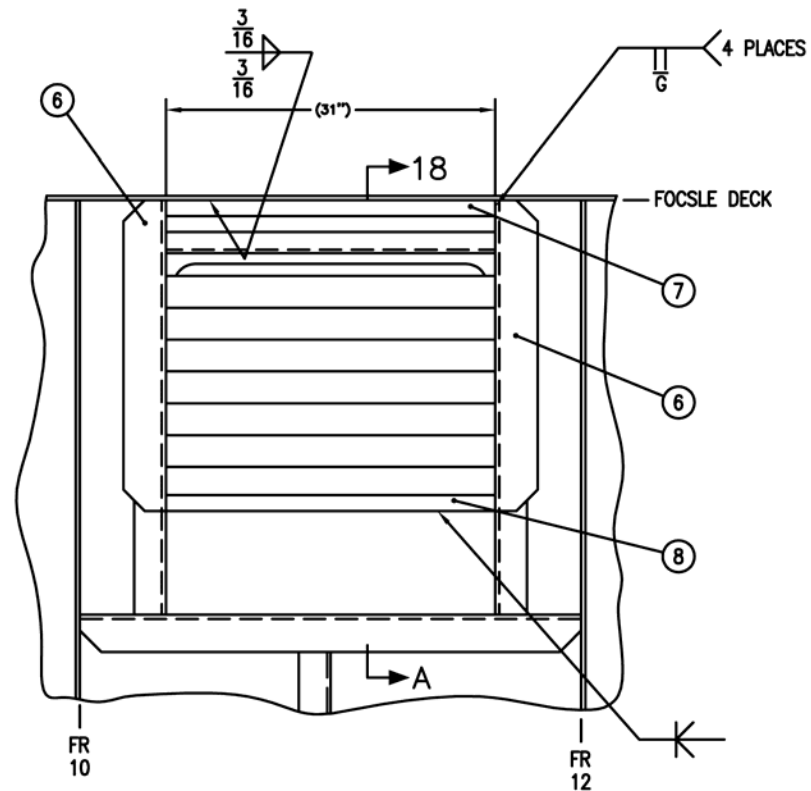


REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED

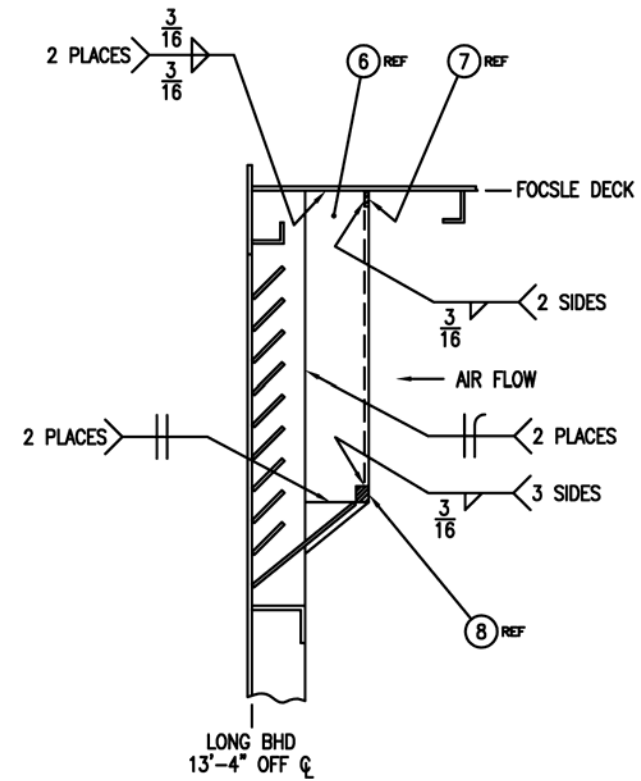


VIEW 22-C  
(14-D)  
BOW THRUSTER COMPARTMENT  
EXHAUST VENT BACKDRAFT DAMPER  
MAIN DECK/FOCSLE DECK  
PORT SIDE  
SCALE 3/4"=1'-0"

FOR INSTALLATION OF  
BACKDRAFT DAMPER  
MOUNTING ANGLES  
SEE VIEW 22-A



VIEW 22-A  
INSTALLATION OF BACKDRAFT DAMPER  
MOUNTING ANGLES  
BOW THRUSTER COMPARTMENT  
EXHAUST VENT TRUNK  
LONG BHD 13'-4" OFF Q  
LOOKING INBOARD



SECTION 18-A  
LOOKING AFT

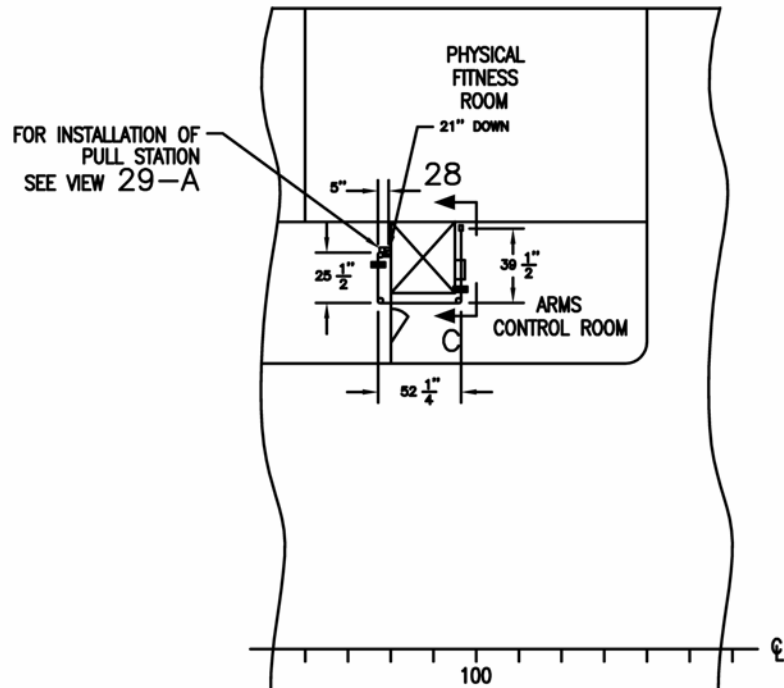
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTR557-97-C-00049		U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±		CONTRACTOR 2R341		U.S. ARMY LSV FM-200 SYSTEM MISCELLANEOUS MODS	
DRAWN BY AM	DATE 03/23/98	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882		SIZE D	CAGE CODE 19207
CHECKER JAS/QC	ENGINEER TR	CLASS DESIGN APPROVAL MARK GENTILE		LSV-5553-2	
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99		SCALE		SHEET 3 OF 6	



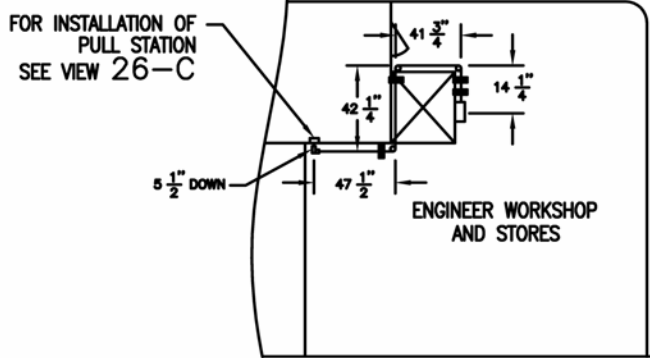


REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED

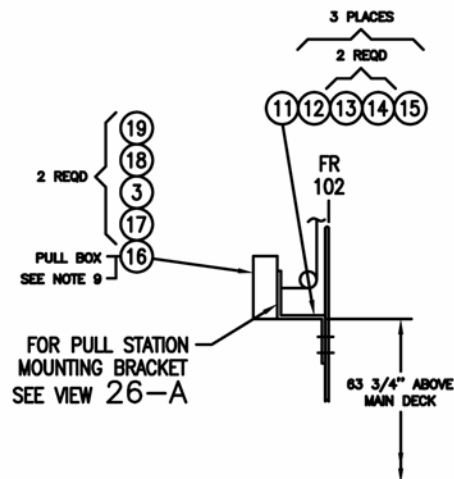
LOCAL NOTE:  
1. "■" INDICATES APPROXIMATE PIPE HANGERS LOCATION, SEE NOTE 10.



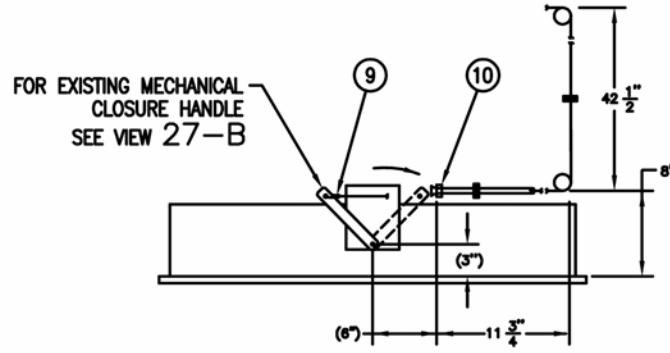
VIEW 31-A  
MODIFICATION TO ENGINE ROOM AIR SUPPLY  
MECHANICAL SHUTTER  
MAIN DECK  
SCALE 1/4"=1'-0"



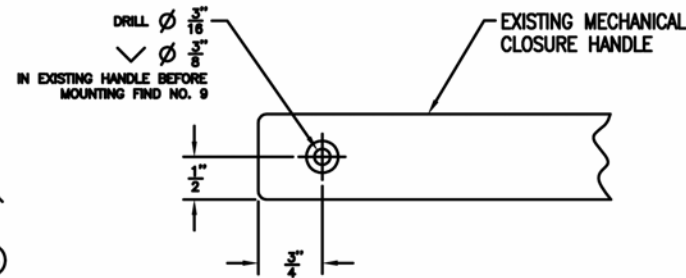
VIEW 29-A  
INSTALLATION OF PULL STATION  
PORT SIDE  
14 1/4" INBOARD LONG BHD 16'-8" OFF CL  
SEE ACTUATION CABLE TABLE  
ITEMS NOT SHOWN  
OMITTED FOR CLARITY



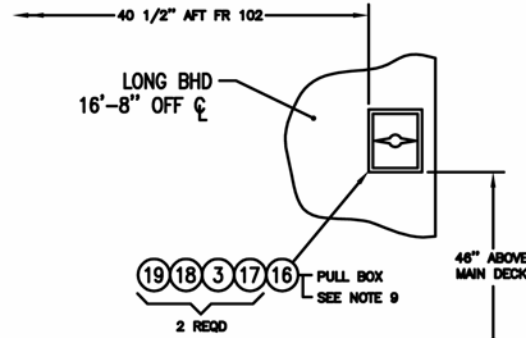
FOR PULL STATION  
MOUNTING BRACKET  
SEE VIEW 26-A



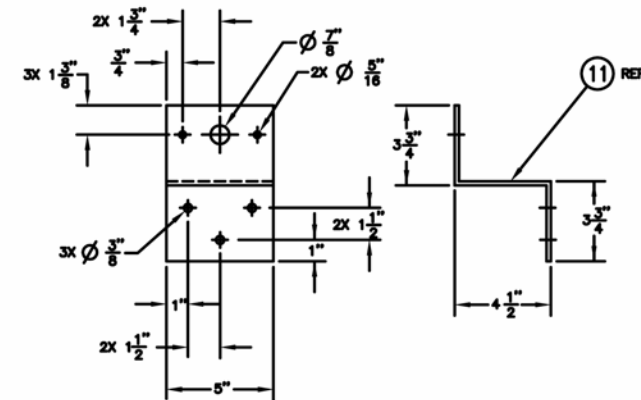
VIEW 27-B  
EXISTING MECHANICAL  
CLOSURE HANDLE  
SCALE 1/1



VIEW 26-C  
INSTALLATION OF PULL STATION  
STBD SIDE  
SEE ACTUATION CABLE TABLE



VIEW 28-C  
MODIFICATION TO ENGINE ROOM AIR SUPPLY  
MECHANICAL SHUTTER  
LOOKING AFT  
PORT SIDE SHOWN  
STBD SIDE SIMILAR  
ITEMS NOT SHOWN  
OMITTED FOR CLARITY  
ROTATED 90° CW

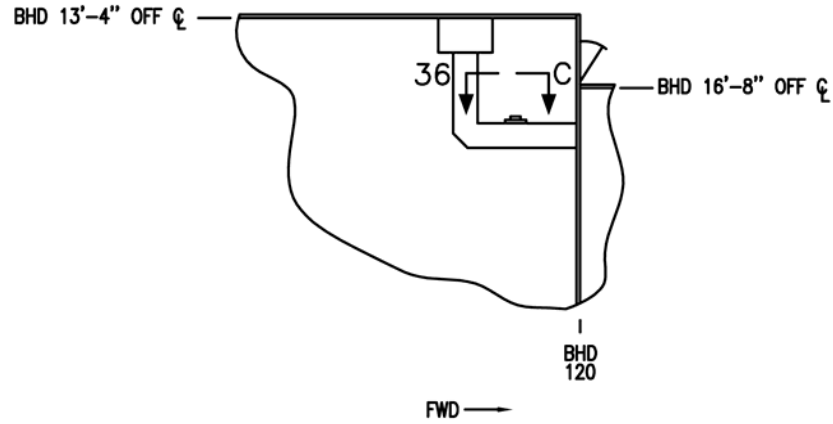


VIEW 26-A  
PULL STATION MOUNTING BRACKET  
SCALE 3"=1'-0"

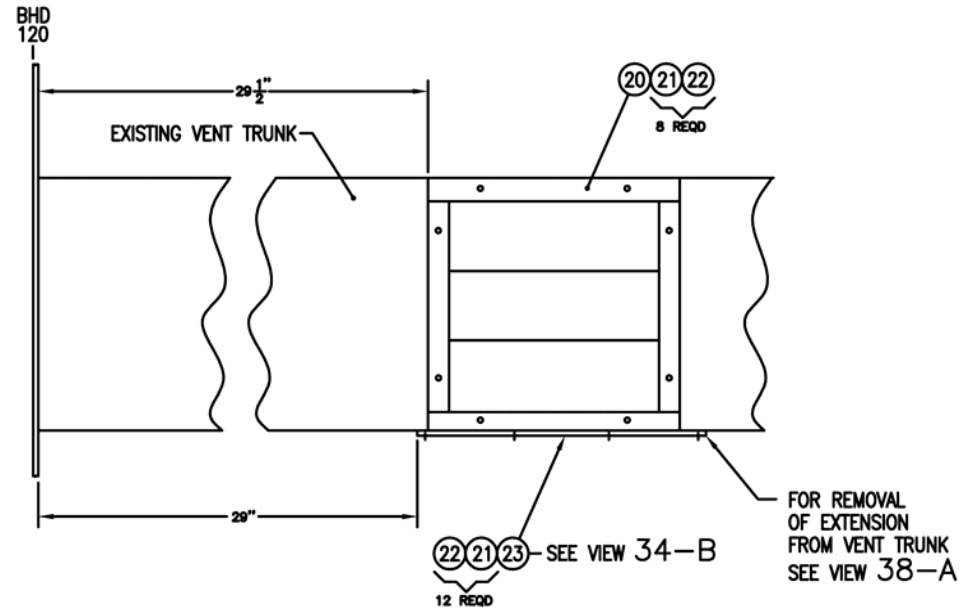
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTR57-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± .005 ± .010 ± .015		CONTRACTOR 2R341	U.S. ARMY LSV FM-200 SYSTEM MISCELLANEOUS MODS	
DRAWN BY AM	DATE 03/23/98	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882		
CHECKER JAS/QC	ENGINEER TR	CLASS DESIGN APPROVAL MARK GENTILE		
CLASS DRAWING APPROVAL MARK GENTILE 4/26/99		SIZE D	CAGE CODE 19207	LSV-5553-2
SCALE		SHEET 4 OF 6		



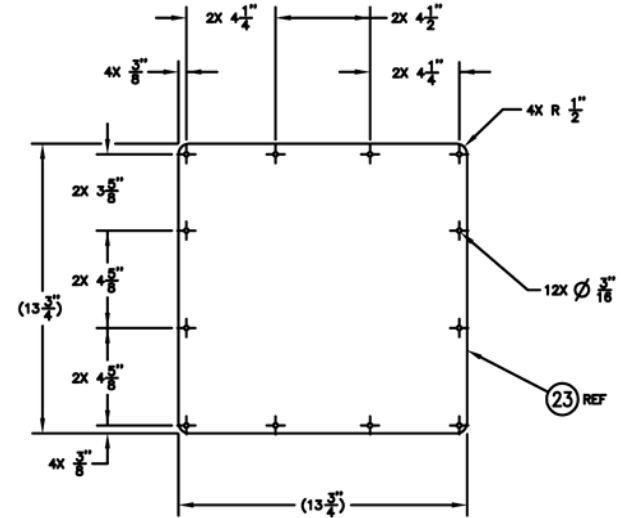
REVISION			
ZONE	REV	DESCRIPTION	DATE



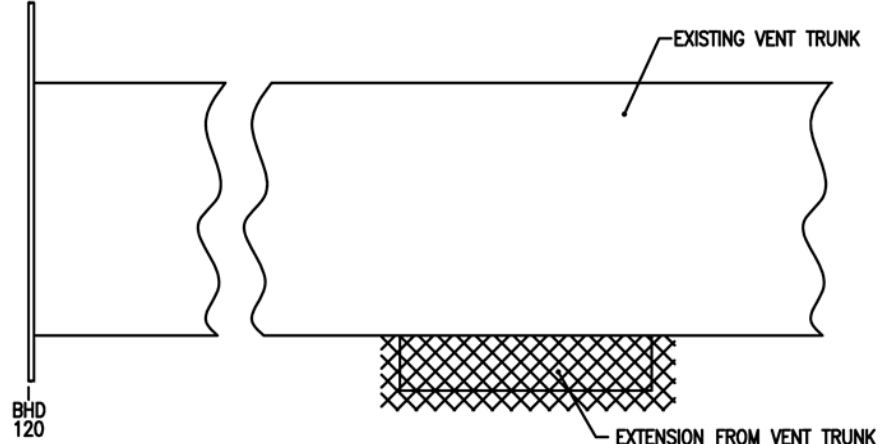
VIEW 39-C  
EMERGENCY GENERATOR ROOM  
MODIFICATION TO SUPPLY VENT  
MAIN DECK  
SCALE 1/4"=1'-0"



VIEW 36-C  
MODIFICATION TO  
GENERATOR ROOM SUPPLY VENT  
LOOKING OUTBOARD  
SCALE 3"=1'-0"  
ROTATED 180°



VIEW 34-B  
COVER PLATE  
SCALE 3"=1'-0"

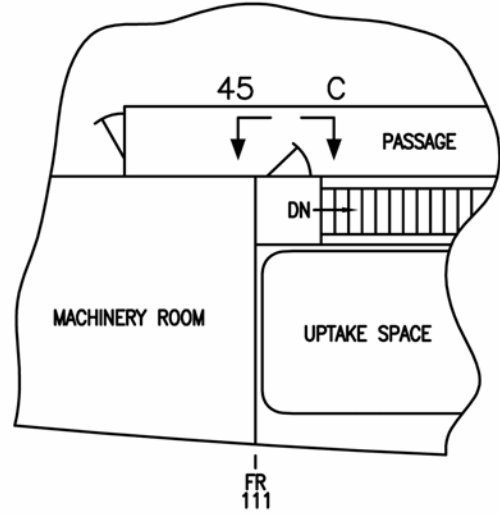


VIEW 38-A  
REMOVAL OF  
EXTENSION FROM VENT TRUNK  
EMERGENCY GENERATOR ROOM SUPPLY VENT  
LOOKING OUTBOARD  
SCALE 3"=1'-0"  
SEE NOTE 8

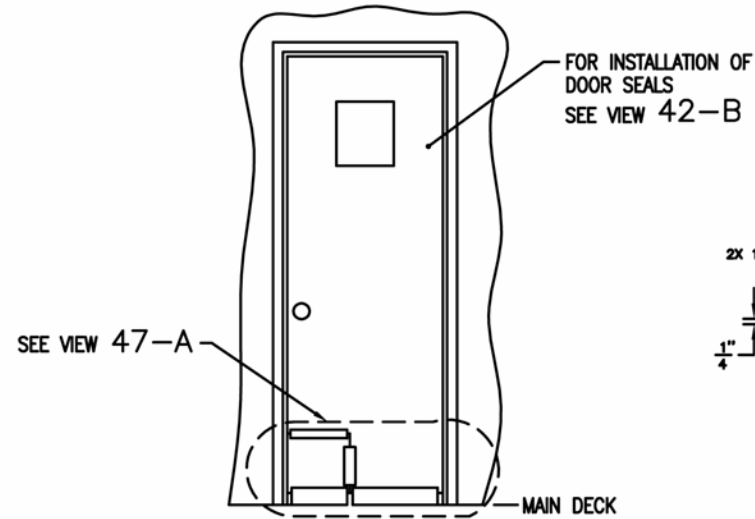
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TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±		CONTRACTOR 2R341		U.S. ARMY LSV FM-200 SYSTEM MISCELLANEOUS MODS	
DRAWN BY BO	DATE 03/23/98	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882		SIZE D	CAGE CODE 19207
CHECKER JS	TR			LSV-5553-2	
CLASS DESIGN APPROVAL MARK GENTILE				SCALE	
CLASS DRAWING APPROVAL MARK GENTILE 4/28/98				SHEET 5 OF 6	



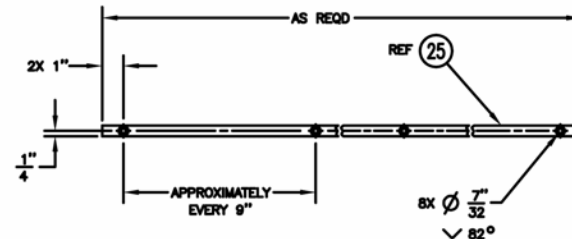
REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



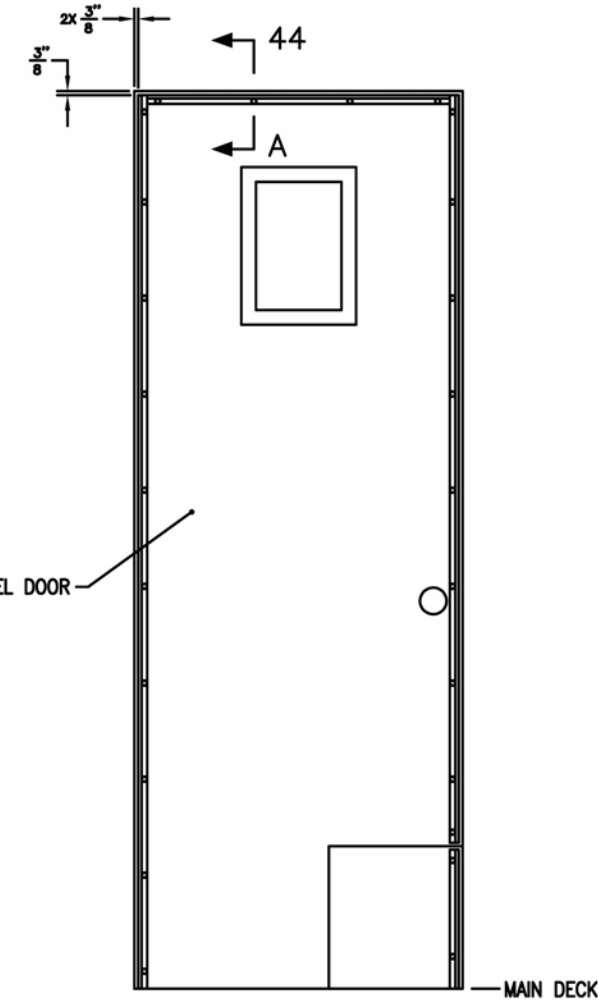
VIEW 47-C  
INSTALLATION OF DOOR SEALS  
MAIN DECK  
STBD SIDE SHOWN  
PORT SIDE OPPOSITE  
SCALE 1/4"=1'-0"



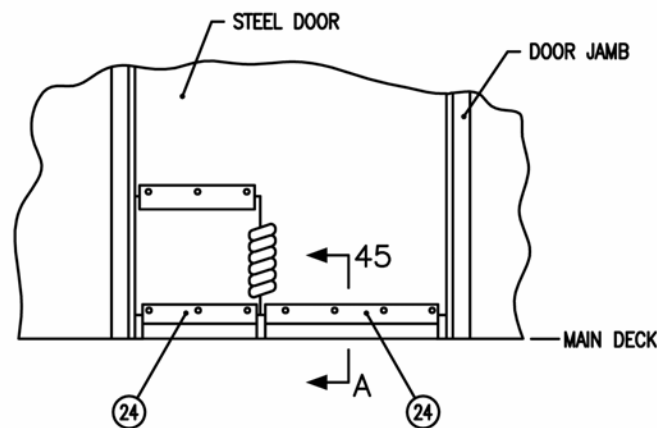
VIEW 45-C  
INSTALLATION OF DOOR SEALS  
STARBOARD ENGINE ROOM DOOR  
MAIN DECK  
LONG BHD 16'-8" OFF  $\phi$   
LOOKING OUTBOARD  
SCALE 3/4"=1'-0"  
ROTATED 180°



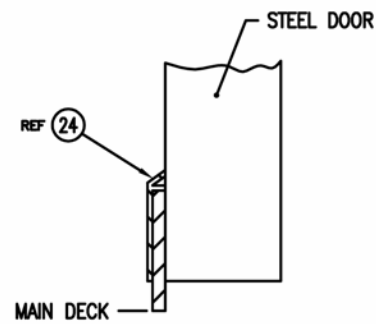
VIEW 44-C  
DOOR BAR  
TOP BAR SHOWN  
SIDE BAR SIMILAR  
SCALE 3"=1'-0"



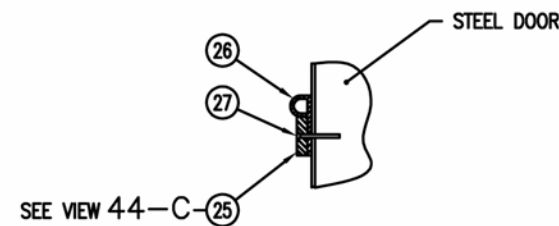
VIEW 42-B  
INSTALLATION OF DOOR SEALS  
STARBOARD ENGINE ROOM DOOR  
MAIN DECK  
LONG BHD 16'-8" OFF  $\phi$   
LOOKING INBOARD  
SCALE 1 1/2"=1'-0"



VIEW 47-A  
INSTALLATION OF DOOR SEALS  
STARBOARD ENGINE ROOM DOOR  
MAIN DECK  
LONG BHD 16'-8" OFF  $\phi$   
LOOKING OUTBOARD  
SCALE 3"=1'-0"  
SEE NOTES 6 AND 7



SECTION 45-A  
BOTTOM SEAL  
SCALE 1/1



SECTION 44-A  
DOOR SEAL  
TOP SEAL SHOWN  
SIDE SEAL SIMILAR  
SCALE 1/1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTR557-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± — ± — ± —		CONTRACTOR 2R341	U.S. ARMY LSV FM-200 SYSTEM MISCELLANEOUS MODS	
DRAWN BY AM	DATE 03/23/98	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882		
CHECKER JAS/QC	ENGINEER TR	SIZE D	CAGE CODE 19207	LSV-5553-2
CLASS DESIGN APPROVAL MARK GENTILE		SCALE		
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99		SHEET 6 OF 6		



SHEETS							STATUS OF REVISION			
7	6	5	4	3	2	ZONE	REV	DESCRIPTION	DATE	APPROVED

NOTES:

- THIS DRAWING HAS BEEN DEVELOPED AS A GUIDANCE DRAWING FOR ACCOMPLISHING ELECTRICAL MODIFICATIONS ASSOCIATED WITH THE INSTALLATION OF FM-200 FIRE SUPPRESSION SYSTEMS ON THE U.S. ARMY LOGISTIC SUPPORT VESSEL (LSV).
- ALL WORK SHALL BE PERFORMED UTILIZING GOOD COMMERCIAL PRACTICES AND SHALL SATISFY THE STANDARDS, REGULATIONS, REQUIREMENTS, AND RECOMMENDED PRACTICES OF THE AMERICAN BUREAU OF SHIPPING (ABS), CODE OF FEDERAL REGULATIONS (CFR), AND THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE) STANDARD 45.
- ELECTRICAL SYSTEM MODIFICATIONS DISCLOSED ON THIS DRAWING ARE DIAGRAMMATIC ONLY. FINAL CONFIGURATION OF EQUIPMENT AND ROUTING OF ELECTRICAL CABLE SHALL BE DETERMINED AT THE TIME OF INSTALLATION. ELECTRICAL CABLE SHOULD BE ROUTED USING EXISTING CABLE TRANSITS AND WIREWAYS TO THE MAXIMUM EXTENT POSSIBLE AND SECURED AT A MAXIMUM SPACING OF 24 INCHES.
- DEVIATION FROM THE DIMENSIONS AND CONFIGURATION SHOWN ON THIS DRAWING MAY BE NECESSARY TO SUIT THE ACTUAL CONDITIONS FOUND ABOARD EACH VESSEL.
- NEW ELECTRICAL CABLE SHALL BE IN ACCORDANCE WITH MIL-C-24643 AND APPLICABLE SPECIFICATION DATA SHEET. ELECTRICAL CABLE IS IDENTIFIED IN THE FIELD OF THE DRAWING BY THE APPLICABLE CABLE DESIGNATION SHOWN BELOW:

FIND NO.	CABLE TYPE	CABLE DESIGNATION
1	LSDSGU-4	D-4
2	LSDSGA-4	DSGA-4
EXISTING	MTNIA-10	M-10
EXISTING	DTNIA-4	DTNIA-4
EXISTING	FTNIA-4	F-4
- DESIGNATION OF GROUPED CABLES SHALL READ FORWARD TO AFT AND PORT TO STARBOARD.
- ELECTRICAL CABLE PENETRATIONS SHALL BE MADE USING CABLE PENETRATION LIST AS A GUIDE.
- NEW ELECTRICAL CABLE SHALL BE TAGGED USING CABLE TAGS, FIND NO. 42, AS CLOSE AS PRACTICABLE TO EACH POINT OF CONNECTION, AND ON BOTH SIDES OF DECK AND BULKHEAD PENETRATIONS AS APPLICABLE. CABLE TAGS SHALL BE EMBOSSED WITH CABLE DESIGNATIONS DISCLOSED ON THIS DRAWING. ALL FM2 CABLE TAGS AND LABEL PLATES ARE NEW.
- EXISTING INSULATION DISTURBED OR DAMAGED BY THIS MODIFICATION SHALL BE REPLACED OR REPAIRED TO A LIKE NEW CONDITION.
- NEWLY INSTALLED MATERIAL AND DISTURBED AREAS SHALL BE CLEANED, PAINTED, AND MARKED USING DEPARTMENT OF ARMY TECHNICAL BULLETIN TB 43-0144 AS A GUIDE.
- IDENTIFICATION OF EQUIPMENT SHALL BE ACCOMPLISHED USING REFERENCE 2 AS A GUIDE.
- REVISE DIRECTORY OF EMERGENCY LOAD CENTER PANEL TO REFLECT "FM-200 ALARMS/EQUIPMENT SHUTDOWNS" FOR CIRCUIT BREAKER EP3A.
- ELECTRICAL CONNECTIONS INSIDE PAINT LOCKER COMPARTMENT SHALL BE MADE USING EXPLOSION PROOF FITTINGS FOR CABLES FM2-PS7, DSGA-4, FM2-PS8A, DTNIA-4, FM2-PS8B, DTNIA-4, FM2-PS8C, DSGA-4, AND FM2-PS8D, DSGA-4. SEE CABLE PENETRATION LIST.
- TEMPLATE MOUNTING HOLE LOCATION FROM JUNCTION BOX, FIND NO. 25, AND DRILL 5/16 INCH HOLES FOR SCREW, FIND NO. 29.
- TEMPLATE MOUNTING HOLE LOCATION FROM JUNCTION BOX, FIND NO. 32, AND INSTALL WELDING STUD, FIND NO. 34, ON BULKHEAD.
- TEMPLATE MOUNTING HOLE LOCATION FROM BELL, FIND NO. 37, AND INSTALL WELDING PAD, FIND NO. 38, ON BULKHEAD.
- ALL BUTT SPLICES WILL BE MADE USING A ONE CYCLE CRIMPING TOOL AND INSULATED BUTT SPLICES.
- VERIFY EXISTING TERMINAL NUMBERS, WIRE COLOR CODES, AND CONNECTIONS, AS THEY MAY DIFFER FROM AS-BUILT DRAWINGS.

CIRCUIT DESIGNATION	CABLE TYPE	PENETRATION LOCATION	FIND NO.				CIRCUIT DESIGNATION	CABLE TYPE	PENETRATION LOCATION	FIND NO.			
			STUFFING TUBE	PACKING ASSEMBLY	PREFORMED PACKING (O-RING)	EXTENSION PIPE				STUFFING TUBE	PACKING ASSEMBLY	PREFORMED PACKING (O-RING)	EXTENSION PIPE
FM2-EP3A	LSDSGU-4	EMER LOAD CTR PANEL	3	4	5		FM2-PS4(C)	LSDSGA-4	ELECTRIC HORN (STBD)	7	8	9	
		BHD 120	USE EXISTING CABLE PENETRATION										
FM2-EP3A(1)	LSDSGU-4	JUNCTION BOX FM2-JB1	6	4			FM2-PS4	MTNIA-10 (EXISTING)	ELECTRIC HORN (PORT)	7	8	9	
		PRESS SWITCH PS-1	3	4	5								
FM2-PS1A	LSDSGU-4	PRESS SWITCH PS-1	3	4	5		FM2-PS5	MTNIA-10 (EXISTING)	PRESS SWITCH PS-4	13	14	15	
		BHD 120	USE EXISTING CABLE PENETRATION										
FM2-PS1A1	LSDSGU-4	AMB STROBE LT (EMER GEN RM)	6	4			FM2-EP3A(3)	LSDSGU-4	JUNCTION BOX FM2-JB2	EXISTING UNDISTURBED PENETRATION			
		PRESS SWITCH PS-1	3	4	5								
FM2-PS1(B)	LSDSGA-4	LONG BHD 16"-8" OFF CL	10	11		12	FM2-EP3A(4)	LSDSGU-4	PRESS SWITCH PS-5	13	14	15	
		EMER GEN RM ALARM BELL	16	11									
FM2-PS1(C)	LSDSGA-4	PORT SSDG BATTERY CHARGER	7	8	9		FM2-PS6A	LSDSGU-4	JUNCTION BOX FM2-JB2	EXISTING UNDISTURBED PENETRATION			
		MAIN DECK	USE EXISTING CABLE PENETRATION										
FM2-PS2	FTNIA-4 (EXISTING)	PRESS SWITCH PS-1	7	8	9		FM2-JB4	LSDSGU-4	LONG BHD 16"-8" OFF CL	USE EXISTING CABLE PENETRATION			
		BHD 120	USE EXISTING CABLE PENETRATION										
FM2-PS2C	LSDSGU-4	ELECTRIC HORN	7	8	9		FM2-JB4(1)	LSDSGU-4	PRESS SWITCH PS-6	3	4	5	
		PRESS SWITCH PS-2	13	44	15								
FM2-EP3A(2)	LSDSGU-4	JUNCTION BOX	EXISTING UNDISTURBED PENETRATION				FM2-PS7	LSDSGA-4	LONG BHD 13"-4" OFF CL	USE EXISTING CABLE PENETRATION			
		JUNCTION BOX FM2-JB1	6	4									
FM2-PS3A	DTNIA-4 (EXISTING)	PRESS SWITCH PS-3	3	4	5		FM2-PS8A	DTNIA-4 (EXISTING)	BHD 16	10	11		
		MAIN DECK (FR 113)	EXISTING UNDISTURBED PENETRATION										
FM2-PS3B	LSDSGU-4	CONTROL ROOM	EXISTING UNDISTURBED PENETRATION				FM2-PS8B	DTNIA-4 (EXISTING)	PAINT LKR ALARM BELL	16	11		
		MCC, 150 A BREAKER, UV TRIP	EXISTING UNDISTURBED PENETRATION										
FM2-PS3B1	LSDSGU-4	PRESS SWITCH PS-3	3	4	5		FM2-PS8C	LSDSGA-4	JUNCTION BOX FM2-JB4	6	4		
		LONG BHD 16"-8" OFF CL	USE EXISTING CABLE PENETRATION										
FM2-PS3B2	LSDSGU-4	BHD 114	10	11		12	FM2-PS8D	LSDSGA-4	BHD 16	10	11		
		ENG RM ALARM BELL	16	11									
FM2-PS3B3	LSDSGU-4	PRESS SWITCH PS-3	3	4	5		FM2-PS8D	LSDSGA-4	BT COMPT ALARM BELL	16	11		
		MAIN DECK (FR 113)	USE EXISTING CABLE PENETRATION										
FM2-PS3B4	LSDSGU-4	AMB STROBE LT (ENG RM CL AFT)	6	4			FM2-PS8D	LSDSGA-4	BT COMPT SUPPLY FAN CONT SP1	16	11		
		AMB STROBE LT (ENG RM CL FWD)	6	4									
FM2-PS4(A)	LSDSGA-4	AMB STROBE LT (ENG RM STBD)	6	4			FM2-PS8D	LSDSGA-4	AMB STROBE LT (BT COMPT)	6	4		
		AMB STROBE LT (ENG RM CL FWD)	6	4									
FM2-PS4(B)	LSDSGA-4	AMB STROBE LT (ENG RM PORT)	6	4			FM2-PS8D	LSDSGA-4	JUNCTION BOX FM2-JB4	6	4		
		EMER GEN BATTERY CHARGER	7	8	9								
FM2-PS4(B)	LSDSGA-4	BHD 120	USE EXISTING CABLE PENETRATION				FM2-PS7	LSDSGA-4	LONG BHD 16"-8" OFF CL	SEE NOTE 13 AND VIEW 43-D			
		PRESS SWITCH PS-4	7	8	9								
FM2-PS4(B)	LSDSGA-4	PRESS SWITCH PS-4	7	8	9		FM2-PS7	LSDSGA-4	PRESS SWITCH PS-7	45	8	9	
		MAIN DECK	USE EXISTING CABLE PENETRATION										
FM2-PS4(B)	LSDSGA-4	ELECTRIC HORN (STBD)	7	8	9		FM2-PS7	LSDSGA-4	SEE NOTE 13 AND VIEW 41-C	45	8	9	

- ALL WIRE SCREW TERMINATIONS WILL BE MADE USING INSULATED, RING TONGUE TERMINAL LUGS. WIRES WILL BE LABELED WITH TERMINAL NUMBER ON TERMINATION.
- CIRCUIT BREAKER, FIND NO. 41, IS MANUFACTURED BY SIEMENS ENERGY AND AUTOMATION, INC. 3333 STATE BRIDGE RD, ALPHARETTA, GA 30202.
- TEMPLATE MOUNTING HOLE LOCATION FROM ELECTRIC HORN/STROBE, FIND NO. 36. INSTALL WELDING PAD, FIND NO. 38, ON BHD OR STIFFENER.
- THE ELECTRIC HORN/STROBE, FIND NO. 36, IS SET AT THE FACTORY FOR THE HORN TONE. ALL SWITCH POSITIONS SET ON POSITION "1". THE TONE SETTING SHOULD BE FIELD VERIFIED, AND RESET TO HORN TONE IF NECESSARY. REFER TO MANUFACTURER'S DATA FURNISHED WITH COMPONENT.

SEE PARTS LIST ON SHEET 2

2	FM-200 SYSTEM LABEL PLATES AND PLACARDS	LSV-5553-4
1	FM-200 SYSTEM PIPING INSTALLATION AND DETAILS	LSV-5553-1
NO.	DRAWING TITLE	DRAWING NUMBER

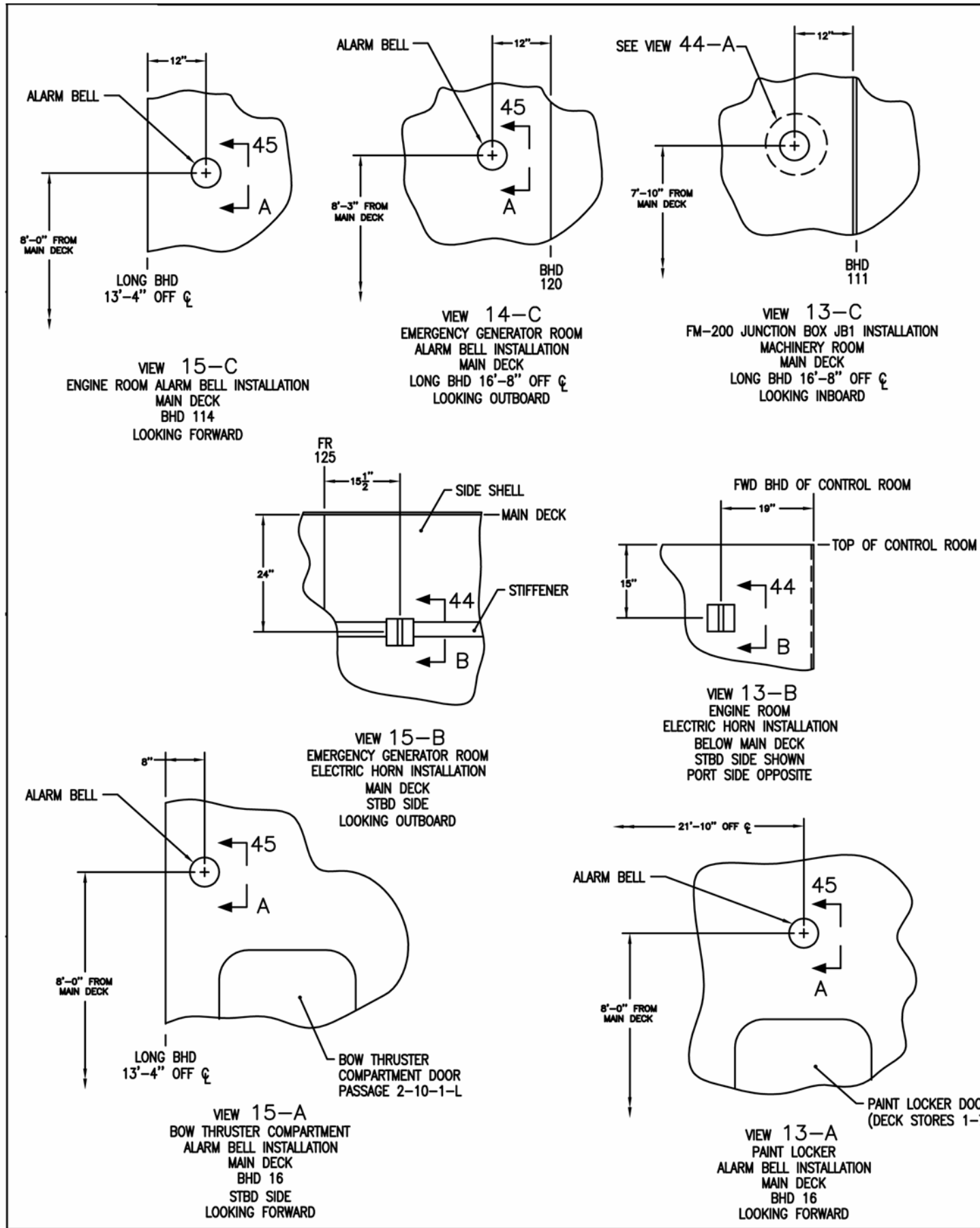
LIST OF REFERENCES

DISTRIBUTION STATEMENT A.  
APPROVED FOR PUBLIC RELEASE;  
DISTRIBUTION IS UNLIMITED.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	CONTRACT NUMBER DTR57-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± — ± — ± —	CONTRACTOR 2R341	U.S. ARMY LSV FM-200 SYSTEM ELECTRICAL MODIFICATIONS	
DRAWN BY AM	DATE 1/20/98	RPE (FP) CLASS APPROVAL	
CHECKED BY JS	ENGINEER GS 4/28/99	PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882	
CLASS DESIGN APPROVAL MARK GENTILE	CLASS DRAWING APPROVAL MARK GENTILE 4/28/99		
SIZE D	CAGE CODE 19207	LSV-5553-3	
SCALE 1"=1'-0"	SHEET 1 OF 7		





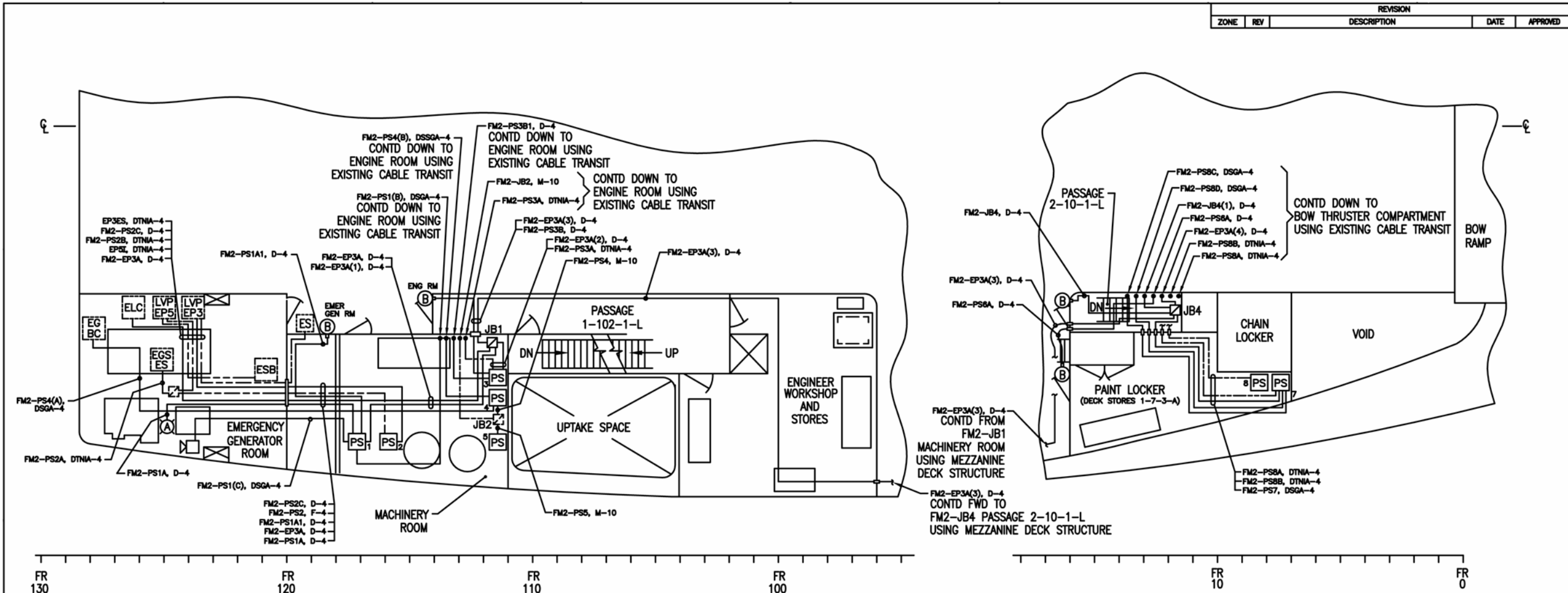


		REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED		
45	M19622/4-03	2 EA	STUFFING TUBE, Y TYPE, SIZE 3	MIL-S-19622/4	NYLON	0.30
44	M19622/19-0001	1 EA	PACKING ASSEMBLY, SIZE 4T (.500 ID BUSHING)	MIL-S-19622/19		1.00
43	06383 MLT1S-CP	2 PKG	CABLE TIES, 1 INCH MAX DIA (100 PER PACKAGE)	COML (PANDUIT)	CRES	1.00
42	06383 AP350HW86-C	1 PKG	CABLE TAGS (100 EACH PER PACKAGE)	COML (PANDUIT)	ALUMINUM	0.70
41	Q115	1 EA	CIRCUIT BREAKER, 1 POLE, 120 V, 15 A, 40° C (FOR PANEL CD-7) (SEE NOTE 20)	COML (SIEMENS)		2.00
40		16 EA	SCREW, CAP, HEX HD, 1/4-20 UNC-2A X 5/8" L	ASME B18.2.1	CRES	-
39		16 EA	WASHER, LOCK, HLCL SPR, 1/4 NOM	ASME B18.2.1	CRES	-
38	76857 9498	16 EA	PAD, WELDING, FOR MOUNTING BOXES	COML (OCEANIC)	STEEL	-
37	73274 96UA6A-115	4 EA	BELL, 6 INCH DIA, WATERTIGHT, 115 V	COML (HOSE-McCANN)		1.00
36	7X933 867STR(A)-AQ	4 EA	HORN/STROBE, ELECTRONIC, SURFACE MOUNT, 24 V	COML (EGS)		2.00
35	62534 JBK-2	1 EA	COVER, JUNCTION BOX, DEEP, W/ONE 3/4 NPS TAPPED HOLE	COML (RED DOT)	ALUMINUM	0.70
34	85105 101-010-003	4 EA	STUD, WELDING, TYPE CFL, 1/4-20 UNC-2A X 3/4" L (FERRULE P/N 100-101-077)	COML (NELSON)	STEEL	0.02
33	62534 JBK-B	1 EA	COVER, JUNCTION BOX, DEEP, BLANK	COML (RED DOT)		0.70
32	62534 JBX-2	2 EA	JUNCTION BOX, DEEP, 4 EA 3/4 NPS OUTLETS, W/PLUGS, W/MTG	COML (RED DOT)		0.70
31		16 EA	NUT, HEX, 1/4-20 UNC-2B, ZINC PL	ASME B18.2.2	STEEL	-
30		16 EA	WASHER, LOCK, HLCL SPR, RGLR, 1/4 NOM, ZINC PL	ASME B18.2.1	STEEL	-
29		12 EA	SCREW, CAP, HEX HD, 1/4-20 UNC-2A X 3/4" L GRADE B, ZINC CTD	ASME B18.2.1	STEEL	-
28	02116 MAX-AC-A	6 EA	LIGHT, STROBE, AMBER, 115 VAC	COML (WHEELLOCK)	LEXAN	2.00
27		6 EA	NIPPLE, THD, CLOSE, 1/2 NPS, GALV	ASTM A 733	STEEL	0.06
26	62534 S-1	6 EA	COVER, JUNCTION BOX, WITH ONE 1/2 NPS HOLE	COML (RED DOT)		0.50
25	62534 S-48	6 EA	JUNCTION BOX, STD, 5 EA 3/4 NPS OUTLETS, W/PLUGS, W/MTG	COML (RED DOT)		0.70
24		6 EA	PLATE, 1/4 STK, 6" DIA	ASTM A 36	STEEL	2.00
23		6 EA	PIPE, SMLS, 1.315 OD X .133 WALL X 36" L, GALV (1 NPS)	ASTM A 53	STEEL	1.68
22	75282 SC-1-LB	1 EA	COMPOUND, SEALING, 1 LB PACKAGE	COML (KILLARK)		1.00
21	75282 PF-16	1 EA	FIBER, PACKING, 1 LB PACKAGE	COML (KILLARK)		1.00
20	75282 R-31	3 EA	FITTING, REDUCER, 1 - 1/2 CONDUIT SIZE	COML (KILLARK)		0.20
19	75282 LUBT-2	2 EA	LUBRICANT, THREAD, 2 OZ PACKAGE	COML (KILLARK)		-
18	75282 ZS208	6 EA	CABLE CONNECTOR, .375-.500 CABLE RANGE	COML (KILLARK)	ALUMINUM	0.30
17	75282 ENY-1-T	6 EA	FITTING, SEALING, 1/2" HUB SIZE, W/NIPPLE	COML (KILLARK)	ALUMINUM	1.00
16	M24235/13-002	4 EA	STUFFING TUBE, SIZE B (1/2 MPT)	MIL-S-24235/13	BRASS	0.20
15	M83461/1-220	2 EA	PACKING, PREFORMED (SIZE 4T STUFFING)	MIL-P-83461/1		-
14	M19622/19-0006	1 EA	PACKING ASSEMBLY, SIZE 4T (.700 ID BUSHING)	MIL-S-19622/19		1.00
13	M19622/1-005	2 EA	STUFFING TUBE, STRAIGHT, SIZE 4T	MIL-S-19622/1	NYLON	0.20
12		6 FT	PIPE, SMLS, .840 OD X .109 WALL, GALV (1/2 NPS)	ASTM A 53	STEEL	0.85
11		10 EA	PACKING, PREFORMED, CLASS 2, TYPE II, SIZE B	MIL-P-16685		-
10	M24235/9-002	6 EA	STUFFING TUBE, SIZE B (1/2 FPT)	MIL-S-24235/9	BRASS	0.20
9	M83461/1-216	14 EA	PACKING, PREFORMED (SIZE 3 STUFFING)	MIL-P-83461/1		-
8	M19622/18-0018	16 EA	PACKING ASSEMBLY, SIZE 3 (.472 ID BUSHING)	MIL-S-19622/18		1.00
7	M19622/1-003	12 EA	STUFFING TUBE, STRAIGHT, SIZE 3	MIL-S-19622/1	NYLON	0.20
6	M19622/3-002	18 EA	STUFFING TUBE, NPT, SIZE 2 (3/4 NPT)	MIL-S-19622/3	NYLON	1.00
5	M83461/1-214	11 EA	PACKING, PREFORMED (SIZE 2 STUFFING)	MIL-P-83461/1		-
4	M19622/17-0004	29 EA	PACKING ASSEMBLY, SIZE 2 (.425 ID BUSHING)	MIL-S-19622/17		1.00
3	M19622/1-002	11 EA	STUFFING TUBE, STRAIGHT, SIZE 2	MIL-S-19622/1	NYLON	0.20
2	M24643/15-02AN	600 FT	CABLE, ELECTRICAL, 1000 V, TYPE LSDSGA-4	MIL-C-24643/15		0.13
1	M24643/15-02UN	1100 FT	CABLE, ELECTRICAL, 1000 V, TYPE LSDSGU-4	MIL-C-24643/15		0.13

**PARTS LIST**

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	CONTRACT NUMBER DTR557-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±	CONTRACTOR 2R341	
DRAWN BY AM	DATE 01/20/98	U.S. ARMY LSV FM-200 SYSTEM ELECTRICAL MODIFICATIONS
CHECKER JAS/QC	ENGINEER TR	
CLASS DESIGN APPROVAL MARK GENTILE	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882	SIZE D
CLASS DRAWING APPROVAL MARK GENTILE 4/26/99		CAGE CODE 19207
		SCALE
		LSV-5553-3
		SHEET 2 OF 7





VIEW 20-B  
CABLING DIAGRAM  
FM-200 ALARMS/EQUIPMENT SHUTDOWNS  
MAIN DECK  
SCALE 1/4"=1'-0"

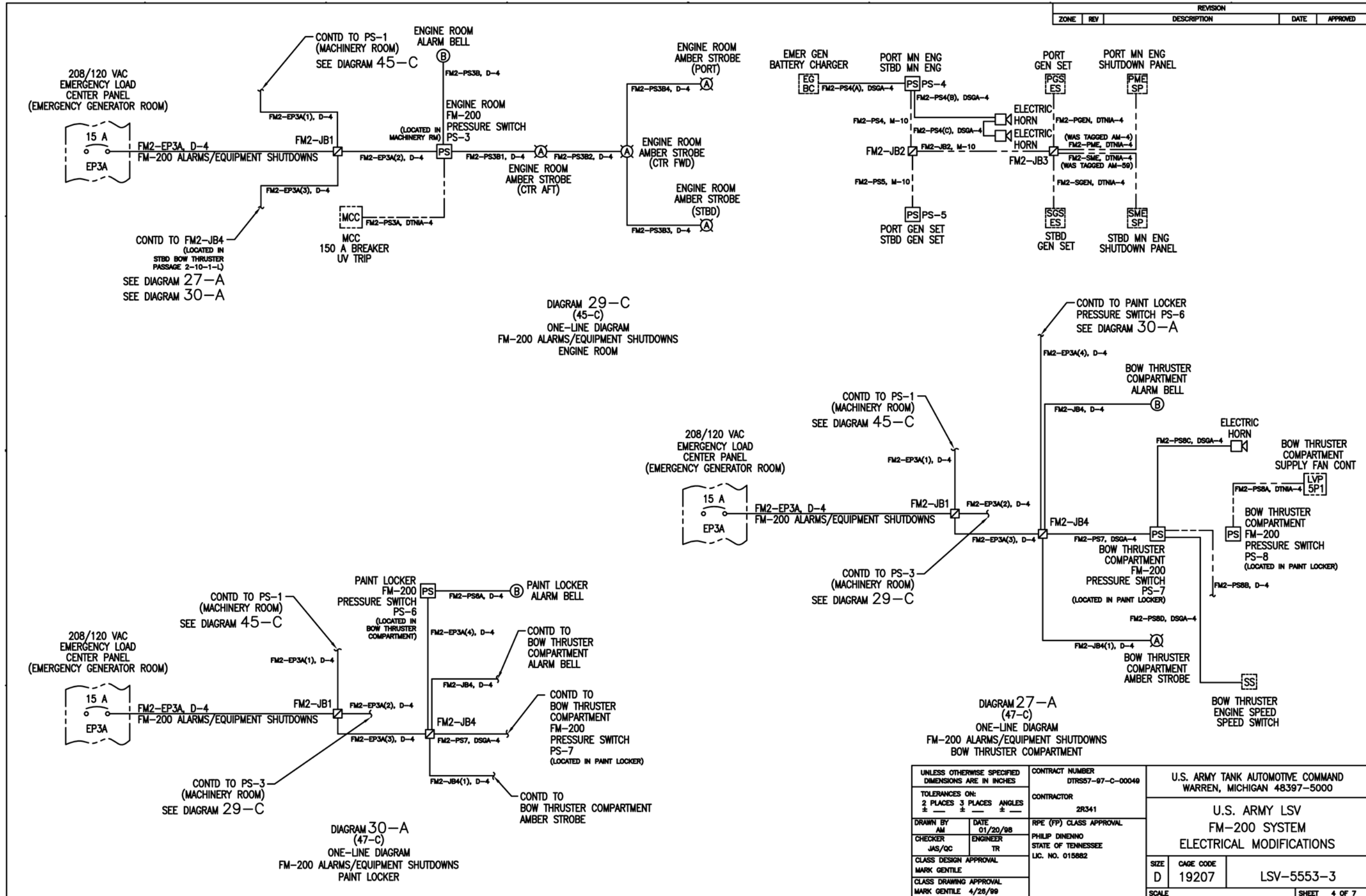
**SYMBOL LEGEND**

- ☐ JUNCTION BOX (FIND NO. 32 AND 33, OR 35)
- Ⓐ AMBER STROBE LIGHT (FIND NO. 25, 26, 27, AND 28)
- Ⓑ ALARM BELL (FIND NO. 37)
- PS PRESSURE SWITCH (REF NO. 1)
- 15 A CIRCUIT BREAKER (FIND NO. 41)
- 🔊 ELECTRIC HORN (FIND NO. 36)
- EXISTING ELECTRICAL CABLE
- NEW ELECTRICAL CABLE
- ➔ BUTT SPLICE
- ES EMERGENCY STOP
- SS BOW THRUSTER ENGINE SPEED SWITCH
- ELC 208/120 VAC EMERGENCY LOAD CENTER PANEL
- ESB EMERGENCY SWITCHBOARD
- EGS EMERGENCY GENERATOR SET
- ES EMERGENCY STOP PUSH BUTTON
- EP3 EP3 (440 VAC) EMER GEN/STEERING COMPARTMENT SUPPLY FAN CONTROLLER
- EP5 EP5 EMERGENCY GENERATOR ROOM SUPPLY FAN CONTROLLER
- SP1 5P1 BOW THRUSTER COMPT SUPPLY FAN CONTROLLER
- MCC MCC 150 A BREAKER UV TRIP
- SP PORT MAIN ENGINE SHUTDOWN PANEL
- SP STBD MAIN ENGINE SHUTDOWN PANEL
- ES STBD GEN SET EMERGENCY STOP
- ES PORT GEN SET EMERGENCY STOP
- EG EMER GEN BATTERY CHARGER
- SSDG PORT SSDG BATTERY CHARGER

FOR BULKHEAD PENETRATION SEE VIEW 48-A

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	CONTRACT NUMBER DTR557-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±	CONTRACTOR 2R341	
DRAWN BY AM	DATE 01/20/98	U.S. ARMY LSV FM-200 SYSTEM ELECTRICAL MODIFICATIONS
CHECKER JAS/QC	ENGINEER TR	
CLASS DESIGN APPROVAL MARK GENTILE	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882	SIZE D
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99		CAGE CODE 19207
		LSV-5553-3
		SCALE SHEET 3 OF 7

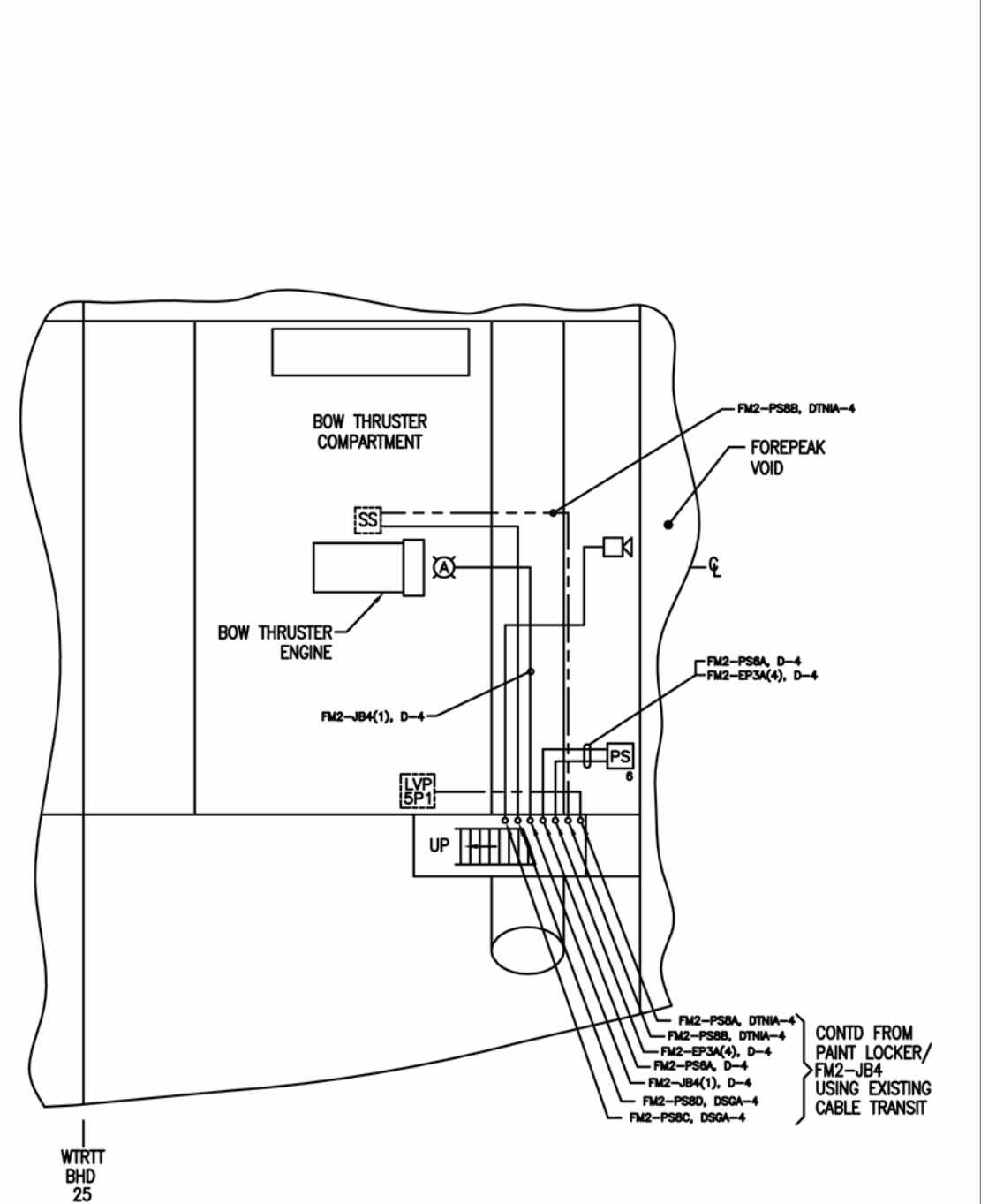
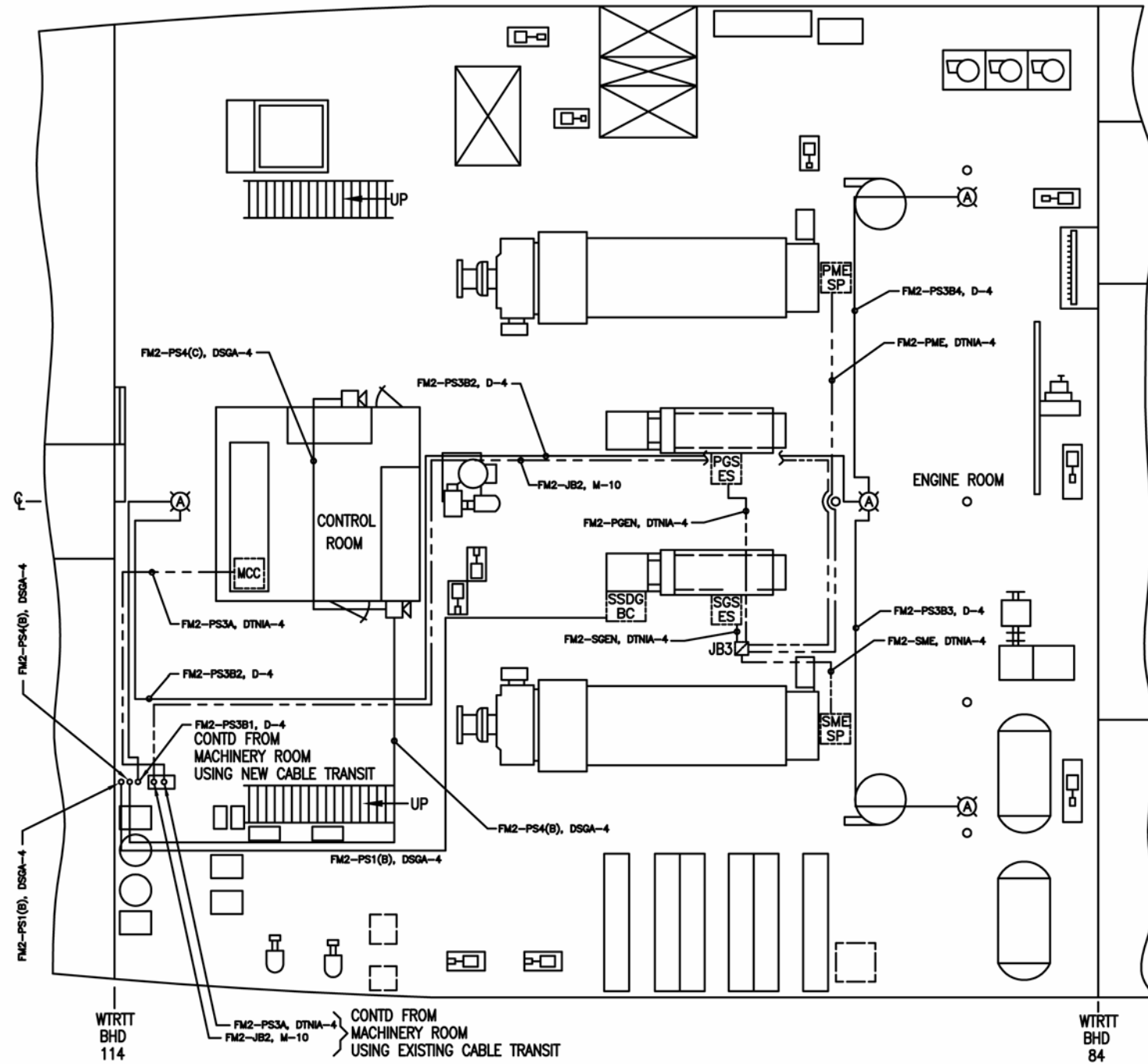




UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTR557-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± — ± — ± —		CONTRACTOR 2R341	U.S. ARMY LSV FM-200 SYSTEM ELECTRICAL MODIFICATIONS	
DRAWN BY AM	DATE 01/20/98	RPE (FP) CLASS APPROVAL		
CHECKER JAS/GC	ENGINEER TR	PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882		
CLASS DESIGN APPROVAL MARK GENTILE				
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99				
SIZE D	CAGE CODE 19207	LSV-5553-3		
SCALE		SHEET 4 OF 7		



REVISION			
ZONE	REV	DESCRIPTION	DATE

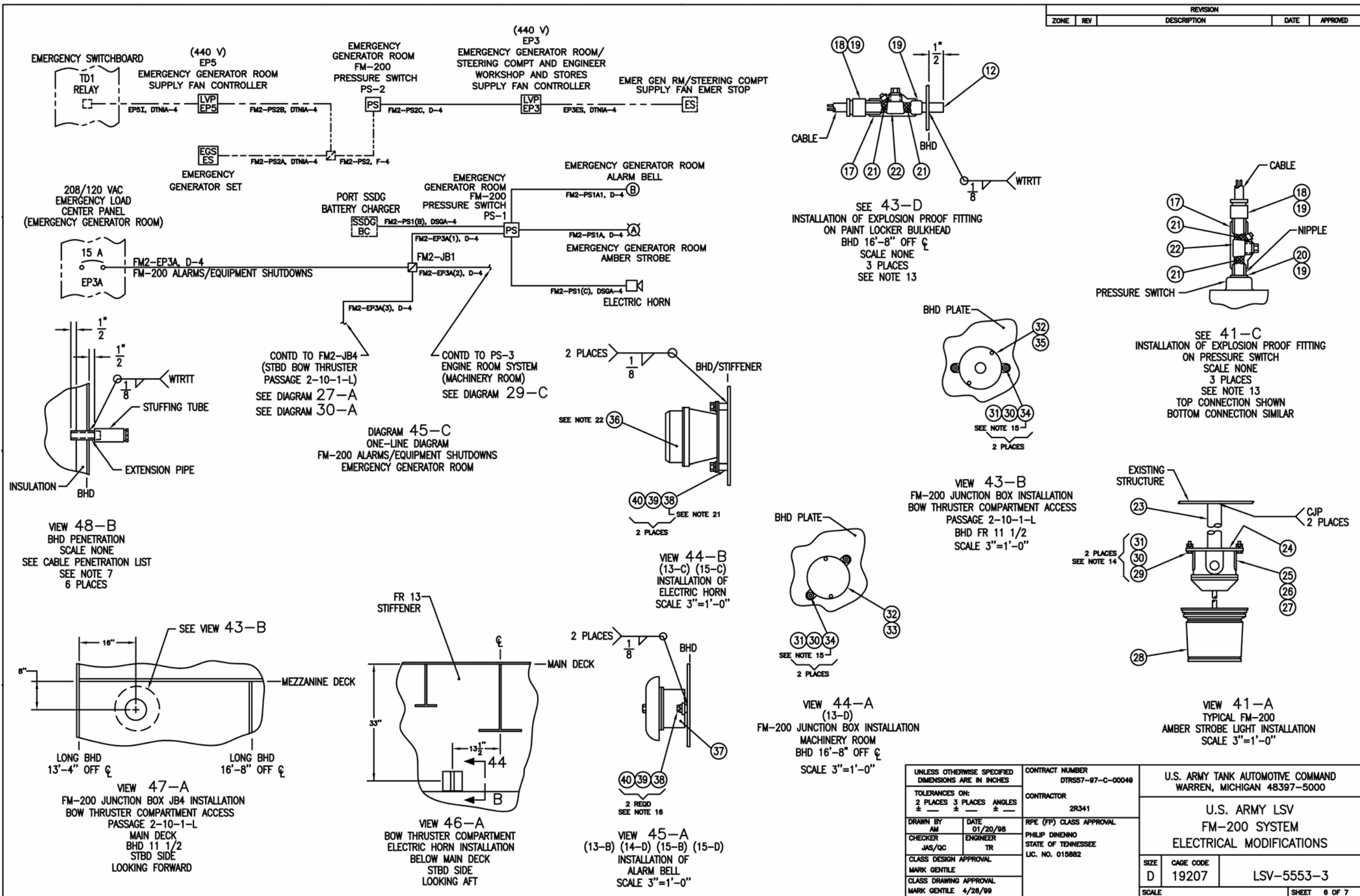


VIEW 37-A  
CABLING DIAGRAM  
FM-200 ALARMS/EQUIPMENT SHUTDOWNS  
BELOW MAIN DECK  
SCALE 1/4"=1'-0"

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTR57-97-C-00049		U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± — ± — ± —		CONTRACTOR 2R341		U.S. ARMY LSV FM-200 SYSTEM ELECTRICAL MODIFICATIONS	
DRAWN BY AM		DATE 01/20/98		RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882	
CHECKER JAS/QC		ENGINEER TR		MARK GENTILE	
CLASS DESIGN APPROVAL MARK GENTILE		CLASS DRAWING APPROVAL MARK GENTILE 4/26/99		SIZE D	
				CAGE CODE 19207	
				LSV-5553-3	
				SCALE	
				SHEET 5 OF 7	







REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTR57-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± .005 ± .005 ± .005		CONTRACTOR 2R341	U.S. ARMY LSV FM-200 SYSTEM ELECTRICAL MODIFICATIONS	
DRAWN BY AM	DATE 01/20/98	RPE (FP) CLASS APPROVAL	SIZE D	CAGE CODE 19207
CHECKER JAS/QC	ENGINEER TR	PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882	LSV-5553-3	
CLASS DESIGN APPROVAL MARK GENTILE		SCALE		
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99		SHEET 8 OF 7		



REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED

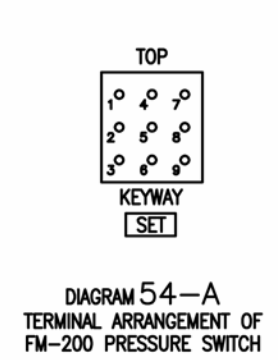
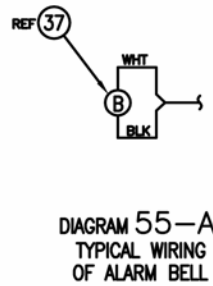
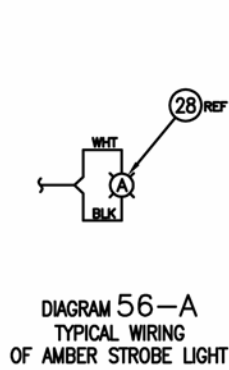
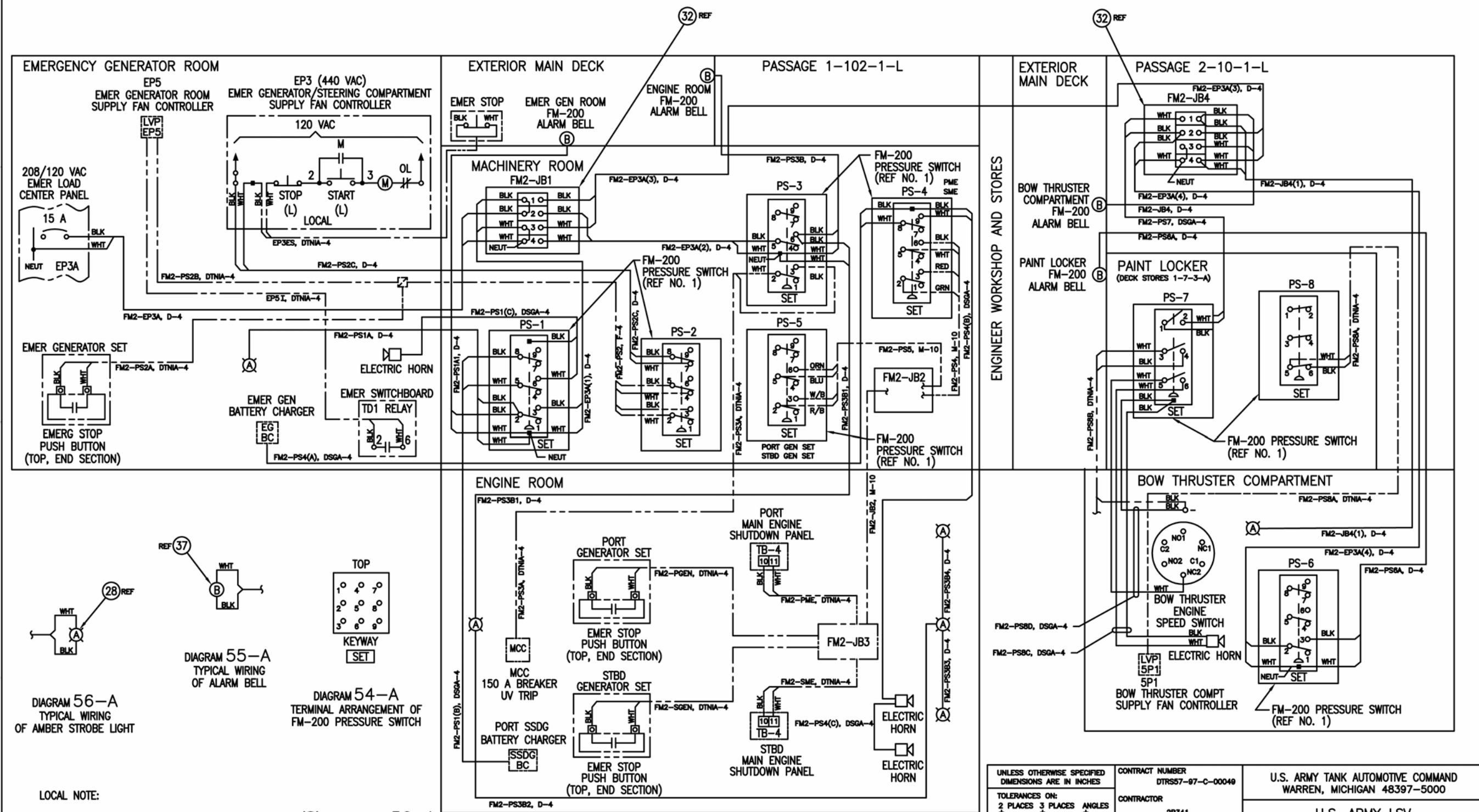


DIAGRAM 53-A  
ELEMENTARY DIAGRAM  
FM-200 ALARMS/EQUIPMENT SHUTDOWNS  
SEE NOTES 17, 18, AND 19

- LOCAL NOTE:
1. FOR TYPICAL WIRING OF AMBER STROBE LIGHT (A), SEE DIAGRAM 56-A
  2. FOR TYPICAL WIRING OF ALARM BELL (B), SEE DIAGRAM 55-A
  3. FOR TERMINAL ARRANGEMENT OF FM-200 PRESSURE SWITCH, SEE DIAGRAM 54-A PRESSURE SWITCH SHOWN IN SET POSITION.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	CONTRACT NUMBER DTR57-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± .005 ± .010 ± .015	CONTRACTOR 2R341	U.S. ARMY LSV FM-200 SYSTEM ELECTRICAL MODIFICATIONS
DRAWN BY AM	DATE 01/20/98	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882
CHECKER JAS/QC	TR	MARK GENTILE
CLASS DESIGN APPROVAL MARK GENTILE	CLASS DRAWING APPROVAL MARK GENTILE 4/28/99	SIZE D
		CAGE CODE 19207
		LSV-5553-3
		SCALE
		SHEET 7 OF 7



NOTES:

- THIS DRAWING HAS BEEN DEVELOPED AS A GUIDANCE DRAWING FOR THE FABRICATION AND INSTALLATION OF LABEL PLATES AND SYSTEM OPERATION PLACARDS ASSOCIATED WITH FM-200 SYSTEM PIPING INSTALLATION AND DETAILS (DRAWING LSV-5553-1) ONBOARD U.S. ARMY LOGISTICS SUPPORT VESSEL (LSV).
- ALL LABEL PLATES SHALL HAVE SMOOTH EDGES AND BE LOCATED SO THAT THE INSCRIPTION IS READILY DISCERNIBLE AND NOT OBSCURED BY PIPES OR OTHER OBJECTS.
- LABEL PLATE (INTERIOR USE), FIND NO. 1, AND SYSTEM OPERATION PLACARD, FIND NO. 2, SHALL BE INSTALLED USING TAPE, FIND NO. 3. TAPE SHALL BE APPLIED TO ENTIRE BACKING OF LABEL PLATE/PLACARD.
- LABEL PLATE (EXTERIOR USE), FIND NO. 1, SHALL BE INSTALLED USING TAPE, FIND NO. 4. TAPE SHALL BE APPLIED TO ENTIRE BACKING OF LABEL PLATE.
- THE PAINT LOCKER, ENGINE ROOM, BOW THRUSTER COMPARTMENT, AND EMERGENCY GENERATOR ROOM FM-200 SYSTEM OPERATION PLACARDS MATERIAL SHALL BE PHENOLIC. PLACARD CHARACTERS SHALL BE ENGRAVED AND CHARACTER HEIGHTS SHALL BE AS INDICATED:  
 OPERATING INSTRUCTIONS \_\_\_\_\_ .156 INCH  
 OPERATING INSTRUCTIONS TITLE \_\_\_\_\_ .188 INCH  
 TABLE AND LEGEND CHARACTERS \_\_\_\_\_ .156 INCH  
 DIAGRAMMATIC CHARACTERS \_\_\_\_\_ .156 INCH  
 PLACARD TITLE \_\_\_\_\_ .250 INCH  
 SYSTEM OPERATION PLACARDS SHALL BE MOUNTED IN A SUITABLE LOCATION NEAR THE CONTROL CYLINDER, TO ALLOW FOR OPTIMUM VISIBILITY.
- THE SYMBOL "□" IN FIELD OF DRAWING REPRESENTS ITEM NO. IN LABEL PLATE LIST.
- LABEL PLATE, ITEM NO. 49, SHALL BE INSTALLED USING SCREWS, FIND NO. 5, WASHERS, FIND NO. 6, AND NUTS, FIND NO. 7.

LABEL PLATE LIST					
ITEM NO.	INSCRIPTION	LABEL STYLE	QTY REQD	LOCATION	REMARKS
1	ENGINE ROOM CYLINDER CONTROL PULL BOX	B-3	2 EA	PASSAGE, STBD (1) MN DK, FR 119 (1)	MT NEAR PULL BOX
2	PS-3	A-1	1 EA	MACHINERY RM BHD 111	MT ON PS
3	PS-4	A-1	1 EA	MACHINERY RM BHD 111	MT ON PS
4	PS-5	A-1	1 EA	MACHINERY RM BHD 111	MT ON PS
5	FOR LABEL PLATE DEPICTION SEE VIEW 22-B	-	1 EA	MN DK FR 114, STBD	MT NEAR BELL
6	ENGINE ROOM FM-200 SYSTEM HF GAS SAMPLING PORT	B-3	1 EA	PASSAGE FR 106, STBD	MT NEAR SAMPLING PORT
7	CONTROL CYLINDER	B-1	4 EA	MACHINERY RM (2) PAINT LOCKER (1) BOW THR COMPT (1)	MT NEAR CYLINDER
8	FOR LABEL PLATE DEPICTION SEE VIEW 22-A	-	4 EA	ENG RM (1) PAINT LKR (1) EMER GEN RM (1) BOW THR COMPT (1)	MT NEAR HORN
9	FOR LABEL PLATE DEPICTION SEE VIEW 43-A	-	7 EA	ENG RM DR (2) ENG RM SLD, AFT (1) PAINT LKR DR (1) EMER GEN RM DR (1) BOW THR COMPT DR (2)	MT ON DOOR
10	EMER GEN RM CYLINDER CONTROL PULL BOX	B-3	1 EA	MAIN DECK FR 119, STBD	MT NEAR PULL BOX

SHEETS								STATUS OF REVISION				
8	7	6	5	4	3	2	1	REV	ZONE	DESCRIPTION	DATE	APPROVED
x	x	x	x					A	38-A 46-C 50-A 58-A	MODIFIED FM-200 RELEASE INSTRUCTION PLATE & OPERATION PLACARD ORDER OF PROCEDURES SWITCHING STEPS 2 AND 3.	10/04/99	WJM

LABEL PLATE LIST					
ITEM NO.	INSCRIPTION	LABEL STYLE	QTY REQD	LOCATION	REMARKS
11	PS-1	A-1	1 EA	MACHINERY RM FR 116	MT ON PS
12	PS-2	A-1	1 EA	MACHINERY RM FR 116	MT ON PS
13	FOR LABEL PLATE DEPICTION SEE VIEW 19-B	-	1 EA	MAIN DECK FR 119, STBD	MT NEAR BELL
14	EMER GEN RM FM-200 SYSTEM HF GAS SAMPLING PORT	B-3	1 EA	MAIN DECK BHD 120, STBD	MT BELOW SAMPLING PORT
15	FOR LABEL PLATE DEPICTION SEE VIEW 27-B	-	1 EA	MACHINERY RM	MT NEAR CONTROL CYLINDER
16	FOR LABEL PLATE DEPICTION SEE VIEW 30-A	-	1 EA	MACHINERY RM BHD 111	MT NEAR CONTROL CYLINDER
17	FOR LABEL PLATE DEPICTION SEE VIEW 38-A	-	2 EA	PASSAGE STBD (1) MN DK, FR 119 (1)	MT NEAR PULL BOX
18	FOR LABEL PLATE DEPICTION SEE VIEW 46-A	-	1 EA	MAIN DECK FR 119	MT NEAR PULL BOX
19	FM2-JB1	A-1	1 EA	MACHINERY RM FR 112	MT ON JB
20	FM2-JB2	A-1	1 EA	MACHINERY RM BHD 111	MT ON JB
21	FM-200 DISCH WARNING LIGHT	B-2	6 EA	ENG RM (4) EMR GEN RM (1) BOW THR COMPT (1)	MT NEAR LIGHT

FIND NO.	CAGE CODE	PART OR IDENTIFYING NUMBER	TOTAL QUANTITY REQUIRED	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL	UNIT WEIGHT (LB)
7	39428	90480A006	1 EA	NUT, MACHINE, HEX, NO. 5-40 UNC-2B, GRADE 8, ZINC CTD (PKG OF 100)	COML (McMASTER CARR)	STEEL	-
6			4 EA	WASHER, PLAIN, TYPE B, RGLR, NO. 5 NOM, ZINC PL	ASME B18.22.1	STEEL	-
5	39428	90272A130	1 EA	SCREW, MACHINE, PAN HD PHILLIPS, CROSS RECESSED, TYPE II, NO. 5-40 UNC-2A X 3/4" L, ZINC CTD (PKG OF 100)	COML (McMASTER CARR)	STEEL	-
4	06KR7	PRO-2032	4 EA	TAPE, POLYETHYLENE, BLACK CLOSED CELL, DOUBLE COATED	COML (PRO TAPE)		-
3	06KR7	PRO-3032	4 EA	TAPE, POLYETHYLENE, WHITE CLOSED CELL, DOUBLE COATED	COML (PRO TAPE)		-
2			4 EA	SYSTEM OPERATION PLACARD, LAMINATED PHENOLIC PLASTIC, WHITE CORE WITH RED SURFACE, 1/16" THK, UV PROTECTED		PHEN	-
1			79 EA	LABEL PLATE, LAMINATED PHENOLIC PLASTIC, WHITE CORE WITH RED SURFACE, 1/16" THK, UV PROTECTED		PHEN	-

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	CONTRACT NUMBER DTR557-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±	CONTRACTOR 2R341	
DRAWN BY BO	DATE 02/13/98	U.S. ARMY LSV FM-200 SYSTEM LABEL PLATES AND PLACARDS
CHECKER JS/AK	ENGINEER JS	
CLASS DESIGN APPROVAL MARK GENTILE	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882	SIZE D
CLASS DRAWING APPROVAL MARK GENTILE 4/26/99		CAGE CODE 19207
		SCALE 1/1
		SHEET 1 OF 8

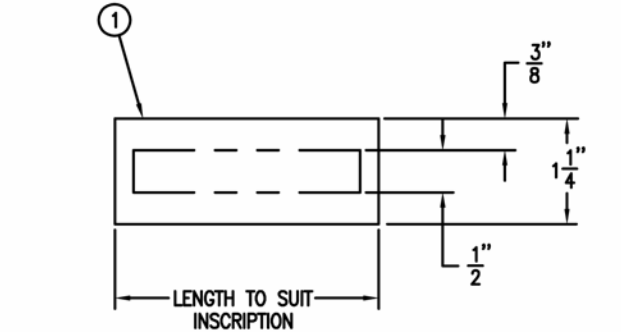
DISTRIBUTION STATEMENT A.  
APPROVED FOR PUBLIC RELEASE;  
DISTRIBUTION IS UNLIMITED.



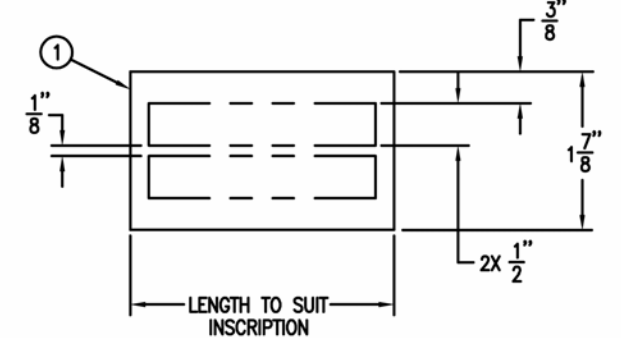
LABEL PLATE LIST					
ITEM NO.	INSCRIPTION	LABEL STYLE	QTY REQD	LOCATION	REMARKS
22	PAINT LOCKER CYLINDER CONTROL PULL BOX	B-3	1 EA	MAIN DECK FR 16, STBD	MT NEAR PULL BOX
23	PS-6	A-1	1 EA	BOW THR COMPT FR 10, STBD	MT ON PS
24	FOR LABEL PLATE DEPICTION SEE VIEW 22-C	-	1 EA	MAIN DECK FR 16, STBD	MT NEAR BELL
25	PAINT LOCKER FM-200 SYSTEM HF GAS SAMPLING PORT	B-3	1 EA	MAIN DECK BHD 16, STBD	MT ABOVE SAMPLING PORT
26	BOW THR COMPT CYLINDER CONTROL PULL BOX	B-3	1 EA	MAIN DECK FR 16, STBD	MT NEAR PULL BOX
27	PS-7	A-1	1 EA	PAINT LOCKER FR 8	MT ON PS
28	PS-8	A-1	1 EA	PAINT LOCKER FR 8	MT ON PS
29	FOR LABEL PLATE DEPICTION SEE VIEW 19-A	-	1 EA	MAIN DECK FR 16, STBD	MT NEAR BELL
30	BOW THR COMPT FM-200 SYSTEM HF GAS SAMPLING PORT	B-3	1 EA	MAIN DECK FR 14, STBD	MT ABOVE SAMPLING PORT
31	FOR LABEL PLATE DEPICTION SEE VIEW 30-C	-	1 EA	BOW THR COMPT FR 10, STBD	MT NEAR CONTROL CYLINDER
32	FOR LABEL PLATE DEPICTION SEE VIEW 34-A	-	1 EA	PAINT LOCKER FR 9	MT NEAR CONTROL CYLINDER
33	FOR LABEL PLATE DEPICTION SEE VIEW 38-C	-	1 EA	MAIN DECK FR 16, STBD	MT NEAR PULL BOX
34	FOR LABEL PLATE DEPICTION SEE VIEW 46-C	-	1 EA	MAIN DECK FR 16, STBD	MT NEAR PULL BOX
35	FM2-JB3	A-1	1 EA	ENG RM FR 95, STBD	MT ON JB

LABEL PLATE LIST					
ITEM NO.	INSCRIPTION	LABEL STYLE	QTY REQD	LOCATION	REMARKS
36	FM2-JB4	A-1	1 EA	BOW THR COMPT PASSAGE STBD	MT NEAR JB
37	WARNING CONTAINS TWO POWER SOURCES	A-3	4 EA	MACHINERY RM (3) PAINT LOCKER (1)	MT NEAR PS-1, 3, 4, 5
38	WARNING CONTAINS THREE POWER SOURCES	A-3	2 EA	MACHINERY RM	MT NEAR PS-2, 7
39	VENT DMPR CLOSURE ENG RM SPLY FAN PORT	B-3	1EA	PASSAGE PORT, FR 102 ARMS CONTROL RM	MT NEAR PULL BOX/LEVER
40	VENT DMPR CLOSURE ENG RM SPLY FAN STBD	B-3	1 EA	PASSAGE STBD, FR 103 ENG WORKSHOP	MT NEAR PULL BOX/LEVER
41	FOR LABEL PLATE DEPICTION SEE VIEW 20-C	-	1 EA	BRDG DK, STBD	MT ON BHD
42	FOR LABEL PLATE DEPICTION SEE VIEW 35-C	-	2 EA	PASSAGE STBD (1) MN DK, FR 119 (1)	MT NEAR PULL BOX
43	FOR LABEL PLATE DEPICTION SEE VIEW 43-C	-	1 EA	MAIN DECK FR 119	MT NEAR PULL BOX
44	FOR LABEL PLATE DEPICTION SEE VIEW 27-C	-	1 EA	BRDG DK, PORT	MT ON BHD
45	EMER GEN RM NAT EXH COVER	B-2	1 EA	MEZZ DK FR 128, STBD	MT ON COVER
46	EMER GEN RM PWR SUPPLY COVER	B-2	1 EA	MEZZ DK FR 122, STBD	MT ON COVER
47	EMER GEN RM/STRG RM PWR SUPPLY COVER	B-2	1 EA	MEZZ DK FR 122, STBD	MT ON COVER
48	FOR LABEL PLATE DEPICTION SEE VIEW 54-C	-	2 EA	MACHINERY RM (1) BOSN STOREROOM (1)	MT NEAR FM-200 CYLINDERS
49	FOR LABEL PLATE DEPICTION SEE VIEW 62-C	-	1 EA	BOSN STOREROOM BHD 116	MT ON PROTECTIVE CAGE
50	FM-200/CO2 VENT DO NOT PAINT OPENING	B-2	3 EA	FR 16, STBD (1) FR 114, STBD (2)	MT NEAR CO2 PIPING

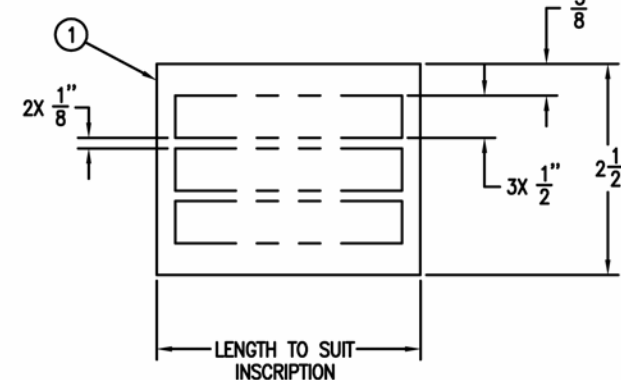
REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



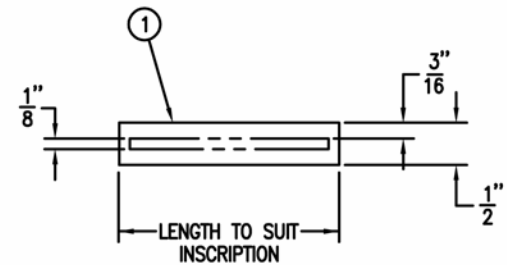
VIEW 10-C  
STYLE B-1



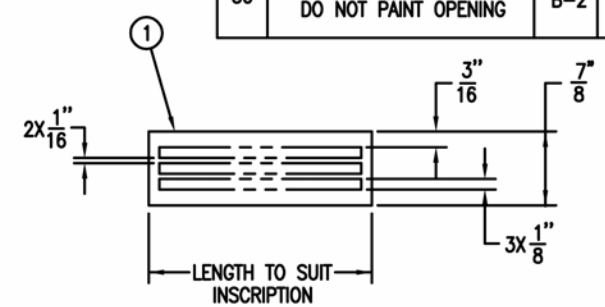
VIEW 10-B  
STYLE B-2



VIEW 10-A  
STYLE B-3



VIEW 15-A  
STYLE A-1



VIEW 13-A  
STYLE A-3

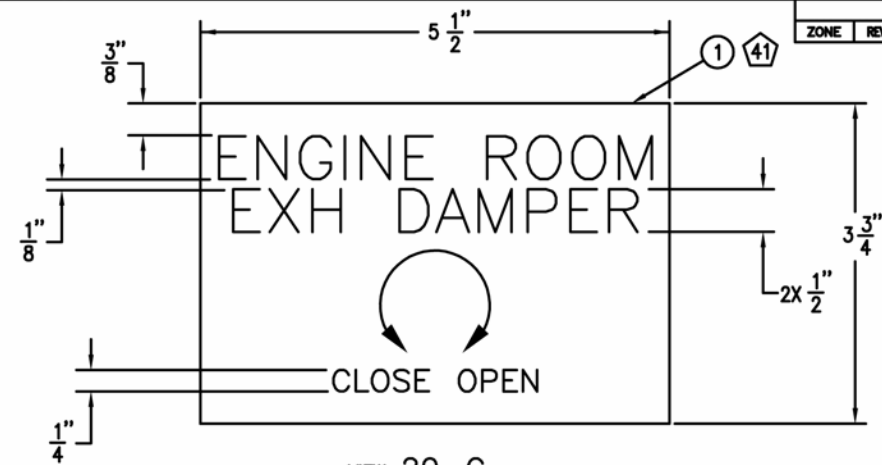
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTRSS7-97-C-00049		U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±		CONTRACTOR 2R341		U.S. ARMY LSV FM-200 SYSTEM LABEL PLATES AND PLACARDS	
DRAWN BY BO	DATE 02/13/98	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882		SIZE D	CAGE CODE 19207
CHECKER JS/AK	ENGINEER JS	CLASS DESIGN APPROVAL MARK GENTILE		LSV-5553-4	
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99		SCALE		SHEET 2 OF 8	



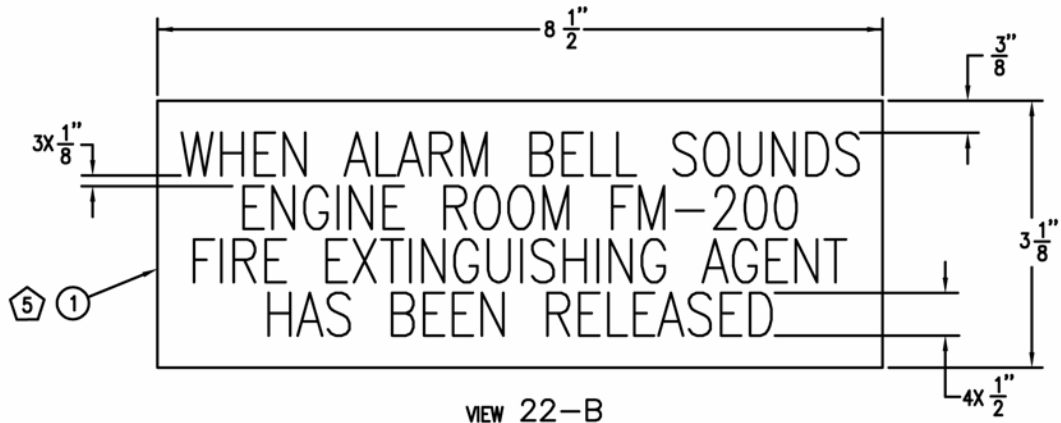




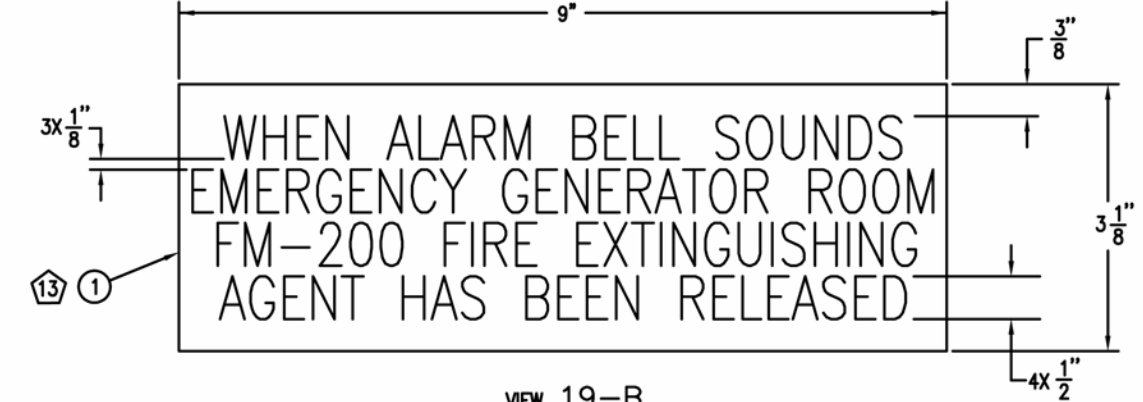
VIEW 22-C  
PAINT LOCKER FM-200 SYSTEM ALARM BELL  
LABEL PLATE



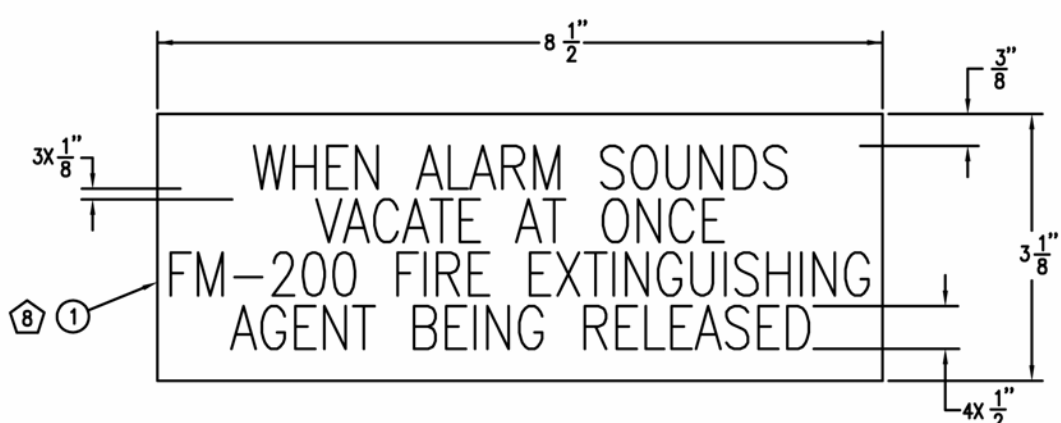
VIEW 20-C  
ENGINE ROOM FM-200 SYSTEM  
INSTRUCTION PLATE



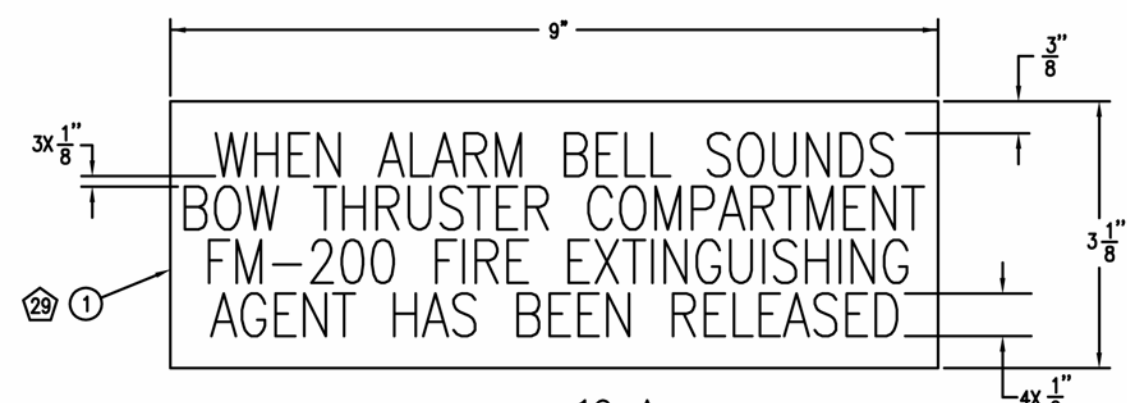
VIEW 22-B  
ENGINE ROOM FM-200 SYSTEM ALARM BELL  
LABEL PLATE



VIEW 19-B  
EMERGENCY GENERATOR ROOM FM-200 SYSTEM ALARM BELL  
LABEL PLATE



VIEW 22-A  
FM-200 SYSTEM HORN  
LABEL PLATE



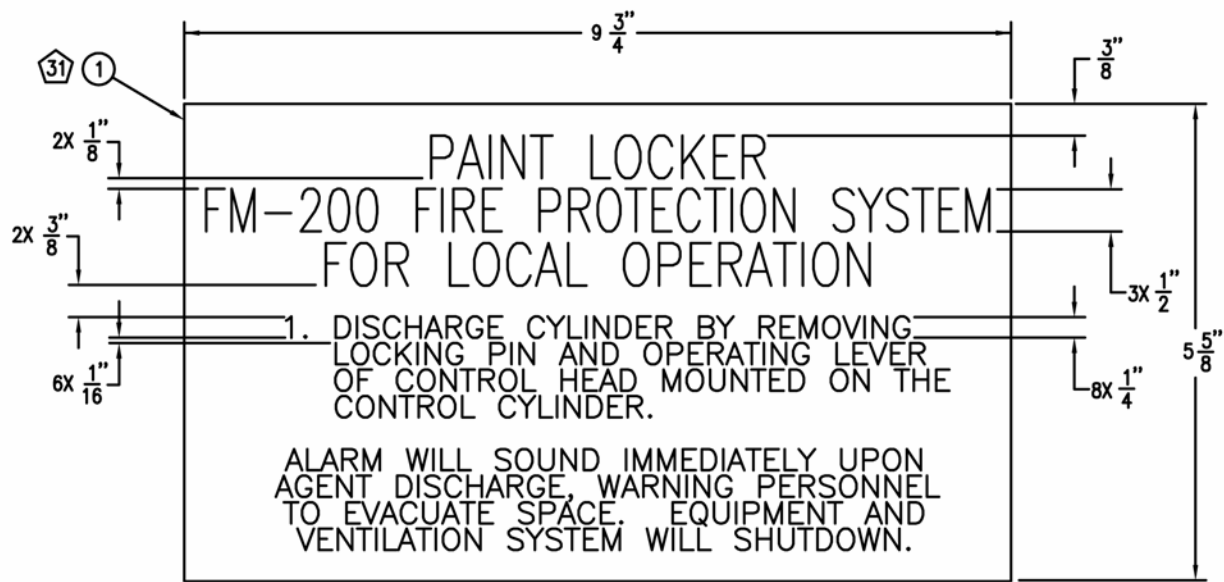
VIEW 19-A  
BOW THRUSTER COMPARTMENT FM-200 SYSTEM ALARM BELL  
LABEL PLATE

REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED

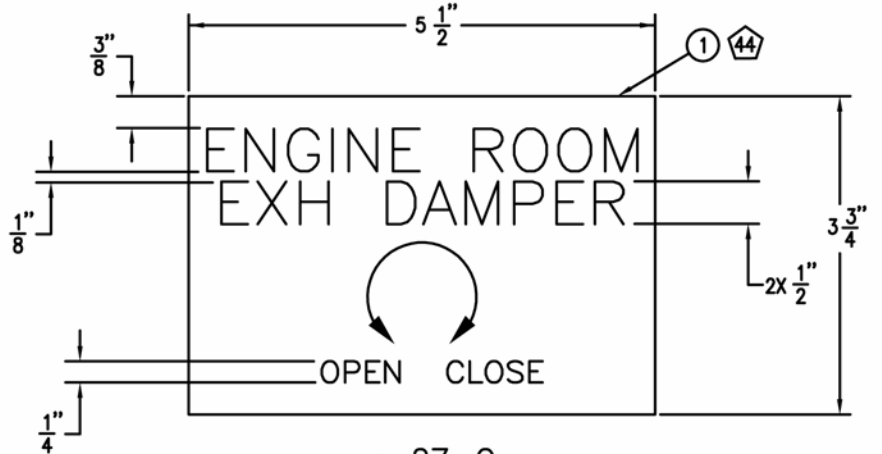
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTRS57-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES ± 3 PLACES ± ANGLES ±		CONTRACTOR 2R341	U.S. ARMY LSV FM-200 SYSTEM LABEL PLATES AND PLACARDS	
DRAWN BY BO	DATE 02/13/98	RPE (FP) CLASS APPROVAL	SIZE D	CAGE CODE 19207
CHECKER JS/AK	ENGINEER JS	PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882	LSV-5553-4	
CLASS DESIGN APPROVAL MARK GENTILE		SCALE		
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99		SHEET 3 OF 8		



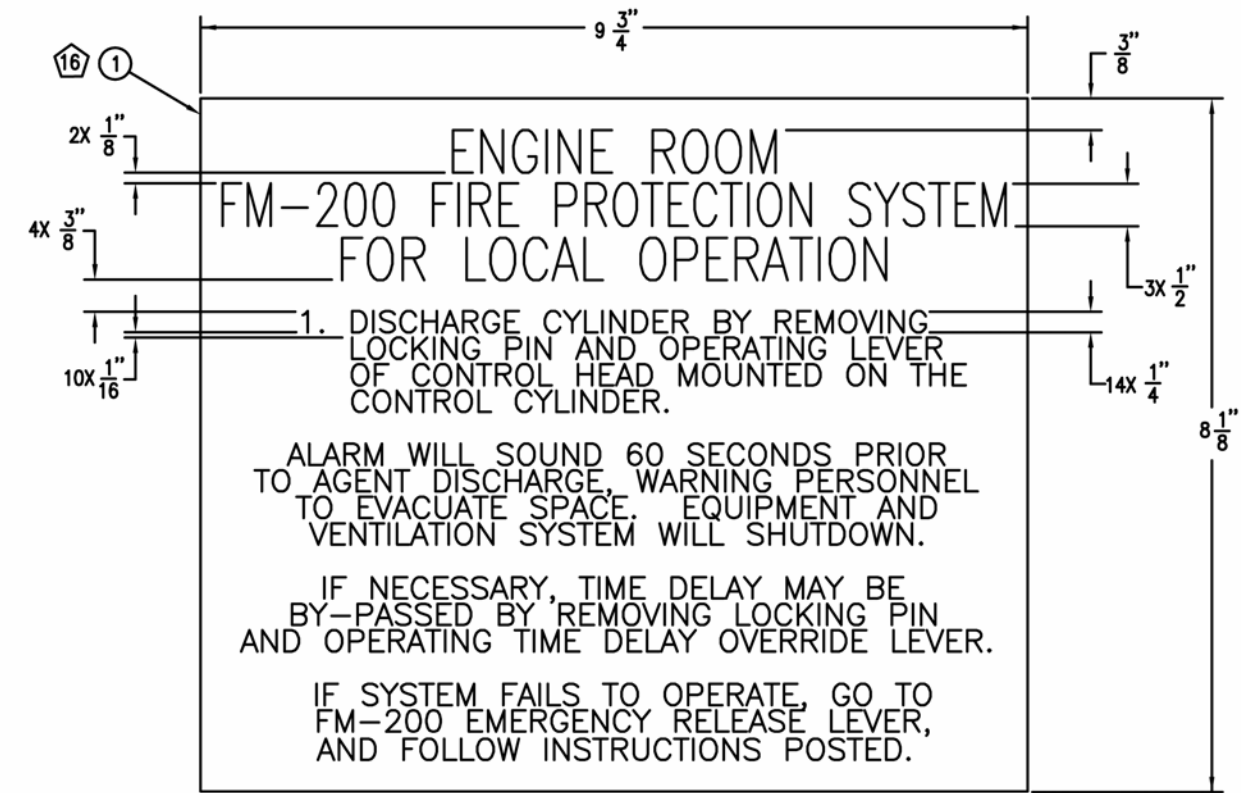
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ZONE	REV	DESCRIPTION	DATE	APPROVED



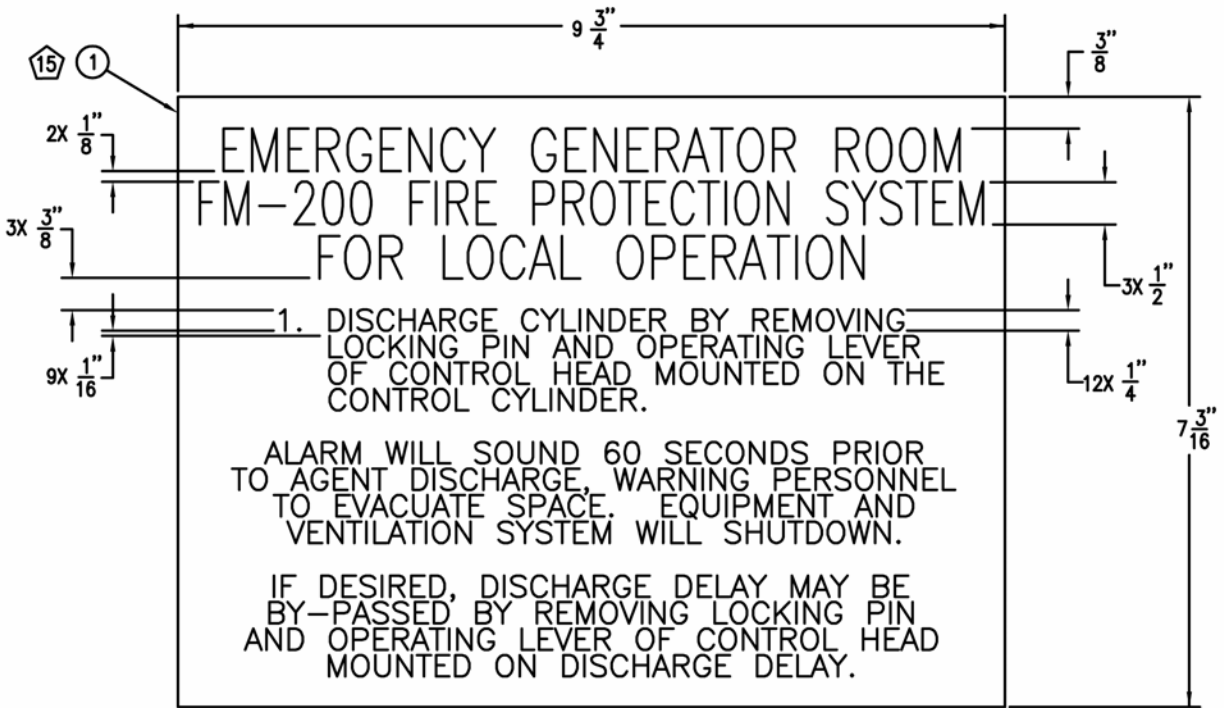
VIEW 30-C  
PAINT LOCKER FM-200 SYSTEM  
LOCAL OPERATION INSTRUCTION PLATE



VIEW 27-C  
ENGINE ROOM FM-200 SYSTEM  
INSTRUCTION PLATE



VIEW 30-A  
ENGINE ROOM FM-200 SYSTEM  
LOCAL OPERATION INSTRUCTION PLATE

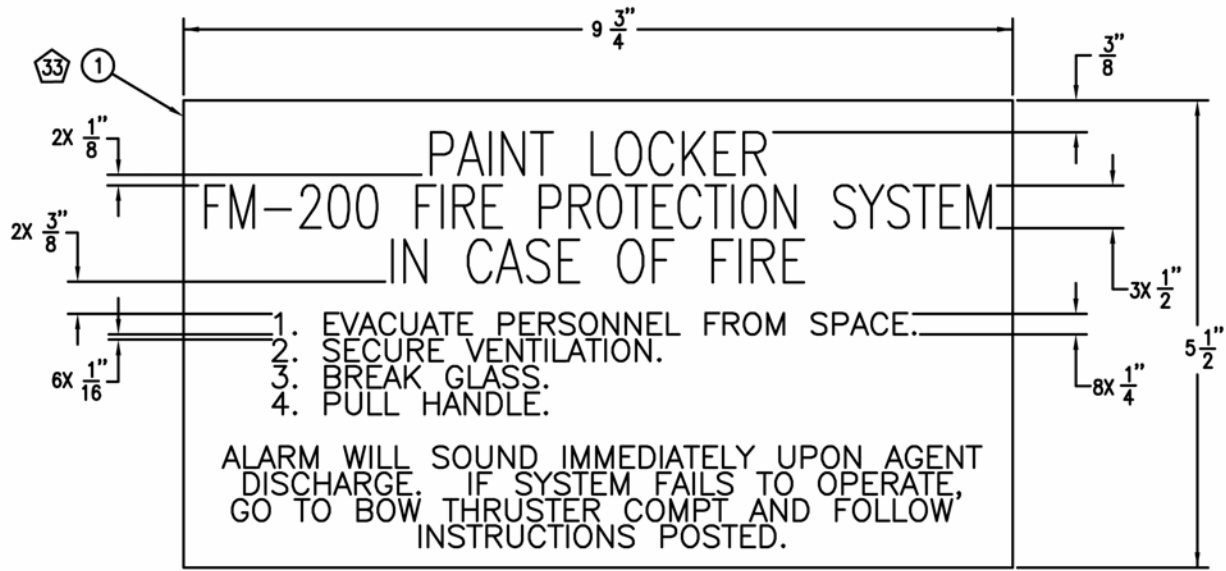


VIEW 27-B  
EMERGENCY GENERATOR ROOM FM-200 SYSTEM  
LOCAL OPERATION INSTRUCTION PLATE

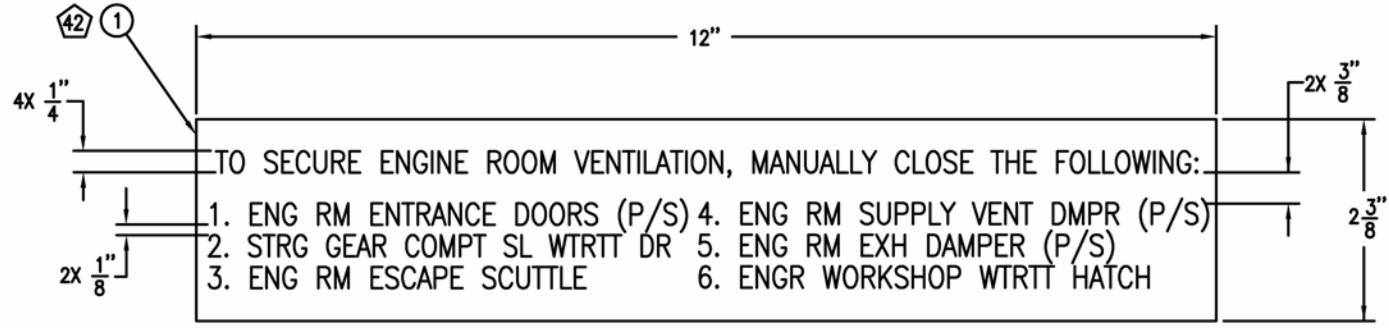
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTR557-97-C-00049		U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES $\pm$ 3 PLACES $\pm$ ANGLES $\pm$		CONTRACTOR 2R341		U.S. ARMY LSV FM-200 SYSTEM LABEL PLATES AND PLACARDS	
DRAWN BY BO	DATE 02/13/88	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882		SIZE D	CAGE CODE 19207
CHECKER JS/AK	ENGINEER JS			LSV-5553-4	
CLASS DESIGN APPROVAL MARK GENTILE				SCALE	SHEET 4 OF 8
CLASS DRAWING APPROVAL MARK GENTILE 4/28/00					



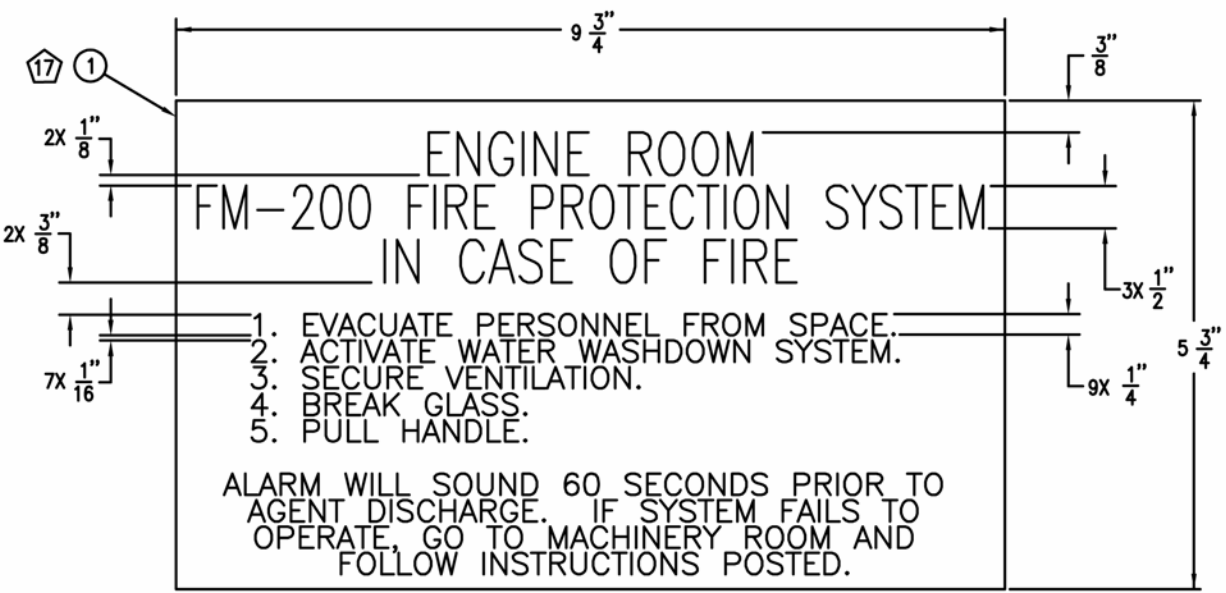
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ZONE	REV	DESCRIPTION	DATE	APPROVED



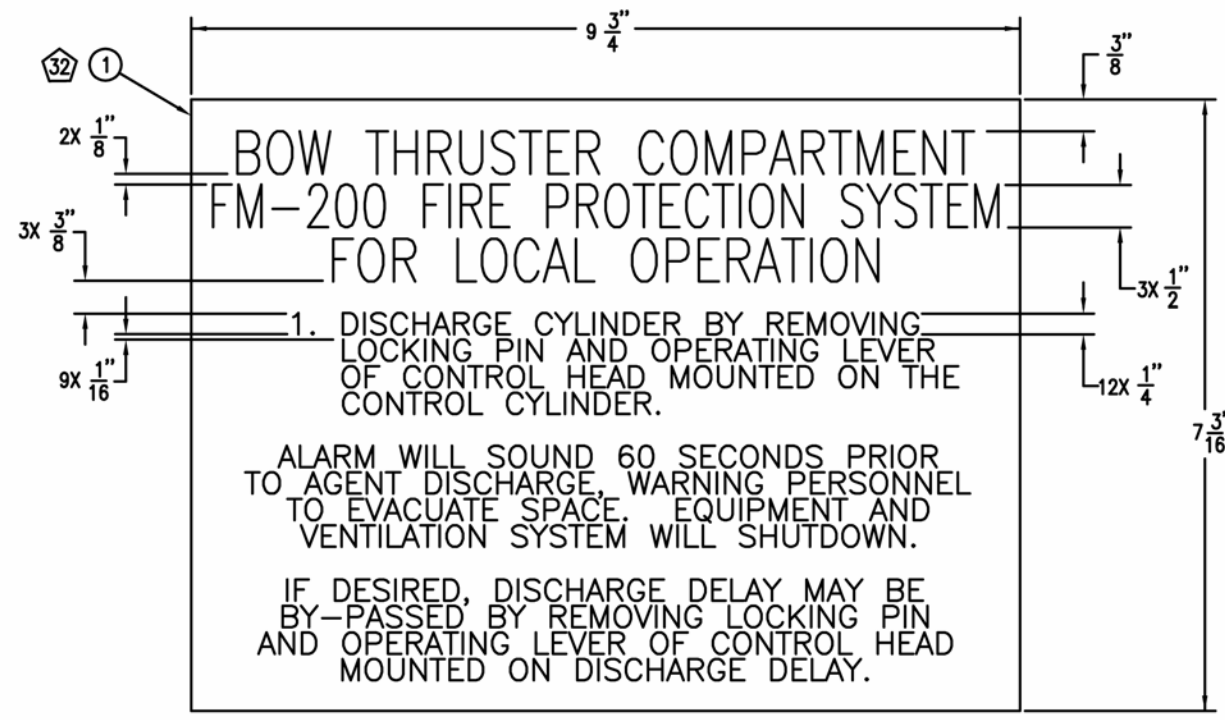
VIEW 38-C  
PAINT LOCKER FM-200 SYSTEM  
REMOTE OPERATION INSTRUCTION PLATE



VIEW 35-C  
ENGINE ROOM FM-200 SYSTEM  
VENTILATION CLOSURE INSTRUCTION PLATE



VIEW 38-A  
ENGINE ROOM FM-200 SYSTEM  
REMOTE OPERATION INSTRUCTION PLATE



VIEW 34-A  
BOW THRUSTER COMPARTMENT FM-200 SYSTEM  
LOCAL OPERATION INSTRUCTION PLATE

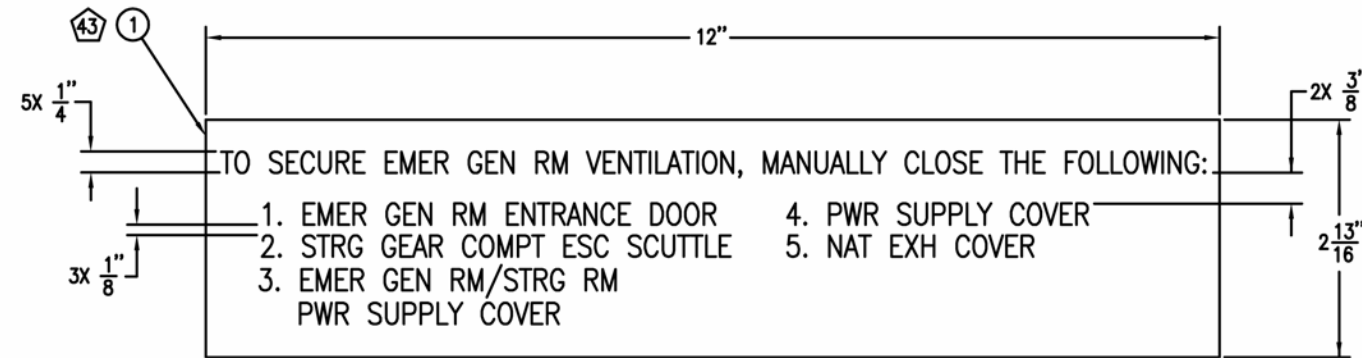
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTR557-97-C-00049		U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±		CONTRACTOR 2R341		U.S. ARMY LSV FM-200 SYSTEM LABEL PLATES AND PLACARDS	
DRAWN BY BO	DATE 02/13/98	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882		SIZE D	CAGE CODE 19207
CHECKER JS/AK	ENGINEER JS			LSV-5553-4	
CLASS DESIGN APPROVAL MARK GENTILE				SCALE	SHEET 5 OF 8
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99					



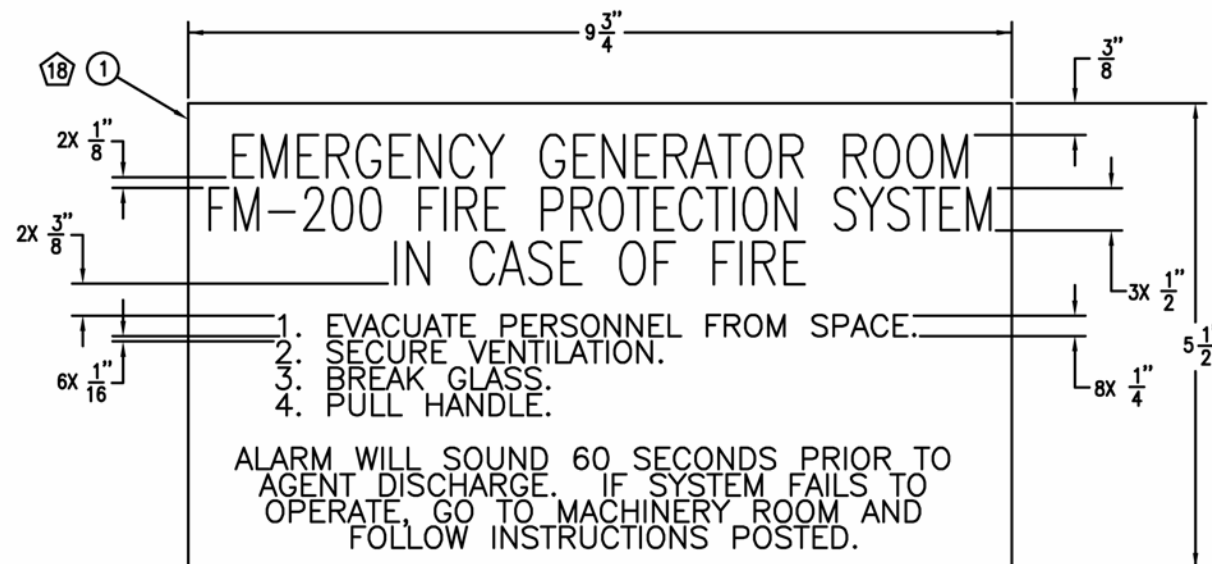
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ZONE	REV	DESCRIPTION	DATE	APPROVED



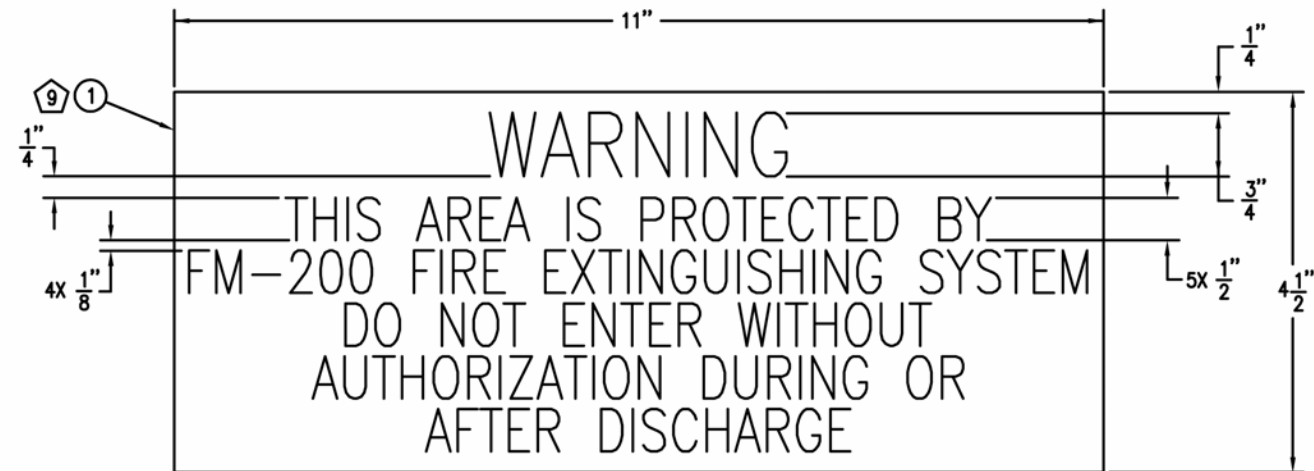
VIEW 46-C  
BOW THRUSTER COMPARTMENT FM-200 SYSTEM  
REMOTE OPERATION INSTRUCTION PLATE (A)



VIEW 43-C  
EMER GEN RM FM-200 SYSTEM  
VENTILATION CLOSURE INSTRUCTION PLATE



VIEW 46-A  
EMERGENCY GENERATOR ROOM FM-200 SYSTEM  
REMOTE OPERATION INSTRUCTION PLATE



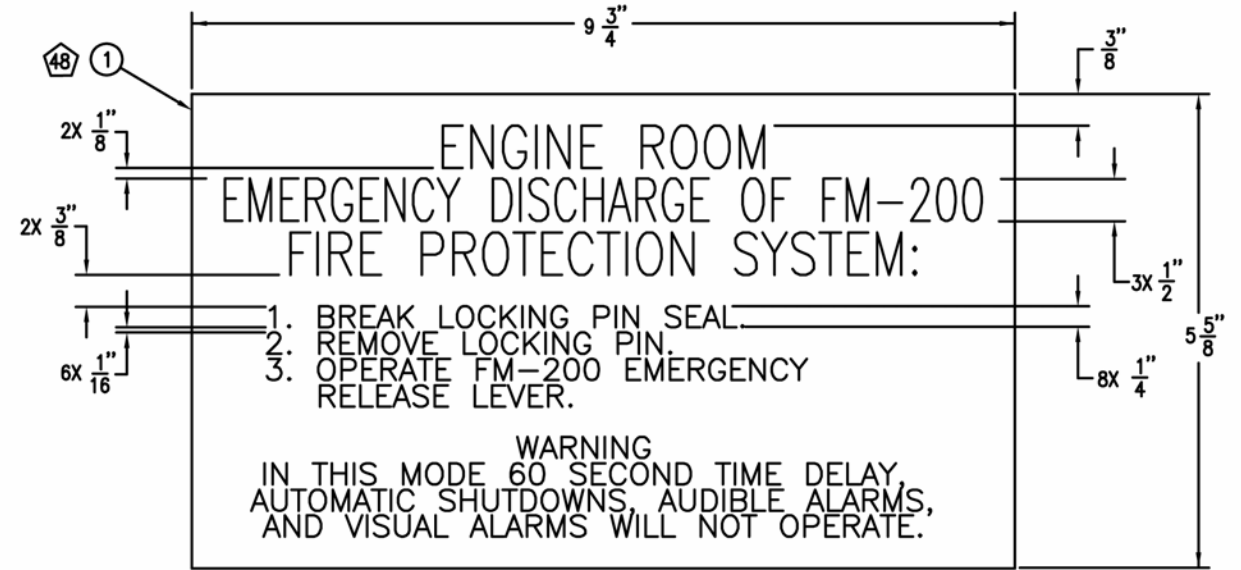
VIEW 43-A  
FM-200 SYSTEM  
WARNING LABEL PLATE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTR57-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±		CONTRACTOR 2R341	U.S. ARMY LSV FM-200 SYSTEM LABEL PLATES AND PLACARDS	
DRAWN BY BO	DATE 02/13/98	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882		
CHECKER JS/AK	ENGINEER JS	SIZE D	CAGE CODE 19207	LSV-5553-4
CLASS DESIGN APPROVAL MARK GENTILE		SCALE		
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99		SHEET 6 OF 8		

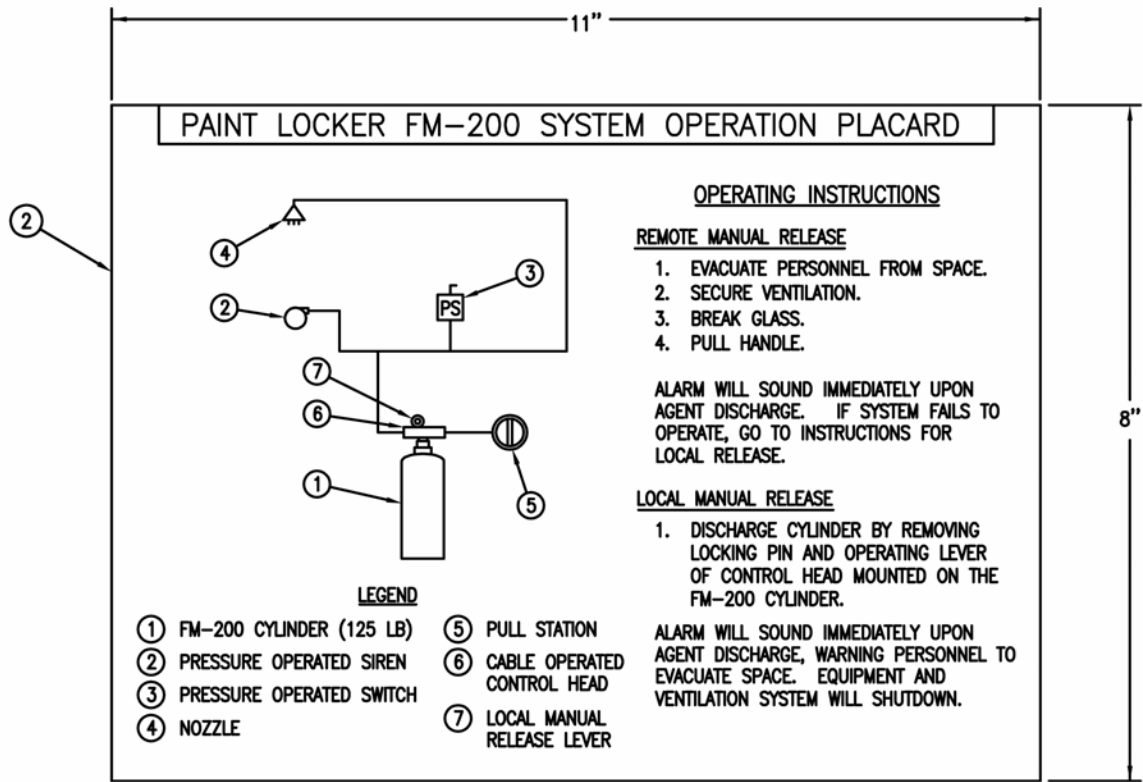




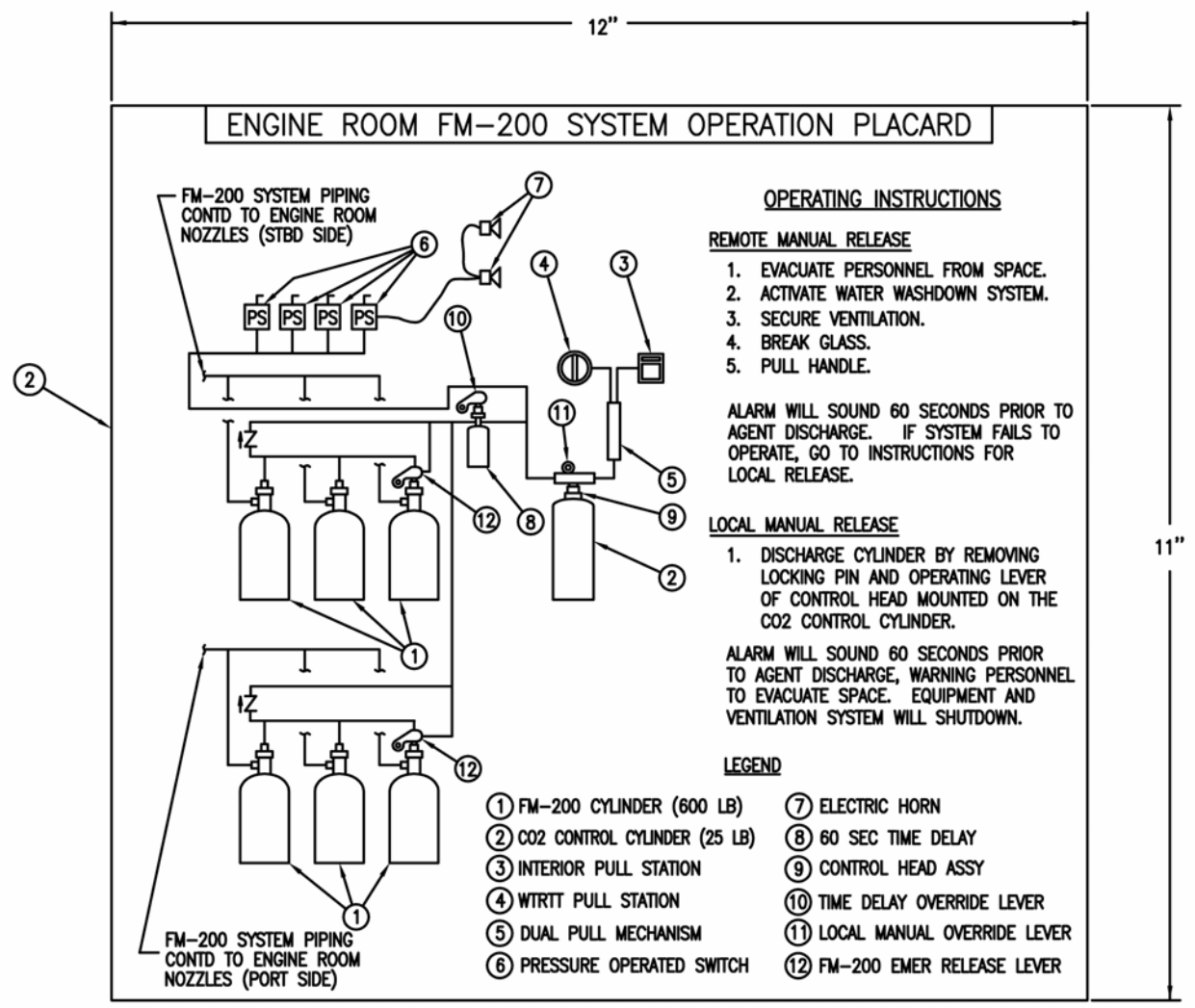
REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



VIEW 54-C  
ENGINE ROOM FM-200 SYSTEM  
EMERGENCY DISCHARGE OPERATION INSTRUCTION PLATE



VIEW 54-A  
PAINT LOCKER FM-200  
SYSTEM OPERATION PLACARD  
WTRIT BHD 10, STBD SIDE, NEAR CONTROL CYLINDER

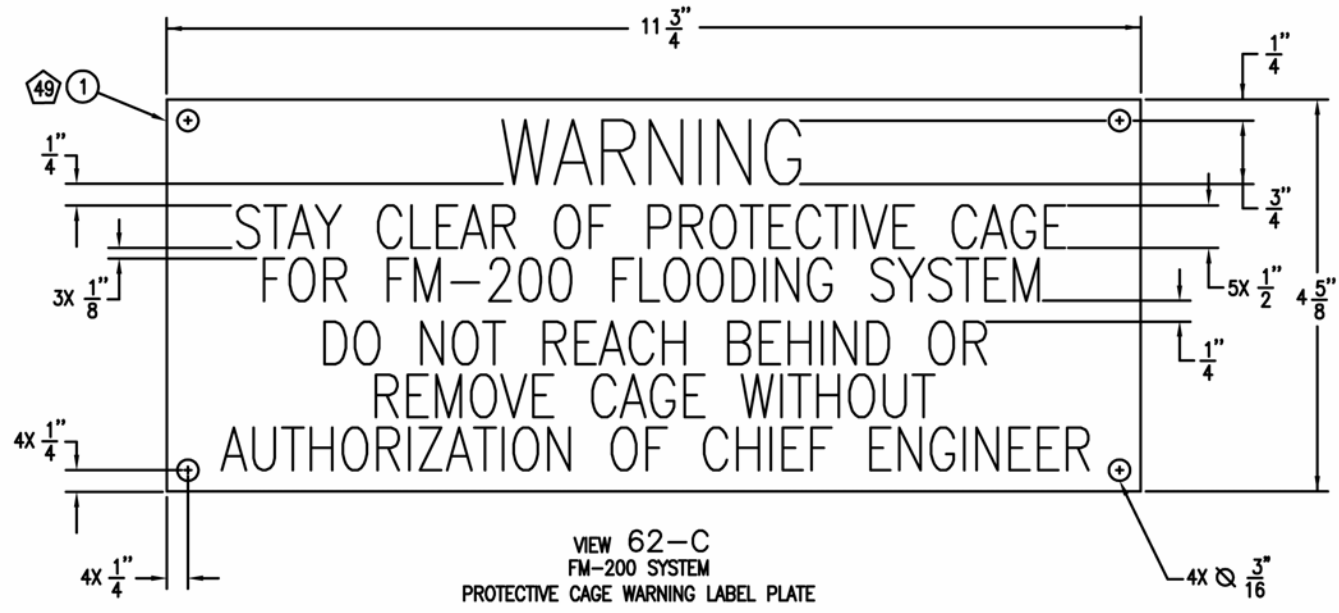


VIEW 50-A  
ENGINE ROOM FM-200  
SYSTEM OPERATION PLACARD  
BHD 111, MACHINERY RM, NEAR CONTROL CYLINDER

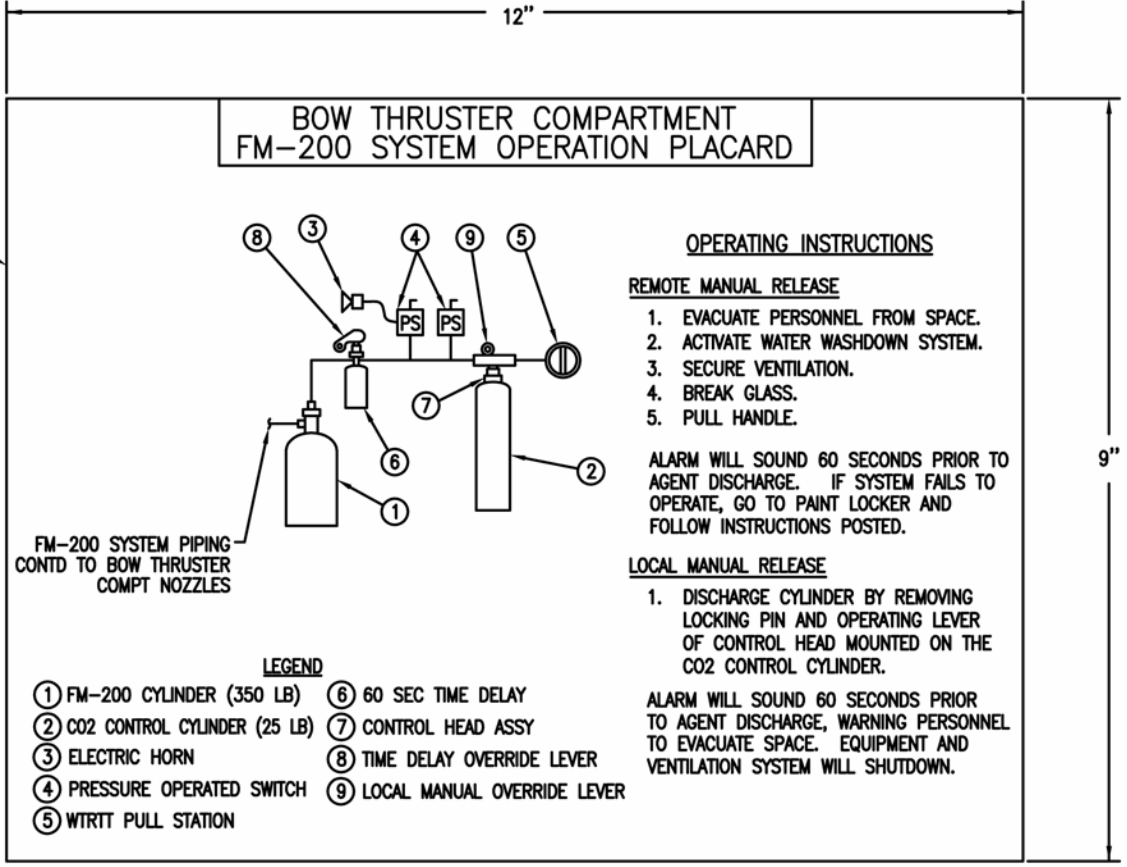
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTRS57-97-C-00049		U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±		CONTRACTOR 2R341		U.S. ARMY LSV FM-200 SYSTEM LABEL PLATES AND PLACARDS	
DRAWN BY BO	DATE 02/13/98	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882		SIZE D	CAGE CODE 19207
CHECKER JS/AK	ENGINEER JS	CLASS DESIGN APPROVAL MARK GENTILE		LSV-5553-4	
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99		SCALE		SHEET 7 OF 8	



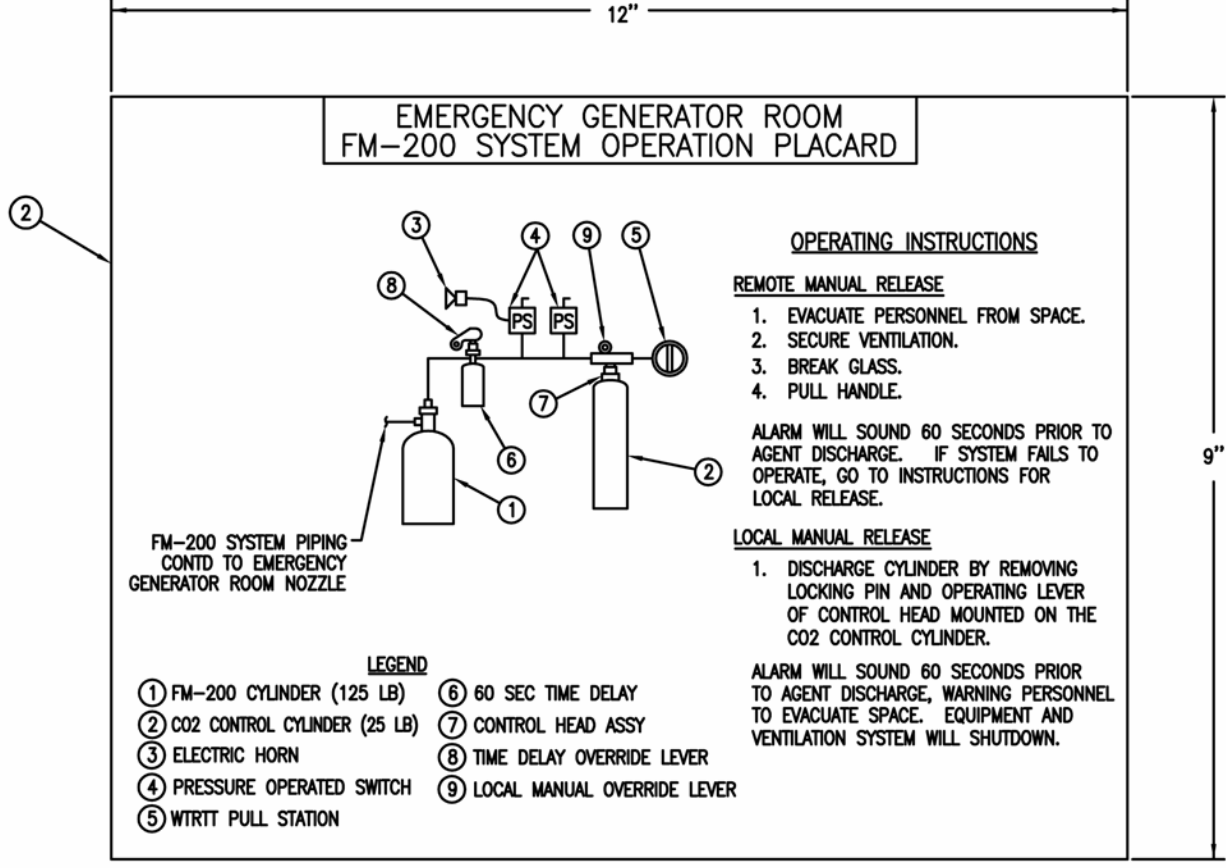
REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



VIEW 62-C  
FM-200 SYSTEM  
PROTECTIVE CAGE WARNING LABEL PLATE



VIEW 58-A  
BOW THRUSTER COMPARTMENT  
FM-200 SYSTEM OPERATION PLACARD  
LONG BHD 20'-0" OFF CL, FR 8, NEAR CONTROL CYLINDER



VIEW 62-A  
EMERGENCY GENERATOR ROOM  
FM-200 SYSTEM OPERATION PLACARD  
SIDE SHELL, FR 115, NEAR CONTROL CYLINDER

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTR57-97-C-00049		U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±		CONTRACTOR 2R341		U.S. ARMY LSV FM-200 SYSTEM LABEL PLATES AND PLACARDS	
DRAWN BY BO	DATE 01/20/98	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882		SIZE D	CAGE CODE 19207
CHECKER JS/AK	ENGINEER JS	CLASS DESIGN APPROVAL MARK GENTILE		LSV-5553-4	
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99		SCALE		SHEET 8 OF 8	



NOTES:

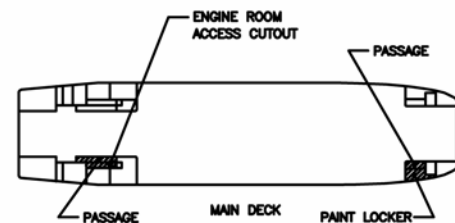
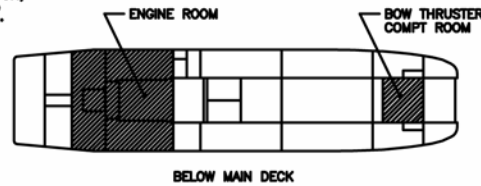
- THIS DRAWING HAS BEEN DEVELOPED AS A DETAILED DESIGN/INSTALLATION DRAWING FOR THE INSTALLATION OF A WATER WASHDOWN SYSTEM ASSOCIATED WITH THE FM-200 FIRE SUPPRESSION SYSTEM ON THE U.S. ARMY LOGISTICS SUPPORT VESSEL (LSV).
- ALL WORK SHALL BE PERFORMED UTILIZING GOOD COMMERCIAL PRACTICES AND SHALL SATISFY THE STANDARDS, REGULATIONS, REQUIREMENTS, AND RECOMMENDED PRACTICES OF THE CODE OF FEDERAL REGULATIONS (CFR) AND THE STATEMENT OF WORK ASSOCIATED WITH THIS CONTRACT.
- ANY DEVIATIONS IN ROUTING OF SYSTEM PIPING OR NUMBER OF FITTINGS SHALL BE APPROVED BY THE DESIGN ENGINEER, REGISTERED ENGINEER (FP), AND THE GOVERNMENT CONTRACTING ACTIVITY PRIOR TO INSTALLATION.
- NEWLY INSTALLED MATERIAL, EQUIPMENT, AND DISTURBED AREAS SHALL BE CLEANED, PAINTED, AND MARKED USING DEPARTMENT OF THE ARMY TECHNICAL BULLETIN TB 43-0144, "PAINTING OF WATERCRAFT", AS A GUIDE.
- PRIOR TO PERFORMING FUNCTIONAL TESTING, SYSTEM PIPING INSTALLATION, INCLUDING ALL WELDING, SHALL BE COMPLETE. PNEUMATIC TESTING OR HYDROSTATIC TESTING, AS DESCRIBED BELOW, MAY BE PERFORMED.  
 PNEUMATIC TESTING: UPON INSTALLATION (INCLUDING CONNECTION TO FIRE MAIN) AND PRIOR TO INSTALLATION OF SPRAY NOZZLES, SYSTEM PIPING SHALL BE CLEANED, BLOWN OUT, AND SUBJECT TO A PNEUMATIC TEST IN ACCORDANCE WITH 46 CFR 56.97-35 (EXCLUDING (F) ) AND INVC 6-72, CHANGE 1, SECTION D.3. THE GAS USED AS A TEST MEDIUM SHALL NOT BE FLAMMABLE (NITROGEN OR OTHER INERT GAS). IF CO2 IS USED AS THE TEST MEDIUM, IT SHALL BE VAPORIZED AND AT AMBIENT CONDITIONS PRIOR TO AND DURING TESTING. TEST PRESSURE SHALL BE 1.5 TIMES THE MAXIMUM SYSTEM WORKING PRESSURE AND SHALL BE HELD FOR A MINIMUM OF 10 MINUTES. AT THE END OF 10 MINUTES, THE PRESSURE DROP SHALL NOT EXCEED FIVE (5) PERCENT OF THE TEST PRESSURE. FOR SYSTEMS WHERE THE FIVE (5) PERCENT PRESSURE DROP IS EXCEEDED, THE PIPING SHALL BE CHECKED USING SOAPY WATER TO LOCATE LEAKS ONLY. EXTREME CAUTION SHALL BE USED WHILE THE SYSTEM PIPING IS CHARGED.  
 HYDROSTATIC TESTING: UPON INSTALLATION (INCLUDING CONNECTION TO FIRE MAIN) AND PRIOR TO INSTALLATION OF SPRAY NOZZLES, SYSTEM PIPING SHALL BE CLEANED, BLOWN OUT, AND SUBJECT TO A HYDROSTATIC TEST IN ACCORDANCE WITH 46 CFR 56.97-30. TEST MEDIUM SHALL BE FRESH WATER. TEST PRESSURE SHALL BE 1.5 TIMES THE MAXIMUM SYSTEM WORKING PRESSURE AND SHALL BE HELD FOR A MINIMUM OF 10 MINUTES. FOLLOWING APPLICATION OF THE TEST PRESSURE FOR 10 MINUTES, AN EXAMINATION OF ALL JOINTS, CONNECTIONS, AND REGIONS OF HIGH STRESS SHALL BE MADE. AT THE END OF 10 MINUTES, THE PRESSURE DROP SHALL NOT EXCEED FIVE (5) PERCENT OF THE TEST PRESSURE. FOR SYSTEMS WHERE THE FIVE (5) PERCENT PRESSURE DROP IS EXCEEDED, THE PIPING SHALL BE CHECKED TO LOCATE ALL LEAKS. EXTREME CAUTION SHALL BE USED WHILE THE SYSTEM PIPING IS CHARGED.
- PIPING MUST BE REAMED FREE OF BURRS AND RIDGES AFTER CUTTING, WELDING, OR THREADING. ALL THREADED JOINTS SHALL CONFORM TO AMERICAN NATIONAL STANDARD TAPER PIPE THREADS IN ACCORDANCE WITH ASME B1.20.1. JOINT COMPOUND OR THREAD TAPE SHALL BE APPLIED ONLY TO MALE PIPE THREADS, EXCLUDING THE FIRST TWO THREADS.
- EXISTING INSULATION DISTURBED OR DAMAGED BY THIS INSTALLATION SHALL BE REPLACED OR REPAIRED TO A LIKE NEW CONDITION.
- ALL WATERTIGHT BOUNDARY PENETRATIONS ABANDONED BY THE REMOVAL OF HALON FIRE EXTINGUISHING SYSTEMS AND VESSEL MODIFICATIONS SHALL BE WELDED CLOSED. OTHER ABANDONED BULKHEAD, DECK, AND FRAMING PENETRATIONS SHALL BE WELDED CLOSED AND ALL BRACKETS REMOVED. ALL WELDED FITTINGS SHALL BE GROUND FLUSH, PRIMED, AND PAINTED IN ACCORDANCE WITH TB 43-0144, "PAINTING OF WATERCRAFT".
- REQUIRED PIPE LENGTHS ARE DISCLOSED AS "XX/XX/XX", REPRESENTING FITTING TO FITTING CENTER LINE DISTANCE DISCLOSED IN FT/IN/FOURTHS. IN LOCATIONS WHERE CONCENTRIC REDUCERS ARE USED ADJACENT TO PIPES, THE PIPE LENGTHS DISCLOSED INCLUDE THE REDUCER'S LENGTH.
- "Z" DIMENSION REPRESENTS DISTANCE FROM DECK ABOVE TO PIPE CENTER LINE.
- CRES FITTINGS CONFORM TO DIMENSIONS OF ASME B16.3 AND CHEMICAL REQUIREMENTS OF ASTM A 351, GRADE CF8 (SIMILAR TO GRADE 304).

- PIPE HANGERS:  
 ALL PIPING SHALL BE SUPPORTED BY PIPE HANGERS TO PREVENT VIBRATION AND PROTECT AGAINST DAMAGE. PIPE HANGERS SHALL BE DESIGNED TO SUPPORT FIVE TIMES THE WEIGHT OF THE PIPE WHEN FILLED WITH WATER PLUS 250 LB. AT EACH POINT OF PIPING SUPPORT. PIPE HANGERS SHALL BE IN ACCORDANCE WITH ASTM F 708 (SEE VIEW 15-A):  
 - STANDOFF: ANGLE, 42° L  
 - LINER: SYNTHETIC RUBBER - NUTS: NYLOCK OR EQUIVALENT  
 - FINISH: PRIMER  
 SPACING OF PIPE HANGERS SHALL BE IN ACCORDANCE WITH TABLE 2, ASTM F 708 TITLED; PIPE HANGER SPACING. SPACING OF PIPE HANGERS AS DISCLOSED IN THE FIELD OF THE DRAWING BY SYMBOL "■" ARE FOR GUIDANCE ONLY.
- BRANCHLETS, FIND NO. 22 AND 25, ARE MANUFACTURED BY:  
 ALLIED PIPING PRODUCTS INC.  
 P.O. BOX 848  
 VALLEY FORGE, PA 19482-0848  
 PHONE (610) 666-5950  
 FAX (610) 666-7606
- GASKETS, FIND NO. 44, 62, 81, 82, 83, 84, AND 85, ARE MANUFACTURED BY:  
 THERMOSEAL INC.  
 2350 CAMPBELL RD.  
 SIDNEY, OH 45385  
 PHONE (937) 498-2222

SHEETS										STATUS OF REVISION				
10	9	8	7	6	5	4	3	2	1	ZONE	REV	DESCRIPTION	DATE	APPROVED

PARTS LIST CONTINUED ON SHEET 2

QTY	QTY	FIND	CAGE	PART OR	TOTAL	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL	UNIT
REQUIRED	REQUIRED	NO.	CODE	IDENTIFYING NUMBER	QUANTITY				WEIGHT
ENG RM	BT				REQUIRED				(LB)
7 EA	45	2E666		7 EA	FLANGE, SLIP-ON WELDING, CL 150, 3 NPS	COMIL (CAMCO)	CRES		5.25
5 EA	44			5 EA	GASKET, NITRILE C-4401, SMALL FLAT RING, 3 NPS, 1/16" THK	SEE NOTE 14			0.10
1 EA	43			1 EA	FLANGE, SLIP-ON WELDING, CL 150, 3 NPS	ASME B16.5	STEEL		4.00
11FT	42			11FT	PIPE, SMLS, 3.500 OD X .216 WALL, GALV (3 NPS)	ASTM A 53	STEEL		7.58
1 EA	41	07971		1 EA	WELDOLET, REDUCING, 4 X 3 NPS	COMIL (BONNEY FORGE)	STEEL		4.35
1 EA	40	13205		1 EA	REDUCER, CONCENTRIC, BTWLD, SCHED 10, 3 TO 1 1/2 NPS	COMIL (MARKOVITZ)	CRES		2.14
1 EA	39	2E666		1 EA	INSERT, SWLDG, CL 3000, 3/4 TO 1 1/2 NPS	COMIL (CAMCO)	CRES		0.41
8 EA	4 EA	38	2E666	12 EA	FLANGE, SWLDG, CL 150, 3/4 NPS	COMIL (CAMCO)	CRES		1.12
1 EA	37	13205		1 EA	REDUCER, CONCENTRIC, BTWLD, SCHED 10, 2 1/2 TO 2 NPS	COMIL (MARKOVITZ)	CRES		2.14
1 EA	36	13205		1 EA	REDUCER, CONCENTRIC, BTWLD, SCHED 10, 3 TO 2 1/2 NPS	COMIL (MARKOVITZ)	CRES		3.30
1 EA	35	13205		1 EA	TEE, BTWLD, SCHED 10, 3 NPS	COMIL (MARKOVITZ)	CRES		4.78
60 FT	34			60 FT	PIPE, WLD, GRADE TP304H, 3.500 OD X .120 WALL (3 NPS)	ASTM A 312	CRES		3.26
12 EA	33	13205		12 EA	ELBOW, 90°, BTWLD, SCHED 10, 3 NPS	COMIL (MARKOVITZ)	CRES		3.94
2 EA	1 EA	32	2E666	3 EA	TEE, SWLDG, CL 150, 1 1/2 NPS	COMIL (CAMCO)	CRES		2.08
10 FT	60 FT	31		70 FT	PIPE, WLD, GRADE TP304H, 1.990 OD X .145 WALL (1 1/2 NPS)	ASTM A 312	CRES		2.72
2 EA	11 EA	30	2E666	13 EA	ELBOW, 90°, SWLDG, CL 150, 1 1/2 NPS	COMIL (CAMCO)	CRES		1.64
	1 EA	29	2E666	1 EA	COUPLING, SWLDG, CL 150, 3/4 NPS	COMIL (CAMCO)	CRES		1.28
3 EA	28	2E666		3 EA	ELBOW, 45°, SWLDG, CL 150, 1 NPS	COMIL (CAMCO)	CRES		0.61
3 EA	27	2E666		3 EA	TEE, SWLDG, CL 150, 2 NPS	COMIL (CAMCO)	CRES		3.31
2 EA	26	13205		2 EA	ELBOW, 45°, BTWLD, SCHED 10, 3 NPS	COMIL (MARKOVITZ)	STEEL		2.65
1 EA	25			1 EA	BRANCHLET, SWLDG, SCHED 10, 2 1/2 TO 3/4 NPS	SEE NOTE 13	CRES		6.65
4 EA	24	13205		4 EA	ELBOW, 45°, BTWLD, SCHED 10, 2 1/2 NPS	COMIL (MARKOVITZ)	CRES		1.86
50 FT	23			50 FT	PIPE, WLD, GRADE TP304H, 2.875 OD X .120 WALL (2 1/2 NPS)	ASTM A 312	CRES		3.53
6 EA	22			6 EA	BRANCHLET, SWLDG, SCHED 10, 2 1/2 TO 1 NPS	SEE NOTE 13	CRES		6.65
7 EA	1 EA	21	2E666	8 EA	INSERT, SWLDG TO THD, CL 3000, 1/2 TO 1/4 NPS	COMIL (CAMCO)	CRES		0.28
11 EA	3 EA	20	2E666	14 EA	ELBOW, 90°, SWLDG, CL 150, 1/2 NPS	COMIL (CAMCO)	CRES		0.33
50 FT	10 FT	19		60 FT	PIPE, WLD, GRADE TP304H, 0.840 OD X .109 WALL (1/2 NPS)	ASTM A 312	CRES		0.85
6 EA	1 EA	18	2E666	7 EA	INSERT, SWLDG, CL 3000, 1 TO 1/2 NPS	COMIL (CAMCO)	CRES		0.91
2 EA	17	2E666		2 EA	COUPLING, SWLDG, CL 150, 1/2 NPS	COMIL (CAMCO)	CRES		0.15
1 EA	1 EA	16	2E666	2 EA	COUPLING, SWLDG, CL 150, 1 NPS	COMIL (CAMCO)	CRES		0.43
5 EA	15	2E666		5 EA	ELBOW, 90°, SWLDG, CL 150, 2 NPS	COMIL (CAMCO)	CRES		2.25
20 FT	14			20 FT	PIPE, WLD, GRADE TP304H, 2.375 OD X .154 WALL (2 NPS)	ASTM A 312	CRES		3.65
3 EA	1 EA	13	2E666	4 EA	INSERT, SWLDG, CL 3000, 1 1/2 TO 1 NPS	COMIL (CAMCO)	CRES		1.13
51 EA	9 EA	12	2E666	60 EA	ELBOW, 90°, SWLDG, CL 150, 3/4 NPS	COMIL (CAMCO)	CRES		0.53
25 EA	4 EA	11	2E666	29 EA	INSERT, SWLDG TO THD, CL 3000, 3/4 TO 1/4 NPS	COMIL (CAMCO)	CRES		0.41
12 EA	10	2E666		12 EA	TEE, SWLDG, CL 150, 3/4 NPS	COMIL (CAMCO)	CRES		0.70
330 FT	65 FT	9		395 FT	PIPE, WLD, GRADE TP304H, 1.050 OD X .113 WALL (3/4 NPS)	ASTM A 312	CRES		1.13
13 EA	4 EA	8	2E666	17 EA	INSERT, SWLDG, CL 3000, 1 TO 3/4 NPS	COMIL (CAMCO)	CRES		0.91
28 EA	8 EA	7	2E666	36 EA	FLANGE, SWLDG, CL 150, 1 NPS	COMIL (CAMCO)	CRES		1.46
4 EA	6	2E666		4 EA	INSERT, SWLDG, CL 3000, 2 TO 1 NPS	COMIL (CAMCO)	CRES		2.87
49 EA	9 EA	5	99134	58 EA	NOZZLE, SPRAY, MODEL TF, 120° FULL CONE, 1/4 MPT	COMIL (BETE)	CRES		0.23
17 EA	4 EA	4	2E666	21 EA	INSERT, SWLDG TO THD, CL 3000, 1 TO 1/4 NPS	COMIL (CAMCO)	CRES		0.91
23 EA	6 EA	3	2E666	29 EA	TEE, SWLDG, CL 150, 1 NPS	COMIL (CAMCO)	CRES		1.11
235 FT	65 FT	2		300 FT	PIPE, WLD, GRADE TP304H, 1.315 OD X .133 WALL (1 NPS)	ASTM A 312	CRES		1.88
29 EA	8 EA	1	2E666	37 EA	ELBOW, 90°, SWLDG, CL 150, 1 NPS	COMIL (CAMCO)	CRES		0.88

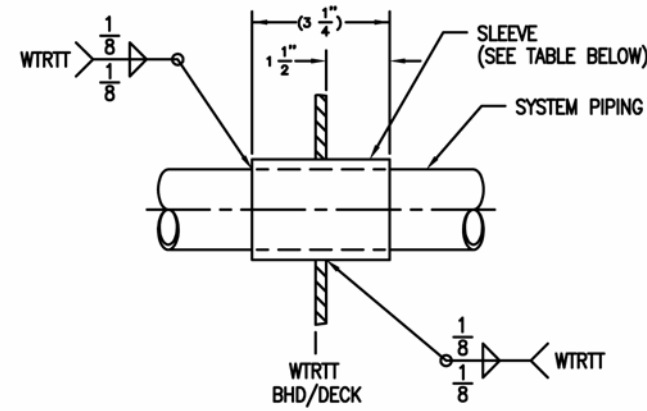


DISTRIBUTION STATEMENT A  
 APPROVED FOR PUBLIC RELEASE;  
 DISTRIBUTION IS UNLIMITED.

1	WWS LABEL PLATES AND PLACARDS	LSV-5231-2
NO.	DRAWING TITLE	DRAWING NUMBER
LIST OF REFERENCES		

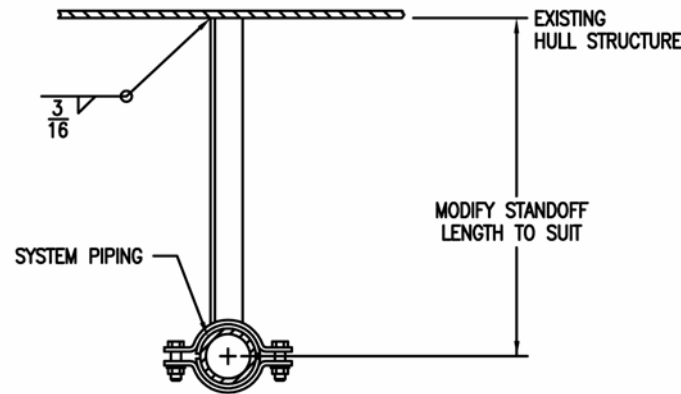
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTR557-97-C-00049		U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± — ± — ± —		CONTRACTOR 2R341		U.S. ARMY LSV WATER WASHDOWN SYSTEM PIPING INSTALLATION AND DETAILS	
DRAWN BY AM 03/23/98		RPE (FP) CLASS APPROVAL		SIZE D	
CHECKED BY JS 4/28/99		PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882		CAGE CODE 19207	
CLASS DESIGN APPROVAL MARK GENTILE				DRAWING NUMBER LSV-5231-1	
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99				SCALE 1/4" = 1'-0"	
				SHEET 1 OF 10	





VIEW 15-C  
TYPICAL WATERTIGHT BULKHEAD/DECK PENETRATION  
NOT TO SCALE

PIPE SIZE	SLEEVE FIND NO.
3 NPS	52
1 1/2 NPS	73



VIEW 15-A  
TYPICAL PIPE HANGER ASSEMBLY  
NOT TO SCALE

PIPE SIZE	HANGER ASSEMBLY FIND NO.
1/2 NPS	93
3/4 NPS	94
1 NPS	95
1 1/4 NPS	96
1 1/2 NPS	97
2 NPS	98
2 1/2 NPS	99
3 NPS	100

NOMINAL PIPE SIZE (IN.)	HANGER SPACING (FT.)
1/2" NPS	5 FEET
3/4" NPS	5 FEET
1" NPS	6 FEET
1 1/4" NPS	6 FEET
1 1/2" NPS	6 FEET
2" NPS	8 FEET
2 1/2" NPS	8 FEET
3" NPS	8 FEET
3 1/2" NPS	8 FEET
4" NPS	8 FEET

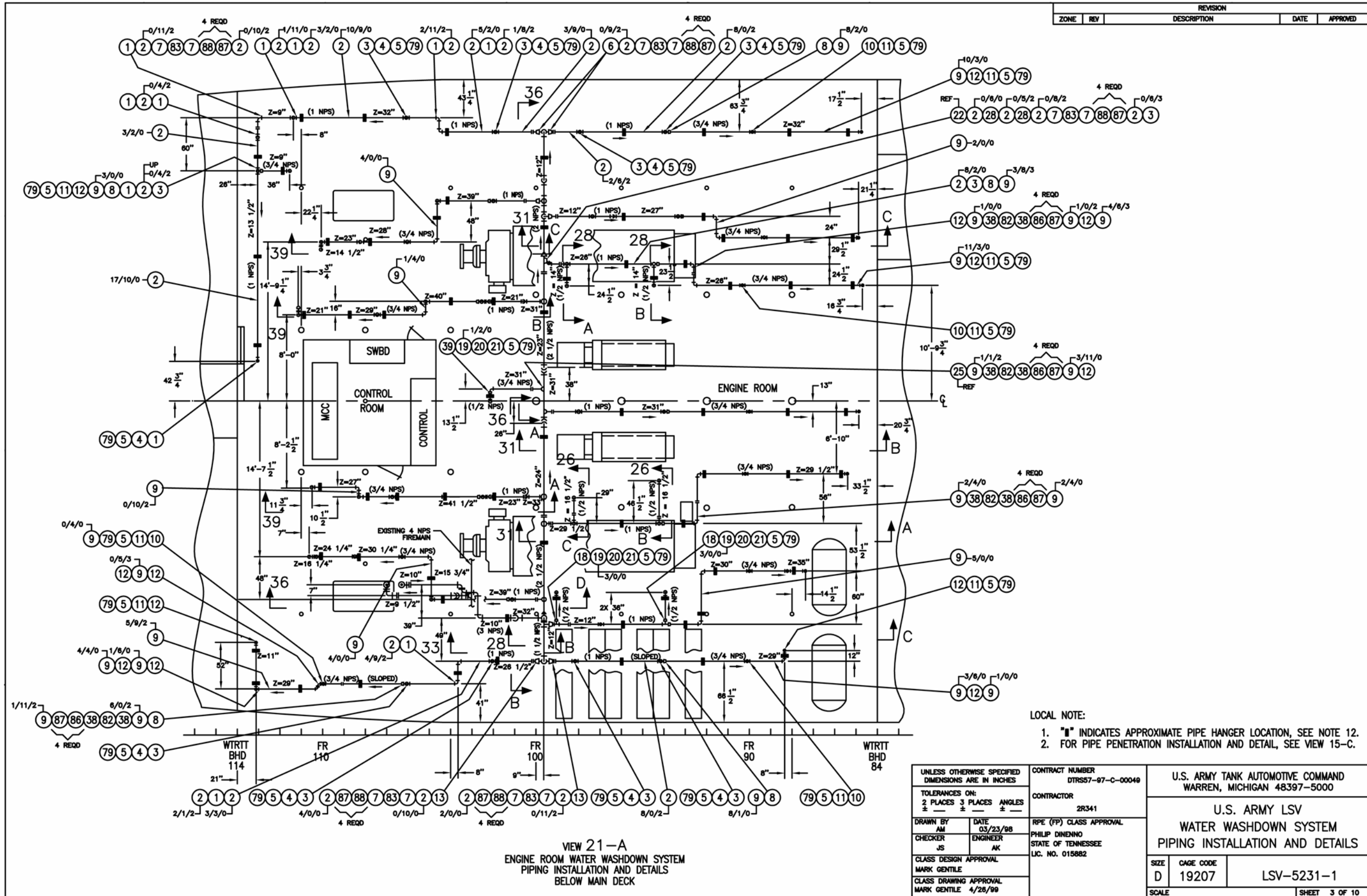
		REVISION							
		ZONE	REV	DESCRIPTION	DATE	APPROVED			
1 EA	101			1EA ELBOW, 90°, BTWLD, SCHED 10, 3 NPS		COML (MARKOVITZ) STEEL 3.94			
1 EA	100			1 EA HANGER ASSY, SPLIT CAP, SGL LEG STDF, W/LINER, 3 NPS		ASTM F 708 SEE NOTE 12 3.00			
3 EA	99			3 EA HANGER ASSY, SPLIT CAP, SGL LEG STDF, W/LINER, 2 1/2 NPS		ASTM F 708 SEE NOTE 12 2.50			
2 EA	98			2 EA HANGER ASSY, SPLIT CAP, SGL LEG STDF, W/LINER, 2 NPS		ASTM F 708 SEE NOTE 12 2.00			
1 EA	97			10 EA HANGER ASSY, SPLIT CAP, SGL LEG STDF, W/LINER, 1 1/2 NPS		ASTM F 708 SEE NOTE 12 1.50			
1 EA	96			1 EA HANGER ASSY, SPLIT CAP, SGL LEG STDF, W/LINER, 1 1/4 NPS		ASTM F 708 SEE NOTE 12 1.25			
17 EA	95			26 EA HANGER ASSY, SPLIT CAP, SGL LEG STDF, W/LINER, 1 NPS		ASTM F 708 SEE NOTE 12 1.00			
41 EA	94			53 EA HANGER ASSY, SPLIT CAP, SGL LEG STDF, W/LINER, 3/4 NPS		ASTM F 708 SEE NOTE 12 0.75			
4 EA	93			5 EA HANGER ASSY, SPLIT CAP, SGL LEG STDF, W/LINER, 1/2 NPS		ASTM F 708 SEE NOTE 12 0.50			
1 EA	92	01599	MK-MK-06	2 EA PIN, HITCH, 3/16 X 3 1/2 SIZE		COML (REID) -			
24 EA	91			24 EA NUT, HEX, 5/8-11 UNC-2B		ASME B18.2.2 CRES 0.06			
24 EA	90			24 EA SCREW, CAP, HEX HD, 5/8-11 UNC-2A X 3" L		ASME B18.2.1 CRES 0.31			
20 EA	89			20 EA SCREW, CAP, HEX HD, 1/2-13 UNC-2A X 2 1/2" L		ASME B18.2.1 CRES 0.16			
56 EA	88			76 EA SCREW, CAP, HEX HD, 1/2-13 UNC-2A X 2 1/4" L		ASME B18.2.1 CRES 0.15			
80 EA	87			128 EA NUT, HEX, 1/2-13 UNC-2B		ASME B18.2.2 CRES 0.03			
24 EA	86			32 EA SCREW, CAP, HEX HD, 1/2-13 UNC-2A X 2" L		ASME B18.2.1 CRES 0.14			
2 EA	85			2 EA GASKET, NITRILE C-4401, SMALL FLAT RING, 2 1/2 NPS, 1/16" THK		SEE NOTE 14 0.10			
1 EA	84			1 EA GASKET, NITRILE C-4401, SMALL FLAT RING, 1 1/4 NPS, 1/16" THK		SEE NOTE 14 0.10			
14 EA	83			18 EA GASKET, NITRILE C-4401, SMALL FLAT RING, 1 NPS, 1/16" THK		SEE NOTE 14 0.10			
4 EA	82			6 EA GASKET, NITRILE C-4401, SMALL FLAT RING, 3/4 NPS, 1/16" THK		SEE NOTE 14 0.10			
2 EA	81			2 EA GASKET, NITRILE C-4401, SMALL FLAT RING, 1/2 NPS, 1/16" THK		SEE NOTE 14 0.10			
4 EA	80	2E666		4 EA FLANGE, SWLDG, CL 150, 1/2 NPS		COML (CAMCO) CRES 0.83			
49 EA	79	7N423	SPC1	58 EA GUARD, SPRINKLER		COML (BROOKS) STEEL -			
2 EA	78	2E666		2 EA INSERT, SWLDG, CL 3000, 1 1/4 TO 1 NPS		COML (CAMCO) CRES 1.04			
1 EA	77	2E666		1 EA TEE, SWLDG, CL 150, 1 1/4 NPS		COML (CAMCO) CRES 1.90			
2 EA	76	2E666		2 EA FLANGE, SWLDG, CL 150, 1 1/4 NPS		COML (CAMCO) CRES 1.87			
10 FT	75			10 FT PIPE, WLD, GRADE TP304H, 1.660 OD X .140 WALL (1 1/4 NPS)		ASTM A 312 CRES 2.27			
1 EA	74	2E666		1 EA INSERT, SWLDG, CL 3000, 1 1/2 TO 1 1/4 NPS		COML (CAMCO) CRES 1.13			
3 EA	73			3 EA PIPE, SMLS, 2.375 OD X .218 WALL, 3 1/4" L (2 NPS)		ASTM A 53 STEEL 0.99			
4 EA	72	2E666		4 EA FLANGE, SLIP-ON WELDING, CL 150, 2 1/2 NPS		COML (CAMCO) CRES 4.25			
1 EA	71	0WJY8		1 EA STRAINER, "Y", FLANGED, MODEL 150YESS, 1 1/2 NPS		COML (SSI) CRES 12.00			
1 EA	70	06LW3		1 EA VALVE, BALL, SWLDG, 1000 PSIG WOG, 1 1/2 NPS, W/LOCKING HANDLE		COML (SHARON PIPING) CRES 4.64			
1 EA	69			1 EA PLATE, 1/4 STK, 12" X 12"		ASTM A 36 STEEL 10.21			
1 EA	68	06LW3		1 EA VALVE, BALL, THD, 2000 PSIG WOG, 1/2 NPS		COML (SHARON PIPING) CRES 0.63			
2 EA	67			2 EA NIPPLE, THD, CLOSE, 1/2 NPS		ASTM A 733 CRES 0.08			
2 EA	66	2E666		2 EA ELBOW, 45°, SWLDG, CL 150, 3/4 NPS		COML (CAMCO) CRES 0.42			
4 EA	65			4 EA NUT, HEX, 1/2-13 UNC-2B		ASME B18.2.2 MONEL 0.10			
4 EA	64			4 EA SCREW, CAP, HEX HD, 1/2-13 UNC-2A X 2 1/2" L		ASME B18.2.1 MONEL 0.39			
9 EA	63	2E666		9 EA FLANGE, SWLDG, CL 150, 1 1/2 NPS		COML (CAMCO) CRES 2.00			
6 EA	62			6 EA GASKET, NITRILE C-4401, SMALL FLAT RING, 1 1/2 NPS, 1/16" THK		SEE NOTE 14 0.10			
1 EA	61			1 EA FLANGE, SWLDG, CL 150, 1 1/2 NPS		ASME B16.5 STEEL 2.00			
5 FT	60			5 FT PIPE, SMLS, 1.900 OD X .145 WALL (1 1/2 NPS)		ASTM A 53 STEEL 3.63			
1 EA	59	07971		1 EA WELDOLET, REDUCING, 2 1/2 X 1 1/2 NPS		COML (BONNEY FORGE) STEEL 3.00			
1 RO	58			2 RO TAPE, ANTI-SEIZE, SIZE II		MIL-T-27730 PTFE 0.03			
1 EA	57			1 EA PLATE, 1/4 STK, 39 1/2" X 29"		ASTM A 36 STEEL 81.82			
1 EA	56			1 EA PLATE, 1/4 STK, 16" X 11"		ASTM A 36 STEEL 15.88			
1 EA	55			1 EA PLATE, 1/4 STK, 28 3/4" X 11"		ASTM A 36 STEEL 22.23			
1 EA	54	0WJY8		1 EA STRAINER, "Y", FLANGED, MODEL 150YESS, 3 NPS		COML (SSI) CRES 40.00			
1 EA	53	06LW3		1 EA VALVE, BALL, SWLDG, 1000 PSIG WOG, 3 NPS, W/LOCKING HANDLE		COML (SHARON PIPING) CRES 40.36			
2 EA	52			2 EA PIPE, SMLS, 4.00 OD X .226 WALL, 3 1/4" L (3 1/2 NPS)		ASTM A 53 STEEL 2.47			
1 EA	51			1 EA PLATE, 1/4 STK, 37 1/2" X 11"		ASTM A 36 STEEL 29.25			
1 EA	50			1 EA BAR, FLAT, 3/8 X 2 STK, 30" L		ASTM A 36 STEEL 6.37			
1 EA	49	06LW3		1 EA VALVE, BALL, THD, 1500 PSIG WOG, 1 NPS		COML (SHARON PIPING) CRES 3.06			
	48			NOT USED					
4 EA	47			4 EA NUT, HEX, 5/8-11 UNC-2B		ASME B18.2.2 MONEL 0.10			
4 EA	46			4 EA SCREW, CAP, HEX HD, 5/8-11 UNC-2A X 3" L		ASME B18.2.1 MONEL 0.39			
QUANTITY REQUIRED ENG RM	QUANTITY REQUIRED BT	FIND NO.	CAGE CODE	PART OR IDENTIFYING NUMBER	TOTAL QUANTITY REQUIRED	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL	UNIT WEIGHT (LB)

PARTS LIST (CONTINUED FROM SHEET 1)

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	CONTRACT NUMBER DTR557-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± .005 ± .010 ± .015	CONTRACTOR 2R341	
DRAWN BY AM	DATE 03/23/98	U.S. ARMY LSV WATER WASHDOWN SYSTEM PIPING INSTALLATION AND DETAILS
CHECKED BY JS	ENGINEER AK	
CLASS DESIGN APPROVAL MARK GENTILE	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882	SIZE D
DRAWING APPROVAL MARK GENTILE 4/26/98		CAGE CODE 19207
		LSV-5231-1
		SCALE
		SHEET 2 OF 10







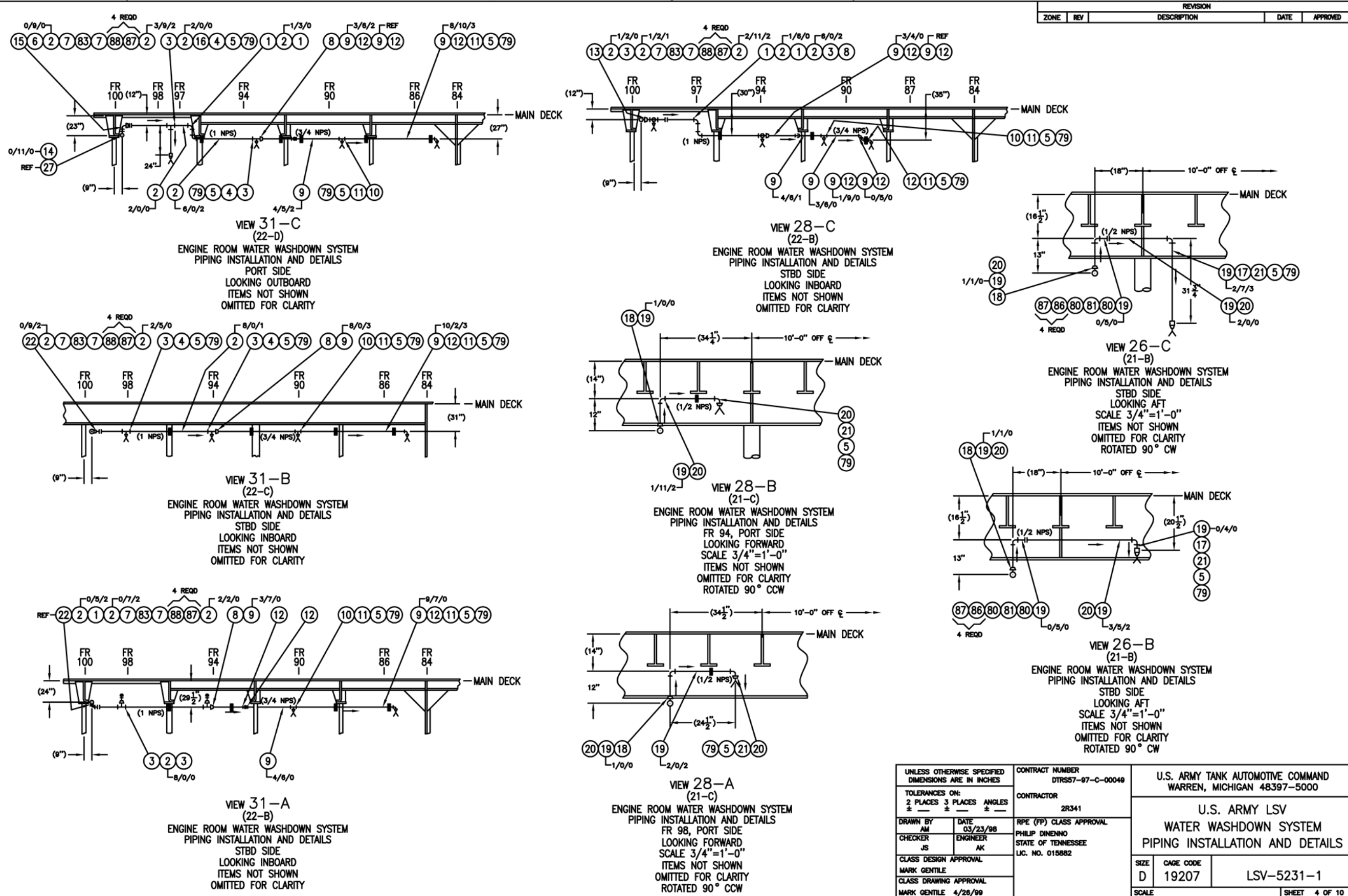
REVISION			
ZONE	REV	DESCRIPTION	DATE

- LOCAL NOTE:
- "H" INDICATES APPROXIMATE PIPE HANGER LOCATION, SEE NOTE 12.
  - FOR PIPE PENETRATION INSTALLATION AND DETAIL, SEE VIEW 15-C.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTR557-97-C-00049		U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±		CONTRACTOR 2R341		U.S. ARMY LSV WATER WASHDOWN SYSTEM PIPING INSTALLATION AND DETAILS	
DRAWN BY AM		RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882		SIZE D	
CHECKER JS		DATE 03/23/98		CAGE CODE 19207	
CLASS DESIGN APPROVAL MARK GENTILE		CLASS DRAWING APPROVAL MARK GENTILE 4/28/99		SCALE LSV-5231-1	
				SHEET 3 OF 10	

VIEW 21-A  
ENGINE ROOM WATER WASHDOWN SYSTEM  
PIPING INSTALLATION AND DETAILS  
BELOW MAIN DECK

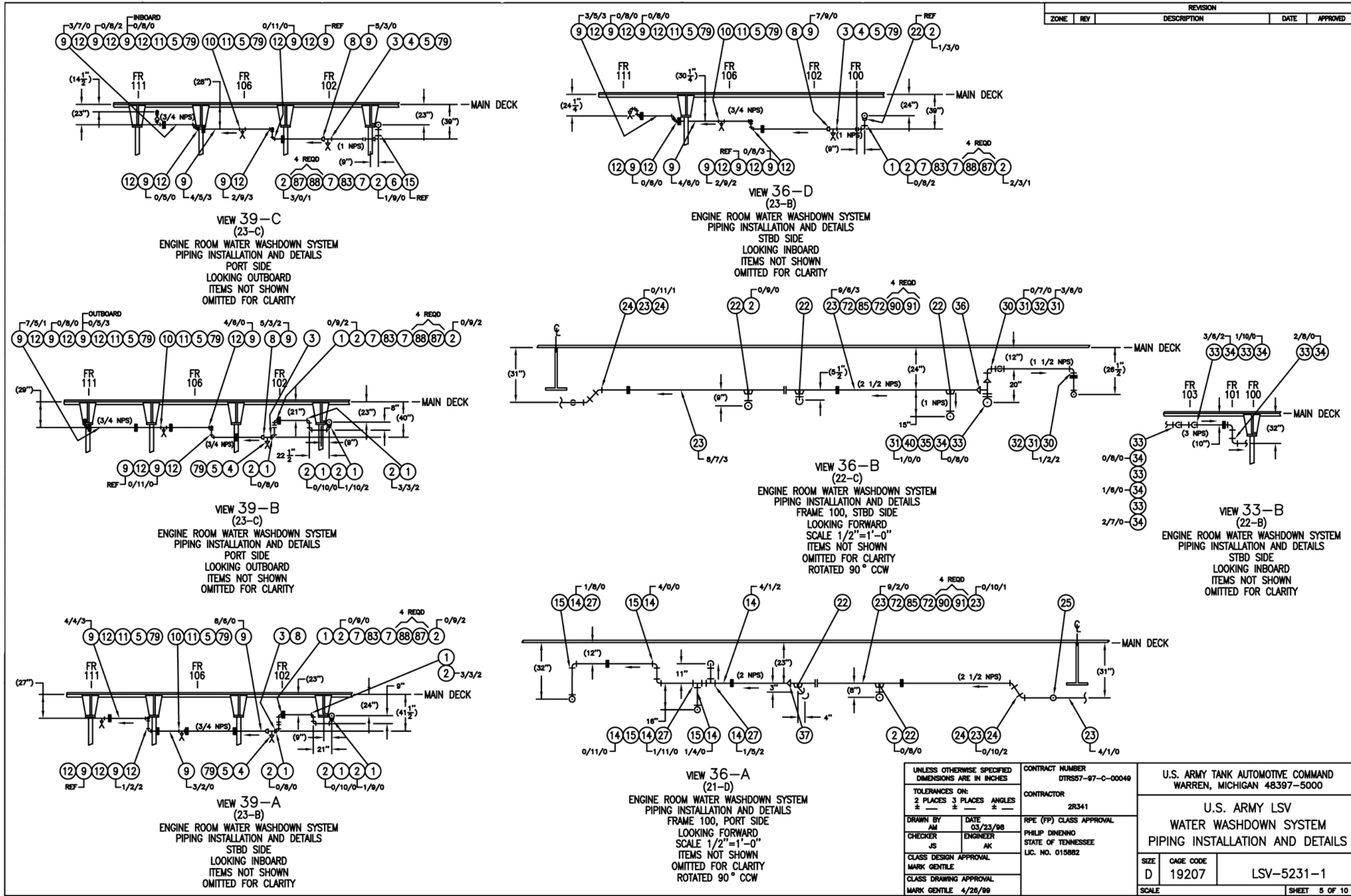




REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTRSS7-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ± ± ±		CONTRACTOR 2R341	U.S. ARMY LSV WATER WASHDOWN SYSTEM PIPING INSTALLATION AND DETAILS	
DRAWN BY AM	DATE 03/23/98	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882	SIZE D	CAGE CODE 19207
CHECKER JS	ENGINEER AK	CLASS DESIGN APPROVAL MARK GENTILE	LSV-5231-1	
CLASS DRAWING APPROVAL MARK GENTILE	DATE 4/26/99	SCALE	SHEET 4 OF 10	

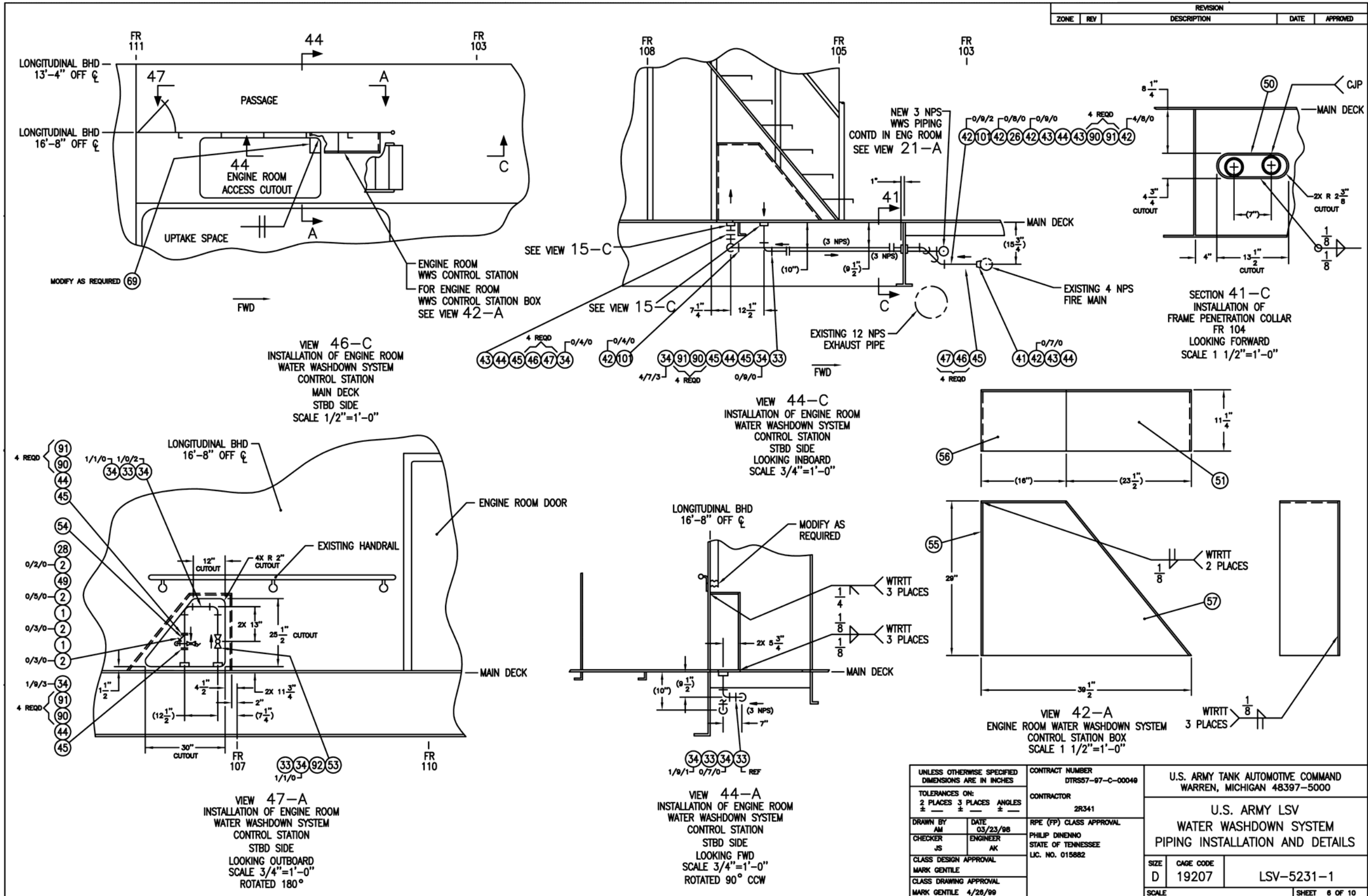




UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTR57-97-C-00049
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±		CONTRACTOR 2R341
DRAWN BY AM	DATE 03/23/98	RPE (FP) CLASS APPROVAL
CHECKER JS	ENGINEER AK	PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882
CLASS DESIGN APPROVAL MARK GENTILE		
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99		

U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000		
U.S. ARMY LSV WATER WASHDOWN SYSTEM PIPING INSTALLATION AND DETAILS		
SIZE D	CAGE CODE 19207	LSV-5231-1
SCALE	SHEET 5 OF 10	





REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED

VIEW 46-C  
INSTALLATION OF ENGINE ROOM  
WATER WASHDOWN SYSTEM  
CONTROL STATION  
MAIN DECK  
STBD SIDE  
SCALE 1/2"=1'-0"

VIEW 44-C  
INSTALLATION OF ENGINE ROOM  
WATER WASHDOWN SYSTEM  
CONTROL STATION  
STBD SIDE  
LOOKING INBOARD  
SCALE 3/4"=1'-0"

SECTION 41-C  
INSTALLATION OF  
FRAME PENETRATION COLLAR  
FR 104  
LOOKING FORWARD  
SCALE 1 1/2"=1'-0"

VIEW 47-A  
INSTALLATION OF ENGINE ROOM  
WATER WASHDOWN SYSTEM  
CONTROL STATION  
STBD SIDE  
LOOKING OUTBOARD  
SCALE 3/4"=1'-0"  
ROTATED 180°

VIEW 44-A  
INSTALLATION OF ENGINE ROOM  
WATER WASHDOWN SYSTEM  
CONTROL STATION  
STBD SIDE  
LOOKING FWD  
SCALE 3/4"=1'-0"  
ROTATED 90° CCW

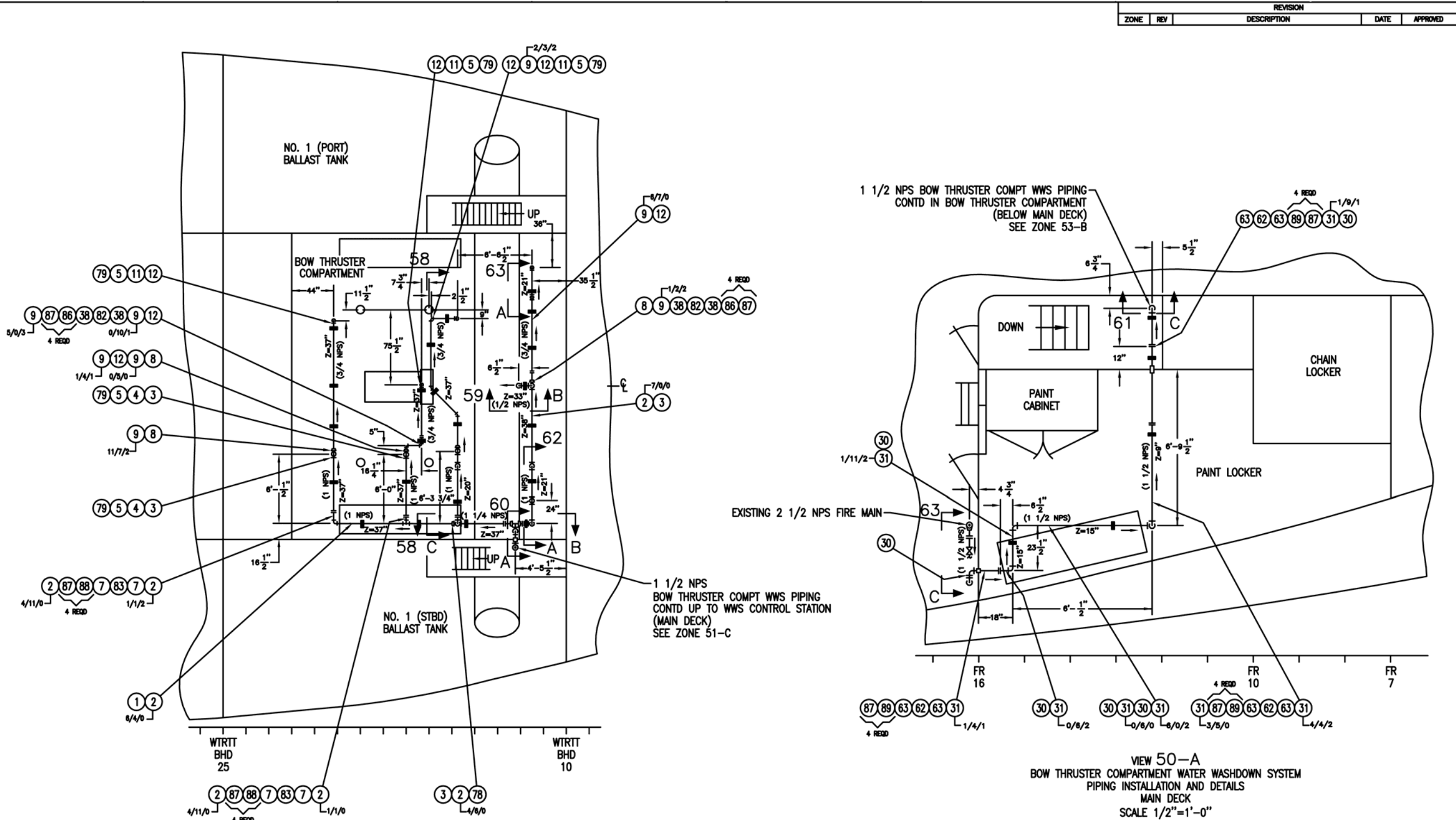
VIEW 42-A  
ENGINE ROOM WATER WASHDOWN SYSTEM  
CONTROL STATION BOX  
SCALE 1 1/2"=1'-0"

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTR557-97-C-00048		U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±		CONTRACTOR 2R341		U.S. ARMY LSV WATER WASHDOWN SYSTEM PIPING INSTALLATION AND DETAILS	
DRAWN BY AM	DATE 03/23/98	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882		SIZE D	CAGE CODE 19207
CHECKER JS	ENGINEER AK	CLASS DESIGN APPROVAL MARK GENTILE		LSV-5231-1	
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99				SCALE	SHEET 6 OF 10





REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



VIEW 54-A  
BOW THRUSTER COMPARTMENT WATER WASHDOWN SYSTEM  
PIPING INSTALLATION AND DETAILS  
BELOW MAIN DECK

VIEW 50-A  
BOW THRUSTER COMPARTMENT WATER WASHDOWN SYSTEM  
PIPING INSTALLATION AND DETAILS  
MAIN DECK  
SCALE 1/2"=1'-0"

- LOCAL NOTES:
- "■" INDICATES APPROXIMATE PIPE HANGER LOCATION, SEE NOTE 12.
  - FOR PIPE PENETRATION INSTALLATION AND DETAILS, SEE VIEW 15-C

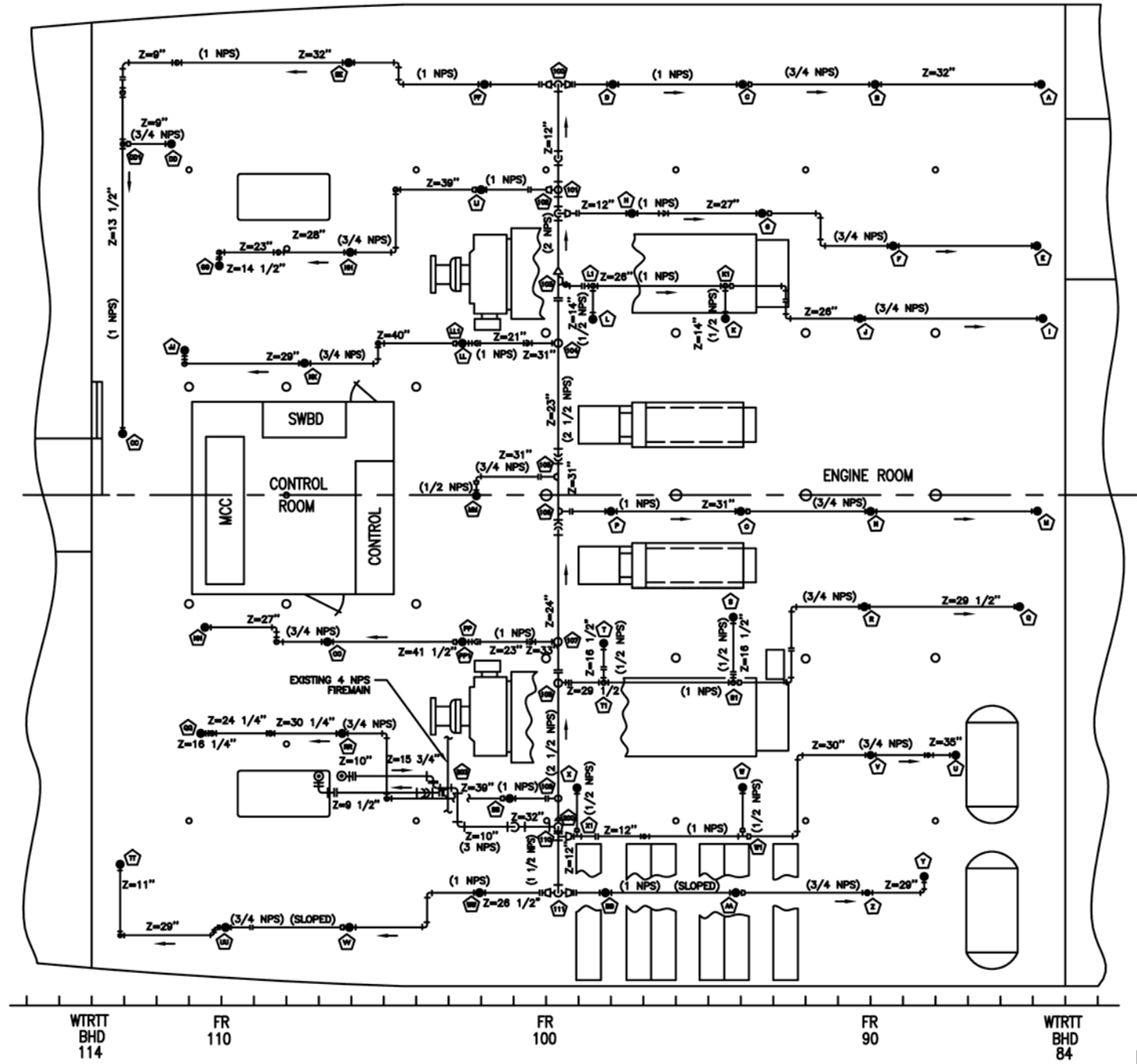
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	CONTRACT NUMBER DTRSS7-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±	CONTRACTOR 2R341	U.S. ARMY LSV WATER WASHDOWN SYSTEM PIPING INSTALLATION AND DETAILS
DRAWN BY AM	DATE 03/23/98	SIZE D
CHECKER JS	ENGINEER AK	CAGE CODE 19207
CLASS DESIGN APPROVAL	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882	SCALE LSV-5231-1
MARK GENTILE	CLASS DRAWING APPROVAL	SHEET 7 OF 10
MARK GENTILE 4/28/99		







REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



**WATER SUPPLY/DEMAND**

FIRE PUMP NO. 1:  
 RATED AT 500 GPM @ 125 (+) PSI

FLOW REQUIREMENTS:  
 5.6 GPM MINIMUM @ 80 PSI FROM EACH SPRAY NOZZLE  
 MINIMUM FLOW REQUIRED IS 140 GPM @ 80 PSI AT NOZZLES

CALCULATED FLOW RATES:  
 280.0 GPM TOTAL FLOW WHILE MAINTAINING 80 PSI AT ALL NOZZLES AND 111.1 PSI AT THE PUMP DISCHARGE.

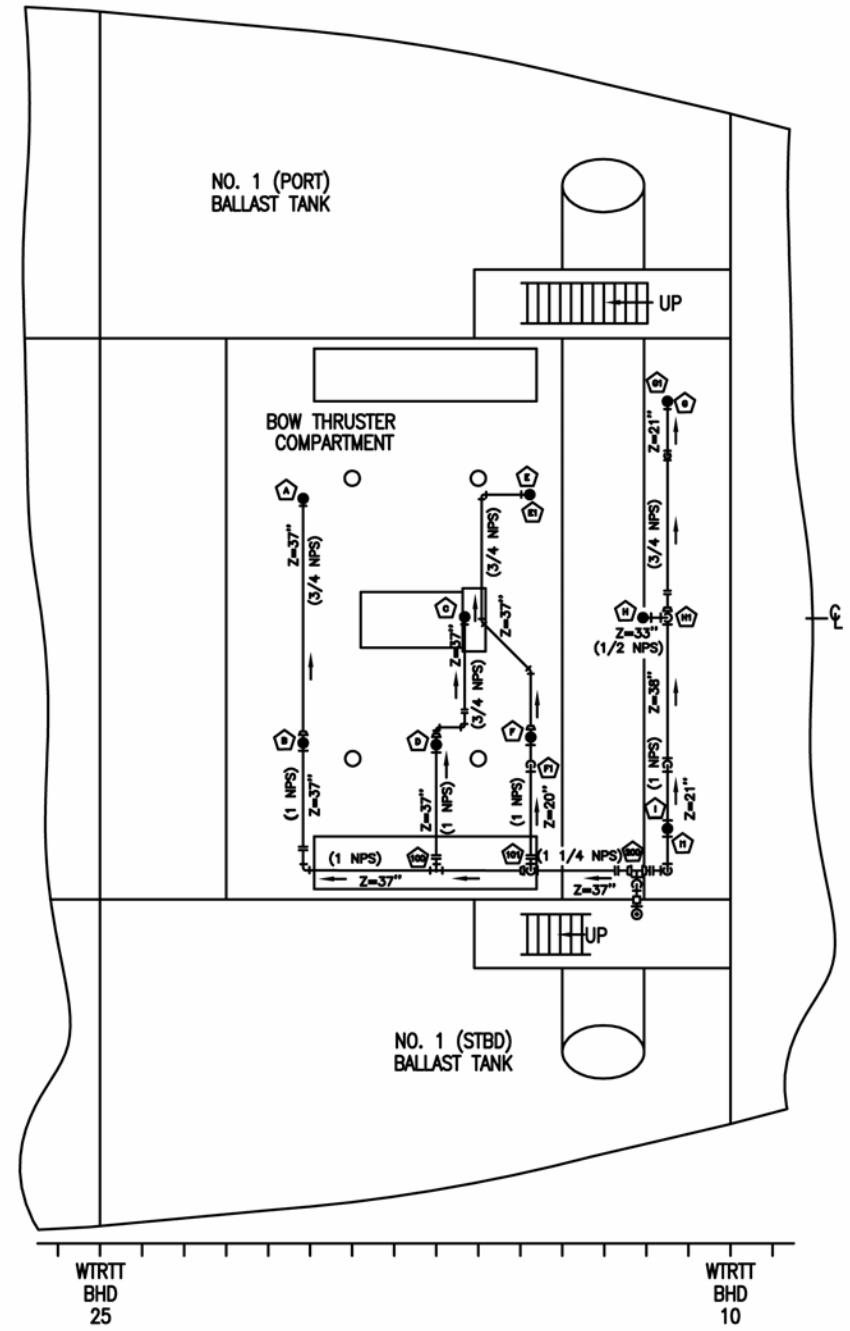
- SYMBOL LEGEND**
- WATER SPRAY NOZZLE
  - ◻ HYDRAULIC REFERENCE POINT
  - Z<sup>+</sup> DISTANCE FROM DECK ABOVE
  - FLOW DIRECTION
  - NEW PIPE
  - EXISTING PIPE
  - PIPING CONTD UP
  - PIPING CONTD DOWN

DIAGRAM 69-A  
 ENGINE ROOM WATER WASHDOWN SYSTEM  
 MODELING AND FLOW ANALYSIS DIAGRAM  
 BELOW MAIN DECK

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTR557-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±		CONTRACTOR 2R341	U.S. ARMY LSV WATER WASHDOWN SYSTEM PIPING INSTALLATION AND DETAILS	
DRAWN BY BO	DATE 03/23/98	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882	SIZE D	CAGE CODE 19207
CHECKER JS	ENGINEER AK			LSV-5231-1
CLASS DESIGN APPROVAL MARK GENTILE			SCALE	SHEET 9 OF 10
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99				



ZONE		REV		REVISION	DATE	APPROVED



WATER SUPPLY/DEMAND

FIRE PUMP NO. 1:  
 RATED AT 500 GPM @ 125 PSI

FLOW REQUIREMENTS:  
 5.6 GPM MINIMUM @ 80 PSI FROM EACH SPRAY NOZZLE  
 MINIMUM FLOW REQUIRED IS 50.4 GPM @ 80 PSI AT NOZZLES

CALCULATED FLOW RATES:  
 50.6 GPM TOTAL FLOW WHILE MAINTAINING 80 PSI AT ALL NOZZLES AND 94.8 PSI AT THE PUMP DISCHARGE.

SYMBOL LEGEND

- WATER SPRAY NOZZLE
- ◡ HYDRAULIC REFERENCE POINT
- z" DISTANCE FROM DECK ABOVE
- FLOW DIRECTION
- NEW PIPE
- EXISTING PIPE
- PIPING CONTD UP
- PIPING CONTD DOWN

DIAGRAM 78-A  
 BOW THRUSTER COMPARTMENT WATER WASHDOWN SYSTEM  
 MODELING AND FLOW ANALYSIS DIAGRAM  
 BELOW MAIN DECK

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTRSS7-97-C-00049		U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±		CONTRACTOR 2R341		U.S. ARMY LSV WATER WASHDOWN SYSTEM PIPING INSTALLATION AND DETAILS	
DRAWN BY BO	DATE 03/23/98	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882		SIZE D	CAGE CODE 19207
CHECKER JS	ENGINEER AK			LSV-5231-1	
CLASS DESIGN APPROVAL MARK GENTILE				SCALE	SHEET 10 OF 10
CLASS DRAWING APPROVAL MARK GENTILE 4/26/98					



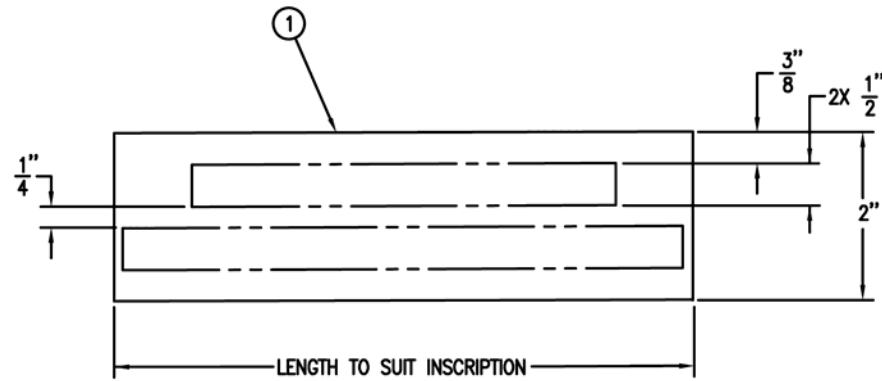


STATUS OF REVISION					
SH	ZONE	REV	DESCRIPTION	DATE	APPROVED
2					

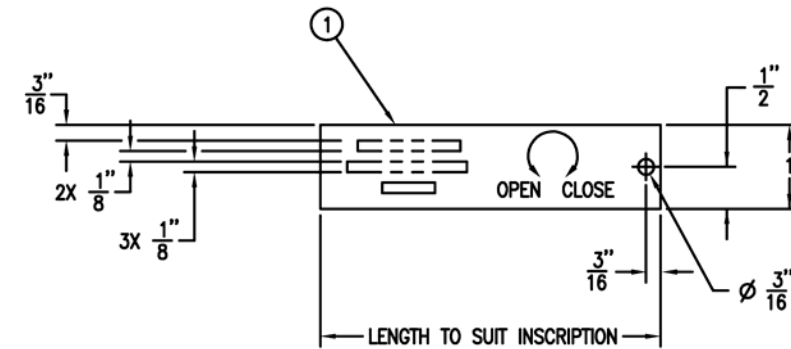
NOTES:

- THIS DRAWING HAS BEEN DEVELOPED AS A GUIDANCE DRAWING FOR THE FABRICATION AND INSTALLATION OF LABEL PLATES AND SYSTEM OPERATION PLACARDS ASSOCIATED WITH THE WATER WASHDOWN SYSTEM PIPING INSTALLATION AND DETAILS (DRAWING LSV-5231-1) ONBOARD U.S. ARMY LOGISTICS SUPPORT VESSEL (LSV).
- ALL LABEL PLATES SHALL HAVE SMOOTH EDGES AND BE LOCATED SO THAT THE INSCRIPTION IS READILY DISCERNIBLE AND NOT OBSCURED BY PIPES OR OTHER OBJECTS.
- STYLE B LABEL PLATE (INTERIOR USE), FIND NO. 1, AND SYSTEM OPERATION PLACARD, FIND NO. 2, SHALL BE INSTALLED USING TAPE, FIND NO. 3. TAPE SHALL BE APPLIED TO ENTIRE BACKING OF LABEL PLATE/PLACARD.
- STYLE B LABEL PLATE (EXTERIOR USE), FIND NO. 1, AND SYSTEM OPERATION PLACARD, FIND NO. 2, SHALL BE INSTALLED USING TAPE, FIND NO. 4. TAPE SHALL BE APPLIED TO ENTIRE BACKING OF LABEL PLATE/PLACARD.
- STYLE V LABEL PLATES, FIND NO. 1, SHALL BE INSTALLED USING CABLE TIE, FIND NO. 5.
- THE ENGINE ROOM AND BOW THRUSTER COMPARTMENT WATER WASHDOWN SYSTEM OPERATION PLACARD MATERIAL SHALL BE PHENOLIC. PLACARD CHARACTERS SHALL BE ENGRAVED AND CHARACTER HEIGHTS SHALL BE AS INDICATED:  
 OPERATING INSTRUCTIONS — .156 INCH  
 OPERATING INSTRUCTIONS TITLE — .188 INCH  
 TABLE AND LEGEND CHARACTERS — .156 INCH  
 DIAGRAMMATIC CHARACTERS — .156 INCH  
 PLACARD TITLE — .250 INCH

SYSTEM OPERATION PLACARDS SHALL BE MOUNTED IN A SUITABLE LOCATION NEAR WWS CONTROL STATIONS, TO ALLOW FOR OPTIMUM VISIBILITY.



VIEW 5-C  
STYLE B-2



VIEW 2-B  
STYLE V-3

LABEL PLATE LIST					
ITEM NO.	INSCRIPTION	LABEL STYLE	QTY REQD	LOCATION	REMARKS
1	ENG RM WWS CONTROL STATION	B-2	1 EA	MN DK PASSAGE FR 107, STBD	MOUNT NEAR CONTROL STATION
2	ENG RM WWS CONTROL VALVE WWS-1	V-3	1 EA	MN DK PASSAGE FR 106, STBD	MOUNT ON VALVE
3	ENG RM WWS STRAINER BLOW OFF WWS-2	V-3	1 EA	MN DK PASSAGE FR 106, STBD	MOUNT ON VALVE
4	BOW THR COMPT WWS CONTROL STATION	B-2	1 EA	MAIN DECK FR 17, STBD	MOUNT ON SIDE SHELL
5	BOW THR COMPT WWS CONTROL VALVE WWS-1	V-3	1 EA	MAIN DECK BHD 16, STBD	MOUNT ON VALVE
6	BOW THR COMPT WWS STRAINER BLOW OFF WWS-2	V-3	1 EA	MAIN DECK BHD 16, STBD	MOUNT ON VALVE

FIND NO.	CAGE CODE	PART OR IDENTIFYING NUMBER	TOTAL QUANTITY REQUIRED	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL	UNIT WEIGHT (LB)
5	06383	BT31-C	1 EA	CABLE TIE, 3" MAX BUNDLE DIA, 11.1" L, 100 PER PKG	COML (PANDUIT)	NYLON	—
4	06KR7	PRO-2032	1 EA	TAPE, POLYETHYLENE, BLACK, CLOSED CELL, DOUBLE COATED	COML (PRO TAPE)		—
3	06KR7	PRO-3032	1 EA	TAPE, POLYETHYLENE, WHITE, CLOSED CELL, DOUBLE COATED	COML (PRO TAPE)		—
2			2 EA	SYSTEM OPERATION PLACARD, LAMINATED PHENOLIC PLASTIC, WHITE CORE WITH RED SURFACE		PHEN	—
1			6 EA	LABEL PLATE, LAMINATED PHENOLIC PLASTIC, WHITE CORE WITH RED SURFACE		PHEN	—

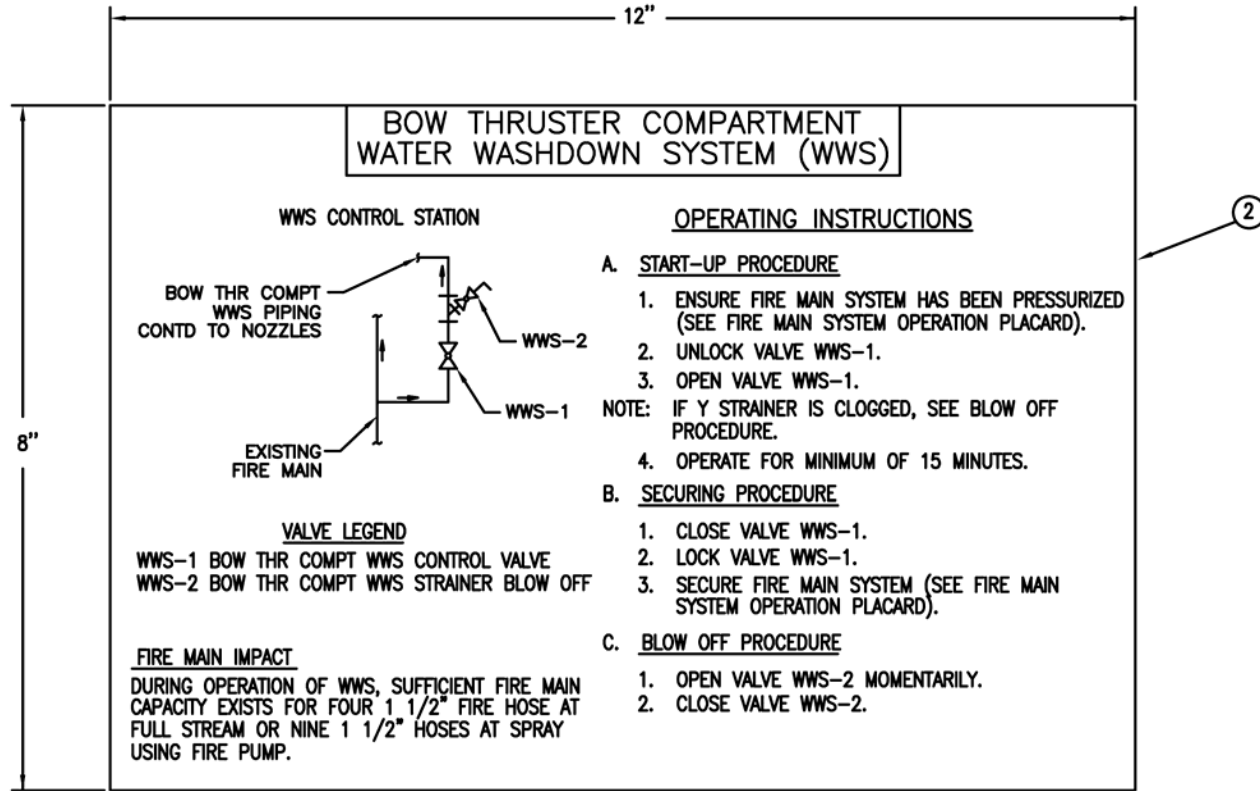
PARTS LIST

DISTRIBUTION STATEMENT A  
APPROVED FOR PUBLIC RELEASE;  
DISTRIBUTION IS UNLIMITED.

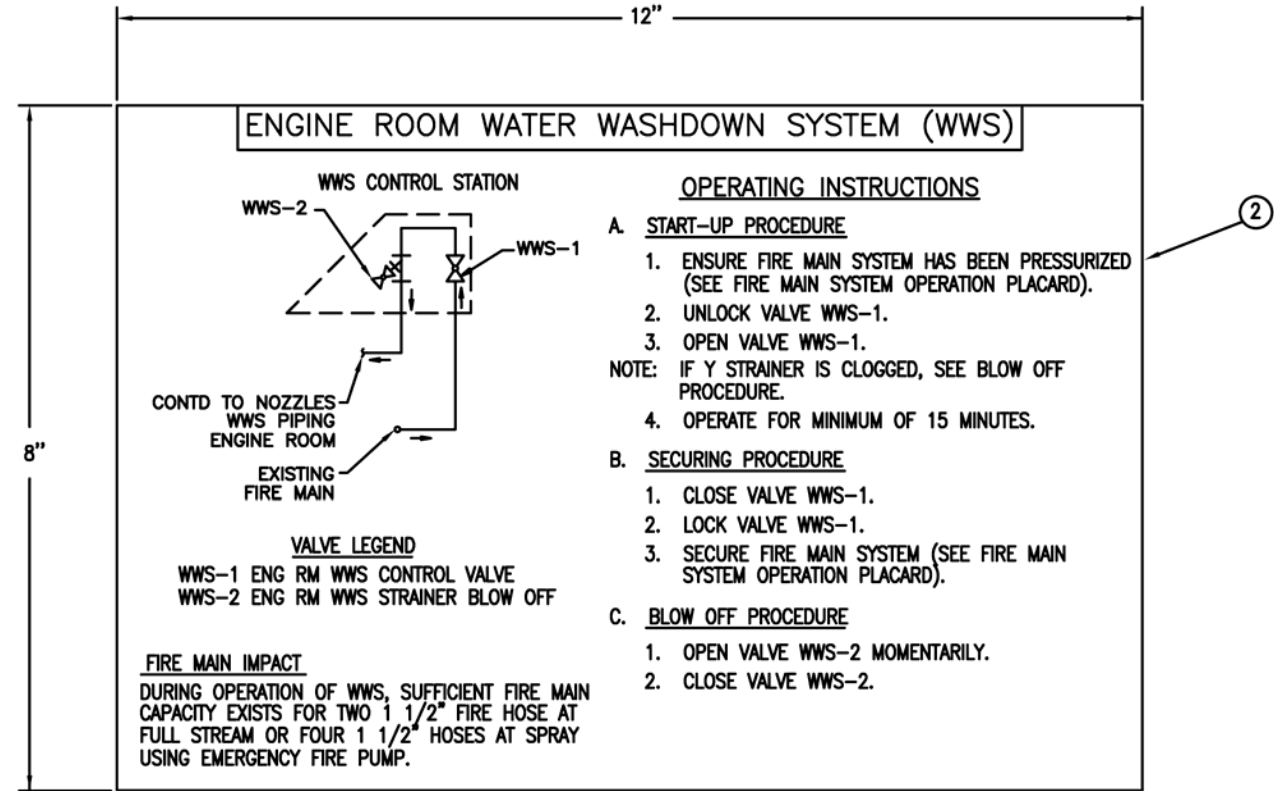
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	CONTRACT NUMBER DTRSS7-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000
TOLERANCES ON: 2 PLACES ± .005 3 PLACES ± .003 ANGLES ± .005	CONTRACTOR 2R341	U.S. ARMY LSV WATER WASHDOWN SYSTEM LABEL PLATES AND PLACARDS
DRAWN BY BO	DATE 02/13/98	RPE (FP) CLASS APPROVAL
CHECKER JS/AK	ENGINEER JS 4/26/99	PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882
CLASS DESIGN APPROVAL MARK GENTILE		
CLASS DRAWING APPROVAL MARK GENTILE 4/26/99		
SIZE D	CAGE CODE 19207	LSV-5231-2
SCALE 1/1		SHEET 1 OF 2



REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



VIEW 14-B  
BOW THRUSTER COMPARTMENT WATER WASHDOWN SYSTEM  
OPERATION PLACARD




VIEW 11-B  
ENGINE ROOM WATER WASHDOWN SYSTEM  
OPERATION PLACARD

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTRSS7-97-C-00049		U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± .005 ± .010 ± .015		CONTRACTOR 2R341		U.S. ARMY LSV WATER WASHDOWN SYSTEM LABEL PLATES AND PLACARDS	
DRAWN BY BO	DATE 02/13/98	RPE (FP) CLASS APPROVAL PHILIP DINENNO STATE OF TENNESSEE LIC. NO. 015882		SIZE D	CAGE CODE 19207
CHECKER JS/AK	ENGINEER AK			LSV-5231-2	
CLASS DESIGN APPROVAL MARK GENTILE				SCALE	
CLASS DRAWING APPROVAL MARK GENTILE 4/28/99				SHEET 2 OF 2	



By Order of the Secretary of the Army:

Official:

  
JOEL B. HUDSON  
*Administrative Assistant to the  
Secretary of the Army*  
0223102

ERIC K. SHINSEKI  
*General, United States Army  
Chief of Staff*

DISTRIBUTION: To be distributed in accordance with Initial Distribution Number (IDN) 115875 Requirements for TM 55-1905-251-24&P.



These are the instructions for sending an electronic 2028

The following format must be used if submitting an electronic 2028. The subject line must be exactly the same and all fields must be included; however only the following fields are mandatory: 1, 3, 4, 5, 6, 7, 8, 9, 10, 13, 15, 16, 17, and 27.

From: "Whomever" <whomever@avma27.army.mil>  
To: TACOM-TECH-PUBS@ria.army.mil

Subject: DA Form 2028  
1. From: Joe Smith  
2. Unit: home  
3. Address: 4300 Park  
4. City: Hometown  
5. St: MO  
6. Zip: 77777  
7. Date Sent: 19-OCT-93  
8. Pub no: 55-2840-249-23  
9. Pub Title: TM  
10. Publication Date: 04-JUL-85  
11. Change Number: 7  
12. Submitter Rank: MSG  
13. Submitter FName: Joe  
14. Submitter MName: T  
15. Submitter LName: Smith  
16. Submitter Phone: 123-123-1234  
17. Problem: 1  
18. Page: 1  
19. Paragraph: 3  
20. Line: 4  
21. NSN: 5  
22. Reference: 6  
23. Figure: 7  
24. Table: 8  
25. Item: 9  
26. Total: 123  
27. Text:

This is the text for the problem below line 27.







<b>TO:</b> <i>(Forward direct to addressee listed in publication)</i>	<b>FROM:</b> <i>(Activity and location) (Include ZIP Code)</i>	<b>DATE</b>
---	--	-------------

**PART II - REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS**

<b>PUBLICATION NUMBER</b> TM 55-1915-251-24&P	<b>DATE</b> 15 October 2002	<b>TITLE</b> FM-200 Fire Fighting System for Logistics Support Vessel (LSV)
--	--------------------------------	--

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

**PART III - REMARKS** *(Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

--

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
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TO: <i>(Forward direct to addressee listed in publication)</i>	FROM: <i>(Activity and location) (Include ZIP Code)</i>	DATE
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**PART II - REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS**

PUBLICATION NUMBER <b>TM 55-1915-251-24&amp;P</b>	DATE <b>15 October 2002</b>	TITLE <b>FM-200 Fire Fighting System for Logistics Support Vessel (LSV)</b>
--	--------------------------------	--

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

**PART III - REMARKS** *(Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
----------------------------	--	-----------



TO: <i>(Forward direct to addressee listed in publication)</i>	FROM: <i>(Activity and location) (Include ZIP Code)</i>	DATE
--	---	------

**PART II - REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS**

PUBLICATION NUMBER <b>TM 55-1915-251-24&amp;P</b>	DATE <b>15 October 2002</b>	TITLE <b>FM-200 Fire Fighting System for Logistics Support Vessel (LSV)</b>
--	--------------------------------	--

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

**PART III - REMARKS** *(Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
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## The Metric System and Equivalents

### *Linear Measure*

1 centimeter = 10 millimeters = .39 inch  
 1 decimeter = 10 centimeters = 3.94 inches  
 1 meter = 10 decimeters = 39.37 inches  
 1 dekameter = 10 meters = 32.8 feet  
 1 hectometer = 10 decameters = 328.08 feet  
 1 kilometer = 10 hectometers = 3,280.8 feet

### *Weights*

1 centigram = 10 milligrams = .15 grain  
 1 decigram = 10 centigrams = 1.54 grains  
 1 gram = 10 decigrams = .035 ounce  
 1 dekagram = 10 grams = .35 ounce  
 1 hectogram = 10 dekagrams = 3.52 ounces

1 kilogram = 10 hectograms = 2.2 pounds  
 1 quintal = 100 kilograms = 220.46 pounds  
 1 metric ton = 10 quintals = 1.1 short tons

### *Liquid Measure*

1 centiliter = 10 milliliters = .34 fl. ounce  
 1 deciliter = 10 centiliters = 3.38 fl. ounces  
 1 liter = 10 deciliters = 33.81 fl. ounces  
 1 dekaliter = 10 liters = 2.64 gallons  
 1 hectoliter = 10 dekaliters = 26.42 gallons  
 1 kiloliter = 10 hectoliters = 264.18 gallons

### *Square Measure*

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch  
 1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches  
 1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet  
 1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet  
 1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres  
 1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

### *Cubic Measure*

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch  
 1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches  
 1 cu. meter = 1000 cu. decimeters = 35.31 feet

## Approximate Conversion Factors

<i>To change</i>	<i>To</i>	<i>Multiply by</i>	<i>To change</i>	<i>To</i>	<i>Multiply by</i>
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29.573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.356	metric tons	short tons	1.102
pound-inches	newton-meters	.11296			

## Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C
----	---------------------------	-------------------------------	------------------------	----

